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A Downsized Manhattan Between Analogy and Abstraction by Mariabruna Fabrizi

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# BOOK OF ABSTRACTS

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# The Eastern Japan Earthquake and Tsunami: its Effects, Aftermath, Lessons learned

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**Abstract**
it's clear to the world that the eastern Japan earthquake was the biggest disaster the modern world had ever came to face, that's why it was of great importance that we took crucial lessons of it on every aspect possible so that we can be more ready for future disasters, no matter what is their scale, because as we know disaster are going to come, in all shapes and kinds, and a major disaster like the Great Eastern Japan Earthquake is going to be upon us every few decades, so being ready, as calculations have proofed, spending and providing for the preparedness phase, is 7 times better, safer and cheaper, than trying to solve the problems in the recovery phase, after the disaster happens, in this study we'll be doing an analysis of the event, and suggesting numerous solutions to prevent the likelihood of a similar scenario in the future.

## 1. Introduction

This earthquake caused a disturbance to the whole extension of the Pacific Ocean, which lasted more than 12 hours, but the main wave hit the shores of east Japan causing many casualties. After about 1 hour the tsunami waves hit the Japanese shore, they were thirty-nine meters high and travelling at about 690 km/h in the open sea and then slowing down to about 50km/h when they reached shallow water, then eventually hit the city.(Norio et al., 2011)
The tsunami hit many cities, but the biggest number of casualties was in Fukushima.
The focus here will be at the approaches taken by the Japanese government and what are the positivity's and the negativities of those implementations and how well they are going so far.
The main objective of this study is to compare the case of the Daiichi Nuclear Powerplant unfortunate event to other case studies that went through similar circumstances yet being able to overcome it with minimal damage.

### 1.1. Methodology

The used methodology will include going through the literature reviews on concepts such as disaster response, preparedness for various kinds of disasters, and the application of both in a wide scale globally, the research framework and base material were built on this information.
And to that end, the best method to understand what went wrong in our case is to check similar events that had better outcomes, two cases will be used as comparison references in this study, the Daini Nuclear powerplant, as well as the impact of the said disaster (Fukushima) on the public Chinese opinion regarding nuclear facilities and how tolerance towards all kinds of mistakes or even natural threats dropped to an unprecedented level.
After finding out what are the different aspects that went wrong, taking into consideration the different circumstances for each case and comparing the similarities and analysing our case with the provided case studies to find flaws and mistakes, we then will check if the set criteria is satisfied with the changes made in order to decrease the losses of life and material to satisfactory levels (usually in different scales, close ratios to the case studies at hand taking into consideration the country and time of disaster difference), if so, the recommendations, the main obstacles and opportunities for the optimal preparedness and response model possible would be dictated.

## 2. Literature Review

Japan is a country that has one of most dangerous earthquake hazard probabilities, as throughout history, this geographic spot had an unfortunate record with earthquakes, as the strongest earthquake records ever recorded are from that area, and given that the country has very little area real estate, solutions were invented to solve the ever increasing demand for energy in all its forms, mostly, electricity, and one of those was nuclear powerplants, they were very efficient, small, and overall an invaluable addition to the power generating facilities in the country, the issue that we want to discuss here though is the deadly combination of nuclear powerplants and any factor of instability, natural disasters count as the number one dangerous factor here, especially earthquakes, hence, the unfortunate events of 2011 took place, and here we would like to investigate what made it a very painful experience, especially when a very similar one took place at the same time not very far away at the (Daini Nuclear powerplant) but the results weren't as disastrous.




**Fig 1.** A Nuclear Map of Japan. Source: en.wikipedia.org/wiki/Nuclear_power_in_Japan

**3. Nuclear Powerplants and Vulnerability to Disasters**

Nuclear powerplants require a great deal of stability, as the core where the interaction takes place demands the cooling systems to be always running, or an overheating could happen, and a melting nuclear core is the nightmare that had terrorized all countries on earth several times in the last century.

**3.1. The Fukushima Daiichi station**

This is the powerplant we want to discuss, it is located east of Japan, it was generating about 1.6 % of Japan's total electric capacity at the time (in 2011 Japan had 282GWe being Produced).

**3.1.1. Capacity, Properties, and timeline.**

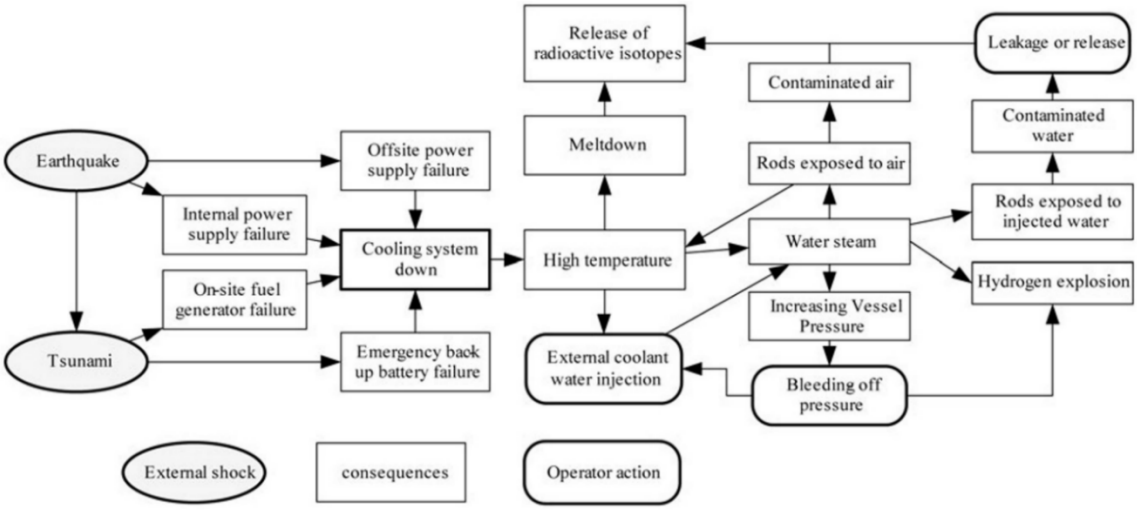
The full capacity of the powerplant was 5,306Mwe when all 6 of its reactors are running, and after the tsunami wave hit, it damaged 3 of the station's 6 reactors (1st(439MWe) – 3rd(760MWe) – 4th(760MWe in the three following days, and the fourth reactor (reactor 2)was heavily damaged through the next (3 – 4) days, the remaining 2 reactors were already shutdown when the event took place, but they were partially damaged still, even though their level was relatively higher than the rest of the reactors, given that they were within 20km evacuation area (that is still active until now) made reaching them problematic.

Even though the fourth reactor was in an unloaded core state, but it shared the same exhaust channel with the 3rd reactor, and when the 3rd reactor was dry and its core began to meltdown, the radioactive hydrogen was transferred to it (reactor 4 core) and caused it to heat up and eventually explode without the proper cooling needed.

There were someone attempts to cool the reactors using sea water, but unfortunately, they were not the most practical solution, as it wasn't enough to tip the scales.

in mid of December 2011, it was announced that the three reactors in official cold shutdown, which means that the cooling water going through the core is not evaporating anymore and is coming out of it with a degree less than one hundred Celsius.

it was estimated that the melted cores will be in that state for the next 4 decades until they can be decommissioned.




**Illustrative chart of the 2011 Fukushima nuclear crisis**
**Table. 1**, Source: (Norio et al., 2011)

### 3.1.2 Response

A wall of ice was established around the powerplant to prevent radioactive materials from escaping, but they still do.

For the next four decades (until the cores are completely cold) Japan has to always pump water into the core and then filter it (because we don't want radioactive water being dumped in the sea for the next 40 years) before sending it back to the sea, and for that purpose they built the biggest, most expensive cooling and filtering system as you can see, (2004 – 2012 – 2019) respectively

the red outlined areas are all water tanks and filtering systems.



**Fig. 2.** Source: Google Earth

In all nuclear scenarios, every second is imperative, and decisions must be made with high delicacy and efficiency, which leads us to the importance of each step that was taken to try prevent a larger disaster than what we already got, a major one which had even a political aspect later was, pouring the sea water into a reactor core, because once it was done, the reactor of concern is considered irreparable, and that in itself is a huge economic loss to the country.(Norio et al., 2011)

## 4. Impact of the Disaster in Different Fields

The disaster had sadly laid its shadow on many aspects of civil life, and in the next section we will be presenting some of the most impacted sectors:

**4.1. Economically**

The Japanese Economy took a sever hit, the losses of the tsunami wave were estimated to be about 360 billion USD, being the most expensive natural disaster to ever take place, forced more than 600 companies in 2012 to declare bankruptcy, as well as the loss of the buildings, and many of the cars manufacturers in japan had to stop producing their products because of the Tsunami wave, many buildings were either affected by the earthquake (190.000) among which are buildings that are completely destroyed by it (45.700), as well as many of (23.600) hectares of agricultural lands were corrupted.(Norio et al., 2011)

**4.2. Human Lives**

The tsunami waves took about 15,890 people's lives, and left the rest in case of trauma, either from losing their properties, and some who lost family members or friends.(Matsubara et al., 2014)

As its noticed that depression rates among the tsunami survivors increased dramatically, which is represented as a psychological burden, it hits hardest on women and older people especially the ones living in their damaged houses or the people that were forced to live with more than 5 people, as well as the lack for basic services in the affected areas contributed to the deterioration of the psychological state of the residents. (Matsubara et al., 2014)

Of course, there have been some models regarding the fatality ratio (number of deaths in an area as a proportion of its population) of the tsunamis trying to understand its relationship with the arrival time of the tsunami, the different areas geographical properties, gender, age, and evacuation procedures followed.(Latcharote et al., 2018)

Evacuation process was different with individual cases depending as we discussed on age and gender, as well as previous experiences with disasters, the perception of one's house safety, and other variable reasons.(Latcharote et al., 2018)

As noticed, most of the tsunami waves took between 20mins until 70mins after the earthquake to hit the shoreline, as we can see that this value is not proportional to the death toll, unlike the height of the tsunami waves which was proportional to the fatality ratio.(Latcharote et al., 2018)

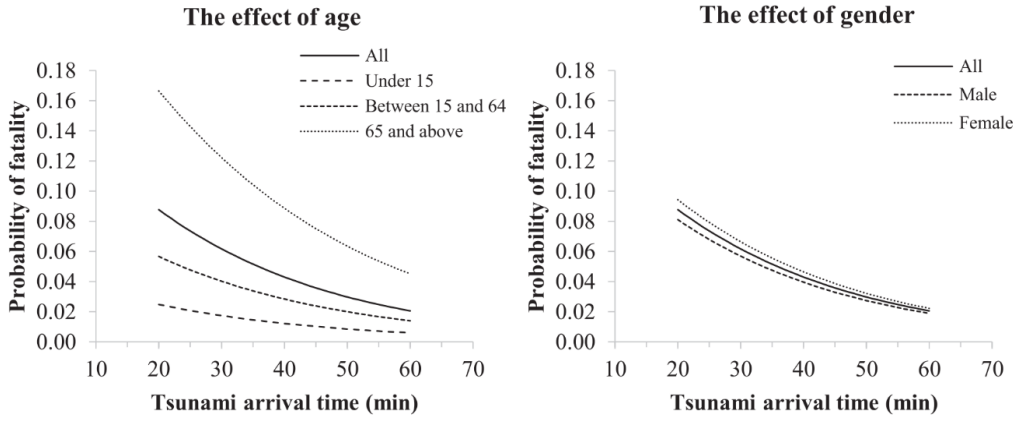



**Fig 3**. Source: (Latcharote et al., 2018)

As we can notice that the fatalities among people who are older than 65 is higher than the rest of the statistic group.(Latcharote et al., 2018)

**4.3. Ecological impact**

The lack and pattern less of tsunamis made it hard for us to obtain accurate data about their impact on ecosystems, so after the great eastern Japan earthquake and tsunami, a study was conducted regarding this matter, and it was found that when a tsunami hits a beach or a coastal area, it actually enriches the species of plants in that area, in our case a sum of 103 plants were found in the place, about 34% of which were coastal species, it's important to notice here that this ratio significantly dropped after the tsunami, and the rest 66% were non-coastal species, but the interesting part is that more than 10 new species appeared after the tsunami, reasoning of which is thought to be because of the soil accretion.(Hayasaka et al., 2012)

A recent study also shows that the concentration of radionuclides (tritium and equivalents) in groundwater had rose in two examined water sources within 35km radius of the Fukushima Daiichi nuclear powerplant, the amounts of these radioactive materials found in the water is explained by the penetration of a soft and fractured bedrock which allowed them through, as well as the combination between underground water with new water from whatever source (irrigation, fall water…) that had high concentrations of these materials, and it was estimated that this water

would take between 10 and 26 years until it's possible to obtain usable water from the mentioned sources.(Sakakibara et al., 2019)

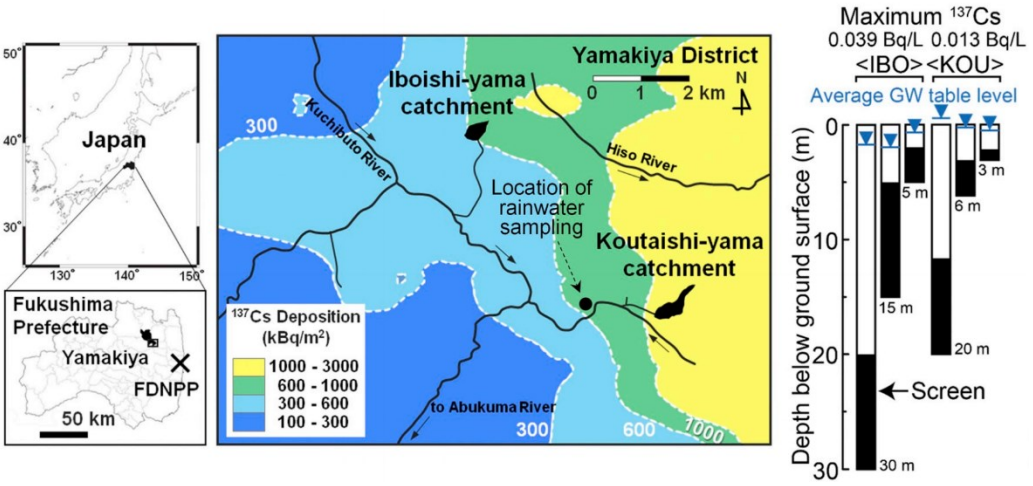



**Fig 4.** Source:(Sakakibara et al., 2019)

**4.4. Energy issues**

The tsunami waves caused the Fukushima nuclear powerplant to fail causing radioactive radiations to be released at extremely elevated levels, the power plant consisted of 6 reactors at the time and was generating 4.5GWe of energy.

4 of the reactors were seriously damaged (they summed up to generate 2719MWe) and TEPCO decided to not restart the remaining 2 reactors.

As they will have to dismantle the melted reactors, which will take roughly 4 decades, The melting of three reactor cores in the Fukushima powerplant forced about 160,000 people to leave their contaminated homes, and about 60,000 are currently living in temporary housing.

After the nuclear accident all aspects of environment were exposed to radioactive volatile materials, monitors were installed in various places around the affected area to observe the quantity of radioactive materials in each area as well as knowing the distance they reached.

Monitors like air dust monitors, drinking water monitors were installed, and from those monitors points we acquired the following results (Yamaguchi & Kunugita, 2019):

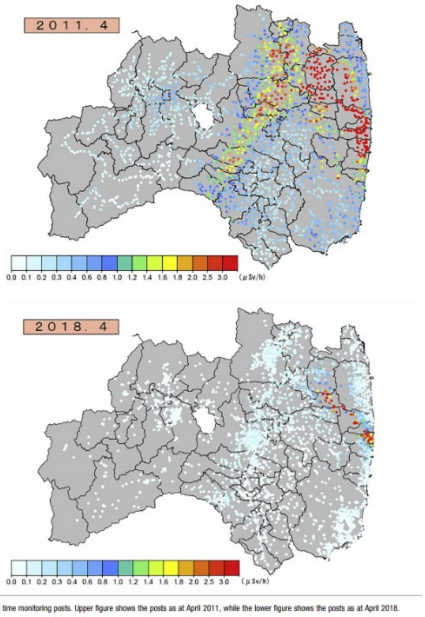



**Fig 5.** Source: (Yamaguchi & Kunugita, 2019)

Even cattle that wasn't close to the area of the accident was affected, as it was found in its meats after 4 months of the accident, which was explained later by the food the cattle were eating was exposed and had in fact contained a ratio of radioactive materials.(Yamaguchi & Kunugita, 2019)
due to these ratio's, cancer and other diseases occurrences increased affecting the wellbeing of the people in the affected areas. (Yamaguchi & Kunugita, 2019)

**5. Preparedness and Response**

Considering the BBG (Build Back Greener) approach keeping in mind that we need to be better prepared for any possible future disasters, most of the coastal areas correlated with tsunami need the biggest scale rebuilding process, problem here is that rebuilding needs decades of observation for damaged area to make sure that its contamination has dropped down to liveable values, the BBG concept aims basically for three targets, 1st of which was to make DRR through eco-solutions clear which encourages more country's to take the same approach, 2nd is to increase the awareness of the stability of green approaches and their resilience while making the land scape greener and more beautiful, 3rd make sure that it's clear that it takes a qualified planner(s) to be able to realize when a green(er) solution could be applied and beneficial, because not all cases benefit from this type of solution.(Mabon, 2019)
As in the conducted study it's been shown that this tsunami caused tremendous damage to the coastal area, but this damage was a price for a lesson must be learned in the pursuit of making more resilience coastal communities, as numbers show that tsunami waves with height lower than 2m were damaging but with no devastating outcomes on households, waves with height more than 6m are considered ruining to households.(Koshimura et al., 2014)
In the figure we can notice a suggested model of a coastal protection wall, in the Sendai city example we can see that it supposes having several layers of protection to weaken any waves that might come.

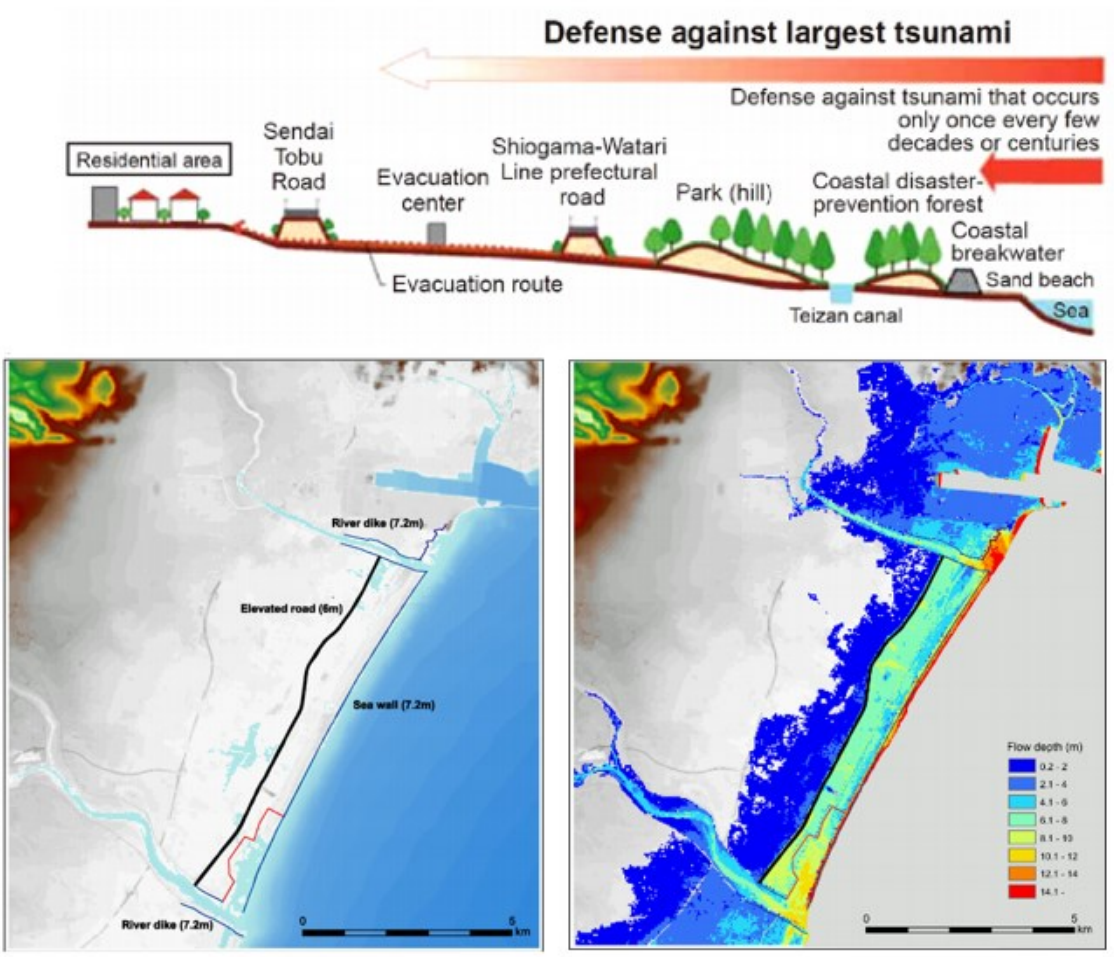



**Fig 6.** Source: (Koshimura et al., 2014)

The tsunami speed reached about 8m/s up to 1km into the land with inundation of more than 6.3m had the ability to wash away everything in its way, which is why its advised to consider those numbers while re-zoning the area for any future events. (Koshimura et al., 2014)
Following the GEJE there have been numerous studies regarding the need to improve the earthquake detection systems to make them able to anticipate the velocity, direction and estimated time of arrival of a tsunami resulted by an earthquake, the approach is based on improving the q-factor aka (Tsunami detection function) which is a factor related to the changes in water velocity at sea, and by using this factor with the radar attached equations, it's possible to obtain graphs regarding the speed of the waves correlated with the time of the earthquake, as we can notice from the graphs, when the q-factor's value starts dropping and becomes negative, it's an indicator that the tsunami waves speed is dropping, which can only take place in case the tsunami isn't aimed towards the shore anymore.(Chaturvedi, 2019)

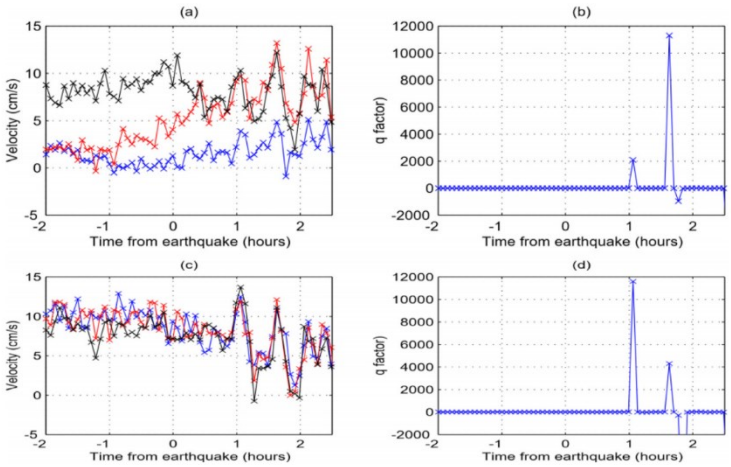



**Fig 7.** Source: (Chaturvedi, 2019)

There was a problem that didn't help at all when the disaster took place, it's that Japan has no guidelines to manage a disaster situation traffic, which caused many jams that were in the best interest of no one, so after the disaster this issue was noticed and there have been some steps to take care of it and make the overall responding process more sustainable (Nakanishi et al., 2013)
So, in order to solve the problem of a post catastrophic traffic issues we need to understand what are the needs that arise after such an event, to be able to solve them one by one, before the disaster took place, the municipalities had no idea nor statistics regarding the roads' limitations in a case of a tsunami, which made conducting an emergency strategy not possible for them.(Nakanishi et al., 2013)

## 6. Case Study

In these sections we will be comparing the Fukushima Daiichi powerplant event to other similar cases with similar conditions but different outcomes (less disastrous one)

### 6.1 The Fukushima Daini Station

A smaller nuclear power plant than the Fukushima daiichi power plant located south to it producing 1067 MWe which is less than 1% of Japan's total power generation capacity at the time.

#### 6.1.1 Timeline and challenges

This station faced a very close fate to its 10km neighbour Daiichi, but with some more luck and preparedness it had better outcomes in comparison to our main case.
In this station and after the tsunami they still had some undamaged diesel generators, the problem in this powerplant however was that the wiring of the station was completely destroyed and the backup diesel generators were to an extent useless as they had the same weaknesses as the main system, which made them more of a secondary system rather than a backup one (Norio et al., 2011) until 1 more day when they got cables and wired the water pumps by hand and had to wire very thick cables to an estimated distance of 5.2km.

**6.2 perception of the event**

the Chinese perception of nuclear powerplants after the Japanese disaster, how the people began to realize that nuclear accidents are more serious than anything else, therefore in the coming graphs we will be able to see that the public tolerance towards nuclear events had dropped immensely, regardless of the cause of the accident or whose fault it was, following the GEJE disaster, while taking the people's opinions, 5 main perception factors were measured (Acceptance, Knowledge, Perceived risk, Benefit and Trust).(Huang et al., 2018)

It is debated that a part of the problem is brought back to two main reasons, 1st of which being that when the disaster happened municipalities of the damaged areas were extremely understaffed, which left them paralyzed in front of the huge event that was completely out of their capacity, 2nd of which is that at the time, Japan didn't have such thing as decentralized disaster management infrastructure distributed around the country, which had forced to contact Tokyo to get their every move, a responsible move that had to happen because of the chain of command, but it delayed everything and made the situation that may could have been handled faster, an unsolvable disaster.(Aoki, 2016)

And as for our case we've seen what happened in the response period, now we need to look at some other levels as well.

Basically, Japan is a country that has always been hungry for energy (worlds 5th energy consumer) and the 2011 accident didn't help this issue at all, in fact it made it worse, this disaster affected Japan on both short and long terms dramatically, which is something explained by many explanations.

**7. Results**

Having all its nuclear powerplant near the sea, made them all exposed in the future for such an incident.

Which actually forced The Capital "Tokyo" to adopt a new energy providing approach, the old one, which as we know requires lots and lots of fossil fuel, which made it worse – but safer anyway- for Japan on two aspects, Economically as the prices of fossil fuel were sky-rocketing, of course Japan has no sources of which they can acquire fuel whatsoever which held them forced to buy all the amounts required as they can't produce any.(Vivoda, 2012)

as well as regarding the greenhouse emissions which forced Japan to be in a situation they didn't want to be in as they had signed the Kyoto Protocol, which is a protocol that took effect since 2005 but was created and signed on since 1997.

It renewed Japan's needs for Fossil fuel and in that year specifically, Japan's needs of fossil fuel went 25.5% up, which is not a small number at all, which made the imported fossil fuel make up to one 3rd of Japan's total importing's, as nuclear powerplants were producing up to 24% of Japan's production of energy (Vivoda, 2012) of course before the 2011 disaster they were looking to increase this number up to 40 – 50% by 2030, unfortunately, they had to withdraw this offer.

As we can see in figure 10, the left side is the energy production sectors in Japan pre-2011, and the right one is the after 2011.

With a quick look we can notice that nuclear energy lost a huge share that was replaced by the fossil fuels (Oil). (Vivoda, 2012)

the energy future in Japan is affected by three factors which are:

1. Public opinion
2. Energy policy Making system
3. Relative energy prices

Japan as a country is one of the biggest energy consumers in the world, and as we know, up to the Fukushima accident Japan had been using nuclear energy to satisfy its needs, what brought Japan to this type (Nuclear) of energy was nothing other than the 1973 oil crisis that made it lose its belief in fossil fuels and turn away from them, but now after Fukushima, they seem to have the same trust issues that they had in 1973, only this time its with nuclear powerplants, this made it important for them to once again find an energy source that can satisfy their needs as well as prevent their history of power supplement to reoccur again, they found their answer in renewables, especially in solar PV over wind even though that cost wise, wind is far cheaper than solar PV, as Japan is considered as one of the biggest manufacturers of solar PV, in Year 2000 Japan had almost half the share of their production globally, which made them their no.1 manufacturer, Japan had to face it's energy transition in a rather early time, and issue that all major countries are going to have to consider at some point.(Li et al., 2019)

**8. Discussion**

Japan is in an active seismic area, and yet it had the nuclear energy approach, the country officials knew that at some point, a disaster would come along, and to an extent they were ready up to a certain scale.

Japan did have a plan to respond to disasters, but the problem was that they weren't prepared to answer to something this big, something they never thought would happen.(Norio et al., 2011)

Another very important point was the medical attention needed after such a disaster, of course the need for medical care centers increased dramatically after the disaster took place, as well as the most of the affected areas lost most of their medical capacity when the earthquake hit, which made the need for help a very big issue, and taking care of such issues, and knowing their statistics, makes us more aware and gives us better preparing capability for future events(Omama et al., 2018) The main aim of the stations that were installed in the damaged area's soon after the earthquake was to provide first aids for the affected people in the flooded/affected area's while the main hospitals and centers were restored(Omama et al., 2018) Even though these mobile and installed stations were providing first aids as best as possible, it took more than 7 days for them to be deployed in their required areas as it was
also noted that 30 – 50% of the consultations were to require medicine, which shows an advanced awareness of the residents of the damaged municipalities.(Omama et al., 2018)
As there was an effect on the people on the long-term as after one year of the great eastern Japan earthquake, the ratio of disabilities among the people increased noticeably(Tomata et al., 2015) As it is a good place to consider whether the rising number of disabilities is caused by the radioactive materials released by the disaster or not(Tomata et al., 2015) As well as the spreading of some kinds of infectious diseases that were reported in the period following the tsunamis, due to some evacuation conditions and some questionable drinking water in that level, lack of food, which caused these issues. (Takahashi et al., 2012)
So, in terms of preparedness, we will be talking about individuals to begin with, it is a given fact that elderly people are harder to evacuate that all other categories, and they tend to find the shelters that are closest to their living place, but they face an issue actually being warned by the evacuation alarm which can cause a problem. (Sun & Sun, 2019) also, some differences were noticed depending on gender, as men are more responsive to an evacuation alarm than women, especially in nighttime, which makes it harder for a unit to evacuate effectively. (Sun & Sun, 2019) it is also that people that are alone or single are less responsive to an evacuation warning than a family, the previous cases and categories are depended on statistics, which can give us an impression about a certain society's preparedness for disasters and its responding capacity. (Sun & Sun, 2019) So, in the preparedness stage we need to realize that delivering the warning in right manner could save many lives, because as we've seen, some people just didn't get the chance to know they had to evacuate in the first place, which is a very serious problem.(Naylor et al., 2018) so, the efficiency of a warning is as much ratio of the people that can receive it, as well as its capability to get people to evacuate rather than just ignore the warning. (Naylor et al., 2018) warning systems are one of the most important aspects in a disaster scenario, therefore we'd like to present some recommendations that could help improve future warning systems ability to reach out for more and more people involving the people in the deciding process of the alarm system, knowing that there isn't one kind of a warning system that is applicable to a whole country, and that every group of people should have their own warning system that is effective on them, as well as some of the upcoming technology isn't showing much promise in helping to spread such an info. Also, making sure that all the sirens and electricity dependent systems are always operational, so they are ready when the time comes. as it can be beneficial involving the community in spreading, planning, such alarms. (Naylor et al., 2018)
It is noticed that tsunamis during the last 20 years have caused gradually more and more damage, the reason for that is the more expansion of residential and different activities that are taking places near coasts, which proves that a globalized tsunami warning could prove more useful, effective, and precise and could save many lives, of course in any community (especially the Japanese one) education about and awareness of the disaster can prove to be the most cost, life effective method among them all. (Imamura et al., 2019; Naylor et al., 2018)
as illustrated in Fig 18, they used 3 surveys, each of which serving a different goal, the 1st survey consisted of two sections, 1st of which contained general questionnaire regarding some demographic questions, as in the 2n section there were disaster perception questions as for the 2nd and 3rd surveys, an additional sector was added to the surveys, regarding the acceptance of the happening of a nuclear disaster.(Huang et al., 2018)
we can notice a spike in the 2nd factor in the 2nd survey which was conducted in the period following the EJGE and it targeted the population around the closest Chinese nuclear powerplant to Fukushima Daiichi nuclear powerplant.(Huang et al., 2018)

**9. Conclusion**

In those two cases Japan couldn't have possibly been able to apply a waiting strategy, because when we talk about nuclear powerplants, every single second matters, so what they were forced to do and what was the rational thing to do at the time and in the following period was a mix of a phased strategy and an umbrella strategy, as they 1st had to respond to the problem at hand with whatever materials at hand, then changed their strategy to containment after the urgent part of the disaster was handled by the phased strategy.
Reaction window was very narrow as the 1st tsunami hit 65 minutes after the earthquake, even though they had already shutdown the reactors, the problem was that the nuclear reactors shutdown period Is around 24 hours, but

in this case they had less than one, so one solution here could be them having better protection systems for such a sensitive facility.
Expected waves were not higher than 3.5m while the real waves were more than 15m high
The protection wall in front of the power plant was very short to stop such a wave, it was only 7.5m high, so that gave them the feeling of false protection, while they were far from this, no one knew though, until it was too late.
At the time of the occurrence, why did they need to bring everything from Tokyo which was about 265km away and with the tsunami wave destroyed areas, the actual travelling time between them was higher than anticipated which was about 3.5 hours in normal conditions.
Japan had never seen in the recorded history of earthquakes (since 684) an earthquake of a magnitude of 9.0 Mk, and they do still have many earthquakes happening that are above 6 Mk.
A tsunami wave of this destructive capacity is the 1st since 1703 where a tsunami wave also following an earthquake took the lives of 110.000 people.

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# The Effects of Developing Information Technologies on 21st Century Library Architecture

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**Abstract**
Changes began taking place in the storage, transmission and production of information as Information and Communications Technology started to develop from the mid-20th century onwards. Said changes in the field of information have affected the sources of information, and while altering people's habits of acquiring information, they have presented a new vision with new roles for libraries. This situation required libraries to be reinterpreted with design criteria that affect the function and architectural formation in order to adapt to the new roles. In this study, it is aimed to examine the new design criteria on how developments in Information and Communication Technologies affect the function and architectural formation of 21st century libraries and how they differentiate them from traditional libraries. Within the scope of the study, the functional and architectural design features of three next-generation library buildings selected from different countries were analyzed within the scope of a set of new design criteria. As a result of the research, it has been seen that the 21st century libraries present a new vision with integrated information technologies and architectures as per new design criteria. It has been determined this vision reflects a user-oriented design product that supports social, educational learning and teaching models and makes positive contributions to urban life with its new iconic architectures.
**Keywords:** Information and Communication Technology; Library; Library Architecture; 21st Century Libraries.

## 1. Introduction

While technology is being developed with the knowledge that exists in all areas of life and can be produced and developed continuously, the use of technology is also realized with knowledge (İspir & Torlak, 2018). The continuous interaction between technology and information has led to changes and transformations in the information paradigm as a result of developing technology. Changes began taking place in the storage, transmission and production of information as Information and Communications Technology started to develop from the mid-20th century onwards. (Sirel, 2021). In this context, the research question is “How should library architecture adapt to the changes created by the developing Information and Communications Technology in the 21st century?" That’s because, according to Edwards (2002), Information and Communications Technology has changed the balance of functionality of libraries and made them a public institution that provides more professional services. Therefore, it is crucial to investigate how the changes occuring as a result of Information and Communications Technology should be adapted to libraries, in order to ensure institutional continuity for the information resources of libraries and society.

Regarding studies conducted on the subject in his paper entitled *New Aspects of Library Design* (2006), Hohmann emphasized that libraries need replanning principles to meet the evolving digital revolution and user needs. The main design principles were examined by taking into account current trends seen in the Dresden and Göttingen State and University Library, the Seattle Public Library and the Idea Stores in London. As a result of said study, it was noticed that new planning principles of library buildings and spaces were evaluated as access and orientation, unique space, comfort, communication and sustainability. In his paper entitled *Emerging Initiatives in Library Management Systems* (2009), Haravu discussed changes in user expectations and information scanning behavior depending on the effect of Information and Communications Technology on library management systems. In their paper entitled *Spatial Effects of "Information Technologies" and "Sustainable Architecture" Approaches on "New Library Architecture"* (2015), Moza and Tokman examined the variable learning styles as a result of information technology and the need to renew learning spaces.

As a priority, the theoretical framework related to the function and architectural formation of libraries from past to present has been revealed in this study. A general evaluation was made in the resulting theoretical framework, and new design criteria affecting the function and architectural formation of the libraries were determined. The identified criteria were examined with the selected international specimen library buildings and the findings were revealed. As a result of the findings obtained, an evaluation was made regarding the innovative vision of the 21st century libraries. It has been been revealed that new roles of libraries, which are also cultural institutions, include

supporting lifelong learning, revitalizing the city and community where they are located as well as making positive contributions to urban life.

## 2. Theoretical Background

### 2.1. Libraries as Information Centers and Their Architectural Features

***Libraries of Antiquity:*** Subsequent to when writing was first invented around 3500 BCE, archive/library rooms established to store information resources began with the Sumerians and continued with the Assyrian-Babylonian and Hittite civilizations (Lerner, 2007; Odabaş and Akkaya, 2020). The Egyptians stored their information resources in the library of the Alexandria Museum, which included an archive chamber, museum, botanical garden, observatory, and anatomy room (Cited from MacLeod, Odabaş & Akkaya, 2020). Some archaeologists and researchers are of the opinion that the library was situated as an administrative section within the Alexandria Museum (Lerner, 2007). As for the ancient Greek civilization's Pergamon Library, which was comprised of a series of rooms in the city acropolis, the information resources were placed in a large hall with wooden shelves in the wall niches. Three small chambers on the side were used as reading rooms surrounded by bookshelves as well as a study room for the preparation of written scrolls (Lerner, 2007). The Roman civilization built the Library of Celcius in the town square. The library was designed with three niches in the north and south walls and four niches on the west walls, whereas a two-storey high gallery space was obtained with the niches. When the niches were not enough, a second floor was built, whereby there are historians who believe a two-storey gallery was erected in front of the niche to access this floor. Thus, a three-story high library with two galleries had been created (Yıldız, 1985).

***Medieval Libraries:*** In this period when religion was first and foremost, a typical monastery library was comprised of a rectangular chamber with a high domed ceiling, three or four times its width, with large high windows. Pieces of parchment paper, which started to take the form of a book, were chained and arranged in three different shelf systems. First, books were chained to the curved tabletops by the windows. Later, bookcases with shelves on both sides were used. There was a table-height surface between the shelf compartments. These surfaces were hinged to access the lower chests or additional shelves. Manuscripts were read at both rack systems, sometimes either by standing up or sitting on a bench. Finally, shelves or bookcases were positioned in wall niches. Thus, more books were arranged with the wall system and reading tables were located in the center of the room (Lerner, 2007).

***Renaissance and Reform Age Libraries:*** Johannes Gutenberg's invention of the printing press in the second half of the 15th century made it easier to produce books, rendering a vast increase in the number of books to be read (Dalkıran, 2013). Bookcases and readers in Renaissance libraries were the main elements that played a role in determining the indoor layout and lighting. For readers, there was usually a special armchair or table placed next to a bay window or flat window (Edwards, 2002). Positioned in the middle of the building, reading rooms constituted the main gathering place (Tercan, 2010).

***Industrial Age Libraries:*** The first original specimens of the emergence of libraries as a building typology were seen in the 18th century. Typical library architecture of this century was a reading hall with a circular layout, and domed and deaf walls. A dome covered the reading room and halls, providing illumination via window openings. Bookcases were positioned along the surface of the deaf walls. Accessed via a slight hump above street level, the semi-buried basement of the library building was utilized as storage (Edwards, 2002). In this period, when 'public' libraries as we know them today began to emerge, museums and libraries were generally designed as part of the same building until the 19th century. The characteristic library architecture of the 18th century continued to be incorporated until the 20th century (Tercan, 2010).

***Modern Period Libraries:*** The function and architecture of libraries witnessed significant changes in the 1930s. The open shelf system, which began to be utilized at this time, was effective in shaping the library area (Dahlkild, 2011). Reading rooms were turned into foyers and library entrances that ensured communication between staff and users (Edwards, 2002). The monumental effect, strict geometric form as well as the dome cover over the reading room were abandoned, which resulted in a flexible architectural formation that allowed for more fluid spaces (Tercan, 2010). When library buildings of the Modern Era are examined, it's seen that book checkout units, subject shelves, study rooms, offices, spaces for children, conference rooms, exhibition areas have all been added to the functional program.

***Libraries of the Islamic World:*** Libraries were generally comprised of a domed section and a narrow and a long corridor in the early Islamic world. There were ornate, wooden-covered bookcases in the rooms around the corridor as well as on the walls of the domed section (Baysal, 1991). Subsequent to their conversion to Islam, the Turks established palace and madrasah (university) libraries (Cunbur, 1963). Libraries continued to be founded in madrasahs, lodges and mosques of the Ottoman Empire (Cunbur, 1963; Baysal, 1987, 1991) after the conquest of Istanbul. The first public library, *Kütüphane -i Umumi* (Beyazit State Library), was established by the state in 1882. In 1908, the idea of a 'National Library' was tabled for discussion whereas national libraries were established in

many cities around Turkey (Baysal, 1991). Turkish Libraries of the Republic Period, on the other hand, began to be set up as university, public, national, private and children's libraries in many different cities throughout the country.

**2.2. Conceptual Transformation in Information Acquisition and Digitalization of Libraries**

Throughout history, there has been a need to record information produced and developed in all areas of life for purposes of storage/protection, as well as the transfer and utilization in the future. After the invention of writing, information written in its most known forms (clay tablets, papyrus and parchment rolls) in Antiquity, continued with printed books after the developments in paper and printing. Graphic resources (photographs, maps, etc.) as well as audio/visual resources (records, cassettes, microfilm, etc.) that emerged as technology has progressed have become new tools in which information is stored and transferred along with printed resources (Dalkıran, 2013). Nevertheless, countless changes have occurred in the field of information since the second half of the 20th century, with Information and Communication Technologies (BIT).

- Librarians commenced the integration of bibliographic information of the collections of each library into the MARC (Machine Readable Cataloging) data standard between 1960 and 1970 (Haravu, 2009).
- Access to inter-library catalog information was provided by librarians via OPAC (Online Public Access Catalog) technology as a result of the rapid spread of the Internet between the 1970s and the 1990s (Haravu, 2009).
- With the development of optical disc technology in the 1980s, information resources were transferred to CD-Rom, whereby users checked out CD-Roms from the librarian to access resources via the help of computers (Dalkıran, 2013).
- As a result of the Internet's widespread use in social life along with steadily improving Information and Communication Technologies, individuals began to access information outside the library after the 1990s.

The 'Digital Library' concept emerged with the transfer of library information resources to digital media and the occasional production of information in digital media (Cleveland, 1998). Being able to access digital information from anywhere, growing up with technology or establishing a relationship has brought about the creation of 'digital natives' and 'digital immigrants' (Prensky, 2001). These so-called digital natives/immigrants began getting involved in a number of activities such as entertainment, free communication, shopping, etc. in the digital environment, thus moving away from social environments. At this juncture, the concept of a 'third space' (Cited by Demir, 2017), defined by the American urban sociologist Ray Oldenburg (1999) for libraries, initiated the contact of libraries with urban culture as public spaces providing opportunities for socialization.

The International Federation of Library Associations' (IFLA) *Multicultural Communities: Guidelines for Library Service* (Pestell et al., 2009) defined three new roles for libraries. As *learning centers*, libraries need to encourage learning by providing materials and services necessary for everyone. As *cultural centers*, libraries need to preserve and present materials and collections from local and different cultures. As *information centers*, libraries need to produce, store and make accessible, as well as transfer all kinds of information in a multi-cultural community (Pestell et al., 2009). So, it's these new roles that have created an opportunity for libraries to renew and adapt to developments.

**2.3. Innovative Libraries of the 21st Century and New Design Principles**

Libraries need to be innovative in order to sustain their institutional existence and present their new roles to the users. Alaca (2018) stresses that, amongst the innovative models developed so far, an 'outwardly innovative model' should be adopted in order to get familiar with the needs of the outside and provide services in accordance with its ideas. What is meant here is 'external users.' Considering different user opinions in order to become innovative in libraries is one of the crucial beginnings for innovative library design. In this regard;

*Architect Harry Faulkner-Brown* (1987) stressed that a successful library design should be flexible, compact in order to keep distances as short as possible, accessible, expandable, diverse, organized, comfortable, stable environment with invariably comfortable conditions, safe and economical, not to mention maximum service at a minimum cost.

*Architect Steven Foote* (1995) emphasized that print and electronic resources should be together, the neighborhoods between venues should be fluidly designed and the reader and staff need to be brought together.

*Academician Brian Edwards* (2002) mentioned that in addition to the ten basic principles that Harry Faulkner-Brown laid down for successful library designs, they should be sustainable and spirit invigorating as well.

*Library user Bernhard Fabian* (2002) stated that the most important thing in libraries is the effect of the reading space on the reader. That's because the act of reading is a psychological process and the reader should be able to control his external environment whenever he needs to.

*Director of Library and Learning Services, Andrew McDonald* (2006) stated that a nice library should be functional, adaptable, accessible, diverse, interactive, convenient, environmentally friendly and safe, efficient, suitable for information technology, while having powerful spaces that are inspirational.
*Designer Lori Gee* (2006) emphasized that the learning space needs to be healthy, stimulating, adaptable by balancing community and solitude.
According to *Academician Nancy Van Note Chism (*2006), a learning space should have flexibility, comfort, sensory stimulation, technology support, centrality, studio classroom, solution partners/collaboration, live & learn spaces and corridor niches.
*Architect Moshe Safdie* stressed in a public Q & A session that while designing a library, a fine program can be made based on the attributes and needs of the city (City of Boise, 2018).
It is seen that the opinions of different users for innovative libraries have been directly and indirectly influential in the creation of '**new design criteria**' for next-generation libraries and learning centers of the 21st century. The aforementioned 'new design criteria' are provided in brief below.
***Urban Location and Accessibility:*** In serving important roles in the realization of common life in the community, libraries need to be located at a spot that can be easily accessed by everyone, including the physically challenged. Paths to the library should be legible and result in a memorable stay. Thus, location/place psychology should be considered together with transportation (Edwards, 2002). Recently, many new libraries have been situated in high-traffic areas, further enhancing interaction between the library and community, while supporting the retail mix (Worpole, 2013).
***Visibility, Aesthetics, Image:*** With their new roles, libraries should make their presence felt in the urban environment with their architectural formation, by becoming the symbol of a new kind of environment at the hub of urban life and culture (Worpole, 2013). Libraries need to attract the community with their architectural form. With a wide, transparent entrance facade, users should be able to see inside the library and feel invited and safe (Khan, 2009).
***Offering Different Activities:*** The role of the learning center has brought about the necessity of different learning environments for everyone in libraries. For instance, the concept of 'third space,' such as digital labs, computer areas, training classrooms or labs, makerspace areas, etc. highlights the importance of socio-cultural spaces in libraries. For instance, According to Worpole (2013), libraries should offer performance spaces like exhibition areas, multi-purpose halls, auditoriums, seating areas, etc. and create meeting spaces for live events such as book signing tours, children's storytelling sessions, etc.
***Indoor Access and Routing:*** Since libraries are multi-functional and complex, circulation should be natural and instructive. Once inside, the user should be provided a place for reflection or overview of the indoor layout (Edwards, 2002). Circulation should be easily monitored and vertical circulation should be visible. The effect of control areas in circulation should be soft and information boards and flexible usage areas should be positioned in these areas (Khan, 2009, Amen & Nia, 2020). A space in the library should evoke the next space and thus an instinctive orientation should be provided (Worpole, 2013).
***Space Organization:*** While planning the neighborhoods between the spaces, it should be established with the relationship of adjacency. Because sometimes it may require decent visual communication from one space to another, sometimes a space may need to be visually or acoustically isolated, sometimes one space may require convenient access to the other neighboring space, while it may require complete separation from the other (Khan, 2009). Khan (2009) groups this situation briefly as follows;

- *Positive Adjacency*, spaces are directly related.
- *Neutral Adjacency,* spaces have no common relation.
- *Negative Adjacency*, spaces must be separated.

Horizontal placement is as important in space organization as it is in vertical placement. According to Foote (1995), the neighborhoods between floors should be fluid and a continuity of relationship should be provided between services on different floors.
***Access to Collections:*** Along with Information and Communications Technology, the library collection is divided into two groups, digital and non-digital resources. Both types of collections may require different technical demands and attributes. For instance, computer space for digital resources and another space for printed resources. The important thing is to include collections of local and different cultures in libraries so that everyone can access various resources.
***Learning Processes:*** Many different people have various desires and ways of working in their knowledge/learning processes. While some people don't wish to be disturbed in order to maintain concentration while learning, others enjoy learning together with different individuals in more comfortable and flexible environments. The important thing is that there should be areas in the library that support both individual learning and learning by doing together in order to meet different requests.

***Sustainability:*** Libraries need to give a set of messages to the environment by displaying their architectural formations and sustainability practices in the most appropriate way within the scope of the service they provide (Edwards, 2011). Sustainability and environmental protection policies on a universal scale are handled in three different dimensions; 'Economic,' 'Social' and 'Environmental.'(Aziz Amen,2022)

Economic Dimension; To ensure sustainability by avoiding sectoral imbalances produced in order to ensure continuity in the use of scarce resources and harming this production, and by managing debts under appropriate conditions (Tıraş, 2012). According to the Urban Libraries Council (2010), libraries are the best institutions to create brainpower, which is the material unit of success in the 21st century. From this aspect, libraries play a role in achieving economic development and welfare.

Social Dimension; Every individual needs to benefit from social services such as education and health on equal terms by putting people at the center (Tıraş, 2012). According to the Urban Libraries Council (2010), library resources should be accessible to everyone.

Environmental Dimension; Aims to use renewable resources by protecting the resources in the ecosystem and the balance between them (Tıraş, 2012). According to the Urban Libraries Council (2010), the community should be included in environmental sustainability issues with sustainable architectural design practices.

***Smart-Comfortable Interior Elements:*** Libraries should have various kinds of indoor elements for many reasons such as function, collection types, and user diversity (Odabaş & Akkaya, 2020). Table and seating elements can be examined in separate groups with different sizes, types, textures and materials, mainly collection storage, transportation and access tools (Odabaş & Akkaya, 2020). However, the important thing is that these elements should be of such a variety that will provide comfort conditions for everyone (children, adults, elderly, disabled, etc.).

***Spatial Impact Quality***: Libraries should be spaces that provide comfort conditions that meet both current and anticipated user needs. Comfort conditions can be examined in three groups as Visual, Acoustic and Climatic Comfort;

Visual Comfort; lighting is important in ensuring harmony with color, texture and material components. That's because all the components that affect the indoor design will directly affect the performance of the library users with psychological factors. When different components are used together, the ambiance in the space will change.

Acoustic Comfort; Libraries are comprised of places where there is sound and where silence is desired. Therefore, acoustic comfort should be considered in the architectural design process (Odabaş & Akkaya, 2020).

Climatic Comfort; Climatic comfort levels are different for library usage areas and collection materials. For instance, it is different in general usage areas with appropriate temperature and humidity adjustments for the preservation of rare artefacts and important documents without deformation (Odabaş & Akkaya, 2020). Appropriate climatic comfort analysis should be made for each space.

## 3. Case Study

### 3.1. Materials and Research Method

The materials of this study are next-generation library buildings. Data collection and analysis method was used in the research. Three next-generation library buildings, namely Sendai Mediatheque, Library of Birmingham and Dokk1 Library, have been selected as examples in order to better explain how the 'new design criteria' determined as a result of literature readings are applied within the scope of the study.

Specimen library buildings are determined by the features of being built in the 21st century, having features that distinguish them from traditional libraries, providing maximum diversity, and being public libraries with a wide and different user base compared to other library types. Library buildings; theoretical information, visuals and videos were examined and then new design criteria related to the subject were analyzed through architectural plans and sections. Findings obtained from the analyses were visualized in tables and presented the result of the study.

### 3.2. Sendai Mediatheque

Designed by architect Toyo Ito, Sendai Mediatheque is a public library opened in 2001 in Sendai, Japan. The Royal Institute of British Architects (RIBA) awarded this library the Royal Gold Medal in 2006 (URL-1).

Before starting the design, Toyo Ito decided that he didn't want to create a room in the library and designed the library with a square plan scheme. Functions are usually separated with indoor elements and curtains. The only mass of the library surrounded by walls is the conference hall and administrative offices located on the fifth floor (Jordana, 2013).

The library uses vertical carrier elements formed by tubular steel elements placed in 13 different support glass tubes that serve as transparent shafts allowing natural light and air to enter the indoor. There are vertical circulation elements inside the widest glass tubes. When the eight movable glass panels used on the ground floor facade are opened, both the integration of the ground floor with the city and natural air and light enter the library.

The south (main) facade is covered with a double-layered glass shell, while the west facade is covered with metal facade elements. Transparent glass, polycarbonate sandblasted glass, and aluminum cladding were used, differently on each floor of the east and north facades (URL-1; Jordana, 2013) (Figure 1). Functions in the library building such as the main entrance, library, information and communication center, exhibition areas and workshops are generally separated between floors. The functional program distribution offered by the library is provided in Table 1.

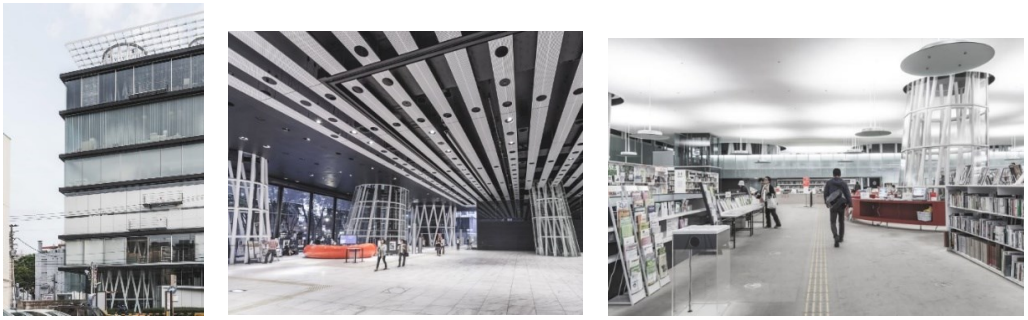
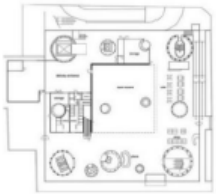
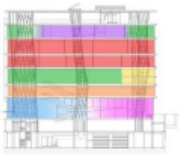
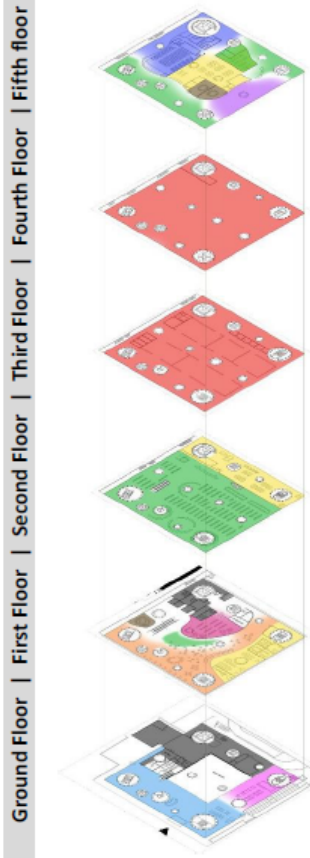


**Figure 1.** Facade, Entrance Square, Newspaper and Magazine Collection Area [URL-1]

**Table 1.** Sendai Mediatheque Function Chart [created by the authors using URL-1]

| Sendai Mediatheque | | |
|---|---|---|
| **Location:** Sendai, Japan<br>**Year:** 2001<br>**Architect:** Toyo Ito | <br>Location | <br>Sendai Mediatheque |
| **Plan and Section** | **Plan Chart** | **Layout of Functions by Floors** |
| <br>Ground Floor Plan<br><br>Section | <br>Ground Floor \| First Floor \| Second Floor \| Third Floor \| Fourth Floor \| Fifth floor | **Fifth floor**<br>• Conference Hall and Foyer<br>• Audio-Visual Library<br>• Art and Culture Library (with reading and study areas)<br>• Open Studio / Workshop Areas<br>• Project Room<br>• Offices (Administrative Units)<br>**Third and Fourth Floor**<br>• Exhibition Area and Foyer<br>**Second Floor - Mezzanine**<br>• Local Culture Collection Area<br>**Second Floor**<br>• Librariy (with reading and study areas)<br>• Borrowing / Lending Units<br>• Offices (Administrative Units)<br>**First Floor**<br>• Library for Children<br>• Offices (Administrative Units)<br>• Newspaper and Magazine Collection<br>• Computer Research Area<br>• Talking Room<br>• Meeting room<br>• Storage Space<br>**Ground Floor**<br>• Main Entrance / Square<br>• Cafe<br>• Sales Area (Bookstore)<br>• Delivery Entry and Warehouse |
| ■ Entrance / Square<br>■ Offices (Administrative Units)<br>■ Storage Space<br>■ Library<br>■ Computer Research Area<br>■ Library for Kids<br>■ Exhibition space<br>■ Conference Hall<br>■ Cafe<br>■ Meeting Room<br>■ Open Studio / Workshop Area | | |

**Compatibility of** the **Sendai Mediatheque Library with New Design Criteria is as follows:**

***Urban Location and Accessibility***: Surrounded by business centers and high-rise apartments, the library building is located on a tree-lined street and provides access for everyone.
***Visibility, Aesthetics, Image***: The library building is in harmony with the high-rise buildings in the vicinity with its cubic volume, but is distinguished by its transparency. The transparent design integrating the library and public space is a clear symbol of knowledge, learning and sociability.
***Offering Different Activities***: In addition to the 'information' and 'learning' spaces open to everyone, there are computer technology areas, exhibition areas for socio-cultural interaction, a conference hall and a workshop area in the library.
***Indoor Access and Routing***: In its open plan design, routing is provided in the circulation with the indoor elements. The circulation elements positioned within the glass column tubes can be grasped in the space at first glance. The three raised yellow lines on the floor are a means of orientation for the visually impaired.
***Space Organization***: The library building functions are separated according to the floor, namely the main entrance, library, information and communications center, exhibition areas and workshops. The spatial relationship between similar needs and functions has been analyzed within the same floor.
***Access to Collections***: Various library collections placed on the first, second and fifth floors with different functional areas are made available to the user as open shelves.
***Learning Processes***: Reading areas, meeting rooms and open workshop areas in the library are environments that support both individual and collaborative learning.
***Sustainability***: The social and economic dimension of sustainability is supported by education programs for everyone, providing public spaces amidst business centers and apartments, providing internet and technology to the user in the library building that is accessible and safe for everyone, and a myriad of service and activity areas along with education. The environmental dimension of sustainability is supported by various facade designs in its architecture, ensuring the climatic balance in the interior and being located in the city center.
***Smart-Comfortable Interior Elements***: A variety of interior elements have been provided with seating elements, desks and shelf arrangements of different sizes and shapes for different collection types in the library.
***Spatial Impact Quality****:* In general, visual comfort is highlighted, using white on the flooring and walls and various colors in the indoor elements. Nevertheless, the separation of functions with curtains in some places weakens the visual effect. While paying attention to acoustic comfort with the balanced distribution of sound and silent functions between floors and double-glazed facades, climatic comfort is provided through its structural techniques.

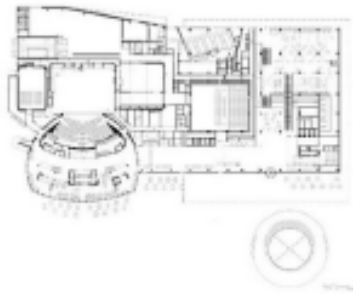
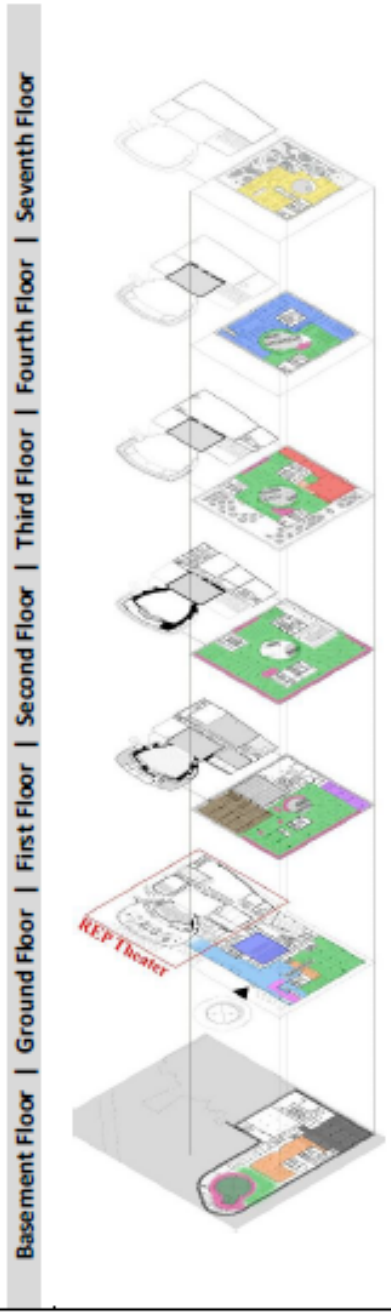
**3.3. Library of Birmingham**

Designed by the Mecanoo architecture office, the Library of Birmingham is a public institution that opened in Birmingham, U.K. in 2013. The library received the BREEAM Certificate of 'Excellence' in 2013 as well as the 2014 RIBA (Royal Institute of British Architects) National Award (Mecanoo, 2022). Comprised of four different prismatic volumes, the library building intersects vertically at different points. The intersecting volumes form terraces in a cantilevered building mass.
Natural light and air enters the library from a central point via the chimney effect of the circular Book Rotunda in the center of the library (URL-2). The circular Underground Outdoor Performance Area in the library square provides the basement floor with natural light and air. Acoustic materials are affixed on the ceiling as per the spaces in the library where silence is highly desired or less desired. Curtain walls and double paned glass are used on the facades to hinder street noise from entering the building. Separate measures have been implemented into the walls and floors to dampen out any excessive noise stemming from mechanical ventilation systems, workshop/studio and equipment (URL-2). A foyer links the main entrance of the library to the Repertory Theater, which dates back to 1962. Designed in 1882, the Shakespeare Memorial Room is integrated into the library's attic rotunda (Mecanoo, 2022) (Figure 2). A breakdown of the functional program available at the library is provided in Table 2.



**Figure 2.** Entrance Square, Book Rotunda, Bookcases and Children's Amphitheater, Study Area [Cited by Harry Cock and Christian Richters, Mecanoo, 2018]

**Table 2.** Library of Birmingham Function Chart [Mecanoo, 2022; Created by the authors using URL-3]

<table>
<tr><th colspan="3">Library of Birmingham</th></tr>
<tr>
<td>Location: Birmingham, United Kingdom<br>Year: 2013<br>Architect: Mecanoo Architecture</td>
<td><br>Location</td>
<td><br>Library of Birmingham</td>
</tr>
<tr><th>Plan and Section</th><th>Plan Chart</th><th>Layout of Functions by Floors</th></tr>
<tr>
<td><br>Ground Floor Plan<br><br>Section<br>Entrance / Square<br>Offices (Administrative Units)<br>Book Storage<br>Library<br>Library for Children<br>Exhibition space<br>Conference Hall<br>Cafe<br>Meeting room<br>TV Rooms<br>Flexible Sitting Area<br>Underground Outdoor Performance Area<br>Open Research Units<br>Study Rooms</td>
<td><br>Basement Floor | Ground Floor | First Floor | Second Floor | Third Floor | Fourth Floor | Seventh Floor</td>
<td>Eighth and Ninth Floors<br>• Shakespeare Memorial Room<br>Seventh Floor<br>• Offices (Administrative Units)<br>• Open Terrace<br>Sixth and Fifth Floor<br>• Archive and Heritage Collections<br>Fourth Floor<br>• Archive and Heritage Collections Open Research Units<br>• Library (Map, Microfilm, Genealogy, etc. Resources)<br>Third Floor<br>• Exhibition space<br>• Library and Reading Area (with Sitting Areas)<br>• TV rooms<br>• Open Terrace<br>Second Floor<br>• Library and Reading Area (with Sitting Areas)<br>First Floor<br>• Library and Reading Area (with Sitting Areas)<br>• Group Rooms<br>• Meeting Rooms<br>Ground Floor<br>• Entrance / Square<br>• Cafe and Sales Areas (Bookstore)<br>• Auditorium<br>• Music Library<br>• Weston Research Library<br>Basement Floor<br>• Book Storage<br>• Children's Library<br>• Libraries and Reading Areas<br>• Underground Outdoor Performance Area</td>
</tr>
</table>

**Compatibility of the Library of Birmingham's with the New Design Criteria is as follows:**

***Urban Location and Accessibility:*** A conference center, a concert hall, an ice rink, and a city park are located in the immediate vicinity of the library, which has been situated adjacent to the Birmingham Repertory Theater (REP) since 1962. Situated in close proximity to key focal points, the library offers access to people of all walks of life.

***Visibility, Aesthetics, Image:*** Comprised of four various sized prismatic volumes, the library building is distinguished from other buildings by its glass, gold, black and motif-patterned facade cladding. A functional facade design was created by means of transparent appearance of the main entrance square, opaque motif coatings on the library and management floors, and opaque design of the archives/warehouses.
***Offering Different Activities:*** Rather than a book-oriented building approach, the library structure offers a functional program with socio-cultural functions replete with various education and activity areas.
***Indoor Access and Orientation***: A central circulation point has been created with the stairs and elevators located in the Book Rotunda of the library building. The panelboards in the interior provide orientation to the users.
***Space Organization:*** While the spaces where user density is higher are placed on the ground and upper/lower floors, spaces not used by the user, such as management units and archives/warehouses are located on the top floors.
***Access to Collections:*** Different collections that appeal to everyone are shared between floors and presented openly to users.
***Learning Processes:*** The study and seating areas, group rooms and meeting rooms found in reading areas support both individual and collaborative work.
***Sustainability:*** Sustainability is economical, social and environmental dimensions are supported with various education and learning programs for everyone, bringing the internet and technology closer to users, being an accessible and safe institution for everyone, benefiting from daylight and natural ventilation, having different facade designs for functional natural lighting, and well as being located in the city center.
***Smart-Comfortable Interior Elements:*** Various seating elements and work areas, as well as a variety of shelf arrangements for different collection materials, diversity and comfort are provided in the library's interior elements.
***Spatial Impact Quality:*** A visual effect suitable for the functions is provided with the color matches of the interior. Acoustic and climatic comfort is provided by the library's architectural formation and technical details.

**3.4. Dokk1 Library**

Designed by the Schmidt Hammer Lassen architecture office, the Dokk1 Library is a public library that opened in 2015 in Aarhus, Denmark. The library building received the Public Library of the Year Award in 2016 at a ceremony held at the IFLA congress (Schmidt Hammer Lassen Architects, 2022). Raised from the ground up, the library building features a polygonal form. The library's main entrance is via the first floor by accessing the open terrace on the ground floor with a transparent surface. Comprised of light-colored metal coatings, the facade has continuous transparency. Six different skylights found on the roof of the library draw daylight deep into the building (Hapel et al., 2015) (Figure 3).
Certain criteria were taken into consideration so as to ensure the library building complies with the low energy statute of 2015. As it is situated on the seashore, the water's natural effect in the air is utilized to cool the building in summer, whereas a protective measure has been taken against sunlight thanks to the installation of a wide roof plate. Thanks to its compact form, thermal loss has been reduced as much as possible, whereas the use of solar panels, LED lamps, motion and daylight sensors have all been incorporated (Schmidt Hammer Lassen Architects, 2022; Hapel et al, 2015). A breakdown of the functional program offered at the Dokk1 Library is provided in Table 3.

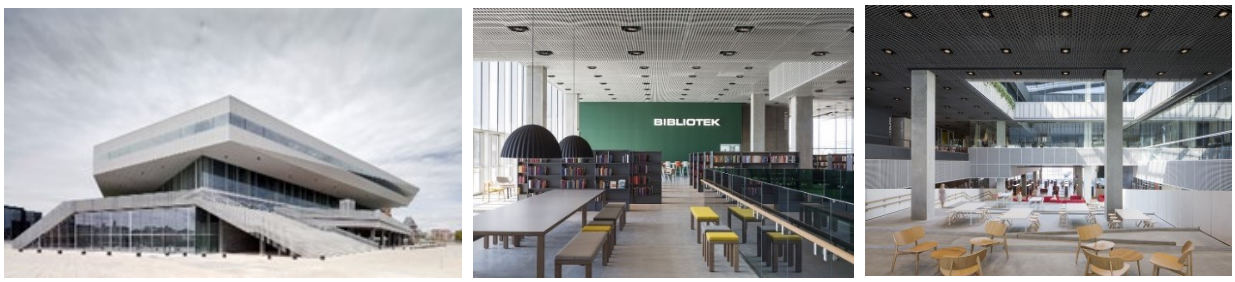
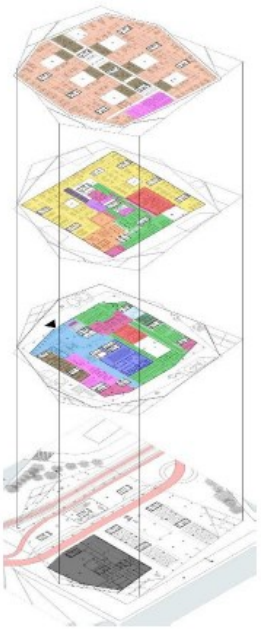



**Figure 3.** Public Square, Libraries, Media Ramp [Schmidt Hammer Lassen Architects, 2022; URL-4]

**Table 3.** Dokk1 Library Function Diagram [created by authors using URL-4]

<table>
<tr><th colspan="3">Dokk1 Library</th></tr>
<tr><td>Location: Aarhus, Denmark<br><br>Year: 2015<br><br>Architect: Schmidt Hammer<br><br>Lassen</td><td><br>Location</td><td><br>Dokk1 Library</td></tr>
<tr><th>Plan and Section</th><th>Plan Chart</th><th>Layout of Functions by Floors</th></tr>
<tr><td><br>Ground Floor Plan<br><br>Section<br><br>Entrance / Square<br>Offices<br>Book Separation/Forwarding Units<br>Libraries<br>Areas for Kids<br>Media Ramp<br>Conference Hall<br>Cafe<br>Meeting room<br>Rentable Office Rooms<br>Flexible Seating Area<br>Project Room<br>Transformation Room<br>Play ground<br>Aarhus Historical Archive Room</td><td>Third Floor | Second Floor | First Floor | Ground Floor<br></td><td>Third Floor<br>• Rentable Office Rooms<br>• Meeting Rooms<br>• Cafe / Canteen<br>Second Floor<br>• Offices (Administrative Units)<br>• Bookcase (with sitting areas)<br>• Media Ramp<br>• Children's Play Library, Learning Area and Laboratory<br>• Play ground<br>• Aarhus Historical Archive Room<br>First Floor<br>• Library (with reading and study rooms)<br>• Transformation Room<br>• Project Room<br>• Media Ramp<br>• Meeting Rooms<br>• Conference Hall (two for adults and children)<br>• Cafe<br>• Flexible Seating Areas<br>• Open Terrace<br>Ground Floor<br>• Parking area<br>• Rail Transportation Line<br>• Book Separation/Forwarding Units</td></tr>
</table>

**Compatibility of the Dokk1 Library with the New Design Criteria is as follows:**

***Urban Location and Accessibility***: The library building is part of a plan to revitalize a former industrial port zone and incorporate the historic port into the city (Hapel et al., 2015). Surrounded by Filmby Aarhus Town Hall, the police department and commercial centers, the library building is situated along the light rail transit line.

***Visibility, Aesthetics, Image:*** With its polygonal form, its ice floe-like appearance over a raised ground distinguishes it from the buildings in the vicinity. The outdoor square and steps in front of the library offer a public space for users.

***Offering Different Activities:*** In addition to the library, reading and study areas, socio-cultural spaces are included and different functions are offered for the users. With office rooms of many different sizes to let, the library building is an indication the library can be used for everyone (e.g. for business meetings).

***Indoor Access and Routing:*** There are circulation elements at many different spots in the library. The library is generally designed with an open plan setup, creating a flexible circulation space between functions. However, the areas where the administrative units are located have been created with a corridor layout. The Media Ramp in this library is not only a social area for users, but also offers a circulation area between the first and second floors, just like an amphitheater comprised of ramps. The panelboards and writing on the floor direct the users to the functions.

***Space Organization:*** In choosing an open plan layout for the relationship between the libraries and the square on the ground floor, a positive adjacency relationship has been established in the continuous functional organization. Vertical building elements partition the administrative units on the second floor of the library from other functions. Finally, more room arrangements were made and special working environments were created on the third floor.

***Access to Collections:*** Along with reading, working and seating areas, a myriad of collection materials is available to users only on the first and second floors.
***Learning Processes:*** The project and learning rooms, open activity areas, rentable office areas or meeting rooms, open study areas found in the library offer spaces that are suitable for individual or collaborative, loud or silent, flexible or serious working processes.
***Sustainability:*** Rental offices, as well as study, project and teaching rooms providing internet and technology support for everyone, being an easily accessible and reliable institution for everyone, having community service counters in the main entrance square to support and serve the personal needs of citizens, the benefitting from the water's natural cooling effect, protection against sunlight with a wide roof plate, the reduction of thermal loss in compact form, the solar panels on the roof, LED lamps, motion and daylight sensors all support the economic, social and environmental dimensions of sustainability.
***Smart-Comfortable Interior Elements:*** Diversity and comfort are provided with various interior seating and study settings, different collection shelf arrangements, as well as furnishings and equipment suitable for function and purpose.
***Spatial Impact Quality:*** Though concrete, wood and metal colors are generally incorporated in interior horizontal and vertical partition elements, a visual effect suitable for functions is achieved by coloring the space with furniture and equipment. Attention has been paid to acoustic comfort by making horizontal partitions and furniture distinctions between functions that require intense sound or silence. Climatic comfort has been provided with the decisions taken for architectural formation.

**4. Findings**

The 'new design criteria' set forth in the literature section of the study on 21st century next-generation libraries were accepted as the analysis parameters of this study. The Sendai Mediatheque, Library of Birmingham and Dokk1 Library buildings, which are the sample areas of the study were scrutinized over these parameters whereas the following findings were compiled.

- Within the scope of urban location and accessibility criteria, the library buildings in question are amongst the important socio-cultural and commercial structures in their city centers and offer a public space to the citizens. Since they are located in the city center, they are easily accessible by everyone.
- Within the scope of visibility, aesthetics and image criteria, transparent facade design on the main entrance floors of the libraries and facade designs in which transparency and opacity are balanced in accordance with the function are in the forefront of the upper floors. The transparent and original designs of the libraries have highlighted the information spaces. Moreover, these library buildings are integrated with open public space in front of them, thus offering outdoor activity opportunities.
- Within the scope of the criteria for offering different activities, in going beyond traditional library spaces, the computer technology area, workshop areas, meeting rooms, rental offices, project and transformation rooms as information and study spaces have been incoporated in their functional programs. Moreover, a myriad of spaces such as exhibition areas, conference hall, open performance areas, small TV rooms, open terrace areas, amphitheater designs, flexible seating areas and reading/ game/activity areas for kids as socio-cultural spaces have begun to be incorporated into 21st century libraries.
- Within the scope of indoor access and orientation criteria, rather than the traditional corridor layout in libraries with generally open plans, circulation areas are created between functions. Control points have been created in the circulation by using flexible, short-term and low-intensity areas in areas with combined functions. Circulation elements are situated at various points at the Sendai Mediatheque and Dokk1 Libraries, and at a central point at the Library of Birmingham. Moreover, panelboards were used as auxiliary elements to provide access and orientation at all three libraries.
- Within the scope of space organization criteria, functions requiring short-term, intense movement and sound are located on the lower floors, while functions requiring long-term silence and concentration are located on the upper floors at all three libraries. Positive and neutral relations were provided, depending on the intensity and duration of use (more or less intense/short-long term) of the functions (educational, social, etc.) and acoustic levels (loud and silent) between the floors.
- Within the scope of access to collections criteria, collections and materials for everyone, from different cultures are presented to the user in a balanced way with reading/study and seating areas.
- Within the scope of the learning processes criterion, open study spaces, meeting rooms, group study rooms and workshops, as well as spaces that support individual, collaborative/cooperative learning processes are offered to the users.

- Within the scope of sustainability criteria, the libraries in question provide the economic dimension of sustainability by offering lifelong learning to all users with their education and training programs and improving their city location. They provide access to library services by everyone, provide digital balance by bringing all users together with computers and technology, are institutionally accessible and reliable, and provide social-cultural sustainability with different education, training and activity programs. Different design strategies such as the form, the chimney effect created by the courtyard in the center and the facade design, solar panels, sustainable lighting elements, which are effective in the architectural formation, support the environmental dimension of sustainability.
- Within the scope of the Smart-Comfortable interior elements criterion of the libraries in question, diversity is provided in interior elements in accordance with different functions and needs. Various interior elements in the reading/study and seating areas offer the users the opportunity to choose, depending on their personal wishes and comfort. With shelf arrangements suitable for different collection materials, the collections are both preserved and presented to the user.
- Within the scope of the spatial effect quality criterion, a balance of visual comfort was achieved in the interior as a result of the matching of colors in the ceiling, wall, floor and indoor elements of the libraries in general. The relationship between acoustic levels in the interior organization and design decisions considered in the architectural formation provided acoustic and climatic comfort in the library.

Findings pertaining to compatibility with the new design criteria of the Sendai Mediatheque, Library of Birmingham and Dokk1 Libraries are summarized in Table 4.

**Table 4.** Compatibility of 21st century next-generation libraries with 'new design criteria' [Compiled from text readings by authors]

| New Design Criteria | Sendai Mediatheque | Library of Birmingham | Dokk1 Library |
|---|---|---|---|
| **Urban Location and Accessibility** | | | |
| • In the city center | ✓ | ✓ | ✓ |
| • Associated with surrounding buildings | ✓ | ✓ | ✓ |
| • Access by public transport/private vehicles | ✓ | ✓ | ✓ |
| • Access for all | ✓ | ✓ | ✓ |
| **Visibility, Aesthetics, Image** | | | |
| • Iconic architectural formation | ✗ | ✓ | ✓ |
| • Inviting entrance and square | ✓ | ✓ | ✓ |
| • Being a symbol | ✓ | ✓ | ✓ |
| **Offering Different Activities** | | | |
| • Spaces of knowledge and learning | ✓ | ✓ | ✓ |
| • Socio-cultural spaces | ✓ | ✓ | ✓ |
| • Spaces for everyone | ✓ | ✓ | ✓ |
| **Indoor Access and Routing** | | | |
| • Soft control areas | ✓ | ✓ | ✓ |
| • Routing tools | ✓ | ✓ | ✓ |
| • Easily monitored circulation | ✓ | ✓ | ✓ |
| **Space Organization** | | | |
| • Positive adjacency | ✓ | ✓ | ✓ |
| • Neutral adjacency | ✓ | ✓ | ✓ |
| • Negative adjacency | ✗ | ✗ | ✗ |
| **Access to Collections** | | | |
| • Inclusion of different collection materials | ✓ | ✓ | ✓ |
| • Finding collections for everyone | ✓ | ✓ | ✓ |
| • Access for all | ✓ | ✓ | ✓ |
| **Learning Processes** | | | |
| • Self-study learning | ✓ | ✓ | ✓ |
| • Learning by doing together | ✓ | ✓ | ✓ |
| **Sustainability** | | | |
| • Economic | ✓ | ✓ | ✓ |
| • Social | ✓ | ✓ | ✓ |
| • Environmental | ✓ | ✓ | ✓ |
| **Smart-Comfortable Interior Elements** | | | |
| • Need and purpose oriented | ✓ | ✓ | ✓ |
| • Suitable for comfort conditions | ✓ | ✓ | ✓ |
| • Choices with width satisfying the user | ✓ | ✓ | ✓ |
| **Spatial Impact Quality** | | | |
| • Visual comfort | ✗ | ✓ | ✓ |
| • Acoustic comfort | ✓ | ✓ | ✓ |
| • Climatic comfort | ✓ | ✓ | ✓ |

**5. Conclusions**

Having started out as archive rooms in order to protect, store and transfer information resources to the future, Library buildings have begun to have different purposes and are being totally revamped as a result of the developing Information and Communications Technologies. As a result of the digitization of many of the materials that constitute information resources of libraries, the paradigm shifts in the methods of searching and acquiring information have had an impact on the function and shaping of the libraries. Unlike the old-school library concept, which presents its materials on shelves and in quiet working environments, libraries have now become a place of communication. These circumstances necessitated the redefinition of architectural designs of library buildings, rearranging them under the heading of 'new architectural design criteria,' whereas 'Urban Location and Accessibility,' 'Visibility, Aesthetics, Image,' 'Offering Different Activities,' 'Indoor Access and Routing,' 'Space Organization,' 'Access to Collections,' 'Learning Processes,' 'Sustainability,' 'Smart New Design criteria such as "Comfortable Indoor Elements' and 'Spatial Impact Quality' gained importance in designing new libraries.

In going beyond being mere information centers, 21st century libraries have begun operating as learning and cultural centers. As is seen in the three libraries examined within the framework of this study, 21st century libraries are designed for children, adults, elderly, etc. Thanks to its new functional programs for everyone, they have begun to be designed not only for readers but also for everyone in the urban environment to become everyone's library. Along with their printed and electronic information resources, they are committed to a new library vision that gets the user more involved in 'learning by doing,' provides communication between socio-cultural areas and users, and integrates information and socio-culturalism. In addition to individual developments, this vision that supports lifelong learning includes the richness of creating a more social and collaborative society structure that adopts social learning and interaction. Next-generation libraries have become institutions that revitalize and occasionally support the city and society, both by offering a public space in their communities and by establishing relations with other socio-cultural areas. While beginning to serve all segments of society, libraries have become one of the clear examples of sustainability with their operations and architectural formation. 21st century library buildings differ from traditional library buildings and other cultural institutions by their architectural design strategies that sustain urban life, while developing society and protecting environmental resources.

As a result, as Information and Communications Technologies become more and more integrated into libraries, it is inevitable that next-generation libraries will come to the forefront with both new functions and new architectural formations. In supporting social and educational learning and teaching models, these libraries reflect a user-oriented design product, while making positive contributions to urban life with their iconic architecture.

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# A Study on the Female Architects' Approaches to Design in the 21st Century

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**Abstract**
The female architects play an active role in the 21st century architecture, which is characterized by a quest of new forms, albeit they are few in number in the sector. Accordingly, the present study focused on the design approaches of today's female architects, and furthermore, the sources used in their designs, their focal concepts, and the formal language of their forms were investigated. In this context, ten well-known contemporary female architects were included in the scope of the study. A dual methodical pattern, namely textual analysis and visual analysis, was used for the purposes of the study. The texts of female architects, which described their projects, were conceptually analyzed using the textual analysis method, where their formal language was analyzed by means of the visual analysis method. The data were then organized into data sets and presented in tabular format. The results of the present study indicated that the female architects mostly made use of nature and socio-cultural elements in their designs and considered the data therefrom as an important input to be incorporated into their design. On the other hand, although they had similar points of departure in terms of design, they did not have a common language in terms of form.
**Keywords:** Women Architects; Design Approaches in the 21st Century; Design Resources.

## 1. Introduction

Architecture was shaped within the framework of a patriarchal approach for centuries. The fact that the role assigned to women was primarily that of a wife and mother, and the belief that architecture was a profession that could only be practiced by men, prevented women from taking part in this discipline. Although the Renaissance architectural texts prescribed that architecture required both female and male qualifications (Fowler and Wilson, 2004), women were excluded from architecture schools and professional organizations in many countries until the beginning and even in the middle of the 1900s (Dostoğlu, 2016). Women would be allowed to trace the plans and write specifications at the most until the late nineteenth century (Caven, 2004). During the late nineteenth and early twentieth centuries, when women were able to get a university degree in architecture, albeit difficult, some women could have opened their own offices and hired other women (Allaback, 2008).

The female architects architects (Devlin, 1997), who had to struggle with sexism, a fundamental type of cultural discrimination, were able to reverse the society's belief over time that architecture was a masculine cause. As a matter of fact, relevant studies suggest that the number of female architects increases each day, and a balance has almost been achieved as regards the number of female and male students, especially in the architecture schools. On the other hand, the recognition of female architects in the architectural circles and in the public is even more limited compared to their male counterparts, despite the said increase in numbers (Dostoğlu, 2016).

## 2. Female Architects in the 21st Century

The architecture was predominantly considered a profession that men could practice until the end of the 19th century, due to the restrictive and discriminatory conduct of the respective societies based on economic, social, and cultural factors. The female architects, who, until recently, had to fight an uphill struggle both in the sector and in academies, still face to various difficulties, yet they are much more active than a century ago. Records published by the regulatory bodies also confirm the said development. For instance, as of 19 November 2020, 29% of 43,059 architects registered with the Architects Registration Board (ARB) in the United Kingdom (UK) were women. Notwithstanding above, the same records also indicated that 50% of the architects aged below 30 years were female (URL 1). Therefore, female architects now play an active role in shaping the built environment as much as male architects do. A similar result can be seen in the field of architecture education as well. The United States National Architectural Accrediting Board (NAAB) reported in 2019 that the gender breakdown in NAAB-accredited programs was 13,285 (51%) male students and 12,776 (49%) female (URL 2). This is consistent with the reports in Turkey. The ratio of female students, who were placed in the faculties of architecture in public universities, was 55%, according to the data reported by the Higher Education Institution in 2021. This rate was even higher with regard to the foundation universities.

The quantitative data above makes it possible to suggest qualitative remarks. In the light of the above, it is reasonable to suggest that the female architects, no more a minority group, have played an active role in shaping

the architecture of the twenty-first century. The female architects have contributed to contemporary architecture both intellectually, and by their construction methods, and furthermore, the buildings of their design attracted a wide audience. In this context, Zaha Hadid, the winner of the Royal Gold Medal of the Royal Institute of British Architects (RIBA); Pakistani Yasmeen Lari and Farshid Moussavi, the winners of the Jane Drew Award; Denise Scott Brown, one of the pioneers of the post-modern architecture; Jeanne Gang, well-known for her sustainable design techniques; and Amanda Levete, who designed the world's first magnetized fusion power plant for the UK, inter alia, can be given as examples of the rise of women in architecture.

**3. Study Method and Procedure**

Architectural texts of ten female architects, who were included in the scope of the study, were used as the basic sources of information, due to the fact that they included empirical evidence as a rich source of information. These texts were analyzed so as to investigate the problems as defined by and the data as considered design input by the designers. Furthermore, the forms, i.e., one of the most important elements in determining the quality of an architectural design, were analyzed by the visual analysis method and the type of forms the architects inclined to were determined. The method is explained in more detail below in the respective subheadings.

**3.1 Research Field**

Ten female architects were determined as the research field of the present study and 60 different projects designed by those architects during the post-1990 period constituted the focus of the research. For the purposes of the present study, relatively well-known architects were selected from different nationalities, including American, Mexican, Iranian, and Irish, etc. The projects of these selected architects were limited to cultural buildings on the grounds that those included diverse contexts. In this context, personal projects, including hotels, residences, and offices were excluded from the study, while cultural buildings, including museums, art centers, galleries, theaters, opera and ballet halls, trade show and congress centers, and exhibition halls were analyzed. The selected architects and the associated buildings are shown in Table 1.

**Table 1.** Selected Architects and Associated Buildings

| ARCHITECT | BUILDING |
|---|---|
| Zaha Hadid | Astana Expo 2017 |
| | Beethoven Concert Hall |
| | Changsha Meixihu İnternational Culture and Art Centre |
| | Eli & Edythe Board Art Museum |
| | Glasgow Riverside Museum of Transport |
| | Guangzhou Opera House |
| | Heydar Aliyev |
| Jeanne Gang | Longgang Cultural Centre |
| | Arkansas Arts Center |
| | Writers Theatre |
| | Bengt Sjostrom Starlight Theatre |
| | Kaohsiung Maritime Cultural & Pop Music Center |
| | Taipei Pop Music Center |
| Francine Houben | National Kaohsiung Centre for the Arts |
| | La Llotja Theatre and Conference Centre |
| | Futian Civic Culture Center |
| | Oldham Coliseum Theatre |
| | KRONA Knowledge and Cultural Centre |
| | Xiqu Chinese Opera Centre |
| Farshid Moussavi | Ismaili Center Houston |
| | Museum of Contemporary Art Cleveland |
| | Guggenheim Competition, Helsinki |
| | Spanish Pavilion at the 2005 World Expo, Aichi, Japan |
| | Torrevieja Municipal Theatre and Auditorium |
| Amanda Levete | Paisley Museum |
| | MAAT Lisbon |
| | Centre for Music London |

| | |
|---|---|
| | MPavilion Melbourne |
| | Mumbai Museum |
| Odile Decq | New Cyprus Museum |
| | Tangshan Fangshan Geopark Museum |
| | Macro Museum |
| | Wrocław Museum of Contemporary Art |
| | L. Museum |
| | Nanjing Jiangning District Library & Cultural Center |
| | Linz Musiktheater |
| Elizabeth Diller | Tarrkarri – Centre for First Nations Cultures |
| | Museum Of Image & Sound, 2022 |
| | United States Olympic & Paralympic Museum |
| | Prior Center for the Performing Arts |
| | The new Art Gallery of Nova Scotia |
| | Shenzhen Opera |
| Annabelle Selldorf | Hauser & Wirth 22nd Street |
| | Shaker Museum |
| | Rubell Museum |
| | The Museum of Contemporary Art San Diego |
| | David Zwirner 20th Street |
| | Steinway Hall |
| Alison Brooks | Sara Hildén Art Museum Tampere |
| | The Smile London |
| | M.K. Čiurlionis Concert Centre Kaunas |
| | Hammerfest Arctic Culture Centre |
| | Helsinki Central Library |
| | Olympicopolis: Sadler's Wells & Smithsonian Stratford |
| Kimberly Dowdell | Southport Theatre and Convention Centre |
| | The Dalí Museum |
| | Kentucky International Convention Center |
| | Hampton Roads Convention Center |
| | National Air and Space Museum Steven F. Udvar-Hazy Center |
| | Florida International University Patricia and Phillip Frost Art Museum |

**3.2 Research Tool**

Two different tools were used for the purposes of the study. The first tool was the texts by the ten selected female architects regarding their designs. These texts were conceptually analyzed. The second tool was the forms of the buildings included in these texts and they were analyzed visually.

**3.3 Method**

A dual methodological pattern, including textual analysis and visual analysis, was used in the present study. The textual analysis method was based on the briefs written by the architects on their respective projects. These briefs were conceptually analyzed in the context of the data, which were considered design input, and the factors, which paved the way towards the form. For example, a review of Zaha Hadid's brief on the Riverside Museum in Glasgow indicated that the architect wanted to symbolize the dynamic relationship between shipbuilding, seafaring, and industrial heritage based on the unity of the city and the river, and therefore relied upon socio-cultural data. Furthermore, the architect considered the natural environmental factors, including climate and geography and expressed them through certain concepts such an 'acting as a mediator between the city and the river', 'creating the landscape vista', 'ensuring visual continuity', 'bringing natural light inside' and 'providing protection from prevailing winds'. In the visual analysis method, the forms designed by the architects were analyzed on the basis of visual data and the collected data were broke down into concepts. An example of the application of the method is provided in Figure 1.

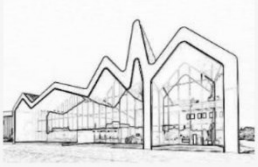
| Building / Architect | Concerns | Forms |
|---|---|---|
| **Glasgow Riverside Museum of Transport / Zaha Hadid**  | Symbolizing dynamic relationship between Glasgow and the ship-building, seafaring and industrial legacy of the river Clyde. Becomes a mediator between city and river. establishing a clear connection between its exhibits and their wider context. Allow visitors to build up a gradual sense of their external context. Reduce exposure to prevailing winds. Allow light to flood through the main exhibition space. Create a seamless continuity with the river. | A sectional extrusion open at both ends. Encapsulated a wave or pleat |

**Figure 1.** An Example for the Application of the Method

**3.4 Organization of Data and Conversion to Data Sets**

The data from the analysis of sixty different structures by the ten female architects were converted into and presented in the data sets within the scope of the study (Table 2). The design problems as considered by the architects, the factors incorporated into their designs, and the form approaches they adopted/produced were presented in the said datasets. Notwithstanding above, it should be noted that these data were not comprehensive, or inclusive of all the buildings by the selected architects. Nevertheless, this step was instrumental in providing an overview of the design approaches of the selected female architects.

**Table 2.** Analysis Data on Selected Buildings

| RESULTS | | |
|---|---|---|
| **Architects** | **Concerns** | **Forms** |
| **ZAHA HADID** | A desire to create an unusual image; Reflecting socio-cultural values; Responsiveness to function; Making use of geography; Using Metaphor and analogy; Urban factors | Disproportionate exterior surfaces, non-basic geometries, asymmetrical axes, and fragmented forms as well as free forms that establish close relationships with nature |
| **JEANNE GANG** | Ecologic concerns; Climate-related factors; Making use of geography; Conserving and making use of the biotic environment; Responsiveness to function; Urban factors | Often dynamic forms established by regular repetitions, unity, harmony, proportional geometries, and unitary units |
| **FRANCINE HOUBEN** | Responsiveness to function; Making use of physical environment data; Climate-related factors; Conserving and making use of the biotic environment; Reflecting socio-cultural values; Ecologic concerns; Utilizing topography | Nature-inspired free forms as well was monolithic forms of expanding and proportional geometries |
| **FARSHID MOUSSAVI** | Reflecting socio-cultural values; Urban factors; Responsiveness to function; Ecologic concerns, Ensuring physical and sensory comfort of the users | Forms with predominantly positive-negative balance of form, consisting of regular repetitions, proportional geometries, and multiple surfaces |
| **AMANDA LEVETE** | Reflecting socio-cultural values; Urban factors; Ensuring physical and sensory comfort of the users; Using Metaphor and analogy; Factors regarding building and construction | Inorganic forms with folds and curves along with dynamic forms that change direction and rotate |
| **ODILE DECQ** | Reflecting socio-cultural values; Urban factors; Ensuring physical and sensory comfort of the users; Responsiveness to function; Conserving and making use of the biotic environment, Using topography | Overlapping, wavy, curved, continuous, and free forms that establish close relations with nature |

| | | |
|---|---|---|
| **ELIZABETH DILLER** | Making use of geography; Reflecting socio-cultural values; Using topography; Designing according to barrier-free design criteria | Non-basic geometries, asymmetrical axes, forms consisting of unique surfaces as well as compact forms created by means of a metaphorical approach |
| **ANNABELLE SELLDORF** | Responsiveness to function; Using physical environment data; Ecological concerns; Making use of geography; Reflection of socio-cultural values | Basic forms dominated by a quest for plain and simple visual order |
| **ALISON BROOKS** | Reflecting socio-cultural values; Making use of geography; Factors regarding building and construction; Making use of metaphor and analogy; Ensuring physical and sensory comfort of the users; Ecologic concerns; Using physical environment data | Curved, curly, and continuous analogical forms as well as forms established by unitary units with a positive-negative balance of form |
| **KIMBERLY DOWDELL** | Responsiveness to function; Climate-related factors; Making use of geography; Urban factors; Conserving and making use of the biotic environment; Factors regarding building and construction | Euclidean forms with geometric extrusions, regular, and proportional geometries as well as analogical forms |

**4. Findings**

The results of the present study are indicative of the fact that the selected female architects most frequently focused on natural environment issues, including climate, biotic environment, geography, and ecology. The concerns with regard to natural environment, which were characterized by certain concepts, including responding to harsh climatic conditions; preservation of rural characteristics; being surrounded by rivers, mountains and lakes; minimizing energy and resource consumption, were the primary factors that the selected female architects took into consideration in the course of their design efforts.

Another remarkable consideration was their concerns about reflecting the socio-cultural values. The concern to preserve and reflect the history, traditions, and values of the relevant city or region was one of the primary factors expressed by almost all the selected architects.

Branding the city, economic development, and creation of urban focal points were also among the prominent factors considered by the selected architects.

It was seen that female architects also considered factors related to the built environment as a design input. In this context, the selected female architects considered certain factors as important data, including the location in a commercial area or in a historical surroundings or proximity to important buildings, in the course of design.

The selected female architects also prioritized the function, an ancient design problem in the history of architecture. Functional concerns, including spatial organization, and physical and sensory comfort were among the factors emphasized by the female architects in their texts.

The analyzed texts were also suggestive of the female architects' desire to create a remarkable, extraordinary, and powerful form. Accordingly, the selected female architects rather resorted to analogies or metaphors and often inspired by the nature. The female architects, who focused on building- and construction-related factors with an aim to create an unusual structure, shell, or material, made use of technology not only in the design but also in the production of the form.

Although the factors that led women architects towards form and shaped their designs were similar, it is difficult to say that they had a common language in terms of form. Furthermore, it was seen that the forms, in which function is prioritized, were mostly based on Gestalt principles, including proximity, similarity, and closeness and/or basic design concepts such as harmony, balance, unity, repetition, and symmetry. The forms presented organic images with curvilinear lines generally created on the basis of metaphors and analogies in the designs, which prioritized the socio-cultural and urban factors. Nevertheless, those forms varied by geography and the architect's approach.

**5. Results and Discussion**

Aimed to understand the design approaches of the female architects in the 21st century, the present study reviewed sixty different cultural structures of the ten selected female architects, and sought answers to the questions, including what they identified as design problems, through which factors they shaped their designs, and what was the formal language of the resultant forms. An inductive method was followed in the study, and accordingly, it was considered that a general framework could be generated on the basis of the individual analysis of the samples.

The results of the study suggested that the selected female architects considered multiple factors in their designs. Among those, the female architects most frequently emphasized the natural environment factor. Approaches such as incorporating geography into design, making use of existing vegetation, using climatic data, emulating and being inspired by nature were indicative of how close the female architects were to nature and that they used nature as a source of design. For the female architects, the nature was beyond a design problem to deal with, it was an element that must be protected, cared for, and incorporated into the design. As a matter of fact, they were inclined towards free forms that relate to nature in the forms of their produce.

Readings through the texts suggested that the social context was also very important for the female architects. In particular, reflecting socio-cultural values in designs, and accordingly, strengthening the relationship between the city and the citizens, and reinforcing the relations at the intersection of the city and society were the prioritized considerations in the design approaches of the female architects. It was seen in the designs, which emphasized cultural values, that patterns and geometries specific to the relevant region, city, or country were reflected by the form, and occasionally there were forms produced with curvilinear and/or asymmetrical axes on monumental scales. While shaping their designs, the female architects were also inspired by the built environment. The data collected from the built environment surrounding the construction area was an important resource for architects in terms of presenting an original design. The forms produced on the basis of the data collected from above sources seemed to have either coalesced, or conflicted with the environment.

Functional considerations, including spatial organization and providing users with physical and sensory comfort were also attached importance by the selected female architects. The female architects frequently expressed certain concerns, including responding to the physical needs at the optimum level, arousing strong emotions in the users, or offering surprising spaces. In this context, the female architects seemed to have mostly strived for creating rich and unusual spatial arrangements and introducing interior organizations that would refer to the minds of the users. In cases where the function was taken as a starting point in the design, the female architects mostly resorted to Euclidean forms.

The results suggested that the female architects made maximum use of technology in resolving building and construction related problems. Technology, an important component of architecture like science and art, played an active role in both the design and production stages of construction components such as shell, structure, and material of the selected female architects.

In conclusion, it is reasonable to suggest the female architects of the twenty-first century identified nature, socio-cultural and social elements, and the built environment as the prominent sources of design, shaped their designs with the data from the foregoing, and observed the balance between form and function. In that regard, it should be noted that the approaches of the female architects towards design were not dramatically different from that of Frank Gehry, Norman Foster, Renzo Piano, Daniel Libeskind, and Rem Koolhaas and dozens of other male architects, who are frequently referred to both in the public and academic circles. Therefore, as a conclusion, being a female architect or male architect did not make any difference in shaping the architectural design in the twenty-first century with a quest for new forms.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Architecture as a tool of financial power

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**Abstract**
This essay aims to define the role of architecture as a bridge between spatialization and financialization processes which had characterized the *neoliberal* expansion of the economy during the last decades. According to the significant impact financialization had since 1980s, architectural forms and spaces of financial power became a tool for celebrating a new social paradigm, so which are the main elements characterizing the use of these instruments? The research method of this essay discusses, on one hand, the role of international economic and political actors and, on the other hand, the function of architecture typologies, collective imaginaries and media spectacularization in design-making. Finally, through the analysis of the connections among architectural, urban and social aspects, the author argues that contemporary architecture has begun a tool for supporting and giving consensus to financial investments into the real estate market worldwide in order to realize great urban transformations.
**Keywords:** Architecture, Urban transformations, Financialization, Real Estate, Neoliberalism

## 1. Introduction: How Much the Architecture of Power Weight?

Architecture had always been a representation of power in each established society. Considering the Western culture in the globalization period (1989-now), there are at least three elements which had characterized the forms of building environment as a tool of power: the tower, the fort and the palace. Since the beginning of the Roman Empire, these three architecture typologies had represented a territorial mark of socio-economic influence led by the élites and they are currently still used. If we think about the Burji Khalifa in Dubai, the Pentagon in Washington or the Australian Parliament House in Canberra, we could observe that these architectural figures are prominent on the urban design of the cities which host political or economic power.

As addressed in the American Pavilion of Venice Biennale “Free space”, there is a link between citizenship and the urban dimension that is expressed through the iconic meaning of the buildings (Atkinson, Lui, Zeiger, 2018, Aziz Amen, 2022). In *On dimensions of citizenship*, the questions about belonging and inclusion are related to capitals, digital technologies and geopolitical transformations. Conventional ideas about citizenship disappear and, with them, the way of conceiving the spatial organization of power. We define the word “citizenship” as a tangle of rights, responsibilities, attachments related to the built environment but how can contemporary architecture respond, configure and express the rhizomatic and paradoxical requirements of citizenship? In particular, there are at least 6 dimensional layers that give a soul to the city: citizenship, civitas, region, nation, world and network. These layers are essentially addressed by the ordering capacity of architecture that is used to make the paradoxes and formulations of belonging visible. Nowadays the process that constituted the abstraction-materialization relationship has become blurred within cities and nation states, so architecture tends more to enhance the interests that dispose of it in a spectacular rather than monumental way in the strict sense (Aziz Amen & Nia, 2017) . In fact, as Niall Atkinson declares «buildings are not laws», alluding to the concept of the lack of relationship between complexes belonging to large dimensions and city users.

Furthermore, as emerges in the essay Expulsions, the social constraint in which people live in many parts of the world is not in the least contemplated by the flow of capitals and technologies present in developed countries which, on the contrary, tend to ignore them by building walls based on the principle of "national security", subjecting itself to geopolitical logics defined also by large corporations (Sassen, 2014: 96). So, it is emerging a great paradox between political sovereignty and economic capitalism which is vented in the “bigness” (Koolhaas, 2002), because of the concentration of capitals in financial markets. In her essay, Saskia Sassen asks herself: «What are the excluded spaces? Exactly those who allow us to glimpse new models of members in their local economies».

These great intangible geopolitical infrastructures of our days are what have undermined the concepts of identity and inclusion of citizenship, watering down the urban design of the architecture of power. Public networks and digital democracy represent a server of over 65 million citizens who, around the world, use more than 50% of the goods and services offered by the network. This process represents a global form of matchmaking that has radically changed the functions and way of living our urban areas, converging towards an increasingly mobile system which today is preparing to collide with the national realities and cultural identities that gravitate around they.

It follows that the materializations of this phenomenon, such as buildings and infrastructures, develop in a dimension that tends to increase the gap between development and concentration on the one hand, and impoverishment and

decentralization on the other, placing geographical division as a secondary index compared to world networks between cities and connected realities. This is a condition that poses enormous problems to the legitimacy of democratic representation and to the regulation of citizenship rights and duties, increasingly conceived in its global dimension, rather than in the local one.

Based on these arguments, much of the architecture of power has to do with the imagery it creates through its perception, which is subject to constant change implemented by the spatial discoveries of science. As happened with the invention of X-rays and the influences connected to modern architecture, the new visions of intergalactic space amplify the psychological space by configuring another type of perception (Colomina, 2018). Steven Holl argues that space is connected to a concept of time which therefore also has an effect on the monumentalism and hieratic nature of the architectures of power. In the essay *Parallax* he argues that «space is connected to a perceived duration and a certain point of view necessarily feeds an indeterminate flow of perspectives», in particular clarifying that «the spectacle of spatial flow is always alive in metropolises, as well as in any part of the world, therefore perception and cognition balance the volumes of architectural spaces with the understanding of time itself» (Holl, 2000). Consequently, it is precisely at the level of spatial perception that strong architectural meanings come to the visible surface.

**2. Materials and Methods**

This essay focus in which ways architecture deals with power. Because of this reason, this article carries out literature materials regarding considerations on how power has shaped architecture through the ages and what is the state of the art of this kind of dialectics nowadays.

The method empathized in this essay is theoretically-based and it includes researches and considerations made by several authors worldwide. So, after presenting a theoretical framework on the “architecture of power”, it investigates the power of icons in the collective imagery in order to highlight how architecture could empower or mitigate the government which commissioned itself.

Moreover, this article focuses tendencies and practices which affect the architectural design today. In other words, the role of architecture affects the global phenomena regarding the built environment of several large-scale cities all around the world.

The structure of this papers is composed of: a review on the architecture of power, the power of icons in the collective imagery and the role of architecture in international phenomena. So, the structure of this analysis deals both with the role of architecture and uses and functions which come for architecture in relation to the scale of power exercised.

Finally, this essay includes some open considerations and key findings regarding *Neoliberalism* and the project financing of the architecture of power.

**3. The Architecture of Power: A Review**

Power commits resources in building plans because building is the primary activity of the powerful leaders. At an elementary level, this commitment creates useful jobs to stabilize the restless workforce, but it also lends itself to expressing the skills, resolve and determination of power. First of all, architecture tells the story of those who created it. Political and economic leaders use it to seduce, impress and intimidate, «the monuments of power are universal in their kitsch, as can already be seen in those used to celebrate the victories in the wars of the Peloponnese or in the triumphs that the architecture of imperial Rome granted to the generals» (Sudjic, 2005: 88).

Architecture exists independently of its patrons, and there is no reason to find an architect guilty just because he worked on behalf of one of the most inhumane leaders of recent times. It is still an open question, and constantly re-proposed, whether architecture can convey an intrinsic meaning. Is there, in fact, an architecture typical of totalitarian, democratic or nationalistic regimes?

And if it exists, what makes this particular meaning take on? Can classic columns or glass walls really be presented as distinctive features of a fascist or democratic building, as some argue? Are they fixed and permanent characters, or do they change over time? We must ask ourselves whether architecture constitutes an end in itself, or a means to an end.

It is built for emotional and psychological purposes, but also for ideological and practical reasons. Architectural language is used as much by software billionaires, who fund museums in exchange for the right to have their name featured in a project, as well as by sociopathic dictators. Architecture has been shaped by the ego and the fear of death no less than by political and religious demands. And in turn it shapes and models all these causes: wanting to explain the world without recognizing the psychological influence that architecture has on it means not grasping a fundamental aspect of its nature. It would be like ignoring the influence of war on the history of technology and vice versa.

Unlike science and technology, which are conventionally represented as devoid of ideological connotations, architecture is both a practical tool and an expressive language, capable of conveying extremely specific messages. And yet the difficulty of establishing the precise political meaning of a building, and the very elusive nature of the political contents of architecture, have prompted the current generation of architects to proclaim the autonomy and neutrality of their work, or to believe that if openly political architecture existed, it would be confined to an isolated ghetto, unable to represent cultured architecture any more than a shopping mall or casino in Las Vegas could.

This is an erroneous presumption. It may also be that a given architectural language does not have a fixed political character, but this does not mean that architecture cannot take on political meanings. Whether they liked it or not, at some point in their careers few established architects have been able to avoid building related buildings of some political significance, and in turn most political leaders use architects for their own purposes. It is a relationship that exists in all sorts of regimes. There are photographs of Tony Blair - with Rogers' Millennium Dome - and of Francois Mitterrand, of Winston Churchill, of countless mayors, archbishops, CEOs, billionaire tycoons all stretched out around architectural models.

Versailles was built as a palace in which the architectural splendour and physical location aimed to neutralize the power base of the provincial nobility. Two centuries later, Napoleon III used architecture again as an instrument of power, when he commissioned Baron Georges-Eugene Haussmann to rebuild Paris on a monumental scale - not so much to harness the Parisian masses, but to legitimize his own questionable claims to the imperial title. And Francois Mitterrand himself saw in a Paris embellished by the interventions of the Louvre, and by the Grande Arche de la Defénse, an essential element of his strategy to make the city the undisputed capital of a modern Europe. For these two rulers, the outward appearance and the monuments played the same key role as their content. Mitterrand chose aggressive architecture, based on simple geometric shapes in glass and steel, to symbolize France's tension towards modernity just as the Sun King made Versailles a temple for royal worship in support of the divine right of the monarchy.

Every kind of political culture uses architecture for purposes that we can essentially define as rational and pragmatic, even when it comes to symbolic issues. But when political calculation is mixed with psychopathology, architecture is no longer just a problem of practical politics, it becomes an illusion, and even a disease that consumes its victims. There is a psychological parallel between marking a territory by means of a building and the exercise of political power. Both things depend on an act of will. Seeing one's vision of the world affirmed in an architectural model, through the reduction of an entire city to the size of a doll's house, in itself exerts a certain fascination on those who do not recognize any value to the individual.

But even more attractive is the possibility of physically imposing one's will on that same city, reshaping it as Haussmann did for Paris. Architecture feeds the ego of predisposed subjects. Building becomes the means by which the selfishness of individuals is expressed in its purest form: "the building complex".

As Sudjic writes, «there is something absurdly childish in the irrational impulse to build tall for the sake of being the tallest in the world. Yet, on a global level, the idea of extreme elevation shows no sign of having let go of the imagination. Those who present themselves as businessmen, rational, practical, and infinitely prudent launch themselves with their heads down in the enterprise of building ever taller buildings. Faced with such a high stake, a curiously elaborate set of rules has been developed to measure and compare the height of skyscrapers, in order to avoid the possibility of cheating: the highest inhabited floor, the highest enclosed space, the maximum elevation of the overhanging surfaces have all been recorded and documented with the zeal of the schoolboy who enthusiastically collects the numbers of the airplanes to make sure that the like compares with the like» (Sudjic, 2005: 132).

**4. The Power of Icons in The Collective Imaginary**

With the advent of the "Society of Networks", a trend has increasingly emerged which, in parallel with the crisis of competence and technical knowledge, consists in taking refuge of projects in a technicality that removes them from qualitative judgment. This approach appears frequent in cases in which the reins of the project are held by large engineering companies but is also present, in many cases, in projects developed by the internal design offices of the promoters or by public administrations. In these cases, complex dashboards of quantitative values (often referring to the general issues set out above) accompany and support the projects, also assuming a monitoring of the results over time.

The branding of urban design operations is grafted into this consolidated scenario. Similarly to what has already happened with architecture since the second half of 90s, the practice of linking development interventions to a signature that certifies their quality and appeal in the eyes of the general public is spreading, also because the intervention of the designers is concentrated in the architectural dimension, consolidating its authorial aspect, when it is not even limited to the production of an imaginary that is only partially linked to the real physical outcome of the transformation (Aziz Amen & Nia, 2018). In this sense, the international fame of great architects is an emblematic

case of this situation: everywhere on the planet they mark the places of the new prestige, of the new power, tracing "the great plan of the world-cities" as Marc Augé calls it, defining the world like a city, «an immense city where the same great economic and financial enterprises, the same products, can be found everywhere» (Augé, 2007: 12).
An important icon of the collective imagination worldwide was represented by the Twin Towers, interpreted as a sign of power and authority by those who wanted to challenge the power of the United States on the globe. It has even been suggested that they were the personification of the evils of capitalism. The idea of building them was originally supported by David Rockefeller as part of an urban renewal plan designed to safeguard his investments in the area.
The World Trade Centre was conceived as a demonstration of trust in New York, a city that just then was experiencing a certain disorientation and facing financial crises of increasing severity. It was a gigantic urban survival machine, a lung of steel designed to bring about the resurrection of the city, an unequivocal and extraordinarily visible sign that New York was still a force to be reckoned with. Outside the States, all the nuances of this elbow fight between cities tended to be indistinct. The WTC became the icon of the United States rather than a reflection of NYC's nervousness about jobs given to the suburbs and Southern States. However, as Dejan Sudjic writes: «the real genius of the project lay in its dualism: Yamasaki fixed the conception of the Twin Towers as a typological element of multi-level buildings» (Sudjic, 2005: 73).
Just a couple of years ago, things were very different. After the revolt against the bulky skyscrapers of the 1970s, in most European cities it was taken for granted that what were tacitly considered strict height limits should no longer be violated. Then in an equally unexpected way, the prevailing opinion was reversed: building in height became the obsession of architects, not only in Asia and America but also in Europe. In Asian cities, towers are being built with maximum speed in a deliberate effort to modernize, and Western cities, which don't, look picturesquely old-fashioned and immobile.
In the best examples, tall towers are elegant, technologically sophisticated and represent the future of cities, built as a by-product of a primitive and elementary clash of personalities. Politicians are fascinated by the image of a city built up, both in Shanghai, under the influence of the Mori Corporation, and in Ken Livingston's London. As Mayor Livingstone has done his best to give London new towers, ostensibly in an attempt to induce multinationals not to move to Frankfurt or New York, but reality is far more influenced by the elementary symbolism inherent in being the largest and most the highest, therefore the most important.
Dimensions are very important in the collective imaginary. The emphasis attributed to the power of dimensions, assuming it is truly intentional, is echoed in a striking way in some of the six reconstruction projects of the World Trade Centre, bringing the theme back to New York. Richard Meier and Peter Eisenman had designed a tower 338 meters high, probably on the basis that a tower only 277 meters high, as per the competition regulations, would have been too low to arouse due interest. As is well known, Daniel Libeskind went up to 541 meters, unequivocally applying the paradigm of the skyscraper as a tool of power.
These last considerations, let we understand how icons and architecture of power is nowadays deeply linked to financialization. According to Greta Krippner definition: «financialization is a pattern of accumulation in which profits accrue primarily through financial channels rather than through trade and commodity production. "Financial" here refers to activities relating to the provision (or transfer) of liquid capital in exaptation of future interest, dividends, or capital gains» (Krippner, 2005: 174). This phenomenon works because of the intertwining between neoliberalism and globalization. While a progressive development of globalization happened since 90s, the innovation of financial systems became more efficient allowing a faster move of financial flows and the globalization of financial transactions is now integral through all the economies worldwide as David Harvey highlighted. A crescent number of financial investments was simultaneously driven and securitized in housing and the real estate market in general, and this process closely linked architecture to financialization.
The emerging of finance capitalism had clearly represented the most significant sociocultural transformation of the last decades, and architecture – buildings – played a key role in its affirmation.
As Matthew Soules recently remarked there are two significant cleavages of finance capitalist urbanism: "zombie urbanism" and "ghost urbanism". According to his definitions: «Zombie urbanism describes the phenomenon of significantly underoccupied secondary homes that function as investment properties» while «"ghost urbanism" signifies a greater amount of vacancy than "zombie urbanism" and typically exists in overt crisis conditions» (Soules, 2021: 17).
In other words, starting from these two categories, we should take into account that financialization is characterized by a chain of processes which, since circulation and accumulation of capital, move to the building investment transforming the way of designing architecture.
In conclusion, we actually have to take into account that the most significant landmark and icons in architecture are deeply connected to financialization not just because skyscrapers and huge buildings represent the headquarters and the spectacularization of financial power, but mostly because of the process which had been possible their

construction. So, financialization became a mandatory in building construction like capitalism became a state of mind in the globalized society, as we will analysed in the conclusions of this essay.

**5. The Role of The Architectural Project in The Framework of Global Phenomena**

The space of flows has been transformed not only into the media space of politics and command but also, at the same time, into space of power and financial counter-power that is expanding becoming ways of being of the direct or metaphorical content of expression of urban life: therefore, material for the architectural project. As David Harvey affirms: «Capitalism continually strives to create a social and physical landscape in its own image and suited to its needs at a given time and it will surely end up undermining, disrupting and even destroying that landscape at a later time» (Harvey, 2019). It is for this reason that the internal contradictions of capitalism are expressed through the restless formation and reformation of geographical landscapes, a continuous and incessant transformation of the cities most affected by its strength.

Building does not only mean setting up a shelter or building the modern infrastructure of a State. While it may appear deeply rooted in pragmatic attitudes, this activity is also the powerful and extraordinarily revealing expression of the human spirit, endowed with meaning at both the broadest and the most restricted level of the person. It is a means of enlarging the individual ego to the size of the landscape, the city and even the nation. It reflects the ambitions, insecurities and motivations of colour that they build, and therefore faithfully reflects the nature of power, its strategies, its consolations and its impact on those who manipulate its levers, today intrinsically linked to spectacularization, therefore to *star-architecture* as state of mind. What architecture does, like no other form of culture, is to glorify and magnify the autocrat and suppress the individual within the mass. It can be considered as the first, and still very powerful form of mass communication. That is why it has developed into so many dictatorial political systems, and that is why it fascinates the powerful who aspire to make a mark: its impact is as material as it is intellectual.

Architecture is always about the same things: power, glory, spectacle, memory, identity; and it is for this reason that nowadays the great urban transformations are intertwined, with the role of star-architects (Loricco, Micheli, 2003). Architecture causes emotional reactions both on a personal level and in society as a whole: it reflects our vanities and our aspirations, our weaknesses and our ambitions, and also our complexes. Understanding what it is that drives us to build, and what nature the ambiguous relationship between architecture and power has, helps us to understand our own existence and to get rid of its most harmful aspects. Architecture exerts a persistent fascination on the most egocentric individuals, who frantically use it to glorify themselves. It can also be used by reforming mayors who try to transform their cities for the better. But whatever their intentions, in the end the activity of architects is defined not so much by their rhetoric, as by the impulses that push the rich and powerful to use them to try to shape the world.

All the most important capitals worldwide were not, in fact, immune from the narrative that Davide Ponzini defines as the "Bilbao effect" (Ponzini, 2016: 41), that is the belief that a spectacular architectural project, be it large, medium or small, erected approximately in any urban context, can increase tourism. and the economic revitalization of a city with a global vocation.

This narrative has crossed entire emerging countries, global cities, developing countries that seem to compete with each other for those who have the most *star-architecture*, spectacular skyscrapers and large cultural installations often commissioned and built with little attention to the context but connected to the role the site covers in the global economic market.

These forms of development have clearly transformed the urban landscape of many cities but the decision-making processes in the creation of these interventions are often limited and the works conceal speculations led by international corporate groups that do not always have at heart the development of a city in a philanthropic sense.

In fact, as Leslie Sklair writes, «explaining that typically capitalist business gives traction to a speculative trend where iconic architecture becomes the tool to shape public attention, finds some difficulties when this is also the way to hide the will of real estate players behind the real estate projects» (Sklair, 2017: 67). Although the scenographic spectacularization of these projects should be able to represent the dominant local power, since the process of creating *star-architectures* is the child of globalization, paradoxically the global cities that are part of the network of city-states use the same *archistars* with each other, effectively homogenizing their urban landscape as final result.

Architecture used as a tool of financial power is also the weapon of a symbolic logic that aims to give a show to policy makers rather than indicate the right procedural path for the creation of place-making or to investigate new building styles.

The spectacular projects typical of *star-architecture* then clash with an important cultural theme relating to the cities where they are grafted. Although these buildings aspire to be all different from each other, in fact their powerlessness, their large size, makes them suitable for being placed in the category of large size which therefore has to do with media impact and brands. But if architecture of this kind constitutes an "urban fact", destined to

become an urban permanence, how can urbanized space be subject to the fashions of brands? Calculating the impact of branded projects in the context of a pervasive narrative in public decision-making processes is what most of all reasoning constitutes the debate on the cultural image of the city.
But what is *star-architecture* then? Ponzini defines it as an evolution of the affirmation of global cities in mainstream culture: «the general theories that explain star-architecture as a necessary manifestation of competition between cities in the globalized context of capitalism or ideological hegemonies tend to create the reasons of why and of the ways in which the actors of the show act differently on every urban context but the star architecture is a branded, similar, uniform and generalized architecture that manifests itself in very different urban realities» (Ponzini, 2016: 48).

**6. Conclusions**

As shown in this essay, architecture became an essential instrument of financial power. As «architecture has become finance and finance has become architecture» (Soules, 2021: 33), a key aspect for a future overview of financialization processes related to architecture will be deeply connected to the paradigm that Covid-19 pandemic is defining. For three entire decades our paradigm was fully composed of *neoliberal* theories and ideals, so the "glorification of the businessman" and the praise to the "free market" became a state of mind of each new generation of citizens. In particular, the millennial generation has been educated to a world apparently without ideologies or an addressed point of view for watching social changes. *Neoliberalism* has represented a huge renovation also in social control of power through all the democratic states of the world. Contrariwise to several past radical social changes like the French or the Soviet Revolution, during 1980s global economic élites took the power without the use of any army and this transition happened because of a huge investment in what is actually universally called "cultural hegemony" (Gramsci, 1951). So, the difference of *Neoliberalism* to many other ideologies is about the way of government which makes everybody thinking like the economic élites, independently by our social *status.* According to this consideration, global economic business did not need to establish their power on the world financial system through a "military financialization", they only directed flows of money in a proper way, financing cultural and political institutions setting a popular mentality based on the glorification of the financial market.
This social paradigm produced deep conflicts which had contributed to the question of radical change in Western societies. Despite of the 2008 subprime mortgages crisis, *Neoliberalism* kept its power, even if the international élites became richer as the *Elephant Curve* demonstrated (Milanovic, 2016). However, Covid-19 imposed an important modification in the globalization through the reinforcement of regional economies on one side and the reduce of people moves worldwide on the other side, problematizing and highlighting that capitalism in XXI Century has mainly to do with commerce and finance. The pandemic empowered the role of National States accelerating a significant re-organization of the scales of interests, which consist in the theory of *Rescaling* (Brenner, 2004: 211). In other words, because of the role of public service in the management of the emergency, Covid-19 changed the *Neoliberal* paradigm into a more social one where the supremacy of States is again crucial for defining public policies. So, the future processes of urban transformation and financialization will take in account a different kind of governance and this scenario has immediate effects on architecture.
In conclusion, at least during the last three decades, architecture had been used as a powerful tool of demonstration of financial power because of the primary importance of financialization processes in urban transformation all over the world. This scenario had many consequences both on social inequalities and on architectural practices, with a spectacularization of star-architectures and star-architects on media, public opinion and global real estate market. We still do not know if this socio-economic paradigm will characterize also the next decade but, as analysed through this essay, the controversial aspects of *Neoliberalism* highlines the need of a new architecture vision which could make architecture an instrument for other forms of power in addition to financial élites.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# An Approach to Control the Illuminance Distribution on Vertical Display Surfaces

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**Abstract**
In museum exhibition halls, two-dimensional artworks are displayed usually on vertical surfaces. The uniformity of illuminance distribution in the exhibition area is significant. The control of the illuminance distribution depends on the dimensions of the exhibition hall, the size and location of the exhibition area, and the type, luminous intensity distribution, and position of the luminaire. This study aims to identify the optimal conditions to acquire the targeted illuminance uniformity. For this purpose, sixteen situations were composed concerning four different heights of the exhibition hall and four exhibition areas of various sizes. The luminaires used in the investigation were small and linear with symmetrical and asymmetrical luminous intensity distributions. The position of each luminaire was arranged in the mentioned sixteen situations to obtain optimum conditions. The comparison of the results referred to the energy consumption.
**Keywords:** Vertical Display; Illuminance Uniformity; Energy Consumption; Luminaire Features.

## 1. Introduction

Museums preserve and display works of art and valuable and interesting objects of artistic, historical, or cultural importance. International standards guide museum lighting to balance display and conservation needs. The works of art and other objects to be displayed in exhibition rooms are classified by the European Committee for Standardization (CEN) and the International Commission on Illumination (CIE) in four categories in terms of light sensitivity classification; insensitive, low sensitivity, medium sensitivity, and high sensitivity. The annual exposure time and the upper limit of annual luminous exposure as well as the limiting illuminance are defined for each of these categories (CEN, 2014; CIE, 2004).

An exhibit's background affects its perceived colour. The background against which an exhibit is viewed should be achromatic and medium-light to minimize the simultaneous contrast based on the chromatic adaptation mechanism. Wilson (2006) and Feltrin et al (2017) examined the influence of the background colour on the appearance of the exhibition items (Wilson, 2006; Feltrin et al., 2017). Wilson (2006) suggests a low chroma background with a reflectance of 20–60% depending on the circumstances. Feltrin et al., (2017) found that the change in the background (white, grey, black) did not have a considerable impact on the observers' assessments. Cuttle (1998) pointed out the general effect that the relative damage potential increases as the colour temperature of light increases. Several studies were conducted to determine subjects' preferences regarding the perceived appearance of objects at different correlated colour temperatures (Feltrin et al, 2017; Csuti et al, 2015; Garside et al, 2017; Vidovszky- Németh & Kosztyán, 2016; Luo et al, 2016; Scuello et al, 2004). Measures to avoid direct glare and glare by reflection in exhibition halls are contained in the literature (CEN, 2014; IESNA, 1996). The energy consumption in museum lighting is also taken into account and the advantages of LED lighting compared to conventional light sources are highlighted (Csuti et al, 2015; Garside et al, 2017). Care must be taken to ensure that the maximum illuminance on the display surface does not exceed the allowable illuminance according to the sensitivity class of the object. Illuminance uniformity is a further important aspect of lighting design. The required minimum illuminance uniformity ($U_o$) for specific tasks or activity areas is given in the European Standard (CEN, 2021). However, there is no recommendation in this or any other standard for illuminance uniformity ($U_o$=$E_{min}$/$\bar{E}$) for vertical display surfaces. As no reference has been found specifically for museum lighting, the recommended value (≥0.70) given in the EN 12464-1 standard for hand painting, colour inspection, art rooms in art schools is used as the reference value for artworks displayed vertically on surfaces (CEN, 2021). The perceived colours of the artefact may differ from the original work if the illumination isn't homogeneous. As a result of this, the meaning and effect of the work may deviate from the artist's intention.

The literature on uniform illumination of vertical surfaces offers general knowledge. General knowledge refers to calculating the optimal position of a luminaire depending on parameters such as ceiling height, object size, eye level, and optimal viewing angle. The distance (x) between the luminaire and the display surface shall be calculated using the formula "x= y × tan 30°" according to the distance between the viewer's eye and the ceiling (y). The recommended angle of inclination of the luminaire is 30° to the surface (FGL, 2000; IESNA, 2000). This guiding information does not consider the luminous intensity distribution of the luminaire and the luminaire spacing for a regular array of luminaires. This study

aims to develop an approach to uniformly distributed illuminance on vertical display surfaces using minimal energy consumption.

**2. Conditions for Uniform Illumination on Vertical Surfaces**

The theoretical luminous intensity distribution that enables homogeneous illumination on a vertical surface can be determined depending on the location of the light source and the size and position of this surface. Such a theoretical distribution produces the same illuminance on every point of the illuminated area. The required luminous intensities are to be calculated by the formula 1.

$E_v = I_\alpha \times \cos^3 \beta / h^2 \times \tan^2 \alpha$

(1)

where

$I_\alpha$ is the luminous intensity of the light source in the direction of the angle α,

α is the angle between the direction of light and the vertical,

β is the angle between the direction of light and the surface normal,

h is the distance of the light source from the floor.

For simplifying the calculation, the distance of the light source from the surface ($h^2 \times \tan^2 \alpha$) assumes '1', and the luminous intensities of the light source in the 90°-10° directions calculate proportionally by the formula 2.

$I_\alpha = E_v / \cos^3 \beta$

(2)

The luminous intensity in the direction of 90° to the vertical is 1 ($I_{90}$ =1) according to formula 2. For example, to determine luminous intensities in the directions of 50° and 10°, this formula can be expressed as follows.

$I_{50} = I_{90} / \cos^3{}_{40}$

$I_{10} = I_{90} / \cos^3{}_{80}$

Figure 1 shows an example of the luminous intensity's proportional change towards the display surface. The limiting angle (21°-47°) of the incident rays changes according to the size of the display surface (DS), the ceiling height (h) and the distance (x) between the light source and the wall.

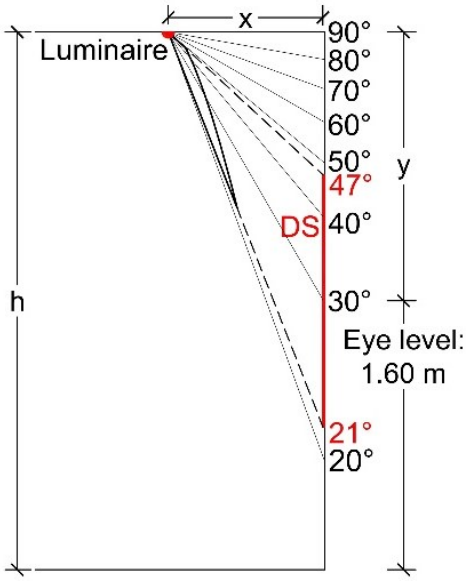



**Figure 1.** An example of luminous intensity distribution for uniform illumination.

The selection and placement of the luminaire should predicate the theoretical luminous intensity distribution. The similarity between the intensity distribution of the luminaire and the theoretical one leads to easier control of the illuminance generated by direct light. Reflected light in the room increases the uniformity of the illuminance. Selecting the appropriate luminaire is essential for the uniformity of illuminance in the vertical direction but is not enough. Large display areas are in exhibition halls, and for this reason, a regular array of luminaires is a prerequisite. Hence, it is significant to determine the appropriate luminaire spacing for uniform illuminance in the horizontal direction.

## 3. Material and Methods

The type and the position of the luminaire, the size and the location of the display surface and the characteristics of the exhibition hall play roles in controlling illuminance distribution. This study aims to identify the optimal conditions to acquire the targeted illuminance uniformity, and the stages of the study are as follows.

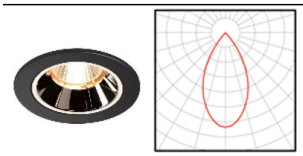
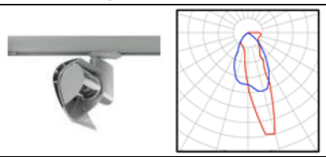
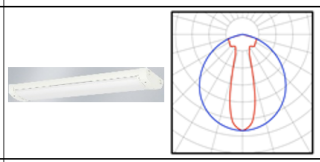
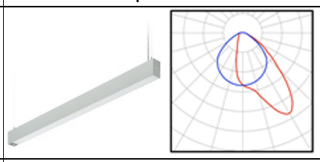
- Selecting the luminaire,
- Identifying the size of the display surface,
- Specifying the exhibition hall characteristics,
- Positioning the luminaire,
- Studies on glare by reflection,
- Determining the calculation method.

### 3.1 Selection of the Luminaire

In this research, four different luminaires (A, B, C, D) are used (Table 1). Care is taken to ensure the luminous intensity distributions of the selected luminaires are similar to the theoretical ones.

A. Small luminaire, symmetrical luminous intensity distributions
B. Small luminaire, asymmetrical luminous intensity distributions
C. Linear luminaire, symmetrical luminous intensity distributions
D. Linear luminaire, asymmetrical luminous intensity distributions

**Table 1.** Luminaire Characteristics

| A | B | C | D |
|---|---|---|---|
| Slv Numinos | Sylvania Torus | Norka Brünn | Philips Trueline |
|  |  |  |  |
| 28.4 W, LED, 2333 lm<br>CCT: 3966 K, CRI: 91 | 42 W, compact fluorescent<br>2129 lm, CCT: 3951 K, CRI: 92 | 45 W, fluorescent, 3183 lm<br>CCT: 4000 K, CRI: 80 | 28 W, LED, 3400 lm<br>CCT: 3000 K, CRI: 99 |

### 3.2 Size of the Display Surface

The identification of the size and the position of the display surface depends on the factors such as the size of the art piece, the visitor's location, eye level and view angle. Due to the variety of the artworks to be exhibited and different possible approaches to exhibition concepts, literature information about the subject is limited. According to EN 12464-1, the eye level for a standing person is 1.6 m above the floor (CEN, 2021),. FGL states that the distance between the visitor and the display surface varies between 1 m-1.6 m (2000), and the distance between the luminaire and the display surface should be one-third of the ceiling height (2016). To create a comfortable viewing angle, Dean (2002) suggests the display surface centre the eye level. According to Panero & Zelnik (1979), the vertical visual field of vision is between sightlines +50° and -70°. The limit of the human visual field for colour discrimination is between sightlines +30° and -40°, maximum eye rotation is on sightline +25°, and optimum eye rotation is on sightline -30°).

Considering the above-noted information, the accepted eye level, visual field, and three different distances for the visitor to the display surface are 1.6 m, ±30°, and 1 m, 1.3 m, 1.6 m, respectively. Thus, based on formula no 3, the display surface sizes are defined as 1.15 m, 1.5 m, and 1.85 m. The fourth display surface for circumstances the exhibited objects cover the entire wall starts 0.5 m above the floor and ends 0.5 m below the ceiling (DS=h-1 m) (Figure 2).

$DS = d \times 2\ tg\ 30^0$

(3)

where

DS is the display surface,

d is the distance between the visitor and the display surface.

### 3.3 Definition of Room Dimensions

Exhibition halls have various dimensions. The height of the exhibition hall is assumed to be 2.8 m, 3.2 m, 3.6 m, and 4 m to monitor the influence of ceiling height on the outcomes. Generally, some walls throughout are allocated for exhibition purposes in these rooms. Ensuring uniform illumination depends on controlling the illuminance produced by the light falling directly from the luminaire onto the surface. The inter-reflected light generated in the room is distributed uniformly on interior surfaces. Thus, this study analyses the conditions to acquire uniformity of illuminance caused by

direct light via a black room with a 5 m x 15 m floor area. A long wall of the room is regarded as the background of the display surface. Following the determination of the appropriate luminaire spacing and the inclination angle in the black room, calculations are repeated for the same conditions in the grey rooms. Consequently, the influence of reflected light on the illuminance and the illuminance uniformity is observed. The reflectances of the grey room are 0.70, 0.50, and 0.20 for the ceiling, the walls, and the floor, respectively. The wall colour chosen represents the optimum background in terms of simultaneous contrast. Various conditions regulated for the black and grey room dimensions and the number of walls allocated for the exhibition are as follows:

- Black room: 5 m× 15 m, exhibition on one long wall
- Grey room 1: 5 m× 15 m, exhibition on one long wall
- Grey room 2: 10 m× 15 m, exhibition on one long wall
- Grey room 3: 10 m× 15 m, exhibition on two long walls
- Grey room 4: 10 m× 15 m, exhibition on two long walls and one short wall

A total of 320 rooms are modelled by the DIALux evo lighting program, based on five rooms (1 black + 4 grey rooms), four ceiling heights, four display surfaces and four luminaires. The required investigations and calculations are conducted correspondingly.

**3.4 Determination of the luminaire location**

The position of the luminaire (distance from the floor and display surface) and its tilt angle are as significant as the luminaire type to control illuminance distribution. Different choices on the mentioned parameters will lead to different mean illuminance and illuminance uniformity. In this study, the distance (x) between the luminaire and the wall is calculated by formula 4, suggested in the literature (FGL, 2000; IESNA, 2000) (Figure 1). Luminaires are mounted on the ceiling of the modelled rooms.

$x = y \times \tan 30^{o}$

(4)

where

x is the distance between the luminaire and the wall,

y is the distance between the eye level and the ceiling.

For ceiling heights of 4 m, 3.6 m, 3.2 m and 2.8 m, the calculated distances between the luminaire and the wall are 1.39 m, 1.15 m, 0.92 m and 0.69 m, respectively. The related literature suggests a tilt angle of 30° towards the wall. However, in this study, the recommended inclination angle (30°) did not perform positive results. Therefore, the appropriate inclination angle needed to be adjusted separately for each room, display surface, and luminaire. The theoretical luminous intensity distribution was used to determine the suitable inclination angle. The luminous intensity distribution of the selected luminaire is placed at the same point as the theoretical luminous intensity distribution. The luminaire is tilted more or less to increase the similarity with the theoretical luminous intensity distribution. Then, the inclination angle is specified precisely with minor alterations.

**3.5 Control of glare by reflection**

On the surface of non-matte objects or the works displayed in a glass frame, the reflected image of the luminaire may occur. Possible glare by reflection may cause difficulty in visual perception and should be avoided in lighting design. Hence, four ceiling- and four display surface heights (16 conditions) are analysed for glare by reflection. The shortest possible distance that a visitor can come close to the display surface without being affected by reflected glare is calculated for each situation. For the case where the ceiling height is 3.2 m and the display surface height is 1.5 m, the shortest possible distance between the visitor and the wall should be 0.82 m ($d_{min}$) as shown in Figure 3. If the allowed remoteness to avoid glare by reflection is smaller than the distance between the luminaire and the wall (x: 0.92 m), the latter should be taken as $d_{min}$ ($d_{min}$=x). Nevertheless, this issue can be neglected if the luminaire's characteristics, such as location, beam- and tilt angle prevent the visitor's shadow from being cast on the display surface. Since the angle of inclination shall not be towards the visitor, there is no need to assess direct glare.

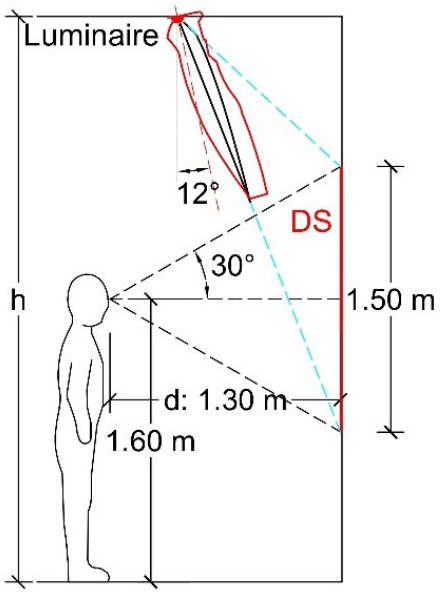



**Figure 2.** Size and location of the display surface

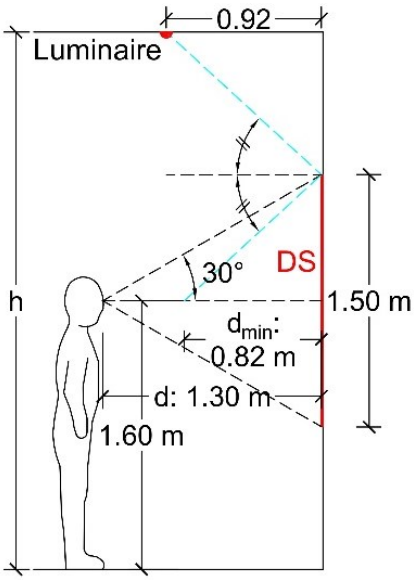



**Figure 3.** Control of glare by reflection

**3.6 Determination of the calculation method**

The control of vertical illumination differs depending on the number of luminaires used. Locating the luminaire (x) according to the ceiling height (h) and adjusting the tilt angle to obtain the desired uniformity shall be adequate when using a single luminaire. Illuminance distribution in the horizontal direction along the width of the display surface should be examined besides the control in the vertical direction along the height of the surface when using multiple luminaires. Since this study employed an array of luminaires, the uniformity of illuminance was controlled in both directions simultaneously in 16 conditions. First, the location of the luminaire (x) is determined. Afterwards, the appropriate tilt angle and the spacing of luminaires are analysed simultaneously to provide the desired uniformity in both vertical and horizontal directions. The dimension of the longer wall identifies the required number of luminaires. The span of the display surface starts with the centre of the first luminaire and ends with the last one. Luminaire spacing and the corresponded number of luminaires vary depending on the type (small, linear) and luminous intensity distribution (symmetrical, asymmetrical) of the luminaire, ceiling height and display surface height.

The decision on the optimal outcome of a specific condition relied on a two-phase evaluation. In the first phase, the mean illuminance ($\bar{E}$) and the illuminance uniformity ($U_o$) are taken into consideration. In general, when $\bar{E}$ increases, $U_o$ decreases and vice versa. The targeted illuminance uniformity was 0.65 in this phase, which was performed in a black room. In grey rooms, a uniformity of 0.70 could be achieved through the contribution of reflected light. In some cases, the target uniformity ($U_o$=0.65) could not be acquired, as a matter of course. The attained maximum $U_o$ is accepted as the best result in these cases. The desired uniformity of illuminance (or the maximum possible $U_o$) was yielded with different luminaire spacings and tilt angles. In other words, there were several positive results.

In the second phase of the study, the optimum one among these positive results was inquired. For this purpose, two additional criteria are considered. The first criterion is the 'total luminous flux ($\Phi$) required for 200 lx illuminance, recommended for the artworks categorised as low sensitivity. The second criterion is the proportion of this luminous flux received by the display surface ($\Phi_{DS}$). Thus, a comparison based on the luminous flux emitted from the luminaire regardless of the power and luminous efficacy of the light source and the luminaire efficiency could be conducted (Çelikmez & Dokuzer Öztürk, 2020). Providing the considered illuminance with a low amount of luminous flux and that this luminous flux falls on the display surface to a large extent have been positive outcomes in determining the optimum result. So, the energy efficiency is taken into account in determining the optimum result.

**4. Calculation Results**

For 16 black room conditions, the total luminous flux ($\Phi$) required for the mean illuminance of 200 lx, the ratio of this luminous flux received by the display surface ($\Phi_{DS}$), and the uniformity of illuminance ($U_o$) are calculated. For each display surface (16 conditions), the results of four luminaires are compared and rated between 1 and 4, with (4) being the most positive and (1) the least one. The result for the case where the ceiling height is 2.8 m and the display height is 1.15 m is presented as an example in Table 2. The values of grey rooms 3 and 4 in table 2 belong to the longer walls. As apparent in Table 2, luminaire B delivered the most positive while luminaire D supplied the least satisfactory result. Luminaire's ranking from the most positive to the least is based on $U_o$, $\Phi_{DS}$ and $\Phi$ values in black and grey rooms. Luminaires B and C

provided higher uniformity in illuminance. As in practice, the uniformity of illuminance being below 0.70 in black rooms increases in grey rooms with the contribution of inter-reflected light. When these two luminaries, whose uniformity is close to each other, are compared in terms of energy consumption, the luminous flux required for 200 lx illuminance on the display surface is higher in luminaire C. In other words, luminaire B is more economical. In addition, the ratio of luminous flux ($\Phi_{DS}$) received by the display surface is higher for luminaire B, which is more affirmative. Lower $\Phi_{DS}$ means that more luminous flux falls on the wall or/and floor outside the boundaries of the display surface. The ranking for luminaires A and D is based on the same reasoning.

**Table 2.** Calculation results; h: 2.8 m, DS: 1.15 m

| Rank/ | Black room | | | Grey room 1 | | | Grey room 2 | | | Grey room 3 | | | Grey room 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lum. | $U_o$ | $\Phi$ | $\Phi_{DS}$ | $U_o$ | $\Phi$ | $\Phi_{DS}$ | $U_o$ | $\Phi$ | $\Phi_{DS}$ | $U_o$ | $\Phi$ | $\Phi_{DS}$ | $U_o$ | $\Phi$ | $\Phi_{DS}$ |
| 1 / B | 0.63 | 10505 | 31% | 0.68 | 9605 | 34% | 0.68 | 9736 | 33% | 0.69 | 9270 | 35% | 0.71 | 8396 | 36% |
| 2 / C | 0.64 | 15256 | 20% | 0.68 | 13677 | 22% | 0.68 | 13922 | 21% | 0.69 | 13113 | 23% | 0.69 | 12438 | 24% |
| 3 / A | 0.55 | 9613 | 34% | 0.58 | 8881 | 37% | 0.57 | 8986 | 37% | 0.59 | 8616 | 38% | 0.57 | 7777 | 39% |
| 4 / D | 0.54 | 9835 | 28% | 0.57 | 9084 | 30% | 0.57 | 9207 | 30% | 0.59 | 8815 | 31% | 0.58 | 8546 | 32% |

Rankings per display surface based on the evaluations for each ceiling height and display surface are presented in Table 3. The comparison of all conditions revealed that the uniformity of illuminance generally decreases when the ceiling height decreases and the display surface height increases. The illuminance uniformities ($U_o$) related to black rooms are given in Table 4. $U_o$ increases approximately 5% in grey rooms.

**Table 3.** Ranking of luminaires

| Ceiling height (h); m | Height of display surface; m | | | |
|---|---|---|---|---|
| | 1.15 | 1.5 | 1.85 | h-1 |
| 4 | 3 | 4 | 4 | 1 |
| | 4 | 3 | 3 | 4 |
| | 2 | 2 | 2 | 3 |
| | 1 | 1 | 1 | 2 |
| 3.6 | 4 | 4 | 3 | 1 |
| | 3 | 3 | 4 | 4 |
| | 2 | 2 | 2 | 3 |
| | 1 | 1 | 1 | 2 |
| 3.2 | 4 | 3 | 1 | 1 |
| | 2 | 4 | 4 | 4 |
| | 3 | 2 | 3 | 3 |
| | 1 | 1 | 2 | 2 |
| 2.8 | 2 | 1 | 1 | 2 |
| | 4 | 4 | 4 | 4 |
| | 3 | 3 | 3 | 3 |
| | 1 | 2 | 2 | 1 |

Luminaire type: A B C D

**Table 4.** Illuminance uniformity

| Ceiling height (h); m | Height of display surface; m | | | |
|---|---|---|---|---|
| | 1.15 | 1.5 | 1.85 | h-1 |
| 4 | 0.65 | 0.65 | 0.57 | 0.23 |
| | 0.63 | 0.63 | 0.65 | 0.63 |
| | 0.65 | 0.64 | 0.64 | 0.64 |
| | 0.65 | 0.56 | 0.49 | 0.39 |
| 3.6 | 0.65 | 0.60 | 0.51 | 0.27 |
| | 0.64 | 0.62 | 0.63 | 0.65 |
| | 0.64 | 0.62 | 0.53 | 0.64 |
| | 0.64 | 0.56 | 0.48 | 0.39 |
| 3.2 | 0.65 | 0.53 | 0.37 | 0.27 |
| | 0.64 | 0.65 | 0.62 | 0.65 |
| | 0.65 | 0.54 | 0.65 | 0.65 |
| | 0.60 | 0.53 | 0.45 | 0.38 |
| 2.8 | 0.55 | 0.37 | 0.21 | 0.32 |
| | 0.63 | 0.62 | 0.63 | 0.64 |
| | 0.64 | 0.65 | 0.65 | 0.65 |
| | 0.54 | 0.44 | 0.29 | 0.34 |

The results in Table 3 can be evaluated as below:

- Considering all cases, the small luminaire (B) with asymmetrical luminous intensity distribution received the highest score (58), followed by luminaires C, A and D with 41, 39 and 22 points, respectively. Despite its asymmetrical luminous intensity distribution, the linear luminaire D took the last place in the ranking.
- The two small luminaires, one with symmetrical (A) and the other with asymmetrical (B) luminous intensity distribution, delivered better results for display surfaces 1.15 m and 1.5 m. The luminaires B and C were more successful for the other display surfaces (1.85 m and h-1 m).
- The results provided by the luminaires B and A in high rooms (4 m and 3.6 m) were most satisfactory. On the contrary, luminaires B and C supplied better results at lower ceiling heights (3.2 m and 2.8 m).

**5. Analysis of Glare by Reflection**

The visitor's comfortable viewing angle is accepted as ±30° for each calculation surface. Accordingly, the visitor's viewing distance (d) to the display surfaces with the height of '1.15 m, 1.5 m, and 1.85 m' are '1 m, 1.3 m, and 1.6 m', respectively. The size of the fourth calculation surface (h-1) varies depending on the ceiling height and is 3 m, 2.6 m, 2.2 m, and 1.8 m for the ceiling heights of 4 m, 3.6 m, 3.2 m, and 2.8 m, respectively. For this calculation surface, the distance (d) between the visitor and the display surface should be 3.29 m, 2.6 m, 1.905 m, and 1.905 m for the ceiling heights of 4 m, 3.6 m, 3.2 m, and 2.8 m, respectively. Based on this data, the analysis results regarding glare by reflection for the four ceiling heights and four display surfaces are submitted in Table 5. This table presents the minimum distance ($d_{min}$) that the visitor can approach the exhibition surface without the risk of glare by reflection and the relevant viewing angle at this distance. The cases in which the observer is affected by glare are indicated by darkened cells in the table. Actually, under the condition h: 2.8 m, DS: 1.85 m, glare by reflection occurs at the defined distance (1.905 m) based on the visual angle of ±30°. To avoid this, the distance between the visitor and the display surface must be ≥2.36 m. Likewise, at ceiling heights of 4 m, 3.6 m and 3.2 m, the visitor must view the display surface at an angle of less than ±30°, which means moving farther from the surface.

**Table 5**. Control of glare by reflection

| | | Height of display surface; m | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1.15 | | 1.50 | | 1.85 | | h-1 | |
| | | $d_{min}$ | view angle | $d_{min}$ | view angle | $d_{min}$ | view angle | $d_{min}$ | view angle |
| h (m) | 4 | 0.44 | ±53° | 0.63 | ±50° | 0.87 | ±47° | 5.27 | +27°, -12° |
| | 3.6 | 0.47 | ±51° | 0.70 | ±47° | 1.00 | ±43° | 3.46 | +23°, -18° |
| | 3.2 | 0.52 | ±48° | 0.82 | ±43° | 1.27 | ±36° | 2.03 | ±28° |
| | 2.8 | 0.64 | ±42° | 1.16 | ±33° | 2.36 | ±21° | 0.97 | +36°, -49° |

**6. Comparison in Terms of Energy Consumption**

Today, energy scarcity and carbon emissions are significant issues facing many countries (Lukosa, 2017). Lighting accounts for a large part of the energy consumption of buildings. Therefore, lighting energy savings in all sectors are essential to reduce $CO_2$ emissions and global warming (Lee & Cheng, 2016). The use of high efficacy lamps and lighting control systems are some of the measures to reduce energy consumption (Xu et al, 2017; Haq et al, 2014; Pandharipande & Caicedo, 2015; Hag et al, 2014).

Total luminous flux ($\Phi$) required for an average of 200 lx illuminance is considered to compare the results of this study in terms of energy consumption. For this purpose, the results of 320 situations were compared, depending on four ceiling heights, four display dimensions, four luminaires, and five rooms (four grey+ one black). Among the mentioned 320 situations, the case requiring the highest luminous flux (100%) was determined and accordingly, the needed luminous flux for the rest of the situations is found separately in percentage. Table 6 shows the results of an example based on a ceiling height of 2.8 m and a display surface of 1.15 m. Regarding grey rooms 3 and 4, which have more than one wall allocated for exhibition, the result of a single long wall is in this table. The results in Table 6 show that the luminous flux required to provide the aimed illuminance on the display surface is minimum in luminaire A and maximum in luminaire C. Put another way: luminaire A is the most economical one, followed by luminaires D, B and C. By contrast, in terms of illuminance uniformity ($U_o$), the rank order of the luminaires is different. Because luminaire B provides the most uniform illuminance, followed by luminaires C, A and D. Another comparison was between black and grey rooms and the effect of the reflectance of inner surfaces on energy consumption is observed. The energy requirement in grey rooms is lower than in black rooms (Table 6). The number of luminaires employed in grey room 1 (GR1) and grey room 2 (GR2) is the same. However, the increase in the room size without changing the number of used luminaires reduces the contribution of reflected light from the interior surfaces to the illuminance on the display surface (GR2/BR>GR1/BR). As the number of display walls increases in the same size of rooms, the contribution of the reflected light to the illuminance on the display surface increases (GR4/BR< GR3/BR<GR2/BR). The effect of reflected light on energy consumption is parallel in all considered cases.

**Table 6.** Comparison of energy consumption; h: 2.8 m, DS: 1.15 m

| Rank/ Lum. | Black room | | | Grey room 1 | | | Grey room 2 | | | Grey room 3 | | | Grey room 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $U_o$ | Φ | BR | $U_o$ | Φ | GR1/ BR | $U_o$ | Φ | GR2/ BR | $U_o$ | Φ | GR3/ BR | $U_o$ | Φ | GR4/ BR |
| 1 / A | 0.55 | 25.7% | 1 | 0.58 | 23.7% | 92% | 0.57 | 24.0% | 93% | 0.59 | 23.0% | 90% | 0.57 | 20.7% | 81% |
| 2 / D | 0.54 | 26.3% | 1 | 0.57 | 24.3% | 92% | 0.57 | 24.6% | 94% | 0.59 | 23.5% | 90% | 0.58 | 22.8% | 87% |
| 3 / B | 0.63 | 28.1% | 1 | 0.68 | 25.6% | 91% | 0.68 | 26.0% | 93% | 0.69 | 24.8% | 88% | 0.71 | 22.4% | 80% |
| 4 / C | 0.64 | 40.7% | 1 | 0.68 | 36.5% | 90% | 0.68 | 37.2% | 91% | 0.69 | 35.0% | 86% | 0.69 | 33.2% | 82% |

The energy consumption of four luminaires is compared with each other on the scale of the display surface. The luminaire that requires the lowest luminous flux has the best score (4 points), while the luminaire that requires the highest amount has the worst score (1 point). This comparison was conducted in two ways, considering only 'black rooms' and 'all black and grey rooms'. The results obtained in both conditions were significantly parallel to each other. Table 7 presents the ranking in energy consumption for each display surface.

**Table 7.** Ranking of energy consumption

| | | Height of display surface; m | | | |
|---|---|---|---|---|---|
| | | 1.15 | 1.5 | 1.85 | h-1 |
| Ceiling height (h); m | 4 | 2 | 4 | 4 | 4 |
| | | 4 | 1 | 1 | 2 |
| | | 3 | 3 | 2 | 1 |
| | | 1 | 2 | 3 | 3 |
| | 3.6 | 2 | 4 | 4 | 4 |
| | | 3 | 2 | 1 | 2 |
| | | 4 | 3 | 3 | 1 |
| | | 1 | 1 | 2 | 3 |
| | 3.2 | 2 | 4 | 4 | 4 |
| | | 1 | 1 | 2 | 2 |
| | | 4 | 2 | 1 | 1 |
| | | 3 | 3 | 3 | 3 |
| | 2.8 | 4 | 4 | 4 | 4 |
| | | 2 | 2 | 2 | 2 |
| | | 1 | 1 | 1 | 1 |
| | | 3 | 3 | 3 | 3 |
| Luminaire type: | | A | B | C | D |

The evaluation of the energy consumption comparison is as follows:

- As the ceiling height increases, the energy consumption required for the same display surface increases.
- While the ceiling height is constant, the larger the display surface, the more energy consumption.
- Considering all cases, the order of the luminaires from the lowest energy consumption to the highest is A, D, B, and C. When the energy requirement is minimum, i.e. minimum luminous flux emitted from the luminaire (luminaire A), the level of reflected light is also less. As the luminous flux emitted from the luminaire increases, the contribution of the reflected light to the illuminance on the display surface increases, in general.
- Considering all cases, luminaire B delivers the highest average uniformity of illuminance ($U_o$), followed by luminaires C, D and A. In other words, the energy consumption and the uniformity of illuminance change in the opposite direction.

**7. Discussions**

It is essential to provide the recommended illuminance and uniformity in the task area. In museums and art galleries where the exhibition is vertical, the task area is the vertical display surface. The illuminance should be uniform and not exceed the allowed level to properly and fully appreciate the artworks exhibited. In practice, however, high luminance contrasts are often encountered. The zone of highest luminance will be on the work of art or the background surface, depending on the conditions. The limited knowledge of the vertical control of illumination also plays a role in the low success in practice.

This study considered the literature data to determine the location and size of the display surface (Dean, 2002; FGL, 2000; Panero & Zelnik, 1979). The distance (x) of the luminaire from the wall corresponding to the ceiling height (h) was also determined using the literature (FGL, 2000; IESNA, 2000). Another commonly used specification relates to the angle of inclination of the luminaire to the vertical (30°) (FGL, 2000; IESNA, 2000). However, in 64 cases examined, only one positive result was (h: 4 m, DS: 1.15 m, luminaire A) with an inclination angle of 30°. Thus the uniformity of the illuminance not only depends on the inclination but also on the luminous intensity distribution of the luminaire (narrow/broad, symmetrical/asymmetrical).

Firstly, the tilt angle providing the desired uniformity in the vertical direction of the display surface is determined; afterwards, the spacing of luminaires ensuring the same uniformity in the horizontal course of this surface is analysed. However, the desired uniformity could not be acquired when using multiple devices. This observation revealed the importance of simultaneous consideration of the inclination angle and the luminaire spacing. Given this data, various luminaire spacings are taken into account, and the most suitable tilt angle for each spacing is defined. This approach delivered multiple states that yield the target uniformity in illuminance distribution. The decision on the optimum one among these states ensued under consideration of; 'uniformity of illuminance ($U_o$)', 'total luminous flux ($\Phi$) required for an average of 200 lx illuminance and the proportion of this luminous flux received by the display surface ($\Phi_{DS}$)', and the required number of luminaires. The selected optimal condition provided the desired illuminance and uniformity by using minimum energy and prevented the background illuminance from being higher than the display illuminance. Optimizing the inclination and spacing of the luminaires is a significant and original result of this research. Regarding any level different from 200 lx or respecting the maximum illuminance instead of the mean illuminance will not affect the obtained results.

The first step in illuminance control is to select the luminaire's luminous intensity distribution. Therefore, the theoretical luminous intensity distribution (Figure 1) should be defined that enables homogeneous illumination depending on the room height, display area and luminaire position. The ideal approach is to design a reflector that provides the required theoretical luminous intensity distribution (Özmen & Dokuzer Öztürk, 2009). However, selecting the most suitable one among the available luminaires is preferred usually. Using the theoretical luminous intensity distribution as a reference in luminaire selection and tilt adjustment speeds up the lighting design process and enables positive results. This perspective of the lighting designer will increase the number of competent applications. Drawing attention to this phenomenon is believed to fill a crucial deficiency in the literature.

It is a general opinion that an asymmetric luminous intensity distribution provides positive results for a uniform illumination (FGL, 2016). However, 'asymmetric luminous intensity distribution' alone is not enough for a competent result. Intrinsically, both the best and the worst results supplied the luminaires with asymmetrical light distribution in this study. Besides being symmetric/asymmetric, the shape of the luminous intensity distribution is decisive. It is unrealistic to assume that a luminous intensity distribution delivers positive results for all room heights (h) and display sizes (DS). The results of this study also changed according to the dimensions h and DS. The luminaires A and B provided successful results for small display surfaces (1.15 m, 1.5 m) and high rooms (4 m, 3.6 m). On the contrary, the luminaires C and B submitted satisfactory results for larger display surfaces (1.85 m, h -1 m) and lower rooms (3.2 m, 2.8 m). Some opinions argue that the entire wall should be lit and accordingly perceived as equivalent (FGL, 2016). It is meaningful for the conditions in which the objects cover a large portion of a wall. However, for circumstances in which the exhibited objects are placed on a particular part of the wall, trying to provide uniform lighting over the entire wall, regardless of the area reserved for the works, does not seem sensible due to energy saving. In most cases, the illumination created by the reflected light is sufficient to ensure the visibility of the interior surfaces of the room. In addition, as the area illuminated by direct light from the luminaires increases, the uniform distribution of the illuminance becomes difficult.

The amount of luminous flux required to generate the target illuminance increases as room height and display area size increase. Comparing the energy consumption of the handled luminaires supported this conclusion. On the other hand, the uniformity of illuminance and the energy consumption contradict each other. Evaluations based on various criteria revealed that the luminaires B and C are superior to the others (A and D). On the other hand, the luminaires A and D, whose $U_o$ values were generally below the target, proved to be more economical when compared just in terms of energy consumed. The goal of lighting design should be to offer visual comfort with the lowest possible energy consumption. In cases where these two contradict each other, it is apparent that the preference should favour visual comfort.

**8. Conclusions**

The principal purposes of electric lighting in museums are to ensure that the exhibited objects are perceived fully and comfortably, prevent these objects from being damaged and use energy efficiently. Providing illuminance uniformity on vertical display surfaces is one of the significant tasks of lighting design. If the illumination is not homogeneous, the perceived colours of the artefact may differ from the original, and the meaning and effect of the work may deviate from the artist's intention. This study presents an approach to distributing illuminance uniformly on vertical display surfaces using minimal energy consumption. According to this approach, the luminous intensity distribution of the luminaire shall

be appropriate for the location and size of the display surface. It also emphasizes that the angle of inclination and luminaire spacing shall adjust simultaneously.

This approach is applied to assess the results conveyed by four luminaires with different luminous intensity distributions. The evaluation takes into account the luminous flux required to produce a certain level of illuminance, the targeted illuminance uniformity, and the ratio of the luminous flux received by the display surface. For each display surface (16 conditions), the four luminaires are rated between 1 and 4, being (4) the most positive and (1) the least one. The most positive results delivered the small luminaire (B) with asymmetrical luminous intensity distribution considering all cases. The linear (C) and small (A) luminaires with symmetrical luminous intensity distributions followed luminaire B. The linear luminaire (D) with asymmetrical luminous intensity distribution supplied the worst results under the conditions of this study. If one compares these luminaires only to energy consumption, the most economical is A, followed by D, B and C. However, it was not possible to achieve the desired illuminance distribution with the more economical A and D luminaires in most cases. In addition to the visual discomfort, the non-uniform illuminance also causes the annual luminous exposure will not be the same for the whole surface of the artwork. Efficient use of energy is undoubtedly critical. However, in museum lighting design, priority should be given to maintaining visual comfort and preserving artefacts.

Interior, lighting and exhibition design in museums should be conducted simultaneously. If this is not the case, it is inevitable to compromise at least one of the subjects, namely the preservation of objects, the provision of visual comfort and energy efficiency. For example, necessary analyses should be carried out to avoid glare by reflection that can occur on the surface of non-matte objects or works displayed in a glass frame. When setting up the exhibition layout, the shortest possible distance that which the visitor can approach the work should be taken into consideration.

The acquired results revealed that a single luminaire does not deliver positive results in all 16 cases. The choice of the luminaire shall regard the geometry of the room and the properties of the presentation area. The lighting designer can benefit from the outcomes of this research based on four luminaires in museum lighting. Assessing any luminaire using the approach presented in this study will provide optimal results in many respects.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# The Importance of Light in Steven Holl's Perception of Form

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**Abstract**
The essential factor in the perception of form and space is light which enables the perception of the form or space, its colour, texture, material, that is, the whole. Daylight significantly affects the shaping of structures and the enrichment of sensory perception, psychologically and biologically. This article aims to examine the importance given by Steven Holl on the effects of natural light in the perception of the form. Within the scope of the study, through three different museum structures of Holl, functional and symbolic perception of the form and its contribution to the design were examined. Results show that in Steven Holl's design process, the inclusion of light in the building is an important design criterion that affects the form phenomenon and the perception of space. Contextually, it has been seen that it is dependent on the location, the angle of incidence of the sun's rays, and it reveals a sustainable design product because it saves energy.
***Keywords:*** Form; Daylight; Perception; Steven Holl; Sustainability.

## 1. Introduction

When the change on the architectural form throughout history is investigated, light affects the structure in terms of visually and functionally. The existence of the light is the most crucial condition to comprehend the form, space and structure. According to Kuban (1974) existence of space appears with light. As an essential part of life, light is also indispensable to understand the attributes of the space. Light has a big impact on a perception of the individual and it is used by many designers throughout the architectural history. Steven Holl's designs, in the essence is composed by light. Holl uses daylight in his designs to create different ambients according to function of the space. He achieves this by adding the light indirectly in the space and controlling its reflection. Light is received indirectly by gaps on the double layered walls, windows, half transparent cloths and even by the materials on the horizontal surface.

Chernyshov (2008), indicates that Holl put importance to the light because of its effect on the perception and spatial experience. He states that Holl sees light not only physically but also as a great poetical and spiritual power. Alves (2009) remarks that in Holls thoughts, light is an important contributor to understand the architectural quality of the space and makes the spaces visible. Structures of Holl aims to express, abstract concepts and perception and indicates the strongest expression method is light and shadow for this purpose.

Holl studies light and its effect on the space in his watercolor sketches and uses light for the perception of the space during nights. Holl achieves spatial effect with minimum natural light usage and uses shadows of the objects in the nature for his landscape designs. Affect of the natural light and shadow gives the design liveliness, energy and dynamism (Özorhon, 2002)

Yorgancıoğlu (2004) states that Holl uses tactical sensitivity of the form and space, also uses light poetically together with changing properties of the natural light. In Holl's phenomenological trials, the defining factor for the existance and the sensation of the depth of the space is light. Thanks to this, light inside the space creates artistic and aesthetic effects.

In this article, it is aimed to investigate the Steven Holl's thoughts on the importance of the natural light to perceive the form. In this context, functional and symbolic usage of the light for 3 different museum structure is investigated in terms of perception of the form and sustainable effect of the light for design.

## 2. Theoretical Background

### 2.1 Effect of Light on the Formation of the Architectural Form

Bacon (1974) states that there is a connection between architectural form, mass and space. Architectural form, texture, color, material, shadow and change of light are the attributes to reveal the space. Lowson indicates that existance of light is the most significant factor on the creation of the architectural form and perception of it. Light achieves the perception of the color, texture and material of the form (Lowson, 2003). According to Kuban (1992), light is an important part of the space to understand the attributes of the limited gap. Light also provides the connection between the structure, color, form and material. Çoban (1999), thinks that light and shadow affect the expression of the form and the mobility of the space. Good lighting of the space depends on the quality of the light not the amount of it.

Pallasmaa (2005), states that light gains meaning when it creates shadows. Due to this, biggest effect of light is the shadow. Light is accepted as an architectural factor historically. Gürel (2001) remarks that attributes like light inside the

space, darkness, spaciousness, dimness, focusing problem of the people and their anxiety, stress and tension are affected by light. Thus, light that are used for different purposes inside spaces has psychological effects.
In order to perceive and feel the effect of the space and to ability to see light has big impact. Light that is used inside the space also affects physical movements. According to Tezel (2007) diffusers with wide surface and light colors creates shadowless effects. This kind of spaces feels wide and comfortable. Not enough light or too much of it inside the space makes the actions like reading difficult. Allowing natural light into the space or avoiding it affects the design. Natural light affects the design, space, facade design, porousness, and structure rhythm. Functionally, there is a need of light in different levels inside the space. To create wanted effects, allowing light into the space affects the form. In different periods of architecture, using the water objects as mirrors, different properties of the light are benefited.
Özorhon (2002) states that, light functionally ensures us to understand the texture, volume, color, natural and real form of the objects inside the space. To understand our position, direct our movements and performing our routines inside the space, light has qualitative and quantitative effects.

**2.2. Steven Holl and Daylight**

Steven Holl whose form and space design depends on experience, uses light as an architectural object and material. As any experience is affected by light, Holl puts a lot of importance to usage of light. Light is not divided in perception of form. Thanks to this, light interacts with the shadow of a tree, shiny surfaces of concrete walls and the bodies. Holl is inspired by experientially and sensorial dimensions in his architecture and performs his designs that uses light and shadow significantly. According to Holl light that defines form has poetical value and enriches the space. Holl often uses light tricks as an expression method. The most effective way to visualize the phenomenological thoughts and architecture for Holl is to use the light (Chernyshov, 2008; Holl, 2000; Skandali, & Lambiri, 2018).
Holl uses modern styles and gives importance to handcraft in his designs. He uses fourth dimension often and striking effects of this in the space are shown by the reflection of light. In addition to the structural architecture, he also tends to the interior architecture as well to provide completeness. Structure as spatially product of many meanings layer (Gündüz, 2015). Steven Holl starts his design with watercolor sketches and three-dimensional drawings, carefully uses perceptive interactions of body and space and proper usage of light and materials in his projects that include the history of the city and the power of the modern scientific ways. In Holl's perspective, space is bound to be forgotten without the usage of light. The expression of the space is achieved by the reflection, refraction, lucency and opaqueness of the light. Light transits through the living spaces and makes the space ambiguous. This ambiguity is expressed by the effect of the light on a surface and showing the psychological and remarkable limits of the architecture. The transparency of the wall, reflection of the mirror, light beam and its interactions to an individual's life directs the perceptions (Holl, 2000).
Steven Holl uses daylight by passing it through certain filters to create different atmosphere according to the functionality inside the space. His material choice also decided by the effect of the light. Water objects are used to give the feeling of depth to the light in his designs. Artificial pools are placed between big and heavy forms to not allow the space to be stationary and the reflection from the water surface gains more meaning on the space. Holl shows the psychological limits of the architecture by the shadows that are created with a pool of light inside a space or on a surface (Özorhon, 2002; Holl, 2000; Medayese et al., 2019).
Experience is put on front in Holl's designs, he focuses on the texture of the material, details, and the effects of reflection of lights inside a space. This effect is shown by the tricks of light inside the space and its shadow to transfer the texture, smell, and architecture of the space (Kipnis, 2003).
In Holl's structures, diversity of the light that happens in different time of the day creates a special experience. Fluent spaces are dissolved by the effect of light and new spaces appears. By describing changing light forms positive effects are shown (Descottes, 2009).
Steven Holl thinks that functions of land and structure, daylight receiving angle, circulation and structure entrances position are the deciding factors for designs and believes location affects the architecture. In design process, he calculates the time of receiving daylight for the land and considers the reflections and refractions of the light by planning on the model to involve light in the process (Tezel, 2007). Holl tries to bring daylight where normally would not receive any. In his designs he always takes care to bring daylight without thinking about the purpose of the structure. Schoof states that, for Holl to understand how the time passes inside the space, a sunset need to be seen (Schoof, 2017).

**2.3. Important Principles in Daylight Usage of Steven Holl**

***Usage of Daylight***: The way of allowing daylight inside the space offers different meanings. The method to use the light directly affects the design. Holl uses the changing properties of daylight and its spatial effects. He uses light poetically, to control light reflections and structure them he does not use direct methods but prefer architectural objects to transfer the light to interior spaces. Using light creates plastic and artistic effects (Yorgancıoğlu,2004). Holl connects the resources of the natural and artificial lights and combine them with the geometry of the space (Descottes, 2009). Holl uses direct light functionally in his museum designs and indirect lights are used symbolically. Holl reflects the light from the colorful

areas or water surfaces to use the light symbolically and brings visual enrichment. By adding fully transparent surfaces, he collects daylight as much as possible for the interior spaces and use the light functionally (Tezel, 2007).

***Effect of Light on Sustainability:*** Holl uses daylight for heating in winter and cooling for summer in his structures. In his designs by orientation, he takes advantage of the daylight. By receiving daylight from horizontally and vertically from the roof he creates visual effects for the users. Due to big gaps on structure fronts, he controls the light. In some structures, these gaps, performs the natural ventilation of the space and allow light reaching to landscape corridors (Amen, 2021). Holl uses daylight from the roof to creates warm atriums for the design taking place in cold environments (Tezel, 2007). In museums daylight is preferred to save from energy consumption. Because of this Holl prefers to distribute the light homogenously inside the space (Fiederer,2016).

***Form-Space Perception by Effect of Light:*** Holl, phenomenologically uses light for experience of the space. Light achieves depth of space and defining factor of the space. Holl thinks spaces shows poetical properties. Poems which have both existential and creative ways, are effective methods to express emotional and experimental intensity in architectural aspects. Holl, achieves this poetical spatiality by form, light and shadow (Yorgancıoğlu, 2004). For instance, he uses light as a 'silent but dramatic surface' for museums and different unorganized exhibit rooms to show unique artistic items (Fiederer, 2016). The diversity of the exhibit differentiates by the light coming from the surface gaps inside the space. Light causes feel of motion inside the space. Due to this usage of light depending on the motion creates spatial perception. Holl focuses on experiential and poetic so according to Holl geometry of the form, material and experience of the light depends on the individual perception of the space (Kipnis, 2003).

## 3. Case Study

### 3.1. Material and Research Method

Material of the case study are the chosen museums of Steven Holl. To understand how Holl uses daylight, first effect of light on architectural form is investigated by literature works. Furthermore, principals of daylight usage on the structures of Steven Holl are specified. To better explain the principals of Holl on daylight usage; **"*Usage of Daylight*"**, **"*Effect of Light on Sustainability*"** and **"*Form-Space Perception by Effect of Light*"**; three different museum structures has been chosen. Chosen museums are Kiasma Modern Art Museum, Nelson Atkins Art Museum and Nancy and Rich Kinder Museum. These museums are chosen based on them addressing wider user group, being most renown work of Holl, being built apart 10 years between and being competition projects. Museums are investigated by theoretical knowledge and visuals and analyzed by the principals of daylight usage and architectural plans. Findings form this analysis are shown in tables and present the results.

### 3.2. Kiasma Modern Art Museum

In 1992, after a competition between 516 projects, design of Holl is chosen for an art museum in Helsinki. Museum has collections, art exhibits, stage shows, conferences, seminars, workshop activities, dans and music events which opened to public in 1998. This museum is accepted as a masterpiece of Holl and receives the AIA Design award in 1998 (Sirel and Sirel, 2021) (Figure 1).

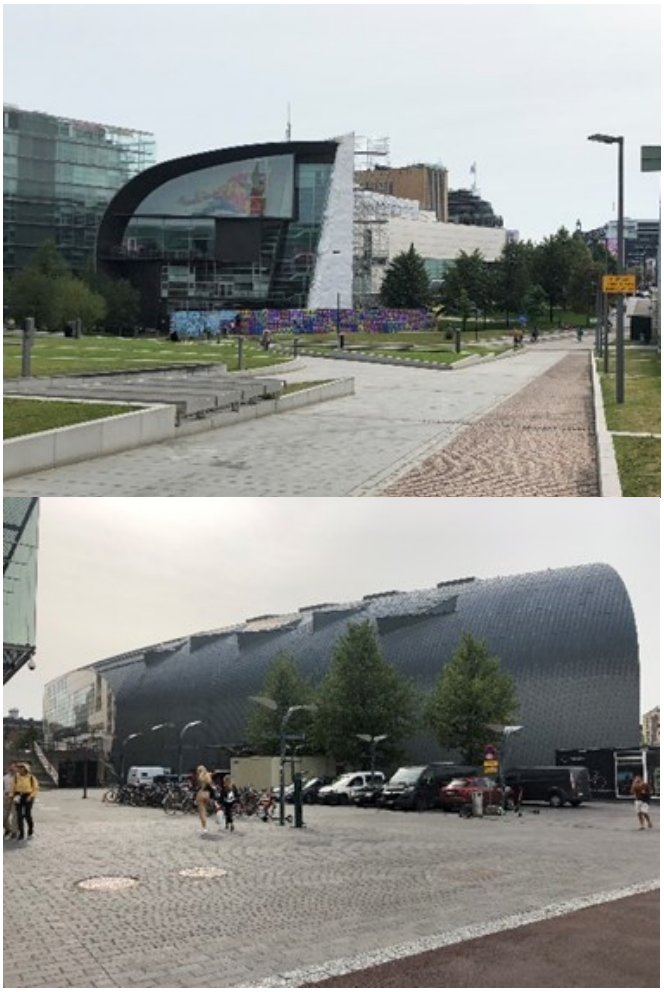


**Figure 1.** Kiasma Museum general view (Sirel, 2019)

It is placed in the hearth of Helsinki and one the center of the most important structures of the city. Museum is placed on the Töölö gulf and it being on the "ground" is the deciding factor of its form. Museum building is on a triangle island that reaches the Töölö Gulf and Park. Many of the important and architectural government and cultural structures are nearby such as Finland Parliamentary Building, Alvar Aalto Congress Building, Eliel Saarinen's Helsinki Station (Table 1). This location helps the form of the structure getting shaped. Museum connects to the Congress Center with a cultural way, also connects to the natural view such as Töölö gulf naturally. West side of the structure is a linear mass and east side is a shape of arc. Two sides of the form connect on the north end and intersects with the fully reflective pool on the south side of the Töölö gulf (Fiederer, L., 2016, Sirel and Sirel, 2020), (Figure 2).

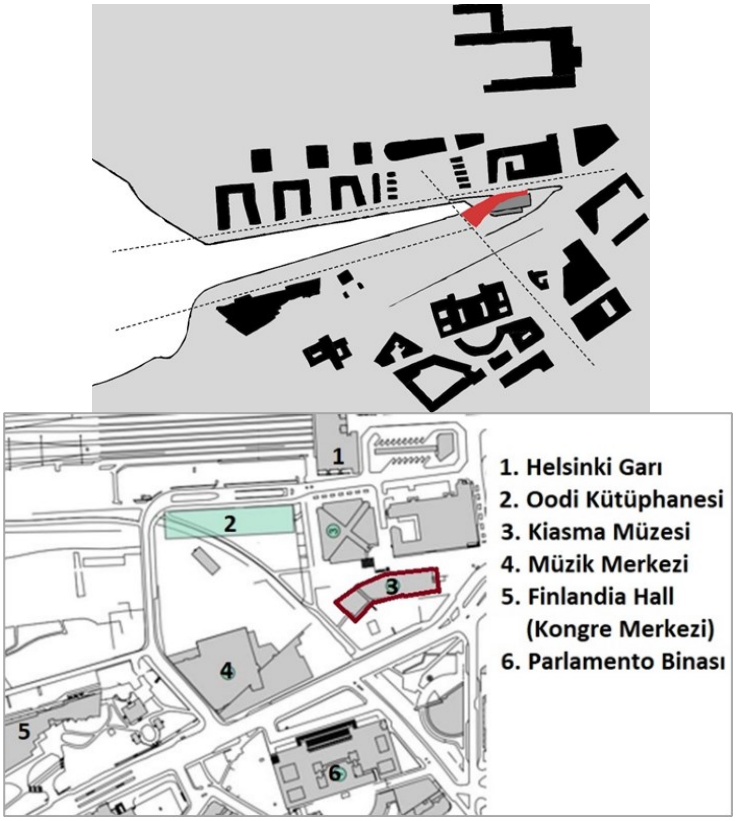



**Figure 2.** Kiasma Museum Location (Sirel, 2019)

"Chiasma", in Greek derives from a word "χιασμος-khiasmos" meaning cross link, transit or change and root of it comes from letters "x" and " khi". Ancient world defines the "khiasmos" thing that all part of it is connected to each other thightly and combines to a mirror symmetry. Holl also put the background of his project into connection part of this word and design the museum like two hand holding each other. Name of the project Chiasma later on adapted to Finnish and permanent name of the Museum becomes "Kiasma" (Sirel and Sirel, 2021).

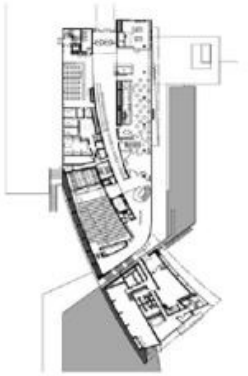
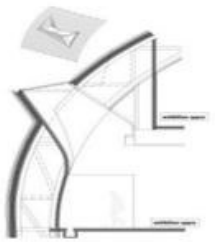
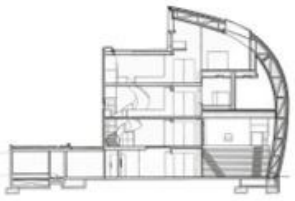
***Kiasma modern art museum daylight usage principal are the followings:***

***Usage of Daylight:*** In architectural design of the Kiasma one of the critical aspects is usage of the light. When Holl design the arc shape building, more than form is considered. This arc shape form is designed in a way to catch the very low angled sunlight during long lasting winters of the country that is the in the top part of the northern hemisphere. Windows and gaps are designed which take advantage of often changing character of the daylight, thus creating unique visuals to the mass. Daylight coming from wide, shows difference due to angled surface of the building during the day (Bianchini, 2019). Most of the windows in Kiasma have the half transparent mirrors that distributes the light (Sirel and Sirel, 2021). Since exhibit areas does not require to be connected to outer world, just windows on the roof are used for daylight. Thanks to curved shape of the structure, it receives daylight directly and reflects it to the exhibit rooms. Lower room galleries receive indirect daylight from the transparent linear shaped surface of the front side of the building (Holl, 2000; Sirel, 2021). The most riveting part of the in the interior side of the building is where visitors enter the museum on the glass roofed lobby. Lobby is the entrance to the corridor with rotary stairs and curved ramp. According to Holl, galleries must be created by rectangular shaped areas which have curved valls (Table 1). These spaces looking ordinary, once light enters inside, creates visual and spatial experiences. Thanks to the effect of this light and the interconnections of unorganized formed spaces and dynamic inner circulations creates variety of spatial experiences (Fiederer, 2016). Thus, direct daylight is used functionally, and indirect daylight is used symbolically.

***Effect of Light on Sustainability:*** Holl, in design of Kiasma, uses the orientation and daylight in utmost importance. Daylight is used in a way to be distributed homogenously inside the whole museum space to save from energy consumption (Fiederer,2016). Horizontal daylights are received from the gaps that are located on the curved shape of the building. These windows are also used for natural ventilation and daylight connection to landscape corridors.

***Form-Space Perception by Effect of Light:*** Holl uses light in the design of the Kiasma, as a factor to create the feeling of spatial depth and define the space. While creating the architectural form of the structure, for the purpose of reflecting very low angled daylight to the interior spaces during the winters, curved shapes and curved roof shell are used.

**Table.1** Kiasma Modern Art Museum, Properties of Daylight (URL-3, Sirel, 2019)

<table>
<tr><td colspan="4">Kiasma Modern Art Museum and Panoramic Visual<br></td></tr>
<tr><td rowspan="3">Principals of Daylight Usage</td><td>Usage of Daylight</td><td>Light is received from directly and indirectly to be used functionally and symbolically.</td><td rowspan="2"><br>Views of Plans</td></tr>
<tr><td>Effect of Light on Sustainability</td><td>Due to area receiving low amount of light, structure is designed to reflect the light and gaps are added to allow light inside constantly.</td></tr>
<tr><td>Form-Space perception by effect of light</td><td>Depth feeling of the space and definition of space is done by usage of light.</td><td rowspan="2"><br>Entrance Level Plan</td></tr>
<tr><td colspan="3"><br>General View<br><br>Daylight Detail</td></tr>
<tr><td colspan="3"><br>Natural Lighting Methods</td><td><br>Section</td></tr>
</table>

### 3.3. Nelson Atkins Art Museum

Nelson Atkins Art Museum first opened in 1933 as 'William Rockhill Nelson Art Gallery' and 'Mary Atkins Fine Arts Museum' in the state of Kansas, USA. Beaux Arts architectural style is used for the design and a need for further expansion to the existent building appeared. For this purpose, a competition for the design started. In 2007, new structures named "Bloch Buildings" are constructed by Steven Holl Architects. With the new buildings, new galleries and warehouse areas are created for the further expanding collection of the museum (Arslan, Orhan and Disli, 2020).

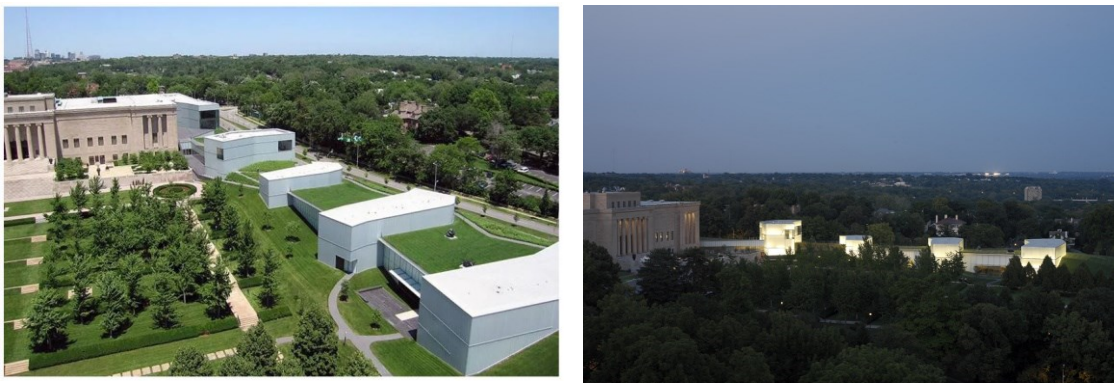


**Figure 3.** General View of the Nelson Atkins Art Museum (Ryan, 2008)

Bloch buildings are placed on the east side of the museum area according to the inclined area of the land, on a linear line. Majority of the needed are for the Bloch buildings are on the underground of the museum area. Bloch buildings are elevated gradually and thanks to the lenses underground galleries and lobbies are brightened by daylight (Reid, 2009), (Figure 3). Bloch buildings are designed with a contradictory way. Bloch buildings are multi surfaced forms. While existing building are covered with limestone and has a heavy frontside, front of Bloch Buildings has U shaped semitransparent mirror channels (Stephens, 2007) (Figure 4).

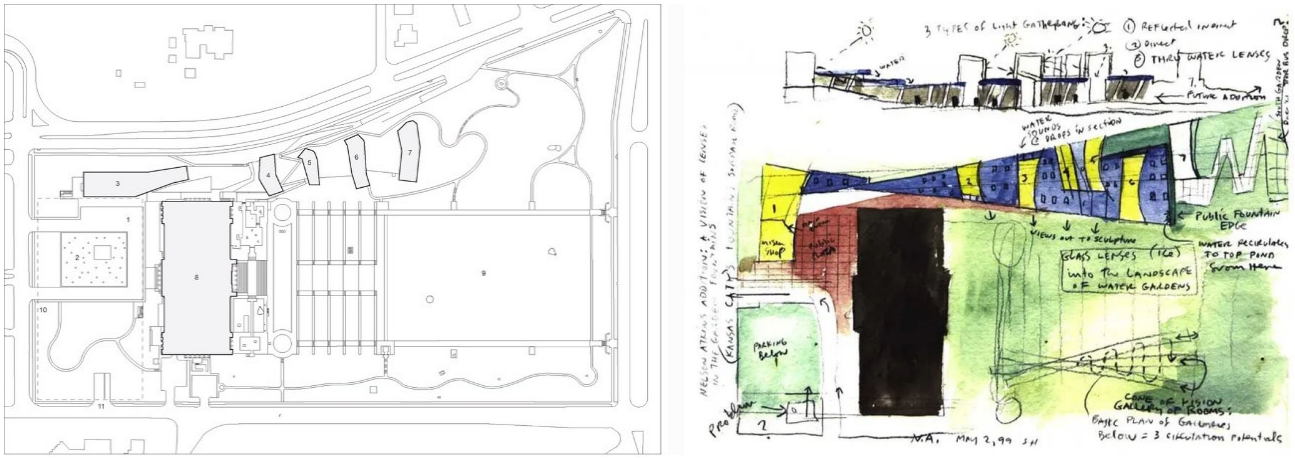


**Figure 4**. Nelson Atkins Art Museum Location (Bianchini, 2019)

***Nelson Atkins Art Museum's daylight usage principals are the following:***

***Usage of Daylight:*** The movement between the circulation area on the land and the lenses of the Bloch Buildings that collect light, creates visual experiences for the visitors. Glass lenses gains the variety of light properties for the galleries. For the addition of new buildings to the museum, instead of adding massive mass, five connected structures are added to create contrast (Table 2). Lenses gives daylight during the day, and during night light in the gallery reflects to the sculpture garden. For the entrance, a lobby is designed with shiny and transparent mirror and transit to the galleries are achieved by ramps. Thanks to the lenses that are placed on the surface of the reflective pool parking area is brightened which connecting directly to the lobby (Tanyeli, 2002). In addition, shining light of the entrance reflects from the pool that is located on the front courtyard. Design expresses the physical existence. (Roginska-Niesluchowska,2016)

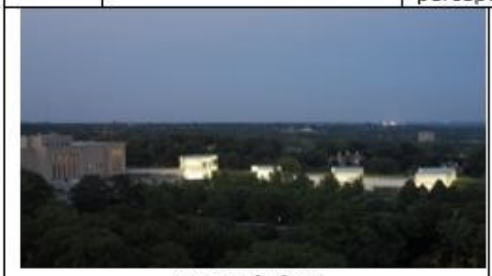
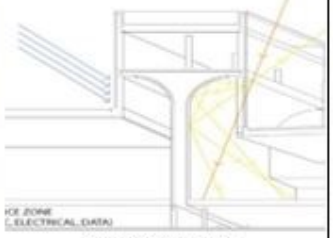
***Effect of Light on Sustainability:*** New structures has a sustainable concept, in which sculpture garden continues on the roof of galleries creating sculpture courts and also creates highly insulated green roofs to control rains (Ryan,2008).

In front of glass lenses, with the thought of lighting and ventilation a structure is designed. Curved lower surfaces reflect light on the galleries, hanger system contains both glasses and ventilation channels. Double glass gaps of the lenses, stores the air that is heated by the dayligt and uses for the heating of the building on the winter season, for summer seasons the air is released outside. Optimum light levels for any art and media corporation and seasonal flexibility needs are achieved by computer-controlled screens and half transparent insulated materials that are placed on the glass gaps (Tanyeli, 2002; Ryan, 2008).

***Form-Space Perception by the Effect of Light:*** Nelson Atkins Art Museum's five additional lenses creates very lively interaction between architecture and landscape with half transparency, opaqueness, tranquility, and energy. Half transparent multi layered glass levels of the lenses sometimes materialize the light like a block of ice, collects and

distributes them. During the day, galleries receive the light in different ways, on nights sculpture garden brightens with its own lights (URL-5). Holl combines the architecture with landscaping to create the experimental architectural form. "Experience", appears when people move inside space and time and once their perception changes. New additional structure combines with sculpture garden and enriches the experience of the people (Glassfabrik Lamberts, 2007).
Transits of the museums do not overlap and placed in a way to see each other. Due to natural light, spaces are designed to allow different perspectives. Thanks to this, inside the space, different perspectives and experiences will occur (Çopur, 2018).

**Table.2.** Nelson Atkins Art Museum Daylight Properties (Ryan,2008; URL-4)

<table>
<tr><td colspan="4">Nelson Atkins Art Museum and Panoramic View</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="3">Principals of Daylight Usage</td><td>Usage of Daylight</td><td>Light is used indirectly inside the space symbolically.</td><td rowspan="2"><br>Views of Plans</td></tr>
<tr><td>Effect of Light on Sustainability</td><td>Light that is heated by the daylight is stored to heat the building on winter and released on summer.</td></tr>
<tr><td>Form-Space Perception by the Effect of Light</td><td>Half transparent glass layers of the structure receive light in different angles to create interactions on the perception of the space.</td><td rowspan="2"><br>Floor Plan</td></tr>
<tr><td colspan="2"><br>General View</td><td><br>Daylight Detail</td></tr>
<tr><td colspan="3"><br>Natural Lighting Details</td><td><br>Section</td></tr>
</table>

### 3.4. Nancy and Rich Kinder Museum

In 2011, Steven Holl Architects crew compete on the Renovation and Development Project and succeed to construct Nancy and Rich Kinder Building in 2020 in Houston. In the first stage of the competition, building is seen to be the part of the campus for Houston Fine Art Museum (Figure 5). The important factor is, moving the park areas underground and creating a pedestrian friendly area and for this concept, empty areas are created for outdoor gathering places. Structure

is placed in the center of important architectural symbols such as Caroline Wiess Law Building, Audrey Jones Beck Building, Cullen Sculpture Garden, Glassel Art School (Yukyung, 2021).



**Figure 5.** Nancy and Rich Kinder Museum General View (Url-7)

Steven Holl Architects leads the project which was the biggest North America cultural design. Seven garden that exist on the project, are on the entrance of the structure. From entering in any entrance, atrium that includes monumental, curved stairs is reached. Galleries on the structure constantly provides circulation on the space. Galleries creates openness feeling, in which circulation is intuitional. Gardens on the museum provides porousness throughout the structure. Old and new structures are combined to each other on horizontal level (Sitz, 2020), (Figure 6).

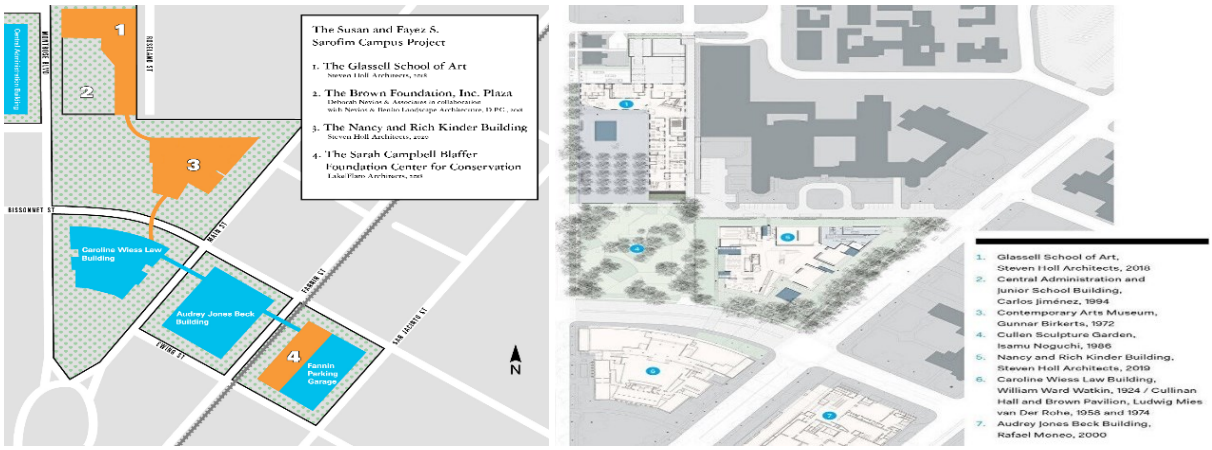



**Figure 6.** Nancy and Rich Kinder Museum Location (Url-7, Url-8)

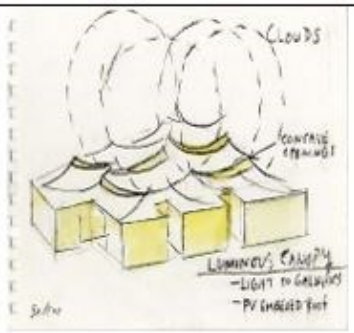
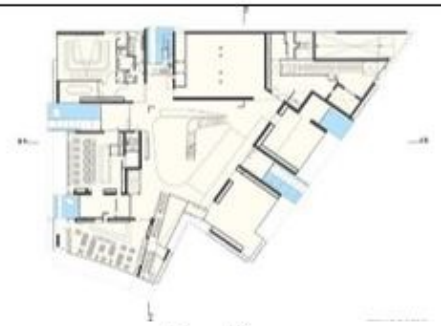
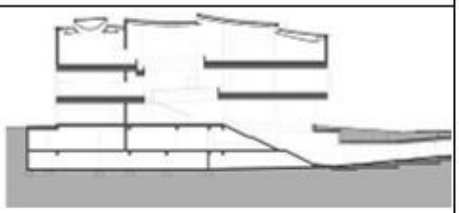
***Nancy and Rich Kinder Museum's daylight usage principals:***

***Usage of Daylight:*** Light coming from the galleries on third floor of the structure, provides %16-20 light on the art area walls. Daylight measurements, achieves lighting and natural light integration. Exhibition of the art in a confident way is achieved by designing paneled roof system which consist of I shaped, curved, light steel beams which receive enough light. Light is collected on a canopy roof and received with a delicate measure and balance by the concave curves that are inspired by cloud circles and brings the geometry of the roof down. Lower sections of the curved ceiling collect the light and becomes the reflector for light (URL-6), (Table 3). Daylight is not mechanical and repetitive and has a fluency that shows the dynamism of the gallery. Curved light beams provides unity with flora and organic form of the water (Gibson, 2020).

***Effect of Light on Sustainability:*** Half transparent and permanent front of the museum creates a confined light perception. While distributing the light inside also creates a shiny flash outside. White, curved surface of the front behaves like a curtain against threes on direct light and with indirect light reflection of green view and blue sky is achieved. Also pipes on the front provides ventilation. Ventilation on the front helps hot air to elevate passively and leave from the concrete walls by the glass tubes. Heat gain creates cold jacket effect around the structure (Yukyung, 2021).

***Form-Space Perception by the Effect of Light:*** Structure is placed on high elevation and on the circulation way. Thanks to galleries constant circulation areas are created for visitors. In any way of the entrance to the structure, monumental, curved stairs cover the three floored area and reaches to the atrium. So, circulation is felt intuitionally (Yukyung, 2021; Sitz, 2020).

**Table.3** Nancy and Rich Kinder Museum Daylight Properties (Url-6, Url-7)

<table>
<tr><td colspan="4">Nancy ve Rich Kinder Museum and Panoramic View<br></td></tr>
<tr><td rowspan="3">Principals of Daylight Usage</td><td>Usage of Daylight</td><td>Light is used indirectly and symbolically inside the space.</td><td rowspan="3"><br>Views of Plans</td></tr>
<tr><td>Effect of Light on Sustainability</td><td>Glass tubes on the front reduces the sunlight energy by %70.</td></tr>
<tr><td>Form-Space Perception by the Effect of Light</td><td>Light from galleries and canopies achieves constant and intuitional circulation.</td></tr>
<tr><td colspan="2"><br>General View</td><td><br>Daylight Details</td><td><br>Floor Plan</td></tr>
<tr><td colspan="2"><br>Natural Lighting Details</td><td><br>Section</td></tr>
</table>

**4. Findings**

In this study, the way of using the daylight, effect of light on sustainability and perception of light on form and space are chosen for the analysis principals. Example structures are investigated based on these factors.

Sun that gives life to all organisms is the natural light source that keeps the continuity of all vital functions. When people designed the living spaces throughout the history, gaps are opened for functional needs. Designers who use natural daylight on their museum designs, highlight the 'effect and experience' subjects which is a functional property of the museums. Museum structures, beside every other function tries to leave positive-negative traces on minds of people and aims to give unique experience. In museum structures, understanding of shown works and achieving the emotional effects of space on the people requires the use of natural and artificial light. Natural light brings diversity of shadows on the works and creates dynamism while lighting the exhibit spaces homogenously. While form is configured, light is an effecting factor functionally and visually. Primary factor to understand the form and space is light. Light and shadows are effective to the movement of the space.

Steven Holl uses light as a material in his designs. Any spatial experience is affected by daylight so light is very crucial. Light defines the form and space and brings poetic meaning to the space. Holl filters the light according to the function he designs for the space, creates soft atmospheres, and makes material choice according to light. To use every experience of the effect of light he uses water objects. While he uses spatial effect of the reflected light from the water, also breaks the stationary and heavy effect of the mass. Fluency between spaces is achieved by light and circulation is provided intuitionally inside the space.

Kiasma Modern Art Museum, Nelson Atkins Art Museum and Nancy and Rich Kinder Museum are analyzed in terms of the way of using the daylight, the effect of light on sustainability and form-space perception by the effects of light. Findings are represented on Table.4.

According to this, based on the need and the location of the space daylight is used in variety of different ways. For the places where low level of daylight is presented, gaps from the roof and other surfaces are used to receive daylight continuously and used to contribute to the sustainability by helping the heating and ventilation of the space. Holl thinks form and space perception is based on the experience and creates the circulation of the people by the direction of the light. Over the years, in his changing designs, besides the effect of light also spatial fluency achieves the intuitional orientation inside the space. While exemplary structures are placed in the center of the important architectural buildings, thanks to the variety usage of the lights these structures become the known factors for the people and contribute to the touristic publicity of the areas.

**Table.4** Daylight Usage Principles of Kiasma Museum of Contemporary Art, Nelson Atkins Museum of Art, and Nancy and Rich Kinder Museum

| | Steven Holl's Principals on the Usage of Daylight | | | | | |
|---|---|---|---|---|---|---|
| MUSEUMS | *Usage of Daylight* | | *Effects of Daylight on Sustainability* | | *Form-Space Perception by the Effect of Light* | |
| | Symbolical | Functional | Heating-Ventilation Usage | Continuous Usage of Daylight | Orientation by the Effect of Light | Intuitional Circulation |
| Kiasma Modern Art Museum | ✓ | ✓ | - | ✓ | ✓ | - |
| Nelson Atkins Art Museum | ✓ | - | ✓ | - | ✓ | - |
| Nancy ve Rich Kinder Museum | ✓ | - | ✓ | ✓ | ✓ | ✓ |

**5. Results**

Steven Holl gives a lot of importance to the light in his designs and sees the light as a defining factor of the space. Generally, he uses the natural light in the most influential ways and creates fluent spaces that gains meaning with the light. Holl, creates different and unique experiences in every hour of the day. Holl uses natural light as a design object and uses volume with a light to create architectural spaces to give unique properties of his designs. Holl achieves different meanings in the space with the form, angle, transparency, and the reflection of light.

Holl uses light for different purposes during the day and during the night for the perception of the space. He uses minimal lighting to achieve the wanted effect inside the space. Light and shadows causes the orientation inside the space. These light and shadows also bring dynamism, liveliness, and movement to the design.

As a result, Kiasma Modern Art Museum, Nelson Atkins Art Museum and Nancy and Rich Kinder Museum analysis shows that Holl uses light both horizontally and vertically on the form and the space to create soft and colorful ambientes. Direct daylight is used functionally while indirect light is used symbolically. Holl generally uses light symbolically for museum designs. Throughout the architectural process importance of the light for Holl does not change and becomes the most important material for designs.

Daylight other than the purpose lighting also used for ventilation, heating, and cooling systems as well. Daylight is used for heating on winter, while summer it is used for cooling. Gaps on the front of the structures creates natural ventilation and helps to bring light to the landscape corridors. While using light actively inside the space, contributes positively to the sustainability of the building. In museums, daylight is generally used for the saving on the energy consumption.

Architecture achieved by the form, space and light affects the daily experiences. Holl gives importance to the phenomenological experiences and uses light to achieve the feeling of depth of space, perception of the form and circulation. For this purpose, light is used poetically. Using light based on the movements, spatial perception is achieved. Holl designs his structures based on location and the angle of light affects the design.

Three examples for the analysis shows that daylight can be used for museum designs. When daylight is received correctly on the space, it brings creative effects to the works shown in the exhibits. Daylight received directly or indirectly makes people feel enlightenment and different experiences. Also, ventilation and heating, continuous lighting are useful properties to help the sustainability of the building. With the effect of light, inside the space is perceived with different experiences and intuitional circulation is achieved.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# A Comparison of Energy and Daylighting Performances of Different Window Glazing Types Used in the Traditional Harput House

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**Abstract**
A review of the history of glass that dates back to the mid-2000 BC pursuant to the archaeological data suggests that the effects of the thermophysical properties of window glass on building energy performance could have been understood only over time. Today, the optimum combinations of thermophysical parameters help significantly reduce the energy demand of the buildings. Furthermore, the energy sustainability is also achieved by increasing building energy efficiency during the early design phase, using building simulation tools. The present study was aimed to comprehensively review the improvements in glazing technologies from past to present. Furthermore, the energy and daylighting performances of the retrofitted traditional Harput house in Turkey were analyzed using a building simulation tool. The results indicated that the use of retrofit measure, i.e., the triple-glazed window with low-e coating filled with Argon gas combined with daylighting control system improved the annual primary energy performance of the building in question located in a cold climatic region of Turkey by %8.20. In addition, it was found that the illuminance of indoors increased by means of higher visible transmittance ensured by the retrofit measure.
**Keywords:** Building Energy Performance; Daylighting; Energy Performance Simulation; Energy Retrofit; Energy Sustainability; Traditional Building; Window Glazing.

## 1. Introduction

The current archeological data suggests that the use of glass in architecture began with the mid-2000's BC. Using the mosaic technique, the glass pieces were applied as a coating on the columns or walls of palatial or significant structures alike throughout the said period. Functional uses of glass in architecture, however, started with the mounting of glazing onto the windows. The earliest use of the window panes dates back to Caerleon (in Wales) [1]. In Anatolia, many finds of window glass in the forms of glass panes and stained-glass fragments were unearthed from the structures belonging to the Roman and Byzantine period. Those data will surely be expanded by future research and studies. This paper is limited to a brief introduction on window glazing in the Ottoman structures.

Natural lighting of the earliest Turkish buildings in Anatolia were provided by means of slit windows or small-scaled oculi (pl. oculus) with the roofs hosting either oculus or lanterns [2]. There were traces of oculus in the early 13th century single-floor Seljuk buildings, however it was not clear whether the façades included windows [3]. Only after the mid-13th century the windows became prominent on the façades, which prevailed thereafter with lower story windows having been provided direct access to the exteriors [4]. As the windows needed temporary covers due to the climatic conditions, upper windows were incorporated to the buildings with an aim to provide natural light and reduce the load of the upper walls. Called as skylights, those windows was manufactured in tandem form with inner and outer windows since they were fixed and placed at high levels. Covering the windows on the exterior, the lattices with or without transparent glass were called "dışlık" (the exterior), while wooden or gypsum windows with glass, thin hide, waxed paper, or parchments that stretched between the frames were called "içlik" (the interior). Those windows with gypsum frames with colored glass panes attached thereto were called as "revzen-i menkuş", or stained glass [5]. Today, the authenticity of extant Ottoman ornamental glasses is subject to ongoing debate. However, revzens from the tombs of Sultan Mustafa and Cem in Bursa were suggested to have received "little restoration" that they were authentic, and thus proved the existence of interior windows during the 15th century [6].

There was a significant development and increase in production of Turkish glass crafts during the 15th century. This may be associated with the institutionalization of glass-making under the patronage of the Ottoman state, where the "camgeran" (glass makers) of the glassmakers' guild were considered "Ehl-i Hiref", i.e., artisans (Figure 1a).

Surnâme-i Hümayun, an illustrated manuscript from Topkapı Palace Library, prepared in commemoration of the circumcision ceremony held for Şehzade Mehmed, son of Sultan Murad III (Inv. No. TSH Hazine 1344), depicted the procession of entertainers and guilds of craftsmen and tradesmen held at Atmeydanı/Hippodrome, which also included the miniatures of glassmakers. One of the miniatures represents the glassmakers in a cart, while another one shows their procession with workshops (Figure 1b). Most likely drawn in 1582-84, the miniatures present gypsum frames similar to those we see on contemporary Ottoman buildings today, indicating their importance as a source for future restorations. From 17th century onwards, the utilization of revzen became popular for the purposes

of civic architecture. By late 17th century, however, the Western large glass pane products made an impact on Ottoman architecture, the examples of which can be seen on Baghdad Kiosk and Revan Kiosk along with their depictions in the miniatures of the period. Due to changes in the traditional architecture, the ornamented upper floor windows started to disappear following the mid-19th century.



(a) (b)

**Figure 1:** *Surnâme-i Hümayun* (circumcision ceremony from the reign of Murad III), glassmakers and traders as a part of the parade walking through in front of Ibrahim Pasha Palace [7].

The designers should consider a number of design possibilities during the early stages of building design and have to make the majority of relevant decisions for the entire process. Choosing the appropriate window area and materials is a part of early design stage decisions, which are hard to change later. For example, large windows will allow more daylight into the room and improve the indoor visual comfort, but they may be associated with excessive heat gain or loss as well, which would affect the indoor thermal environment and energy consumption. Furthermore, window design involves multiple parameters, including the window to wall ratio (WWR), glazing, and filling gas of the window material. Changing one parameter could potentially lead to the fact that important interactive effects may be unnoticed. Window design is therefore typically a multi-factor and multi objective optimization problem. It is important to simultaneously optimize the window parameters during the early stages of building design and find a balance between the energy consumption, indoor thermal environment, and visual performance.

Thalfeldt et al. [8] optimized the facade parameters, including the window type, wall insulation, WWR, and shading devices for the best energy performance. Su and Zhang [9] focused on the environmental impact of a typical office building to determine a suited limited value for the WWR for different orientations and window materials. Ma et al. [10, 11] studied the relationship in thermally autonomous buildings between maximum WWRs and the ambient temperature amplitudes with different thermal envelope resistances. Lee et al. [12] optimized the annual heating, cooling, and lighting energy consumption in five typical climatic zones in Asian regions upon an analysis of the window properties, including the WWR, U-value, solar heat gain coefficient (SHGC), and visible transmittance. Hiyama and Wen [13] proposed a rapid response surface creation method to optimize the window geometry using dynamic daylighting and energy simulations. There has been certain focus on the daylighting performance and potential energy savings. Most studies focused on performance assessment and prediction. The optimization of the daylighting performance and energy savings were implemented separately. Yu et al. [14] presented the metrics and methods for indoor daylight availability assessment and the estimation methods used for predicting potential energy savings from daylight. Ghisi [15] presented a method to predict the potential energy savings for lighting using an ideal window area concept for effective daylight integration with an artificial lighting system. Mangkuto et al. [16] investigated the influence of the WWR, wall reflectance, and window orientation on various daylight metrics and the lighting energy demand in simple buildings located in the tropical climate. Krarti et al. [17] proposed a simplified method to estimate the energy savings of artificial lighting by investigating several combinations of building geometries, window opening sizes, and glazing types for four geographical locations. A generalized window energy rating system (WERS) for typical office buildings was presented by Tian et al. [18] and the energy effects of window parameters were analyzed and indicated using the localized WERS. Recently, several studies focused on the window design with simultaneous optimization of the energy and daylighting performance [19]. However, the research is far from being deemed as adequate [20] and the optimization process is very complex without consideration of the interaction of the window parameters. Ochoa et al. [21] used a graphical optimization method to determine the

window size, when simultaneously optimizing the low-energy consumption and high visual comfort. Vanhoutteghem et al. [22] determined the appropriate window solution by evaluating the effect of the window design parameters on the heating demand, daylighting, and thermal environment using a contour plot.

**2. Material and Methods**

The present study aimed is to investigate the energy and daylighting performance of the traditional Turkish houses, which were designed as compatible with the climatic conditions, using a building energy simulation tool. It was also aimed upon an analysis of the existing performance of house to improve both the energy, and daylighting performance using window glazing designed by contemporary glazing technologies replacing the existing glazing.

For the purposes of the study, the Şefik Gül House located in Harput within the Elazığ Provincial borders in Turkey was chosen as the case-study building and the energy performance of this building was modelled using the DesignBuilder simulation tool, featuring a detailed dynamic calculation methodology. Accordingly, different kinds of window glazing were tested for Şefik Gül House considering the thermophysical properties of the selected glazing materials with an aim to decrease the annual primary energy demand and increase the level illuminance (light level) on the spaces in the house.

The numerical values of energy demand of the building are multiplied by the energy conversion factors specified for each country in order to calculate the primary energy demand of a building. The energy conversion factors as specified by the Turkish Ministry of Environment and Urbanization were used for the purposes of the present study; where, the energy conversion factors were provided by the BEST (Ecological and Sustainable Design in Buildings) Residential Certification Guide [23]. The foregoing guide specified the energy conversion factors for electricity and natural gas for Turkey as 2.36 and 1, respectively. The relevant equations for the calculation of primary energy demand are as follows, where;

$PED_e$ is primary energy demand for electricity (kWh/$m^2$y),

$T_e$ is conversion factor for electricity,

$PED_n$ is primary energy demand for natural gas (kWh/$m^2$y),

$T_n$ is conversion factor for natural gas,

$PED_t$ is total PE consumption (kWh/$m^2$y).

$$PED_e = T_e \times 2.36 \quad (1)$$

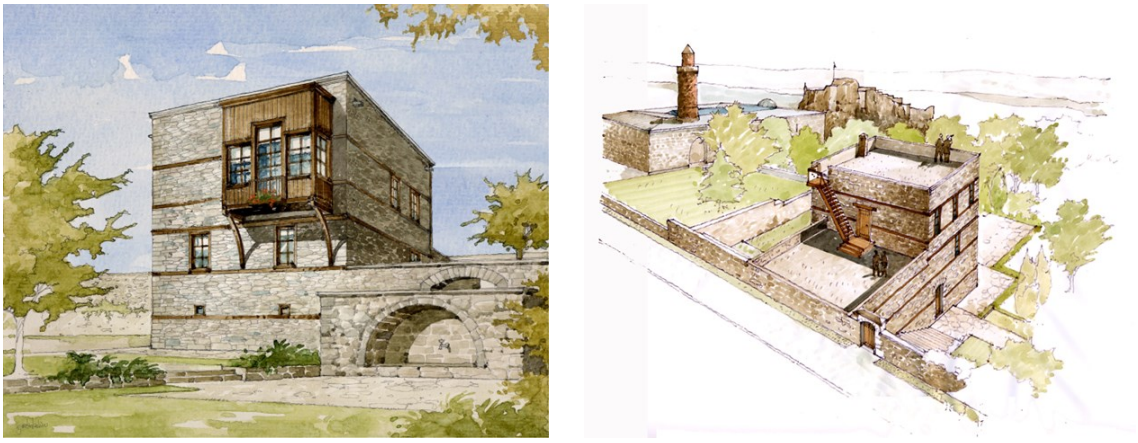
$$PED_n = T_n \times 1 \quad (2)$$

$$PED_t = PED_e + PED_n \quad (3)$$

The DesignBuilder building simulation tool was used to analyze the energy and daylighting performance of the window glazing. The DesignBuilder software is a building simulation tool by a United Kingdom (UK) based developer that can be used with a user-friendly interface to model all kinds of buildings, which performs the energy and daylighting analyzes using the EnergyPlus and Radiance infrastructure, respectively. All these simulation tools were tested by a number of other research studies, which confirmed their accuracy. Furthermore, their calculation methodology is based on a detailed-dynamic methodology stated in EN 13790 [24].

**3. Definition of the Case Study Building**

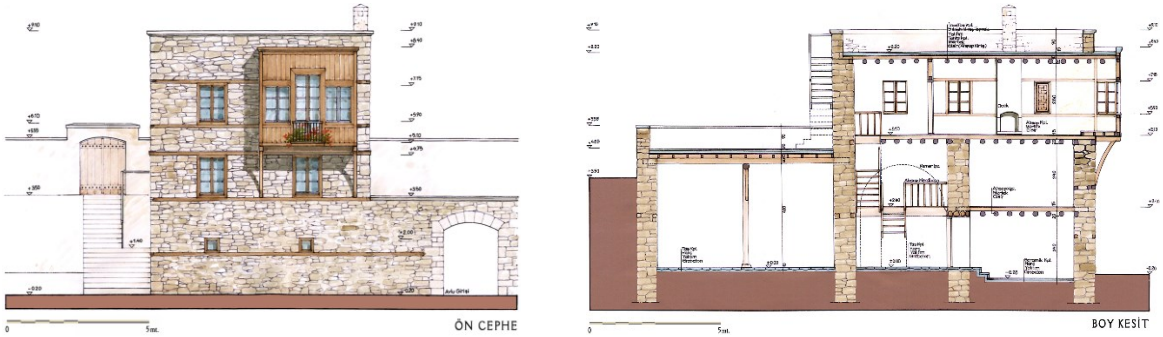
The Elazığ province, which hosts the Şefik Gül House, is located in the cold climatic region of Turkey. The views of the south and north façades of the Şefik Gül House are given in Figure 2. One of the important parameters of designing a building compatible with climate is the windows. In the said region, the windows are designed in a smaller form in order to minimize heat loss, because of a prolonged and colder winter season and a shorter, but hotter summer season.



(a) (b)

**Figure 2:** The view of the south (a) and north (b) façade of the Şefik Gül House (case study building) [25].

The mean dry bulb temperatures of Elazığ for winter and summer seasons are -12°C and 38°C, respectively. Accordingly, the impact of the window glazing to the energy efficiency and daylighting performance of traditional Harput houses were considered in this study. As such, different glazing types utilizing contemporary glazing technologies were tested and the optimum glazing type was specified for the cold climate region of Turkey.
The Şefik Gül House was bought by GÜLSAN AŞ in 2004 and put into service in 2005 as the Harput Şefik Gül House of Culture. Since there is no inscription on the building, the construction date isn't known clearly but it's construction is considered to have started in the first quarter of the XX. century based on a comparison with other existing traditional buildings around Harput [26]. The Şefik Gül House has the characteristics of architectural design features of the traditional Harput houses, and it was built using traditional and organic construction materials. The building, oriented towards the south on the inclined terrain, was built with a flat roof and in three floors as seen in Figure 3.




(a) (b)

**Figure 3:** The front (a) and sectional (b) view of case study building [25].

Upon a review of the floor plans provided in Figure 4, the thickness of external walls is remarkable. The Elazığ province is located in the cold climatic region of Turkey, so the envelope of traditional building was designed to minimize the heat transfer to provide indoors energy conservation.

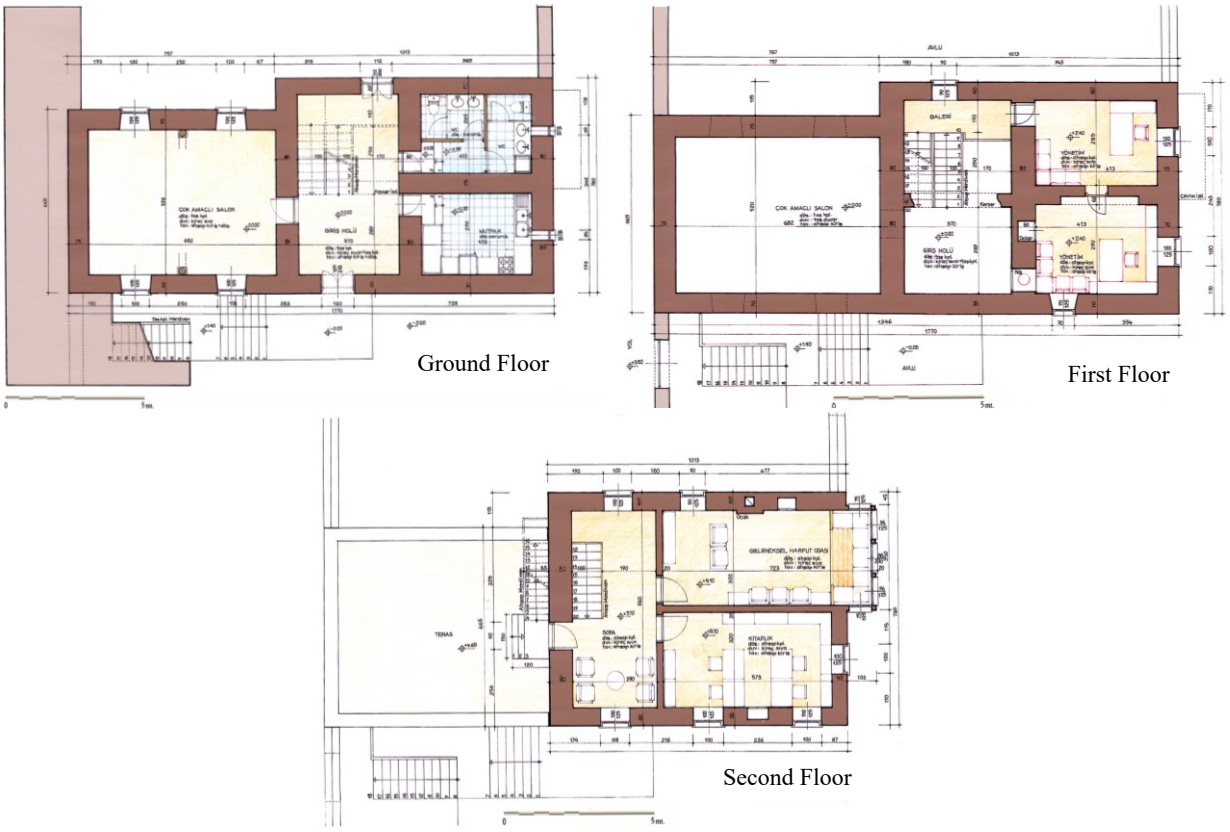



**Figure 4:** The Floor plans of case study building [25].

The construction materials of case study building with the thermophysical properties of the opaque and transparent materials are given in Table 1. The U–value (or factor) is the overall heat transfer coefficient for a wall, floor, ceiling, door, and glazing system. It is defined as the rate at which heat is transmitted through it, per unit surface area per unit temperature difference between its two sides. It is measured in watts per $m^2$ per degree Kelvin ($W/m^2K$) [27]. The lower the U-value, the lower the amount of the heat transferred by the construction material. The solar heat gain coefficient (SHGC) is given as a number between 0 and 1. It represents the portion of heat addition due to the solar radiation transmitted directly by fenestration, added to the portion that is absorbed and re-emitted to the inside of the building by the fenestration itself [28]. The lower the SHGC, the more effective the glass in blocking solar heat gains. Visible light, called the visible spectrum, is that portion of the electromagnetic spectrum having wavelengths from about 380 nm (nanometers or billionths of a meter) to 780 nm. Light of different wavelengths is perceived as having different colors [29]. The visible light transmission (T-vis) is given as a number between 0 and 1. The higher the T-vis, the higher the proportion of visible light transmitted to indoor. The U-value of the window glazing is quite high compared to the opaque materials generally, upon a review of the thermophysical properties of the Şefik Gül House given in Table 1. The U-value of construction materials should comply with the reference values prescribed in the Turkish Heat Insulation Requirements (TS 825). However, it was concluded that the U-value of window glazing in the Şefik Gül House was higher than 2.4 $W/m^2K$, which was specified for window glazing in TS825.

**Table 1:** The thermophysical properties of building construction materials in case study building [26].

| Building Envelope | Thickness (m) | U-value ($W/m^2K$) | SHGC (%) | T-vis (%) |
|---|---|---|---|---|
| Exterior Wall | 0.070 | 1.26 | - | - |
| Ground Floor (Stone Coating) | 0.042 | 2.143 | - | - |
| Ground Floor (Ceramic Coating) | 0.025 | 3.057 | - | - |
| Ground Floor (Timber Coating) | 0.015 | 0.538 | - | - |
| Ceiling | 0.020 | 0.01 | - | - |
| Window | - | 4.975 | 0.321 | 0.201 |
| Door | - | 2,381 | - | - |

## 4. Energy Performance and Daylight Modelling of the Case Study Building

The energy performance of the Şefik Gül House was modelled using the DesignBuilder simulation tool. Typical Meteorological Year (TMY) data, ie., the weather data source for the Elazığ province, were included in building performance calculation to analyze the building's response to outdoor conditions during the year. The passive system model views of Şefik Gül House are provided in Figure 5.

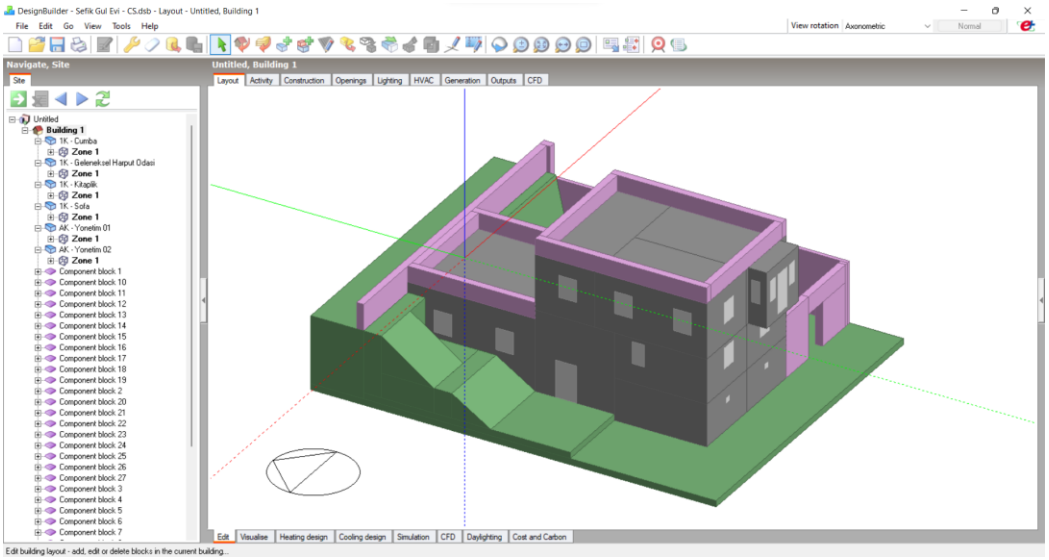


**Figure 5:** The energy model view of architectural system for the Şefik Gül House captured by DesignBuilder

In the present study, the Şefik Gül House was considered as a residence building, so the building energy model was constituted on the basis of the heat loads and setpoint temperatures of residence buildings stated in ASHRAE 90.1 standardization. To perform the energy analyzes, the heating, cooling and ventilation design features of the building should be entered to the simulation tool. The design features of the case study building are seen in Table 2, below. The heat given off by people, lighting systems, and household equipment represent the internal heat gain of a building. The internal gain significantly impacts the energy demand of the building. In order to calculate the annual heating and cooling energy demand of a building by including the internal gains, the setpoint temperatures of building zones are required. All these building parameters were met considering the data stated in ASHRAE 90.1 standardization.

**Table 2:** The design features of the case study building.

| | Zone | Area ($m^2$) | People ($m^2$/person) | Lighting ($W/m^2$) | Equipment ($W/m^2$) | Heating Setpoint Temperature (°C) | Cooling Setpoint Temperature (°C) | Orientation | Ventilation |
|---|---|---|---|---|---|---|---|---|---|
| Ground Floor | Saloon | 31.43 | 59.11 | 3.75 | 3.06 | 21 | 24 | West-East | Natural |
| | Corridor | 23.52 | 64.50 | 2.50 | 1.57 | 21 | 24 | West-East | Natural |
| | Kitchen | 11.42 | 42.19 | 7.50 | 30.28 | 21 | 24 | South | Natural |
| | WC | 11.22 | 41.12 | 2.50 | 1.61 | 21 | 24 | South | Natural |
| First Floor | Bedroom 01 | 11.87 | 43.59 | 2.50 | 3.58 | 21 | 24 | South | Natural |
| | Bedroom 02 | 11.67 | 43.59 | 2.50 | 3.58 | 21 | 24 | South | Natural |
| Second Floor | Saloon 01 | 15.75 | 59.11 | 3.75 | 3.06 | 21 | 24 | South | Natural |
| | Saloon + Bay Window | 21.52 | 59.11 | 3.75 | 3.06 | 21 | 24 | South | Natural |
| | Saloon 02 | 16.50 | 59.11 | 3.75 | 3.06 | 21 | 24 | West-East | Natural |
| **Total Zone Area** | | **154.89** | | | | | | | |

## 5. Energy Retrofits

In the present study, certain energy retrofit measures were applied considering the thermophysical features of the window glazing with an aim to reduce the lighting energy consumption of the building and increase the illuminance

of spaces. Each window glazing type, which was tested for its impact on the building energy performance, was called a single measure for the purposes of the study. The thermophysical features of the glazing type of the case study building (CS) and the single measures (SM) are shown in Table 3, below.

**Table 3:** The single measures applied to the case study building.

| Single Measures | Glazing Type* | U-value ($W/m^2K$) | SHGC (%) | T-vis (%) |
|---|---|---|---|---|
| **CS** | 3 mm Clear Glass | 4.975 | 0.321 | 0.201 |
| **SM 01** | Vertical Glazing** | 2.27 | 0.45 | 0.56 |
| **SM 02** | Double Clear 3/6/3 mm Air | 3.159 | 0.762 | 0.812 |
| **SM 03** | Double Clear 5/13/5 mm Arg | 2.526 | 0.818 | 0.834 |
| **SM 04** | Double Clear 5/13/5 mm Air | 2.682 | 0.818 | 0.834 |
| **SM 05** | Double Elec Ref Bleached 6/13/6 mm Arg | 1.493 | 0.643 | 0.727 |
| **SM 06** | Double LoE Elec Ref Bleached 6/13/6 mm Arg | 1.323 | 0.428 | 0.634 |
| **SM 07** | Quadruple LoE Films (88) 3/8/3/8/3 mm Krypton | 0.781 | 0.466 | 0.624 |
| **SM 08** | Triple LoE (e2=e5=.1) Clr 3/13/3/13/3 mm Arg | 0.780 | 0.474 | 0.661 |

* All the glazing types are designed using wooden window frames compatible with traditional Harput houses.
** Compatible with the reference U-value for the windows as prescribed in the TS825 Standardization

In the present study, the energy retrofit packages were applied by combining each single measure with daylighting control systems as seen in Table 4. Thus, it was aimed to reduce the annual lighting energy consumption of the building, when there were adequate light levels in the house spaces during the year. The daylight-controlled lighting systems were preferred to avoid lighting overuse. The artificial lighting systems were dimmed or switched off, when sufficient light levels were achieved on the working plane or the space was unoccupied, using an integrated lighting system (daylight and artificial lighting system). Benefits of daylighting control systems:

- Save money spent on electrical energy
- Automated control of lights
- Health benefits of correct lighting

**Table 4:** The packages applied to the case study building.

| Packages | |
|---|---|
| **P 01** | CS + Daylighting Control System |
| **P 02** | SM 01 + Daylighting Control System |
| **P 03** | SM 02 + Daylighting Control System |
| **P 04** | SM 03 + Daylighting Control System |
| **P 05** | SM 04 + Daylighting Control System |
| **P 06** | SM 05 + Daylighting Control System |
| **P 07** | SM 06 + Daylighting Control System |
| **P 08** | SM 07 + Daylighting Control System |
| **P 09** | SM 08 + Daylighting Control System |

**6. Results**

Upon the energy efficiency analysis, the annual primary energy demands of the existing building and the retrofitted buildings were obtained. Figure 6 indicates the energy performance results by total annual primary energy demand of the case study building and upon building retrofits.

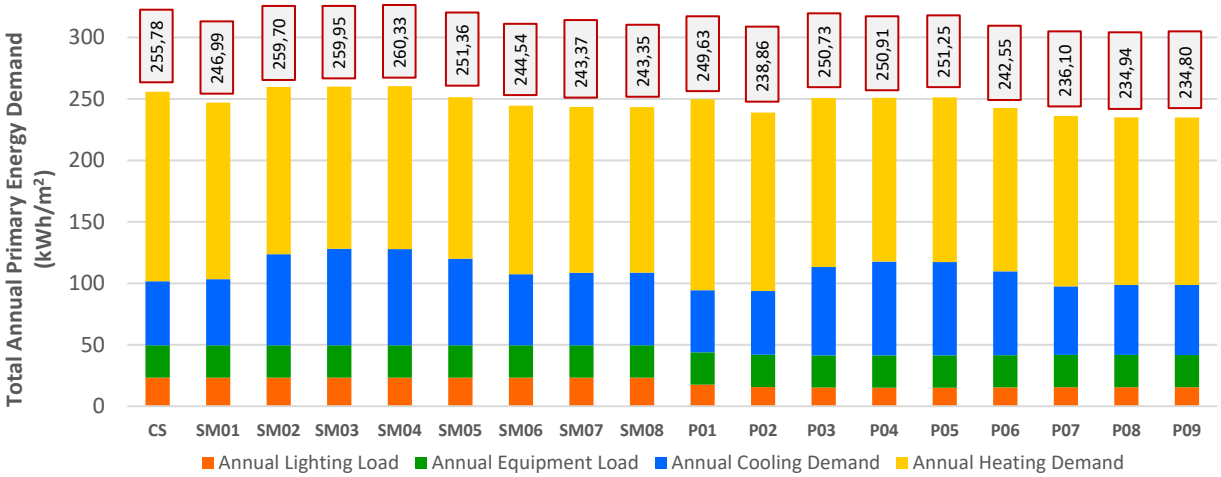



**Figure 6:** The total annual primary energy demand of the case study building and retrofitted building.

As regards the daylighting performances, the light levels of the saloons and the kitchen in the building at 12 pm as of 21th June and 21th December which are longest day and longest night respectively, were measured.

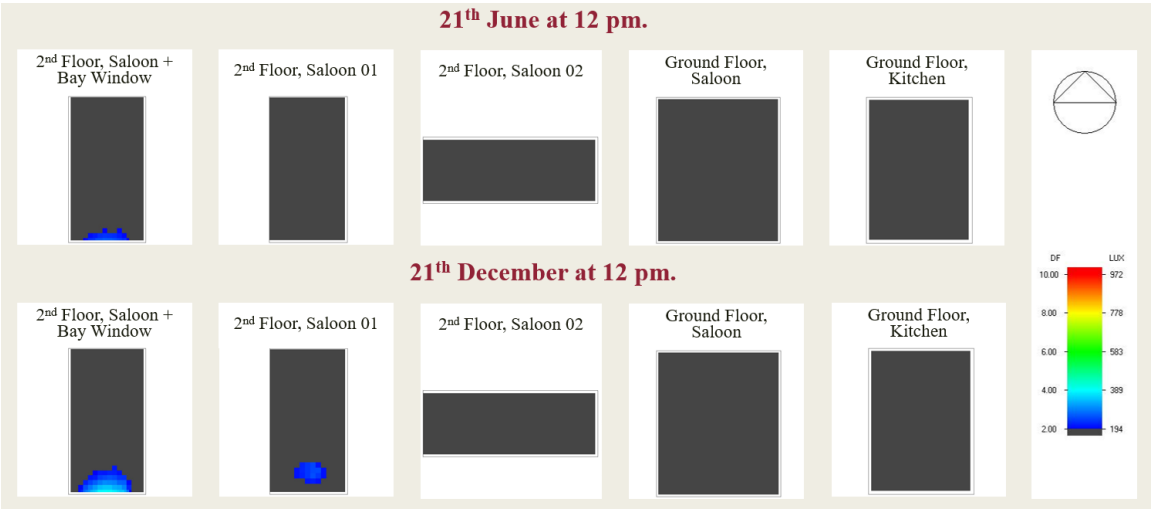



**Figure 7:** The daylighting performance of the case study building at 12 pm in 21th June and 12 pm in 21th December.

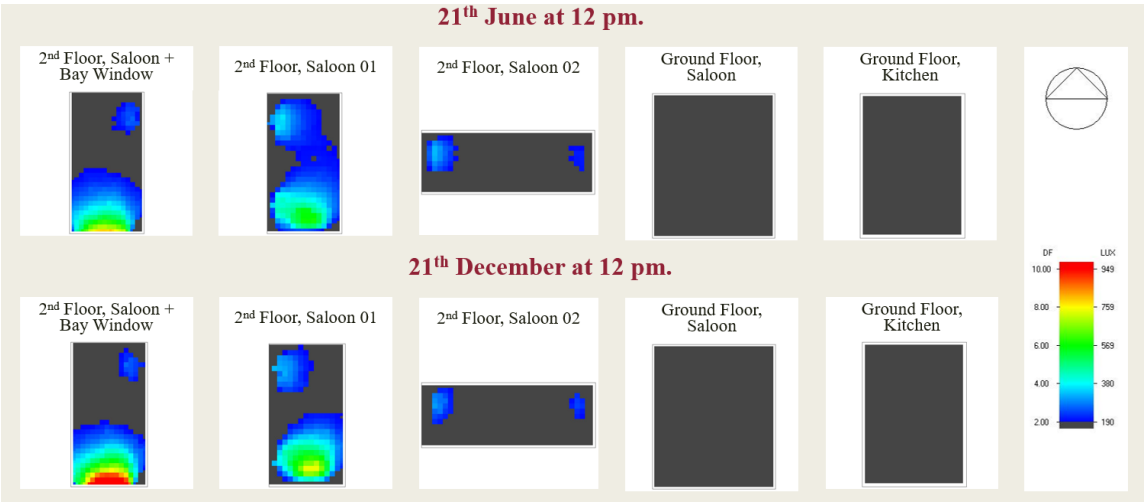



**Figure 8:** The daylighting performance of the SM 01 at 12 pm in 21th June and 12 pm in 21th December.

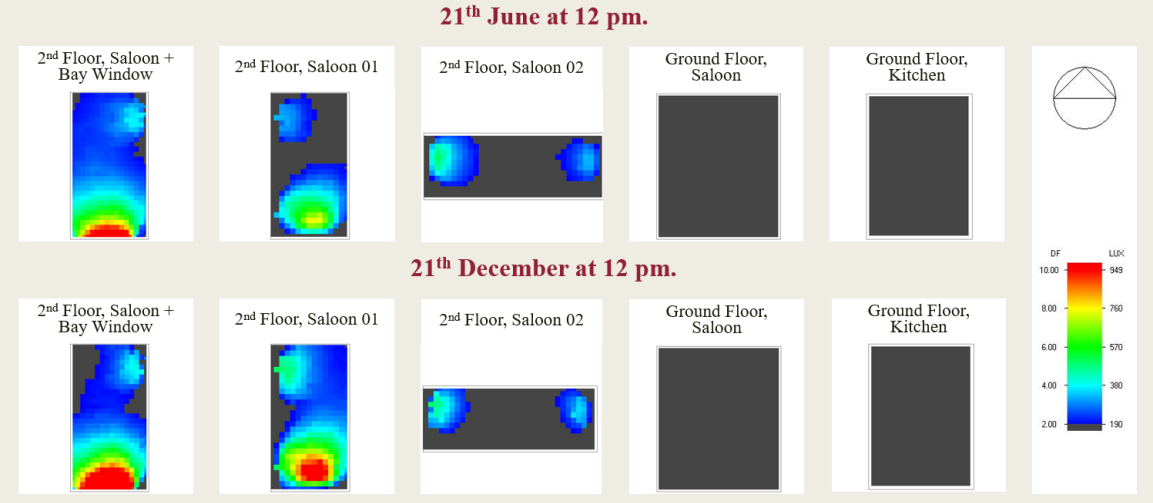



**Figure 9:** The daylighting performance of the SM 02 at 12 pm in 21th June and 12 pm in 21th December.

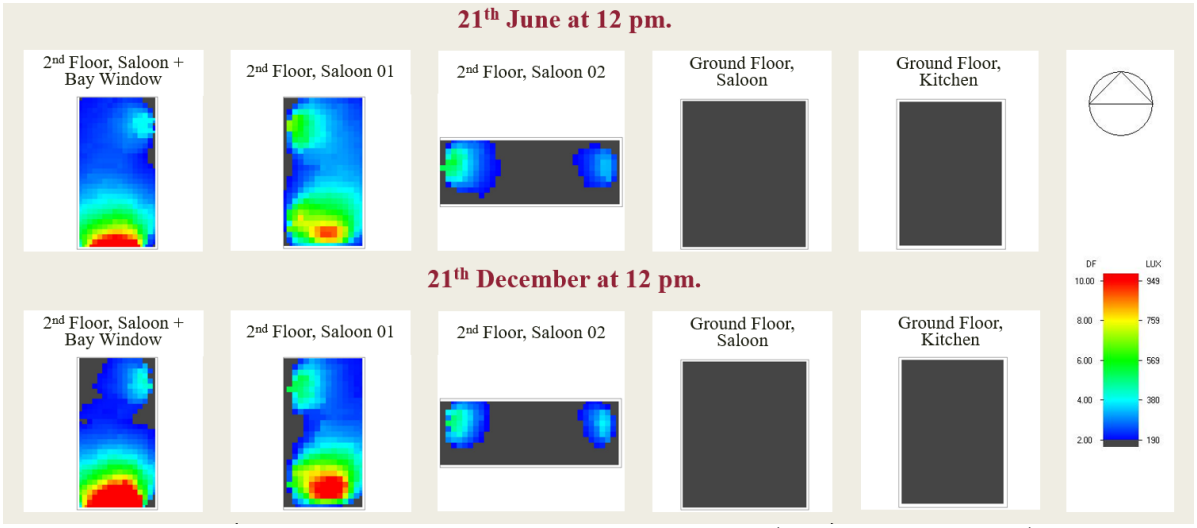



**Figure 10:** The daylighting performance of the SM 03 at 12 pm in 21th June and 12 pm in 21th December.

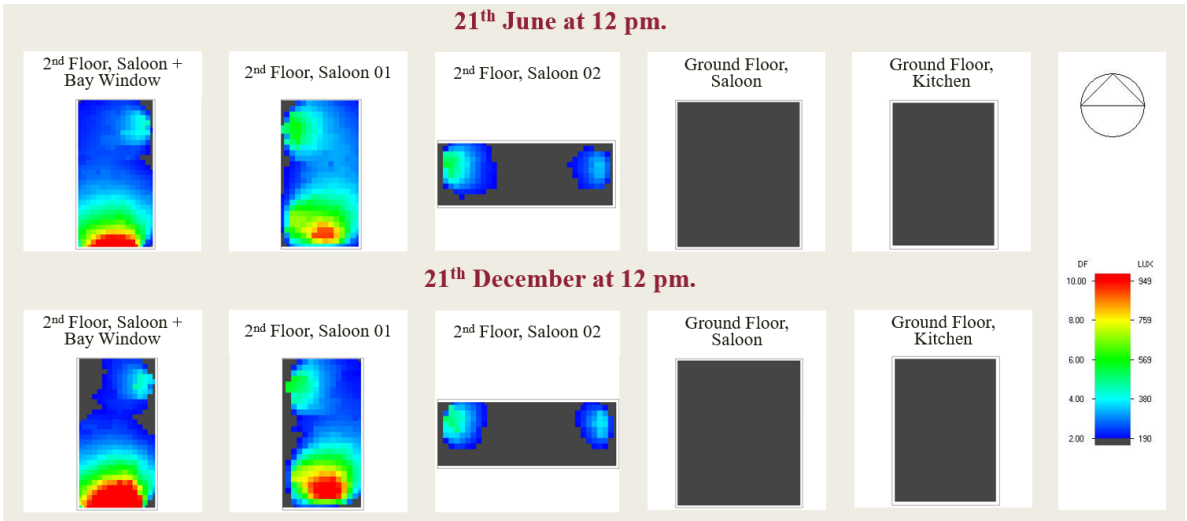



**Figure 11:** The daylighting performance of the SM 04 at 12 pm in 21th June and 12 pm in 21th December.

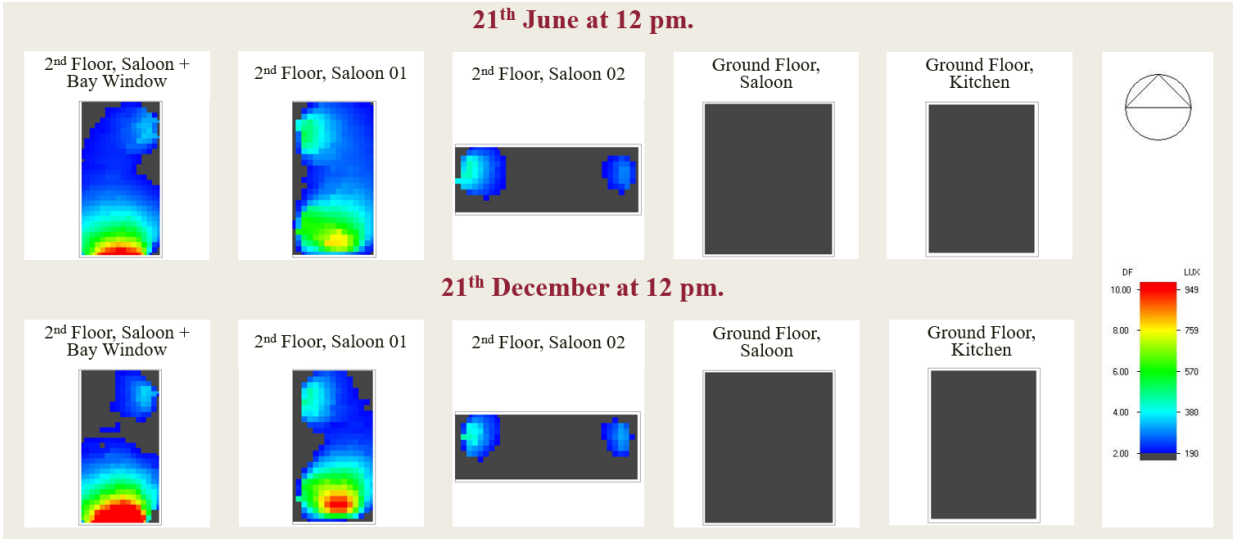



**Figure 12:** The daylighting performance of the SM 05 at 12 pm in 21th June and 12 pm in 21th December.

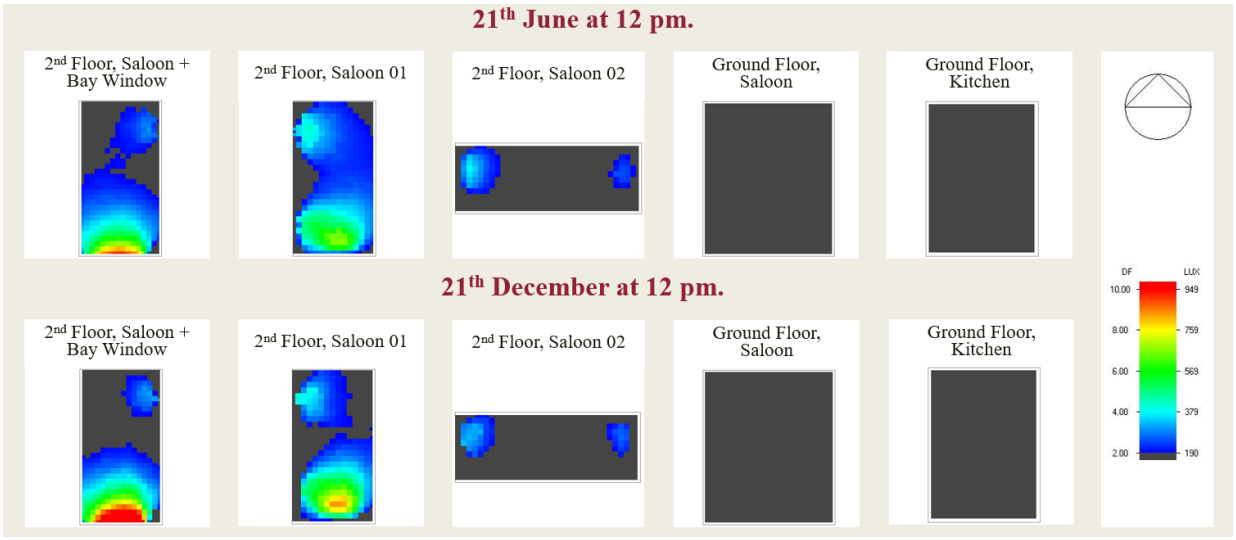



**Figure 13:** The daylighting performance of the SM 06 at 12 pm in 21th June and 12 pm in 21th December.

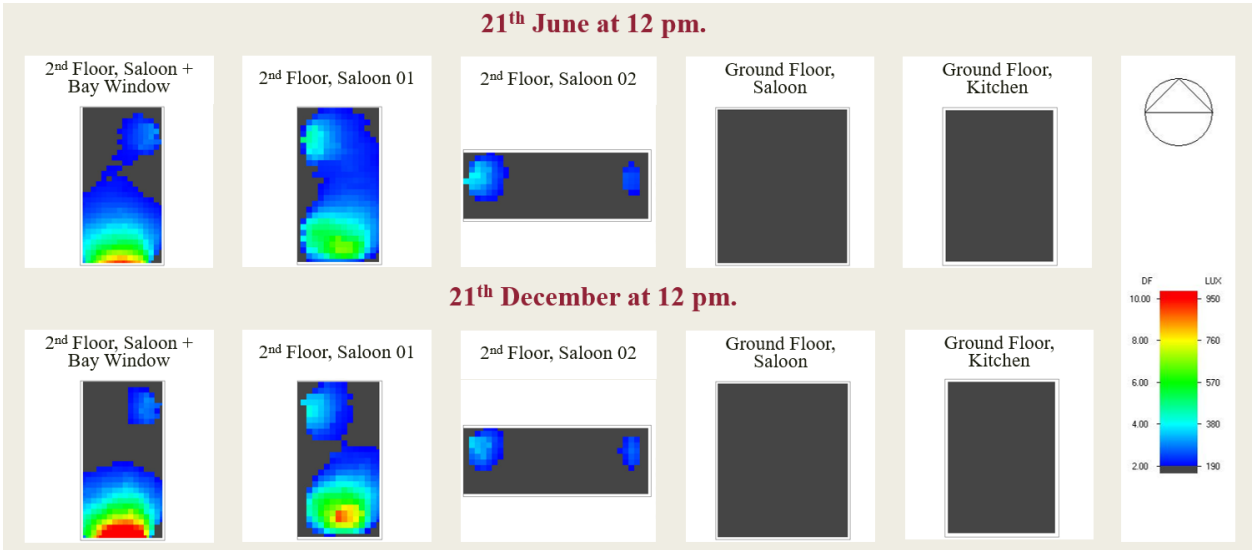



**Figure 14:** The daylighting performance of the SM 07 at 12 pm in 21th June and 12 pm in 21th December.

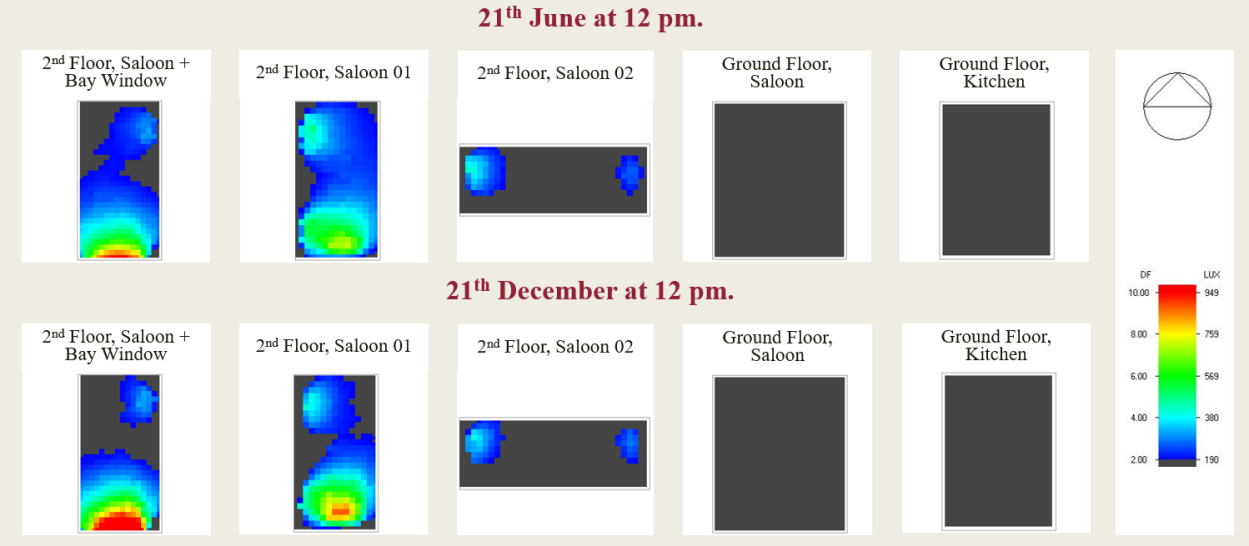



**Figure 15:** The daylighting performance of the SM 08 at 12 pm in 21th June and 12 pm in 21th December.

## 7. Conclusions

The existing window glazing (3mm clear glass) was not adequate to ensure a decrease in the annual heating demand and an increase in the light level of spaces of the Şefik Gül House. Therefore, it was decided to apply energy efficiency measures for the building considering contemporary glazing types with an aim to improve the energy and daylighting performance of the building.

A review of the building energy performance results indicated that the annual primary energy demand of the building was reduced in direct proportion to the reduced U-value of the glazing type. However, it was concluded that even if the U-value was lower compared to the existing case, the total annual primary energy demand increased due to higher SHGC (solar heat gain coefficient) in the SM 02, SM 03, and SM 04 measures.

As regards the retrofit packages, it is concluded that the daylighting control system ensured a significant amount of energy efficiency in the annual lighting energy consumption of the building. Furthermore, the annual cooling demand was reduced due to the reduced internal gain given off by artificial lighting systems.

The visible light transmittance (T-vis) of the glazing type was a highly important thermophysical feature to ensure the minimum illuminance in spaces as specified in the lighting standards, including the CIBSE, EN, and TS standards. For the purposes of the present study, the daylighting simulations were performed for the saloons, dining areas, and the kitchen, where people spent longer time and needed to clearly see the objects, colors, and patterns. In those indoor areas, the working plane was considered 0.75m above the ground to perform the illuminance (lux) calculation.

A review of the daylighting performance of each single measure suggested that the higher the increase in T-vis the lower the light level increase in the spaces at the second floor. However, it was notable that the illuminance of the living room and kitchen on the ground floor did not change, despite the glazing type was changed. This might be associated with the fact that window sizes of those areas were not large enough to achieve the required light level. Besides, the windows of the saloon were west- and east-oriented, and the garden walls around the house created a shading effect lessening the exposure to the sunlight.

It is restricted to amend the architectural form of traditional buildings and it isn't permitted to use methods other than the traditional construction methodology in cases when the building needs repairs pursuant to the Law on the Conservation of Cultural and Natural Property as introduced by the Republic of Turkey.

In conclusion, a review of all the study results suggested that the optimum retrofit measure, which allowed an improvement in the energy and daylighting performance of the Şefik Gül House was the Package 08.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Effect of Indoor Operational Environment on Workers' Well-Being in Industrial Buildings: The Case for Pharmaceutical Factory in Nigeria

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**Abstract**
In 2021, the worth of the pharmaceuticals market across the globe was estimated and projected to $1.17 trillion resulting in increasing pharmaceutical factories. Yet, less attention is given to the indoor operational environment of these buildings and the impact on the workers' well-being. To address these emerging concerns, this study investigated the indoor operational environment of pharmaceutical buildings. A field survey was conducted on purposively selected 14 pharmaceutical factory buildings in Southwestern Nigeria. Measurements of indoor environmental parameters were taken from the buildings with the aid of multifunctional air quality, and other handheld instruments. Findings show the presence of gaseous substances in the air within the production area and inadequate ventilation to dissolve and evacuate the gases which could negatively impact workers' well-being. The study concludes that a multidisciplinary approach encompassing the stakeholders in the pharmaceutical industry is critical to developing optimal design solutions for a well-designed pharmaceutical factory in Nigeria.
**Keywords:** Indoor Environment; Industrial Buildings; Nigeria; Pharmaceutical Factory; Workers' Well-Being.

## 1. Introduction

The primary objective of a building is to provide sheltered housing that is comfortable, convenient, safe, and attractive to its users (Ransom and WHO, 1988; Hanson, 2001; Smith and Pitt, 2011; Akadiri et al., 2012; and Scruton, 2013, Aziz Amen & Nia, 2017). Although the pharmaceutical factory building (PFB) is not just like any other building, the fact that it houses the drug production process means it has to be secure, serene, and controlled from contaminated air (Xiaoguang et al., 2011). Indoor air has a large share of the impact a building has on inhabitants compared to outdoor air due to its composition of both biological and chemical contaminants, as suggested by (Smith and Pitt, 2011; Abdulaali et al., 2020; and Bawa et al., 2022). Carbon monoxide (CO), carbon dioxide (CO2), radon, nitrogen oxide (NOx), asbestos, respirable suspended particles (RSPs), construction chemicals, and ozone are chemical components of the pollutants (Smith and Pitt, 2011,Amen,2021). Pests, dust mites, houseplants, molds, endotoxins, and pollen are examples of biological pollutants (WHO, 1979; Ghodrati et al., 2012; Abdulaali et al., 2020; and Mannan and Al-Ghamdi, 2021).
It has been proven that these contaminants can cause asthma, sick building syndrome (SBS), as well as various respiratory allergies that affect the users of the building. The importance of indoor air quality (IAQ) to the health and productivity of building occupants has been discovered (Dubbs, 1990; Wargocki et al., 2000; Lee et al., 2009; Smith and Pitt, 2011; Abdulaali et al., 2020; Bawa et al., 2022). Air pollution is the world's most serious environmental health concern, according to researchers (Abdul-wahab et al., 2015; Jones and Molina, 2017; Taştan and Gokozan, 2020; Paleologos, et al., 2021; and Bawa et al., 2022). Air pollution has negative consequences for human health, the climate, and ecosystems because it pollutes the air with a large amount of hazardous gases and particulate matter (Manisalidis et al., 2020).
One of the most essential criteria in determining the quality of any structure is having high-quality indoor air (Khazaii, 2014). Similarly, Korkmazer et al., (2018) and Ukpong et al., (2022) showed how hazardous lighting pollution can be as it affects perception, causes glare and even blindness.
The quality of the interior air and lighting in the building where people live and work has a direct impact on their health and productivity (Vimalanathan and Ramesh, 2014 and Arif et al., 2016). Armstrong et al., (2005), Khazaii (2014), and Gawade et al., (2020) opined that there is a need for efficient ventilation systems that can provide a healthier indoor environment.

## 2. Workers' Well-being and Productivity

Workers' productivity is defined by Sreekumar et al., (2018) and Mahamid (2013), in agreement with Al-Saleh (1995), as the amount of goods and services produced by a worker in a given amount of time, taking into account the availability of raw materials, appropriate tools or equipment, construction methods, political factors, project financing, and environmental factors. All these factors will be carefully reviewed because some equally constitute the variables of indoor environmental quality, according to Abdulmujeebu (2019). Carrasquel (2019) studies the three (3) factors that contribute to workers' productivity in the workplace, and workers' engagement was found to be the greatest tool required to increase productivity. Since worker productivity is a vital element to organizations, the work environment is a key contributor to workers' productivity where the environment describes the people and the people describe the environment. The study noted that when the work environment is tense and filled with negativity, employee management, and productivity levels obviously decrease significantly, thereby affecting the company's output as well as workers' motivation.

This is a typical description of production workers of PFBs. The Chartered Institute of Personnel and Development (CIPD) (2017) asserted that among the factors that can influence the work environment are morale among colleagues, increased stress, increased racial discrimination, or race-related harassment and bullying at work. Another important factor to consider is the design of the factory, also known as the construction method. If the spaces are proportionate to the sizes of the equipment and the number of workers and permit ease of circulation and seating to work and walk around effectively while having sufficient natural lighting and ventilation, then workers will be productive, and the productivity of the workers means an adequate design requirement. Carrasquel (2019) also described the use of technology as a factor that contributes to the well-being and productivity of a worker. The research argued that the latest and adequate technological tools could be employed to make the job easier for the workers, which could increase their productivity. This could equally improve the way workers interact with work and each other in the PFB.

## 3. Materials and Methods

This study used a mixed-method approach to achieve its goal (Tashakkori and Teddlie, 2003; Creswell and Plano, 2010). According to Johnson and Onwuegbuzie (2004), mixed methods research is a type of study in which the researcher employs both quantitative and qualitative research methodologies. This method ensures that the results of both data sets can be used as a check against conclusions drawn solely from one of the approaches. As a result, the data collection in this study included both numerical and textual information, ensuring that the final database has both quantitative and qualitative data (Creswell, 2012). This study aimed to provide a more comprehensive grasp of the research issue than could be obtained by using only one of the methodologies (Morse, 2005, Creswell and Plano, 2010). The research considered two (2) broad characteristics for the selection of the pharmaceutical factory: the pharmaceutical factory must be manufacturing a drug at the time of the survey and it must be in one of the stratified categories (Large, Medium, or Small PFBs). The characteristics of the three categories are described in Table 1.

Table 1. The Criteria for the inclusiveness in a category of a sample

| Categories of PFBs | No. of Workers | No. of Drugs Produced | Size of production Hall |
|---|---|---|---|
| Small PFBs | 1-100 | 5-10 | 100-250sqm |
| Medium PFBs | 101-200 | 11-15 | 251-400sqm |
| Large PFBs | 201-300 | 16-20 | 401-550sqm |

This study surveyed 14 PFBs in Lagos and Ogun state, Nigeria, between October 2020 and November 2021, which extended into three climatic seasons, with the rainy season studied two times, and so the survey was carried out three times with the firs being a pilot study. The handheld digital laser distance meter was used for the measurements of lengths, breadth, heights, and perimeters of the production area and all the various production rooms in the 14 PFBs. The other handheld devices used included a multifunctional air quality detector that was used to measure temperature, relative humidity, air velocity, particulate matter $PM_{1.0}$, $PM_{2.5}$, and $PM_{10}$, formaldehyde (HCHO), a digital sound level meter to measure the sound level generated by the machines, and the workers, The LCD CO Gas carbon monoxide detector measured CO and the digital anemometer measured air velocity and airspeed. Each of the 14 PFBs was measured 15 times at various points, and the measurements were done within 3–5minutes interval. Questionnaire forms were administered to the production workers as well as the management staff in each of the 14 PFBs surveyed.

### 3.1 Research Site

The choice of the location of the study area was based on the number of pharmaceutical factory buildings. The Southwest was chosen because it has a higher concentration of PFBs in Nigeria, thereby having a larger workforce in the pharmaceutical industry. Lagos State had the highest number of PFBs in Nigeria with 57, which was followed by Ogun with 16 ou of the 16 recognised PFBs in Nigeria, (pharmapproach, 2021).

### 3.2 Description of the Equipment

The instruments that were used for the field survey included the Multifunctional Air Quality Detector D9 model (Plate I), which is ideal for measuring temperature, relative humidity, particulate matter ($PM_{1.0}$, $PM_{2.5}$, $PM_{10}$), Total Volatile Organic Compound (TVOC), formaldehyde (HCHO), and carbon dioxide (CO2). A handheld digital sound level meter of 30–130dB (Plate II) was used to measure the sound level in the 14 PFBs. A Digital Laser Distance meter of 100m (Plate III) was used to measure the length, breadth, and height of the production areas of the PFBs. The Digital Lux Meter AS803 was used to calculate the illumination of the production rooms. A KXL-801 LCD CO detector was used to measure the amount of carbon monoxide (CO) present in the production rooms. The HABOTEST HT625A digital anemometer (Plate IV) was used to calculate the air velocity and airflow. While an Infinix Note 4 X626B Android phone camera was used to take photographs and record videos of the indoor environment to capture the equipment, spatial arrangement, circulation spaces, the activities going on in the production areas, and the building components.




Plate I: Multifunctional Air Quality Detector



Plate II: Digital Sound Level Meter




Plate III: Digital Laser Distance Meter 100M




Plate IV: HABOTEST HT625A Digital Anemometer

**4. Results**

Some of the variables present in the PFBs are due to the activities relating to the production of drugs that involves chemical mixes that goes on in the PFBs as described by (Abdul-wahab et al., 2015) namely; temperature, relative humidity, air velocity, lighting, sound, particulate matters ($PM_{1.0}$, $PM_{2.5}$, $PM_{10}$), carbon dioxide ($CO_2$), carbon monoxide (CO), formaldehyde (HCHO) and total volatile organic compound (TVOC)) were assessed by the use of digital handheld devices as presented on Plates I-VI. The temperature, relative humidity, air velocity, lighting, and sound were assessed as independent variables in this study, while the $PM_{1.0}$, $PM_{2.5}$, $PM_{10}$, $CO_2$, airflow, HCHO, and TVOC were assessed as dependent variables.

Fourteen (14) pharmaceutical plants were chosen for two reasons, including both inclusive and exclusive criteria: Inclusive criteria are qualities that prospective units (PFBs) must possess in order to be included in the study. Exclusive criteria are traits that disqualify potential participants from participating in the study (Patino, 2018) and the permission bottlenecks faced in the field were the second reason. All the readings were taken between 1-1.2m in height to maintain consistency; as a result, high air velocity readings were expected. The airflow rate was calculated using $m^3/h$ since the diffuser flow area was $0.36m^2$. Using the equation below, the values were converted to airflow velocity.

$$v = \frac{Q}{3600A}$$

Where,

v = air flow velocity

Q = air flow rate in $m^3/h$

A = cross section area of the diffuser

The air velocity was also measured at 15 points in production rooms or halls occupied by machines and workers doing the production of various kinds of drugs, which included tablets, capsules, syrups, and sterile. A handheld HABOTEST HT6254 Digital Anemometer (environmental meter) device was employed to measure air velocity and airflow as well as the corresponding scales.

## 5. Discussion

The indoor air quality data obtained from the 14 PFBs includes the temperature, air velocity, particulate matter ($PM_{1.0}$, $PM_{2.5}$, $PM_{10}$), total volatile organic compounds (TVOC), and formaldehyde (HCHO). The Air temperature was measured at about 1m height from the ground according to Zhu et al., (2021). Generally, the acceptable range of the indoor air temperature is between 22.5-26°C, the maximum limit of air velocity recommended by Amens et al., (2020) is $0.25ms^{-1}$. The acceptable limit of TVOC of below 3ppm was used as consistent with the recommendation of Dosh (2005). ASHRAE Standard 2017 recommends levels of 1000ppm in the case of continuous exposure to $CO_2$. Zhu et al. (2021) asserted that headaches, sore throat, breathing difficulty such as asthma can result in occupational exposure to HCHO which is above 0.1ppm.

The average air temperature (29.42°C); air velocity (0.98 m/s) and formaldehyde (0.87ppm) were beyond the acceptable and recommended threshold by ASHRAE and WHO. All the 14 PFBs measured for TVOC had far low below the allowable limit 0.1ppm and 1.23ppm as the lowest and highest calculated averages respectively. The total average was calculated at 0.31ppm as seen in Figure 2.0. The average calculated $CO_2$ of 14 PFBs with 12 factories measuring below the ASHRAE threshold of 1009ppm. Only factories 006 and 010 had higher than the recommended standard. The total average of $CO_2$ for the 14 PFBs was 773.56ppm. It could be observed from Figure 2.0 that 11PFBs out of 14 had largely exceeded the suggested limit with the total average of HCHO giving about 0.87ppm.

The IAQ data with the highest difference was the HCHO measurement with a variation of about 199% in difference from the average measurement spread out through the 14PFBs, this is followed by the $PM_{2.5}$ and $PM_{10}$ as the measurements were seen to vary by 137% from the average measurements for the PFBs, this showed the magnitude of the differences in the $PM_{2.5}$, $PM_{10,}$ and HCHO present in the PFBs, the Table 1 presents that the IAQ data with the least difference is between the individual PFBs and the average measurement from all the PFBs for each of the IAQ data. The average air temperature (29.42°C); air velocity (0.98 m/s) and formaldehyde (0.87ppm) were beyond the acceptable and recommended threshold by ASHRAE and WHO.

Figure 1 illustrates that the total average variation of the temperature reading of all the PFBs in the study was found to be sum up to about 5% away from the average air temperature reading of 29.42°C from Table 1. This showed that the air temperature levels were consistent. The variation in the carbon dioxide and air velocity at 239% and 412% respectively, were the other two IAQ variables in these PFBs that had total average variations that were less than 500%, though there were PFBs that had readings varying from a carbon dioxide level as high as 126% above the 772.99ppm as well as an air velocity level of about 100% above the 0.99m/s average readings. The variations of the HCHO, $PM_{1.0}$, $PM_{2.5}$, $PM_{10}$, and TVOC were the most dispersed of all having this total average variation at levels between 1000% and 2500% from the readings of 18.47mg/m for $PM_{1.0}$, 33.92mg/m for $PM_{2.5}$, 0.31ppm for TVOC and 0.86ppm for HCHO (Table 1 and Figure 1).

**Table 1.** Average IAQ data from the 14PFBs

| | Av. Temp. (°C) | Av. Air Vel. (m/s) | AV. $PM_{1.0}$ (mg/m) | AV. $PM_{2.5}$ (mg/m) | AV. $PM_{10}$ (mg/m) | Av. TVOC (ppm) | Av. $CO_2$ (ppm) | Av. HCHO (ppm) |
|---|---|---|---|---|---|---|---|---|
| **Standard [source]** | Average of 24.25 [ASHRAE standard 55, 2010] | 0.25 [ASHRAE standard 55, 2010] | Nill | Nill | Nill | Below 3 [Dosh, 2005] | Below 1000 [ASHRAE standard, 2017] | Below 0.1 [Zhu et al. (2021)] |
| **14PFBs Av. IAQ data** | 29.42286 | 0.989286 | 18.46929 | 33.915 | 18.46929 | 0.305714 | 772.9893 | 0.860786 |

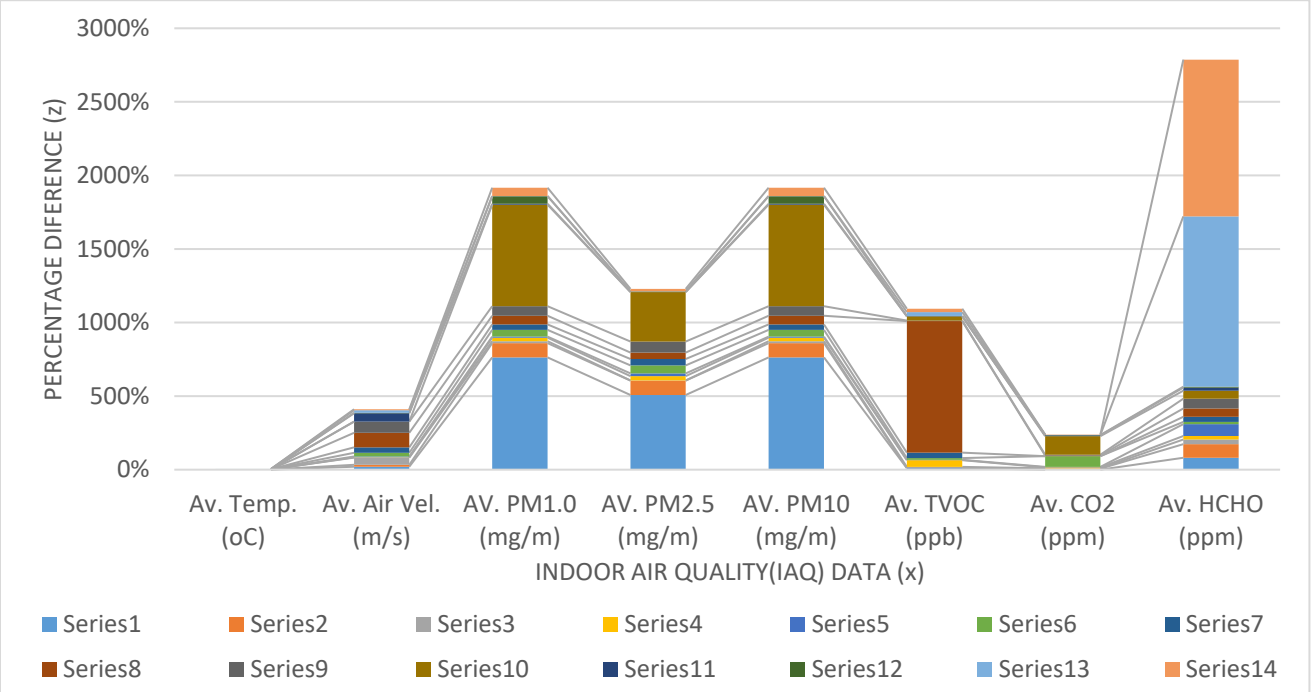


**Figure 1.** Percentage difference between IAQ data

Figure 2 demonstrates the performance of the different PFBs in these IAQ performances with about nine (9) of them having an average difference in IAQ data summing up to about 50% or less while five were between 150% and 300%. It could be observed from Figure 2.0 that 11PFBs out of 14 had largely exceeded the suggested limit with the total average of HCHO giving about 0.87ppm. The IAQ data with the highest difference was the HCHO measurement with a variation of about 199% in difference from the average measurement spread out through the 14PFBs, this is followed by the $PM_{2.5}$ and $PM_{10}$ as the measurements were seen to vary by 137% from the average measurements for the PFBs, this showed the magnitude of the differences in the $PM_{2.5}$, $PM_{10,}$ and HCHO present in the PFBs,

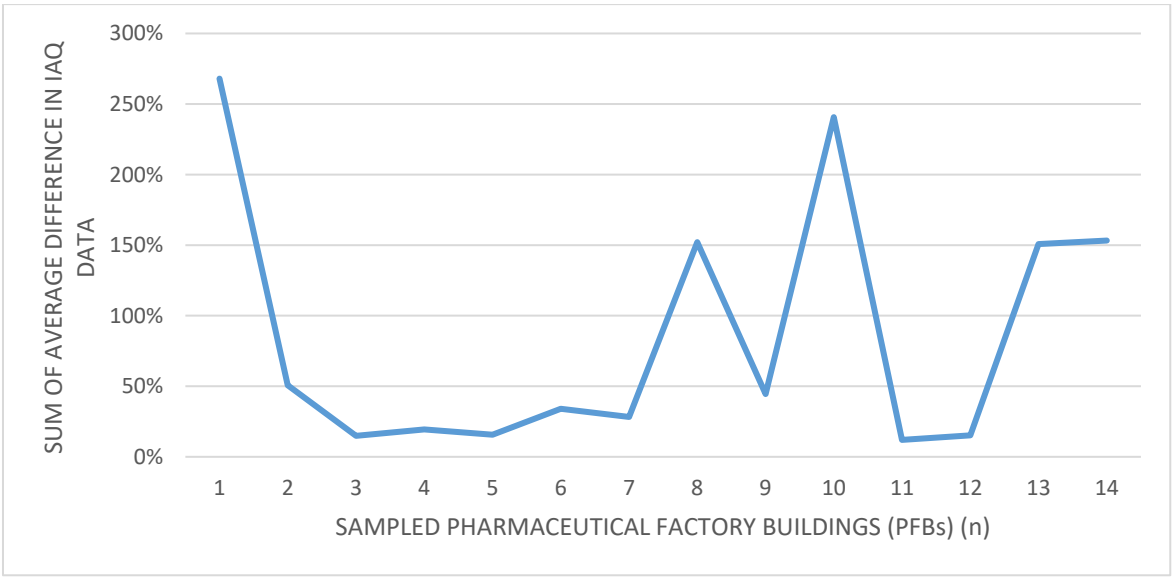


**Figure 2.** Average percentage difference in IAQ data from 14 PFBs

The questionnaire result (Table 2) described how the environmental performance variable affected the user's performance in the PFBs. The temperature, sometimes being uncomfortable during production, had a significant influence with low impact. The perception of 54% of respondents was that the temperature is sometimes uncomfortable during production. The air velocity impact was fair, as 63% disagreed that the hall is usually not airy enough. At the rate of about 57% agreed that they were able to meet the production target.

**Table 2.** Crosstab on the comfort level of the Temperature and whether the hall is usually not airy enough

| | | | Are you able to meet the production target? | | Total |
|---|---|---|---|---|---|
| | | | Yes | No | |
| The temperature is sometimes uncomfortable during Production | Agree | Count | 149 | 152 | 301 |
| | | Expected Count | 170.4 | 130.6 | 301.0 |
| | undecided | Count | 37 | 21 | 58 |
| | | Expected Count | 32.8 | 25.2 | 58.0 |
| | Disagree | Count | 127 | 67 | 194 |
| | | Expected Count | 109.8 | 84.2 | 194.0 |
| The hall is usually not airy enough | Agree | Count | 71 | 102 | 173 |
| | | Expected Count | 97.9 | 75.1 | 173.0 |
| | Undecided | Count | 20 | 13 | 33 |
| | | Expected Count | 18.7 | 14.3 | 33.0 |
| | Disagree | Count | 222 | 125 | 347 |
| | | Expected Count | 196.4 | 150.6 | 347.0 |

## 6. Conclusion

However, the values obtained for $CO_2$, $PM_{1.0}$, $PM_{2.5,}$ and $PM_{10}$ were satisfactory. The IAQ of the PFBs is consistently challenged by the HCHO which is though seen at different rates through the samples PFBs, is constantly one of the factors exceeding the set standard for its presence. In determining the wellness of workers of indoor environment of PFBs, more research needs to be carried out to investigate the best way to consistently mitigate the high amount of PMs and HCHO in PFBs, as this research suggests that these could be the major reason for ill-health, discomfort, and low-production in PFBs.

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# Nanotechnologies Brooding Smart and Economic Green Architecture

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**Abstract**
More than six decades ago, surprising nanotechnologies with its so effective dynamic researches became the passage for approaching a dream of existing smart and economic tools with its so accuracy of synergy. Nanotechnologies, currently, cover a multinomial discipline including construction industry. However, an economic assessment , proved that nanotechnology has a significant impact for resulting smart and economic construction. However, architecture as a core field in construction industry became more sustainable with nanotechnologies and their applications through the use of nanomaterial brooding smart and economic buildings that are so friendly with the hoped healthy environment. This results in green architecture with high durability, performance, energy efficiency, and safety. That green architecture having smart components with their self-senses, self-repairing and self-cleaning resulting in friendly usage and optimum sustainability. This paper highlights on that surprising effectiveness of nanotechnologies as a brooding facility for smart and economic green architecture.

**Keywords**: Nanotechnologies; Smart; Economic Buildings; Green Architecture.

## 1. Introduction

• **Nanotechnology**, sometimes shortened to nanotech, is the manipulation of a matter on an atomic and molecular scale, One nanometer (nm) is $10^{-9}$, of a meter. The concepts that seeded nanotechnology were first discussed in 1959 by renowned physicist Richard Feynman in his talk There's Plenty of Room at the Bottom, in which he described the possibility of synthesis via direct manipulation of atoms. The term; "nano-technology" was first used by Norio Taniguchi in 1974, though it was not widely known (Ganesh, 2012), (Al-Sharkawy, 2014).

• **green architecture**, indicating philosophy of architecture that advocates sustainable energy sources, the conservation of energy, the reuse and safety of building materials, and the siting of a building with consideration of its impact on the environment. However; In the early 21st century the building of shelter, in all its forms, consumed more than half of the world's resources, translating into 16% of the Earth's freshwater resources, range of 30 up to 40 % of global energy supplies, and 50% by weight of global raw materials withdrawn from Earth's surface. Architecture, in its traditional trends, was responsible for 40 up to 50% of waste deposits in landfills and 20 up to 30% building' gas emissions. At the turn of the 21st century, however, a building's environmental integrity, in the way of the conception of green design, building, zone and city for approaching how architecture to be so key factor in that hoped healthy environment while increasing their greening effect (Encyclopaepedia Britannica, 2022): *https://www.britannica.com/art/*green-architecture.

• **Nanotechnologies for green architecture,** nanotechnologies have an effectiveness on sustainability or green architecture through buildings and urbanism with high functional efficiency. However, Nano architecture increasingly directs for using Nano-materials, Nano products, and what may be called Nano shapes for accurate and long-run treatment of structures as well as construction. Also, nanotechnology as green technology is so promising for adopting Nano technological methods to treat the scarcity of natural resources and to reduce the environmental pollution. In addition, in conception of greening or environmental sustainability, the knowledge about sustainable development, preservation of nature, elimination of wastage and reusability, will be more possible in a successful manner (Rehan N.,2021; Rani K. and Sridevi V., 2017; Biswas et al., 2022 ).

• **Nanotechnologies for smart architecture,** nanotechnologies, strictly, affecting architecture' function through its focal columns; utility, durability and beauty. However, **n**anotechnologies' effectiveness on architecture, extremely, displays these surprising features as; aesthetic aspects of buildings, eco-efficiency of industrial processes and products.

These efficient products, as new and innovative materials, are having their unique properties of ultra-insulating, self-sensing, self-repairing and self-sending of reports. Nanotechnologies became having so positive impact on architectural design for brooding a recent generation of green buildings with their innovative materials having that so high ability for connecting needs of environmental aesthetic, electronic and communicative facilities. That high ability is resulting in smart architectural building, zones and cities (Mattia Federico Leone, 2012; Tok et al., 2022 ), (Figure 1).



**Figure 1.** Bletchley Park, as first smart community, 1938-1993 as museum, location; England-UK. http://www.constructionleadershipcouncil.co.uk./smart-construction-guide-and-case-studies

• **Nanotechnologies for economic green architecture**, these surprising technologies have so positive effectiveness on economic components of architecture and urbanism via achieving that longevous high safety, security, utility, durability and efficient architectural requirements. These requirements are approached through; reducing energy' consumption, conserving economic resources and minimizing pollution (Rehan N., 2017).

**2. Materials and Methods**

• Main frame of materials and methods of this present Research paper is structured as: Abstract 1. Introduction 2. Materials and Methods. 3. Smart Buildings. [ 3.1 Early smart buildings 3.2 Useful smart building' services 3.3 Smart power grid (SG)] 4. Smart construction 5. A smart city [ 5.1 History of Smart Cities 5.2 Why do we need them? 5.3 Are Smart Cities Sustainable? 5.4 Safety of Smart Cities 5.5 Examples of smart cities] 6. Economics of nanotechnologies in smart green architecture 7. Sustainable green architectural into Building and Eco village. [ 7.1 Nano House 7.2 Green building 7.3 Eco village] 8. Conclusions.

**3. Smart Buildings**

- **Early smart buildings** ever constructed were primitive shelters built with stones, sticks, animal skins and other natural and plantation materials. These primarily buildings to provide, relatively, a comfortable space for people inside. Over time, the components inside a building had been developed and improved, allowing recent building' owners to control lighting, security, heating, ventilation and air conditioning systems. Future' buildings approaching to connect numerous devices into an integrated, dynamic and functional way. These future' buildings to fulfill the mission for minimizing energy cost, supporting a robust electric grid and mitigating that negative environmental impact. (Danielle Crownover, 2019).
- **Useful smart building' services** making occupants with high level of illumination, thermal comfort, air quality, physical security, sanitation, and many more at the lowest cost and environmental impact over the building lifecycle. Achieving the vision requires adding intelligence or that smartness from the initial design phase to the end of the building's useful life. Smart buildings use information technology during operation to connect a variety of subsystems, operating independently, to enable these systems for sharing information to optimize total building performance. Smart buildings look beyond the building equipment within their four walls. These smart buildings are connected and responsive to a smart power grid, and they interact with building operators and occupants to empower them with new levels of visibility and actionable functional information. These

functional information for fulfilling; Connecting building systems, connecting people and technology, connecting to the global environment, Connecting to the smart power grid (Al-Sharkawy, 2022).

**- Smart power grid (SG)** Yonghong Ma. And Baixuam Li. (2020), Shiwani Goyall, Mrs. Shimi S. (2017) illustrated; Smart Grid (SG) also called smart power grid, smart electrical grid, intelligrid, intragrid, intergrid, intelligent grid or future grid however, there is no different from the traditional term but with certain enhancements that indicating the integration of information systems into the electrical energy distribution grid. In general, the traditional power grids are used to transfer power from a few and centralized power generation facilities to a large number of potential customers over a vast geographical area. The smart grid allows real time tracking and management of energy supply and demand thereby making the customer one of the essential roles in the whole power distribution system. In addition, smart buildings, are ready for Connecting to an intelligent future. However, Intelligent Future, will go far beyond saving energy but extend for contributing to the architectural sustainability goals. smart buildings, increasingly, extend capital equipment life and also impact security and safety of all resources both human and capital with a robust purification and economic future human 'life (Figure 2).

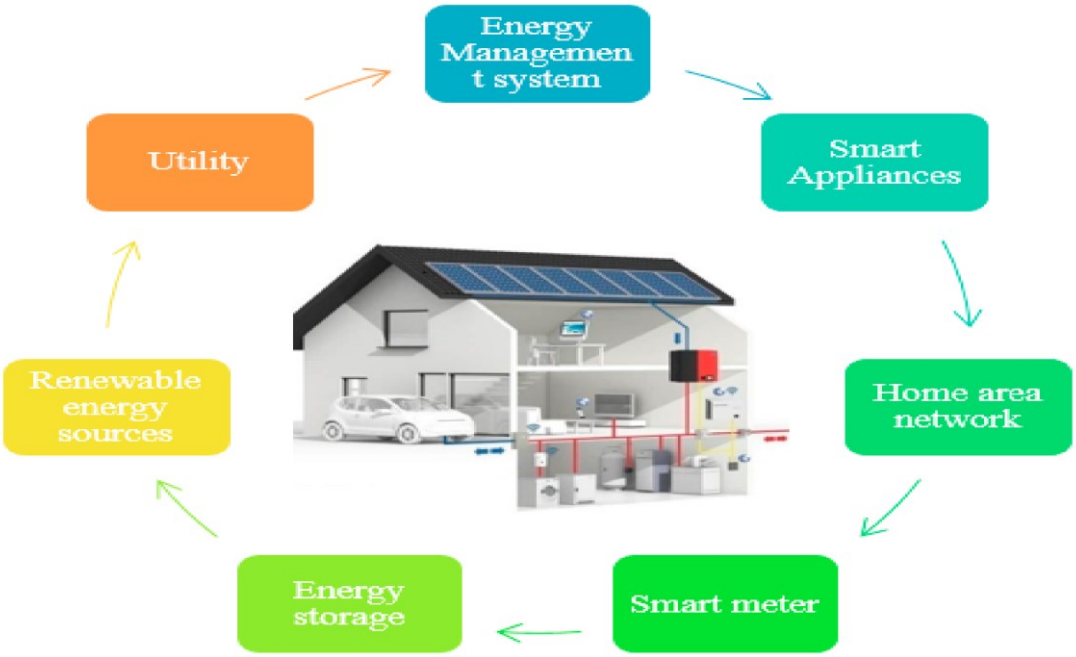


**Figure 2.** Home Energy Management System with smart Grid, (Yonghong Ma. And Baixuam Li., 2020).

**4. Smart construction**

Smart construction may be defined as; the design, construction and operation of assets achieved for fulfilling the full use of digital technologies and industrialized manufacturing techniques to improve productivity, minimize whole life costs, improve sustainability and maximize user benefits (Al-Sharkawy A. , 2019). UK HM-Government (2013) published; 'Construction 2025, setting out its long-term vision through proposal directing, by 2025, the industry should be 'smart'. The report proposes that there is a need to ensure UK construction for describing the conception of smart construction and digital design by: Working to remove barriers against innovation, Bringing forward more research and innovation, Improvement collaboration between industry, academia and research organizations. Capturing lessons learned from successful innovations. Improving access to innovation and R&D incentives. Investing in people and technology and making better use of existing technologies.

Delivering more sustainable buildings, more quickly and more efficiently, and Adopting off-site manufacturing, which has the potential to achieve greater precision and quality and reducing manufacture and assembly time, and using 25% less energy (Figure 3).



**Figure 3.** Lillis Business Complex; University of Oregon; The Lillis Business Complex, known for its environmentally friendly design, for having one of the largest solar installations in the Northwest, and for its innovative use of photovoltaic solar glass, on the campus of the University of Oregon in Eugene, Oregon, USA. https://www.britannica.com/art/green-architecture & https://en.wikipedia.org/wiki/Eugene,_Oregon

**5. A smart city**

A smart city, as a term, means a city that uses information and communication technology (ICT) for improvement operational efficiency, share information with the public, providing a better quality of public and private services and maximizing citizen welfare. The key goal of a smart city is achievement of city' functions and promotion of economic growth while enhancement quality of life for citizens. However, city' smartness contains; an infrastructure based on innovative technologies, environmental initiatives, effective and highly functional public transportation, well ability for people while living with work within the city, using its resources (TWI.UK., 2022). One of many smart cities, as illustrated in following article 5.5, is the Smart Columbus in Columbus, Ohio, USA, founded in 2016. (Andrew J. Ginther, Mayor, 2022)

**5.1 History of Smart Cities**

The concept of smart cities began as far back as the 1960s and 1970s when the US Community Analysis Bureau began using databases, aerial photography and cluster analysis to collect data, direct resources and issue reports in order to direct services, mitigate against disasters and reduce poverty. This led to the creation of the first generation of smart cities. The first generation of smart city was delivered by technology providers to understand the implications of technology on daily life. This led to the second generation of smart city, which looked at how smart technologies and other innovations could create joined-up municipal solutions. The third generation of smart city took the control away from technology providers and city leaders, instead creating a model that involved the public and enabled social inclusion and community engagement. This third-generation model was adopted allowing citizens to invest for affordable housing issues.

**5.2 Why do We Need Them**?

Smart cities should provide an urban environment that delivers a high quality of life to residents while also generating economic growth. This means delivering a suite of joined-up services to citizens with reduced infrastructure costs. This becomes increasingly important for the future population growth in urban areas, where more efficient use of infrastructure and assets will be required (Amen,2021). Smart city services and applications will allow these improvements which will lead to a higher quality of life for citizens. Smart city improvements also provide new value from existing infrastructure while creating new revenue streams and operational efficiencies to help save money for governments and citizens alike.

**5.3 Are Smart Cities Sustainable?**

The reply; Sustainability is an important aspect of smart cities as they seek to improve efficiencies in urban areas and improve citizen welfare. Cities offer many environmental advantages, such as smaller geographical footprints. However, smart technologies present the implementation of an electric transport system to reduce emissions. Such sustainable transport options should also cause in a reduction in the number of cars in urban

areas. Creating such sustainable solutions could deliver environmental and societal benefits with so high economical level.

**5.4 Safety of Smart Cities**

Smart cities offer benefits for improvement citizen safety through intelligent roadways and public safety monitoring. However, core security objectives may be broken down into; Availability of Data in real time with reliable access in order to make sure it performs its function in monitoring the various parts of the smart city infrastructure, Integrity with availability, data not only be readily available, but it also be accurate. Confidentiality with Sensitive data being kept confidential and safe from unauthorized access. Accountability, however, system' users need to be accountable, in case problems, for their actions and interaction with sensitive data systems.

**5.5 Examples of Smart Cities**

These existing ones in; Barcelona, Spain, Columbus, Ohio, USA, Dubai, United Arab Emirates, Hong Kong, China, Kansas City, Missouri, USA, London, England, Melbourne, Australia, New York City, New York, USA, Reykjavik, Iceland, San Diego, California, USA, Singapore, Tokyo, Japan, Toronto, Canada, Vienna, Austria (Figure 4).
Safety of Smart Cities:




**Figure 4.** Smart Columbus in Columbus, Ohio. Smart Columbus was founded in 2016. https://en.wikipedia.org/wiki/Smart_Columbus, - https://www.columbus.gov/smartcity/

**6. Economics of nanotechnologies in smart green architecture**

In studies of the long-term economic impacts of major technological accomplishment relating to nature, Philip Shapira and Jan Youtie, (2015), presented a review of multiple studies. These studies have examined the consequences of public R&D investments. These multiple studies illustrated the variety of channels through which economic and societal impacts are generated through growth in the stock of knowledge, human capital enhancement, new instruments and methods, networks and social interaction, problem solving, new firms, and social knowledge. However; green nanotechnologies have the potential to make significant contributions both to addressing green challenges and to fostering sustainable economic development. Through this sustainable economic development there is substantial promise, especially, in nano-enabled applications in solar cells, photovoltaics, batteries, fuel catalysts, and water filtration. Other nano-enabled applications have the potential to reduce operational energy required through offering comparable or better performance with less weight, more durability or greater efficiency.
While this economic contribution of green nanotechnologies with surprising nano-scale materials results in environmental, health, safety and broader societal values and comfortable considerations**.**

**7. Sustainable green architectural into Building and Eco village**

**- Nano House** in Sustainable green architectural with Building and Eco village, the term Nano house, was named to be the world's smallest sustainable house (Al-Sharkawy, 2022). The Nano Living System with its

green pre-engineered concept for residential use presenting an innovative and sustainable architectural proposition. The design is based on creation of flexible spaces, through Nano Living Systems' suspending technology and use of renewable energy systems. This suggests an optimistic and environmental solution for the global housing issue of very small living spaces. As an example, model, the Nano House can be used by a family of three in an area consisting of 25 square metres (270 sq ft). This is made possible by the incorporation of the suspending technology, which nearly doubles the size of the living area within this space by transforming what is common living space by day into two separate bedrooms by night. The suspending technology can be used in new construction and can also be adapted to be used in existing structures, such as hotels, studios, dormitories and very small housing.

**- Green building** also known as green construction or sustainable building) refers to both a structure and the application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle. However, that responsibility and efficiency beginng from planning to design, construction, operation, maintenance till renovation, and demolition. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Leadership in Energy and Environmental Design (LEED) is a set of rating systems for the design, construction, operation, and maintenance of green buildings which was developed by the U.S. Green Building Council. Other certificate systems that confirm the sustainability of buildings are the British BREEAM (Building Research Establishment Environmental Assessment Method) for buildings and large-scale developments or the DGNB System (Deutsche Gesellschaft für Nachhaltiges Bauen e.V.) which benchmarks the sustainability performance of buildings, indoor environments and districts. Currently, the World Green Building Council is conducting research on the effects of green buildings on the health and productivity of their users and is working for promotion Green Buildings in Emerging Markets through EDGE (Excellence in Design for Greater Efficiencies) Market Transformation Program and certification. There are also other tools such as Green Star in Australia, Global Sustainability Assessment System (GSAS) used in the Middle East and the Green Building Index (GBI) predominantly used in Malaysia.

Building information modeling (BIM) is a process involving the generation and management of digital representations of physical and functional characteristics of places. Building information models (BIMs) are considered files to support decision-making regarding a building or other built asset. Although new technologies are constantly being developed to complement current practices in creating greener structures. while the common objective of green buildings is to reduce the overall impact of the built environment on human health and the natural environment by; Efficiently using energy, water, other resources, protecting occupant health and improving employee productivity, reducing waste, pollution, and environmental degradation.· (info. On; https://en.wikipedia.org/wiki/Green_building).

**- Eco village** as an example of it, is the village of Findhorn (Al-Sharkawy, 2019) as an experimental architectural community project based at The Park, in Moray, Scotland, near the village of Findhorn. The project's main aim is to demonstrate a sustainable development in environmental, social, and economic terms. Work began in the early 1980s under the auspices of the Findhorn Foundation but now includes a wide diversity of organizations and activities. Numerous different ecological techniques are in use, and the project has won a variety of awards, including the UN-Habitat Best Practice Designation in 1998.

An independent study concludes that the residents have the lowest ecological footprint of any community measured so far in the industrialized world and is also half of the UK average. Although the project has attracted some controversy, the growing profile of environmental issues such as climate change has led to a degree of mainstream acceptance of its ecological ethos. (Info., on: https://en.wikipedia.org/wiki/Findhorn_Ecovillage). (Figures 5., 6. and figure 7.).



**Figure 5.** A 3D-snapshot of the mkSolaire (or "Smart House"), a house design originally designed by Michelle Kaufmann, design is now owned by Blu Homes. See http://www.mkd-arc.com//homes/mksolaire/chicago_museum.php for the ecology behind its features.



**Figure 6.** A Barrel House, the first new dwelling to be created at Findhorn Ecovillage https://en.wikipedia.org/wiki/Green_building#/media/File:PA120016.JPG



**Figure 7.** An eco-house at Findhorn Ecovillage with a turf roof and solar panels. https://en.wikipedia.org/wiki/Green_building#/media/File:PA120016.JPG.

**8. Conclusions**

• **Architecture** as a core field in construction industry became more sustainable with nanotechnologies with their applications for approaching the hoped so friendly and healthy environment. • **Green architecture** indicating architectural philosophy motivating sustainable energy sources, conservation of energy, reuse and safety of building materials, and siting of a building with consideration of its impact on the environment. • **Nanotechnologies** have an effectiveness on sustainability or green architecture through buildings and urbanism with high functional efficiency into Nano architecture with using Nano-materials, Nano products and Nano shapes for accurate and long-run treatment of structures as well as construction. Nanotechnologies is brooding of; • **Smart building** with its surprising services making occupants with high level of illumination, thermal comfort, air quality, physical security, sanitation, and many more at the lowest cost and environmental impact over the building lifecycle, • S**mart construction** for fulfilling full use of digital technologies and industrialized manufacturing techniques for productivity improvement, minimizing whole life costs, improving sustainability and user benefits, • **Smart cities** providing an urban environment that delivers a high quality of life to residents while also generating economic growth, • **Sustainable green architectural into Building and Eco village, however,** green nanotechnologies have the potential making significant contributions for fostering sustainable economic development with so cost' reduction accomplished with so long-run of buildings' usage into their high smartness and sustainability. This summary proves that nanotechnologies brooding smart and economic green architecture.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# The Readiness of Smart Office Interior Implementation in Malaysia

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**Abstract**

Covid-19 is the most trending indication that digitalization and generation Z's arrival into the labour supply -drive companies to reconsider traditional office space. Smart office interior is the future of today, which involves using technology to facilitate productive and effective working. As a consequence of this occurrence, researchers and industry professionals are focusing on the research and development of smart office interiors. This study aimed to emphasize the readiness of smart office interiors and the potential consequences of implementing smart office interiors in Malaysia. Descriptive statistics were obtained using the questionnaire survey responses from various industrial sectors. This study indicated the corpus of knowledge on Malaysia's current readiness for smart office interiors adoption. To summarise, Malaysia's everyday situations show that more strategies are needed to be introduced in Malaysia to reap the benefits of the smart office revolution, which will save energy, time, and money.

**Keywords:** Smart office; Smart interior; Readiness; Office interior; Malaysia.

## 1. Introduction

This article will discuss the readiness of smart office interiors in Malaysia by distributing a questionnaire survey, and the analysis was carried out using the SPSS software. In the past few decades, the interior design of offices has evolved with each generation, and this trend will continue. Many businesses are incorporating the most recent office interior design ideas into their operations to provide their employees with a stimulating and convenient working environment to perform their jobs. Two years after the beginning of the COVID-19 virus, 78% of Malaysians think that a lack of technology has hindered their capacity to learn new skills (*Malaysians Are Hopeful That Their Digital Skills Have Improved since the Pandemic Began, but Continue to Be Held Back by Fears of Job Security and Automation*, n.d.)The lack of technology could be because there isn't enough appropriate technology, or it could mean that Malaysian businesses need to act quickly to close the skills gap by implementing an excellent upskilling plan. As a result of their placement in potentially hazardous areas, sensors, actuators and routers are used in smart space technology solutions that provide a poor user experience (Jing Zeng, Laurence T.Yang, 2012). Aside from that, in 2016, approximately 83.8 per cent of Malaysia's total workforce put in 40 hours or more per week, representing a ten-percentage-point increase since 1990 and an estimated rate of growth throughout that time (*Kilm 7.0 Hours of Work*, 2016). This issue demonstrates that users have inadequate hands-on familiarity with the technology and still lack productivity in the workforce. Therefore, this research will focus on the readiness of smart office interiors and the potential consequences of implementing smart office interiors in Malaysia. The highest level of familiarity with technologies and the highest level of readiness for smart offices bring significance to the workforce to enhance productivity.

## 2. Literature review

An "office" refers to the tasks performed by a certain number of people rather than the position where clerical work is done; and the act of gathering, sorting, storing and transmitting information requires office functions (Dr. R.K. Chopra, 2015). Offices have been through an evaluation since the 1950s and changed every decade until the 2010s, as shown in Figure 1 ( Aziz Amen & Nia, 2017Chen, 2020). Depending on the size of the office, a different number of office staff members is employed there. So the office is crucial because it serves as a focal point of knowledge and provides information to those in the surrounding area relevant to market changes and developments.

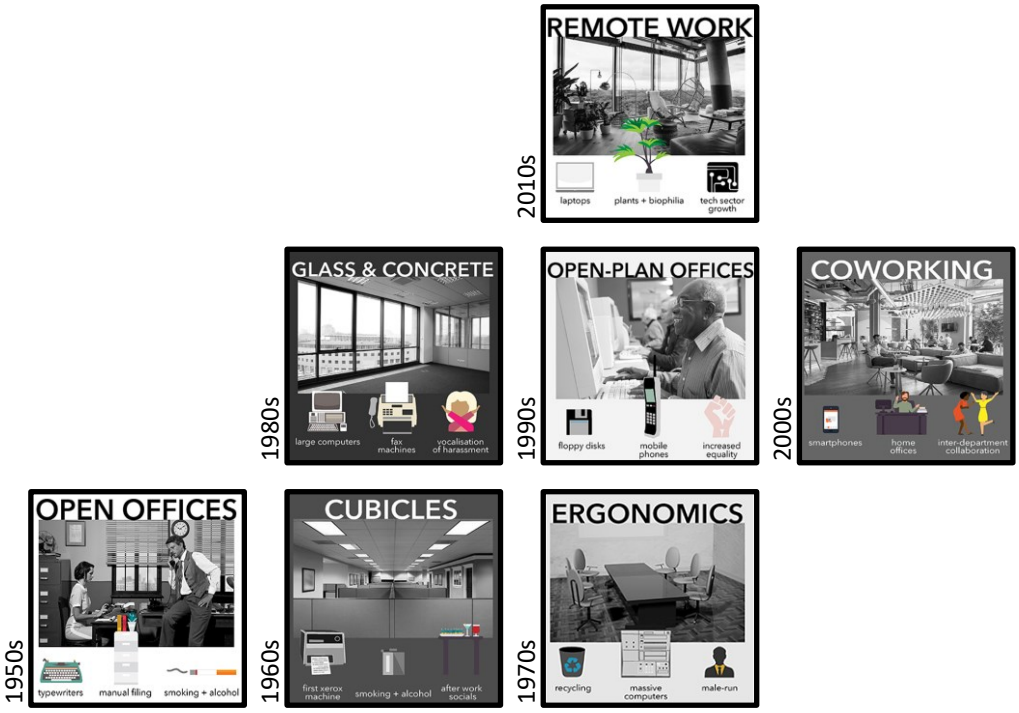


**Figure 1.** Evaluation of an office (Chen, 2020)

Over the years, the office has undergone a significant transformation, transitioning from a traditional office to a smart office. A smart office can be defined as a well-equipped office equipped with Internet of Things devices such as various sensors connected to the internet (Shinde et al., 2020). Besides, according to Tehseen et al. (2019), " Smart offices are also designed to combine physical equipment, people, and computing technology to provide employees with a safe, friendly, engaging, and smart environment." Nowadays, offices are getting more and more connected to our digital world with the assistance of smartphones and WIFI, which are becoming commonplace technology. The evaluation of smart offices began in 1996 (the first phase), introducing technologies such as mobile phones and the internet. Next, it continued until 2017 (third phase), with the integration of automated systems to make their offices super-efficient, reduce operating costs, and create a suitable and well-connected working environment for their employees.

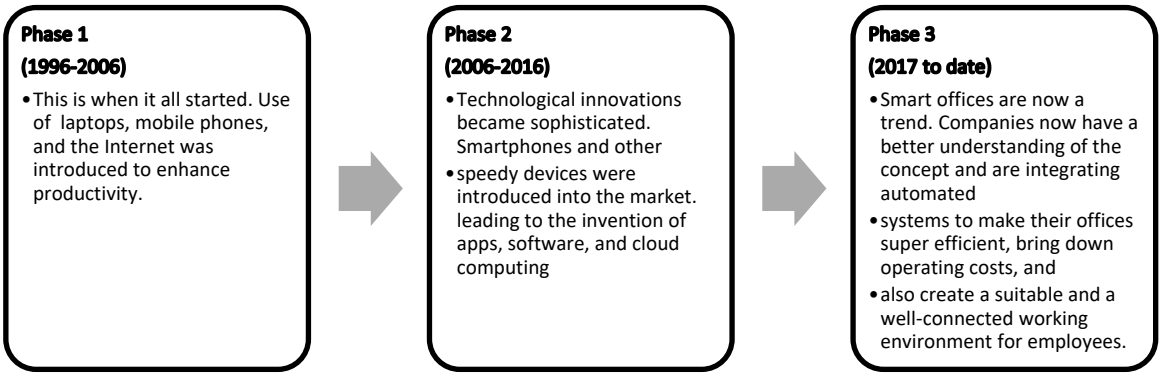


**Figure 2.** Timeline evaluation of smart office (*What Is a Smart Office? History, Benefits and Hot Desking Apps. — Do You Want To Optimize Your Workspace?* n.d.)

The way emerging technologies and systems have influenced how we live, work, play and communicate has shifted radically over the past few decades. In the past, technology and systems have been used to help people perform everyday tasks more efficiently. However, technology and systems have become the key to success in the business world. Furthermore, because the evolving activities involve specific technologies in offices made up of people who have come together for the same reasons, mainly the Y generation born between 1981 and 2000, the offices are becoming more diverse(Tuncel & Kayan, 2018). Technology is concerned with determining how information may be effectively used to organize issues requiring people and machinery to achieve long-term goals (Lane, 2019). Individuals use technology to perform their tasks in a well-organized manner and solve all the problems and challenges (Kapu, 2019). Technology plays

an essential role in the workplace and has created an ecosystem that has allowed for innovation and creativity. According to Allen (2019), "technology has also made interactive learning and collaborative, allowing people to better engage with the content they are learning and struggling with."

Implementing a smart office brings out many advantages to the employee nowadays. For instance, a smart office provides comfort to office workers by conserving energy and working more efficiently (Miraoui, 2018). Rather than that, the design of smart spaces is concerned with the various technological challenges that must be overcome to improve the overall quality of the experience (QoE) (Zeng et al., 2015). As a result, smart offices reduce the decision-making process by providing, for example, access from any location and by aggregating expertise and information sources (Ramos et al., 2010).

**3. Material and Methods**

The quantitative approach was used in this study to assess the readiness and significance of implementing smart office interiors. The primary data was gathered by distributing a questionnaire survey online. A non-probability sampling method, which is often appropriate for exploratory research, was used for sampling. In this research, convenience sampling of people who are easy to reach was chosen because it was a more convenient and cost-effective way to collect initial data. Responses to a questionnaire survey from several industrial sectors were used to generate descriptive statistics. Statistical methods such as descriptive statistics organize and summarise data by describing the relationship between variables in a sample or population (Kaur Parampreet, Jill Stoltzfus, 2018). According to Phoong Seuk Yen (2021):

> "Descriptive statistics can be divided into several categories. There are several types of descriptive statistics, including descriptive statistics for a single numeric variable, descriptive statistics for multiple numeric variables, and descriptive statistics organized by group. The numeric variable is created through the use of a Descriptive procedure. Meanwhile, the frequency distribution should be used to look at categorical variables. Therefore, this is the case since it doesn't make sense to ask for means and standard deviations for categorical variables".

The descriptive statistical analysis was carried out using the SPSS software. The following subsection will interpret the statistical analysis results more broadly.

The survey area for the research was around the Selangor and Wilayah Persekutuan due to having been known as Malaysia's most developed and progressive state. These states are a beacon of abundance and prosperity, renowned for their highly skilled and innovative knowledge workforce and attractive cosmopolitan living standards. A set of questionnaire surveys has been distributed to several companies in Selangor and Wilayah Persekutuan to address a lack of hands-on familiarity with technology and a consequent lack of productivity. In addition, 130 respondents from 26 offices responded to the questionnaire survey, as shown in Table 1 above.

**Table 1.** The table summarizes the responses received from the designer's office

| Location | Number of offices | Total designer | Number of respondents |
|---|---|---|---|
| Petaling | 7 | 35 | 29 |
| Gombak | 8 | 49 | 42 |
| Klang | 3 | 10 | 10 |
| Hulu Selangor | 1 | 4 | 3 |
| Kuala Lumpur | 7 | 52 | 46 |
| *Total* | *26* | *150* | *130* |

**4. Result and discussion**

A total of 150 questionnaire surveys were sent out, with 130 responses from 26 different offices. The demographics of the respondents are shown in Table 2 below. The results revealed that the majority of respondents (n=57, 43.8 per cent) were from the interior design profession, followed by architects (n=43, 33.1 per cent), specialized designers (n=28, 21.5 per cent) and developers (n=2, 1.5 per cent). Aside from that, most respondents (n=124, 95.4 per cent) have less than five years of working experience, with only a few (n=6, 4.6 per cent) having 6 to 10 years of working experience.

**Table 2.** Respondent demographic (N=130)

| General information | Categories | Frequency | Percentage (%) |
|---|---|---|---|
| Profession | Interior designer | 57 | 43.8 |
| | Architect | 43 | 33.1 |
| | Developer | 2 | 1.5 |
| | Specialized designer | 28 | 21.5 |
| Working experience | Less than 5 years | 124 | 95.4 |
| | 6 to 10 years | 6 | 4.6 |

### 4.1 Readiness of smart office

The readiness survey results for implementing smart office interiors in Malaysia are presented in Table 3. The survey results on respondents' experience in designing a smart office revealed that almost all respondents (n=126, or 96.9 per cent) had no prior experience in developing a smart office. Furthermore, when it comes to results familiarity with the technologies, only four out of eleven (4/11) received more than half familiarity with them. The smart door lock received the highest level of understanding across the entire profession (n=114, 87.7 per cent), followed by the lighting control (n=88, 67.7 per cent). The smart sensor (n=85, 65.4 per cent familiarity) and voice control assistant (n=82, 63.1 per cent familiarity) ranked third and fourth in the profession. According to Figure 3, eleven example technologies have been indexed from most familiar to least familiar to professionals. This demonstrated that most professionals are still unfamiliar with technological advances and that smart offices are not yet ready to be implemented in Malaysia.

**Table 3.** Result of readiness of smart office interior based on familiarity of technologies among the profession

| Item | Categories | Frequency | Percentage (%) |
|---|---|---|---|
| Experience in designing a smart office | Yes | 4 | 3.1 |
| | No | 126 | 96.9 |
| Familiarity with technologies | Smart sensor | 85 | 65.4 |
| | Smart door lock | 114 | 87.7 |
| | Smart desk | 26 | 20 |
| | Lighting control | 88 | 67.7 |
| | Appliance control | 18 | 13.8 |
| | Smart air conditioner | 25 | 19.2 |
| | Recognition program | 33 | 25.4 |
| | Indoor maps | 3 | 2.3 |
| | Voice control assistant | 82 | 63.1 |
| | Smart entertainment | 18 | 13.8 |
| | Smart curtain | 21 | 16.2 |

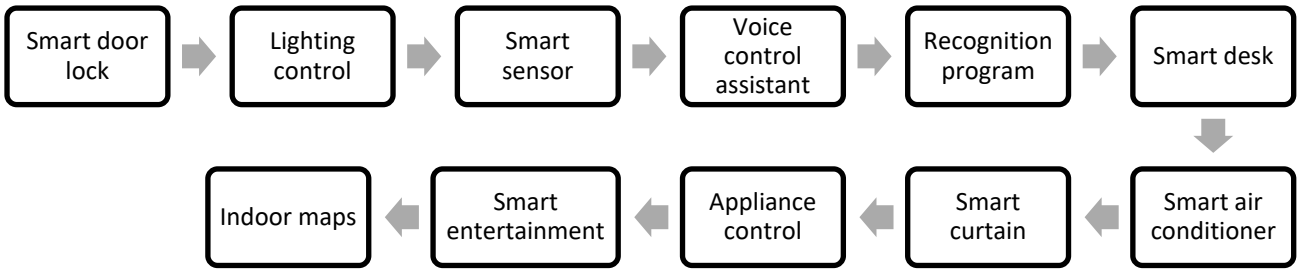


**Figure 3.** Ranking from the highest familiarity (smart door lock) until the lowest familiarity among the profession

Figure 4 depicts the results of a cross-tabulation of data among the various types of technology and professions to determine which professions are the most prepared for the transition to a smart office environment. Interior designers (blue line) and architects (orange line) are the professionals who are most familiar with smart office technology, according to the graph. Meanwhile, the specialized designer has the third-lowest familiarity with the technology, behind only the developer.

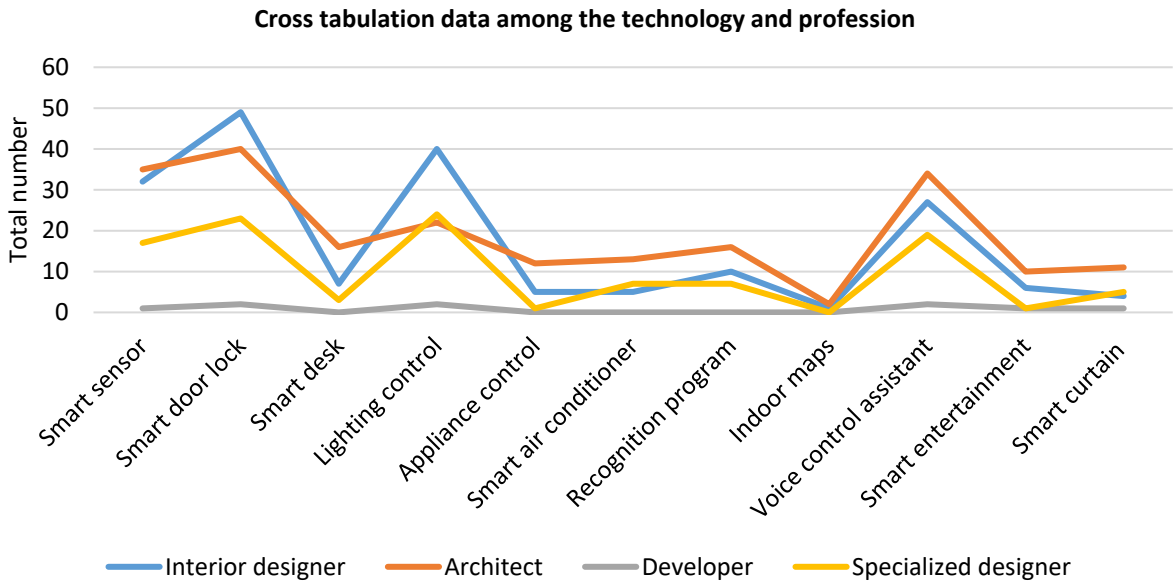


**Figure 4.** Cross tabulation data among the various types of technology and professions

### 4.2 Significance of implementing a smart office

There is significance to implementing a smart office interior, including energy savings, increased comfort level, reduction of all paperwork, improved productivity, increased workplace safety, and increased working efficiency. There are six significances of implementing smart offices, which are ranked from not at all important to extremely important. The outcome is depicted in the preceding Figure 5. Increased workplace safety received the highest number of responses from respondents, who rated it extremely important to their wellbeing. In addition, improving working efficiency received the highest number of responses and was extremely important to most respondents.

Meanwhile, improved productivity, increased comfort, and energy savings are all considered of moderate importance by the respondent. However, only a tiny amount of the paperwork was given a small amount of importance by the respondent. As a result, this demonstrates that having a smart office is extremely important among those who responded to the survey.

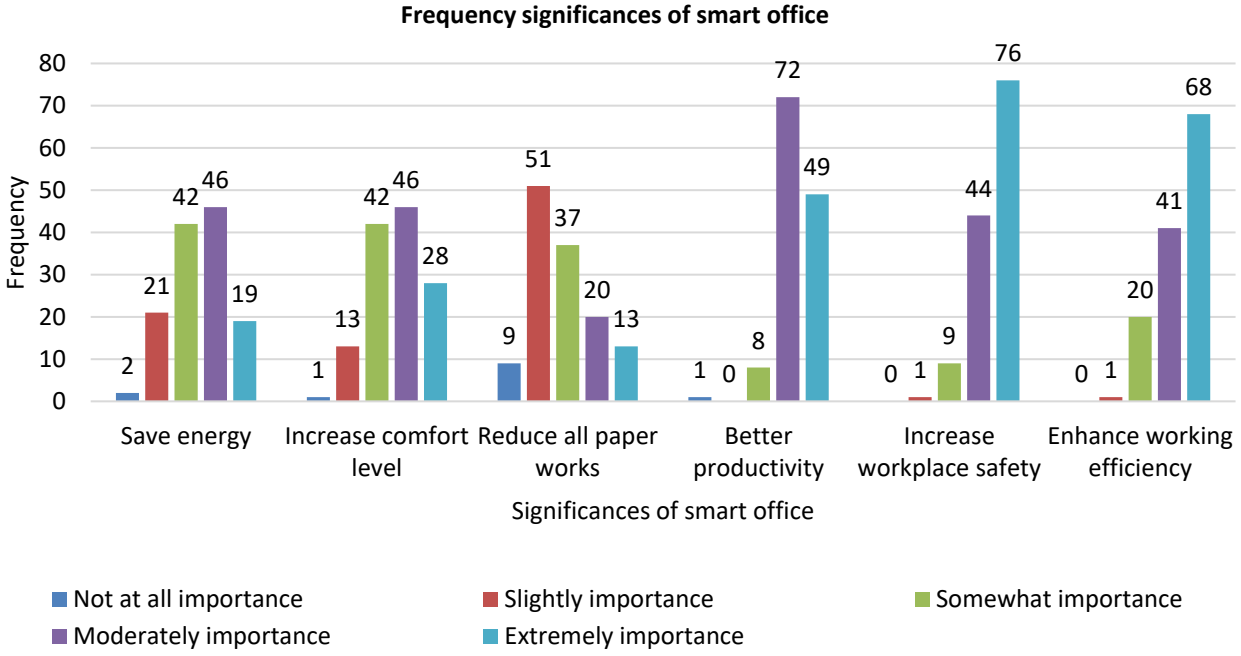


**Figure 5.** Frequency significance of smart office

A few steps can be taken to overcome the low level of familiarity with the technologies used in the smart office. For example, according to Elsey (2021), " to make the office ready to use a smart office, think about everything that could be smart and purchase the AI and sensors to increase smart office efficiencies." Examples of AI (artificial intelligence) include smart personal assistants such as Siri, Cortana, and Google Now and smart devices that adapt to users' habits and preferences. Aside from that, investing in user-friendly technology that requires little to no training empowers employees while simultaneously reducing administrative work on your end.

**5. Conclusion**

It is possible to conclude that Malaysia is not yet fully prepared to adopt smart offices because of the low degree of familiarity with technology in the professional sector. According to the survey findings, even if most individuals who participated understand the relevance of smart offices in today's world, they do not have adequate knowledge of the technology utilized to develop smart office interiors. As a result of this research, we have contributed to the existing body of knowledge regarding the readiness of Malaysia at present to implement smart offices and increased awareness regarding the significance of implementing smart offices in Malaysia. This research has also provided significant benefits by identifying areas requiring more extraordinary efforts to steer future research in a more concentrated manner. In addition, these areas have been identified as having considerable potential for further investigation.

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# Reinventing the Relationship Between Architecture, Biology and Human Experience

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**Abstract**
The oblivious implementation of 'biology' or 'study of life' into architectural design has been shaping human experiences for centuries. The human body consciously or subconsciously accepts the constructed surroundings to design emotions, senses, behavior, and logical order of its own. Likewise, the identity of a group of individuals occupied by a built structure to a certain extent reflects the spatial experience outlined by the structure. The current gap in biological understanding in design often assists in resulting imbalance between the human body and the surrounding environment. With this in mind, the first phase involves an exploration of existing biological theories regarding user spatial experience. The second phase studies a complex range of human movements, sensory stimuli, and emotional and behavioral responses recommending probable approaches for assuring structural soundness, aesthetic pleasure, and functional accuracy of an architectural setting. This research finally opens an opportunity to re-evaluate design solutions based on the potential applications of bio-scientific research for future design development.
**Keywords:** Built Environment; Biology; Sensory Perception; Spatial Experience; Bio-adaptive design.

## 1. Introduction

The relationship between a man-made structure and the man himself is a complex one. The first representatives of *Homo Sapiens* appeared more than 300,000 years ago. Human survival instincts along with their inclination toward material culture resulted in the expansion of construction practice with time. People change their behavior to fit in the physical environment (Lawrence & Low, 1990). That means, humans, build defenses and shelters used for protecting themselves from biotic and abiotic conditions, which at the same time employ their very own behavior. Winston Churchill's statement, "We shape our buildings: thereafter they shape us", emphasizes this age-old correlation between the two. The survey data of 'The National Human Activity Pattern Survey (NHAPS), 2001,' states that people spend 90% of their time indoors. The UN predicts that 68% of the world population to live in urban settings by the year 2050. Though several studies have been conducted on POE (post-occupancy evaluation) in recent times, the majority emphasizes building performance, function, and durability. Despite the consistency of technological success in the field of architecture, there still exist several neglected areas. Design complexities encountered during the process of adaptation conventionally rely on technological solutions. Why and how man-made settings impact cognitive performance, psychological as well as physiological mechanisms can be hardly examined only through analysis and modernizations of the technological features.

The built structure not only hosts its inhabitants but experiences the performance of an occupant and gradually behaves like one. The process is vice versa and accordingly, a building assists in facilitating the functional, aesthetic, and physiological growth of the human body when designed sensibly. A thorough examination of innate impulses which are generated as the reaction to various stimuli produced by architectural elements is logically capable of determining how design models connect with modern-day users. The present paper reveals the significance of this very symbiosis between architecture, biology and human experience and the promising results of their integration for the future design of buildings.

## 2. Research Strategy

Formulation of the design principles considering biological aspects focuses on the investigation of three major areas in the study:

i. Human Biology;
ii. Biology derived design inspiration;
iii. Interconnectivity of i and ii.

The research firstly aims to explore the significance of the existing bio-inspired design and conduct a literature review leading to the argumentation of the study. Furthermore, it tends to investigate the present scenarios of the implementation and practice covering biological aspects in design, including the scope of discussion for future research.

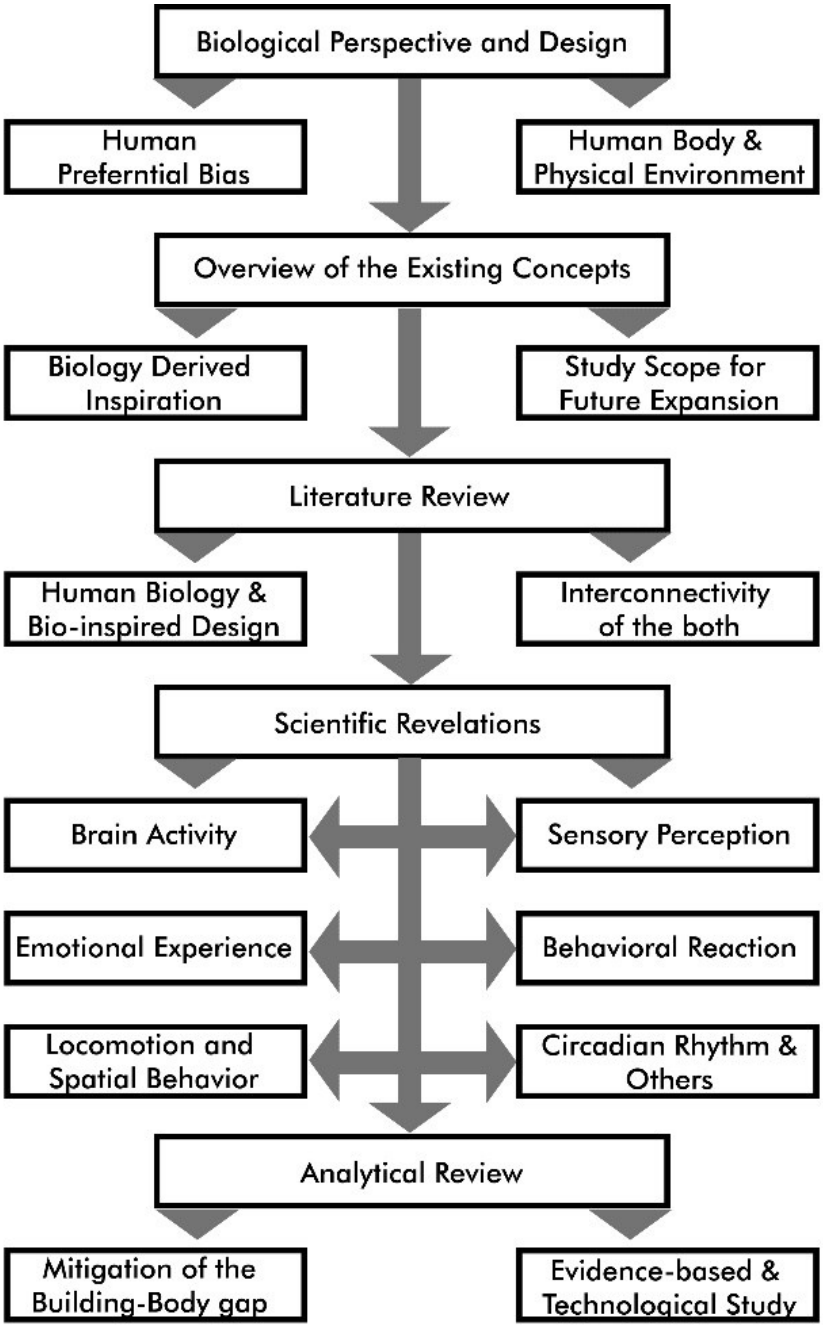


**Figure 1.** Structure of the Study (Developed by Author)

**3. Biological Perspective and Design**

Orians and Heerwagen's (1992) 'habitat theory' proposes that humans have a preference for certain visual landscapes, which later several studies have compared to the ancestral habitats. The savannah-like characteristics of open spaces with the availability of sufficient resources (water features, vegetative elements) and opportunities for protection, well-being, and productivity in which hominins evolved clarify the reason behind pre-existing biases. Preference of the involved participants in several empirical studies for such types of landscapes has been the subject matter regarding aesthetic judgment for centuries. Ricci (2018) insists that the process of pattern recognition in human beings that takes place at a subconscious level since the ancient period has been forming the mere sense of beauty and aesthetic perception. According to her study, modifications in this pattern generate unpredictability which occasionally deteriorates cognitive and physiological states.

Pallasma (1996) states that human bodies and movements constantly interact with the surrounding environment i.e. the environment and the individual inform and redefine each other constantly. He further expresses that buildings of this technological age intentionally encourage ageless perfection without including the dimension of time, or the inevitable processes of aging. Though human bodies possess the aptitude of adapting to a wide range

of complex environmental features, the innate adaptive bias has been disfavored in numerous cases in the previous decades owing to the designer bias and technology-centric approach. The co-adaptation of the building/the immobile body and the living body regulates the quality of life. Our sense of balance relies largely on the external environment, and a slight disorder in each of the senses (vision, taste, smell, hearing, touch) results in the disruption of human behavior. A sensible design model to realize adaptation and functional needs thus necessitates a comprehensive assessment of the biologically inspired designs and a thorough understanding of the biological functions of humans.

**4. Overview of the Existing Concepts**

According to Ripley and Bhushan (2016), Bio architecture is a multiscale approach for utilizing the solutions and opportunities existing in nature to solve universal human problems. They also settled that bioarchitecture includes both direct bioinspiration and derived bioinspiration, and it is a practice yet to be achieved. Various bio-inspired design methods such as 'Biomimetic', 'Biophilic', 'Bionic', 'Biornametics' and 'Biomorphic' have become popular strategies and sources of inspiration for the designers over the last few decades.

(a) (b)

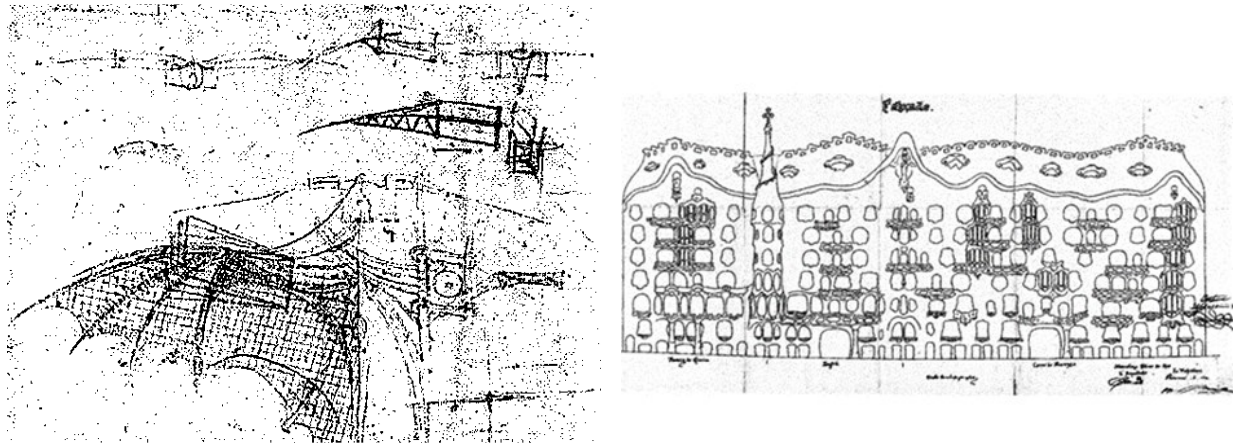

**Figure 2.** (a) Design for a Flying Machine, Leonardo Da Vinci, c. 1505 (Source: drawingsofleonardo.org); (b) Casa Milà, or La Pedrera, designed by Antoni Gaudí (Source: Gaudi: Introduction to his Architecture, Juan-Eduardo Cirlot, 2000.)

While the 'Biophilia Hypothesis' emphasizes the benefits of the human-nature relationship (Encyclopædia Britannica, 2014), 'biomimetics' or 'biomimicry' studies and mimics the nature-inspired solutions to answer complex human problems (Benyus, 1997). The idea and purpose of these approaches were explicated in the mid-19th-century (Steadman, 2008), although the biophilic movement began long before 600 BCE with the establishment of the Hanging Gardens of Babylon (Almusaed, 2011). Leonardo Da Vinci's sketches of flying machines and diving fins mimicking (Choi, et al., 2012) and observing the senses, behavior, and locomotion of living organisms like birds, fish, and bats in the 16th century to some extent instigated the movement of 'Biomimetics'. Likewise, Biornametics research studies the functionality of many natural patterns by examining the principles of nanotechnology research for the implementation purpose in an architectural design (Gebeshuber, Gruber and Imhof, 2015).

A closely related field to 'Biomimetics' is 'Bionics'. The term is a combination of the Greek word 'bios' meaning 'life' and the English word 'technics' indicating 'study' (Iouguina, et al. 2014). The Hungarian Etymological Dictionary of Foreign Words defines 'Bionics' as the 'scientific discipline researching the mechanism and functions of animal organisms, from the perspective of technical usability' (Sugár et al., 2017). The approach has been widely discussed and put into operation towards the end of the 18th century with Catalan architect Antoni Gaudi's bionic innovations e.g. 'La SagradaFamilia', 'Casa Mila', and so forth. A recent day example is the mechanical iris system on the building façade of Nouvel'sInstitut du Monde Arabe which simulates the real function of the iris of human eyes to achieve shading and ventilation of the built form (Megahed, 2012). Furthermore, other fields similar to Biomorphic, Zoomorphic, and Organic design, centering on biological forms and symbols have not been popular concepts in architecture only, but in other branches such as art, sculptures, and paintings as well. These branches of knowledge also remain as old as the times when the Greeks and Romans incorporated leaf and flower motifs into their built forms.

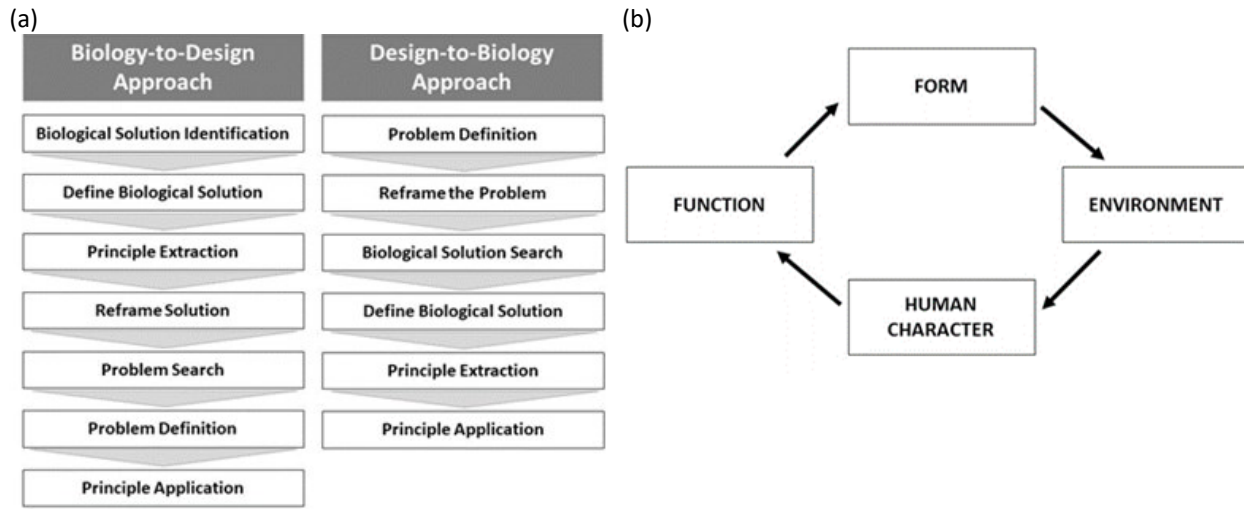


**Figure 3.** (a) Steps of design through Biomimicry, Image modified by Author (Source: Vattam, H et. al 2009, Sharif, S., 2010, Pandremenosa et. al, 2012, http://www.biomimicryinstitute.org/about-us/biomimicry-atool-for-innovation.html); (b) Building a Better World through architecture, By Arc. David 'Lola Majekodunmi, mnia, riba, aia (intl.assoc.).

However, to date, architecture and design have been limited mostly to direct imitation of natural shapes and ornamentation or inspired strategies that include one or another biological aspect (Ripley and Bhushan, 2016). There is undoubtedly room for this field to expand its scope. In this regard, how human spatial experience and biological response play a role in design remains a question. In recent times, assessment of the effects of environmental stress on cognitive performance led to a rise of several disciplines. For example, brain activity to external stimuli can be monitored and measured to formulate evidence-based design approaches for future intelligent buildings. The reevaluation of the influences of more of such growing ideas becomes essential to resolving existing challenges of architecture and future human survival.

**5. Literature Review**

Mathematician Luca Paccioli in 1498 through his mathematics book, De Divina Proportione expressed, "First we shall talk of the proportions of man because from the human body derive all measures and their denominations and in it is to be found all and every ratio and proportion by which God reveals the innermost secrets of nature." Similarly, the medical sciences emphasize the impact of human functional development, suggesting the necessity to rediscover the significance of 'place' for human health (Frumkin, 2003). On the other hand, Salingros and Masden (2006) established that biological systems and natural processes which are responsible to shape every living structure simultaneously rendered architecture and the built environment replete with life. However, whether the human response to the built environment to date has been considered in Bio-inspired design research, remains a question. Though humans are behaviorally flexible and can adjust to a wide range of environments and habitats (Smith, Borgerhoff Mulder, and Hill 2001), knowledge and understanding derived from human responses to the built environment can be utilized in design decisions to create a further harmonious relationship between humans and the built environment ( Lang, 1987).

The post-industrial habitat design required to first and foremost consider human freedom (Demchak, 2000). Currently, the increase in designers' self-imposed separation from biological directives in design causes irrational construction habits. The negligence in considering bodily reactions to natural and artificial objects has become a habitual construction behavior and such a designer-based approach fails to connect to the reality of the existing physical environment. The long practice to use bodily reference by Vitruvius, through Alberti, Filarete, Francesco Di Georgio and Leonardo appears to be neglected in design (Vidler, 1990). The imposition of particular technical solutions or sets of ready-made variants is often considered standard causing 'the beginning of the process of erosion of the spatial differentiation, or the destruction of 'spatial identity of cities' (Lamprecht, 2016). The evolution of the modernist ideology following Le Corbusier's influential phrase 'The house is a machine for living in' shaped an uninvited trend leading to dehumanization and monotony in several aspects. Industrial and post-industrial architecture based on the mass-production of iron, concrete, and steel depicting "machine houses" lacked a human scale in major areas. Mitchell (1992) pointed out observations of industrial designer and theorist Christopher Jones of being 'frustrated with the superficiality of industrial design' in such a backdrop. Architectural culture accepted very limited industrial-minimalist typology which today benefits not the user, but the profession (Salingros, 2018).

Pinker (2002) criticizes modernist architects for uplifting boxy shapes of buildings made of industrial materials that effectively act like machines, however, eliminating ornamentation, traditional craftsmanship, and green corridors, interactive spaces that form the basic aesthetic and social needs. The practice of trained architects replacing the prevailing appearance of the real world with an abstract, formal set of computer-based images does not fully represent reality but expresses fictitious objects that don't exist (Salingaros, Masden II, 2015). The fabricated reality defines the homogeneity of the urban skylines, which in the long run represent merely collective rectangular boxes. The loss of such a sense of place leads to decreased social interaction, safety, and lack of identity increased social conflict, crime, and transgressions in towns (Nikoofam and Mobaraki, 2017). Thus, habitat arrangements lacking considerations of natural features and human preferential bias in cities become incapable to restore social, cultural, or ecological balance.

In every individual spatial condition of the post-modern world, the relationship between an object (both natural and artificial) and a subject modifies mood states, emotions, and productivity. Buildings, incompatible with their surroundings have been subject to criticism for the failure of function as well as unsatisfactory artistic qualities, alienating people that live in and around them (Farshchi, Fisher, 1997). Chandrasekar (2011) ascertained that a poor office environment does not negatively impact only productivity but health and the work-life balance of an employee. Palpitations, anxiety, sweating, higher adrenaline secretion, etc. may take place in any stressful spatial conditions. Stress, itself is the chief cause of 60% of all human diseases and illnesses (Farghaly, Hany & Moussa, 2021).

Human experience in the built environment refers to the human mindset influenced by external situations and revealed through human psychological, physiological, and emotional measures (Ergan et al., 2018). The elements of the built environment can directly impact physical health, at the same time being capable of both positively and negatively influencing behavior, habits, and feelings. (Lekić et al., 2018). For example, changing the built environment to increase children's physical activity for recreation and transportation can improve access to healthful foods and reduce access to harmful foods providing long-term results to the childhood obesity epidemic (Sallis & Glanz 2006). Moreover, appropriate space management can also have an important contribution to preventing spatial segregation of the elderly who prefer aging in place (Costa-Font et al., 2009). Another research points out that, the impact of the built environment may be a strong determinant in influencing behaviors regarding physical activity and diet as adolescents begin to explore the environment around them independently of parental influences (Papas., et al 2007). Researchers were successful to examine the relationship between the design of indoor environments and stress levels in health care, schools, and office buildings (Beukeboom et al. 2012; Rashid and Zimring 2008; Ulrich et al. 2008). Furthermore, in the last two decades, there have been few experimental studies in psychology and neuroscience that used Immersive Virtual Reality as a tool for observing human behavior and brain activity during natural contact with the external environment (Tarr and Warren, 2002). The evidence-based experiments on biological responses to spaces have been able to a degree to explain the symbiosis between humans and the built environment. The continuation of such research is a necessity at present. Therefore, architects responsible for designing the external environments for all humans should make the best effort to clarify the human-environment interface and environmental design by evaluating human needs and motivations as well as speculating their behaviors, actions, perceptual processes and emotional responses (Moneim, D. W. A., 2005).

**6. Scientific Revelations Regarding Human Biological Response to Design**

Modern humans experience the surrounding environment very differently than the ancient ones. Potential research studies in recent years observe the effects of natural and artificial objects on individuals in achieving preferable stimuli in various functional areas such as office environments, hospitals, schools, etc. Such outcomes depend largely on human physiological, physical, and psychological responses to design. For instance, it is proven that lighting and level of luminance influence our stress and anxiety levels. (Farbstein and Farling 2006; Sternberg and Wilson 2006). Additionally, researchers have found that during exposure to cognitive loads in a darker space, an individual's stress level increases. Developments in science and technology and interdisciplinary collaborations between fields such as bioinformatics, artificial intelligence, virtual realms, and neuroscience formed new perspectives and resulted in the progress of data-collecting devices, and measurement techniques, which helped to strengthen the knowledge of human-built environment interaction (Karakas and Yildiz, 2020). Such fields that now explore organism biological responses and structural adaptions to the physical environment through the investigation of the natural processes, biological forms, and living systems, intend toward human well-being and ecological restoration in the present context.

**6.1 Brain Activity within Built Spaces**

The neural responses to pleasant and unpleasant stimuli regulate decision making, learning, thinking, speaking, and the ability to solve the task in an architectural setting. According to William James, one of the founders of modern

psychology, 'stimulation is the indispensable requisite for pleasure in an experience'. Various contemporary branches, for instance, NeuroeAsthetics, NeuroUrbanism, and NeuroArchitecture study brain activities around and within built spaces. From the formation of emotion to execution of an action, the readings of the frontal lobes dealing with cognitive functions, limbic system with its function to pay attention, cortex developing action tendency, amygdala's notification regarding fear or ventral striatum's about pleasure and activities of other related brain regions can be recorded through the application of scientific research. For example, the brain region amygdala associated with fear processing remains more active for sharp objects than curved contour counterparts (Bar and Neta 2007).

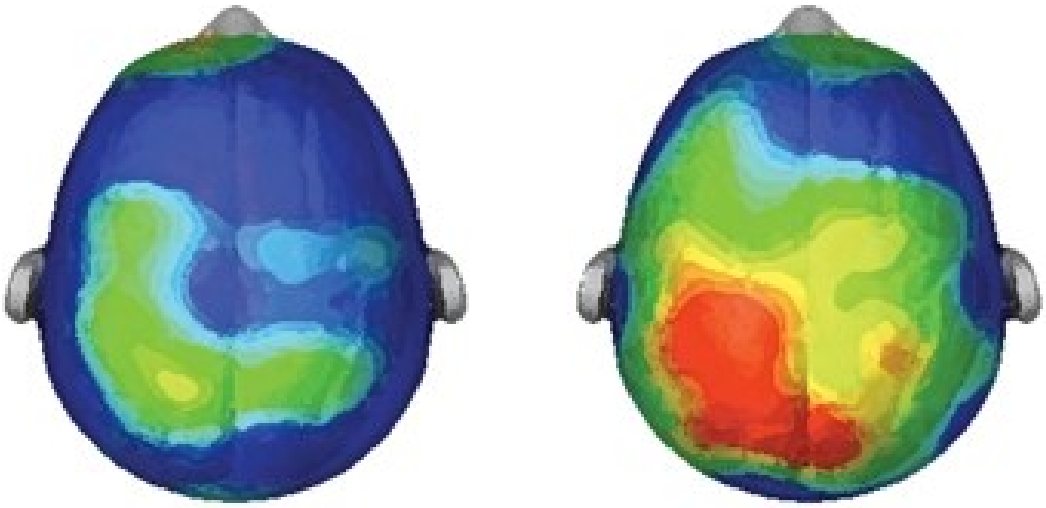

**Figure 4.** The left image shows brain activity for 20 minutes of quiet sitting in the classroom and the right image shows brain activity for 20 minutes of walking before the academic test of preadolescent children, indicating the increase in brain activity and better academic performance due to exercise. (Research by Dr. Charles Hillman, 2009)

Charles Hillman (2009) experimented with 5th-grade students and established that physical activity influences brain activity in due course affecting academic performance. Such scientific applications point toward the set of rules for design differentiating between the right and the wrong design decisions. Though the potential applications of scientific evidence to solve modern-day challenges such as promoting mental health and well-being are still at an experimental stage, the first studies using fMRI, EEG, PET, etc. display promising revelations. For instance, research shows that human beings' perception is highly sensitive to symmetry (Wagemans, 1995). Another study proves that perceivers have a positive aesthetic response when they can fluently process that object (Hekkert 2006). Geometry, light, texture, smell, air, and other factors contributing to the spatial complexities direct signal to the brain which is measured through the bodily responses. Researcher ItaiPalti with neuroscientist Dr. Moshe Bar has been engaged in evaluating the concept of "conscious cities" through human response based on the scientific evidence associated with cognitive sciences. The fact that design affects the brain is undeniable. Through neuroscience data, human response to functional complexity could therefore be assessed and reassessed to achieve better design outcomes.

**6.2 Sensory Perception**

Spatial perception evolves through human sensory exploration of objects and events in an environment. Though humans are considered visually dominant creatures (Levin, 1993), each sensory signal has a distinct influence on the relationship between the human body and its surroundings. Besides auditory, tactile, visual, gustatory, and olfactory aspects, various inherent yet recent-defined senses such as equilibrioception, kinaesthesia, thermoception, etc. in total have been constantly enhancing architectural experience since the beginning. According to the gestalt principle, the sensory input is not perceived as the sum of the individual components, but rather as a whole (Lin, 2004). All the environmental characteristics such as the existence of specific odors, colors, hues and shades, noise, acoustics, temperature, etc. generate sensory input to altogether produce specific reactions in an observer (Franz, 2006). Form and geometry, position and distance, surface and skin, material and texture, etc. of the surrounding objects in an architectural setting enable positive and negative sensations to develop as a reaction to the spatial experience. This may explain the reason behind human's preference for symmetric shapes, as they hold fewer

complexities than asymmetric shapes (Garner, 1974). Also, evidence suggests circular surfaces and shapes to be more pleasing to common people than angular hexagons (Bar and Neta, 2008).

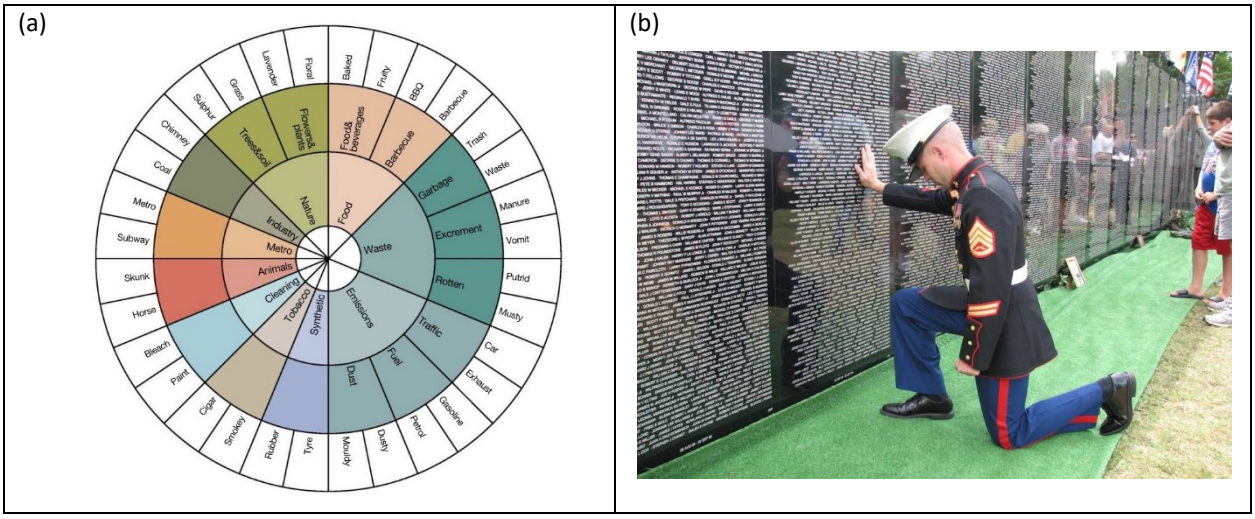


**Figure 5.** (a) Urban Smellscape Aroma Wheel (Aiello L, McLean K, Quercia D, Schifanella R. 2015), (b) Tactile Experience, Vietnam Veterans Memorial (Source: American Veteran Traveling Tribute & The Traveling Wall, AVTT, The Berkeley Observer, 2021).

In an ocular-centric contemporary world, several senses are habitually neglected and the process results in overlooking the effects of the designed environment on the cognition and emotional states of the individuals. Pallasma (1996) fairly quoted "Modernist design at large has housed the intellect and the eye, but it has left the body and the other senses, as well as our memories, imagination, and dreams, homeless." His further argument on the alarming effects of modern architecture on the human body owing to sensory deprivation portrays the increase of separation between the human body and the existing natural world in the present condition. Some research to observe the integrative sensory experiences in certain architectural arrangements experimenting with audio-visual or audio-olfaction, tactile-olfaction or tactile-visual, etc. stability signifies the impact of multisensory design in architecture. Such an experiment observing the effect of music and scent in an interior space of a gift shop has been conducted by Mattila and Wirtz (2001) where consumer satisfaction has been achieved as a result of the coalition, encouraging visit intentions and approach behavior with impulse buying rate. Likewise, tactile-visual aspects to cause composed sensory arousal in a spa have been experimented with to have established similar positive results (Kang, Boger, Back and Madera, 2011). However, the congruency effect between music and smell may produce a different result based on consumer mood and functional situation. This complex integration dictates human rejection or acceptance with respect to the hostility or hospitability of the space. For instance, 'Christmas music' and 'Christmas smell' together result in greater visit intentions and customer satisfaction than without any music or smell; nevertheless 'Christmas smell' with music dissimilar to Christmas melodies produces weaker visit intentions (Spangenberg, Grohmann, Sprott, 2006). Veterans Memorial of Vietnam and Civil Rights Memorial of Alabama, USA stands as a noteworthy example of a texture-rich experience for the human body. As such multisensory responses play an indispensable role to strengthen place identity along with self-identity, investigation of positive and negative olfactory, muscular, haptic, visual, auditory, or combined sensory aspects in every functional setting becomes a prerequisite for measuring the sensibility of the designed space.

### 6.3 Emotional Experience

Human emotional responses cannot be measured in one specific method. Humans react differently to certain stimuli and for determining the reactions, the experiential, physiological, and behavioral responses serve as three major components (Cho, Kim 2017). Among various response patterns, facial and vocal expressions have been considered the chief motor expressions for measurement (Desmet 2004). Charles Darwin's theories (1872) of discrete emotional entities have been focused on and extended by various psychologists in the later century. American psychologist Paul Ekman in early 1970 identified six universal or basic emotions (anger, surprise, disgust, enjoyment, fear, and sadness) through experimentation with human facial behavior. Plutchik R, in 1982 extended it and pointed at eight emotions as of primary and vital importance namely anger, fear, sadness, disgust, surprise, anticipation, trust, and joy. His proposed 'wheel of emotions' in 1980 centers around the relationships among the different emotional entities and the consequences and intensities of their mixture.

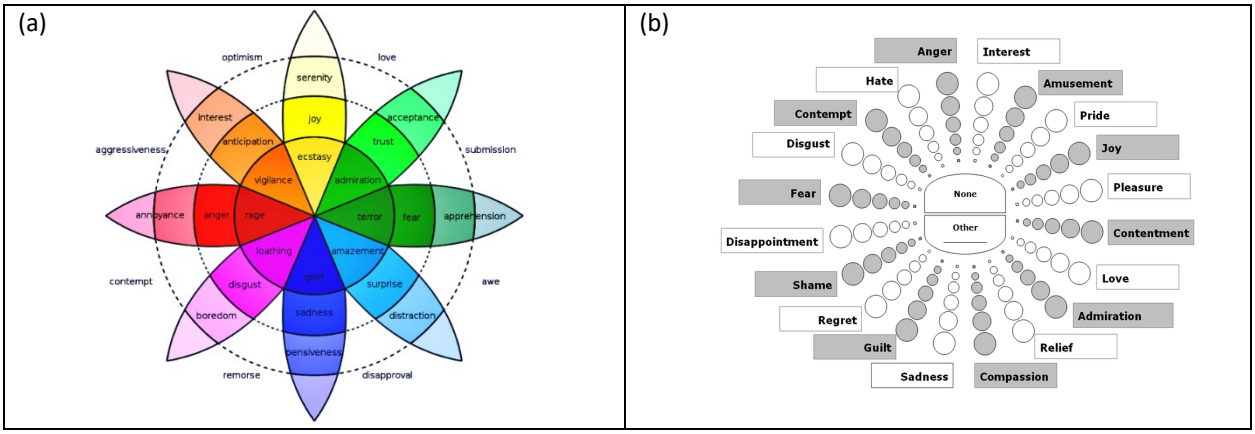


**Figure 6.** (a) Plutchik's Wheel of Emotions, 1980; (b) Geneva Emotion Wheel, 2013 (Source: Blaiech, H., Neji, M., Wali, A & Alimi, A.2013. Emotion recognition by analysis of EEG signals. 13th International Conference on Hybrid Intelligent Systems, HIS 2013.)

Facial behavior, vocal expressions, eye movements, bodily gestures, and other physiological responses to the built environment categorize emotional stimuli and prepare a human for a particular action. Judgments, choice, decision making, and behavior formulation take place throughout the process. For instance, frustration may arise and be depicted typically by the activation of various facial and vocal expressions as a result of behavioral attempts to overcome obstruction when an event interrupts an achievement of a human goal (Brosch et al.,2010). For this reason, a child's body with an impulse for physical movement in an inflexible spatial arrangement inside the traditional classroom model holds restricted choices of actions eventually losing motivation and interest in social interaction. According to a study by Liu and Jang (2009) in a restaurant setting, lighting, scent, music, and temperature have significant effects on both positive and negative emotions. However, an ignorant design approach develops negative emotion effortlessly as studies (Gelder et al., 2005, Pourtouis et al., 2005) show negative stimuli to be more spontaneously and speedily processed than positive ones. In such a case, the stimulation in the human 'bias for bigness' caused by the massive scale of monumental architecture portrays architecture's social function and role (Verpooten, Joye, 2014). An 'awe' is an emotional response caused by overwhelming vastness (Keltner and Haidt, 2003), and a study (Cappellen and Saroglou, 2012) shows such a response creates feelings of togetherness with each other and results in devoted relationships. Research shows that with greater forest cover possibility of 50% less depression and 43% less stress in neighborhoods remains (Cox, Shanahan, Hudson, 2017). Developed by the researchers of MIT's Computer Science and Artificial Intelligence Laboratory, the device "EQ-Radio," can currently detect a person's emotions using wireless signals by measuring breathing and heart rhythms and variations. Various new emotional mapping devices and on-body sensors help measure emotion in a natural or artificial setting. Designing architectural elements with emotional value complements the quality of experiential response. To recognize the human psychological cravings, and assure physical comfort and physiological well-being, the conscious and unconscious emotional experience of human beings in various architectural settings appeals to observation.

### 6.4 Behavioral Reaction

Architecture has been playing a remarkable role in shaping the behavior, perception, and intention of individuals and communities from the very beginning. Psychologist Kurt Lewin in 1936 formulated a heuristic equation to determine behavior that centers on the functional relationship between a person and the environmental situation. His equation "B=f(P, E)" expressing behavior (B) as the function (f) of both individual (P) and environment (E), grows into an influential formula. The behavior-shaping process is imperceptible and the slightest inattention of the bodily factors during the process may cause an unpredictable behavioral outcome. When individuals are compelled to show certain behavior in an unnatural approach through man-made design, they experience difficulties and expose disordered mental patterns during the process of adaptation (TavasoliAra&Bashiri 2015). Russell and Mehrabian (1978) emphasized the fact that emotional experience influence human behavior in an environment. Humans possess a tendency to approach or avoid an object assessing threat or opportunity with respect to the emotional response to finally lead to action tendencies as a component of behavioral response (Cho and Kim, 2018). Such bodily responses may be muscular or glandular, sensory or neural, etc.

ECG, fEMG, GSR, EEG, and PPG determine cognitive and physiological states including attention, memory, stress, emotional valence, fatigue, and so forth. Similarly, the whole-body behaviors in a built environment observed and analyzed through instinctive cortical arousal, bodily changes, eye movement, and facial expression promise to

measure the soundness of the design. Behavior study through examining movement, rest and work, attitudes and actions, etc. measures the experiential quality of the functional space. Meyers-Levy (2007) experimented with such influence of architectural space on thinking style. He observed low-ceiling rooms to be assisting in concrete thinking as concentrating on the details of a particular subject or object while high-ceiling rooms assist in abstract thinking as creative activities, brainstorming, etc. Such role of architects in formulating behavioral intention in space has been overlooked for several years. The research in the field of 'Environmental Behavior' monitors environmental experience and consequences to measure the relationship between human behavior and his surroundings with an intention to promote human well-being. The importance of environmental behavior in architecture is undeniable as it ensures not only human health but predicts and studies pro-environmental behaviors. Habitual behavior patterns, place-attachment, and identity, automated cognitive process, etc. of humans in a man-made setting require thorough attention to gain an understanding of the methodology of behavior modification. Attainment of the preferred behavioral state through design thus requires evidence-based investigation of behavioral choices, judgments, and intentions based on the post-occupancy evaluation.

**6.5 Locomotion and Spatial Behavior**

As stated by architect Bernard Tschumi, "Bodies not only move in space but generate space produced by and through their movements." However, common techniques of architects to describe ideas through drawings, models, sketches, computer visualizations, etc. have been unsuccessful in the past to reveal the spatial quality of human movement (Vroman, Lagrange, 2017). Such spatial values being ignored, the lack of spatial sensibility manipulated people's spatial behavior for years. Many negative health consequences resulting from the lack of movement are caused by the bad structure of the built environment (Heath et al., 2012).

The psychology of motion plays an important role in evaluating architectural experiences. The design factors and elements in a space stimulate spatial continuity and direct the sequence of flow consciously or subconsciously. Humans have definite feelings for every particular shape within a built space (Shemesh, Bar, Grobman, 2015). The movements followed by the stimulation of the objects and the events are not necessarily physical, but often mental. The mental movements occur before the physical ones in maximum situations following the approach, direction, flow, and rhythm of the event and space. An explorer occupying a low degree of enclosure in a built space with a stimulating viewpoint towards a certain direction would habitually develop a sensual tendency to move towards that direction even before the physical action (Ahmadi, 2019). In such a stage where decisiveness of potential, imaginative, or future movement develops, the facial expression with eye movement as well as the shifting of muscular posture dictates the comfort and functionality delivered by the event or space. The research on spatiality at both building and urban scales deals with objects and the space between these objects, the shape, and characteristics of the void, and their mode of arrangement (De Aguiar, 2006). The role of the directional axis along with the surrounding air movement in characterizing human spatial action is immense. This is why Edward T. Hall's (1966) theory of interpersonal distance defines four zones (1969): intimate, personal, social, and public space, which remains a standard to measure stress and relaxation or flexibility and rigidity in a designed space.

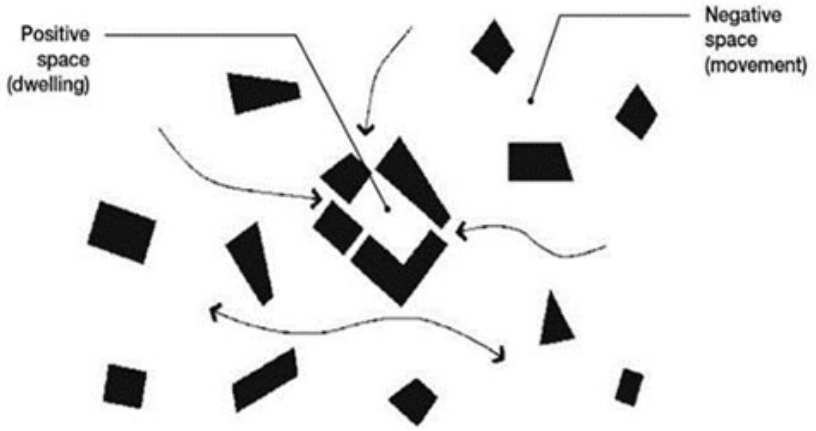


**Figure 7.** A college "quad" is usually the preferred space on campus for social interaction and hanging out, (Relation between ground and figures, Source: Ibrahim A, Mikhail R, 2016).

Though humans possess a variety of navigation abilities, certain behavior while navigating decides the usability of path design and integration. Mapping of everyday human activities is necessary to detect efficient or unused spaces to improve future urban performance through amended placement or design of furniture, lighting, navigation

patterns, or other creative elements (Poulsen et al., 2011). These systematic observations could be carried out in areas of human gatherings and social interactions, or areas without activities. Human experiences both best and worst, eye-to-eye contact, speed of the movement, ignoring or interacting postures, etc. regulates the flow of experience in the urban areas. Experimentations of a diverse range of motion intensity in a public place from walking to with general people uniform remains a prerequisite for adaptable design. Professor of cognitive neuroscience, Collin Ellard in his lab experiments and studies human responses as fear and anxiety around the heavy traffic intersections and hiking paths to predict human urban behavior. According to Wunderlich (2008) "It is while walking that we sensorially and reflectively interact with the urban environment, firming up our relationship with urban places." Eadweard Muybridge famous for his photographic studies of motion, since 1901 used cameras, stop-watches, time-lapse and electric lights (attached to the limbs) to capture sequential photos that represented the flow of the movement. Tracking the eye routes and observing the bodily postures with time and environment assist in predicting human behavior and action. How people move and adapt to space can currently be represented through various methodologies accompanied by the spatial analysis software. For instance, 'Space Syntax' is a visual perceiving system of movement patterns in the context of urban development and 'Kinect' is a data accumulator of people's motion, voice, and facial expression in public spaces. Experiments to observe the lines of movement and spatial behavior require a detailed circulation diagram displaying obstacles and flexibility of the space. It is thus essential to design required performance through the allowance of spaces that enable human movement assisting him to adapt and change as per his wish.

**6.6 Circadian Rhythm**

Disruption of a human's circadian rhythm cause desynchronization in metabolism, appetite, productivity, sleep-wake cycles, and emotional stability. Besides, change in melatonin levels, blood pressure, and blood sugar due to any disturbance of the rhythm are observed among people of different ages. Light, color, and texture have a significant influence on circadian rhythm. Actigraphy being the most common methodology, circadian rhythms in an architectural setting are generally measured by evaluating the core body temperature, melatonin levels, oxygen levels, etc. Though contemporary buildings and skyscrapers ignore the connectivity to the ground levels, physical contact with the earth's ground regulates the human circadian rhythms. Such an experiment of walking barefoot on ground texture has been proved to achieve a similar affirmative result. However, there still exists a lack of detailed research in these areas. Measurement of visual comfort and circadian stimulus in the interiors through experimentation on light exposure has been a common method in recent years. The power of natural light being the utmost, following certain guidelines in the cases of designing artificial light is a precondition. Experiments reveal that the provision of cycled lighting (reduced light levels at night) in neonatal intensive-care units improves sleep and weight gain among preterm infants (Blackburn, Patteson, 1991). Another research shows that controlling the circadian system with natural and artificial lighting, depression, sleep, circadian rest-activity rhythms, as well as the length of stay of the patients or staff in the hospital can be influenced. (Joseph, 2006). Such human response is neglected very often and thus needs to be assessed and analyzed for future design accuracy.

**6.7 Other Measurements**

Various medical and therapeutic testing are capable of measuring human response to the environment. For instance, the measurement of heart rate predicts stress levels (Jovanov et al. 2003). An object is supposed to possess effective 'value' if it can impact a person's breathing, heart rate, hormonal secretions, etc. (Barrett and Bar 2009). Psychophysiological parameters and measurements such as heart rate, respiration, blood pressure, and galvanic skin response (GSR) possess the capacity to predict human emotional experiences (Shemesh et al. 2017). The function of skin conductance to cause psychological or physiological arousal can be used to measure emotional and sympathetic responses (Carlson 2012).

Again, contact with natural landscapes or interrelated features, i.e. plants and animals, is found to be beneficial for child development, human physical and mental well-being, mood, disease, mortality and recovery from illness (Tost and Meyer-Lindenberg, 2015).

**7. Analytical review**

In most post-modern urban settings, the replacement of the naturalness of the landscapes with 'concrete jungle' in the process of stabilizing economic balance and efficiency consistently disregards the aesthetic and cognitive transformation of human beings. Today, there seems to be a huge gap between architects and building users that can be mitigated by current evidence-based research and advanced technology. Hence, bridging the gap between the two is necessary and one important way includes measuring and assessing human bodily responses and spatial experiences in a built space. Though industrial-modernist architects have segregated from the human need deducting the need for a healing environment for a long period by dropping adaptive design instructions, today's

professional practice should implement only tested design processes for health-promoting urban environments (Salingaros, 2018). A post-industrial civilization necessitates fresh design approaches than the industrial one. In such a case, Montana and Fiorentino (2016) suggest the expansion of bio-inspired and biophilic technologies as opportunities for freshness in post-industrial design. They also demanded that present transdisciplinary design practice and research must tackle challenges derived from the industrial revolution by exploring new technologies and design solutions for the betterment of mankind and their environment.

Post occupancy evaluations have been effective as a research methodology in the last decades. The practice of post-occupancy evaluations consists of using questionnaires, one-to-one interviews, field and photographic surveys, walkthroughs, group discussions, time-use recordings, as well as direct observation and evidence (Turpin-Brooks and Viccars 2006). Post-occupancy evaluation results can be implemented during the design process for future facility development, to ultimately devise a more solid theoretical framework directed at improving the process of forming a more responsive architectural environment (Horayangkura, 2012). Rob (2003) points out in his research the emergency for design to recognize and respond to the diversity of bodily needs in the built environment by allowing impulsiveness, overlooking restrictions and sensitizing to the corporealities of the body. As he stated, architects should identify the multiplicity of postural schemata of the body. According to research, the presence or absence of daylight, level of luminance in rooms, wall colors, circulation, spatial openness, accessibility to the built forms, outdoor landmarks, etc. can change people's perception of the space, and this perception is reflected in their bodily measurements (Ergan et al., 2018). The same research studying human experience concludes that one important challenge in quantifying the impact of architectural design features is to build controlled testing settings (Franz et al. 2005) in which design features can be changed and tested independently. Presently, building information modeling (BIM) and virtual reality (VR) tackle challenges by offering the flexibility to swiftly imitate and modify real-life environments under controlled settings with a high degree of practicality for users (Zou et al. 2017).

Architectural design features impact our experience in a space extensively and each design feature influences a specific human experience (Eberhard 2009). We have to understand that architecture and the human body are mutually constitutive (Imrie, 2003). Just as the bodily form is not independent of the architecture, architecture is not independent of the body. The key to a fresh design exists in the understanding of how physical/biological structure develops and embraces; knowledge of the design adaptability with the external and changing circumstances; information about multifaceted interacting systems and understanding of how our intellect links us with the real world (Salingaros and Kenneth, 2007). Hence, design should permit and consider the holistic approach of spanning and integrating the spheres of architecture, biology and human experience.

**8. Conclusion**

Biology and bio-architecture have offered architects a new framework to address the issues of healthy building design. However, bio-architecture is not only restricted to the existing fields. Through several kinds of research, it has been observed that architectural experience and human biology are two attributes that influence each other to a great degree. Current building practices result in an adverse effect on human biology as well as nature. As quoted by Pallasmaa (1996), "The inhumanity of contemporary architecture and cities can be understood as the consequence of the neglect of the body and the senses, and an imbalance in our sensory system." When humans perceive themselves as being isolated from the environment, it leads to unpredictability and mediation, ultimately directing towards extinction. Hence, it is high time to re-examine opportunities to learn from human biology and spatial experience to implement them in the development of design principles. Contemporary society must identify architectural misconducts and practices which today characterize built forms as isolated objects from the human body.

Bio-inspired design as a study dealing with nature, biological forms and processes should be also connected with the anatomy, biological functions and physical and mental states of humans in a built environment. Though mimicking and utilizing biological forms and the biological process in design bring new solutions to the table, a clear dialogue between the fields of biology and architecture cannot be obtained without analyzing human response and experience. Hence, architecture, biology and human spatial experience should be integrated to develop a separate approach or field to ensure quality design and human wellbeing in architecture.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Evaluation of Energy Performance of Main Administrative Office Buildings of Universities in North-Central Nigeria

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**Abstract**
The adverse effect of increasing energy demand on global climate has made buildings objects of research globally. Generally, in Nigeria, lack of building energy data and specifically energy consumption information related to building facilities in universities has been given less attention where bulk-metering has been the common practice. Consequently, energy demand of individual building remains unknown. Hence, Energy Use Index (EUI) was adopted as energy performance indicator for main administrative office buildings of federal universities in North-Central Nigeria. This study been exploratory in nature adopted a case study technique. Simple energy audit was conducted in the absence of individual monthly energy bills. The end-uses disaggregation shown that cooling load accounted for more than 40% of annual energy consumption. Also, the derived EUI of 197.85KWh/$m^2$/yr was above benchmark for similar buildings globally. This outcome implies that the buildings are energy inefficient and need for sub-metering and regular energy audit.
**Keywords**: Energy audit, Energy consumption, End-uses, Energy Use Index, Office buildings.

## 1. Introduction

Environmental sustainability is one of the threatening issues facing the entire world in the 21st century. This has been traced to rapid increasing energy demand for comfortable living standards for growing global population (Rai, 2004). The adverse effect of increasing energy demand particularly greenhouse gas emission has been strongly linked with global warming (Building Research Energy Conservation Support Unit [BRECSU], 2000; ECN, 2015) and cumulatively the dreaded case of climate change as established by quite a number of empirical studies globally (Mazria, 2003; Doughty & Hammand, 2004; Kasozi &Tutesigensi, 2007; Perez-Lombard et al., 2008; Rahbarianyazd, Raswol, 2018). However, improving energy efficiency of buildings had been proven to be fundamental to climate change mitigation by monitoring energy performance of buildings, which also has inherent economic advantage (EC,2003; IEA, 2008). This scenario has made building energy efficiency an integral part of most environmental discourses, thus made buildings object of research globally. Building sector had been found to be accounted for approximately 30% to 45% consumption of energy supply globally (Pout et al., 2002; Huovila, et. al., 2007; UNDP, 2010; Asimakopoulus, et. al., 2012). Moreover, the larger percentage of energy consumed by the generality of building industry globally was found to be consumed during the occupancy or operational phase with cooling energy being the dominant end-use in most cases among other end-uses that included lighting, appliances and building services (Cole & Kernan, 1996; Heiselberg, 2012a; Horsely, 2004; Suzuki & Oka, 1998). Meanwhile, non-domestic buildings, particularly office buildings had been identified as the building type that consumed largest energy during operational phase. This feat had made office buildings a major target for energy reduction globally (Ravetz, 2008; Sadrzadehrafiei, et al., 2012; DEEC, 2013; Chung & Rhee, 2014). In this light, most developed nations have gone to the extent of establishing benchmarks for various building categories and components towards energy reduction for sustainable built environment, while most developing nation including Nigeria are lagging behind in this noble objective (Janda, 2009; Iwaro & Mwasha, 2010). Tertiary educational institutions particularly universities are indispensable organisations globally because of the critical services being rendered to the nations. According to European Commission Joint Research Centre [ECJRC], (2012) universities had been classified has as high energy consuming organisations owing to possession of large stock of buildings and subsequently are expected to report their energy use and improve their efficiency as part of their cooperate responsibilities (Maimunah & Shehu, 2010). In the same vein, Adekunle et al. (2008) had equally stressed the need for monitoring and controlling of energy consumption in Nigerian universities owing to limited supply in order to achieve the aim of teaching, research and community development. However, buildings in universities in Nigeria practise bulk-metering system which make determining energy consumption of individual building a major challenge. Generally, in Nigeria paucity of building energy data which is as a result of inadequate empirical studies on building energy use and absence of local benchmarks were known facts (Mua'zu,2011). This is visible in limited effort that has been geared towards establishing the actual energy end-use distribution for various building categories (Imaah, 2004b; Fadamiro & Ogunsemi, 2004). Also obvious is less attention given to studies related to energy use of buildings in Nigeria universities. Having identified these problems, this study

investigated energy consumption and pattern of energy end-uses distribution with the cumulative aim of determining the performance benchmark for main administrative office buildings of universities in North-Central Nigeria being a typical office building similar in both design and operations to other public office buildings.

## 2. Review of Literature

### 2.1 Brief Global Perspective of Energy Use in Buildings

The building sector which has been strongly associated with consumption of almost 40% of global energy supply (Huovila et.al., 2007). Nevertheless, in recent decades there has been a continuous increase in the global energy use by the built environment. The annual average energy growth between 2005 and 2011 was estimated to be 3.15%. The global energy consumption rate was 8.92Gigaton of oil equivalent/year (Gtoe/year) in 2011 according to International Energy Agency [IEA] in 2014. This value was projected to rise to 14 Gtoe/year by the year 2020; this invariably means that there is a growing trend in energy consumption of the global building industry. This scenario is expected to continue with the dynamics of energy demand particularly countries with emerging economies in Africa, South America, South-east Asia and Middle East (IEA, 2004). This is not unconnected to the fact that energy is significantly necessary and a major determinant of socio-economic development and quality of life of citizenry all over the world (Kousksou, et al., 2014; ASHRAE, 1990). In European countries, built environment and their interrelated activities were valued to account for around 40-45% of total energy demand (United Nation on Environmental Programme UNEP [UNEP], 2007). Brief overview of building energy demand of few developed nations shows that, building sector in United States of America consumes approximately 40% of total energy supply and is accountable for nearly 40% of greenhouse gas emissions (Springer Science and Business Media, 2017). Similarly, in China the building industry was found to be responsible for consumption of above 25% of entire energy supply, this value is expected to rise to about 35% by year 2020. Furthermore, the situation in United Kingdom revealed that building industry accounted for between 40-50% of total energy use and greenhouse gases emission which is over 100 million tons of $CO_2$ per annum. Equally, in India it was reported that building sector accounted for nearly 35% of the of the total energy supply (Manu, et al., 2016). Studies have shown that public buildings were responsible for larger consumption of global energy supply in comparison to residential buildings. Precisely, office buildings have been established as one of the highest consumers amidst non–domestic buildings (Ravetz, 2008). According to investigation by Kumar et al (2010) fossil fuel that has harmful greenhouse gasses has by-product had been reported to account for largest supply of 79% of world energy while the renewable energy (clean energy) is just about 18% and 3% from Nuclear power source.

### 2.2 Review of Energy Situation and Office Buildings Energy Consumption in Nigeria

The energy consumption scenario in Nigeria is closely similar to the global reported cases from industrialized nations, building sector was reported to consume around 40% of electricity supply from the national grid (Akinbami, 2010). However, with epileptic nature and the gross inadequacy of power supply being experience in Nigeria, approximately about 40% of the entire populace were estimated to have access to electricity supply from the central supply and these categories of people were majorly urban dwellers (Anigbogu, 2011; UNDP, 2011). The erratic and inadequacy of energy supply is augmented by back-up generators (Adenikinju, 2005). This probably explained why electricity supply to office buildings in Nigeria through back-up power is about 75% of the time energy is required (Batagarawa, et al., 2011). In Nigeria, few numbers of studies have looked at energy consumption of built environment particularly office buildings. Mambo and Mustapha (2016) had earlier exposed the open-ended nature of how much energy is consumed by average building in Nigeria. Also, Mua'zu (2012) investigated operational energy consumption of selected office buildings in Abuja Nigeria to understand their status and energy performance. The derived performance was between 13KWh/$m^2$ /yr to 134KWh/$m^2$/yr, this result was attributed to prevalent suppressed energy supply. Also, Batagarawa (2013) investigated the likelihood of incorporating phase change material (PCM) on building envelope to save energy and improve indoor comfort. The end-use distribution results shown that cooling, equipment and lighting loads was 40%, 48%, and 12% of the annual energy consumption respectively. Furthermore, Mua'zu (2015) derived a typical performance baseline for 22 office buildings in Abuja. The end-uses disaggregation findings shown that 59%, 43%, 15% and 4% for cooling, equipment, lighting and services respectively and the EUI ranged between 90 KWh/$m^2$ /yr -134 KWh/$m^2$ /yr. In like manner, Salihu et al. (2016) examined the demand, supply and consumption of energy in office buildings in Kaduna metropolis. The study revealed that cooling, equipment and lighting loads accounted for 51%, 35% and 14% of energy demanded. It was obvious that all these studies were out of academic environments. The few studies had attempted to examine energy consumption in universities included by Adekunle et.al. (2008) that examined electricity consumption and demand in University of Lagos, Nigeria. The study concluded that electricity accounted for 79% of energy use among other sources that included kerosene, diesel, fire wood, liquified petroleum gas, charcoal and firewood. The study further revealed that space cooling and lighting are the major end-uses which accounted for 33% and 7% respectively. Also, Adebisi et al. (2019) x-rayed energy performance of selected administrative buildings in tertiary education that included university, polytechnic and college of education in Niger state, Nigeria. The study derived performance benchmark at 181.34

KWh/$m^2$/a while the end-uses distribution for VAC, Lighting, Equipment and building services consumed 45.6%, 9.6%, 44.4% and 0.003% respectively. This implies that limited attention has been given to energy consumption of individual building most importantly administrative office building to understand their operational energy consumption pattern and performance towards a sustainable campus. This scenario created the huge gap that was filled by this study.

**3. Methodology**

This study is exploratory in approach via case study technique as it has been used for similar studies globally (Francis, 2001; Ogbonna, 2008; Batagarawa, 2013; Mua'zu, 2015; Adebisi, et al., 2019). The case study buildings were picked using purposive sampling, the buildings studied were main administrative office buildings of five out of seven (7) federal universities in North-Central Nigeria (Figure 1). This is so because one is uncompleted and the other newly completed has not been put into use. The required data was collected by conducting simple walkthrough energy audit in the absence of monthly energy bills because the universities buildings were not metered separately. The audit was conducted using building energy survey form and observation checklists as adapted from similar research studies (Mua'zu, 2012; Batagarawa, 2013; Adebisi, et al., 2019). Also, Energy Use Index (EUI) was used as performance indicator been the most widely used globally, because it allows for accurate comparison among buildings of different sizes. EUI is the summation of total energy use per unit floor area of condition space per annum. Hence; EUI (KWh/$m^2$ /yr) is expressed as:

$$\frac{\text{Total annual energy consumption}}{\text{Total floor area of building}}$$

Annual energy consumption estimation was carried out using mathematical model adopted from studies of similar characteristics (Batagarawa, 2013; Rosenberg, 2014; Adebisi, et al., 2019). The detail of the mathematical model is express as follows:

Qa = energy rating x quantity x duration of use (hours) …….equation (1)

Where Qa is the quantity of energy consumed by appliance; obtained from manufacturers/label/maintenance manual.

$QA = Qa_1 + Qa_2 + Qa_3 + Qa_n$……. equation (2)

Where QA = total energy consumed by appliance

$Qa_1$, $Qa_{2……}$ $Qa_n$ = different appliances. The same equation (2) is applied for Ventilation (QV), air conditioning (QC) and lighting (QL). Hence,

$QV = Qv_1 + Qv_2 + Qv_3 + \ldots Qv_n$……..equation (3)

$QC = Qc_1 + Qc_2 + Qc_2 + Qc_n$ ……..equation (4)

$QL = Ql_1 + Ql_2 + Ql_3 + Ql_n$.....……equation (5)

So total energy consumption (QT),

QT=QA+QV+QC+QL……. equation (6)

Also, total energy supply (QS),

$QS = Q_P + Q_G$……equation (7)

Where $Q_P$, energy from primary source, and $Q_G$ energy from generator.

However, some assumptions were made in the course of the estimation which were in line with energy audit conducted by Energy Commission of Nigeria (ECN) in conjunction with Japan international cooperation Agency (JICA) in 2017 on selected public office buildings in Abuja. These assumptions included:

i. Appliances such as electric kettles, printers, and photocopy machines are assumed to be actively used for 2 hours daily while other appliances like computers, air-conditioners, fans, lighting and refrigerators are used for averagely 8 hours daily.
ii. Number of operational days in a year was taken to be number of official working day in Nigeria which is 247days.

The annual energy consumption was further disaggregated into end-uses; Ventilation and Air-conditioning (VAC), lighting, equipment and building services in the absence of no heating load. Meanwhile, for ethical reasons the buildings were coded with acronyms CSB 1-CSB 5 meaning case study building one to five in the course of data presentation, analysis and interpretation of results. The data was analysed using descriptive statistics that included tables, percentages. Furthermore, a base case model being a simplified hypothetical case that derived its characteristics from the existing buildings was generated based on the cumulative average values of primary data collected for all the five case study buildings. Revit 2017 software was used to produce 3D model of the base case building. This was later imported into DesignBuilder V6.0 2017 simulation software to estimate the annual energy and energy use index to validate the mathematical model estimation. DesignBuilder V6.0 2017 had been checked and validated internationally for its accuracy in modelling and energy calculations capability in accordance with the European Standard EN15265 (DesignBuilder, 2011). Consequently, a performance baseline was derived in terms of EUI for this category of office buildings. Meanwhile, in the absence of local benchmark in Nigeria, the results were compared with Chartered Institute of Building Service Engineers (CIBSE) in UK and South African Building Regulation SANS 10400-XA benchmarks for office buildings where climate is similar to Nigeria.




**Figure 1**. Pictorial views of the case study buildings (Author, 2022)

## 4. Results

### 4.1 Outcomes of Field Survey Exercise

The results of the building configuration revealed that all the case study buildings were mixed-mode in nature (combination of artificial and natural ventilation strategies) and incidentally have their main axis of orientations (longest side) in the North-East/South-West direction where the openings were majorly located. The plan layout of the buildings cut across, narrow, compact, compact/composite and courtyard plan system. The gross floor areas (GFA) of the surveyed buildings were 4,661.13m$^2$, 6,339.52m$^2$, 6292.13m$^2$, 3327.15m$^2$, 1242.36 m$^2$ for CSB 1, CSB 2 and CSB 3, CSB 4, CSB 5 respectively. The conditioned floor area (CFA) accounted for 67% (CBS 1), 79% (CBS 2), 83% (CBS 3), 84% (CBS 4) and 90% (CBS5). Furthermore, average number of floors was estimated to be 3 while floor to ceiling height was approximately 3.1m. The glazing was made of single pane of 4mm thick glass which cut across clear/transparent, tinted or reflective glass materials which were evenly distributed along the main axis accounted for about 51%, 70%, 75%, 65% and 20% of the total external surface area for CSB 1, CSB 2 and CSB 3, CSB 4 and CSB 5 respectively. All external opaque walling materials and internal partitions for all the buildings were 225 x 225 x 450mm hollow sandcrete blocks which were plastered on both surfaces and finished with different colours of texcote and emulsion paints as the case may be, have an estimated U-Value of 1.4W/m$^2$K. The ground floor were solid concrete slabs laid directly on the soil and finished with ceramic and granite tile while the suspended floors were mostly conventional 150mm solid reinforced concrete slab also finished with various types of ceramic and granite tiles. The average estimated U-value of ground floor and suspended floors are 4.4W/m$^2$K and 6.7W/m$^2$K respectively. Also, the roof covering for all buildings was longspan aluminium sheets of different colours and suspended ceiling with calculated U-value of 0.39W/m$^2$K. The U-Values for building envelope materials were estimated using Also, Chartered Institute of Building Service Engineers (CIBSE) (2007) formula for calculating materials thermal transmittance value. Furthermore, external shading was a noticeable feature on all buildings. The shading devices types cut across vertical, horizontal, combination of vertical and horizontal and overhang with varying depth of 450mm, 600mm and 900mm. Conclusively, all buildings have their operating hours conforming to the standard eight (8) hours working period in Nigeria which started from the hours of 8am to 4pm with isolated cases of working beyond official hours. The occupancy density of these buildings stood at 19.84m$^2$, 16.13m$^2$, 21.32m$^{2,}$ 15.33m$^2$ 12.18m$^2$ for CSB 1, CSB 2, CSB 3, CSB 4, and CSB 5 respectively. These occupancy density values were higher than the range of values of 0.65 m$^2$ minimum and 10.3m$^2$ maximum as stipulated in National Building Code of Nigeria (2006). The base case model being a simplified hypothetical case that derived its characteristics from the existing buildings was generated for this study from the preliminary data collected during field study. Based on this premise, the summary of the significant base case parameters and their sources is presented in Table 1 while 3D building geometry modelled with Revit 2017 which was later imported to DesignBuilder V6.0 2017 for estimating annual energy consumption is presented in Figure 2.

**Table 1**. Base Case Parameters and their Sources

| Base case description | Parameters | Source |
|---|---|---|
| Orientation | NE/SW (longer side) | Fieldwork |
| Plan form | Rectangular /courtyard plan form | Fieldwork |
| Number of floors | 3 | Fieldwork |
| Floor to ceiling height | 3.1 | Fieldwork |
| Number of occupants | 243 | Fieldwork |
| Occupancy density | 17 | Fieldwork |
| Gross floor area | 4138m | Fieldwork |
| Condition floor area | 3292$m^2$ (80%) | Fieldwork |
| Each floor area | 1103$m^2$ | Fieldwork |
| Building volume | 13219$m^3$ (occupants x density x building height.) | Fieldwork |
| Window to wall ratio | 57% | Fieldwork |
| External opaque wall | 225 x 225 x 450mm hollow sandcrete blocks (1.4W/$m^2$K) | Fieldwork |
| Shading device | Horizontal/vertical (600mm deep) | Fieldwork |
| Internal partition | 225 x 225 x 450mm hollow sandcrete blocks (1.4W/$m^2$K) | Fieldwork |
| Glazing type | Tinted reflective glass | Fieldwork |
| Glazing thickness | 4mm | Fieldwork |
| Ground floor | Solid concrete slab (4.4W/$m^2$K) | Fieldwork |
| Other floors | Solid r.c slab with dropped ceiling (6.7W/$m^2$K) | Fieldwork |
| Roofing | 0.36W/$m^2$ | Fieldwork |

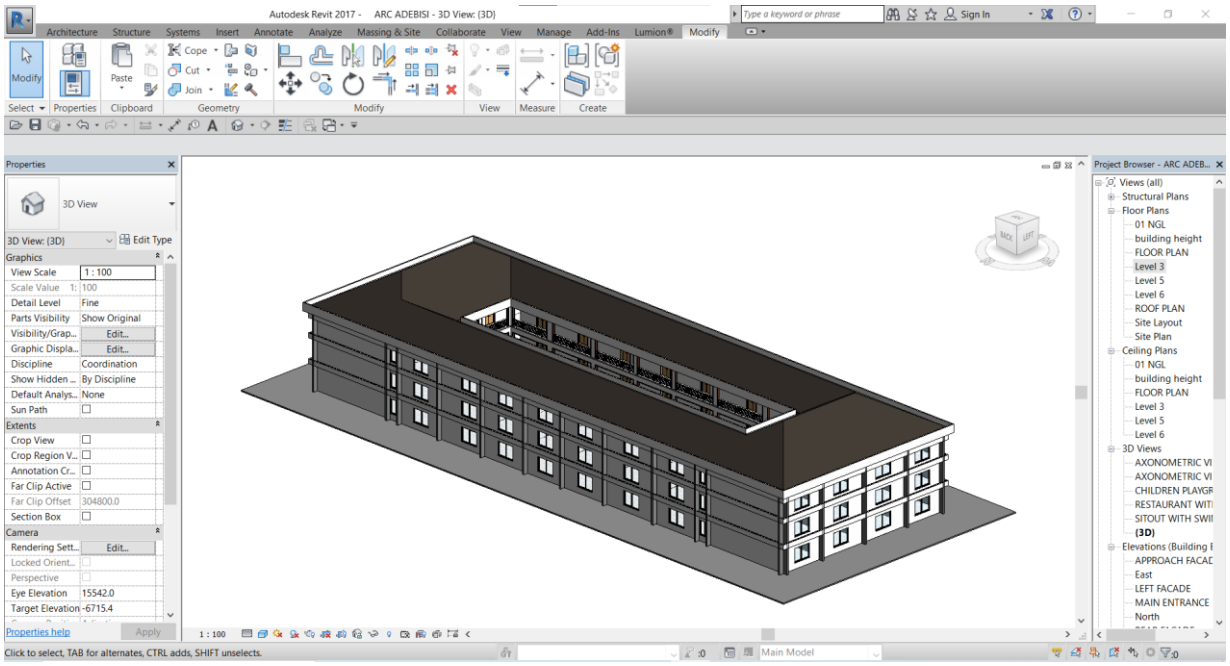

Figure 2: Base Case 3D Building Model (Author, 2022)

### 4.2 Energy Use Index (EUI) and End-Use Disaggregation

The total energy consumed on an annual basis by each of the case study building was computed and the respective EUI estimated. Meanwhile, the disaggregating energy consumption into end-uses gives an insight into quantity of energy demanded by each end-use in a building. Based on this premise, the end-uses is classified into ventilation and air-conditioning (VAC), lighting, equipment and building services in the absence of no heating load. The VAC represented the aggregated annual energy used for ventilation and air-conditioning. The lighting load was the annual cumulative loads demanded by the lighting system of the buildings while the equipment otherwise referred to as appliances load accounted for the overall annual energy consumed by the equipment and other electrical appliances being used by the occupants. Finally, the building services load determined the annual energy use by building service equipment like lift,

escalator, water pump machine and the likes available in any building. Therefore, the annual energy consumption (primary and generator) which averagely was estimated to be 63% to 37% and the corresponding EUI is presented in Table 2. In reference to Table 2 the derived EUI performance baseline stood at 197.85 KWh/$m^{2/}$a. In like manner, the annual energy consumption was disaggregated into end-uses. The results for all the five buildings audited were presented in Table 3. Finally, the results of the annual energy consumption and the estimated EUI from the base case model are 978,452.33 KWh and 233.91 KWh/$m^{2/}$a respectively.

**Table 2**. Annual Energy Consumption and Energy Use Index

| Case study building | Annual energy consumption (KWh) | EUI (KWh/$m^{2/}$a) |
|---|---|---|
| CSB 1 | 767,862.34 | 164.74 |
| CBS 2 | 1,943,240.32 | 306.53 |
| CSB 3 | 976,432.44 | 155.18 |
| CSB 4 | 464,675.33 | 117.87 |
| CSB 5 | 295,214.22 | 237.64 |
| Derived Performance baseline | 197.85 KWh/$m^{2/}$a | |

**Table 3**. Disaggregation of annual energy into end-uses

| Case study building | VAC (KWh) | Lighting (KWh) | Equipment (KWh) | Building services (KWh) |
|---|---|---|---|---|
| CSB 1 | 358,189.37 | 79,294.20 | 330,358.42 | 20.35 |
| CBS 2 | 913,264.67 | 194,324.03 | 835,593.33 | 58.29 |
| CSB 3 | 411,078.05 | 84,949.62 | 447,475.46 | 39.06 |
| CSB 4 | 185,870.13 | 60,407.79 | 217,932.73 | 46.99 |
| CSB 5 | 117,790.47 | 50,186.41 | 126,942.11 | 8.86 |
| Cumulative % average | 42.17% | 10.54% | 44.03% | 0.003% |

**5. Discussion**

Proper orientation of buildings played a significant role in energy consumption of buildings an established by extant literature This study is conducted in a tropical hot and humid climate in Nigeria. However, for effective energy efficiency, buildings in the tropical climate were expected to reduce their exposure to solar radiation and most openings (windows) were recommended to be along the main axis of East/West directions. This implies that longer side where most (openings) windows are located should be facing the North/south direction. Coincidentally, all the case study buildings had their main axis of orientation in the North-East/South-West direction which exposed most opening to direct effect of solar radiation. Although, the buildings introduced shading devices and a courtyard system which is a borrowed idea from traditional architecture in Nigeria that allows for efficient day-lighting and improves ventilation. Improper orientation still significantly responsible for the high energy consumption particularly the cooling loads which partly accounted for high Energy Use index recorded. The buildings did not adopt any advanced energy efficient envelope technology, rather the building envelope materials observed in term of waling, flooring, glazing and roofing materials were in line with conventional provisions of National Building Code (2006) in Nigeria.

The derived EUI performance benchmark for buildings under study was 197.85 KWh/$m^{2/}$a from the fieldwork while simulated EUI result was 233.91 KWh/$m^{2/}$a. These results shown that simulated value is slightly higher than the fieldwork result, this scenario may be owing to stable and uninterrupted energy flow in the building simulation as against the daily interruption/alteration between generator and mains supply observed in the fieldwork. However, in the absence of availability of local benchmark and attempt to compare the results with global best practises this value in comparison to CIBSE (2004) benchmark for similar office building which stood at 33KWh/$m^2$ and 54KWh/$m^2$ respectively for good and typical benchmarks. This implies that the EUI obtained from this study is far above good and typical best practice benchmarks. This may be owing to the difference in climatic conditions under which the CIBSE based its benchmarks on compares to warm climate experienced in Nigeria as well as gap in technological advancements between the countries. Therefore, CIBSE benchmarks may not be adoptable for office buildings in Nigeria. Notwithstanding, comparing these results to South African Building Regulation SANS 10400-XA benchmarks established in 2011 where the climate is similar to Nigeria but technology is a bit more advanced compared to Nigeria. The benchmarks stated that EUI under 130KWh/$m^2$/yr, between 130-210KWh//$m^2$/yr, 210-320KWh//$m^2$/a were established for best, good and typical practices

respectively while any case of EUI more than 320KWh//$m^{2/}$yr was categorised as poor performing office building. The derived EUI performance benchmark for the buildings under study was 197.85 KWh/$m^{2/}$a fell short of best practice. These outcomes implied that these buildings are not energy efficient. However, these buildings could be refurbished to improve their energy efficiency being the usual practise globally.

Furthermore, the annual energy consumption was disaggregated into end-uses. End-uses values affords the opportunity of determining the sources of considerable energy demand where savings can be significant. Therefore, the results of disaggregation into various end-uses for all the five buildings audited as presented in Table 3 revealed that aggregately VAC, Lighting, equipment and building services consumed 42.1%, 10.54%, 44.03% and 0.003% of the annual energy consumption. The results implied that VAC (cooling load) as a weather induced load contributed to more than 40% of energy use in this category of office buildings. These outcomes had validated and re-affirmed the dominance of cooling loads as equally submitted by global reports on similar office buildings and earlier studies on office buildings in Nigeria (Batagarawa, 2013; Mua'zu, 2015; Salihu, *et. al*., 2016; Adebisi, et al., 2019). This implies that cooling loads is an avenue where significant energy saving can be achieved.

**6. Conclusion**

Based on extant literature, issue of energy use by individual buildings in Nigerian universities has generally been given less attention specifically their main administrative buildings being a typical public office building in design and operations. However, having compared the performance with other global best practises, it was clearly evident that these buildings are not energy efficient. Although, these buildings could be refurbished to improve their energy efficiency being the usual practise globally. Notwithstanding, disaggregated end-uses consumption pattern equally affirmed the dominance of cooling loads which is line with global reports and a pointer to where significant energy savings could be achieved. Hence, there is need to give required attention to bio-climatic variables particularly the proper building orientation as it goes a long way to determine energy balance of buildings in tropical climate like Nigeria. Also, universities managements through facilities managers of these universities' buildings should adopt regular energy audit and embrace sub-metering technique of major buildings particularly main administrative buildings. This act will serve as part of their cooperate responsibilities and will ensure clear understanding of energy consumption of individual building and be of great assistance to overall energy management in the university community.

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# Energy Self-Sufficiency of a Tall Building with BIPV

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**Abstract**
This study is to test the reality of the big dream of zero energy skyscrapers. The current state of energy demands of high-rise buildings was investigated. The amount of solar energy that can be harnessed from PV panels installed on the roof and the south façade of a Seagram-size test-bed building in New York was estimated. Comparing the quantities of solar energy produced from and the energy demand of the test-bed building, the energy self-sufficiency of the building was analyzed. It was found that, with the current solar PV technology, building integrated PV systems can meet of about 4.2% of the building's energy demand and 7.7% of its electricity demand. From this study, it was concluded that significant reduction in energy demand is a prerequisite for attaining zero energy large-scale buildings.
**Keywords:** Zero Energy Building; Solar Energy Production; Photovoltaics; Energy Self-Sufficiency.

## 1. Introduction

Using renewable energy technologies, it is possible today to design and build energy self-sustainable homes and small-scale commercial buildings (Voss et. al. 2012, Aeleni et. al. 2014, Wang et. al. 2019; Rahbarianyazd & Raswol, L, 2018 ). Of various renewable energy technologies, solar, wind and geothermal energy technologies are the most technologically feasible for building application (NREL 2002, Del Sol 2010, Larsen 2013, GCCE 2018). As these onsite renewable energy technologies make use of natural energy flow that are available, and their technical feasibility and efficiencies depend on the particular physical, geological and climatic contexts of a building site. As such it is critical for building designers to assess the technical feasibility of each renewable technology as an onsite energy production alternative.

Wind Technology: The availability of wind at a given building site is, first of all, affected by its macro-climatic context of the site, i.e., the geographic location on earth and elevation above the sea level. The wind atlas, a long-term statistical wind data, is a useful resource for evaluating the availability of wind energy on a regional scale. In general, the regions of the world having sufficient year-round reliable wind speeds to start up and operate wind turbines are confined to mountainous regions with high elevation, for instance the Rocky Mountain regions in the U.S., or open coastal strips along Lake Michigan. Other than these limited regions, a majority of inland regions of the continental U.S. are not apt to wind energy production. Practically speaking, most locations of the world are not suitable for producing wind energy from wind turbines.

Wind Energy Production from Buildings: Even in regions where sufficient and reliable winds are available, producing wind energy from building-integrated wind turbines faces multiple challenges. First and foremost, a building itself becomes an obstruction that either blocks or disturbs winds blowing to the turbines (Wilson, 2009). Thus, installing wind turbines on the roof is the only viable option for wind turbine integration with a building. Even wind turbines installed on the roof are affected by the roof itself. For this reason, rooftop wind turbines need to be elevated high above the roof surface to utilize higher speed wind. Next, the constantly changing speed and direction of air flows around a building make building-integrated horizontal axis wind turbines inefficient for energy production. Vertical axis wind turbines can cope with such turbulent winds. Still the turbulent air flows around a building make vertical axis wind turbines far less efficient than directional laminar air flows. Because of these problems, wind technology is not a viable onsite energy alternative for enhancing energy self-sufficiency of tall buildings. Handful of tall buildings with building-integrated wind turbines, such as Pearl River Tower in China and Bahrain World Trade Center, have not been able to serve as models for future buildings to follow suit. There are many publications about the nature and the estimated capacity of their wind systems. But the actual measured performance data of the Bahrain World Trade Center are unrevealed, and no parties who have access to the building's wind system performance data, the building owner and the building manager are eager to disclose the data. The architects who designed the buildings have no interest or merit in finding out how the buildings that designed perform. As such the actual performance of building-integrated wind systems remains in the dark.

Geothermal Energy: Geothermal energy is onsite energy production technology that harnesses the heat contained in the Earth's crust. Using the heat exchanger tubes that are buried in the ground, heat stored in soil or water is conducted to the fluid running in the tubes. Incorporating a heat pump, the heat harness from the ground is then used for space heating in the winter and cooling in the summer. To harness geothermal energy for the space heating and space cooling of a medium size single family home, a substantial length of the tube is required. In order to harness one ton (2000 BUTs/hour) of cooling effect, about a 150-180 m long tube is required (Buschur's Refrigeration Heating and Cooling, 2022). An average

single-family home in the U.S. requires about 1/4 to 3/4 acre of land is required for trenches. Thus, geothermal heat pump systems can contribute to a significant portion of the energy demand for heating or cooling single-family homes or low-rise buildings with a sufficient lot size. But for high-rise buildings, geothermal energy can contribute to a very small fraction of their energy demand (Goldman Copeland Consulting Engineers, 2018). The contribution of geothermal energy to the energy self-sufficiency of tall buildings is intrinsically marginal.

Based on the preliminary assessment of the appropriateness and feasibility of wind, geothermal and solar technology, it was determined in this study that solar technology is the onsite energy technology that is technically feasible as an onsite energy alternative for high-rise buildings. By incorporating solar panels on the roof or on the walls, buildings can now be energy producers. As renewable technologies become increasingly cheaper and feasible for building application, such energy producing buildings can be expanded to net zero-energy, or even energy surplus (Thomas 2008). However, is it really possible to achieve large-scale zero-energy buildings or skyscrapers by incorporating solar? What are the design methods for achieving zero energy skyscrapers? This study examines these questions about the prospect of zero energy high-rise buildings that employ building integrated photovoltaic (BIPV) systems.

**2. Research Objectives, Method and Assumption**

The principal objectives of this study are threefold:

1) to examine energy consumption of tall buildings in cold climates,
2) to evaluate the feasibility of a zero energy skyscraper employing building integrated PV technology, and
3) to examine how much solar energy can contribute to the building's energy self-sufficiency.

Through this feasibility analysis, this study intends to identify strategic directions the building industry has to move forward to attain zero-energy or near zero-energy skyscrapers in the future. In order to assess the feasibility of a zero-energy building, two quantities of building energy are necessary: 1) the energy consumption of the building, and 2) the amount of energy that can be produced from it onsite. The energy consumption data of a test-bed skyscraper was calculated by using a computer energy simulation program, eQuest (Hirsh 2007). In order to check the validity of eQuest, we gathered actual energy consumption data of nine existing skyscrapers in New York. Then, the simulated energy consumption data and the actual energy consumption data were compared. Upon confirming its validity, the energy simulation program was used in assessing the feasibility of a zero-energy skyscraper employing BIPV. Subsequently it was also used in conducting two sets of parametric analyses of the test skyscraper: one with alternative glazing materials in the windows and the other with different HVAC system layouts to examine how alternative glazing materials and HVAC systems increase the building energy self-sufficiency. The amount of energy production from the building skin was calculated by PVWatts (NREL 2022), a program developed by the National Renewable Energy Laboratory.

**3. Skyscraper Energy Consumption**

The test-bed skyscraper is a 30-story 45m wide, 30m deep and 108m high office tower located in New York. The total floor area is 40,500 $m^2$, 1350 $m^2$ for each floor. The floor-to-floor height of the building is 3.9m, and the floor-to-ceiling height 2.7m. The test skyscraper's facade consists of 2.7m single pane PPG glass and 1.2m high opaque spandrel walls. The window-to-wall ratio of all four walls of the building is 0.69. The opaque exterior wall is assembled with 2x4 16" o.c. metal stud construction with insulation in between studs. The heat source of the building is gas-fired boilers, and the cooling source water chillers. The air distribution system is a multi-zone with hot water reheat system. Lighting load is 7.5 $W/m^2$, and task lighting 4.0$W/m^2$, and plug loads 15$W/m^2$.

**3.1 Energy Consumption of the Test Skyscraper**

Employing energy analysis program eQuest, the energy consumption of the test skyscraper was simulated, and its energy performance was analyzed in terms of 1) annual energy consumption by end use, and 2) monthly energy consumption by end use. The annual gas energy consumption is 6375 MWh, which amounts to 54.8% of the building's total building energy consumption, and the annual electricity consumption is 5266 MWh, 45.2% of the building's total energy consumption.

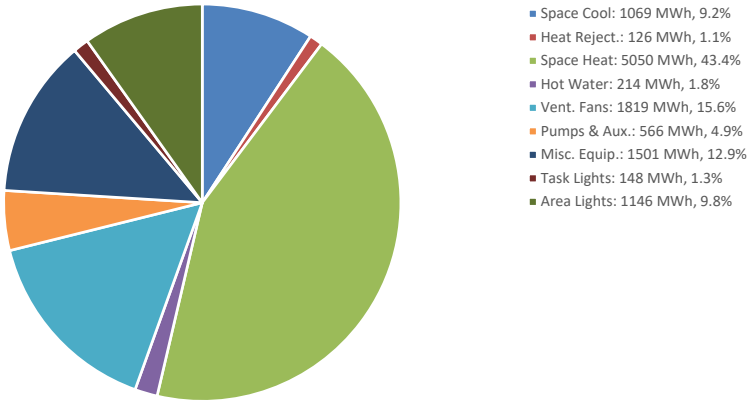


**Figure 1.** Annual Energy Consumption by End Use.

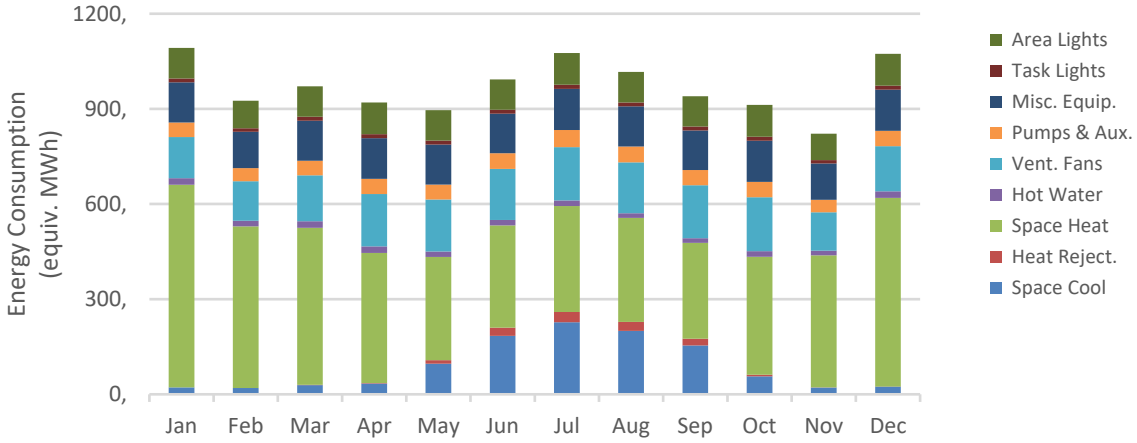


**Figure 2.** Monthly Energy Consumption of the Test Building.

**4. Energy Consumption of Existing Skyscrapers**

To validate if the computer simulation provides reasonable results, we gathered the energy consumption data of nine skyscrapers in the City of New York, and compared them with the simulation results. The energy use intensities (EUI), the annual building energy consumption per unit floor area, of the nine buildings are shown in Table 1.

**Table 1.** Energy use intensity of skyscrapers in New York.

| Building Name | Floor Area ($m^2$) | Year Built | Total EUI (Kwh/$m^2$) | Gas (Kwh/$m^2$) | Electricity (Kwh/$m^2$) |
|---|---|---|---|---|---|
| 4 World Financial | 193688 | 1986 | 260.8 | 60.6 | 200.2 |
| New York Times | 117740 | 2007 | 448.4 | 234.6 | 213.8 |
| Marine Midland | 106067 | 1967 | 418.2 | 236.4 | 181.7 |
| Citi Corp Center | 170565 | 1976 | 399.6 | 235.8 | 163.8 |
| Four Times Square | 152665 | 1999 | 283.8 | 73.4 | 210.4 |
| Hearst Tower | 80855 | 2006 | 270.3 | 84.0 | 186.3 |
| Lever House | 20397 | 1952 | 426.0 | 105.3 | 320.7 |
| Chrysler | 96218 | 1929 | 183.9 | 35.2 | 148.7 |
| Seagram | 78906 | 1958 | 570.2 | 271.0 | 299.2 |
| **Test Building** | **37639** | **2020** | **309.1** | **139.7** | **169.4** |

The annual energy use intensity of the nine skyscrapers ranges from 183.9 (the Chrysler Building built in 1929) to 570.2kwh/$m^2$ (the Seagram Building built in 1958). It is interesting that a building built in 1929 is about three time more energy efficient than one built in 1958, which is a period when the international-style glass towers were a dominant trend. Buildings built after Year 2000 are not necessary more energy efficient than ones built before. The New York Times Building built in 2006, the newest building among the nine sample skyscrapers, is energy intensive with a EUI of 448.4Kwh/$m^2$. The EUIs of the nine skyscrapers in New York range from 183.9 to 448.4/$m^2$, with the average of 362.3Kwh/$m^2$, while the EUI of the test skyscraper is 309Kwh/$m^2$. Five of the nine sample buildings consumed more energy than the simulated building, and four less. With this comparison result, we adopted eQuest as the energy simulation tool for this study.

**4.1. Complexity of Assessing Building Energy Efficiency**

A building's energy performance is affected by a legion of factors related to climate, building and users. First of all, a building's energy consumption is climate-dependent. Though the climate of a region is statistically stable and predictable, the actual weather conditions of a building site are deviant from the long-term statistical means. As such, the actual energy consumption of a building in a particular year is variant as well. The "weather-normalized" energy consumption of a building's take into account the deviation of weather conditions year-by-year. For a given set of physical attributes of a building, its energy performance varies significantly with user behavior, occupancy schedule and activity. For these reasons, a building that consumes more energy is not necessarily an energy-inefficient building. Although there is a general correlation that buildings that consume more energy are less energy-efficient, theoretically one cannot make a judgement that buildings with high energy use intensities are less energy-efficient. This complexity of the correlation between energy consumption and energy efficiency is a factor that needs to be considered in evaluating buildings' energy performance.

Aside from climate and user behavior, a range of architectural and system features of a building affect its energy performance. In the design process, architects and building designers determine those architectural and systems features. Thus, physical variables of a building that influence building energy performance can be categorized into three categories: 1) building form, 2) building skin and 3) building systems. The key variables of Category 1 (building form) include building orientation and the shape of building mass. Category 2 (building skin) variables include window size, window-to-wall ratio, thermal and optical properties of glass and walls. Category 3 (building systems) variables include building's physical attributes associated with lights and HVAC (heating, ventilating and air-conditioning) equipment. Of these architectural and system variables that contribute to building energy performance individually and collectively, it is of particular interest to architects and building designers to examine the relationship between energy performance (consumption) and building skin design of the nine skyscrapers listed in Table 1.

Four of the nine skyscrapers, the Seagram Building (1958), the Marine Midland Building (1967), Lever House (1952) and the Hearst Tower (2006) are all glass towers. And their energy use intensities are highest of the nine sample buildings. Particularly, with an EUI of 570.2 Kwh/$m^2$, the energy consumption of the Seagram Building is the highest of them all, and Lever House is the third highest. Designed by Mies van den Rohe in 1958, the Seagram Building epitomizes international style minimalistic glass towers, as well as an icon of energy inefficient building (See Figure 3-a). It was originally cladded with single-pane glass, which was one of the main reasons for its high energy consumption. The building was later renovated with higher efficiency glass. Though lower, Lever House building built in 1952 cladded with glass on its entire facades shows similarly high energy use intensity (See Figure 3-b). On the other hand, the Hearst Tower, another all-glass skyscraper, designed by the Norman Forster Associates and built in 2006 (See Figure 4-a), consumes low levels of energy. With an EUI of 270.3 Kwh/$m^2$, the building can be regarded as one of the most energy efficient buildings among the sample buildings. This indicates that glass skin is not solely responsible for high energy consumption of tall buildings.

The most energy efficient building among the nine sample skyscrapers is the Chrysler Building built in 1929 (See Figure 4-b). It is the oldest building among the samples. The fact that the oldest building is the most energy efficient building is very intriguing. In the absence of the data on the building's systems and construction materials, it is impossible to diagnose why this art-deco landmark in New York is energy efficient. But based solely on visual inspection of the facade, it is evident that the Chrysler Building has smaller window size, i.e., low window-to-wall ratio. Because windows have low thermal insulation values, they lose heat far more than walls with higher insulation values. In the summer, windows bring in solar heat gain that increases to the cooling energy operating air-conditioning equipment. Thus based on this thermodynamic principle, it is clear that buildings with smaller window size and higher opaque wall fractions are more energy efficient. Yet, the real practical question is whether the architectural practitioners and building owners are willing to change the course of skyscraper facade design from all glass to more energy efficient alternatives that are more thermally and visually advantageous and sustainable. In this study, this question remains to be unanswered. The extensive discourses on this issue are beyond the scope of this study. Yet it is hoped that alternative facade designs to emerge for tall buildings in the future to make them more energy efficient and environmentally sustainable.



(a) (b)

**Figure 3.** (a) the Seagram Building and (b) Lever House.

**5. Solar Energy Production from the Building**

The next step was to analyze how much the test skyscraper can generate energy. Using PVWatts, electricity that can be generated from the solar panels integrated with the test skyscraper's roof and south façade was calculated (see Figure 5). The rooftop PV panels produced the maximum solar energy in July and August and minimum in December. Contrarily, the south wall panels generated the maximum in February and minimum in June. This suggests a strategy for solar energy generation from buildings: when a building needs more electricity in winter, solar panels should be installed on the south façade; when more electricity is needed in summer, PV panels should be installed on the roof. The synchronization of onsite energy generation and energy consumption will reduce the need and size of energy storage for electricity generated onsite (Tronchin et. al. 2018).

**6. Path Toward Zero Energy Skyscrapers**

The energy self-sufficiency of a building, $S_e$, is defined as the ratio of the electricity generated from its PV system, $E_{solar}$, to its total energy consumption, $E_b$, as:

$$S_e = E_{solar} / E_b \quad (1)$$

On an annual basis, the test-bed building's electricity self-sufficiency is 4.2%, i.e., the building can generate only 4.2% of its own energy consumption from the building integrated solar panels. It is clear that in order to increase its energy self-sufficiency, the building's energy consumption must be reduced. The strategies for reducing energy consumption of tall buildings can be classified in three categories. Category 1 strategy is to improve the energy efficiency of building skin including the walls, roof, and windows in particular. The insulation of building skins will keep heat in the building, reducing heating energy in the winter. In the summer, an insulated building skin will prevent conductive heat gain and reduce energy consumption from cooling the building. Category 2 strategy is to incorporate high efficiency building systems, such as HVAC (heating, ventilating and air conditioning) and lighting. Category 3 strategy is to use energy efficient appliances. A significant fraction of building energy consumption is attributed to the use of electrical appliances such as computers, monitors, printers, microwave ovens, refrigerators, etc. But the selection of electrical appliances to be used in buildings is usually made by the IT and facility managers after the building is designed, not by the architect who designed the building.



(a) (b)

**Figure 4.** (a) the Hearst Tower and (b) the Chrysler Building

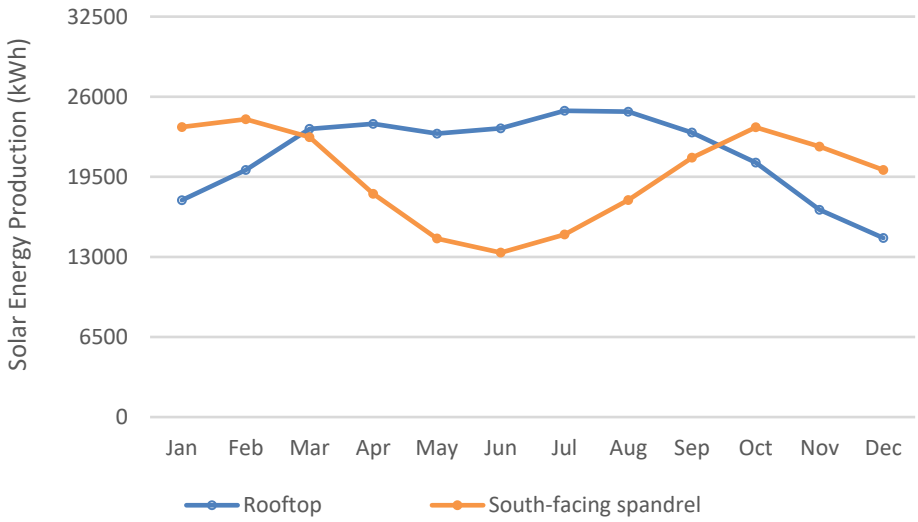


**Figure 5.** Monthly Electricity Generated from Solar Panels.

To evaluate the impact of different glazing materials on the test skyscraper's energy efficiency, a parametric analysis was conducted on a variety of glazing materials that can be used in the windows. The Southwall triple glass was identified to be the most energy efficient. When it was used on all four façades, the energy self-sufficiency of the skyscraper increased to 6.1% (see Figure 6).

Upon identifying the most energy efficient glass type, the next parametric analysis was performed on building HVAC system type. It was found that variable air volume (VAV) air distribution systems is the most energy efficient (see figure 7). With the combined installation of the Southwall triple glass and VAV air distribution for the HVAC system, the energy self-sufficiency of the test skyscraper increased to 10%.

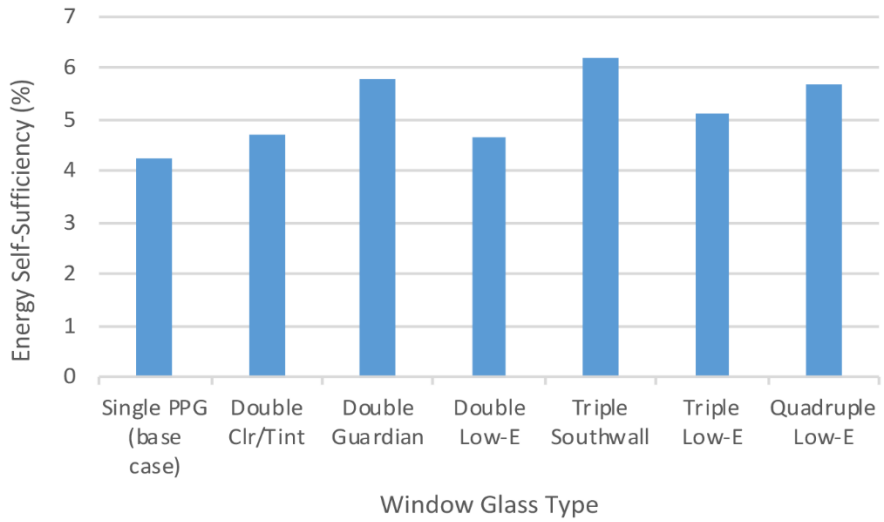


**Figure 6.** Energy Self-Sufficiency of The Test Building with Alternative Glass.

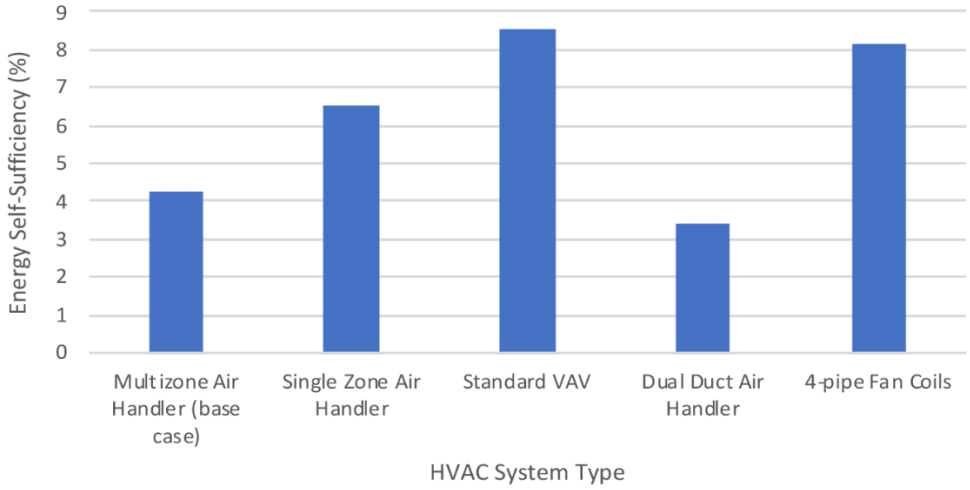


**Figure 7.** Energy Self-Sufficiency of The Test Building with Alternative HVAC systems.

**7. Conclusions and Future Directions**

This feasibility study revealed that the onsite building integrated solar system can provide only a small fraction, 4.2%, of the test skyscraper's energy consumption. In addition to solar, other renewable technologies for producing onsite energy such as geothermal or wind could be incorporated to further increase its energy self-sufficiency. Yet, those other onsite energy production alternatives will contribute to meeting only a marginal fraction of energy demand of tall buildings. Supply-side approaches to zero energy skyscrapers, i.e., attempting to produce more onsite renewable energy, will be futile to attain the tall buildings 'zero-energy goal. From the parametric study, it was found that the combination of two methods of improving the energy efficiency of skyscrapers, use of high-performance windows and VAV (variable air volume) HVAC system, increases the energy self-sufficiency of the test skyscraper significantly, from 4.2% to 10.1%. Yet, it still falls far short from total energy self-sufficiency. In order to attain zero-energy or near zero-energy, if they are ever possible, it is apparent that a radical reduction of the current level of energy consumption is required for moving toward energy autonomy of skyscrapers.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Adaptation Of Dutch Colonial Architecture to Palembang's Humid Tropical Climate

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**Abstract**
The Dutch Colonial Architecture in the Talang Semut Palembang area notes that there is a lot of diversity in the style and function of the building as well as the historical journey that includes the adaptation process. This adaptation process is observed in the design world today and in the future. Proof of the adaptation process is carried out by calculating physical analysis to find out the extent to which this tropical consideration is carried out. The process of adapting Dutch Colonial architecture to a humid tropical climate is expected to be able to provoke the creativity of architects in designing buildings properly without using artificial air conditioning equipment. The arrangement of interior layout, outer space and mass management as well as the environmental pattern of this Dutch residential area with the completion of the detailed construction planned to anticipate tropical problems have really been carried out properly.
**Keywords:** Adaption Architecture, Humid Tropical Climate.

## 1. Introduction

At the end of the sixteenth century the Dutch came to Indonesia at first as traders, but later developed their power as colonizers. During the seventeenth century the Dutch began to settle in Indonesia and at first did not have close cultural contact with the Indonesians. The arrival of the Dutch to Indonesia with the main purpose of trading, together with other nations as traders, but because over time it was felt that it was causing competition with native traders, and traders of other nations, they were often involved in physical conflicts, finally the Dutch fortified themselves by living in an area enclosed by a strong fence (fort) to avoid physical confrontation with the indigenous population. Living overseas with conditions in Indonesia, which at that time was not yet developed, they had to open new lands, lived in the midst of conflict, made the Dutch people yearn for their comfortable homeland. This longing is reflected in the residential buildings, urban planning and their lifestyle. All Dutch developed cities are characterized by pure Dutch architecture, marked by canals with trees along the edges, houses, shop houses lined the roadside and warehouses lined the water's edge. Everything is in the style of Dutch European architecture, without the slightest influence indigenous culture. Even the way they built did not meet the demands of the climate, the way of life in the humid tropics and the existing health (Van Hoytema, J.F., 1946). these historical buildings record events that during the colonial era, many Dutch people lived, lived and worked in Palembang the Dutch who lived in the hemisphere with a moderate climate had to adapt to live in an area with a humid tropical climate. This life adjustment is not only patterned on daily life and behavior, but also includes the adjustment of the building pattern. The building which was built by the Dutch geese still uses the Dutch architectural style, but has been adapted to the local climate, namely a humid tropical climate. Because the form of the building which was built by the Dutch was still characterized by European architecture (including the architecture of colonialism in Indonesia).

## 2. Methodology

In the analysis of this research, there are several things that are analyzed in detail, and one part with other parts being analyzed is a unity. The other parts that are analyzed are a unit that supports and complements each other. Descriptive method was chosen to express all the problems of the research. the parts that are observed and analyzed include:

- Architectural conditions of Dutch buildings in the Netherlands and in Indonesia.
- Urban context in relation to the development of patterns of mass management and environment that affect tropical climatological conditions.
- The process of adaptation of Dutch colonial buildings in Indonesia with the observation area in Talang Semut Palembang.
- The climatological aspect of the humid tropics on the physical comfort of building users adjusted to the prevailing comfort standards.

To describe the research that will be conducted, historical research methods are used, which are expected to be able to describe the business journey of adapting Dutch colonial architecture, buildings that were built in the early

days. From its historical journey, it will reveal the extent to which this adaptation effort has been carried out, the level of technology used and the ability to anticipate climate influences in the interior and exterior spatial patterns. Determination of sample the research was conducted to observe the process of adaptation of Dutch colonial architecture to a humid tropical climate. Observations took case studies in Talang Semut Palembang. From the form of the research to be carried out, it would be very appropriate to use the method of determining the sample in the form of 'Purposeful Sampling' with a more concrete form of 'Criterion Sampling'. Purposeful Sampling is used in research that requires the selection of a lot of information with various cases to get an in-depth study.

**3. Development of Dutch Colonial Architecture in Indonesia**

External Factors as Determinants of Architectural Development.

At the beginning, architecture was formed as a shelter for humans from the influence of natural disturbances such as rain, wind, wild animals and others. simple, namely by occupying natural caves. limited human ability to create a place to live. Humans have not been able to make a shelter . Along with the advancement of culture, ways of thinking and processing natural resources as well as the discovery of household tools and carpentry make humans able to create shelter from natural materials such as wood and leaves. human In line with the level of technology that is controlled by humans and the ability to think, humans produce various forms of buildings even though they are made of the same material. For example, some of the following buildings have similar materials but differ in form due to external influences that play a role in changing the physical appearance of a building.

The Development of the Era of Dutch Architecture.

Traditional Dutch architecture is an architecture with special characteristics that appear on the roof and the details of the walls. But overall it has a lot in common with European architecture in general . This is due to the influence of the climatic equation in mainland Europe, namely the moderate climate. Roofs without eaves, wide and glass-covered windows, plain walls without sun block (sun Roofs are not architecturally moderate in climate. shading), is a feature planned for protect against sun and rain , but only to protect against wind and snow Dutch architecture is famous for its characteristic roof , which can be used for attic , known as Mansard roof The mansard roof has two angular bends , which result in two steep angles , with the goal is to create a roof slope that is sufficient to drain the snow pile in winter and produce a wide enough space under it, so that it is spacious enough as a living room. It is hoped that the sunlight will still be able to enter as much as possible into the Dutch architecture, which is located in this moderate area, using the sun's heat a lot for natural heating through the opening of the wall hole is capable of opening the wall hole in the form of a window, intended to capture direct sunlight (Direct Solar Heat Gain) as much as possible. These windows are stretched to hear the direction of the direction in accordance with the path of the sun which is always on the south side. These windows are closed with glass so that wind gusts do not enter the room. Roof The roof functions as a room, it also has a function to suck heat through the roof covering material so that it can warm the room inside. The ceiling is placed in a position following the slope of the roof covering , so as not to create an air cushion , which can absorb and absorb heat intensity to enter the room . Walls in Dutch architectural buildings are also used to absorb heat by choosing several building materials that do not hinder the absorption of heat much. The wall on the front view of the building is directly facing the sun and there are not many obstacles to be found. Corridors are not found in Dutch buildings.

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# Designing a Hostel in the Touristic Complex of Quri-Gol Lake near Tabriz, Iran

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**Abstract**
Quri-Gol Lake is located in East Azerbaijan province, southeast of Tabriz City, next to the main highway of Tabriz-Tehran. This beautiful region, due to its special and outstanding features, can serve for the development of the tourism sector and ecotourism of the province. The hostel is a cheap and comfortable accommodation, which provides simple and inexpensive food, accommodation, and facilities for passengers who have travelled during the holidays. There are four types of hostels: student hostels, single hostels, workers hostels, and youth hostels. This hostel is designed near Quri-Gol Lake, where all the rooms have beds, closets, toilets, bathrooms, and balconies with a beautiful view of the lake. This article aims to study the different kinds and standards of hostels and also the potential of Quri-Gol Lake as an appropriate location for designing a hostel. The methodology of this survey is qualitative and quantitative, using reliable first-hand resources and references.
**Keywords:** Hostel; Quri-Gol Lake; Tabriz; Hotel; Inn.

## 1. Introduction

Given the existing potential of the country, one of the appropriate strategies for economic development is the development of the tourism industry. In this regard, the ecotourism industry is known as an important tool for tourism development (Al-Dujaili & Amen, 2018). Investing in ecotourism not only protects ecosystems and a healthy natural environment for a living but also generates significant revenue and valuation. East Azerbaijan province in terms of having rich resources in this field can take basic steps to use the ecotourism industry. Quri-Gol Lake in East Azarbaijan is located 18 km Northwest of Bostan Abad and about 45 km Southeast of Tabriz, next to the main Tabriz-Tehran axis and at the end of Shibli defile (Figure 1). The beautiful region of Quri Gol, due to its special and outstanding features, can serve as a stimulus for the development of ecotourism in the province, as well as the development of the tourism sector (Figure 2). The present article is about the design of a hostel around Quri-Gol Lake. The article tries to answer the question of what a hostel is and the different types it has. To get the answer to this question, according to the potential of the site that is considered on the south side of Quri-Gol Lake and hostel standards, the design of the Quri-Gol hostel is discussed. This article consists of two main sections: Quri-Gol Lake and Hostel. First, the location of the site is introduced. Then, the hostel and its different types are defined, regarding some examples implemented, the designed hostel in Quri-Gol is explained with the pictures of the plans and 3D views in detail. The research method used is completely analytical and the research tool is the library study.



**Figure 1.** Aerial View of Quri-Gol Lake (Google Maps, URL1).

**2. Location of Quri-Gol Lake**

"Quri-Gol" means a "dried lake" as "Quri" means dry and "Gol" means lake in the Turkish language. Quri-Gol Lake in East Azarbaijan is located 18 km Northwest of "Bostan Abad" and about 45 km Southeast of Tabriz city (the capital of East Azarbaijan province in Iran), next to the main Tabriz-Tehran axis and at the end of Shibli defile. The nearest settlement to this lake is "Yousef Abad", about 2 km away. Its communication route is through the main Tabriz-Tehran Road. This freshwater lake, which is 1890 meters above sea level, has a maximum length of about 2 kilometres and an average width of 750 meters. The surface of the lake is about 120 hectares. The water of Quri-Gol Lake is supplied by atmospheric precipitation and partly by springs inside the lake (Environmental Protection Organization, General Department of Environmental Protection of East Azerbaijan Province, 2002, p.3) (Figures. 1 & 2). For more information about the history, location, and touristic attractions of East Azarbaijan province and especially Tabriz and Quri-Gol Lake, you can read the bachelor thesis of the author titled "Hostel of Quri-Gol Tourist-Entertainment Complex (Tabriz)" (Asbagh, 2007, pp. 1-53). Furthermore, for more information about the history of Tabriz, you can read the article written by the author titled "A Short Glimpse to the Urban Development of Tabriz during the History" (Asbagh, 2019, pp. 73-83). Similarly, for obtaining general information about Tabriz and its historic buildings, you can read the Master thesis of the author titled "The Conservation and Revitalization of Mirza Mehdi Farashbashi's House in Tabriz" (Asbagh, 2011, pp. 5-74), and the article derived from it by the author with the title of "Adaptive Reuse of the House of Mirza Mehdi Farrashbashi in Tabriz" (Asbagh, 2021, pp. 506-520).



**Figure 2.** General View of Quri-Gol Lake (Dallal Alipour, 2007; Asbagh, 2007, p. 12).

**2.1 Necessity of Creating a Hostel near Quri-Gol Lake**

a) lack of facilities such as restaurants or proper grocery stores and toilets, water and electricity or temporary accommodation in the area for the tourists, which often causes confusion and the visitors usually return to their houses without the opportunity to enjoy their time there; b) although "El-Goli" park ("Il-Goli" Park or "Shah-Goli" Park which was first established during the reign of the "Aq-Qoyunlu Dynasty" in the South-Eastern part of Tabriz; "El" or "Il" means people and the name of the park means "a lake for the people") currently has relative amenities for visitors, it is still not possible to use the facilities due to the overcrowding of visitors, especially during the summer holidays. If the "IL-Goli" park is also developed, it will not be enough for the people at all, so the establishment of a hostel near Quri-Gol Lake will attract some citizens and will take the burden off the "El-Goli" park; c) the distance from Tabriz and "Bostan Abad": Quri-Gol Lake is about 45 km away from Tabriz. This distance can be covered by the vehicle in less than an hour and this time is short for one-day excursions. Therefore, it will be easily accessible for the citizens of Tabriz. In addition, widening the Tabriz-Tehran Road in this area will help the traffic problem during the peak hours and will increase the number of visitors attracted to the Quri-Gol area (the highway is already extended). Also, considering the distance from the Quri-Gol area to "Bostan Abad" (about 15 km), it will be the most suitable place for the residents of "Bostan Abad" too; d) the issue of increasing the water of Quri-Gol Lake: the rising water of the lake and increasing its volume will give more prosperity and beauty to the region and the existence of facilities such as fisheries and boating and sports facilities will attract people. As a result, the least suitable dwelling that has facilities for visitors will be the construction of a park, forest and residence; e) increasing the cultural and economic level of the locals: predicting shops, seasonal exhibitions, libraries, reading rooms, and sports facilities next to the residence in the park where agricultural products and handicrafts of the surrounding villagers will be offered for sale. Also, the use of libraries and sports facilities will increase the level of the culture and economy of rural residents and farmers in the region; f) project revenue: the construction of a park, forest park, sports and boating facilities next to the residence is a source of income so this revenue also creates and develops cultural, recreational and sports centres in the region (Quri-Gol Multi-Purpose Study Plan, Volume 4, Ministry of Energy, East

Azerbaijan Regional Water Organization, Ministry of Culture and Higher Education, University of Tabriz, Library of East Azerbaijan Environmental Protection Organization, 1989, p. 8).

**3. Types and Examples of Hostels**

There are different types of hotels in various price and comfort classes which are classified in five categories: luxury, first-class, comfort, standard (holiday hotel, motel), and tourist (low budget). There are five categories of 1 Star (Tourist), 2 Stars (Standard), 3 Stars (Comfort), 4 Stars (First Class), and 5 Stars (Luxury) by the size of the room and features according to the classification system of the German Hotel and Inn Association (DEHOGA) (Neufert, 2012, pp. 171-173). There is another cataloguing for hotels based on the location of it as city centre (including luxury, convention and city tourist hotels with high plot ratio, high rise construction, and inclusion of shops), motor hotels (for people by car or motoring locally sited at important road junctions and on the outskirt of cities), airport hotels (similar planning to motor hotels but specifically for air travellers), resort hotels (at seaside or mountain resorts or spas usually for package holidays), motels, and convention hotels (Neufert, 1980, pp. 208-223).

Hostel (noun): “a building that provides cheap accommodation and sometimes meals to students, workers or travellers; a building, usually run by a charity, where people who have no home can stay for a short time (also shelter, North American English, British English)” (Oxford Dictionary, URL2). Youth Hostel (noun): “a building that provides cheap and simple accommodation and meals, especially to young people who are travelling” (Oxford Dictionary, URL3). Hostel (noun): “a large house where people can stay free or cheaply: (e.g.) a student hostel; a place where people, especially young people, can stay cheaply for short periods when they are travelling, with shared rooms and sometimes some private rooms; a building where people with no home can live for a short time; a large house where people can sleep for little money: (e.g.) a youth hostel” (Cambridge Dictionary, URL4). Youth Hostel (noun): “a place where people, especially young people, can stay cheaply for short periods when they are travelling” (Cambridge Dictionary, URL5). Hostel (noun): “an establishment that provides inexpensive food and lodging for a specific group of people, such as students, workers, or travellers” (Definitions from Oxford Languages Dictionary, URL6). Youth Hostel (noun): “a place providing cheap accommodation, aimed mainly at young people on walking or cycling tours” (Definitions from Oxford Languages Dictionary, URL7). The formative source of a hospital, hostel, and the hotel is Latin “hospitale”, a word referring to a house or lodging for travellers that is a derivative of the adjective “hospitalis” ("of a guest", "hospitable"), which developed from “hospes” (host) (Google Translate, URL8), and “hospit” (hospital) (Oxford Dictionary, Asbagh, 2007, p. 64). For obtaining more information about different types and standards of hotels and hostels you can read “Neufert, Architects' Data” (1970, pp. 185-193), “Neufert, Architects' Data” (1980, pp. 208-223), “Neufert, Architects' Data” (2012, pp. 171-173, 184), the “Second (International) English Edition of Neufert, Architects' Data” translated by “Gohari” (2000, pp. 208-223), the “Third Edition of Neufert, Architects' Data” edited by “Bousmaha Baiche” & “Nicholas Walliman” (1999, pp. 464-472), the “Fourth Edition of Neufert, Architects' Data”, translated by “Mahmoudi” (2006, pp. 470-478), and also, the bachelor thesis of the author titled “Hostel of Quri-Gol Tourist-Entertainment Complex (Tabriz)” (Asbagh, 2007, pp. 71-83). There are four types of hostels: Student Hostels, Bachelor Hostels, Worker Hostels, and Youth Hostels (Asbagh, 2007, p. 71).

**3.1 Student Hostels**

Single beds with shared facilities. The best case is approximately 70 to 90 students (less than 150 people) in units of 12 to 15 people. Multi-story buildings are more economical than single-story buildings or desert tents. The latter is only suitable for very large organizations (Table 1).

**3.1.1 Basic Needs**

**Table 1.** One-bedroom rooms with desks: 9 – 15 $m^2$ (Asbagh, 2017, pp. 71-72).

| | | |
|---|---|---|
| **10 to 15 single rooms per student per unit** | Ordinary small room | 0.8 – 1.2 $m^2$ |
| | Kitchen | 0.4 – 0.6 $m^2$ |
| | Public Toilet | 0.5 – 0.7 $m^2$ |
| | Bathroom | 0.3 – 0.4 $m^2$ |
| | Toilet | 0.4 – 0.5 $m^2$ |
| | Service room (cleaning) | 0.2 – 0.3 $m^2$ |
| | Total | 2.6 – 3.7 $m^2$ |
| **Per student per group room** | Ordinary large room | 0.9 – 1.2 $m^2$ |
| | Library, reading room | 0.4 – 1.8 $m^2$ |
| | Indoor sports room | 0.2 – 0.4 $m^2$ |
| | Entertainment and recreation room | 0.2 – 0.4 $m^2$ |
| | Total | 1.7 – 3.8 $m^2$ |

It is important to note that public spaces should be located at the intersection of circulation lines. Having a kitchen with a dining area is a must for the students who cook their food. This space may have a small room with a stove for every 4 to 6 people, a work desk (anti-acid and heat-resistant), a two-bowl dishwasher with a place for drying dishes, a cabinet for porcelain and kitchen utensils, a cooling room for food storage for each student, refrigerator, vacuum cleaner and garbage dump unit. The laundry room should be large and accommodate 10 to 15 units of two hostels.

**3.1.2 Bathrooms**

One bathroom with a shower for every 4 to 8 students, and 2 to 3 cabin baths for the whole hostel. A toilet plus 6 to 10 bidets for male students. One toilet for every 6 to 8 female students.

**3.1.3 Necessary Facilities**

A full-time cleaner for every 20 to 24 student rooms with kitchen, toilets, bathrooms, etc. Each floor needs a room with a locked door for cleaning supplies, a wheelbarrow for transportation, and, if needed, a laundry room, parking for bicycles, scooters, motorcycles, etc. Sometimes the concierge room is combined with a shop that caters to the needs of students such as postal services, laundry and public telephones. Central alarm system or speaker for transmitting messages related to telephone booths.

**3.1.4 Design**

One-row plan: building width 5.5 meters, room 3.5 meters, corridor 1.5 meters. Two-row plan: building width 10 meters, 2 rooms each 3.5 meters, corridor 2 meters. Three-row plan: width of the building 14 meters, 2 rooms each 3.5 meters, 2 corridors each 1.5 meters. With 2.5 meters of the window and central ventilation duct for public toilets, etc.

**3.1.5 Dining Room**

Location of the dining hall: near the university buildings, preferably in the green environment of the park. Kitchen and other spaces on the Northside, main dining hall on the Southside, and the other spaces on the East or West. The number of people eating in the canteen varies between 20% and 80% of the total students. The number of seats: 2 – 3 for each meal. The space required depends on the order of the seats and how it is served. This issue must be determined before designing since the determining factor is all the measurements, the size and location of the windows, the location of the canopy in front of the shop, and so on. Serving methods: a) ordinary self-service from the food counter; b) self-service with food trays on the tables that are collected by the waiters; c) individual service by waiters. Types “a” and “c” are usually used together. Unlike restaurants (with a large number of tables for every 2 or 4 people), long tables with thick and uncut maple wood and long chairs are more suitable for dining. These materials are cheap, durable, compact, convenient and easy to clean and tidy. The width of the seat is greater than or equal to 60 cm. The width of the table is 60 cm, preferably 75 cm. Space of any place: which includes access from behind but without the main passageways 1.50 meters * 0.60 meters = 0.6 $m^2$. Space for the cross-shaped circulation: (0.50 * 0.50)/ 3 seats = 0.18 $m^2$ in addition to additional space for sidewalk circulation and space in front of the workplace and the entrance. Therefore, the per capita floor space for each student = 0.9 – 1.0 $m^2$. The chairs should be at a distance of 80 to 100 mm from the table and should be 30 cm wide and 40 – 45 cm high so that students can jump over them easily. The width of the seats next to the wall is 40 cm, which is 12 cm away from the wall for access. It is easier to have access from the side, which of course applies to less than 4 seats next to the wall. For more comfortable and complex furniture that is designed with more comfortable chairs and tables, the sizes are as follows: The width of the seat is greater than or equal to 66 cm. The width of the table is greater than or equal to 70 or 80 cm. Required space (including back access circulation): 1.15 meters * 0.65 meters = 0.75 $m^2$. Cross-shaped circulation: (1.15 meters * 0.55 meters)/ 3 = 0.21 $m^2$. Per capita for each student, taking into account other side spaces is 1.1 – 1.2 $m^2$. If the space parallel to the wall behind the seats is used as the main circulation path, the width will increase to more than 80 cm. Desks with chairs at both ends are uneconomical and weaken students’ sense of equality and communication. Required space for tables in the corner: (2.55 meters * 5.90)/ 12 = 1.25 $m^2$. The required space for each student with all passageways and other side spaces is 1.2 – 1.3 $m^2$.

**3.1.6 Service Spaces**

Kitchens and other spaces are about 40% of the dining space. Preparation area about 20% of kitchen space. Warehouse rooms (fruits and vegetables) about 75%. The fuel depot (if needed) occupies about 10% of the dining space. Ventilation is needed to repel the smell of the kitchen and dining room, which should ensure the flow of fresh air in the dining room and rooms adjacent to the kitchen. The kitchen should be large enough to work so that there is no interruption during operation. Large storage rooms should not be on the dining floor (where the kitchen should be located) but on the ground floor. Also, on the kitchen floor, there should be refrigerated rooms and a daily storage

room for storing daily necessities based on the daily menu. Elevators and ladders used to re-store these warehouses during the day should be placed at the beginning of the circulation path, followed by automatic kitchen appliances, countertops, stoves and ovens, boilers, and other countertops, and if needed, elevators are placed to take food to other floors. The pottery follows the same path and, after use, is transported by handwheels to dishwashers and drying racks. The location of the chef's room is very important and (s)he should be able to see the doors, basement stairs, kitchen, place for washing dirty dishes and even the dining room by using glass partitions. Weights should be at the entrance to the kitchen. In the dining room, the circulation path of those who eat should be one-way. This goal can be achieved by using the correct arrangement of tables, and also by placing columns in the corners of tables, the unused spaces can be reduced.

**3.1.7 Required Space for Students**

1.2 $m^2$ for each chair with three seats. Approximate area of required space suitable for dining: Entrance, the filter of the entrance, and locker room 40%. Small dining room for seminars and small parties and ... 20%. Main dining area (preferably expandable) 20 – 120%. Ordinary small amphitheatre 20%. Three rooms for female students 10%. Rooms for student group work and student activities 20%. Board room (advisory council) and reference library 30 $m^2$. Four or five student rooms, each 15 – 18 $m^2$. Rest and beverage area of 1.5 $m^2$ per person (which is used by about 1/4 of clients). It is better to place the locker rooms on the middle floor between the dining room and the main hall, where the lobbies can be used as resting places. The main dining room can be expanded to any size using folding partitions. The gallery can be used as a small seminar room. The kitchen on the floor of the main dining room should be able to serve as many rooms as possible. Upstairs, in addition to the gallery, it is better to have student rooms and a conference room. The playroom is on the floor of the theatre stage and is also used as a changing room for actors. The student hostel is divided into the entrance, the main dining hall, and the service area, which is divided into high-rise halls and medium-height floors at the entrance and service areas.

**3.1.8 Rooms**

For the supervisor 2 to 3 rooms with bathroom without kitchen 75 $m^2$. For the secretary, 2 rooms and a bathroom 50 $m^2$. For the caretaker, 3 rooms and a bathroom 50 $m^2$. For services 2 – 3 rooms, each 12 – 18 $m^2$ (considering that everyone is dining in the dining hall).

**3.1.9 Office Rooms**

Office of the hostel 30 $m^2$. Supervisory office 15 – 20 $m^2$. 1 – 2 rooms for a student association 30 $m^2$. Consulting and archive room 25 $m^2$.

**3.1.10 Service Spaces**

1 toilet and 2 bidets for 60 – 70 male students. 1 toilet for 30 – 40 female students. 1 washing basin for 50 students. 1 warehouse and a shelf for sweeping with buckets and towels on each floor (Neufert, 1970, pp. 185-188; Asbagh, 2017, pp. 71-77).

**3.2 Bachelor Hostels**

**3.2.1 Location**

Easy access to the city and public transportation, of course in the green space, preferably near sports fields, swimming pools, lakes, rivers, etc.

**3.2.2 Orientation of Bedrooms**

East, West.

**3.2.3 Required Spaces**

Initially, bachelor hostels had the same space as rental homes, but later the models were designed more in the style of American boarding houses.

**3.2.4 Bedroom Spaces**

15 – 25 $m^2$ in addition to the space of the room with common facilities and sometimes the cooking area in the corner as much as 4 $m^2$. The shower and the toilet can be combined and serve 2 rooms, but washing facilities, space for preparing for cooking and cooking area should be separate. In the bathroom, it can also be opened to the hallway, in which case only the toilet, shower and more spacious cooking area are placed in front of the space, or another case is to have a smaller cooking area to have more space for sanitary and toilet. In most examples, there is a bathroom and a kitchen (Neufert, 1970, p. 189; Asbagh, 2017, pp. 77-78).

### 3.3 Worker Hostels

#### 3.3.1 Location

Near the workplace, in the neighbourhood of factories where it is covered and dust-free and not in the wind direction, preferably in the green space near the sports field.

#### 3.3.2 Orientation of Spaces

Bedrooms on the East, living spaces on the Southwest, kitchens on the West or Northwest.

#### 3.3.3 Types of Bed Arrangement

a) large dormitories for 10 to 20 people: the space required for each bed is larger than or equal to 2.60 $m^2$; b) smaller common rooms for 2 to 4 people: the space required for each bed is larger than or equal to 3.70 $m^2$; c) one-bedroom: the space required for each bed is larger than or equal to 4 $m^2$. The most common type of room is 4 beds. Unlike youth hostels, the beds are not two-story and the distance between the beds and the width of the passageways is about 10% larger. Living room space (2 – 3 rooms) about 0.30 $m^2$ per resident. The size of the dining space varies depending on the need, i.e., depending on whether this space is used one or more times for each meal. Therefore, the space required for each chair varies between 0.5 to 1.5 $m^2$. The kitchen is usually combined with the restaurant, otherwise, the floor space is about 20 – 25% of the dining area. The clothing store and offices are located on the ground floor. Warehouse space (bicycles), laundry, heating system, fuel, etc. are located in the basement. The caretaker room is near the entrance and is approximately 50 $m^2$. The manager's room is about 75 – 100 $m^2$ near the stairs and preferably on the first floor. One patient room for every 40 beds, about 9 – 10 $m^2$. Locked shelves between the dormitory and the bathroom (toilet) on each floor. One lockable shelf for each bed = room height * 60 cm * 50 cm. One toilet for every 3 – 4 beds. One shower for every 10 – 15 beds. One bathroom for every 20 – 25 beds. One toilet and 2 bidets for every 2 beds (for gentlemen). In the smallest rooms that use all the space, the necessary arrangements for air conditioning should be considered. The arrangement of the beds, the open space (without shelves) and the laundry depend on the individual needs (Neufert, 1970, pp. 190-191; Asbagh, 2017, pp. 79-80).

### 3.4 Youth Hostels

Youth hostels have offered reasonably priced accommodation for young people, youth groups and school classes traditionally, but the range of services of a modern youth hostel also includes meetings, courses, seminars, education of young people and adults, leisure facilities, school trips, and walking for singles and families. There are children's hostels (up to age 13) and youth hostels (13 – 17) in rural areas, and there are youth guest houses offering tourist and cultural services in towns. The tendency among youth hostels is towards the 3-Star hotel standard, with sizes of 120 – 160 beds (Neufert, 2012, p. 184). The different types of youth hostels are as follows: a) a small hostel for young people with a dormitory of 30 – 50 beds; b) a standard hostel with 40 – 100 boards; c) a large hostel with 100 – 250 boards; d) very large hostel 250 – 600 boards. The hostel with 120 – 180 beds is the optimal size with a maximum of 400 beds. The number of beds depends on the average number of guests, and the maximum number of guests is the criterion.

#### 3.4.1 Location

Outdoors, should be protected from the wind, and main rooms in the southwest or south.

#### 3.4.2 Conformity Table for Standard Hostel Size

In dormitories for each bed: 2.20 – 2.80 $m^2$. For 2-story beds: 1.80 – 2.00 $m^2$. There may be 1 or 2 large dormitories with 20 to 30 beds each, or smaller bedrooms with 4 to 12 beds. In addition, there should be a patient room with 1 or 2 beds. 40% of clients are girls and 60% are boys. The average height of the rooms is 2.80 meters, which should be larger than 2.50 meters. Dormitory floor space (bunk bed) for each bed: 1.50 $m^2$. Normal beds per bed: 1.20 – 1.50 $m^2$. Bunk beds per bed: 1.10 $m^2$. Public space per bed: 1.00 – 1.50 $m^2$. Rooms should be soundproofed and away from the meeting and discussion rooms. The guard kitchen should be close to the entrance and receive light from both sides. Preferably the walls should be wooden and the benches should be foldable.

#### 3.4.3 Kitchen

The required space per bed is 0.50 $m^2$. a) guest kitchen with cooking facilities: in small youth hostels, it may be located in the room, but in larger organizations, it should be independent of the guard kitchen. Larger cooking utensils are needed, such as a 100-litre (20 gallons) boiler and a sink; b) a large kitchen for eating and sitting in a group in winter; c) a guard kitchen near the entrance with a glass door or window to monitor the entry and exit of people and cooking space in the room. It should have a double sink, a low-height drain sink, a cabinet surface about

60 cm below the floor of the windows, a lockable drawer to store money, and electrical outlets for kitchen appliances. In a gas-fired kitchen, cooking surfaces should be low to use large kettles and pans.

**3.4.4 Dishwashing Sink**
The dishwashing sink and the cabinet for keeping pottery should be near the cooking place because the pottery is washed by the clients.

**3.4.5 Food Storage**
Close to the kitchen, long and narrow and cool.

**3.4.6 Guardian Room**
Minimum 3 rooms each about 16 $m^2$. The kitchen may be on the same floor or separate, which if separate should be on the ground floor near the reception and living room. There are 1 or 2 bedrooms and a bathroom upstairs.

**3.4.7 Entrance**
It should be protected from the wind or have a porch, have easy access to the road, need a roof and should be easy for guards to monitor.

**3.4.8 Corridors**
They should be wide enough: where the doors open into the rooms 1.3 – 1.5 meters for the central corridors or where the doors open to the hallway 1.8 – 2.00 meters.

**3.4.9 Stairs**
Step height smaller than or equal to 16 cm, width greater than 1.30 m. The width of the stairs of the dormitories is greater than or equal to 1 meter. If the number of guests is 40 or more, the width of the stairs increases to greater than or equal to 1.30 meters. Emergency measures must be taken to escape during a fire. Hallway and staircase space for each bed 1 square meter.

**3.4.10 Public Toilet**
The floor space for each bed is 0.35 – 0.40 $m^2$. A toilet of about 20 * 45 * 50 cm for every 4 – 6 beds. One scaffolding is about 25 * 35 * 35 for every 15 beds. One shower for every 20 – 40 beds. Showers can be installed in the basement, but it is better to install them near sleeping areas. There should be a public toilet on the ground floor for visitors.

**3.4.11 Sanitary Services**
The required space per bed is 0.30 – 0.35 $m^2$. A toilet for 8 – 10 boys. A toilet for 6 – 8 girls. A bidet for 8 – 12 boys. Less per capita is also acceptable for type 3 and 4 hostels.

**3.4.12 Laundry**
It should not be too small and should be placed at the intersection of baths, showers and heating systems. In large youth hostels, it is desirable to provide washing machines, dryers, etc. The total per capita water required per person per day is 80 – 100 litres.

**3.4.13 Warehouse Space**
For furniture, bicycles, are sports equipment which needs vary according to regional conditions and environmental requirements.

**3.4.14 Drying Room**
For drying wet clothes (with a heating system).

**3.4.15 Service Room**
For hostel equipment plus a first aid kit.

**3.4.16 Basement**
For heating and fuel storage system.

**3.4.17 Building**

Due to the area being in harmony with the yard, as resistant and rough as possible. It is better to use stone and wood with a minimum of plaster (Neufert, 1970, pp. 192-193; Asbagh, 2017, pp. 80-83).

**3.5 easyHotel**

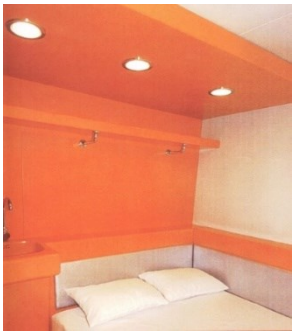
"easyHotel" provides a clean and safe room at a reasonable price for travellers. The purpose of designing this type of hotel in the city centre is the small space of the rooms and their reasonable price. easyHotel offers its customers high quality and standardized products that have a well-known brand. All hotel reservations are made by credit card via the website. Customers can book their rooms by credit card through the website. The sooner they make a reservation, the lower the cost of accommodation and the cost of long-term stays will be higher than short-term stays. Small rooms of easyHotel: dimensions of 6 to 7 $m^2$, which are designed like a cabin and do not have windows. It has a private bathroom with toiletries, a toilet and a shower. There is a flat-screen TV in the room and the remote control of the TV can be rented from the reception desk. The TV has 10 channels and is available 24 hours a day. All rooms have a heating and cooling system and air conditioning. The capacity of all rooms is a maximum of 2 people. The rooms and the beds will be tidy before the passenger arrives. All rooms have 2 beds with towels, sheets, velvet and pillows. Room cleaning service is optional during the stay. Passengers must notify and book from the reception desk if their room needs to be cleaned and bedding changed. Standard rooms All the conditions of these rooms are similar to small rooms, with the difference that their dimensions are 8 to 9 $m^2$ (Figure 3) (URL9).



Double Bedroom and Bathroom



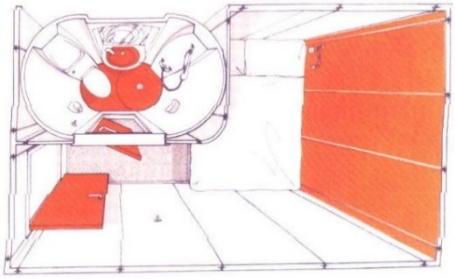
A Room with Window



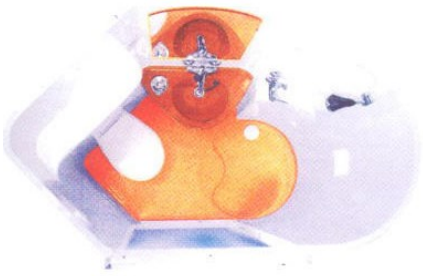
Double Bedroom



Double Bed



Plan of the Room



Plan of the Bathroom




(Above) Bathroom, (Below) TV




The Entrance of easyHotel

**Figure 3.** Pictures of Room, Bathroom, Plan, TV, and Entrance of easyHotel (URL9).

**3.6 Hostel of Camp in Passail**

The "Multifunctional Camp Modules" was the subject of a competition for the young hostel to come up with specific ideas for the future, which in the past had been built separately and with a different look. A type of block-like building system that can be set up on different sites and has the same appearance, which can create a separate image for this type of tourism in the coming years. The winning design included 9.80-metre-long wooden prefabricated timbers with optimal interior dimensions and minimal space required. For different group and joint activities in the youth hostel, there are three module sizes, in all of which the useful ceiling height is 2.50 meters: a 2-metre-wide container for one chaperone, a 3-meter-wide youth module, and an apartment module at 40 $m^2$ for up to eight beds. "Holzbox Triol", the architect of the hostel, planned to transport a series of separate prefabricated wooden tubular units to the project site by lorry. Due to the narrow width of the street to carry long and wide loads, the architects used sandwich-panel construction with prefabricated walls, floors and ceilings for the first camp in Passail. Entrances, façades, interior furniture, and custom furniture are also made of modular components. By changing the location of the sliding door and a dividing wall, double beds can easily be converted into bunk bed. The entire project, which includes the design and construction of 10 apartments with 58 beds, was completed in less than 4 months. The living areas on the concrete foundation are present in both buildings and create a terrace. This courtyard continues below the base of the upper block, which is suitable for activities on rainy days (URL10) (Figure 4).



General View



Exterior View


Arrangement of the Beds


Shared Kitchen


Shared Kitchen


Bathroom

**Figure 4.** Pictures of the Exterior, Bedrooms, Kitchen, and Bathroom of the Hostel of Camp in Passail (URL11).

**4. Designing a Hostel near Quri-Gol Lake**

The external form of this hostel is in the form of 4 rectangular cubes that revolve around a square cube. Each of the rectangular cubes forms a 90-degree angle from the other and is 80 cm different in height. Access to all floors is possible through the central staircase and 4 elevators. There are 2 fire escape stairs on the North and South sides of the hostel for emergencies and fires according to the "Third Volume of Iranian Office of National Building Regulations: Protection of the Buildings against Fire", the distance between these two fire escape stairs is less than the half of the largest diameter of the building (2004, p. 39). All hostel rooms have closets, toilets and bathrooms. There are also public toilets in the hallways. Most of the rooms have a balcony that allows the residents to observe the beautiful view of Quri-Gol Lake. The rotation angle of the building relative to the North-South axis is 15 degrees due to the climate of the site (Kasmaei, 2003, pp. 27-29, 82-84, and 120). Also, all sports fields on the site are rotated 15 degrees relative to the North-South axis. The site has a covered outdoor parking space for 10 cars and 3 buses. There is also an outdoor parking space for the bicycles on the site. Rental bicycles are available in three standard sizes: 19 large bicycles (length = 1.5 meters), 28 medium bicycles (length = 1.10 meters), and 20 small bicycles (length = 0.75 meters). Playing ground is designed for the children plus 20 pergolas on this site. The bike path continues around the site and is intended for the children riding bicycles around the park who are within the sight of their families while staying in the pergola. Also, there are sports fields including basketball, volleyball, tennis, and football arenas and 2 ping pong tables on the site. In the basement, there is a parking lot with a capacity of 27 cars, a motor house, a kitchen and a laundry room. According to the "architectural, construction criteria and classification of inns (hotels) in the country", for every 6 guest rooms, a park unit must be considered. For 23 rooms, 4 cars for employees plus 23 cars for each family are considered. The entrance is located in the main part of the first floor. Spaces such as the lobby, reception desk, and teahouse are designed on the North wing of the building. On the East wing, recreation and entertainment spaces such as a library, internet café, and billiard hall are placed. The restaurant is designed on the West wing, and on the South wing, the prayer room and bathrooms plus a private area for the staff room and the office of the hostel CEO are located. On the second floor, 20 rooms are provided as dormitories for young people, each of which has 5 rooms. The North and East wings have a common fire escape stair for the girls, and the South and West wings have a common fire escape stair for the boys. On each half floor, in the central part adjacent to the lobby staircase, there is a waiting area and a place to sit, which have a beautiful view of the lake on the top floor. On the third floor, which includes only the North and South wings, there are 23 rooms for families. The windows of the

rooms are in the form of a strip with a width of one meter, which is reduced to 50 cm in services (Table 2, Figures 5,6,7, Table 3, Table 4) (Asbagh, 2017, pp. 132-133).

**Table 2.** The Physical Program of Quri-Gol Hostel (Developed by Author based on Neufert Architects' Data, & Architectural, Construction and Rating Criteria of Hotels and Inns in the Country, Iranian Cultural Heritage and Tourism Organization; Asbagh, 2017, p. 131).

| Space | Per Capita | Bed/ Person | Number | Total Area ($m^2$) |
|---|---|---|---|---|
| Room for 8 – 12 people | 3 $m^2$ | 12 | 10 | 360 $m^2$ |
| Room for 4 – 6 people | 2.5 $m^2$ | 6 | 10 | 150 $m^2$ |
| Room for 2 – 4 people | 2.5 $m^2$ | 4 | 10 | 100 $m^2$ |
| Corridor, Elevator, Stairs | 1 $m^2$ | 180 | - | 180 $m^2$ |
| Reception and Lobby | 1 $m^2$ | 30 | 1 | 30 $m^2$ |
| Hostel CEO Room | - | - | 1 | 24 $m^2$ |
| Staff Room | - | - | 2 | 48 $m^2$ |
| Powerhouse | 0.8 $m^2$ | 180 | 1 | 144 $m^2$ |
| Store | - | - | 1 | 16 $m^2$ |
| Restaurant | 1.1 $m^2$ | 180 | 1 | 200 $m^2$ |
| Traditional Teahouse | 0.5 $m^2$ | 180 | 1 | 90 $m^2$ |
| Prayer Room (Ladies and Gentlemen) | 1 $m^2$ | 180 | 2 | 180 $m^2$ |
| Toilet (Ladies) | 0.7 $m^2$ | 180*40%=72 | 10 | 50.4 $m^2$ |
| Toilet (Gentlemen) | 0.7 $m^2$ | 180*60%=108 | 10 | 75.6 $m^2$ |
| Laundry Room | 0.3 $m^2$ | 180 | 1 | 54 $m^2$ |
| Parking (Car, Bus, Bicycle) | - | - | 1 | 500 $m^2$ |
| Game and Entertainment Room | 0.4 $m^2$ | 180 | 1 | 72 $m^2$ |
| Internet Café | 0.4 $m^2$ | 180 | 1 | 72 $m^2$ |
| Library | 0.4 $m^2$ | 180 | 1 | 72 $m^2$ |
| Total | - | - | - | 2418 $m^2$ |

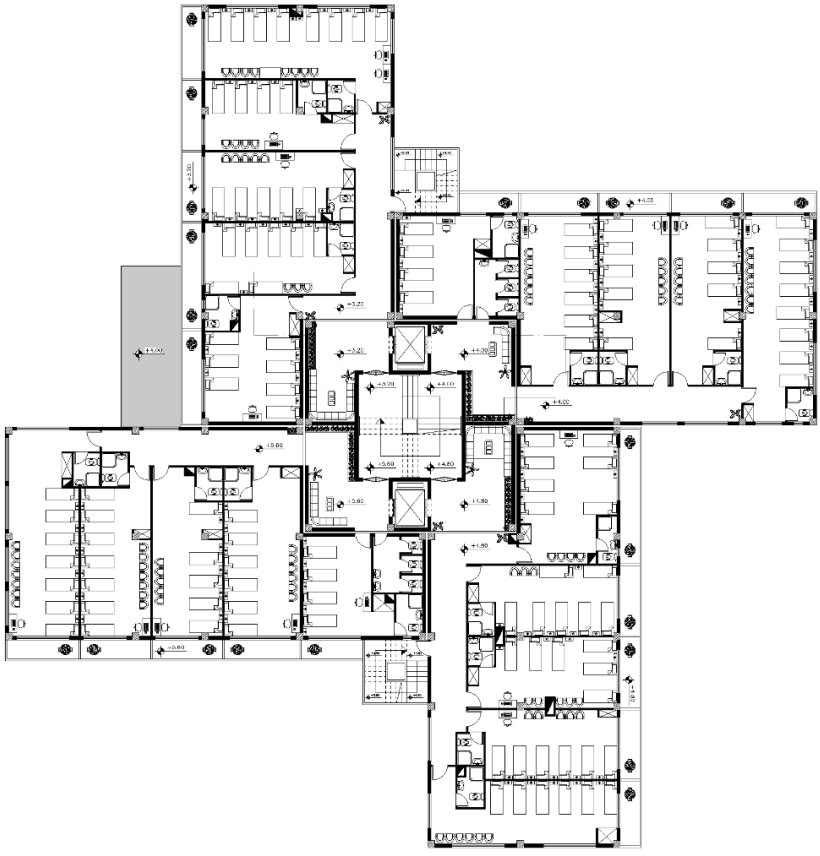


**Figure 5.** The Plan of Quri-Gol Hostel (Designer: Author).



**Figure 6.** The Site Plan of Quri-Gol Hostel (Designer: Author).



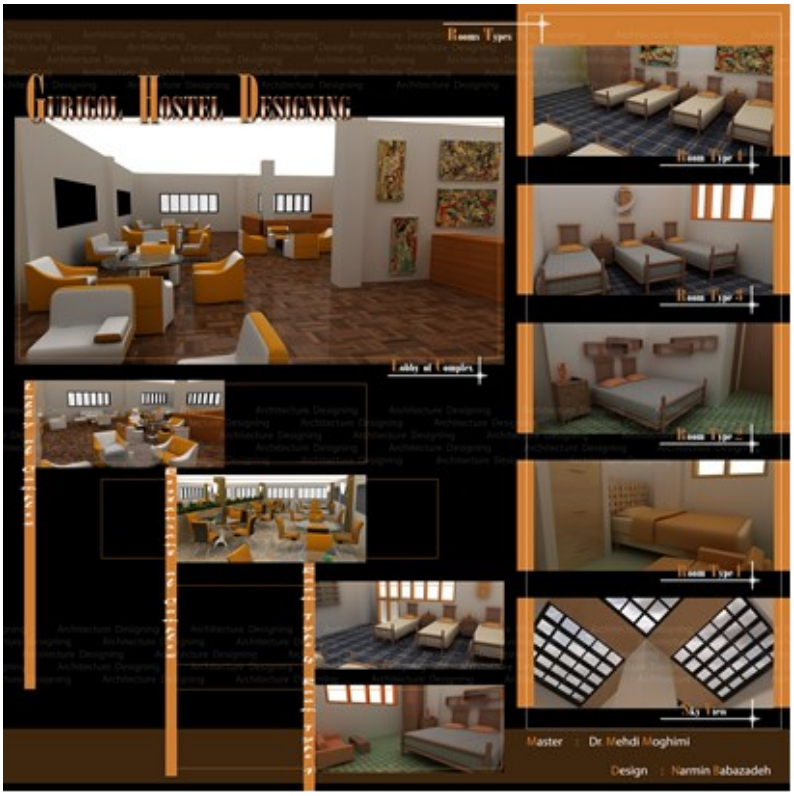
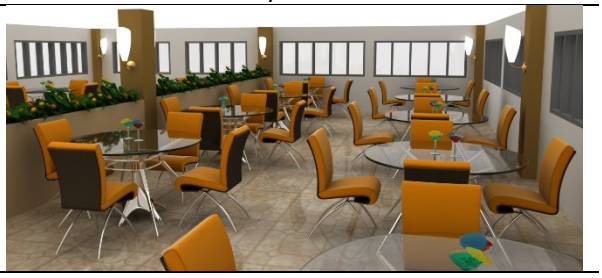



**Figure 7.** Posters of the Exterior (Above), and the Interior Design (Below) of Quri-Gol Hostel (Designer: Author).

**Table 3.** The Various Views of Interior Design of Quri-Gol Hostel (Designed and Developed by Author).

| | |
|---|---|
|  |  |
| The Lobby of the Hostel | The Lobby of the Hostel |
|  |  |
| The Lobby of the Hostel | Restaurant of the Hostel |
|  |  |
| Room Type 1 (Single Bedroom) | Room Type 2 (Double Bedroom) |

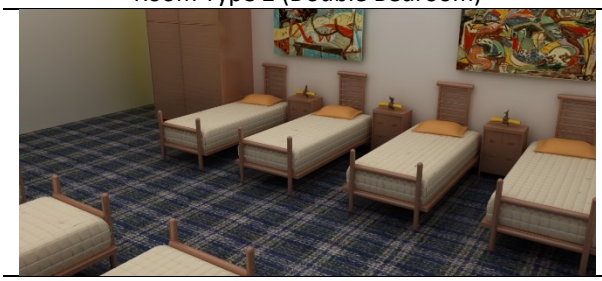
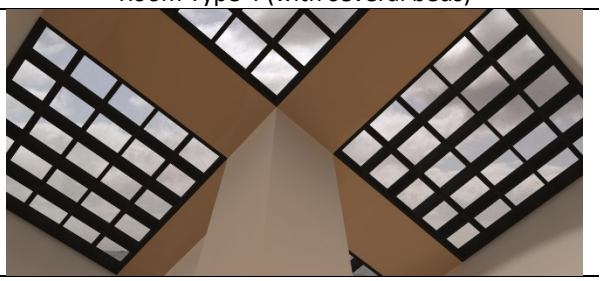
| | |
|---|---|
|  |  |
| Room Type 2 (Double Bedroom) | Room Type 3 (Triple Bedroom) |
|  |  |
| Room Type 4 (with several beds) | Room Type 4 (with several beds) |
|  |  |
| Lobby Roof Skylight | Lobby Roof Skylight |

**Table 4.** The Various Designed Exterior Views of Quri-Gol Hostel (Designed and Developed by Author).

| | |
|---|---|
|  |  |
|  |  |



**5. Conclusions**

Given the existing potential of the country, one of the appropriate strategies for economic development is the development of the tourism industry. In this regard, the ecotourism industry is known as an important tool for tourism development. Investing in ecotourism not only protects ecosystems and a healthy natural environment for a living but also generates significant revenue and valuation. East Azerbaijan province in terms of having rich resources in this field can take basic steps to use the ecotourism industry. The beautiful region of Quri-Gol Lake, due to its special and outstanding features, can serve as a stimulus for the development of ecotourism in the province, as well as the development of the tourism sector. Quri-Gol Lake with its exceptional size in the semi-arid region with side reeds has created an interesting view and its view of the side hills has attracted many travellers who spend part of their time there like a picnic or spend the night as accommodation. The shore of the lake, despite the limited amenities, welcomes large crowds of people, which needs to build a hostel in the short term and develop a hotel in the long term. Quri-Gol Lake with an area of 162 hectares which is less than “Lake Urmia”, is the most important lake in the semi-arid zone of the Azerbaijani plateau with fresh water with an average depth of 3 meters and an altitude of 1897 meters with a watershed of 356 hectares next to the main axis of Tabriz-Tehran highway, located 40 km southeast of Tabriz. Due to being in the way of migratory birds, this lake is a place of rest and renewal of energy to continue their flight and is of great ecological importance. The special beauty of the lake with migratory birds, especially white ducks, has made the travellers who travel to the North-Western part of the country and pass-through this axis spend time along this lake and even stay in tents that are installed at night there. The citizens of Tabriz usually spend the weekend near the lake, especially in parts of the lake that has trees. The subject of this research is designing a Hostel near Quri-Gol Lake. A hostel is an inexpensive accommodation with a bed, pillow, blanket and toilet, usually built in a dormitory-style. Hostels have private rooms or dormitories. Private rooms are usually single, double or sometimes triple. Dormitory rooms vary in size but usually vary from 4 to 20 beds. These types of rooms often have folding beds. Student groups, families, young couples, university students, the elderly, etc. can stay in the hostel. In most hostels, travellers must be 18 years of age or older or with a parent. Some hostels have lockable shelves or luggage storage where travellers can store their backpacks and luggage during the day when travelling outside the hostel. In most hostels, the doors of the rooms can be locked and most travellers usually place their belongings on or under the bed.

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**Conflict of Interests**
The author declares no conflict of interest.

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# The Role of Attraction Factors in Recreational Shopping Gratification: Case of Colombo, Sri Lanka

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**Abstract**
This paper sets out to question: What attraction factors influence recreational shopping gratification. An online questionnaire survey was administered to 220 young adult consumers from two shopping malls in the city of Colombo. A narrative inquiry was employed by conducting 30 interviews from the same sample to light up the research question as to the second step. Exploratory Factor Analysis followed by correlation and regression analysis and content analysis were used as methods of analysis. The result of the research highlighted the importance of socialization, ambience and safety and security towards increasing recreational shopping gratification, while socialization plays the most important role in gratification. Meanwhile, as revealed from content analysis, fun and entertainment is an attractive factor in the Sri Lankan context. The outcomes of the study, using a mixed-methods approach, would enrich both the theory and practice of developing a consumer-friendly environment to increase gratification in recreational shopping.
**Keywords:** Recreational shopping; attraction factors; shopping malls; shopping gratification.

## 1. Introduction

According to many researchers, shopping is not only an activity for purchasing. “Shopping is a recreational activity" and choosing a particular shop depends on the value of “entertainment” (Woodside, Trappery & Randolph, 1992; Wanninayake & Randiwela, 2007, Amen,2022). Shopping seems to be the main cause for recreation and also a routine task for home linked to females in the Sri Lankan concept of shopping malls (Perera & Sutha, 2018). Shopping exemplifies a significant outage for social empathy, communication, and gives short-term release from day-to-day schedules primarily for residents in urban areas (Guiry et al., 2006; Stillerman & Salcedo, 2012; Shim, Santos, & Choi, 2013). Shopping has advanced from obtaining day-by-day necessities counting nourishment to a recreation activity. Other than the fundamental utilitarian work, the recreational aspect of shopping has been resuscitated (Jim & Chen, 2009). There has been a reform of open spaces to blend shopping with recreation (Abaza, 2001). The number of recreation-driven customers has expanded altogether in recent years (Bäckström, 2006). The traditional definition of recreational shopping can be explained as ‘perceived enjoyment’ from shopping. It is also labeled as an activity for leisure time (Bellenger & Korgaonkar, 1980; Bäckström, 2006). Shopping can be explained as a form of recreation in case it is comparatively free from responsibilities and it is recognized for its values of gratification and preferred consequences (Bäckström, 2006). Miller, Jackson, Rowlands, Thrift, & Holbrook (1998) states that recreational shopping is described by the mental state of ‘having the time to shop’. Most of the previous studies have taken into account the overall idea of shopping rather than a recreational shopping (Bäckström, 2006).

It is reported a considerable amount of time at malls is spent by recreational shoppers (Bäckström, 2006). Shopping malls are solid components of urban space, particularly in developing countries (Beiró et al., 2018). In Sri Lanka, shopping malls are likely to be the biggest marketplaces which are found generally in cities (Ratnayake, 2015). People utilize malls to gratify different kinds of requirements (Stillerman & Salcedo, 2012; Beiró et al., 2018). The Korean term “malling” is adapted for explaining people visiting malls for more than the purpose of purchasing. Shim et al. (2013) suggest that the malling experience extends beyond mere consumption, beyond the inspiration to shop, going by a shopping center may envelop numerous other inspirations, such as managing stress, feeling energized, calming down, and socializing. By itself, utilitarian or hedonic conceptualizations are limitedly capable of clarifying all perspectives of the malling (Shim et al., 2013).

As Shim et al. (2013) mentioned, relatively limited research has been done on recreation activities in modern utilization of spaces, for example, shopping malls, even though these spaces are all-inclusive getting to be ever more well known as recreational spaces. The absence of literature on shopping malls in the discipline of recreation is particularly shocking, although the growing importance of “shopping centers as relaxation spaces” is recognized by (Shim et al., 2013). The lack of academic research on entertainment in retailing leads to the absence of information and it makes it marketers difficult to satisfy recreational shoppers’ expectations (Perera & Sutha, 2018). Although there is some research available for other countries such as the United States, Thailand, India, and South Korea (Kowinski,1985; Shim et al., 2013; Vinoditha & Sreeya, 2019), research from Sri Lanka has not yet been aimed to

recognize the shopping malls as a place for recreation. Although one can discover homogeneity anywhere in the world for certain, a diverse setting can be provided by local differences and economic circumstances (Abaza, 2001). Spotting out the dissimilarity in the utilization of shopping malls in a few parts of the world will add value. While technological advancements provide online shopping opportunities, it is worth identifying what makes people attracted to recreational shopping for gratification in malls.

The key idea of undertaking this research came from the instinct of observing that people are likely to go to shopping malls more often than in the previous era, and people living in the city of Colombo are engaging in recreational shopping which is more than mere shopping for purchasing goods. This culture has adapted very recently with the rise of new shopping centers in the city of Colombo. The city of Colombo, which has high adaptation to new trends as it is the largest city by population and the commercial capital of Sri Lanka is selected as the case study area.

The objective of the study is to examine the role of attraction factors in recreational shopping gratification. The research attempts to answer the question: What are the attraction factors that influence recreational shopping gratification?

The significance of this research is viewing recreational shopping and shopping malls with a spatial dimension window, by relating mainly the attraction factors such as ambience, convenience, physical environment, socialization, facilities, etc. (Singh, Prashar, Agarwal, & Sharma, 2014; Khare, 2012; Tandon, Gupta, & Tripathi,2016; El-Adly, 2007). Since shopping malls are viewed as public places, it is important to understand what attracts people to go to them. With a developing trend in the recreational field, this research will be helpful for planners, policymakers, and mall managers. Because of the limited research available in the country, the findings of this research will serve as a national research area.

## 2. Mall Attraction Factors and Shopping Gratification

Consumer Culture Theory (CCT) is adapted for this study. CCT research is commonly an in-depth investigation of consumption that by itself can inspire future studies that strive for a general understanding of particular phenomena. In CCT, it is frequently discussed that consumers create perceptions of the world about meanings, symbols, and experiences (Bäckström, 2006). So, it can serve the purpose of achieving the research objective. Hirschman and Holbrook (1982) proposed two perceptions of consumption that can fluctuate with time and consumers: utilitarian and hedonic. The value of hedonic is more biased toward personal instincts which provide more fun and liveliness rather than its complement utilitarian, which is towards an accomplishment of a task (Holbrook & Hirschman, 1982). According to most of the studies, it is evident that recreational shopping shows hedonic perception (Babin et al., 1994; Kesari & Atulkar, 2016). Some studies interpreted recreational shopping as an activity that cannot be merely explained by utilitarian and hedonic concepts and it should be accepted irrespective of whether the initial purpose was utilitarian or hedonic (Shim et al., 2013; Bäckström, 2006).

Modern-day malls are converting themselves using contended architecture, and with extravagantly rich substances, tenant blends, and complicated design aspects (Han, Sahito, Thi Nguyen, Hwang, & Asif, 2019). Design elements encompass interior structure, high ceilings, landscaping, sunlight, floors, elevators, and washrooms. Also, these kinds of characteristics are naturally pleasant, and they are vital functions of urban form (Lewicka, 2008; Jones et al., 2006). More commonly, malls serve as group-level get-together spots letting individuals meet and recreate with companions, as is popular amongst teenagers. Contrasting with many leisure spots, shopping malls are also welcoming to unaccompanied people. Although there are embarrassments involved in going to eating out or movies unaccompanied, going to a mall alone is usual (Bloch et al., 1991).

Nevertheless, malls are regarded employing several attributes that cannot be brought by separate retail shops; and for that reason, they offer greater values as opposed to simply utilitarian and hedonic values. So, it can be expected that the attraction factors of malls should influence each hedonic and utilitarian purchasing value. Furthermore, shopping malls can also contribute to shoppers' contentment or gratification through leisure and social activities, with the aid of providing a meeting spot for shoppers to hang out (Calvo-Porral & Lévy-Mangín, 2018).

### 2.1 Attraction Factors of Shopping Malls

Many studies are available identifying the attraction factors (Han et al., 2019; Ahmed, Dash, Mahmud, & Sahel, 20.19; Singh & Prashar, 2013), in other terms: determinants (Singh & Sahay, 2012; Mittal & Jhamb, 2016); the dimensions of attractiveness (Wong, 2018; Tandon et al., 2016). Mehrabian & Russell (1974) states that the mall affects the interactive responses of shoppers, such as emotional, physiological, and cognitive, from the view of environmental psychology. The scholars tested the role of factors such as functionality, convenience, atmospherics, safety, socialization, self-identification, and amusement in the happiness of shopping and determined that consumers' happiness increases when shoppers recognize that the malls are functioning well, safe, accessible, enjoyable, desirable and draws different consumers that the shopper can become aware of with (Wong, 2018).

On the other hand, the attributes of the mall which are eye-catching for some customers are not always appealing to others (El-Adly, 2007). Besides the influence of malls' inside characteristics on benefaction, additional attributes for instance travel factors including trustworthiness in the mode of transport, distance, effort, tension, value, and comfort were significant in affecting shopping centers' patronage (Ibrahim, 2002). Han et al. (2019) in their study tested numerous features of urban form, which stimulate sustainable development and initiate buyers towards shopping malls. The assemble ambiance, entertainment, built environment, and consumption are used in studies with factors followed from the literature review.

The tangible nature of the retail environment is studied about numerous factors, for instance: signage (Bitner, 1992); orientating factors; spatial factors, and the ambience of the environment (Davies & Ward, 2002), which Kotler labeled as "atmospherics". Ahmed et al. (2019) discovered that atmospherics is progressively gaining momentum in improving mall shopping involvement in Bangladesh. A summary of the attraction factors is presented in the Table 1 ( a detailed review of the attributes is given in the Annexure 1).

**Table 1:** Summary of Attraction Factors from Previous studies (Compiled by Author)

| No. | Factors | Authors |
|---|---|---|
| **1.** | Ambiance, Consumption, Entertainment, Built environment | Han et al., (2019) |
| **2.** | Atmospherics, Entertainment, Tenant management, Facilities management | Tripathi & Tandon (2014) |
| **3.** | Ambience, Amenities, Safety | Ahmed et al., (2019). |
| **4.** | Merchandising, Variety & selection, Milieu and facilities, Convenience | Mittal & Jhamb, (2016) |
| **5.** | Ambience, Convenience, Physical infrastructure, Marketing focus, Safety and security | Singh & Prashar, (2013) |
| **7.** | Ambience, Design, Interiors, Service, Assortment, Socializing, Entertainment | Khare, (2012) |
| **8.** | Dimensions- Design and convenience, Children safety environment, Parking facilities, Tenant/ Service offering, Ladies/ elderly safety and convenience, Mall marketing activities | Wong & Nair, (2018). |
| **9.** | Comfort, Entertainment, Diversity, Mall essence, Convenience, Luxury | El-Adly, (2007). |
| **10.** | Ambient, Design, Layout, Variety | Wakefield & Baker, (1998) |
| **11.** | Convenience, Tenant variety, Internal environment, Leisure mix, Promotions | Calvo-Porral & Lévy-Mangín, (2018) |
| **12.** | Physical variables (Logistics related-9 and Ambience related-12), Economic variables (Comparative-6 and Promotion based-8) | Rajagopal, (2008) |
| **13.** | Atmospherics, Entertainment, Tenant management, Facilities management | Tandon et al., (2016) |
| **14.** | Variety, quality, supply, and status, Eco-natural environment and design, Mobility and accessibility, Additional services and entertainment, Physical environment, maintenance,<br>Security & information | Ortegón-Cortázar & Royo-Vela, (2017) |
| **15.** | Location, Quality and variety, Popularity, Facilities, Sales incentives | Wong et al., (2001) |

**2.2 Gratification in Recreational Shopping**

The term gratification (Guiry & Lutz, 2000; Arnold & Reynolds, 2003; Singh & Prashar, 2013) is recognised in different terms: satisfaction (Bäckström, 2006; El-Adly, 2007); excitement (Tripathi & Tandon, 2014; Rajagopal, 2009); shopping experience (Tandon et al., 2016; Singh & Sahay, 2012). Scholars consider that nearly all of the visitors of shopping malls, specifically benefit from the value of emotional and sensual fulfillment during shopping (Lee & Hwang, 2018). Shoppers with a gratifying purchasing motivation described their shopping journeys as worthwhile, escaping, getting rid of depression, and taking their minds free from stress (Arnold & Reynolds, 2003). Gratification in this study means personal satisfaction acquired from recreational shopping in shopping malls.

According to Arnold & Reynolds (2003), "gratification shopping" entails searching for strain alleviation, shopping to relieve a negative temper. Nevertheless, Fung (2010) shows that a shopper's subjective values, expectations, perceptions and motivations in the process can intensely influence the shopping involvements as well as leisure participation. Diverse cultures, geographies and financial systems would possibly pick out distinctive ways or solutions to gratify similar central needs (Singh & Prashar, 2013). Research in leisure shopping usually highlights the empirical worth of shopping and the fulfillment recognized from the doings (Bäckström, 2006).

It is assumed that consumers' happiness in malls motivates their objective to revisit, encouraging the frequency of trips, and automatically, their purchase intention (Calvo-Porral & Lévy-Mangín, 2018). Steen (2016) checked the subsequent

hypothesis: A gratification shopping motive is positively interconnected to sensed design. The atmospherics of a shopping mall can make a contribution to the satisfaction or the dissatisfaction of a patron by influencing his/her perceptions (Sabrina, 2014).

## 3. Materials and Methods

The study followed explanatory sequential mixed methods research design (quantitative followed by qualitative equals explanation) where a quantitative survey followed by a qualitative interview is employed with more emphasis to the quantitative part (Creswell & Plano Clark, 2012). The aim of conducting the initial quantitative stage is to identify the mall attraction factors and their attributes. The aim of conducting the follow-up qualitative phase is to help to further understand the real meaning of the attraction factors, attributes and recreational shopping gratification perceived by the consumers. The combination of quantitative survey results and qualitative interviews has given an in depth understanding of the role of attraction factors in recreational shopping gratification. Two recreation shopping malls, namely One Galle Face and Colombo City Centre, located in Colombo, Sri Lanka are taken to examine the phenomena based on the popularity, product variety and the extent of leisure orientation (Figure 1).

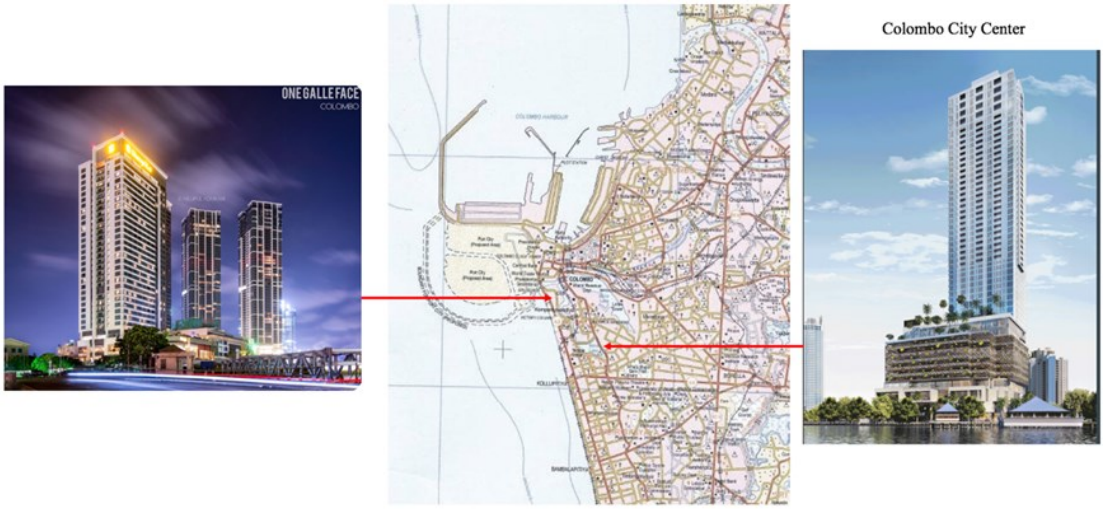


**Figure 1**: Locations of two shopping malls

### 3.1 Variables

***Attraction attributes:*** The selection of attraction attributes for this study includes primary and secondary methods of field reconnaissance namely, observation and the frequent and recent usage of attributes in previous studies. A detailed literature review was done to select the attributes of mall attraction from previous studies. As a result, 42 attributes from 8 recent articles were identified. The previous factor reduction was done based on the semi-structured interview with 20 shoppers. From the frequency of the attributes as well as with the observation, 32 attributes were finalized as the attributes which are most commonly considered by Sri Lankan shoppers. The questionnaire survey included those 32 attributes (Table 2) of mall attraction on a 5-point Likert scale where 5 indicates very important and 1 indicates not important at all.

***Gratification:*** For the dependent variable, five items from previous studies and one item from the shopping experience of shoppers who were involved in the narrative storytelling were taken. Accordingly, six items were included in the questionnaire survey.

**Table 2:** Naming of Variables (Compiled by Author based on literature review)

| Attribute/ Item | Variable Name | Attribute/ Item | Variable Name |
|---|---|---|---|
| Mall lighting | VAR1 | Availability of parking space. | VAR20 |
| Mall temperature | VAR2 | Cleanliness and maintenance. | VAR21 |
| Ambient odour | VAR3 | Facilities for elderly and differently-abled | VAR22 |
| Mall decoration | VAR4 | Convenient location | VAR23 |
| Interior wall and floor colour schemes | VAR5 | Availability of Lifts and escalators | VAR24 |
| Integrating natural elements in design | VAR6 | Proper floor plan/ layout | VAR25 |

| | | | |
|---|---|---|---|
| Overall design | VAR7 | Availability of Related services | VAR26 |
| Availability of cinema theatres | VAR8 | Availability of open space/ recreational place inside | VAR27 |
| Availability of Fun and entertainment programs | VAR9 | Space for walking inside. | VAR28 |
| Availability of play area for children | VAR10 | Availability of Seats / relaxing benches. | VAR29 |
| Availability of good variety of food items. | VAR11 | Availability of Security against act of terror | VAR30 |
| Promotional events | VAR12 | Safety for children. | VAR31 |
| Opportunity to see different people. | VAR13 | Safety for ladies/elderly. | VAR32 |
| Opportunity to relax and spend time. | VAR14 | Feel better. | DEP1 |
| Opportunity meets friends in the malls. | VAR15 | Treat one's self | DEP2 |
| Opportunity to do window shopping. | VAR16 | Enjoyment or deep-down satisfaction. | DEP3 |
| Availability lot of product variety/ well known stores. | VAR17 | Stress relieves | DEP4 |
| Product quality | VAR18 | Relaxation | DEP5 |
| Quality/price relationship | VAR19 | Escape from routine works. | DEP6 |

**3.2 Sample Selection**

***Quantitative phase:*** As the total number of attributes is nearly 32, the number of questionnaires needed to be taken for the validation of variables has to be at least five times of the number items to be tested (Bryant & Yarnold, 1995; Hair, Blake, Babin, Anderson, & Tatham, 2006). Thus, the sample size should be at least 160. However, in order to eliminate errors and to get a decent sample, 220 representatives were examined through questionnaires. The age category of 18 to 40 is targeted for the questionnaire survey since this age category is more recreational according to the field observation. Online questionnaire (Google forms) surveys were carried out to collect data. The sampling method used was snowball sampling. Initially, one hundred and twenty potential mall shoppers were identified and the links for the questionnaire survey were sent to them through email and other social media. The recipients were asked to send the survey link to their known mall shoppers. The basic information collected from the questionnaire survey is the demographic profile of participants, level of interest towards attraction factors, and gratification level from attraction factors of recreational shopping.

***Qualitative phase:*** After completing the quantitative analysis, 30 consumers (15 from each mall) participated in the face-to-face narrative inquiry.

**3.3 Analytic Strategy**

***Quantitative phase:*** First, Exploratory Factor Analysis (EFA) was done with the extraction method of Principal Component Analysis (PCA) in SPSS. The objectives of PCA in this research are data reduction, interpretation and verification of their factorial structure. PCA is the common method used by previous studies for the identification of attraction factors/mall determinants. After that, the bivariate correlation was tested. Bivariate correlation explains the level of significance, direction and strength of the causal relationship between attraction factors and gratification. After that, by assuming the relationship is linear, a multiple regression analysis was done. This is to show the prediction mentioned in the hypothesis. SPSS software was used to analyze the data quantitatively.

***Qualitative phase:*** To further understand the reason for being attracted by the factors, narrative inquiries were held with a number of 30 interviewees. Narrative inquiry considers the focal point of the contributors' tale like an interview, communication, and a story that supports and lights up the research question (Burke & Soffa, 2018). Using this method, the subjective experiences of recreational shoppers regarding the meaning of attraction factors were examined manually. This may give a better explanation of the real interest of people in addition to Factor Analysis.

**4. Results**

**4.1 Demographic Factors**

Of the 220 responses to the questionnaire survey, 49.5% were from Colombo City Centre and 50.5% were from One Galle Face. It shows a fair distribution of respondents and there are no biases based on the cases. Nearly half of the respondents (49%) were male. The frequency is somewhat equal and there are no gender biases. The frequency of 18-30 age group respondents was high at 85%. About three-fourths of the respondents (72%) were unmarried. In terms of occupation, around 46% were students, 27% worked in the private sector and 19% worked in the public sector. More than half of the respondents (56%) spend an average time of 2 to 4 hours during a shopping visit. Half of the participants visit the malls at least once a month.

**4.2 Factor Output**

The attributes of mall attraction and the items considered under gratification were given names for considering them as variables for the factor analysis. The Kaiser–Meyer–Olkin measure for sampling adequacy and Bartlett's test for sphericity were checked. The KMO statistic is 0.897, which is greater than the minimum criterion of 0.5 and comes under the range of 'marvelous', thus the sample size is adequate for factor analysis. According to Bartlett's measure test, the sample size is significant at 1% ($p < 0.001$). An EFA using the extraction method of Principal Component Analysis (PCA) with Varimax rotation was conducted in SPSS to comprise the variables (attributes) which have similar pattern/characteristic under several factors. The variables for further analysis were selected by removing attributes which cannot support factoring and attributes contributing to high levels of cross loading under more than 2 components. By doing the factor analysis iteratively, 16 attributes were excluded resulting in 16 attributes remaining for factoring.

Number of factors that need to be extracted was determined based on the Scree plot. The scree plot is thoroughly checked and identified that there can be five factors extracted. The total variance accounted for those five components was 72.635%. The components were named respectively, Ambience, Convenience, Facilities and Management, Socialization and Safety and Security (Table 3).

**Table 3**: Consolidated Factor Output

| Factor No. | Factor Title | Attributes | Factor Loading | Cronbach's Alpha Value |
|---|---|---|---|---|
| **F1** | Ambience | Interior wall and floor color schemes | 0.844 | 0.764 |
| | | Mall Lighting | 0.694 | |
| | | Mall Temperature | 0.583 | |
| **F2** | Convenience | Convenient mall location | 0.808 | 0.834 |
| | | Inside open space/ recreational space | 0.674 | |
| | | Cleanliness | 0.648 | |
| | | Seats/ relaxing benches | 0.618 | |
| **F3** | Facilities & Management | Lifts and escalators | 0.813 | 0.802 |
| | | Floor plan/layout | 0.798 | |
| | | Facilities for elderly/ differently abled | 0.767 | |
| **F4** | Safety & security | Safety for children | 0.824 | 0.817 |
| | | Safety for ladies/elderly | 0.720 | |
| | | Security against act of terror | 0.669 | |
| **F5** | Socialization | Enjoy meeting friends | 0.871 | 0.759 |
| | | Good place for spending time | 0.706 | |
| | | Good place for window shopping | 0.692 | |

Scored on a scale from 1 to 5, with 1= not important at all and 5= very important

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

The dependent variable is labeled as "Gratification". Cronbach's Alpha test was applied to check the internal consistency and it resulted that all factors and items under gratification (Cronbach's Alpha Value= 0.776) are reliable according to Nunnally's recommended level of 0.6 (Table 4).

**Table 4**: Items under dependent variable

| Items | Cronbach's Alpha Value |
|---|---|
| 1. When I am in a down mood, I go shopping to make myself feel better.<br>2. I go shopping when I want to treat myself to something special.<br>3. For me, it is an enjoyment or deep-down satisfaction.<br>4. To me, shopping is a way to relieve stress.<br>5. I feel relaxed.<br>6. It is a kind of escape from routine work. | 0.776 |

**4.3 Bivariate Correlation**

Table 5 shows the correlation of each attraction factor with gratification. Facilities and management show insignificant but positive relationship with gratification, indicating there is no evidence to support the relationship. Yet, other four factors show a significant positive relationship with gratification.

**Table 5:** Interpretation of correlation with gratification

| Factor | Correlation | Significance level | Interpretation of the relationship |
|---|---|---|---|
| **Ambience** | .319** | .000 | Positive weak |
| **Convenience** | .322** | .000 | Positive weak |
| **Facilities & management** | .124 | .066 | Positive weak |
| **Socialization** | .603** | .000 | Positive moderate |
| **Safety & security** | .347** | .000 | Positive weak |

***p<0.01*

**4.4 Regression Results**

To see the influence of each factor on gratification, regression analysis was done. Each attraction factor and gratification were saved as variables for the following analysis by computing the statistical mean of the attributes/items under the factor.

**Table 6:** Multiple Regression Results (N=220)

| | R | Adjusted $R^2$ | β | t test | Sig. | VIF |
|---|---|---|---|---|---|---|
| **Full model** | 0.629 | 0.382 | | | | |
| **Ambience** | | | .154 | 2.119 | .035 | 1.873 |
| **Convenience** | | | -.129 | -1.624 | .106 | 2.239 |
| **Facilities & Management** | | | -.112 | -1.715 | .088 | 1.507 |
| **Socialization** | | | .574 | 9.061 | .000 | 1.420 |
| **Safety and security** | | | .162 | 2.171 | .031 | 1.979 |

*p<0.01, p<0.05*

Table 6 shows the results of the multiple regression analysis. The VIF values of each independent variable is less than 4. Thus, multicollinearity will not be a potential drawback here. The predictor variables ambience (fi = 0.154, p = 0.035), safety and security **(β** = 0.162, p = 0.031) and socialization (β = 0.574, p = 0.000) reached the standards of statistical significance in the regression analysis. These are the factors influencing gratification. These results indicate general support for the hypothesis that attraction factors are related to shoppers' recreational shopping gratification.

**4.5 Qualitative Data Analysis and Results**

The influence of mall attraction factors on shopping gratification is further explored through the responses to qualitative data. Results of the qualitative data analysis show the link between attraction attributes and items under gratification such as feeling relaxed, enjoyment, or deep-down satisfaction and escape.

**4.5.1 Ambience and Gratification**

This factor includes attributes related to lighting, temperature, and interiors. The meaning of lighting is interesting and it includes visual attractiveness. Temperature means not so cool and not so hot but a mid-range is favourable. It is usual to get attracted to the appropriate temperature in a tropical country like Sri Lanka. Interiors attracting people is expected because the aesthetic aspect is an important element in recreation (Figure 2). As responded commented:

*"Since the lighting is the same for all day, you never know how much time you spent inside" (O-6).*

*"It's raining outside but we don't need to worry about that because we are in a closed safe place. The temperature is always nice inside whatever the climate outside" (C-1).*

*"Because it is aesthetic and beautiful. You can take nice photos because the background is attractive" (C-4).*

Responded agreed that *"When we enter from the hot outside, we can immediately feel the difference. It makes us relax" (O-3): "The art in the walls is attractive. It is suitable for a photoshoot. The walls only are enough to feel relaxed and spend our time smoothly" (O-6),* drawing a link between ambience and the feeling of relaxation.

**4.5.2 Safety and Security and Gratification**

Safety and security are considered all the shoppers whether they come alone or with a companion. Security, as well as safety for children, ladies, and the elderly, is expressed through this factor. Respondents believe that:

*"It is important because we don't need to bother about any crime while shopping. The security guards will take care of it" (O-2).*

*"If the place is not safe for my children, then we won't come right" (C-4).*

*"It is really important. For girls who come alone like me, it is a major concern" (O-1).*

Safety and security were highly linked with enjoyment.

Vast majority of respondents expressed that "*shopping malls are also for family enjoyment. So, it should be safe for kids as well" (O-7,* highlighting Safety and security has a link with enjoyment.



Seats/ Relaxing benches




Variety of food items



Availability of Open Space



Mall Lighting

**Figure 2:** Examples of Attraction Factors

**4.5.3 Socialization and Gratification**

Similar to the regression analysis results, most of the respondents have linked socialization with items of gratification such as enjoyment, relaxation, and escape.

"Yes, of course. Being with friends in malls is a different kind of enjoyment" (O-14).

"Relaxation is important. You can just sit there and watch people" (O-10).

"I don't do much shopping but I like to window shop. When you see different products in the same place, it is kind of taking your mind focusing on those products and other than that nothing else in your mind" (O-12).

In addition to the five factors identified from the Exploratory Factor Analysis, qualitative data analysis results show that there is another possible factor which can be named 'Fun and Entertainment. Even though the EFA does not reveal this factor, a considerable amount of people who participated in the interview responded that attributes such as malls offering a good variety of food items and fun and entertainment programs in the mall are interesting. As respondents appreciated:

*"No matter whether you come with your friends or family or alone. You'll have something to entertain and have fun" (C-7).*

*"Food and entertainment are the topmost things when your purpose is leisure" (O-8).*

As identified from the literature, preliminary interview, and the outputs of an online survey, it is apparent that all six items under gratification are considered by Sri Lankan shoppers. The same meaning has arrived as expected in the narrative inquiry as well. As respondents expressed:

"After coming here, you'll forget everything and you feel like you are in a world of fantasy" (C-10).

"This is a good place for stress release. You don't know how much time you spend here. People who go for leisure purposes only also can have so much fun here with these leisure spaces" (O-12).

*"You have a variety of shops, food, and vast space for leisure. After coming inside, I feel positive and relaxed. They have tried their best to make us feel good like you don't feel that we are inside a man-made place. It is comfortable" (O-15).*

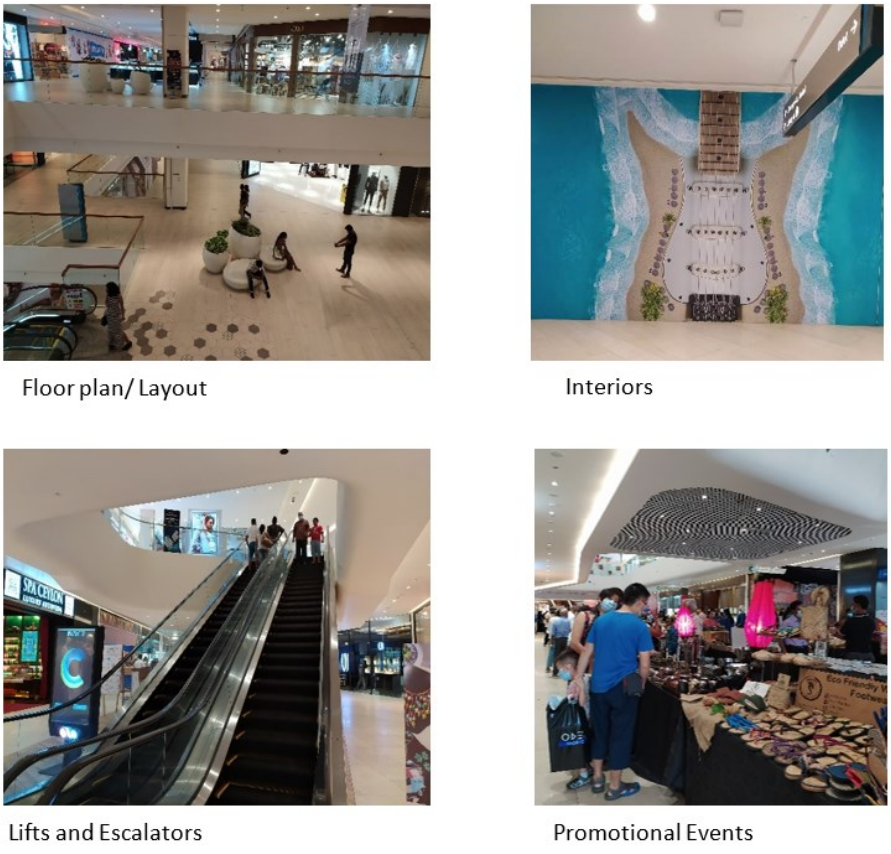


**Figure 3:** Examples of Attraction Factors

In addition to the five factors identified from the Exploratory Factor Analysis, the second interview results show that there is another possible factor which can be named as 'Fun and Entertainment'. Even though the EFA does not reveal this factor, a considerable amount of people participated in the interview rated the attributes such as malls offer a good variety of food items and fun and entertainment programs in mall are interesting as five in a 5-point Likert scale (Figure 3).

"No matter whether you come with your friends or family or alone. You'll have something to entertain and have fun" (C-7).

"I love the games here using new VR technology" (O-6).

"Food and entertainment are the top most things, when your purpose is leisure" (O-8).

And also, the attributes related to product such as ***Quality and Variety*** is revealed in the interview. Promotional events and seasonal decoration also attracted a considerable amount of people.

*"We get to know about the things we never know in our regular life. Some innovative kind of things, I would say" (O-8).*

*"When you see quality products you are automatically induced to buy it. You may not buy immediately, but when you come again you buy it. That's the logic behind having quality products" (C-7).*

*"Even a small thing will look great if it is from an international brand" (C-10).*

*"In festival season, we come just to watch the way they decorated the mall" (O-11).*

As identified from the literature, preliminary interview, and from the outputs of online survey, it is apparent that all six items under gratification are considered by Sri Lankan shoppers. The same meaning has arrived as expected in the narrative inquiry as well.

> *"After coming here, you'll forget everything and you feel like you are in a world of fantasy" (C-10).*
> *"This is a good place for stress release. You don't know how much time you spend here. People who go for leisure purposes only also can have so much fun here with these leisure spaces" (O-12).*
> *"You have variety of shops, food and vast space for leisure. After coming inside, I feel positive and relaxed. They have tried their best to make us feel good, like you don't feel that you are inside the man-made place. It is comfortable" (O-15).*

The results of the narrative inquiry clearly show that Sri Lankan people consider many attributes to gratify their recreational needs. And also, they think about the climate and seasonal changes all over the year while responding.

**5. Discussion and Conclusions**

Consumer behavior towards going to shopping malls has been changed to include more recreational aspects. This research attempted to understand the mall attraction factors-spatial aspects of shopping malls, and their influence on consumers' gratification in recreational shopping. This phenomenon is understudied in different contexts. This study found some important associations. Among the factors, ambience, convenience, socialization and safety and security showed a positive correlation with shopping gratification.

The predictors of gratification also show complements and contradictions with the previous studies. A previous study by Singh and Prashar, (2013) regarding the factors defining shopping experience in the Dubai malls identified marketing focus (which includes promotional events, mall facade, and tenant-mix) as the most significant factor in terms of shopping experience among identified five factors ambience, convenience, physical infrastructure, marketing focus, and safety and security. It is explained by the fact that Dubai has more world-class malls and the shoppers are from all over the world. However, it was found that ambience (which includes illumination, temperature control, background music, general hygiene, ambient odor, and landscaping) is also considered the next significant factor among shoppers. A similar study by Singh & Sahay, (2012) in the shopping malls of the national capital region (NCR) of India found that ambience is the most significant factor followed by convenience (which includes a distance of the mall from home, lifts, and escalators, and utilities inside the mall) to shoppers among the same five factors. Another study by Tandon et al., (2016) in the shopping malls of Indian metro cities shows that tenant management (includes play areas for children, a variety of brands, space management, tenant variety, tenant directory, store space, and prestige of brands), facilities management (parking, seating arrangement, elevators and escalators, maintenance of flooring and clean washroom) and atmospherics (lighting, facilities for elderly and differently-abled, temperature control, attractive interior décor, pleasant odor, landscaping, background music, crowd management, external façade, ventilation) are the significant predictors of shopping experience. It further suggests that Indian shoppers are naturally showing more significance to accomplishing their utilitarian needs. There are differences in the predictors of gratification with the changing geographic context. However, these studies considered shopping as a whole and are not limited to recreational shopping.

The findings of the study reveal the unique nature and taste of Sri Lankan people by contradicting some factors from previous studies of different contexts. It supports the notion that consumers from different geographic settings, cultures, and economy will choose different ways to gratify their needs.

Since modern-day shopping malls serve as places for shopping, recreation, entertainment, and gratification, it is important to learn from these findings in designing and maintaining recreational shopping places in terms of sustaining the urban economy and the socio-physical aspects of the general public in the future. The findings of the research will be helpful while developing a public space or a recreational place in the urban context in the future. In this connection, study findings are useful for many professionals such as investors in shopping malls, developers, policymakers, and urban planners.

This is the time to rethink and redesign the urban public spaces as well as the old shopping malls with the attraction factors that people are demanding. Town planners and mall managers need to address future needs by considering the findings of this study. The additional services provided by shopping malls will add value to upgrade the city's standards. Developing world-class malls will be more profitable for the countries which are high potential tourism destinations. Since this study has only focused on the consumers of the young age group, expanding the research area by focusing on different age categories of consumers. Further research is needed to identify specific factors and specifics and the relationships concerning gender and different income categories. Further, research focusing on the behavior of foreign and local tourists visiting malls would be more helpful in designing world-class malls.

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The authors declare no conflict of interest.

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**ANNEXURE-01**

**Table 2:** Factors identified from previous studies

| No. | Factor | Measurement | Authors |
|---|---|---|---|
| 1. | Ambiance | Light, Colour, Aesthetics, Temperature | Han et al., (2019) |
| | Consumption | Brand, Trained staff, new fashion style, Price | |
| | Entertainment | Food courts, Activities for youth, Games, Cinemas, Children's play areas, Crowds | |
| | Built environment | Sitting areas, Signage, Lifts and elevators, Layouts, Architecture, Accessibility, Parking spaces | |
| 2. | Atmospherics | Lighting, Facilities for elderly/ differently-abled, Temperature control, Attractive interior décor, pleasant scent (odor), Landscaping, Music, Crowd management, External façade, Parking, Ventilation | Tripathi & Tandon (2014) |
| | Entertainment | Mall popularity, Experience of accompanying person, Theme based events, Promotional events, Socialization opportunities, Play area for children | |
| | Tenant management | Variety of brands, Space management, Tenant variety, Tenant directory, Store space, Prestige of brands | |
| | Facilities management | Arrangements for water, Seating arrangement, Maintenance of facilities, Maintenance of flooring, clean washroom | |
| 3. | Ambience | Store layout, Interiors, Lighting, Colour, Aisle, Heating/ in-store, temperature, Store size, Crowd, Music, Cleanliness | Ahmed et al., (2019). |
| | Amenities | Variety of stores, Number of stores, Design, Parking facilities | |
| | Safety | Vehicle, Lift/escalator, Restroom | |
| 4. | Merchandising | Assortment and quality of Merchandise, Packaging of Products, Price | Mittal & Jhamb, (2016) |
| | Variety & selection | Availability of Brands and products, Exchange Facilities | |
| | Milieu and facilities | Parking Facility, Adequate Dressing Rooms, In-Store Promotions, Pleasant Ambience, Children Play Area | |
| | Convenience | Trained Sales Personnel, Convenient Shopping Hours, Suitable Location | |
| 5. | Ambience | Illumination, Temperature control, Background music, General hygiene, Ambient odour, Landscaping | Singh & Prashar, (2013) |
| | Convenience | Utilities, Distance of mall from home, Lifts and escalators, Floor plan | |
| | Physical infrastructure | Size of the mall, Parking space, Open space, Size of atrium | |
| | Marketing focus | Promotional events, Mall façade, Tenant mix | |
| | Safety and security | Compliance with construction laws, Security against act of terror | |
| 7. | Ambience | Music, lighting, temperature | Khare, (2012) |
| | Design | Good facilities, architecture, decoration | |
| | Interiors | Interior wall and floor color schemes, overall design, spacious and clean | |
| | Service | Good restrooms, service staff are helpful | |

| | | | |
|---|---|---|---|
| | Assortment | Good bargains, product variety, product quality | |
| | Socializing | Good place to see different people, relax and spend time, to do window Shopping, enjoy meeting friends in the malls, walking in the malls without buying | |
| | Entertainment | Cinema theaters, entertainment facilities, food courts, good variety of food items | |
| 8. | Dimensions | Design and convenience, Children safety environment, Parking facilities, Tenant / Service offering, Mall marketing activities, Ladies/ elderly safety & convenience | Wong & Nair, (2018). |
| 9. | Comfort | Security, Availability of parking space, has all the family needs, Comfortable seats during shopping, Mall width, Cleanness, Comfortable interior design | El-Adly, (2007). |
| | Entertainment | Promotional campaigns, Presence of fun and entertainment programs, Existence of fun spaces for kids, Entertainment places for youth, Availability of loyalty programs | |
| | Diversity | Plurality and variety of restaurants, int'l stores branches, large food court, cinemas | |
| | Mall essence | Products' quality, appropriate level of prices, Plurality and variety of stores, Availability of after sale services | |
| | Convenience | Supermarket existence, Ease of reaching, Late working hours | |
| | Luxury | External appearance, Popularity of the mall | |
| 10. | Ambient | Music, appropriate volume, lighting, temperature | Wakefield & Baker, (1998) |
| | Design | Architecture, decoration, interior wall and floor color schemes, overall design | |
| | Layout | Easy to get to the stores, food areas, and restrooms, Overall, the layout makes it easy to get around. | |
| | Variety | Variety of food, variety of stores, entertainment alternatives | |
| 11. | Convenience | easy and convenient accessibility, good customer services, free parking | Calvo-Porral & Lévy-Mangín, (2018) |
| | Tenant variety | having renowned retailers and franchises, supermarket, presence of related services (banks, mobile companies, etc.) | |
| | Internal environment | attractiveness of facilities and internal environment, rest/comfortable areas, convenient signposting in commercial area | |
| | Leisure mix | having movie theatres, cinemas, restaurants, cafes, coffee shops and snack bars | |
| | Promotions | have good/attractive sales, promotions, frequent communication, activities and promotions | |
| 12. | Physical variables (Logistics related-9 and ambience related-12) | Distance, Public transport, Feeder roads to shopping mall, Car parking, Convenience for disabled and senior citizens, public phone booths, Security standards, Information booth, Evacuation path, Peripheral mall ambience, Inside mall ambience, Flowers and vegetation, Air conditioning, Lighting, Public audio-video system, Recreational place, Ethnicity, Hallway and shopping space, Relaxing benches, Terrace attractions, social status | Rajagopal, (2008) |
| | Economic variables (Comparative-6 and promotion based-8) | Value for money, Price sensitivity, Quality difference, Customer service, Cross promotion, Competitiveness, Promotional attractions, Product display, In-store ambience, Availability, Length of promotion, Responsiveness, Value added benefits, Partners of promotion | |
| 13. | Atmospherics | Lighting, Facilities for elderly and differently abled, Temperature control, Attractive interior décor, pleasant scent (odour), Landscaping, Music (plying in the background), Crowd management, External façade, Ventilation | Tandon et al., (2016) |
| | Entertainment | Mall popularity, Experience of accompanying person, Theme-based events, Promotional events, Socialization | |

| | | | |
|---|---|---|---|
| | Tenant management | Play area for children, Variety of brands, Space management, Tenant variety, Tenant directory, Store space, Prestige of brands | |
| | Facilities management | Parking, Seating arrangement, Elevators and escalators, Maintenance of flooring, clean washroom | |
| 14. | Variety, quality, supply, and status | Well-known stores, Exclusive clothing, Variety of stores, Variety of the offer and merchandise, Quality of exhibited products, Sensation of status | Ortegón-Cortázar & Royo-Vela, (2017) |
| | Eco-natural environment and design | Natural spaces or scenarios, Environments with vegetation, Eco-environmental design, Architecture integrating natural elements | |
| | Mobility and accessibility | Easy access and movement within the shopping center, Space for walking, Easy access to the Shopping Center, Suitable orientations, Comfortable stores | |
| | Additional services and entertainment | Availability of restaurants and cafes, food areas, movies, good quality/price relationship of products and services | |
| | Physical environment, maintenance, Security & information | Air quality, Bathroom maintenance, Perceived level of security, Cleanliness and maintenance | |
| 15. | Location | Convenient location, Located at retail belt | Wong et al., (2001) |
| | Quality and variety | Owner's reputation, Merchandise quality, Service quality, Merchandise variety, Service variety, General price level | |
| | Popularity | Uniqueness, Fashion | |
| | Facilities | Parking facilities, Adequate and well-organized entrances, Vertical transportation, Store atmosphere, Layout, Resting seats | |
| | Sales incentives | Availability of supermarket, Sales promotion, Food court, Special events, Late closing hours | |

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# Architectural Design Studio as A Knowledge Intensive System: Sociology of Design Knowledge

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**Abstract**
Architectural design studios are still an inseparable part of the architectural design education. Different pedagogical approaches, architectural design norms, evaluation methods and assumptions prevail on how to carry out architectural design studios. It is widely acknowledged that is a futile attempt to search for a unitarist approach on how to carry out architectural design studios. A new conceptualization of architectural design studio can open up new venues to appreciate the plurality of various ways of organizing and running architectural design studios. It is a challenging task to identify how exactly students acquire new design knowledge from the design-oriented, knowledge-intensive, and fragmented architectural design studio environment. Architectural design studio can be conceptualized knowledge-intensive social system in which participants, individually and collectively, acquire *design knowledge*, assimilate *design knowledge*, transform *design knowledge* and finally exploit *design knowledge* to construct an output. This knowledge intensive social system, is in fact, points out the subtle operation of social learning process. Design knowledge is always embedded in design studio environment. It is subjected to the prior assumptions, design routines, practices, and power relations among social actors of the design studio. The basic idea is to conceptualize the design studio environment as a knowledge ecology composed of socially enacted knowledge process provides an alternative view to articulate a systematic framework to explore the social nature of design knowledge and its taxonomy. Understanding how this social learning environment operates can provide important insights on the taxonomy of design knowledge. The research presented herein studies the design knowledge and its typology by developing a new conceptual framework. The proposed framework builds on a succinct review of different, competing and conflicting conceptualizations of "knowledge" and "design knowledge".
**Keywords:** Design knowledge; Knowledge typology; Design studio; Design climate; Sociology of knowledge.

## 1. Introduction

Behavioral psychology has been dominantly occupied with the investigation of *changes in beliefs* and attitudes due to external stimuli whereas cognitive psychology has been focused on how mental process operates. Behavioral psychology proposes that *changes in behavior*s can be conceptualized as *learning* (Dole & Sinatra, 1998). Furthermore, behavioral psychology recognizes that environment (climate) has a paramount effect on behavior in particular, in responding to a stimulus triggered by the environment. This response to the environment which can lead a change in the patterns of behaviors of social actors is called *learning* (Zonooz, Farzam, Satarifar, & Bakhshi, 2011).

However, a *change* in mental process has been a key research area in the field of study in cognitive psychology. From cognitive psychology view, a change in mental process is synonymous with *learning process* (Dole & Sinatra, 1998). Changing the way of thinking can lead to subsequent changes in the structures of knowledge and in turn the creation of new knowledge structures (Piaget, 1952). Piagetian theory proposes that when the new knowledge structure conform with the existing cognitive structure then it leads a process called 'assimilation' where significant changes to existing knowledge structures are not observed. In the spirit of bridging the cognitive and constructivist perspectives of knowledge creation phenomenon, Dole and Sinatra (1998) emphasize the iterative nature of the *change*, in other words *reconstruction knowledge, and conceptualize this process as a continuum which ranges from 'low cognitive engagement' to 'high metacognitive engagement'*. The concept of 'engagement continuum' can be defined as a change in knowledge structure triggered by confronting with a new information that conflicts with prior knowledge. The anomalous degree of new information and/or the lack of conceptual coherence with previous knowledge structure can lead cognitive engagement which eventually results in with *change* (Dole & Sinatra, 1998), reconstruction or *creation* of 'knowledge structure'. In the light of foregoing discussion, it is essential task to answer the following question; 'What knowledge is?

## 2. The Concept of Knowledge

Epistemological view has been occupied with defining the term "knowledge" since antiquity - from the classical Greek era to modern era. Engaging in a debate to question, reconstructing the concept of knowledge and proposing

a universal truth is simply beyond the scope of this research. However, it is necessary to review different perspectives that prevail on the concept of knowledge. Understanding how 'knowledge structures changes' in particular setting such as architectural design studio, requires reviewing the main assumptions proposed for studying the concept of knowledge and its reconstruction or creation.

A common assumption of the concept of knowledge is about its hierarchical nature where knowledge is hierarchy organized as data, information, and knowledge (Alavi & Leidner, 2001; Zack, 1999). Data can be defined as raw numbers and can be in any form, it does not have meaning unless it has been processed and converted to information. The information is converted data by relational connections where its meaning may be given or may not be given. Information is possessed by individuals in a deterministic way and when it has personalized in mind then knowledge can become existed. Therefore, knowledge can be considered as affirmed information which is commonly stored. A piece of knowledge is 'information memorized' in mind. In such case, it has been defined as justified true belief since Plato (360 B.C.E ). It is very common to come across in literature that the hierarchal nature of knowledge, hierarchy between data to information, is questioned on the ground that there are some evidences that support the inverse relationship assumption about the direction in which the cognitive process operates. Unless knowledge has already been created verbalized and structured, the information does not exist and data do not exist if it has not measured for information (Tuomi, 1999). A reconciliation about these competing assumptions can be achieved by accepting its reversible nature of knowledge and the dynamic flow from one state to another state predominantly influenced by the flow of any impetus.

**3. Aspects of Knowledge**

Different perspectives which prevail on the concept of knowledge offer distinctive views when it comes to identify 'what describes the knowledge' and how 'knowledge can be perceived'. A brief review of literature on "concept of knowledge" reveals the presence of alternative dimensions of knowledge such as; (1) a capacity, (2) a process, (3) an object, (4) a situation of having access to information, (5) a state of mind (Alavi & Leidner, 2001) and (6) a barrier (Carlile, 2002). The concept of knowledge has been defined as "a capacity" to use information (Watson, 2008) for decision making. According to this view, knowledge is that of an ability to interpret information by learning and experience. The core theme in this view is mostly focus on 'building intellectual capital'. The concept of knowledge as "a process" refers to the process of knowing and acting simultaneously and the flow of information from one state/social actor to another state/social actor. The concept of knowledge as "an object" refers a process in which it is manipulated and stored (Zack, 1999). The concept knowledge as "accessibility" refers stocks in which it is accessed stocks (Alavi & Leidner, 2001). Furthermore, knowledge can be viewed as a "state of mind" focuses on knowing and understanding based on a cognitive cognition of what is learned, discovered, and perceived. Finally, knowledge can be conceptualized as a routine which is locally embedded and invested in daily practices which can act as a barrier to reconstruct or create new knowledge (Carlile, 2002).

**Table 1** Alternative Conceptualization of Knowledge and Their Focality (Adapted: Alavi and Leidner, 2001)

| **Aspects** | **Focus** |
|---|---|
| Capacity | An ability to interpret information by learning and experience |
| Process | Information flow |
| Object | Can be manipulated and stored |
| Accessibility | Knowledge stocks |
| State of mind | What is learned, discovered, and perceived |
| Barrier | Boundary Spanning |

**4. Taxonomies of Knowledge**

A brief literature on the concept of knowledge reveals that various classification schemes have been proposed in the literature to study the characteristics of knowledge. Polanyi (1966) propose that knowledge can take two forms: (1) tacit knowledge and (3) explicit knowledge. The tacit and explicit forms of knowledge build on the assumption that '*we can know more than we can tell*'. Therefore, expressible knowledge can reflect the only tip of an iceberg on contrary whole-body knowledge which cannot be easily expressed (Nonaka, 1994). Tacit knowledge (implicit) is a personal, context-specific knowledge form and which cannot be stored effectively therefore that has been hard to explicitly formalize and communicated. Explicit knowledge is 'codified', convertible, formal, systematic information or instruction and can be transferred or stored in a codified language (Nonaka & Takeuchi, 1995). The tacit and explicit knowledge classification was reintroduced to the literature early 1990s by Nonaka (1994) to emphasize cognitive and technical qualities of implicit knowledge. Nonaka (1994) points out the cognitive qualities includes a

mental model which refers to beliefs, viewpoints, paradigms, and mental maps, technical qualities refer to concrete know-how, skills, crafts.

Knowledge can also be explored in terms of (1) knowledge content, (2) tacit-ness, and its (3) complexity (Lane, Koka, & Pathak, 2006). The first one, knowledge content, refers to 'know-what' and is usually expressed as *declarative* knowledge. The second one, tacit-ness, refers to 'know-how' which is commonly expressed as *procedural* knowledge. Finally, complexity refers to the number of interdependent routines, individuals, and resources. Alavi and Leidner (2001) state that knowledge can be grouped into four categories namely (1) causal, (2) conditional, (3) relational, and (4) pragmatic. The first category of knowledge can be used to describe or explain situations or reasons where it corresponds to 'know-why' type of knowledge form. The second category, conditional knowledge, describes when certain activities may occur or we call it 'know-when' type of knowledge form. The third category, relational knowledge, refers to relational conditions between events or activities and it corresponds to the 'know-with' type of knowledge form. The last category is pragmatic knowledge form which offers the need and usefulness of knowledge.

Jane Zhao and Anand (2009) present two types of districts but parallel knowledge types: (1) individual and (2) collective. The taxonomy proposed by Jane Zhao and Anand (2009) has close similarity with the one that has been previously proposed by Nonaka, Toyama, and Konno (2000). Jane Zhao and Anad (2009) offer a taxonmy which is well-differentiated in terms of its implicitness and socially embedded nature (i.e., the norms and routines of the organization). In this sense, collective knowledge constitutes individual knowledge and is more complicated to transfer mainly due to its social embedded nature (Jane Zhao & Anand, 2009).

Lim (2009) proposes a conceptual model with three different forms of knowledge; (1) disciplinary, (2) domain-specific and (3) encoded. The ontological dimension used in this model offers a view perspective on how to study the concept of knowledge. The first form, disciplinary knowledge, refers to the process of acquiring raw scientific knowledge while actively interacting with scientific communities. The second form, domain-specific knowledge, refers to the process of acquiring knowledge directly related to the production of new knowledge or innovation. These two forms knowledge are parallel with explicit knowledge forms. The third form, encoded knowledge, refers to the process of absorbing which is already embedded knowledge in tools, procedures, process or artifacts. The last form of knowledge can be also called the tacit form of knowledge. Carlile (2002) introduces a new way of classifying knowledge by borrowing the concept of 'barrier' from linguistics. This model differentiates knowledge based on the presence of three knowledge boundaries. The first boundary, syntactic, refers to a process of expression with a certain kind of structure/form. The second boundary, semantic, refers to a process of expression with a certain kind of content/meaning. Finally, pragmatic boundary refers to a process of expression with a certain kind of use. These three boundaries metaphorically refer to (1) analogies, (2) gestures and (3) patterns (Huang and Huang 2013).

Depending on the degree of objective and subjective interpretation, in other words knowledge epistemology, knowledge can be also classified into two distinct dimensions: objective and subjective knowledge (Popper, 1972). Furthermore, it is clear that the subjective-objective *dichotomous states* of knowledge are related with the tacit-explicit forms of knowledge proposed by Nonaka and Takeuchi (1995).

**Table 2** Knowledge Taxonomies According to Alternative Dimensions

| Epistemological dimension | Socio-cognitive Dimension | Contextual dimension | Ontological dimension | Linguistic dimension |
|---|---|---|---|---|
| • Tacit (objective)<br>• Explicit (subjective) | • Individual<br>• Collective | • Declarative<br>• Procedural<br>• Causal<br>• Conditional<br>• Relational | • Disciplinary<br>• Domain-specific Encoded | • Syntactic<br>• Semantic<br>• Pragmatic<br>• Metaphorical |

### 4.1 Design Knowledge

Lawson's (2004) seminal book titled 'Why might design knowledge be special' proposes that design knowledge can be learned by doing rather than reading a textbook and it is a predictive but uncertain process which is laden with values. Lawson (2004) argues that design knowledge can be only acquired in a special kind of way since the design is a creative process by its nature. Design knowledge can be conceptualized as as *a state of creative or imaginative consciousness*. This state does not involve a solid process. On contrary it is a fluent process and can be characterized as iterative and reflective search process.

One of the intuitively appealing approaches to study the concept of *design* in both engineering and architectural disciplines is conceptualizing it as a *creative knowledge-based activity* (Al-Sayed, Dalton, & Hölscher, 2010). In the sense of creativity, this knowledge base activity, design, relates to a delicate balance between being both 'useful'

and 'original' similar to 'form' and 'function' and also it is concerned with a cumulative search for optimal design solutions (Askland, Ostwald, & Williams, 2010). The view of the design as a solving problem process requires not only *divergent thinking* to the development of new ideas according to design's novelty but also *convergent thinking* relates to the usefulness and appropriateness of the design in which creation takes place (Lawson, 2006). Therefore, design is 'not one way of thinking' but it is a simultaneous mixture of the miscellaneous thinking way which involves primarily deduction, induction, and problem solving (Dorst, 2011), and reasoning (Uluoğlu, 2000) without a sharp distinction between each other.

In the light of contemporary literature on design, it can be argued that there is a close relationship between design and creativity (Askland et al., 2010). Yet this relationship is not solely related with the critical engagement of addressing the 'the nature of creativity', but also understanding the different aspects of creativity. The constructions of 'creativity' have been predominantly discussed under four dimensions since Rhodes' (1961) seminal article which proposes fours dimension study creativity: (1) processes, (2) products, (3) person/people, and (4) environmental press. Each dimension sheds light on a different aspect of creativity. A creative *process which* refers to behavioral aspects and generally emphasizes the solution-focused nature of design thinking. It is argued to involve with the activities of exploration, idea generation, creative leap, use of technology (Askland et al., 2010). A creative *product* which refers to created new structure according to its novelty utility and value (Gero & Maher, 2013). A creative *person/people* which refers to the designers who have the ability of divergent and convergent thinking simultaneously (Lawson, 2006), also able to question prior-knowledge and knowledge structures. Finally, environmental press which refers to the relations of the designer with 'design climate' in particular with the general influences generated by environmental settings (Askland et al., 2010).

#### 4.1.1 The epistemological dimension of design knowledge

The design studio is a critic-centered learning environment in which students engage with the construction of their own design knowledge. In this learning environment, design critiques play a paramount role in design climate. It is widely acknowledged that design knowledge has some unique characteristics such as tacitness, subjectivity, or objectivity. The 'design climate' in this learning environment is primary constructed by (1) absorbing new knowledge, (2) assimilating it with existing values and design routines and (3) finally transferring it from desk critiques to their existing knowledge structure (Goldschmidt, 2003). Design climate is a sub-process of design culture in which diffused knowledge is not always explicit but tacit and constructed by identification, synthesis and integration of any kind of knowledge into design practice. Design knowledge is more heavily dependent on experiential or episodic memory than the knowledge used in many other professions and such knowledge is often tacit which is accumulated through practice rather than through instruction (Lawson, 2004).

#### 4.1.2 The socio-cognitive dimension of design knowledge

The design studio is learning environment which can be viewed as a reflection or image of architectural design practice (Cuff, 1992; Sachs, 1999) or a social environment in which architectural design practice is embedded (Morkel, 2011). Kahvecioglu (2007) assumes that an architectural design studio is more than an environment of knowledge acquisition and transfer for the students of design. It is a creative climate for knowledge creation and a social environment that opens up free access to any information for creating new design knowledge and ideas collectively. Architectural design studios are primarily based on collaborative stimulus and conditions that target (1) to jointly work (co-work) on the design problem together, in other words co-creative process, in a more social and flexible space, (2) to make collective decisions, and (3) to develop and construct design solutions actively as situated in real design settings. It mimics the professionalism, mutual respect, and sharing responsibilities on collective design decisions which prevail in real design practices. The design studio, also promotes social interaction, dialogue, and collaboration between individuals to develop the ability to deal with complex design problems through criticism and discussions which enables student to develop critical thinking, spatial and cognitive sensibility. The design does not solely involve knowledge transfer, "it has a new vision of knowledge, as a building process of collaborative sense-making" (Mozota, 2003, pp.160). The objective is to present opportunities to those involved not only to learn while doing (cognitive learning) but also present a context for conversations which feed dialogic relationships and the social construction of knowledge (Mozota, 2003).

#### 4.1.3 The contextual dimension of design knowledge

Goldschmidt (2003) suggests that design climate, in other words the characteristics of design studio, can encourage participants to acquire, assimilate and transform knowledge. Yet it is quite difficult to decide whether the expertise-driven or creativity-driven tendencies are better in a design studio environment to acquire design knowledge. Therefore, designers need to know relevant contextual knowledge, whether it is in the form of *declarative* (know-what) and *procedural* (know-how) and make sure that all forms knowledge related with the current design problem

should be transmitted and diffused to the participants of design studio setting (Goldschmidt, 2003). On contrast, declarative and procedural knowledge which come with interpretive nature and structure that cannot be easily separable. Yet designers can still construct new knowledge, learn through *explicit* and *tacit* knowledge that they have encountered or exposed during desk critiques in design studios settings (Goldschmidt, 2003).

Uluoğlu (2000) argues that knowledge types in design studio can be studied from four categorical perspectives namely (1) categories, (2) structure, (3) representation, and (4) content. The proposed classification scheme aims to develop a systematical approach to explore the knowledge construction process in design settings. *Knowledge categories* refers to the presence of concepts which can be filled by knowledge content as a function of its depth and scope relationship within a frame structure. *Structuring knowledge* refers to the organization of relational bonds between and/or among interrelated concepts within frame structures which creates a network consisting of hierarchical links between and/or among units under consideration. *Knowledge representation refers* mainly to the specific knowledge flow patterns channeled by the objectives/intents of the design critiques. Finally, *knowledge content* refers to more subjective and individual-specific features in which the quality of knowledge as a function of its qualitative nature (scope) and quantitative nature (depth) which define the conceptual frame for the knowledge involved.

**4.1.4 Ontological dimension of design knowledge**

The design studio is a critic-centered learning environment which supports students to experiment the construction of design knowledge. Design knowledge and its creation in the studio setting commonly takes place under the guidance of design studio instructors. Design studio instructors can be considered as a source of various types of design knowledge. Design knowledge in such a learning setting is accessible through different forms of design critiques (Goldschmidt, Hochman, & Dafni, 2010).

Schön (1987) points out that searching and acquiring available and applicable knowledge are essential processes to develop and construct a structure for the design problem that is under consideration and in turn solve it. However design problem structuring and solving phases have idiosyncratic nature. Yet the demarcation between these processes is not clear cut as it may appear and also intensively influence knowledge search patterns followed by design students (Restrepo & Christiaans, 2004).

During the design problem structuring process, the creation of design knowledge for a solution depends not only on prior knowledge and experience or acquired knowledge but also interacting with design requirements from external knowledge sources and addressing information access challenges for the relevant knowledge (Restrepo & Christiaans, 2004). Information access in a design setting can be defined as an ability to structure design problems while acquiring relevant and proper information about the specific context of design problem that is under consideration (Restrepo & Christiaans, 2004).

The common search patterns used by social actors such as design students can be used classify into three knowledge types: (1) searching for raw scientific knowledge while actively interacting with scientific design knowledge - disciplinary design knowledge, (2) searching for knowledge directly related production of new design - domain-specific design knowledge and, (3) searching gathering which is already embedded knowledge in tools like CAD, process or artifacts - encoded design knowledge.

**4.1.5 The linguistic dimension of design knowledge**

In a design studio setting, the interaction between design students and their instructors is like a different kind of non-scripted drama (Kahvecioglu, 2007). It is not a linear form of knowledge flow that follows a sequential fixed pattern or trajectory. On the contrary, it follows multiple trajectories which include multi-dimensional structural routines which is influence from the current design environment. In this sense, the ability to construct new design knowledge that involves fundamental changes in the syntax of design to perform how to design.

The design process which performed verbally and implicitly by design students mainly involves imitating the design processes or approaches followed by their instructors (Van Aken, 2005). This imitation process is one of the key new knowledge gathering mechanisms observed in the design studio settings. Scholars have been involved to study the linguistic nature of knowledge types to gain deeper insights on subtle role of boundary objects Boundary objects refers to (1) objects that can be described as artifacts, (2) entities that can be physical or virtual concrete or abstract which carry information in the form of explicit or tacit knowledge for a specific social circle or an organization (Fong, Valerdi, & Srinivasan, 2007). Carlile's (2002) pioneering work which to lay the foundation of linguistic nature of knowledge classifies boundary objects into three groups: (1) syntactic which refers to syntax or databases measures, design principles, basic elements, (2) semantic which refers methods, definitions, codified knowledge, and the last group (3) pragmatic which is related to models, projects, sketches, and diagrams. Furthermore, Huang and Huang (2013) have proposed an additional item for that category which is a metaphoric dimension. Metaphorical knowledge refers to whether can be in tacit or explicit knowledge form that consists of analogies gestures, patterns.

These are generally tacit information that has an effective way to shape common cognition to reach a common belief that includes figurative language and genres, nonverbal expressions, visionary objects.

**5. Conclusion**

Design knowledge always has to continue its evolution within its categories because it reveals a previously untested reality in a setting that is structured to simulates real design practice. The main aim of the design studio is to present a so called a theatre or an artificial setting to act as a 'designer' or an 'architect' and let them to perform in the specified design practice while supporting design students to construct their own design knowledge. In this sense, design knowledge is often hidden and tacit which can be transferred by imitation and experience (Mozota, 2003). Design knowledge is more subjective and experiential since it is embedded in studio settings. In design studio, retrieved experience has recorded intellectually and saved in 'design memory' (Eilouti, 2009). Design knowledge that is gained from prior design experience is one of the basic knowledge sources. Praxis of the design studio is primarily oriented toward utilization of prior design knowledge, transforming, extending, stretching, deforming knowledge into new design problem. Cross (1982) labels this process as a 'designerly way of knowing'. Design knowledge can be defined as *a state of creative or imaginative consciousness*. This state is not a solid phase. On contrary, it is a fluent process which involves iteration and reflection. Design studio settings host a unique structured and socialized space approach to problem-based learning (Rodrigo & Nguyen, 2013). The emergence of social integration and accessibility of information in a design studio environment increases the diffusion of design knowledge and destruction of rigid boundaries which inhibits knowledge acquisition and easy exchange of knowledge. However, the structure of design studio does not allow consuming dispensed knowledge like data osmosis but it creates a network that can absorb new design knowledge through various forms of critiques and feedbacks which mainly driven by the rapid iterations of design solutions. Therefore, design knowledge is a state of creative consciousness which has to be *socially constructed.* The creation of design knowledge does not exist in isolation. Praxis of the design studio is structured on the premise of iteration – continuous social interaction between and/or among participants of the design studio such as students, design instructors and their critiques. Design studio imitates real design practice and predominantly demonstrates a social network, whereby design projects are individually designed and collaboratively executed. Investigation on knowledge types provides several indicators to reflect knowledge characteristics that influence the design process; design knowledge is always; (1) *embedded in design studio* setting and is subject to the prior assumptions; (2) *experience-oriented* hence it is more heavily dependent on experiential memory than the knowledge used in many other professions; (3) *tacit* which is accumulated through practice rather than through instruction. Furthermore, design knowledge is highly related to (4) *imagination* and (5) *iterative* process operating within social collectivity which has to be (6) *socially constructed.* The basic idea is to view design studio as a knowledge ecology composed of socially enacted knowledge process provides an objective to articulate a systematic framework for exploring and in turn uncovering the social nature of design knowledge and its taxonomy.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Design Strategies for Façade integrated Photovoltaic Technology (FiPV)

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**Abstract**
The rapid pace of urbanisation has caused a surge in the energy demand, thus emphasizing the need for Net Zero Energy buildings. A plethora of financial and non-financial incentives for promoting energy efficient and renewable energy buildings are being offered by several local governments in India. Policies have favoured the inclusion of photovoltaic technology within the buildings. Despite the efforts, adoption of the technology within the envelope is quite restrictive. The photovoltaic technology is either added onto the rooftops or provided as double façade. The concept of replacing the building skin with this technology has not been explored enough. This paper attempts to propose a framework, for designing a photovoltaic façade, replacing the conventional building skin. It has tried to address some of the barriers, and inhibitors in uptake of the technology. It explores provision of an assessment framework for envelope performance of photovoltaic facade.
**Keywords:** Photovoltaic Façade, Design Strategies, Building Skin, Framework Design.

## 1. Introduction

The dynamics of rapid urbanisation and the energy consumption is a leading cause of increased pressure on the existing fossil fuels. According to Khan, Abas, & Kalair, (2015) the increasing energy demand would lead to exhaustion of oil reserves by 2050, gas reserves by 2070, uranium ores by 2090 and coal reserves by 2150. Globalisation has led to higher rate of urbanisation in major cities, leading to extensive use of energy, swelling the demand of exhaustive fossil fuels. Buildings are a major source of energy consumption in cities, especially the commercial buildings, with central HVAC system, and other state of art technologies. There has been a change in the perspective and use of buildings. Apart from being major energy guzzlers, buildings provide great opportunities to save and generate energy at the same time. The change in perspective of buildings, has brought many technological innovations at the fore front of the building integration. Renewable energy system is a concept being incorporated into building to transform it into energy generator, leading to the realisation of Net Zero Energy buildings (Zhanga, et al., 2018). Highly feasible renewable energy system, with greatest viability of building integration is the photovoltaic system for incorporating the solar energy in the buildings.

Photovoltaic technology has been used in buildings for many years, though the incorporation of this technology is majorly limited to roof-tops, double façade or as add-on components. Nagyn, et al, (2016), had studied the concept of adaptive solar facades, where motorised solar panels were added on to the building façade. Saretta , Caputo, & Frontini, (2019) assessed the potential of façade retrofitting with photovoltaic panels, through analysis of geographical, building technical parameters. In studies like Gholami & Rostvik,(2020), Gholami, Rostovik, & Muller, (2019), the economical evaluation of adding the thin-film photovoltaic panels on a offcie building were evaluated. In studies like Nagyn, et al.,( 2016), Saretta , Caputo, & Frontini, 2019, Gholami & Rostvik,(2020), Gholami, Rostovik, & Muller, (2019), the incorporation of photovoltaic technology on the building façade has only been explored as double façade or as a added on component on the existing façade. The idea of photovoltaic systems replacing the conventional materials and acting as building skin has not been explored enough. Adoption of the photovoltaic technology on the roof is fairly simple process, involving mounting of panels on flat horizontal surface, not affecting the functioning of the building or its envelope. When integration of photovoltaic system on façade is considered, the complexity of designing increases significantly. The process of designing photovoltaic panels to function as façade replacing the building skin, is quite complex. Inspite of the complexities, the integration of technology on the façade is quite efficient. The roof areas are places for installing services, or leisure activites or other leasable activites, creating greater economic benefits. Whereas the façade surfaces of multistoried commercial buildings are unused, unobstructed areas, presenting great opportunity for integration. Efficient designing of photovoltaic façade requires bridging the gap between the technology and the building façade. The framework design, proposed in this paper is an attempt to simplify the process of desinging a photovoltaic façade and allow it to fucntion optimally and effciently.

The complexity in the process of designing a photovoltaic façade is due to: (i) barriers in the adoption of the technology as a building skin and (ii) conflict in the functioning of photovoltaic panels as energy generators and building skin. The paper attempts to identify the barriers and their impact on the designing process. It also tries to identify and reduce the conflict of the photovoltaic façade to act as building skin and energy generator. The solution to mitigate the conflict and

barriers in the adoption, are in the form of design strategies. The paper has been divided into four sections, section one dealing with the identification of barriers and their impact on the design process. Section two describes the design strategy for designing a photovoltaic façade. Section three is the methodology or the framework for designing a photovoltaic façade and achieve its architectural integration. Section four is the conclusion.

**2. Identification of The Barriers and Their Impact on The Design Process**

Designing a photovoltaic façade, requires understanding of the technology, process, issues and concerns of the integrating the technology and the apprehensions of the designers. According to Akinwale, Ilevbare, & Ogundari,(2015), the acceptance of technology is based on its usage, learning, and application. Therefore, for designing the façade with photovoltaic technology, we need to understand and identify the barriers in the adoption of the technology. Barriers are defined as inhibitors, issues and concerns with the product, process and the stakeholders involved in the design process. Inhibitors are the problems identified in the photovoltaic product, system and the designing process, which restrcit the realisation of the photovolataic building skin to its full potential. Issues and concerns are the apprehensions of the different stakeholders involved in designing process.

Ahmad & Zia, (2022), had identified different barriers and categorised them into three categories. Category I barrier was the identified problem in the photovoltaic product and system, category II was the barriers in the designing process and category III barriers were the barriers affecting different stakeholders. Table 1, depicts different categories of barriers identifed in the study by Ahmad & Zia, (2022).

**Table 1:** Categorisation of barriers. source: (Ahmad & Zia, 2022)

| CATEGORY I (Barriers in the Photovoltaic product) | CATEGORY II (Barriers in the photovoltaic façade design) | CATEGORY III (Barriers affecting different stakeholders) |
|---|---|---|
| Type of photovoltaic technology (multi/mono-crystalline technology vs thinfilm technology). | lack of knowledge of the architect/façade designer. | Economic non-feasibility. |
| Reduced efficiency with 90° tilt angle. | Non-availability of codes for integrating photovoltaic system with local bye-laws. | Operating and managing the photovoltaic system. |
| Non-availability of suitable photovoltaic product | Non-availability of suitable photovoltaic product | Non-availability of suitable photovoltaic product |
| Photovoltaic façade's visual and optical properties. | Photovoltaic façade's visual and optical properties. | Photovoltaic façade's visual and optical properties. |
| Non-availability of proper tools for designing photovoltaic façade. | Non-availability of proper tools for designing photovoltaic façade. | Lack of client's interest. |
| | Structural and mechanical integrity. | |
| | Lack of skilled workforce. | |
| | Climatic responsiveness of photovoltaic façade | |

Identifying solutions in the form of design strategy, was the next step in the process. To propose design solutions, it is important to understand and identify the barriers that had a direct impact on the design process. In the study Ahmad & Zia, (2022), the barriers were identified which had a direct impact on the design process. The type of photovoltaic technology and its selection affected the design process as it determined whether a translucent, opaque, or transparent façade could be designed. The insufficiency in architect's and façade designer's knowledge had a direct impact on the process of design, hence it required a proactive approach to solve the problem. Absence of uniform codes that provided a regulatory guideline for incorporating photovoltaic products and system within the building directly impacted the designing process. Non-availability of façade compatible photovoltaic products along with their optical and visual properties had a direct impact on the process. Climatic responsiveness of the photovoltaic façade, mechanical and structural integrity of the photovoltaic product also directly affected design process. The non-availability of skilled workforce was also a very critical barrier affecting the design process. Identification of the barriers with direct impact is a very critical step in planning of design strategies.

**3. Strategy for Designing a Photovoltaic Façade**

Identification of a design strategy for photovoltaic façade, required solution to the barriers with direct impact. The identified solution attempts to transform the barriers into enablers and drive the process to achieve a photovoltaic façade with minimum conflict between its role as energy generator and building skin. The aim of proposing the design

strategy is to remove any hinderances in the process of design, enable the designer with a simplified and efficient process, and to minimise, if not remove the conflict between the photovoltaic roles as energy generator and building skin. The identification of barriers was the first step towards achieving a design strategy. Next step in the process is to understand the conflict between photovoltaic systems acting as energy generator and building skin.

The conflict management is very important to achieve efficiency and provide a sustainable solution for designing of photovoltaic façade. A building façade has its own set of limitation and perceptions, which a material should be able to fulfil. Therefore, photovoltaic technology adopted on façade should be able to provide: (i) connection between the interior and exterior of the building, (ii) daylighting, (iii) thermal comfort, (iv) structural and mechanical integrity. When acting as building skin the primary role of photovoltaic material i.e., energy generation should not be compromised. The main reason for having this apprehension is due to its tilt angle and place of application. When a photovoltaic panel is installed at a tilt angle of 90°, the efficiency of the panel reduces. When installed on the building façade, the sunlight available is not direct but diffused, again affecting the power output from the panel. Hence, it is important to identify a solution to this problem in the design strategy.

Architect's and façade designers involved in designing of photovoltaic façade are faced with the problem of understanding the technology and integrating it within the building envelope. They must reduce if not mitigate the conflict of the photovoltaic material to act as building skin and energy generator simultaneously. The proposed design strategy is an attempt to simplify the process, reduce the complexity of the application of technology and reduce the identified conflict. It is a streamlined sequential process of four identified steps: (figure 1)

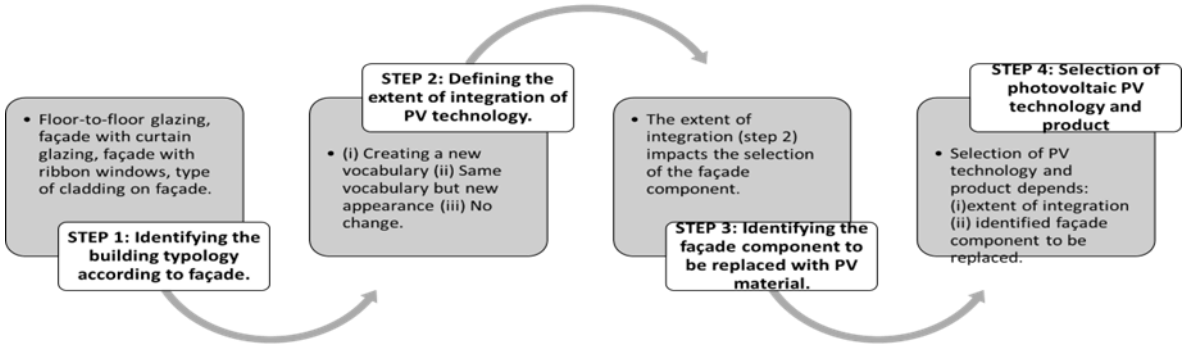


**Figure 1.** Steps of design strategy

**STEP 1:** Identifying the building typology, according to the façade type (façade with floor-to-floor glazing, façade with curtain glazing, façade with ribbon windows, type of cladding on façade).

**STEP 2:** Defining the extent of integration of photovoltaic technology within the building façade. Extent of integration would decide the type of architectural vocabulary. Three extents of integration have been identified: (i) Creating a new vocabulary (ii) Same vocabulary but new appearance (iii) No change.

**STEP 3:** Identifying the façade component to be replaced by the photovoltaic material. The extent of integration (step 2) impacts the selection of the façade component.

**STEP 4:** Selection of the photovoltaic technology and product depending upon the extent of integration and identified façade component to be replaced. **Table 2.** describes each of the steps in detail and delineates the design strategy to achieve a photovoltaic façade.

**Table 2**. Design strategy for generating photovoltaic facade.

| DESIGN PARAMETERS | | DESCRIPTION |
|---|---|---|
| **STEP-1** | **Façade typology of identified commercial building:** | a) Defining the architectural typology. Studies like Sandak, Sandak, Marcin, & Kutnar, (2019) Singh, Ravache, & Sartor, (2018), the prevalent commercial buildings are categorised into three typologies: (figure 2)<br>1. ***TYPOLOGY-I:*** Curtain wall system having aluminium composite panel cladding with ribbon windows.<br>2. ***TYPOLOGY-II***: Floor-to-floor glazing, with a façade of exposed brick work.<br>3. ***TYPOLOGY III:*** Aluminium composite panel clad facade with floor-to-floor glazing.<br>b) The façade typology would be an important determinant of the possibility of the extent of architectural integration.<br>c) According to the typology of the building the façade component to be replaced would be identified. |

| | | |
|---|---|---|
| **STEP -2** | **Extent of application of the photovoltaic panel/glass on the building façade:**<br>Defining the extent of transforming the architectural vocabulary of the new generated variant. | Step one acting as reference point for identifying the extent of integration possible. Step two will determine the architectural vocabulary of the designed building façade.<br>Three levels of integration are possible, depending upon intent of designing the façade:<br>a) **New architectural vocabulary**:<br>1. The designed building façade has a different architectural vocabulary, achieved by the application of photovoltaic panels/glass with different granularity (colour and texture).<br>**2.** Integration of the photovoltaic glass/panel are at different angles or using a combination of solar glass/panel with conventional building material.<br>b) **New appearance maintaining the overall vocabulary**:<br>1. Designed façade will have the same architectural vocabulary. Hence the photovoltaic glass/panel integrated will be having the similar granularity (colour and texture).<br>2. Achieved by using a combination of solar glass/panel with façade glass, aluminium composite panel, or exposed brick masonry.<br>c) **Minimum intervention, same vocabulary**:<br>1. The façade designed will be using photovoltaic panel/glass of same granularity, size, and modularity.<br>2. It can be done by replacing the glass of fenestrations with solar glass or replacing the cladding material with solar panels of same granularity. |
| **STEP-3** | **Identification of façade component for photovoltaic integration:** | a) Feasible façade components as identified, will be the components with highest feasibility of achieving architectural integration and allowing photovoltaic panel/glass to efficiently act as an envelope material without compromising its energy generation potential.<br>b) The integrational façade components are decided based on façade typology:<br>1. Façade with curtain glazing, provide an opportunity to design with a translucent/transparent photovoltaic curtain walling.<br>2. Façade with panelling of aluminium composite panels, provides an opportunity to create a vocabulary with high efficiency opaque photovoltaic panels.<br>3. Windows on the south side can be provided with translucent solar pv glass.<br>4. Combining glass and photovoltaic glass, where possible, allowing the integration of high efficiency opaque glasses.<br>c) Components with highest feasibility of application/integration of photovoltaic component are: - *Window glass, Curtain glazing, Floor to floor glazing, Sunshades, Panels between glass on the façade, Railings (panels between balustrade), walls (covering the fire exits and lift wells), Spandrel areas or areas between floor-to-floor glazing's.* |
| | **Selection of façade component with respect to selected thin film photovoltaic technology and vice-versa.** | a) Amorphous Silicon (A-Si) thin film photovoltaic panels are produced as transparent panels, efficiently and optimally integrated as curtain glazing, window glass.<br>1. The transparency achieved with A-Si technology varies (Visible transparency =30%, 20%, 10%, 0%). Panels with visible transparency of 20%-30% could be integrated as or in combination with window glass and curtain glazing.<br>2. Panels with visible transparency of 0% and 10% could be integrated as cladding materials, spandrel glass, panels between windows, staircase, and lift walls (in case of end cores).<br>b) Cadmium Indium Gallium diselenide (CIGS/CIS) are produced as opaque panels, but in varied colours, can be integrated as cladding materials replacing the conventional ones. They can be provided in combination with curtain glazing. |
| **STEP-4** | **Heat dissipation method for façade application:** | a) The preferred method of heat dissipation is Naturally ventilated cavity (NVC).<br>b) With the application of NVC, daylight admission within building interior would be possible, if transparent photovoltaic panels/glass are used. |
| | **Choice of photovoltaics thin film technology:** | a) Amorphous silicon, CIS (cadmium indium diselenide)/CIGS (cadmium indium gallium diselenide) thin film technology has been favoured over Mono/poly-Crystalline silicon, because of higher potential of customization, transparency without affecting efficiency. (Nguyen, Sang, Vu, & Le, 2019).<br>b) CIGS/CIS, A-Si, and Cadmium Telluride (CdTe) photovoltaic panels and glass can be produced in different colours and sizes. At the same time the thin film technology with the amorphous silicon pv cells, have far efficient performance in diffused light as well as at a tilt of 90° as compared with crystalline silicon technology. (Nguyen, Sang, Vu, & Le, 2019). |
| | | a) Use of thin-film CIGS, frameless glass-glass module, for curtain-walling technique.<br>b) Use of Amorphous silicon PV glass which are available in 2456 x 1245 sqmm, also |

| | | |
|---|---|---|
| | **Selection of pv panel:** | available in other non-standard sizes, for curtain glazing and cladding material.<br>c) Amorphous Silicon PV glass is manufactured in different sizes, and all the different sizes are available in varied transparency levels ($V_{Trans}$=0%,10%, 20%, 30). |
| | **Pv panel customization:**<br>• **Panel shape and size**<br>• **Granularity: transparency**<br>• **Position and inclination** | a) The shape and size of the photovoltaic panel/glass will be rectangular, as it would be efficient and easily adaptable to majority of façades, and easier to expedite in case customization is required in terms of size.<br>b) Granularity as expressed in terms of texture, colour, and transparency, will be like conventional building envelope materials, so it becomes easier to adapt. The texture will be smooth and planar, and transparency will depend on the application component.<br>c) The amorphous silicon modules are available in four transparencies: No Transparency, Low Transparency, Medium Transparency and High Transparency. The efficiency or the energy output changes (reduces), with increasing transparency.<br>d) Mounting of panels will be parallel to the façade in most of the cases. If the façade geometry works out then may be a combination of opaque photovoltaic panel, inclined to the sky and glass inclined to the ground can be designed. |
| | **Mounting of pv panels on the façade** | a. There are different solutions available for the mounting of pv panels on the façade. For example, seamless glass to glass module joining is available.<br>b. Availability of cladding with Aluminium profile (Mullion, transom), with the help of screws and fastener.<br>c. Mounting of solar glass/panel as louvers/sunshades and cladding material is possible with the help of fasteners, aluminium clips, and screws/brackets. |
| | **Pv panel cross section/ cross-section of the facade** | a. The pv panels cross-section chosen should be like the cross-section of the façade component it is replacing, to have least impact on the building footprint.<br>b. Also, the structural system and mounting system will be simple, durable, and efficient, to have maximum possible integrability. |

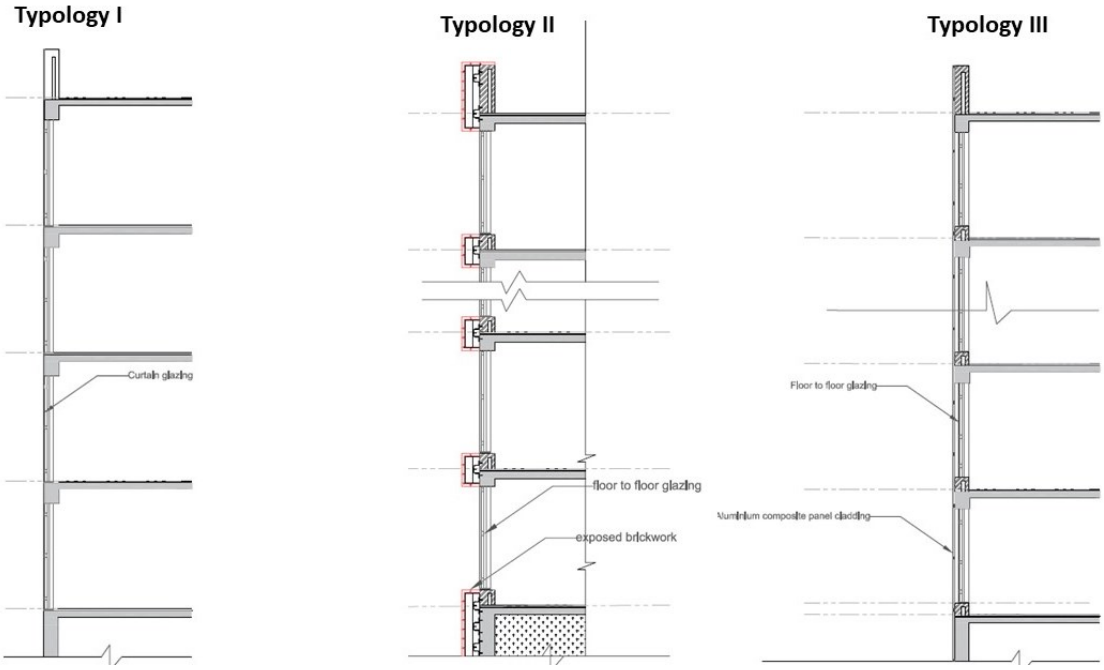


**Figure 2.** Sections of three building typologies

**4. Methodology/ Framework for designing A Photovoltaic Façade and Achieving Architectural Integration**

The framework is a methodology for designing a photovoltaic façade and achieving architectural integration. It is a process, comprising of three interconnected and sequential processes (figure 3).

**STEP ONE:** Identifying and selecting three building typologies for commercial buildings was the first step. Studies like Sandak, Sandak, Marcin, & Kutnar, (2019), Singh, Ravache, & Sartor, (2018) have described the choice of materials for commercial building façade are: glazed façade, aluminium composite panelling and R.C.C. structure with brick infill and exposed brickwork. Hence the three commercial building typologies, are defined as: (i) Typology I: facades with curtain wall and cladding of aluminium composite panel with ribbon windows, (ii) Typology II: exposed brickwork facades having floor to floor glazing, (iii) Typology III: façade with cladding of aluminium composite panels (ACP) having floor-to-floor glazing.

**STEP TWO:** In this step design-oriented strategies are developed. This step has two very critical aspects: (i) identification and assessment of the barriers (ii) Selection of solar glass/panel.

***Identification of the barriers***: It comprises of inhibitors, issues, and concerns (section 2.2). Analysis of barriers and their impact forms the guidelines for development of design-oriented parameters. Design-oriented parameters are proactive strategies of eliminating or minimising the barriers, leading to the formulation of design strategies. For eliminating major barriers, design strategies are developed according to the identified building typologies.

**Selection of type of solar glass/ panel (thin-film photovoltaic technology):** Impacts the development of design strategy. Solar glass/panels selected for integration on the building façade have been described in table 2. Adopted photovoltaic technology must perform two functions: (i) Act as building skin (ii) Generate Energy, simultaneously, efficiently without compromising the other. Thus, the selection criteria for the photovoltaic technology are based upon the two parameters afore mentioned. The prevalent solar panels used were of Mono/Multi-Crystalline technology, which were quite efficient, but their performance as building skin was very low. The weight of the panel, transparency, granularity (colour and texture) were the factors limiting its performance as building façade. When applied at 90° tilt angle, the efficiency of these panels reduced (because of the diffused insolation), thus rendering it ineffective as energy generator. Whereas the thin-film technology is efficient and performs dual functions of acting as building skin and energy generation, without any conflicts. The thin-film technology allows manufacture of translucent panels (A-Si panels), panels with smooth, planar finish in different colours (CIGS panels), thus making the process of adoption as building façade more feasible. The ability of thin-film technology to perform at an efficiency of 20%-22.9% (CIGS panels), even in diffused lighting, renders its application on building façade quite feasible. Also, the rise in temperature did not affect its performance and efficiency, thus eliminating the need for ventilation (Nguyen, Sang, Vu, & Le, 2019). The lightweight of thin-film technology permits its integration within the building façade, by mullion transom system, screws and fasteners and other conventional methods.

**STEP THREE:** It is the process of generating façade integrated photovoltaic system for the three building typologies using the design strategies developed in step two. The design variants are simulated in selected cities. Depending upon the skill set and the time available, simulation software can be selected. Some of the simulation software used for photovoltaic system simulation are PV*Sol, PVSyst, RETScreen Expert. Photovoltaic system simulation is used to assess the energy generation potential of the designed photovoltaic façade. The parameters of assessment identified are energy available at the end of the grid and performance ratio of the designed system. Simulation analysis leads to the identification of efficiently performing system, with respect to the azimuth, tilt, and city of analysis. Simulation is also required to identify the performance of new building skin through comparative analysis with the base-case building. It tries to establish the performance of the new building skin as efficient or non-efficient. Achieved by comparing the energy consumption of the base-case building with the new photovoltaic integrated building. It also helps in working out the economic feasibility of the generated variants.

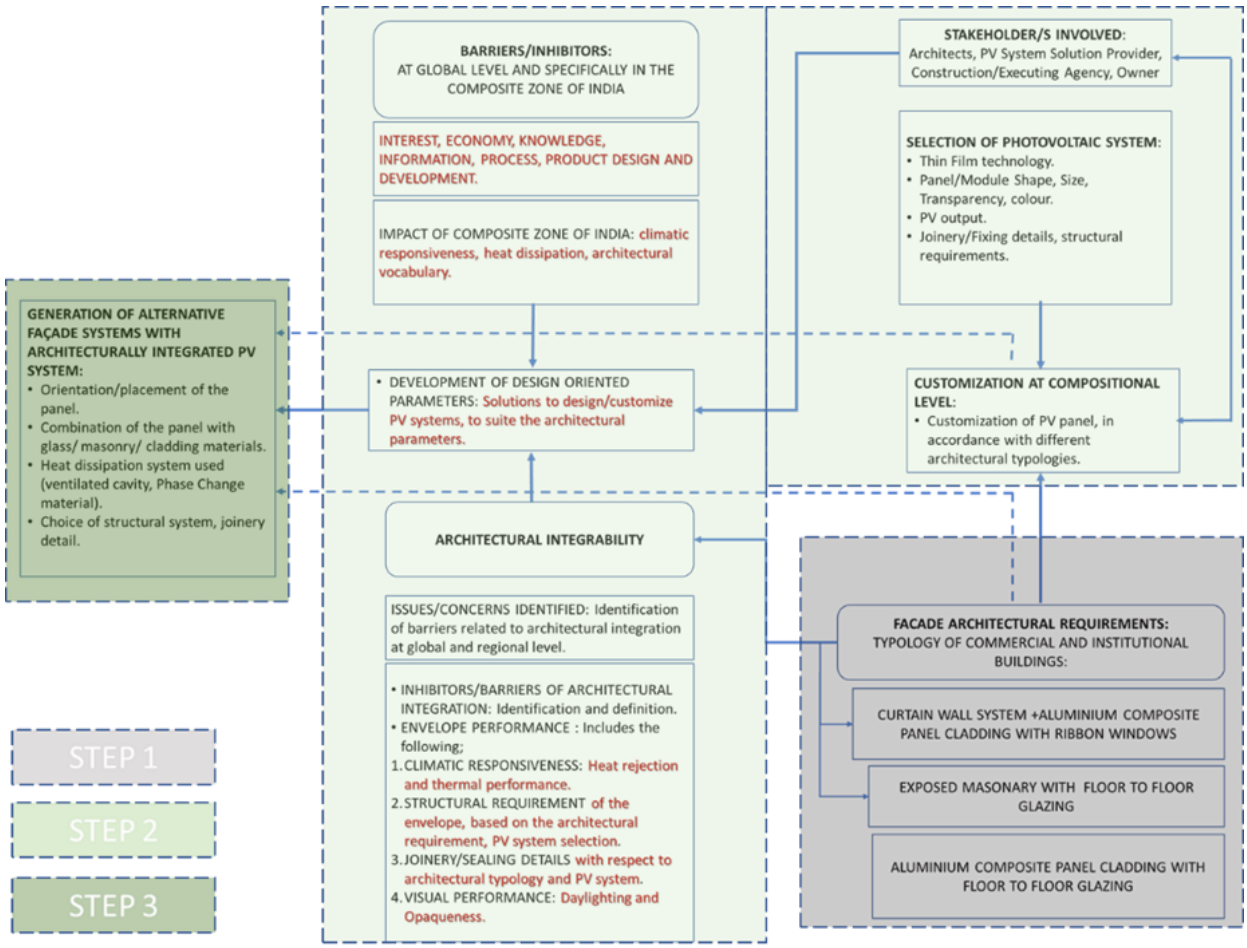


**Figure 3**. Framework for designing of photovoltaic facade and achieving architectural integration.

## 5. Conclusion

Previous studies Nagyn, et al., (2016), Nguyen, Sang, Vu, & Le, (2019) Saretta , Caputo, & Frontini, (2019), Zhanga, et al., (2018) have worked on the renovation of existing buildings with photovoltaic panels or have provided it as add-on components. The need to understand the integration of photovoltaic materials into the architecture of the building is important to achieve a photovoltaic façade functioning optimally and efficiently. It is important to understand the process of designing and achieving architectural integration. The study attempts to systematically identify the barriers and their impacts on design process, followed by the development of a framework to enable adoption of FiPV on commercial building. It has tried to propose a simplified, sequential process of designing a photovoltaic façade, and efficiently achieving architectural integration of the photovoltaic material on the building façade. The developed framework can be used to simulate several design options using PVSyst, RETScreen Expert, PV*Sol depending upon the available skill set. This simulation would enable the designer to take decisions based on parameters like energy generation, visual aspects, aesthetics, and economic implications. The impact of this framework and design strategy can be assessed from the fact that it will enable the architects and façade designers to incorporate renewable energy system within the building envelope and create an energy efficient, sustainable building system. The proposed framework holds the potential to fulfil the world's move towards having more of net zero energy buildings.

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# Evaluation Of Strategies for Employee Participation by Nigerian Construction Organisations

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**Abstract**
In this study, employee participation by Nigerian construction organizations is investigated as labor scarcity is one of the most persistent issues that the construction industry is facing today. This is intended to identify the construction organization's circumstances to increase employee participation in decision-making. The effect of such participation on the performance of the industry was also assessed. This study was carried out through a questionnaire survey of construction professionals in Zamfara State. Data collected were analyzed using the Chi-square and descriptive statistical analysis obtained. In agreement with the results of preceding studies, the employee's participation among construction organizations from the studies in decision making is at a lower stage which buttresses the Chi-Square analysis result that the employees do not participate actively in construction organizations' study area. This study concluded that there is a need for employers in the industry to categorize decisions that employees should make and to adjust their organizational backgrounds to raise employees' participation spirits as desired.
**Keywords**: Employee Participation, Organisation Performance, Organisational Background; Decision Making.

## 1. Introduction

In the concept of HRM, there is no general agreement as to exactly what the term employee involvement should embrace to be effective. Examples of participative practices may include, profit-sharing schemes, quality circles, job enrichment, problem-solving group team briefing, and employee sharing ownership (Loosemore, *et al,* 2003). What is clear is that participation can take different forms depending on the level at which it is focused within the organization. It may be between individual supervisors and immediate subordinates, formal or informal as how a job might be more done effectively, Job safety analysis is a form of group work participation (Loosemore, *et al,* 2003; Akande, 2021 ). This can be achieved by marking them shareholders in the business and clearly, there will be a range of levels of participation between these two extremes but ultimately the degree of influence employees enjoy will be largely determined by the wiliness and eagerness of both employers and employees to embark upon a process of meaningful change (Allen, et al, 2003). Human relations scholars argue that employee participation practices modify high-order needs such as a sense of achievement, respect, and self-expression, which in turn increase organizational commitment (Miller and Monge, 1986; Wagner *et al,* 1997). By embracing employee participation practices, the organization signals that it values the employees' contributions (Allen, et al, 2003).

However, the construction industry is known as one with poor quality emphasis compared to other sectors like the manufacturing and service sectors. Many criticisms have been geared towards the construction industry for frequent shoddy workmanship in the sector, where it is not only the final product that is subject to criticisms but the processes, the manpower, materials, and so on are under tremendous pressure for better quality in construction (Rhokeun *et al,* 2010). Furthermore, there are numerous examples of employee participation being used successfully in other industries, but less in construction (Briscoe and Dainty, 2005). Worker participation in problem-solving groups occurs in only 21% of construction cases (Green, 2002). There is a large volume of published studies describing the motivation of construction workers are minimal (Beekeeper, 2021). The high labor turnover in construction is caused by a little opportunity for training and it will ultimately affect skills shortages. Consequently, the lack of labor skills and high labor turnover is also denoted as major reasons for low productivity in construction. Therefore the implementation of people development and participative approaches will enhance the ability of organizations to retain employees (Mahmood *et al.,* 2020). In the short term, the resignation of a trained worker from a company can be considered a loss to the company, but such training will improve the industry as a whole. In summary, employee participation practices are essential for construction. Yet, the industry has neglected to take advantage of its workforce, which means there is a considerable amount of untapped productive potential waiting to be released and it is against this backdrop that this research was carried out to answer the following fundamental research questions:

- How employee participation do holistically relates to construction project productivity;
- How employee participation could be used to improve the effectiveness of individuals and teams at both construction organization and project levels

**1.1** Concept of Employee Participation in The Construction Industry

Historically, employee participation has taken several forms, resulting in a multitude of definitions of participation; see (Cooper, 1980; Roca and Retour, 1981; Marchington and Parker, 1990; Geroy *et al,* 1998). Employee participation first emerged in the 1970s when employers began to exert influence on decision-making through their leaders or representatives (Hyman and Mason, 1995). The characteristic of participation was first identified by Tannenbaum and Massarick, (1961) to be decision-making. Definitions of participation tend to fall into one of two broad categories, Direct participation occurs where every employee affected by the decisions made is directly involved in the making of those decisions. Indirect participation comprises a representative who participates in the decision-making on behalf of fellow employees. However, indirect decisions often have a wider span than those of direct participation and extend beyond the immediate work of the employees represented (Coffey, 1996). Indirect schemes of participation are more formal and tend to be initiated and precise to varying extents by management. Employees have a much greater interest indirect forms of participation less in indirect forms of participation; the difference is in the attitudes of construction workers in the 1994 survey by Coffey.

As a form of employee involvement in decision making, employee participation describes the self-perceived value that individuals have of themselves as important, competent, and capable within their employing organizations; employees with high organization-based self-esteem have come to believe that "I count around here" (Pierce and Gardner, 2004). As a leader's behavior, participation will foster high levels of organization-based self-esteem. This is because participation provides an employee the opportunity to exercise self-direction and control, which signals to the employee that the supervisor/organization considers them to be able, task-competent, organizationally important, and need-satisfying (Pierce and Gardner, 2004; Gardner *et al,* 2004; Mahmood *et al.,* 2020)). The incorporation of such positive messages into the employee's self-concept leads to enhanced organization-based self-esteem. Whitener, (2001) equated organizational insider status to Graham, (1991) notion of citizenship, with its implied acceptance of certain responsibilities. They, therefore, argued that employees' conception of themselves as an organizational insider leads them to accept their responsibilities of citizenship. Participation of an employee fosters a sense of belonging that encourages employees to explore ways of promoting both their organization's and their future well-being.

In today's working world, salary increases just weren't enough. Employees need to be acknowledged, encouraged, supported, and engaged. But while most of the recent focus on employee participation has targeted office employees, inspired and encouraged workers are essential to every profession. From accountants to artisans, every employee needs motivation, appreciation, and drive. One field in particular where this is prevalent in the construction industry. Unlike office work, construction is constantly moving, changing, and adapting, creating challenges unlike anywhere else. As construction conditions are constantly changing, weather, traffic, temperature, legal requirements, and dozens of other factors significantly influence construction work. Without regular updates and reliable employee participation, construction employees may feel out of the loop, unimportant, and uninformed. Dependable employee participation not only allows workers to make necessary changes but also demonstrates their importance to the organization. Employees need to know their leaders are aware of issues, addressing needs, and able to offer support. Regular employee participation cuts through the confusion and enables a safe, productive, and engaging work environment.

**2. Employee Participation as A Key Component of High Commitment In HRM**

It is widely accepted that employee participation is a key component of the high commitment bundle of HRM, but that it can take a range of forms in practice where employees are involved at the workplace level – through a wider number of participatory practices that are held more frequently and include opportunities for workers to have their say – the more likely it is that investments in employee participation will reap the reward of organizational commitment (Cox *et al*, 2006). The goals set by Egan stimulated a change of culture in the UK construction industry, with a corresponding change in the attitude of its workforce, particularly concerning involvement, participation, and empowerment (Egan, 1998). Employee involvement only occurs voluntarily, involvement cannot be forced, employees must be willing to contribute their ideas and this only occurs where there is a genuine commitment on the part of employees and employers alike. Therefore it is clear that to implement the reforms proposed by Egan, the active involvement of the workforce is necessary, consequently, the attitude of an individual working towards involvement becomes a fundamental issue in the success of the reforms (Coffey and Fowler, 2010).

As a topic of current interest in management thinking, participation has tended to rise and fall in prominence, but it consistently remains a significant part of the management approach adopted by almost all organizations, and the emphasis on teams and team building over recent years (Coffey and Fowler, 2010). Participation also concurs with the more consensual approach to management adopted by post-modern organizations, which have recognized their greater dependency on the intellectual potential of their employees to remain competitive in an increasingly turbulent global business environment (Huczynski and Buchanan, 2007). Employee perceptions of management implementation processes and attitudes in the workplace were much stronger than those associations found between employee attitudes towards participatory structures. From a management perspective, it is therefore particularly important to pay attention to how involvement is applied by Cox, Suter, and Marchington's research in 2006

**2.1 Management Role in Employee Participation in Decision Making By Construction Organizations**

While management's role is critical to achieving total quality, employee participation is often the most overlooked part of the process. Employee involvement evolved out of the business's need to improve performance. The impact of human resources in the organization depends on the kind of empowerment given to them. According to Lawler *et al,* (1992) employee involvement programs have a positive effect on company performance and internal business conditions. Gufreda and Maynard (1992) described employee involvement as the process of transforming an organization's culture to utilize the creative energies of all employees for problem-solving and for making improvements. Mak (2000) recommended that management should pursue the Tao "road" of people-based management that recognizes the importance of daily interaction with all employees and a shared identity with them in solving work problems. Vilasini *et al,* (2012). further recommended that employee participation initiatives should become management's daily routine, rather than considering them as extra activities.

**2.2 Need for Employee Participation In Decision Making By Construction Organizations**

Much has currently been written about the need to encourage employees to share knowledge for the industry to maintain a role as an intelligent provider in a technologically sophisticated environment. However, there is little written about the relationship between employee rights to satisfactory employment conditions, employee responsibilities in decision making, and employee willingness to share their knowledge collaboratively (Kassing, 2007). It is argued that competition in the technologically sophisticated twenty-first century requires intelligent organizations that manage knowledge rather than rely on hard assets. Allee (1997) argued that knowledge has to be developed constantly and shared collectively to facilitate a fundamental change in thinking from that based on Newtonian to one based on quantum physics, Management=employee. Despite recognition of the extent of change required to the management-employee relationship, there is a little detailed discussion about how this can be achieved, particularly how to encourage employees to share their knowledge in construction organizations. There is an assumption that employees, once they understand the importance of knowledge, will be willing to share it (Allee, 1997).

Management theory, although historically arguing for "managerial prerogative" as part of Taylor's (1964) managerial control concepts, began to recognize the need to satisfy a broader range of employee needs through greater employee involvement as part of a socio-technical system (Trist, 1981). This went further than Maslow's needs hierarchy in 1954 and questioned the frontier of management control. By the late 1980s, management theory advocated improved quality of working life and increased employee participation in decision-making to satisfy employee needs for self-fulfillment and encourage their participation in productivity and quality improvement. Researchers on best practices in the United States found that successful construction organizations were characterized by significant levels of participation by employees on a wide range of matters (Deriouzos, 1989).

Yet employees often remain silent and do not raise legitimate concerns about workplace issues out of fear or acquiescence (Kassing, 2002). Relational standing with one's supervisor informs employees about remaining silent (Milliken *et al*, 2003). More so, Milliken, Morrison, and Hewlin's research in 2003 discovered that 85% of employees interviewed reported remaining silent on at least one occasion. Additionally, they found that almost a quarter of employees reported not feeling comfortable speaking to supervisors about their concerns and that employees rated concerns with supervisors as more significant than any other issue about which they would remain silent. Thus, employees' tendencies to remain silent may be exacerbated by superior-subordinate relationship quality. Employee participation, in turn, can be in ways that challenge or threaten superior-subordinate relationships (Kassing 2005; Mahmood *et al.,* 2020). Circumvention, for instance, which involves going around one's immediate supervisor to share concerns with someone higher in the chain of command, can

prove detrimental to superior-subordinate relationship quality (Mak, 2000). Yet employees have regularly circumvented their supervisors as a step in the whistle-blowing process (Brown *et al,* 2007). Brown, Geddes, and Heywood research in 2007 found that the whistle-blowing process began simply with a declaration of concern to one's supervisor that led to circumvention only when an employee believed that the supervisor would or did fail to act on the concern.

Additionally, continuous improvement through employee participation is a core lean principle that identifies the inability to utilize the knowledge and skills of employees as the eighth waste. This waste involves losing time, skills, ideas, improvements, and learning opportunities by not listening to employees. Lean theory suggests improving participative culture through different tools like improvement suggestions, rewarding mechanisms, and multi-skilling. In summary, employee participation practices are required in high-risk and complex projects with a high level of technology. There is a trend in construction projects of increasing implementation of such practices. However, these practices vary with the management and project teams

## 3. Research Methodology

Employee participation in decision-making in the construction industry was investigated in this study from the point of view of management. The point of view of management is considered important since participation is investigated about the backgrounds in the organizations. In this study, we measure employee participation by asking the employers to indicate the positions that are allowed to make specific decisions and management of projects (Kassing, 2009; Ezennaya, 2011). Samples for the study were selected from Zamfara State with a total of 19 organizations randomly selected from the study area where the most concentrated organizations participated in the questionnaire survey. The respondents to the questionnaires were the principals of the organizations and or their representatives. Data were analyzed using the Chi-square was used in analyzing the participation in decision-making variables.

### 3.1 Research Analysis

**Table 1:** Chi-Square Test On Employee Participation

**A = Always, B = Sometimes, C = Occasionally, D = Never**

| | Always | Sometimes | Occasionally | Never | Total |
|---|---|---|---|---|---|
| 1 | 13 | 6 | 2 | 0 | 21 |
| | 11.00 | 6.44 | 2.56 | 1.00 | |
| | 0.364 | 0.031 | 0.121 | 1.000 | |
| 2 | 1 | 9 | 8 | 3 | 21 |
| | 11.00 | 6.44 | 2.56 | 1.00 | |
| | 9.091 | 1.013 | 11.599 | 4.000 | |
| 3 | 3 | 13 | 3 | 2 | 21 |
| | 11.00 | 6.44 | 2.56 | 1.00 | |
| | 5.818 | 6.669 | 0.077 | 1.000 | |
| 4 | 10 | 8 | 2 | 1 | 21 |
| | 11.00 | 6.44 | 2.56 | 1.00 | |
| | 0.091 | 0.375 | 0.121 | 0.000 | |
| 5 | 14 | 5 | 1 | 1 | 21 |
| | 11.00 | 6.44 | 2.56 | 1.00 | |
| | 0.818 | 0.324 | 0.947 | 0.000 | |
| 6 | 10 | 8 | 2 | 1 | 21 |
| | 11.00 | 6.44 | 2.56 | 1.00 | |
| | 0.091 | 0.375 | 0.121 | 0.000 | |
| 7 | 18 | 2 | 0 | 1 | 21 |
| | 11.00 | 6.44 | 2.56 | 1.00 | |
| | 4.455 | 3.065 | 2.556 | 0.000 | |
| 8 | 17 | 2 | 2 | 0 | 21 |
| | 11.00 | 6.44 | 2.56 | 1.00 | |
| | 3.273 | 3.065 | 0.121 | 1.000 | |
| 9 | 13 | 5 | 3 | 0 | 21 |
| | 11.00 | 6.44 | 2.56 | 1.00 | |
| | 0.364 | 0.324 | 0.077 | 1.000 | |

Total 99 58 23 9 189

Chi-Sq = 63.344, DF = 24, P-Value = 0.000

**Table 2.** Summarized Table

| Chi-Sq value | DF | P-Value |
|---|---|---|
| 63.344 | 24 | 0.000 |

Source: Field Survey, 2022

$H_0$: Employees participate actively in the construction activities
$H_1$: Employees do not participate actively in the construction activities
$\alpha$ = 0.05
From the results of the Chi-Square analysis in table 1 above, the P-value of the analysis is less than the alfa value ($\alpha$ = 0.05). We, therefore, reject the null hypothesis and conclude that the employees do not participate actively in Zamfara State construction organizations.

**4. Conclusion**

This research sought to evaluate the relationship between employee responsibility to participate in decision-making and employee willingness to share their knowledge collaboratively. It was argued that despite acknowledgment of the need for employees to participate and share their knowledge, little has been written on how to encourage participation (Rhokeun, *et al,* 2010). Many studies have found that employee involvement is significantly correlated with organizational commitment or its predictors (Taylor, 1964; Femie and Meicalt, 1995; Jones, 2002). Employee participation may reduce the likelihood that employees leave their jobs (the 'exit option') because they have the opportunity to express their opinions (the 'voice option') about their workplace decisions that directly affect them (Jones, 2002). Yankov and Kleiner (2001), Jones (2002), and (Mahmood *et al.,* 2020) also argued that employee participation practices provide opportunities for dissatisfied workers to voice their concerns and thus reduce the likelihood of quitting. The research also revealed that some changes have occurred in the attitude of construction workers towards involvement and participation, but these are mixed and do not at this stage establish a discernible trend towards an increase or decrease. Some important attitudes have changed very little, such as the desire to be involved and the importance of being involved, but there is no enhanced desire from employees towards participation expected as revealed by the Chi-square analysis. Overall, the positive attitude towards participation remains weak, with no indication of any significant improvement, which suggests that the propensity for participation and empowerment still exists. Lastly, there are no shortcuts to improving construction workforce engagement. But with sincere effort on the part of leadership to promote trust, openness, and workplace safety, the construction organizations will be able to reduce turnover and create an engaged, productive workforce.

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**Conflict Of Interests**

The authors affirm no conflict of interest.

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# A Study on Construction Waste Optimization with A Holistic Approach- Literature Review

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**Abstract**
Construction sites are afflicted with challenges like improper planning and management, high waste generation and low awareness on waste reduction. Sustainable work practices are laying emphasis on development of effective waste minimization measures for major construction projects. It is evident from the findings that losses incurred due to construction waste are enormous and proactive measures are needed to cut the cost of construction. Construction waste (CW) is the key factor which has a considerable impact on the environment due to massive landfills and pollution created by its disposal. Literature on construction waste provides best practices that help minimize construction waste. However, it lacks the holistic minimization approach. Therefore, studies approaching this problem comprehensively are needed. Research methodology was rigorous exploration from Research papers of past10 years through various journals to elicit the status related to CW Practices there in and recommend strategies to combat CW generation by addressing it with holistic approach.
**Key words:** Architecture, Environmental sustainability, Construction waste

**Objectives**

- To explore CW control relevant topics for holistic understanding
- To Summarize the essence of the study and recommend Strategies to combat CW generation

**Methodology**
Research problem is derived from the literature review. Rigorous exploration is done from National, International Research and review papers from the past 10 years through various journals to elicit the status related to CW Practices and recommend best strategies to combat CW generation by addressing it with holistic approach.

## 1. Introduction

Research has shown that construction materials and equipment may constitute more than 70% of the total cost for a typical construction project (K V. Patel et al. 2011, Pauline Jeruto Keitany et al. 2014 as cited in A. A. Gulghane, 2015). In the Indian construction industry currently, manual materials management practices and control procedures are unsatisfactory as they are labor intensive, inaccurate, and error-prone. (A. A. Gulghane, 2015)
In general, a really high level of waste is assumed to exist in construction. partial studies from numerous countries have confirmed that waste represents a comparatively giant share of production prices. (Karrar Raoof Kareem, 2013). As per the estimates of the Centre for Science and Environment (CSE), since 2005, India has newly constructed 5.75 billion sq m of additional floor space with almost one billion sq m in 2013 itself. If (according to the Technology Information, Forecasting and Assessment Council's, or TIFAC's, thumb rule) a new construction generates 40-60 kg of C&D waste per sq m, then taking an average of 50 kg per sq. m, India must have generated 50 million tons (MT) of C&D waste in 2013. Over the last eight years, it would have produced 287 MT of this waste. This estimate only accounts for new construction. The Indian construction industry produces a very high level of construction waste material due to poor knowledge on effective utilization of materials, the construction and demolition produce 75% of solid waste in the Indian majority of construction waste end up in landfills, and uncontrolled sites. This mainly causes pollution of air, surface water, underground water, public health, and loss of natural resources (Sayed, Kone Venkatesh, Asadi,2018).

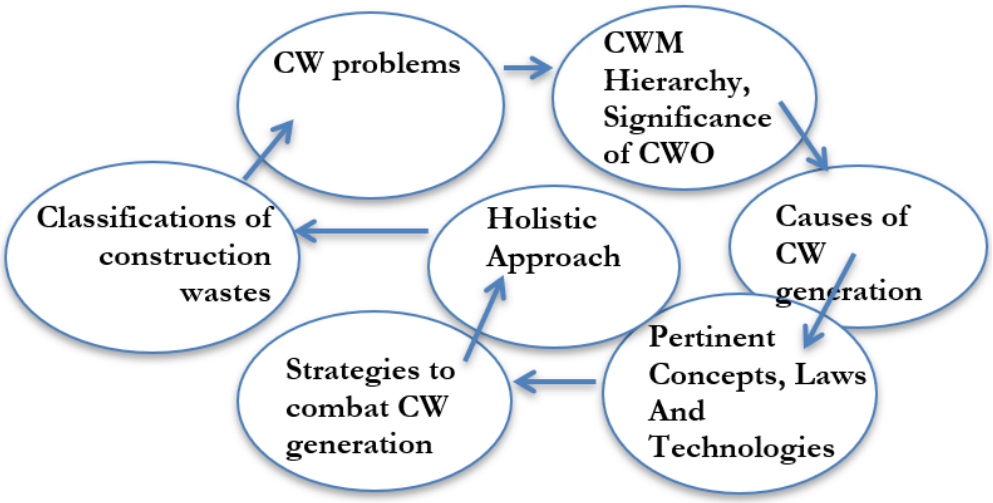


Fig 1 Structure of the study

**2. Definition and Classifications Of CW**

Waste is considered unwanted material (Ferguson et al., 1995 as cited in Yakkaluru Peddavenkatesu 1, 2016) which is a by-product of human and industrial activity that has no residual value (Serpell & Alarcon, 1998 as cited in Yakkaluru Peddavenkatesu 1, 2016). Previous researchers have defined waste as the loss of any kind of resource produced by activities that generate direct or indirect costs and do not add any value to the final product from the point of view of the client (Hwang, 2011 as cited in M.A. Othuman Mydin1, 2014)

Waste is a product or material that is unwanted. CW is clustered into two groups namely the physical and non-physical waste. Physical Waste: Physical construction waste is defined as waste that arises from construction, renovation, and demolition activities including land excavation or formation, civil and building construction, site clearance, demolition activities, roadwork, and building renovation. However, some defined directly to solid waste: the inert waste which comprises mainly sand, bricks, blocks, steel, concrete debris, tiles, bamboo, plastics, glass, wood, paper, vegetation, and other organic materials. Another way to understand the physical waste or construction debris can be seen on the construction site. This type of waste consists of a complete loss of materials, due to the fact that they are irreparably damaged or simply lost. The wastage is usually removed from the site to landfills.

Non-Physical Waste: Non-physical waste normally occurs during the construction process. In contrast with material waste, non-physical wastes are time and cost overruns for construction projects. Similarly, researchers from Indonesia defined waste as not only associated with waste of materials but also other activities such as repair, waiting time, and delays. Besides that, the waste can be considered as any inefficiency that results in the use of equipment, materials, labor, and money in the construction process. In other words, waste in construction is not only focused on the number of materials on-site but also on overproduction, waiting time, material handling, inventories, and unnecessary movement of workers. From the interview, it was found that the least attention was given to this type of waste in the construction industry (Mr.M. KalilurRahman1, Nov-2015)

(Nagapan, 2012) simplified the waste types into two, namely physical waste and non-physical waste. Physical waste is formed from material loss during the construction stage and non-physical waste may cause by poor management such as time overrun and cost overrun as shown in Fig 2.

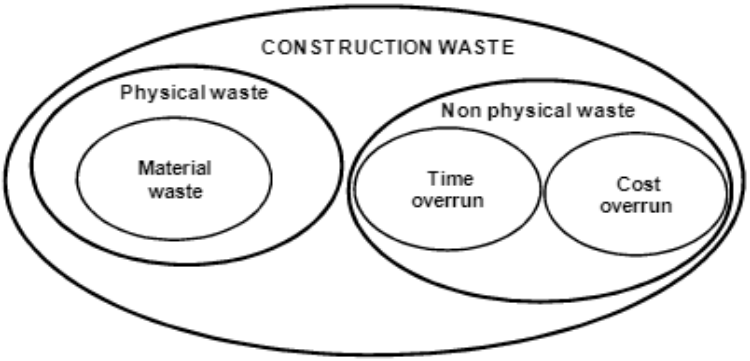


**Fig 2.** Classification of waste (Nagapan, 2012)

(Ohno 1988, as cited in Peddavenkatesu, October 2016) divides the movement (operations) of workers into waste and work. Waste is the movement that does not add value and is not needed. It is often called unproductive time. Work includes both non-value-adding and value-adding work. This definition assumes that some non-value-adding work is necessary in production systems, due to current working conditions-for example, walking to another location to remove parts, removing wrappers from parts, and so on. (Womack and Jones 1996, as cited in Peddavenkatesu, October 2016). Any human activity that absorbs resources but creates no value, such as mistakes that require rectification, production of items no one wants, process steps that are not needed, unnecessary movement of employees, and people waiting for the conclusion of upstream activities is described as waste.
CW is classified into four types. 1. Natural Waste: Waste to a certain extent is inevitable on building sites and this is generally recognized by everybody in the construction industry. This acceptable level of waste is referred to as natural waste. 2. Direct Waste: This is the waste that can be prevented and involves the actual loss. 3. Indirect Waste: Indirect waste is also known as cost waste. Indirect waste is distinguished from direct waste by the fact that materials are not lost physically. 4. Consequential waste: The cost of wasted materials is greater than their value. This additional cost involved with construction waste is related to consequential waste, and this is usually hidden (Peddavenkatesu, October 2016)

**3. CW Problems**

Construction sector is producing an unacceptable level of waste. Waste generated may be on-site or off-site. Both waste generating activities result in an increase in project cost, a decrease in profit margin, and create environmental management. This is also observed that not only the cost of the project gets increased due to the construction waste material but also a significant amount of valuable land is got occupied with waste generated by the construction industry which has a negative impact on our environment. Least priority given to appropriate site waste minimization and management systems in the Indian construction industry leads to the generation of huge quantities of material waste every year. This problem is not only detrimental at an environmental level as most of the waste is disposed of in landfills but also in economic terms as waste materials have their specific economic values before getting mishandled. (Yakkaluru Peddavenkatesu,"et al"2016)

The consequences of high levels of waste are both reducing future availability of materials, energy and creating unnecessary demand on the transportation system. In fact, some building materials and components use a large amount of renewable energy, as well as resources that are in danger of depletion, such as timber, sand, and crushed stone. (Wyatt, 1978, as cited in Yakkaluru Peddavenkatesu 1, 2016) Huge waste generated by construction activities creates negative environmental, economic, and social impacts. The environmental impacts include soil and water contamination and deterioration of landscape by uncontrolled landfills (C. Leiva, 2005, as cited in Olusanjo O. Fadiya, 2014). Material waste significantly contributes additional costs to construction because new purchases are usually made to replace wasted materials; costs of rework, delays, and disposal cause financial losses to the contractor (L. L. Ekanayake,2000, as cited in Olusanjo O. Fadiya,2014). Also, construction waste has social impacts such as the health and safety of workers and the societal image of the construction industry (H. Yuan, 2012, as cited in Olusanjo O. Fadiya, 2014).

**4. CWM Hierarchy, Significance of Construction Waste Optimization**

There are 3R concepts in waste management as shown in fig 3 that need to pass through before being disposal at landfills. The criteria of waste management started with waste reduction, reuse, recycling and lastly disposed to landfills. The process of construction waste management at the end will end up at landfill (Fauziah S H, etal, 2012 as cited in Muhammad Fikri Hasmori etal, 2020).




**Fig 3**. (WM Hierarchy Nagapan S, 2012 as cited in Muhammad Fikri Hasmori etal, 2020).

Losses incurred due to construction waste are enormous & sufficient proactive measures need to be taken to avoid the unnecessary costs of construction. Also from the studies, it is noticeable that the construction waste is affecting the quality of air, water & land and also affects the health of construction workers. Waste reduction is the best and usually the economical of the different waste management alternatives. ( Aishwarya Zunjarrao, 2018) (jannatun naemah ismam, zulhabri ismail) In terms of the guideline, the 'three Rs' principle of waste (reduction, re-use and recycle), otherwise known as the waste hierarchy also has been widely adopted in the UK [A. Vijayaraghavan,2013 as cited in jannatun naemah ismam "et al"2014 ]. These waste hierarchies are broadly used as guidance for designers to adopt a waste minimization approach in their projects [K.-L. Kramer, as cited in jannatun naemah ismam "et al"2014]. Another, in the waste hierarchy, waste avoidance and reduction is the prior choice of measures in the management of waste. However, the 3R strategy is deemed not practically related to all parameters of the designers' environment and it is discredited because the waste occurrence during the architectural design stages is different and unpredicted [M. Osmani, 2012, as cited in jannatun naemah ismam "et al"2014]

Construction waste reduction has the highest priority among waste management options which include reduction, recycling, and disposal [C.-L. Peng, 1997 as cited in Olusanjo O. Fadiya, 2014]

**4. Factors for CW generation**

As per Relative Importance Index and Importance Index techniques, the author analyzed the most important factors which may create problems in the construction industry. Inexperience designer, Design errors, poor planning, poor controlling, ordering errors, Poor quality of materials, and Poor workmanship (Vishal Kumar R.Gajera, "et al." 2015)

Waste management factors for this study are classified into seven categories namely, 1. Design 2. Handling 3. Workers' mistakes 4. Management 5. Procurement 6. Site condition 7. External Factor (Sunil V. Desale, "et al"2013) Based on the survey poor supervision has a high rating, not following the waste management, design changes and design errors give more waste in construction projects. Acquisition of the bad quality materials gets effected on the entire project, in that case, the acquisition of the best quality and quantity materials. In some conditions human errors and equipment malfunction can also produce waste materials, maintain the proper planning at the starting of work to check all conditions. (B. Sayed, "et al."2018) The main causes of waste generation are: Lack of waste management plans, Poor supervision and attitude of workers, Inaccuracy in quantity surveys Complications in order-taking, Issues in material storage, Inferior quality of materials, Poor materials handling (J Prakash Arul Jose1,"et al."2018)

Poor site management , Lack of experience , Inadequate planning and scheduling, Mistakes and errors in design , Incompetent subcontractors, Rework, Frequent design changes , Labour productivity, Inadequate monitoring and control, Inaccurate quantity take-off, Shortage of site workers, Lack of coordination between parties, Slow information flow between parties, Shortage of technical personal (Skilled labor), Changes in material specification and type Equipment availability and failure ,Effect of weather are factors contributing to construction waste(Mohd Hilmi Izwan Abd Rahim,"et al.",2016)

As a solution, the Waste and Resources Action Programme (WRAP) was established by the government to help the UK improve its waste management practices. WRAP has also introduced a waste management framework based on eight key areas (figure 4) that should be taken into consideration in construction activities from start until project completion [ WRAP, 2012 as cited in jannatun naemah ismam, "et al."2014]. For instance, "smart waste" is introduced by WRAP as a tool to facilitate on-site auditing, waste management, and cost analysis to deal with waste that has already been produced (Defra, 2011, CIPS as cited in jannatun naemah ismam,"et al."2014) while tending to improve contractors' waste management strategy [Y. Li and X. Zhang, 2013 as cited in jannatun naemah ismam, "et al."2014]. this key area is viewed as a holistic process of waste management and stakeholder roles in handling waste management. (jannatun naemah ismam, "et al."2014).

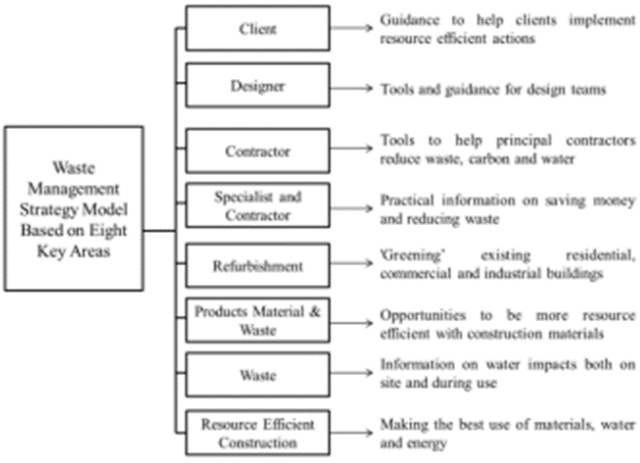


**Figure 4.** (WRAP, "Achieving Good Practice Waste Minimization and Management," United Kingdom, 2012, as cited in jannatun naemah ismam, "et al."2014)

**5. Pertinent Concepts, Laws and Technologies**

The study emphasizes the importance of reverse logistics decision-making in the early phases of the construction process. Furthermore, it stressed the importance of making appropriate decisions regarding reverse logistics options without blindly following the common practices in the industry. The support of all industry stakeholders is crucial for the successful implementation of reverse logistics. The slow uptake of these practices can critically impact the future of the construction industry as the depletion of natural resources and environmental pollution worsen. Therefore, industry decision-makers must make their decisions with future long-term life-cycle considerations instead of merely focusing on current waste problems. Waste issues can be addressed automatically when implementing the approach offered by reverse logistics. (NNC Pushpamali ,"et al."2019)

Design of last planner system in lean design assists in waste management at the construction site besides keeping check of other factors that makes the productivity getting lowered. (J Prakash Arul Jose,"et al."2018)

Most effective measures were deemed to be those that fostered "waste minimization partnerships" throughout the supply chain The findings reveal that the most effective measures are those which seek to develop alliances with suppliers and recycling companies to remove materials from the site more efficiently, the increased use of off-site fabrication to control waste and damage, and the greater standardization of design to improve build ability and reduce the number of off-cuts.( Andrew R.J. Dainty and Richard J. Brooke, 2004)

The premise behind BIM is the coordination among all stakeholders in different phases over the lifecycle of a facility that will help to insert, extract, update or modify information. BIM provides a design team with a tool to evaluate the impact of the design decisions on the overall construction process with the assistance of virtual prototyping on the other hand; it is widely acknowledged that associating BIM with the development and use of 3D parametric, 4D time dimension and 5D which is the quantities and costs of material. BIM solutions for C&D

waste reduction include conflict, interference and collision detection, construction sequencing and construction planning, reducing rework, synchronizing design and site layout, and detecting errors and omission in design (Ahankoob, A," et al",2015as cited in Abioye A. Oyenuga et al,2015).

Conventional method for construction work is not environmentally friendly because of the poor quality control at the construction site and the uncontrolled waste production. This has contributed to pollution problems to the environment in the form of air and water pollution, and construction waste. The IBS technology is the best option in order to overcome the present problems. (Mohamed Nor Azhari Azman,"et al"2013)

"Polluter Pays Principle" as introduced by China's government and enacted under environmental law [A. T. W. Yu, C. S. Poon,2013, as cited in jannatun naemah ismam,"et al."2014]. According to [R. E. Cordato, 2001as cited in jannatun naemah ismam, "et al."2014], the "Polluter Pays Principle" is defined as: - "Whoever is responsible for damage to the environment should bear the costs associated with it." (Taking Action, the United Nations Environmental Programme)

EPR provides an opportunity to firstly prevent waste generation (Acree, G.A.,2003as cited in Salmon Shooshtarian,2021), secondly divert additional waste away from landfills to reuse and recovery (Hanisch,2000as cited in Salmon Shooshtarian,2021) and thirdly creates and stimulates markets for C&D waste resources (Shooshtarian,2020as cited in Salmon Shooshtarian,2021). Ideally, EPR is recognized as an incentive for producers to take into account environmental considerations when designing their products, resulting in preventing waste at the source through better product design, technology development and incorporation of green design and effective waste management schemes into overall production arrangements [Pouikli, K,2020 as cited in Salmon Shooshtarian,2021)

**6. Strategies to Combat CW Generation**

Reduction of waste can be done by practicing attitude towards Zero wastage, proper decisions at design stage, site management, proper standardization of construction materials, and Codification of the same (S. Sanmath 2011as cited in A. A. Gulghane, "et al', 2015).

Construction waste can also be reduced by using waste management system on project. The project activities are to be planned at every stage by every construction personnel, who are involved, in minimizing the overall waste generation at project (J. Thomas et al. 2013as cited in A. A. Gulghane, "et al', 2015).

Various strategies for Construction and Demolition waste reduction also include standardization of design, stock control for minimization of over ordering, environmental education to workforce etc. (N. Bagdi et al. 2013as cited in A. A. Gulghane, "et al', 2015).

Government implemented construction waste disposal charging scheme (CWDCS) can provide financial incentives to C&D waste generators to reduce waste and encourage reuse and recycling. Government's interventions like Landfill tax, higher tax for using virgin construction materials, tax credits for recycling etc. can be used on construction site for waste minimization (C. S. Poon et al. 2013, as cited in A. A. Gulghane, "et al', 2015).

(Andrew R.J. Dainty and Richard J. Brooke)" Towards improved construction waste minimization: a need for improved supply chain integration? "The research suggests that for waste minimization to be effective, each project needs to consider these systems individually; not all 16 waste measures will be practicable on every project.

Proper and detailed rules & regulations needed to handle the huge mass of construction waste and detail guidelines for the management of various type of CW which helps to deal with the quantum of waste, which is nowadays unutilized and partially utilizing in some of the areas. All the stakeholders who are directly dealing with the sites and handling the material they should have detailed legislations and information, so in future optimal utilization can be done and saving rate also increase. (Pintu Badatiya,"et al",2015)

Waste rate estimation method can be used to improve the handling material, reduce the waste rate, and improve productivity (A. Al-Hajj, "et al'. 2011 as cited in A. A. Gulghane, "et al', 2015).

The prediction of waste flow can be modeled through the building elements at the construction stages (Siti Akhtar Mahayuddin et al. 2013as cited in A. A. Gulghane, "et al', 2015).

One major factor that affects the amount of construction phase is the design. Engineering firms must establish new design standards to help reduce the amount of construction waste by designing to dimensions available in the market that will eliminate cutting and shaping steel frames, plywood, and drywall (Prof. Kinnari Mishra1, Joshi Jay2, 2019)

Good operating practices generate less waste by making existing processes more efficient. Using non-hazardous or less hazardous materials in products and services can reduce or even eliminate waste generation. Production changes that can decrease the company's generation of wastes include: Changing the production process,

Changing the placement or layout of equipment, replacing existing equipment with more efficient models, and Automating the production process. (Yakkaluru Peddavenkatesu 1, 2016)

The recommendations to minimize and manage waste in building construction projects are: (1) The contractors should pay attention to construction documents and drawings to see any discrepancy and seek advice or answers from the owner or designers prior to construction; (2) The contractors must try to understand the owner's and designer's intention for the project to mitigate rework; (3) The contractors should have sufficient knowledge and expertise. They should gain experience before the construction stage so that they can seek out needed resources; (4) The amount and quality of materials on site should be checked and stored in the proper locations; (5) Site supervision and management should be done regularly, the lack of supervision may result in mistakes, reworks, and poor workmanship; (6) Coordination among parties is a key to reducing waste. Effective coordination can ease most of construction waste generation factors. Appropriated coordination among various parties should be formed for all phase of construction lifecycle. ( Chakkrit Luangcharoenrat, 2019).

**6. Conclusion**

This Explorative study could throw light on several CW control relevant topics and best practices for holistic understanding which can aid in framing an effective CW control plan by integrating the latest Management concepts, pertinent Policies, Strategies and Technologies.

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# "Boxes" Versus "Architecture for People"

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**Abstract**
Designing for people must be the main goal of architecture, or, in other words, not designing following fashion or fame, which can bring serious consequences in what really matters, as energy, environment or yet functional problems, in the literal sense of the word. With the proliferation of what I call the "boxes", clean, minimal, we observe a mischaracterized monotonous architecture, missing often the good sense, what brings the need to rethink the main purpose of architecture: people, environment, cultural, social and historical context, local resources, climate, all factors in prowl of a sustainable and consistent attitude towards architecture.
This paper aims to review what the concept "designing for people" means, beginning a research through a critical reflection of what happens when we follow fashion tendencies "versus" an attitude where architecture should be a human right.
**Keywords:** "Boxes"; Sustainable Architecture for People.

## 1. Introduction

"To think, nowadays, is a revolutionary act". I read this in an interview with Daniel Innerarity[1] in "Expresso", a portuguese magazine, and I find it so curious, in the sense that it contains a certain behaviour of what happens today, in general, and in what concerns architecture, and, in a larger scale, the city, we can say the same.
This paper pretends an approach to what should be the main objectives of architecture today, reviewing and reflecting on nowadays concepts, like sustainability and the "humanization" of Architecture and Urbanism, remembering and reflecting, with a critical vision, about what happened with the architectural and urban theories that marked the 20th century.

## 2. Materials and Methods

### 2.1 Modernism and Postmodernism

To review the concept of "designing for people" it will be important and necessary to back off to the Modern Movement, genesis of rationalism and purism in architecture, the postulates of the Athens Charter[2], and the consequents reactions of postmodernism.
Since the Second World War, it took place, in Europe a series of initiatives, which had as objective the reconstruction of the devastate areas, essentially the urban centres. These new projects had, by reference, the urbanistic models advocated by the Modern Movement, through the manifests of the International congresses of Modern Architecture.
In the new cities, the rationalist principles were defined in the postulates of the Athens Charter, which proposed a doctrinal reformulation, not only through the pragmatism of its principles, but also by the theories of "zoning", which compartmentalized the city in main functions: to work, to sleep, leisure, with strong infrastructures connecting them all. They were cities for the car and for transports. The scream of freedom expressed in the main principles of Modern Architecture was so strong, as they indeed created a statement by its attitudes and tendencies in such a way, that many people, today, when seeing a house by Mies Van der Rohe, Alvar Aalto or Philip Johnson, for instance, will think that they were designed nowadays. And thus, by its rationality, pragmatism and pureness, from the organization of spaces, the transparencies, the kind of material, to the integration in the landscape, but mainly by the contemporaneity of the concept itself. Everything comes together to give the idea that they were conceived and built today.
It was undoubtedly one of the great chapters of the History of Architecture.
Inevitably all this had expected consequences at various levels, and the reactions (postmodernism) came from several authors from different countries in the late sixties and seventies, mainly from the School of Venice, with "La Tendenza" movement, Germany, England, and the United States of America, not only in architecture and

[1] Daniel Innerarity is, according to the magazine "Le Nouvel Observateur", one of the twenty-five most important philosophers of our time, with a vast literary work about the contemporary era.
[2] The Athens Charter surged from the IV Congress (1933-1947), dominated by the personality of Le Corbusier. There were nine congresses, the first one in 1928, and the ninth in 1950.

urbanism, but also in other levels of knowledge, through different disciplinary areas, like psychology, sociology, anthropology, economics, among others[3].

These critics had a voice from a series of people. Names like Kenneth Frampton, Robert Venturi, Charles Jenks, Christopher Alexander, Jane Jacobs, Kevin Lynch, Gordon Cullen, Amos Rapoport, Norberg-Schulz, Carlo Aymonino, Aldo Rossi, Rob Krier, Collin Row, made part of a list, whose theorical argumentation had an unquestionable value for the practice of architecture and urbanism.

It was mainly in urbanism, and in urban design, that this vast group of authors gave a rich contribute, though several methodologies of thinking, reading and producing urban space, covering several fields of knowledge. These was the great contribute of postmodernism: an integrated and multidisciplinary vision and attitude towards architecture an urbanism.

From these methodologies, the most important analysis concepts are: Urban Morphology (Aldo Rossi, Robert Krier), Visual Analysis (Gordon Cullen, Roberto Venturi, Charles Jencks), Urban Perception (Kevin Lynch, Norberg Schultz), and Environment Behavior (Hall, Lang, Sommer).

Modernism and postmodernism were completely different in ideology; nonetheless they had something in common: both were structured, and supported by their own philosophy, an ideological basis, inserted in a social and political context, genuine and inspiring, whether we agree or not.

In every period in the History of Architecture, the new tendencies had always been launched by the intellectual elites, in consequence of social, political, economic and artistic factors, and stopped to be fashion, when other tendencies occurred, while the previous ones spread out.

**2.2 And now?**

Meanwhile, in the last decades, let us say the last twenty years, “new” concepts and concerns emerged, like sustainability, which contains itself a series of inherent sub concepts.

Said this, where are we now?

Observing the exponential growth of the cities around the world, specifically those in Asia, Africa and South America, the truth is that both in architecture, and mainly in urbanism, it seems that we did not leave the modern movement, we still are there.

Cities grew up disorderly and, worse, grew without any kind of philosophy, just with the need of growing, growing, growing, becoming more and more into large suburbs, monofunctional, mischaracterized, asphyxiated, without any planning policy, or at least none apparently visible.

In what concerns Architecture, with its big equal concrete blocks, like giant boxes, that multiply infinitely, and where millions of people live, independent of climate and cultural habits, the problem is not different, is just another side of the same scenario. If we think that part of this was done and thought by architects, the problem gets even bigger.

This reminds us of another difficulty, that is what is being taught in the architecture programs, not only in the contents of the several disciplines, but also in the programs themselves, mainly in the way they are structured.

The Architecture and Urbanism programs, which should be, by definition, the time for experimentation, in the real sense of the laboratory, became, many of them, spaces where students and teachers follow the fashion of the moment, with references of architects elected by the elites of the moment. The studios lost their real meaning. Of course, it is important and even fundamental to be aware of what is being done and by whom, with updated references, but, not less important, is to be aware of the needs of our time. For that it is crucial, besides to teach by doing, or learning by doing, to teach and to learn by thinking. To learn how to think, not in a fragmented way, but with an integrated and integrator attitude, connecting in the right way all forms of knowledge. And to think in Architecture implies to think in its the real purposes, in the ethical responsibility, as well as to rethink architecture as a human right, what implies to go beyond the “boxes”, to face sustainability as crucial, necessary, as a conscientious need, and not just one more “nowadays” concept.

It is urgent to think that architecture for people obliges to use the integrate knowledge of several disciplines and interconnect them as fundamental tools to draw with ethic, quality and aesthetic, concerned with social and cultural factors, with a proper philosophy and with a true, consistent conviction, in the sense that is not occasional or according to some momentary, ephemeral fashion.

It is here that begins the real distance from the Modern Movement and Postmodern Movement.

It may seem a contradiction to say that to draw for common people does not have to be different from drawing to the elites, in the sense that drawing in architecture must always deal with the conscience of climate, comfort, beauty, important factors to rich and poor, to which we must add the concerns of sustainability, the respect for the culture and the needs of everyone.

[3] The objective is not an intensive description of authors, but to mention those considered more significant to the subject.

The problem with the exponential proliferation of the "boxes" is essentially the mischaracterization, the decontextualization and the non-respect, or worse, the disinterest in the real needs of the people, something that remind us of the problematic of the Modern Movement. It is important to question "for whom and where are we doing this (?)".

It is in this context that is required to review, and to re-evaluate the main purposes of architecture, which has been lost, what failed in the practice of the modern and postmodern principles, what obliges us to think and to reflect, since very early in universities, and later in the professional life, with conscience, in architecture and urbanism as a fundamental instrument to give answer to a human right: the right to a house, the right to the difference, in terms of culture, the right to the urban space, the right to comfort, to quality, independent of the social status. Quality, aesthetics, and comfort cannot be a symbol of status, but a right for all.

If in the last century the Modern Movement failed, becoming a reproduction of speculative logics, and the postmodernism was not able to change it, it is our obligation to contribute, through architecture and urbanism to ways of life more adjusted to contemporary needs, to integrate instead of breaking, being more heterotopic instead of entropic.

**3. Results**

All these are factors to be considered in the act of designing (scales, typologies, character, activities, spatial configuration, circulation, free spaces, urban furniture, relations with existing architecture, morphological relationships, etc.). Although they may not have an immediate effect on the practice of Urbanism, they have the merit of constructing theoretical material for reflection, which requires time to mature before it can be applied to interventions in cities.

The attempt to build a theoretical body, thought to qualify the projects, the uncharacterized peripheries, using new traditional patterns, applied within the new contexts of urban production (administrative, economic, social and cultural) is something that seems unquestionable, as well is unquestionable to transfer these concerns to the education fields in universities, at all disciplinary and scientific areas.

**4. Discussions (for further discussions)**

We can consider that the question of the invention of cities, in their design, in their infrastructural, social, economic and cultural complexities, is not a stabilized territory, in terms of concepts and theories. It accompanies the permanent interrogations of man, in his image of time.

The rules, the laws, the attitudes, are always referenced in space and time, always leaving open something that may come from nothing (POPPER), or from the future, as is commonly said.

These reflections only intended to draw attention to exalting "moments", with real consequences in the transformation of cities.

The conclusions of the Habitat I in Vancouver, Canada (June 1976), promoted by the United Nations, could be considered, at that time, as a conclusive synthesis of this theme, whose continuity were expressed, twenty years later, in the conclusions of Habitat II in Istanbul, Turkey (June1996), in the Special Sessions of the General Assembly on Habitat: Istanbul +5, in New York, USA (June 2001), in Habitat III, in Quito, Ecuador (October 2016) and in the sustainable development goals in the Strategy for Agenda 2030 (New York 2016), in the consequence of conferences like Rio+20, Cairo+20 or Pequim+20.

Due to its opportunity of virtues and conflicts, it constitutes today, in the second decade of the 21th century, a non-exhausted subject, whose debates should be included in the contents of the Architecture and Urbanism programs. Hence, the choice of this theme topic (Rainha, 2007).

**5. Conclusions**

The human heritage is something that has no name but is in its whole dimension bigger than the parts.

When in the early eighties (1982), the picture "Blade Runner" from Ridley Scott appears, we were far from imagine that some decades later it will be a reality, when confronted with the decadence of the urban scenario, where unfortunately live a large part of humanity, all over the world.

Sometimes it is necessary to build and to rebuild fast and at low costs, but we learned from the last century models and experiences that was not the better solution. We can create now the chance and the opportunity of doing things in the right way. These were some reflections which oblige us to review, in a critical approach a period of the History of Architecture, where the social and political context obliged to create new attitudes and concepts, like the Modern Movement, that pretended to give answers and to find solutions to rebuild a destroyed Europe, but, in the end, did not manage people needs and ways of living.

Even with a luxury cast of authors and theories, the postmodernism did not have strength enough to change the fails of modernism.

When Francis Kéré won the last “Pritzker” Prize, it was as if a new page surged in the path of doing architecture and urbanism for the people.
As I began this text, referring Daniel Innerarity saying that thinking is a revolutionary act, I ended it saying that revolutionary or not, thinking is the only way capable of breaking the “praxis” and make the change.

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**Conflict of Interests**
The authors declare no conflict of interest.

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# Artificial Neural Network Analysis for Cost Estimation of Building Projects in India

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**Abstract**
In Construction Management, it is difficult to predict the cost estimate during the preliminary stage of the project because of limited information and unknown factors. Artificial Neural Networks can help in the prediction of estimate because of their simplicity and adaptability to non-linear problems. Due to their self-organizing nature they can be used to solve the problems even with low level programming. This makes them useful in interpreting and generalizing inadequate input information. ANN's are crude derivatives of the biological neural network with single layered or multi-layered neuron in the form of input layer, hidden layer and output layer. The neural network first has to undergo training from historical data in order to make predictions or show results. The size of the data set, number of hidden neurons and the neural network architecture determines the success of the results. Selecting the right data set becomes imperative in this case. For the purpose of cost estimation, the cost drivers were taken as inputs and their estimated costs were taken as the target value. The cost drivers were selected carefully through literature review and survey to provide more accurate results for the estimate. The main drivers identified were: type of building, location, seismic zone, project complexity, ground condition, soil condition, plot area, plinth area, built-up area, number of stories, number of basement, principal structural material, type of foundation, level of design complexity, modular design, market conditions, construction conditions, risk factor, impact of risk, estimated duration of work, specification, quality of work and detailed cost estimate of project. A Pareto analysis performed on the significant drivers showed that the Duration of Work, Complexity of the Building, Plinth Area and Built-up Area, Height and Specifications were the most important cost drivers in a construction project. A problem was formulated based on these drivers with numerical and categorical data. The data set was trained with a neural network using the MATLAB software using feed forward backpropagation. Training was carried out till the greatest correlation and least Mean Squared Error was obtained after multiple iterations. This trained data was used to predict the cost for a new project. The output of the testing was 87% accurate despite the small data set used.
**Keywords:** Artificial Neural Network, Cost estimation, Construction projects, Building projects.

## 1. Introduction

In Construction Management, it is a difficult challenge to produce an accurate project cost estimate that takes into account the risks and uncertainties which may result in costs overruns. Cost estimation generally involves predicting labour, material, utilities or other costs over time given a small subset of factual data on "cost drivers."
The different types of costs involved in building construction projects are as follows:

**Category I.** Direct charges, which are identifiable as being associated with a particular project—standard labour, project labour, material, installation, salaries, and miscellaneous costs;

**Category II.** Allocated costs, which are charged to the project as the result of applying various formulas to the direct charges—standard overhead, other manufacturing costs, construction overhead, and general sales and administrative expenses.

In project management, cost estimation is not just a simple arithmetic based process. Estimation is an experience based task which includes assumptions, inclusions and exclusions. Cost estimation plays a crucial role in the initial part of a project as it enables decision making for investors, helps in the quantitative assessment of project and selection of alternatives.
This cost estimate is used to set up a budget during the front end of the project. The same budget is used as a baseline to assess the performance of the project during the later stages and to avoid cost overruns. In the worst cases, cost overruns can cause the interruption of construction activities, and even the abandonment of projects, situations that occur when the owner does not have the financial capacity to meet the unexpected costs (Herrera, 2020).

Artificial Neural Network (ANN) can be used here in cost forecasting because it is an analogy based process that works well with limited data- in the same way as the human brain. Our brain has been developed after thousands of years of evolution, and holds several advantages over the von Neumann or modern parallel computers. These include massive tolerance, learning and generalization ability, adaptivity and low energy consumption (Jain, 1996). Neural networks use a process which is analogous to the brain, wherein the existing data undergoes "training". By using an adaptive learning rate for training, a trained neural network is developed for a better test accuracy. (Takase, 2018) The trained network becomes an "expert" in the category of information that it has been given to analyse. This "expert" can then be used to provide projections for new scenarios. Artificial neural networks are purely data driven models which transit from a random state to a final model through iterative training. Artificial neural networks are non-parametric statistical estimators which have proven to be universal approximators, and thus have potential for use in cost estimation modelling.

**1.1 Aim**

This research aims to examine the performance of cost estimation modelling through neural networks to predict the initial cost estimate for building construction projects in India.

**1.2 Need**

Conceptual cost estimates play a crucial role in initial project decisions, even when scope is not finalized and very limited design information is available during early project stages. Some categories of problems and challenges faced in the project environment may depend on so many subtle factors that a computer algorithm cannot be created to calculate the initial cost. There exists a need to predict reliable results from complicated or imprecise data for obtaining the initial cost estimate of a project. Artificial Neural Networks (ANN) are a family of statistical learning models inspired by the way biological nervous systems that process information. Unlike some conventional statistical systems, ANN adapt continuously to new data and possess an ability to learn from arbitrary and noisy data permits (Abraham, 2005). Hence they can lend themselves towards cost estimation in the early stage of the project. ANN method is appropriate for cost prediction due to the following reasons: (a) it is able to determine the interdependencies between data when considering significant variables in construction, (b) it can deal with non-linear relationships (c) it can handle incomplete data sets (Arafa, 2010, Amen,2022).

**1.3 Objectives**

The objectives of the paper are as follows:

- Analysis of the cost drivers based on historical data and identification of significant cost drivers.
- Formulating a problem based on the identified data set for cost estimation.
- Finding the cost estimate for a test project based on input from simulated and actual data sets using artificial neural network analysis tool for projects in residential, office, commercial and institutional category.
- Analysis of artificial neural network analysis tools in cost estimation in terms of accuracy, variability, model creation and model examination.

**2. Methodology**

***Step 1- Identification and collection of data set for cost estimation.*** The data set is a key factor in cost estimation of the project. If the data set is not reliable, the results from the networks calculations will not be reliable. This dataset is collected through literature study and actual survey.

***Step 2- Identifying the variables in the data set and classifying them into the following types.***

***Categorical data.*** Dependent Category: Dependent or output variable whose possible values are taken from a set of possible categories; for example, yes or no, or red, green, or blue.

- Dependent Numeric: Dependent or output variable whose possible values are numeric.
- Independent Category: Independent variable whose possible values are taken from a set of possible categories; for example, yes or no, or red, green, or blue.

***Numeric data***. Independent variable whose possible values are numeric.

***Step 3- Setting the input variables for cost estimation of the project.*** These input variable will differ based on typology, complexity, location, materials, labor and other specifications of the project.

***Step 4- Estimating the cost using neural network analysis technique for the sample set.*** Regression analysis is a statistical technique used to measure the extent to which a change in one quantity (variable) is accompanied by a change in some other quantity (variable).

***Step 5- Comparing the results of ANN with the actual results based on accuracy, variability, model creation and model examination.***

***Step 6- Determining the relevance of the quantitative tools for the project environments.***

**3. Artificial Neural Network – An overview**

- An Artificial Neural Network (ANN) provides a method to characterize synthetic neurons to solve complex problems in a manner which is similar to the human brain. (Huang, 2009).
- An artificial neural network is composed of many artificial neurons that are linked together according to a specific network architecture.
- The objective of the neural network is to transform the inputs into meaningful outputs.
- The ANNs have a high degree of self-organizing ability. In its crude imitation of the biological neural network, it enables low level programming to solve complex problems- especially those which are non-linear, non-analytical, non-stationary and stochastic.
- The types of neural networks are classified based on learning systems which include a) Supervised, b) Unsupervised and c) Deep learning. A feedforward neural network is a simple type of artificial neural network with supervised learning where the units do not form a cycle between the connections of the units. It is the first and simplest type of ANN. (Mishra, 2018)

**4. Identifying the Cost Drivers for A Construction Project**

In order to write a neural network program for cost estimation in a project (with reasonable accuracy), the factors which have an impact on the overall cost have been listed.

The cost of building materials can themselves account for 60% of the cost of residential buildings (Olotuah, 2002). However, it is important to understand that there are several factors which may affect the cost of construction. They can range from accountable factors like quantity of materials to unaccountable factors like bribes resulting from corruption. It is necessary to narrow down the factors to streamline the neural network and get a logical output.

The following steps are used to sort through cost drivers and decide the input parameters:

**4.1 Identification of Significant Factors Based on Literature Study**

Table-1 demonstrates the list of factors elicited through literature study. (Stoy, 2007), (Ferry, 1999), (Toh, 2012), (Chan. S, 2005), (Ji S.H, 2019). Based on their frequency of occurrence, they were classified as significant and non-significant factors.

**Table 1:** Identified factors from literature study.

| Sl. No. | Parameters | Significance |
|---|---|---|
| 1 | Historical Database | Non-significant |
| 2 | Accuracy and experience of estimator | Significant |
| 3 | Knowledge of Client | Significant |
| 4 | Weather | Non-significant |
| 5 | Design Team Resources | Non-significant |
| 6 | Type of Estimation Method Used | Significant |
| 7 | Site Investigation/ Geotechnical Data | Significant |
| 8 | Structural Materials used | Significant |
| 9 | Cost of Construction Materials | Significant |
| 10 | Availability of Labour | Significant |
| 11 | Labour Wage Rate | Non-significant |
| 12 | Contractor's / Sub Contractor's Experience | Non-significant |
| 13 | Project Manager's Experience | Non-significant |
| 14 | Size of project | Significant |
| 15 | Location of Project | Significant |
| 16 | Typology of Project | Significant |
| 17 | Regulatory Requirements | Non-significant |
| 18 | Political Influence | Non-significant |
| 19 | Environmental Conditions | Non-significant |

| | | |
|---|---|---|
| 20 | Social and Religious Impact | Non-significant |
| 21 | Construction Site Conditions | Non-significant |
| 22 | Availability of services | Non-significant |
| 23 | Insurance | Non-significant |
| 24 | Number of Stories/ Height | Significant |
| 25 | Gross Floor Area, Plot Area, Built-up Area | Significant |
| 26 | Shape of the Building | Non-significant |
| 27 | Probability of Force Majeure (Earthquake, Flood or Cyclone, Fire) | Significant |
| 28 | Ground Conditions | Significant |
| 29 | Design Complexity | Significant |
| 30 | Market Conditions | Significant |
| 31 | Type of Foundation | Significant |
| 32 | Availability of Labour and Equipment Required | Significant |
| 33 | Labour Productivity | Non-significant |
| 34 | Quality of Work Required | Significant |
| 35 | Specification of Finishes | Significant |
| 36 | Total Duration of Project | Significant |
| 37 | Project Program | Non-significant |
| 38 | Changes in design/ Scope Change | Non-significant |
| 39 | Changes in Material | Non-significant |
| 40 | Change in Schedule | Non-significant |
| 41 | Risk Factor | Significant |
| 42 | Impact of Risk | Significant |
| 43 | Volume of HVAC work | Non-significant |
| 44 | Overheads | Significant |
| 45 | Mark-up and Profit | Non-significant |
| 46 | Amount of Rework | Non-significant |
| 47 | Inflation Rates | Non-significant |
| 48 | Delay in construction | Significant |

**4.2 Finding the Rank of The Cost Drivers Based on Relative Importance Index from Survey**

A survey was carried out amongst construction industry professionals, project managers and architects to identify the critical cost drivers amongst the significant factors which were identified. Table-2 and Table-3 exhibits the weightages and ranking of the previously identified cost drivers consecutively, which are derived by analysing the surveyed data by using RII (Relative importance index) by using Eq. 1.

$$\mathrm{RII} = \frac{\sum W}{A * N} \quad (1)$$

Where, W—weighting given to each statement by the respondents and ranges from 1 to 5; A—Higher response integer (5); and N—total number of respondents.

Ranking is done based on relative importance index.

**Table 2:** Identified factors from literature study.

| Type of building | Location of Building | Sector | Complexity | Ground Conditions | Soil Condition | Plot Area, Plinth Area, Built-up Area | Number of Stories (or Height) | Number of Basements | Principal Structural Members (Masonry, R.C.C or Steel) | Type of Foundation (Isolated, Raft or Pile) | Design Complexity (Modular or Non-Modular Design) | Market Conditions | Seismic Zone | Risk factor (High, Medium, Low) | Construction Conditions (Climate, Site access, storage) | Duration of Work | Specifications (for finishes) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 5 | 3 | 5 | 3 | 5 | 4 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 3 | 5 | 2 |
| 5 | 3 | 3 | 3 | 2 | 2 | 5 | 5 | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 3 | 5 | 5 |
| 4 | 5 | 2 | 4 | 5 | 5 | 4 | 3 | 2 | 4 | 4 | 2 | 3 | 4 | 3 | 3 | 4 | 3 |
| 3 | 3 | 2 | 3 | 3 | 4 | 4 | 4 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| 4 | 4 | 2 | 5 | 5 | 2 | 3 | 4 | 1 | 3 | 4 | 5 | 5 | 2 | 5 | 5 | 5 | 5 |
| 5 | 4 | 3 | 4 | 4 | 4 | 4 | 3 | 2 | 4 | 4 | 2 | 5 | 3 | 2 | 4 | 5 | 5 |
| 5 | 5 | 4 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 5 | 3 | 5 | 3 |
| 1 | 5 | 5 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 4 | 1 | 4 | 1 |
| 5 | 5 | 3 | 3 | 3 | 3 | 3 | 4 | 2 | 4 | 2 | 2 | 5 | 2 | 3 | 2 | 4 | 5 |
| 5 | 3 | 4 | 4 | 5 | 5 | 4 | 3 | 4 | 3 | 5 | 4 | 5 | 4 | 5 | 5 | 5 | 5 |
| 4 | 5 | 2 | 4 | 5 | 5 | 2 | 3 | 2 | 3 | 3 | 3 | 4 | 3 | 3 | 2 | 2 | 2 |
| 2 | 4 | 2 | 5 | 5 | 4 | 3 | 3 | 5 | 4 | 4 | 4 | 3 | 2 | 3 | 2 | 4 | 3 |
| 5 | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 4 | 3 | 5 | 5 |
| 3 | 5 | 4 | 4 | 5 | 4 | 5 | 5 | 4 | 5 | 5 | 4 | 4 | 5 | 4 | 3 | 4 | 3 |
| 4 | 4 | 3 | 4 | 3 | 3 | 5 | 5 | 5 | 4 | 3 | 4 | 4 | 4 | 3 | 3 | 4 | 4 |
| 4 | 3 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 4 | 4 | 3 | 3 | 4 | 4 |
| 1 | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| 3 | 3 | 3 | 4 | 1 | 3 | 5 | 1 | 1 | 4 | 1 | 3 | 4 | 3 | 1 | 4 | 3 | 3 |
| 5 | 4 | 4 | 5 | 5 | 4 | 4 | 2 | 1 | 4 | 4 | 5 | 5 | 2 | 3 | 4 | 5 | 5 |
| 3 | 5 | 1 | 3 | 3 | 4 | 2 | 2 | 5 | 5 | 5 | 3 | 1 | 3 | 3 | 4 | 5 | 5 |
| 5 | 4 | 2 | 3 | 4 | 4 | 5 | 5 | 4 | 5 | 4 | 3 | 3 | 3 | 3 | 4 | 4 | 5 |
| 5 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 5 | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 5 |
| 4 | 5 | 2 | 4 | 3 | 4 | 1 | 4 | 2 | 3 | 3 | 3 | 4 | 3 | 4 | 3 | 4 | 4 |
| 5 | 5 | 5 | 5 | 3 | 2 | 5 | 5 | 5 | 5 | 5 | 2 | 5 | 3 | 3 | 4 | 5 | 5 |
| 5 | 5 | 3 | 5 | 3 | 3 | 5 | 5 | 5 | 4 | 3 | 3 | 4 | 5 | 3 | 5 | 5 | 5 |
| 3 | 2 | 5 | 5 | 4 | 3 | 3 | 5 | 2 | 4 | 2 | 3 | 5 | 4 | 3 | 4 | 3 | 4 |
| 5 | 3 | 2 | 3 | 3 | 2 | 5 | 5 | 4 | 4 | 4 | 2 | 3 | 2 | 2 | 2 | 3 | 4 |
| 5 | 2 | 2 | 4 | 2 | 3 | 5 | 5 | 4 | 4 | 4 | 3 | 2 | 2 | 3 | 2 | 3 | 4 |
| 4 | 3 | 3 | 3 | 3 | 2 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 4 | 5 |
| 0.8066667 | 0.786667 | 0.6066667 | 0.82 | 0.726667 | 0.72 | 0.8 | 0.793333 | 0.68 | 0.78 | 0.7266667 | 0.66 | 0.773333 | 0.633333 | 0.66 | 0.653333333 | 0.82666667 | 0.793333 |

The 48 cost drivers which were initially identified were narrowed down to 18 critical factors based on the weightages assigned to them by the surveyors. This was carried out to create a compact list of parameters as input for the artificial neural network, as a higher number of parameters could lead to inaccuracy of test result.

**Table 2:** Ranking of the significant cost drivers.

| Parameter | RII | Rank |
|---|---|---|
| Sector | 0.606666667 | 18 |
| Seismic Zone | 0.633333333 | 17 |
| Construction Conditions | 0.653333333 | 16 |
| Level of Design Complexity (Modular or Non-Modular Design) | 0.66 | 15 |
| Risk Factor (High, Medium, Low) | 0.66 | 14 |
| Number of Basements | 0.68 | 13 |
| Soil Conditions | 0.72 | 12 |
| Ground Conditions | 0.726666667 | 11 |
| Type of Foundation (Isolated, Raft or Pile) | 0.726666667 | 10 |
| Market Conditions | 0.773333333 | 9 |
| Principal Structural Members (Masonry, R.C.C or Steel) | 0.78 | 8 |
| Location of buildings | 0.786666667 | 7 |
| Specifications (for finishes) | 0.793333333 | 6 |
| Number of Stories (or Height) | 0.793333333 | 5 |
| Plot Area, Plinth Area, Built-up Area | 0.8 | 4 |
| Type of Building | 0.806666667 | 3 |
| Complexity | 0.82 | 2 |
| Duration of Work | 0.826666667 | 1 |

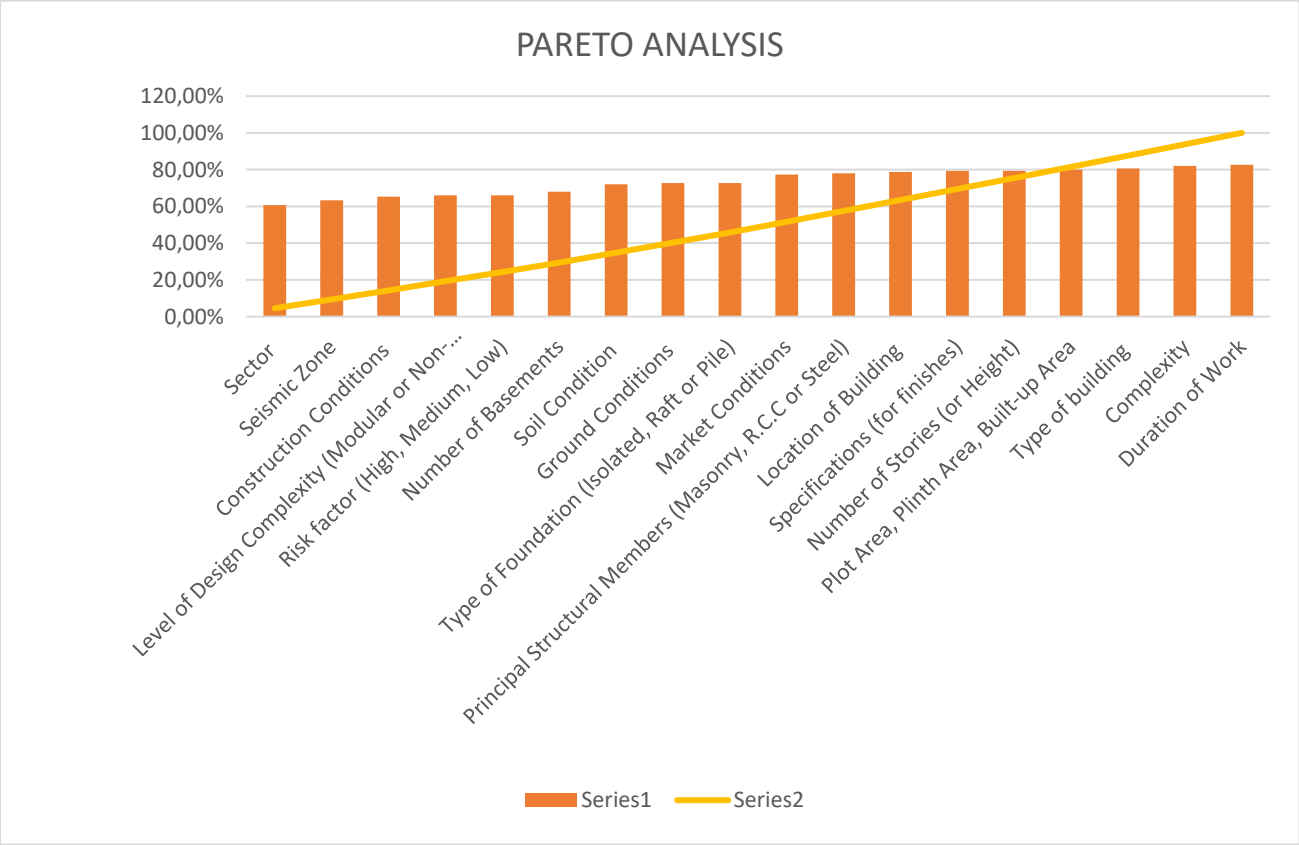


**Figure 1.** Pareto analysis of the significant cost drivers.

Fig. 1 depicts a Pareto analysis deployed to elicit the major issues to focus on to sort the cost estimate effectively. For example, targeting first 5 cost drivers would automatically take care of ~80% of the cost of construction.
From the rank chart based on survey, it is found that the following drivers have maximum impact on the cost of construction:

- Duration of Work
- Complexity of the Building (In terms of plan, elevation, interior spaces etc.)
- Plinth Area and Built-up Area
- Height
- Specifications (in terms of finishes, furniture etc.)

**5. Problem Formulation for Initial Cost Estimation Using Artificial Neural Networks**

A problem was formulated for cost estimation by dividing the critical cost drivers, identified after survey and ranking into numerical and categorical data with description (Refer to Table 4).

**Table 4:** Problem formulation for initial cost estimation of project.

| Project characteristics | Type of information | Unit | Description |
|---|---|---|---|
| Type of building | Categorical | Number | 1-Residential<br>2- Educational<br>3-Institutional<br>4- Assembly<br>5-Mercantile<br>6-Business and Industrial<br>7-Storage<br>8-Healthcare |
| Location | Categorical | Number | 1-Central Business District<br>2-Metropolitan |

| | | | |
|---|---|---|---|
| | | | 3-Regional |
| Seismic Zone | Numerical | | |
| Sector | Categorical | Number | 1-Government<br>2- Public (Statutory and Departmental)<br>3-Private Sector<br>4-Public-Private |
| Complexity (Dependent on constraints of material procurement, technological availability, legal and organizational issues ) | Categorical | Number | 1-Low<br>2-Medium<br>3-High |
| Ground Condition | Categorical | Number | 1-Plane Land<br>2-Gentle Slope<br>3-Steep Slope |
| Soil Condition | Categorical | Number | 1-Soft Soil (Sand and Gravel)<br>2-Silt and Clay<br>3-Rock<br>4-Black Cotton Soil |
| Plot Area | Quantitative | sq.m. | |
| Plinth Area | Quantitative | sq.m. | |
| Built-Up Area | Quantitative | sq.m. | |
| Number of Stories | Quantitative | Number | |
| Number of Basement | Quantitative | Number | |
| Principal Structural Material | Categorical | Number | 1-Masonry<br>2-R.C.C<br>3-Steel |
| Type of foundation | Categorical | Number | 1-Isolated<br>2-Pile Foundation<br>3-Raft Foundation |
| Level of Design Complexity | | | |
| Modular design | Categorical | | |
| Market Conditions | Categorical | Number | 1-Good<br>2-Fair<br>3-Bad |
| Construction Conditions | Categorical | Number | 1-Good<br>2-Fair<br>3-Bad |
| Risk factor based on relevance | Categorical | Number | 1-Low Relevance<br>2-Average Relevance<br>3-High relevance<br>4-Extremely High Relevance |
| Risk factor based on probability of unknown circumstances | Categorical | Number | 1-Low Risk<br>2-Medium Risk<br>3-High Risk |
| Estimated duration of work | Quantitative | Number (in months) | |
| Specification | | | 1-Poor<br>2-Average<br>3-Rich |
| Quality of Work | | | |
| Detailed Cost Estimate of Project** | | | |

*The Risk quantification model estimates the probable consequences in terms of cost, schedule and quality. It is measured by rating the level of relevance with respect to the consequences.

**6. Data Set and Training of Artificial Neural Network**

A dataset was prepared based on the problem formulation sheet as input for the neural network (Figure-5) considering 10 construction projects which includes residential, commercial, institutional, healthcare and retail buildings.

| PARAMETERS | Project A | Project B | Project C | Project D | Project E |
|---|---|---|---|---|---|
| TYPE OF BUILDING | 8 | 8 | 1 | 3 | 6 |
| LOCATION | 1 | 2 | 2 | 2 | 2 |
| SEISMIC ZONE | 4 | 3 | 4 | 4 | 3 |
| PROJECT COMPLEXITY | 3 | 2 | 1 | 2 | 2 |
| GROUND CONDITION | 1 | 1 | 1 | 1 | 1 |
| PLINTH AREA | 9104.85 | 1150 | 1800 | 5040 | 5027 |
| BUILT-UP AREA | 108849 | 3467 | 4900 | 13100 | 10054 |
| NUMBER OF STORIES | 9 | 3 | 3 | 3 | 2 |
| NUMBER OF BASEMENTS | 3 | 0 | 0 | 1 | 0 |
| PRINCIPAL STRUCTURAL MATERIAL | 2 | 2 | 2 | 2 | 3 |
| TYPE OF FOUNDATION | 3 | 2 | 1 | 1 | 1 |
| LEVEL OF DESIGN COMPLEXITY | 3 | 2 | 1 | 2 | 1 |
| MARKET CONDITIONS | 1 | 1 | 1 | 1 | 2 |
| CONSTRUCTION CONDITIONS | 2 | 2 | 2 | 2 | 1 |
| RISK FACTOR | 2 | 2 | 2 | 2 | 2 |
| IMPACT OF RISK FACTOR | 3 | 3 | 1 | 2 | 1 |
| ESTIMATED DURATION OF WORK | 24 | 12 | 8 | 16 | 6 |
| SPECIFICATION | 3 | 3 | 2 | 3 | 2 |
| QUALITY OF WORK | 3 | 3 | 2 | 3 | 3 |
| COST ESTIMATE | 2363006505 | 407032054 | 563540744 | 936459256 | 69616000 |

| PARAMETERS | Project F | Project G | Project H | Project I | Project J |
|---|---|---|---|---|---|
| TYPE OF BUILDING | 1 | | 4 | 1 | 1 |
| LOCATION | 3 | | 1 | 3 | 3 |
| SEISMIC ZONE | 3 | | 2 | 3 | 3 |
| PROJECT COMPLEXITY | 1 | | 2 | 2 | 1 |
| GROUND CONDITION | 1 | | 1 | 1 | 2 |
| PLINTH AREA | 166 | 2668 | 7343.92 | 110 | 2832 |
| BUILT-UP AREA | 720 | 8403 | 56953.46 | 271.55 | 34215 |
| NUMBER OF STORIES | 4 | 3 | 6 | 3 | 11 |
| NUMBER OF BASEMENTS | 0 | | 2 | 0 | 0 |
| PRINCIPAL STRUCTURAL MATERIAL | 2 | | 2 | 2 | 2 |
| TYPE OF FOUNDATION | 1 | | 1 | 1 | 2 |
| LEVEL OF DESIGN COMPLEXITY | 1 | | 2 | 2 | 2 |
| MARKET CONDITIONS | 1 | | 1 | 1 | 2 |
| CONSTRUCTION CONDITIONS | 1 | | 2 | 1 | 2 |
| RISK FACTOR | 1 | | 1 | 1 | 1 |
| IMPACT OF RISK FACTOR | 1 | | 2 | 1 | 1 |
| ESTIMATED DURATION OF WORK | 18 | | 25 | 9 | 28 |
| SPECIFICATION | 1 | | 3 | 2 | 2 |
| QUALITY OF WORK | 2 | | 2 | 2 | 2 |
| COST ESTIMATE | 11495407 | 65402135.87 | 2796053034 | 9960000 | 696913416 |

**Figure 2.** Prepared data-set used as input in the Matlabs software

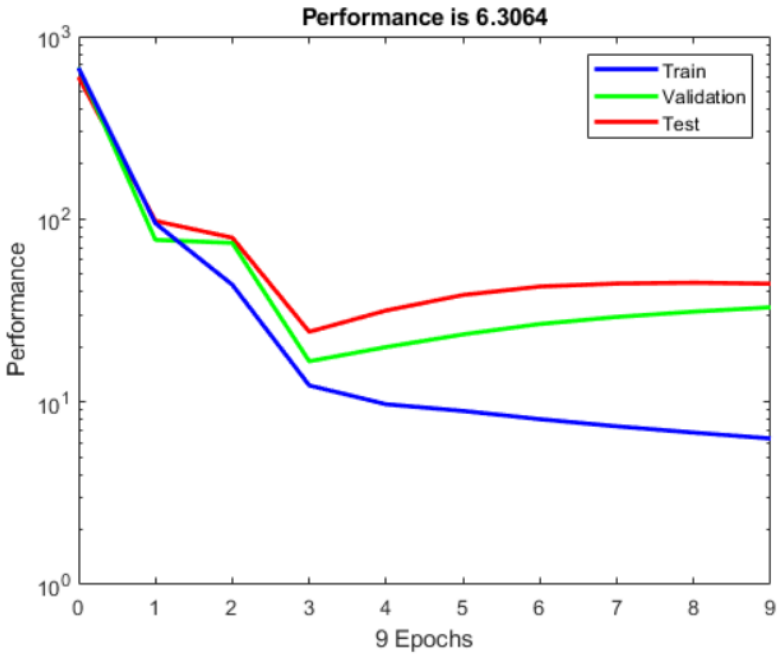


**Figure 3.** Mean Squared Error curve for trained data-set

The trained neural network shows a mean squared error of 6.0364. MSE is one of the best ways to check the performance of the trained neural network. While performing the testing of the network, the network with the least MSE was selected as the trained network.
MSE can be defined mathematically as (highlighted in Eq. 2:

- sum_i 1/n (desired_output(i) - model_output(i))^2

$$MSE = \frac{\sqrt{\sum_{i=1}^{n}(x_i - E(i)^2}}{n} \quad (2)$$

- A well trained neural network should have a very low value of MSE.
- The mean squared error is defined as the average of squares of the 'errors'. It is the difference between the attribute which is to be estimated and the estimator.
- The above figure indicates that the training has shown a positive outcome since the validation and the test curves are nearly similar (as seen in Fig. 3).

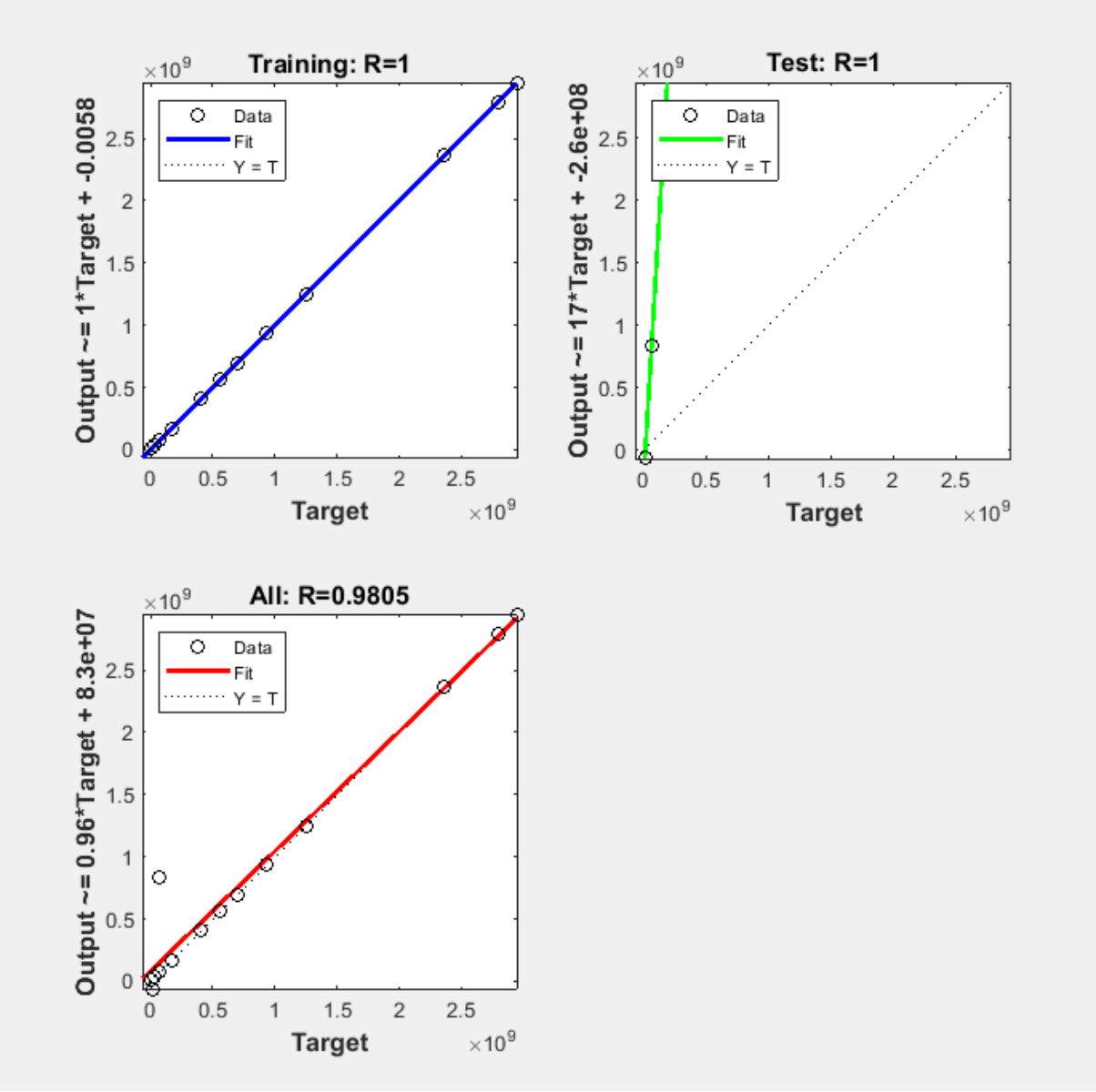


**Figure 4.** Regression Results for Training, Test and Target Data.

The coefficient of correlation or R values indicate whether the training data is a good or bad fit. It measures the direction and strength of the linear relationship between actual and predicted value.
An agreement can be seen between the actual and predicted lines, especially in the training and overall regression line, as indicated by the concentration of predicted values around the 45 ° line (Ongpeng, 2014).
An R value of 1 means a close relationship while 0 means a random relationship. A well trained neural network must have an R value of more than 0.8 (as seen in Fig. 4 the trained neural network shows an R values of 0.9805).

**7. Prediction of Cost by The Trained ANN Model**

Theoretically, testing the artificial neural network shall be same as training it. With the introduction of new data, the network needs to generalize the results from the test data and forecast the results. This evaluates the performance of the network after the training process.
For the purpose of testing the following new project dataset was taken:

| TEST PROJECT<br>PARAMETERS | AIIMS JAMMU-MEDICAL COLLEGE |
|---|---|
| TYPE OF BUILDING | 3 |
| LOCATION | 2 |
| SEISMIC ZONE | 4 |
| PROJECT COMPLEXITY | 1 |
| GROUND CONDITION | 2 |
| PLINTH AREA | 3865 |
| BUILT-UP AREA | 17416 |
| NUMBER OF STORIES | 6 |
| NUMBER OF BASEMENTS | 0 |
| PRINCIPAL STRUCTURAL MATERIAL | 2 |
| TYPE OF FOUNDATION | 2 |
| LEVEL OF DESIGN COMPLEXITY | 2 |
| MARKET CONDITIONS | 2 |
| CONSTRUCTION CONDITIONS | 2 |
| RISK FACTOR | 1 |
| IMPACT OF RISK FACTOR | 2 |
| ESTIMATED DURATION OF WORK | 18 |
| SPECIFICATION | 1 |
| QUALITY OF WORK | 2 |

**Figure 5.** The test project dataset considered in the Matlabs software

For Fig. 5 (which shows the data of the test project for the trained ANN in Matlabs), the following results were obtained):

- Predicted value of Cost using the trained Artificial Neural Network: Rs. 691920130.2
- Actual Estimated Value of the project as per the BOQ: Rs. 614330223
- Percentage Difference in Estimated Value= +12.63%
- Therefore on the basis of the input data set and training of the ANN, the results are 87% accurate.

[Note: Only one project has been used as a test case. This is because the data size is low. Increasing the data size would have improved the accuracy of the result.]

**7.1 Remarks for the Artificial Neural Network model in Matlabs**

A three layer function (Fig. 6) has been used for the designed artificial neural network: It consisted of the input layer, hidden layer and output layer.

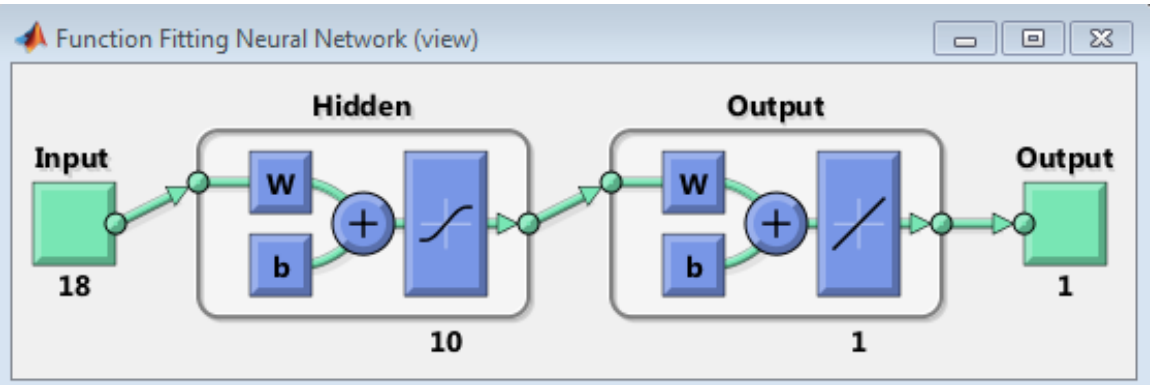


**Figure 6.** Three layer function analysis.

For the same set of data, the network has been trained multiple times till we reach the least MSE (Mean Squares Error) and Maximum R value (Coefficient of Correlation). A feed forward back propagation type of the network has been designed as it is the simple and most commonly used to generate the best model (Kulkarni, 2017). The backpropagation algorithm gradually reduces the error between the model output and the target output by minimizing the mean square error (MSE) over a set of training set (Murat Günaydın, 2004). Each time we initiate a feed-forward network, the network parameters become different, due to assignment of different weights.

The MSE is a good overall measure of the success of the training process. If the network is still not trained properly then we can try increasing the number of hidden neurons. This is because the larger number of hidden neurons give the network more flexibility as there are more parameters to optimize. However, if the hidden layers are too large then the problem itself might become under-characterized.

Two different types of training algorithms were tried for this project: Bayesian and Lavenberg-Marquardt. The final neural network was trained using the Bayesian regularization method. The Bayesian function (trainbr) is used for difficult, small or noisy datasets. The algorithm requires more time to execute than the Lavenberg-Marquardt (trainlm) function but shows better results. For this ANN the Lavenberg-Marquardt function showed the best coefficient of correlation result as 0.8385 whereas the Bayesian function has shown a much better coefficient of correlation result- 0.9805 indicating a better fit.

The ANN showed a better result when the training data set was increased. Providing additional data helps in producing a network that can generalize well to new data and shows more accurate prediction values.

Too much input data is also not good for the training of an artificial neural network as it can result in a common problem known as overfitting. In this case the error in the training set is driven to a small value because of the large data-set provided. But when a new data is added to the network, the error margin increases because the network has memorized the training samples but it has not learnt to generalize to new situations.

**8. Conclusions**

When different typologies of buildings across India were used for training, validation and testing of an Artificial Neural Network (taking a data-set with 15 samples or case studies) the following conclusions were drawn:

- The neural networks can successfully predict the early stage cost of construction for a building project.
- The accuracy of the predicted cost increases with the data size.
- With the increase in the sample size, the results showed a higher coefficient of correlation (R) and a lower Mean Squared Error (MSE).
- The neural network shows different training results and prediction outcomes if any of the parameters of the training data are altered or there is a change in weight from the original training. The training needs to be repeated till the best results are obtained.
- After repeated training iterations for this exercise, the training model with 10 hidden nodes gave the best results.
- For the training of construction cost data set in ANN, the Bayesian function (trainbr) shows better training results as compared to the Lavenberg-Marquardt (trainlm) function but the process takes more time to run (by a couple of seconds). The optimal neural network models involve a good combination of input data set, network architecture and training method.
- Apart from cost estimating in the decision making phase of the project, the ANN can also be used to find the lowest estimated bid of a supplier or the cost of insurance.

**9. Limitations and Future Scope**

The artificial neural network has a wide range of applications in the analogous field of cost estimation. It shows accurate results when the data sets, comprising of a large number of independent variables, have a non-linear structure or functional discontinuities.

Given the accurate results after successful training, the ANN can be considered as an alternative for parametric cost estimating especially during the earlier stages of the project. It is a great tool if we have a reliable historical data set. However the most tedious and expensive task in this process is to gather the right data for training and testing.

Artificial Neural Networks are yet to be used for live projects and a standard benchmark needs to be developed in order to determine the accuracy of the predicted results through ANN. They cannot be used where little or no information is available and they cannot be used for precise and arithmetic calculations (Mishra, 2018).

Apart from the early stage cost estimation of projects, the ANN can also be used to find the lowest estimated bid of a supplier or the cost of insurance. (Egemen, 2007).

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**Conflict of Interests**
The authors declare no conflict of interest.

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# Fire Safety of Tall Buildings: Approach in Design and Prevention

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**Abstract**
Design of tall buildings is a multidisciplinary process and requires a wide range of measures to take to withstand in various emergencies. Fire is one of them and can cause of chaotic situations considering hundreds of users in multistorey. The measures are divided into two categories, active and passive fire protection. Architectural design and detailing are part of the passive systems. Along with the fundamental solutions in fire protection, tall buildings require more specific and often design-specific solutions. Detection and extinguishing systems are part of the active fire protection systems. The failure of the World Trade Centre pointed the vulnerability of steel structures; the fire at the Grenfell Tower pointed the significance of the enveloping materials for facades, and the fire at the One Meridian Tower pointed the significance of the active systems for every floor. The paper focuses on the fire case studies of tall buildings and follows with an assessment of the approaches in architectural design and detailing applicable from the structural design to the finishing interior detailing.
**Keywords:** Tall Buildings; Fire Safety; Fire Protection; Steel Structures; Fire-proof Design.

## 1. Introduction

Fire safety of buildings is a critical issue that either saves lives or cause deaths. In most sources, the statistics uncover the fact that smoke inhalation is the most common cause of death in most fire cases (Bush, 2015). For example, NFPA (National Fire Protection Association) in USA surveyed the fire cases between 2017 and 2019 and found that 2770 deaths were resulted only from 1900 fire cases in residential buildings, which accounted for 77% of all estimated fire fatalities. Furthermore, 37% of victims were found in fire escapes as they attempted to run away from the disaster, and 31% of victims were caught asleep. Bedrooms were, thus, reported by 50% as the place where the people caught in the first place, pointing at the night fires in buildings (National Fire Data Center, 2021). FRSs (Fire and Rescue Systems) across England examined the cases by September 2021 compared with the previous ten years. and published it on 10 February 2022. According to this fresh data, FRSs involved in 537,039 incidents including non-fire events and false fire alarms, of which 145,208 were fires. The fire cases were decreased by 5% compared with that occurred in 2020. In 2021, 243 fire-related casualties were reported, which was 231 in the previous year, 2020. Out of 145,208 fires, 26,950 were residential fires, with 73% were in houses, bungalows, converted flats etc., whereas 27% were in flats in multi storeys. Above 10 storeys, the building is considered high-rise, and 772 cases were reported in such buildings. 6468 fire cases took place in buildings with 9 or less storeys. Residential fires were decreased by 13% compared to that in 2016 and by 26% compared to that in 2011 (Home Office, 2022). According to the data of Modern Building Alliance, in United Kingdom, fire-related casualties were decreased by 56% comparing the numbers from 1982 to 2013. In France, fire-related casualties were decreased by 48% comparing the numbers from 1982 to 2012. Across the Europe countries the decrease was 65% for the past 30 years.
Building fire is often a result of human made mistake, e.g., cooking, smoking, heating etc. Other reasons include electrical problems, e.g., short circuit, old and unmaintained wires, faulty fuses and so on. To say, fire is a preventable hazard. In Table 1, there is a list of memorable fire cases from the past 50 years. Only very few of them are intentional, like Dupont Plaza Tower fire, which was an arson fire, killed 97 people. Not on the list but as a memorable one, World Trade Centre destruction in 2001 was also a terrorist attack, which killed nearly three thousand and left six thousand injured.

**Table 1.** The list of important fire cases in the world from 1970 to date.

| Building | Height (m) | City | Country | Year | Death |
|---|---|---|---|---|---|
| New York Plaza | 192 | New York | USA | 1970 | 2 |
| Taeyongak Hotel | 77 | Seoul | South Korea | 1971 | 163 |
| Andraus Building | 115 | Sao Paulo | Brazil | 1972 | 16 |
| Joelma Building | 83 | Sao Paulo | Brazil | 1974 | 179-189 |
| MGM Grand Hotel | 86 | Las Vegas | USA | 1980 | 84 |
| Dupont Plaza Hotel | | Puerto Rico | USA Territory | 1986 | 97 |
| Hotel International | 85 | Zurich | Switzerland | 1988 | 6 |

| | | | | | |
|---|---|---|---|---|---|
| One Meridian Plaza | 150 | Philadelphia | USA | 1991 | 3 |
| Garley building | 53 | Hong Kong | Hong Kong | 1996 | 41 |
| Ostankino Tower | 540 | Moscow | Russia | 2000 | 3 |
| Cook County Administration Building | | Chicago | USA | 2003 | 6 |
| Lakanal House | 47 | London | UK | 2009 | 6 |
| Torre Ejecutiva Pemex Tower | 214 | Mexico City | Mexico | 2013 | 33 |
| Plasco Building | 42 | Tehran | Iran | 2017 | 21 |
| Grenfell Tower | 80 | London | UK | 2017 | 72 |
| Marco Polo Apartments | 119 | Honolulu | USA | 2017 | 3 |
| Wilton Paes de Almeida Building | 80 | Sao Paulo | Brazil | 2018 | 7-9 |
| FR Tower | | Dhaka | Bangladesh | 2019 | 25 |
| Cheng Chung Cheng Building | | Kaohsiung | Taiwan | 2021 | 46 |
| Twin Parks North West | | New York | USA | 2022 | 17 |

In our modern world today, most people live in multi storey buildings as the cities are densely populated urban areas. Tall buildings shape the cityscapes in many metropolitan areas. This also raises the question of how we can make tall buildings safe in terms of fire safety. Almost every country has their own fire safety codes, and this issue requires specialisation both at architectural and engineering level in the construction industry. Ensuring the fire safety can be provided based on the verification that the fire resistance of the structure is greater than the fire severity. Fire resistance measures the ability of the structure to resist the collapse, and the fire severity measures the destructive impact of the fire as such constantly increasing fire loading cause failure in the building. The relation between them can be seen in Table 2.

**Table 2:** The relation between the fire resistance and fire severity (Buchanan and Abu, 2017).

| **Domain** | **Units** | Fire resistance | **≥** | **Fire severity** |
|---|---|---|---|---|
| Time | Minutes or hours | Time to failure | ≥ | Fire duration as calculated or specified by code |
| Temperature | C | Temperature to cause failure | ≥ | Maximum temperature reached during the fire |
| Strength | kN or kNm | Load capacity at elevated temperature | ≥ | Applied load during the fire |

Modern fire safety measures are divided into two categories: active fire protection systems and passive active fire protection systems (Purkiss, 2007, p:13), as explained below:

Active fire protection systems include:

- Alarm systems,
- Smoke control and detection systems,
- Fire control systems,
- Access of external firefighting,
- Fire management system.

Passive fire protection systems include:

- Appropriate compartmentation,
- Control of flammability of the structure fabric,
- Plan of escape routes,
- Ensuring adequate structural performance.

Ensuring fire safety in design cannot only rely on fulfilling the code requirements but should demonstrate the results of various worst-case scenarios. Each scenario should study the likely spread path and smoke movement, considering the human behavioural features for a safe evacuation. Fire spread begins within the room, room of origin, may spread the adjacent rooms through open doors, windows or even through pipe and wire gaps in the walls. And this follows the spread to other floors eventually. One of the worst cases is the fire jumps to the adjacent building. While the horizontal spread is more likely to happen on a street with full of building with similar height, if a tall building

exists nearby a shorter building, then the fire can easily jump to the façade of the tall building and then spread continues if the fire resistance was not fully provided (Buchanan and Abu, 2017).

**2. Fire Vulnerability of Tall Buildings**

On 14th June 2017 in London, UK, a fire started on the 4th floor of a 23-storey building namely Grenfell Tower, which was a social housing block. The fire began because of a malfunctioned fridge-freezer in a flat located on the east side of the block and the spread continued from the south side. The fire rapidly wrapped the building in less than half an hour (Figure 1) and killed 72 people. The building was constructed between 1972 and 1974 and refurbished in 2016, including the new façade cladding material, windows renewal, and replacement of common heating system. However, the main responsible of the rapid spread was found the cladding material, which was aluminium panel with flammable core, laterally continued all four sides of the building and above and below the windows on each storey. The infill material of the façade was polyethylene polymer, which increased the fire temperature. Post-fire refurbishment was planned to begin in January 2020 (BBC, 2019).




**Figure 1.** Grenfell Tower plan, burnt enveloping façade on the North, West and South (Source: https://www.bbc.com/news/uk-40301289)

Another deadly disaster took place on 9th January 2022, a fire wrapped a 19-storey building in Bronx, New York. 19 people were killed, including 9 children, and 44 were injured, including 13 in serious condition. The fire started because of a space heater malfunctioned on the 3rd floor and the fire door was not in closed situation, the dense smoke was able to flee to upper floors through the stairwell shaft of the building. The building was built in 1972 and had no fire escapes and no sprinklers. The fire doors were reported failed in the inspections in 2013 and 2019 as 'not-self closing' (Anderson et al., 2022). This case was announced as the second most deadly residential fire in the past 40 years (Westhoff, 2022). The building (Figure 2) was a part of affordable housing block that was built for low- and moderate-income families. The building had another fire case in 1986 as the garbage compactor between the 12th and 13th floor sparkled, with no death or injury reports (Fitz-Gibbon, 2022).



**Figure 2.** Twin Park North West blocks, Bronx, New York.

These residential and non-luxury tall buildings encountered such deadly fire cases. Apparently, tall buildings become vulnerable in fire cases, particularly when the fire cannot be taken under control. Fire vulnerability of tall buildings can be examined in two-folds. One is the performance of users' evacuation, e.g., egress strategy, and the other one is the building performance, which also can be examined in two-folds: structural performance and resistance to fire spread (Cowlard et al., 2013). The latter is the concern of architects and engineers and considering the technological advances and material varieties in the sector, fire safety requires expertise in the field.

## 3. Research Aspects and Methods

The paper, accordingly, focuses on the fire safety approaches primarily concerning architects. At the design stage, it is the responsibility of the architect to ensure the safety at some level through design, though material selection and finishing details. Thus, the paper explores the fire cases regarding the cause of fire, the established safety methods for the problem and enriches with the scientific outcomes of the literature review. It is expected to highlight the fire safety measures with cases and refer to the current knowledge for architects.

## 4. Safety Measures in Tall Buildings

Fire safety of tall buildings is more complicated than the safety of low-rise buildings. It often requires the passive protection systems unique in design and full consideration of active protection systems. Although fire codes in many countries outlines the requirements in plan layout and in selection of material, not every architect is familiar with it. The following titles analyses the safety measures to ensure in design, in detail, in structure and the elements of active protection systems. Successful examples along with the failed examples highlight the significance of the safety measures.

### 4.1 Safety Measures in Design

Fire safety in tall buildings can be ensured from the beginning of the design. Compartmentation is the most well-known approach. Compartments can be designed vertically, horizontally and in combination of both. A compartment volume helps to limit the spread of fire and smoke inhalation of users, which can give them space to evacuate the building (Purkiss, 2007). It can be planned as seen in Figure 3. For tall building, generally every floor is designated to be a compartment with fire resistance of one hour. Additionally, if the building has basement floors, used as parking, technical rooms etc., the ground floor can be fully designated as compartmented from the basement, so the upper floors would not be affected by the fire. In hotel floors, for example, it is necessary to design the doorways as fire resistant at least 90-120 minutes to ensure the fire safety. In Scotland, Fire Act guidance specifies that in care homes, where the residents depend on the assistance to flee, the floor area should be divided into two compartments with a self-closing fire door. Accurately, if the floor area exceeds 1500 sqm, the area to be sub-divided in two parts, each part not exceeding 1500 sqm. All the floor material, door and wall covering will be at least one hour resistant.

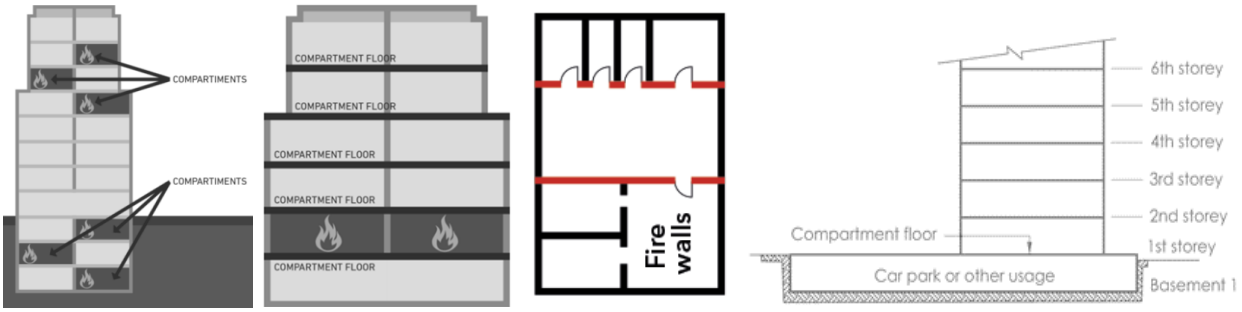


**Figure 3.** Design of compartmentation in various conditions.

Atrium is also highly preferred in architectural design, but it comes with a cost of increasing the risk of fire vulnerability. Atrium void causes a stack effect and draws the fire smoke and temperature move upwards rapidly. Hence, the top of the atrium fills with dense smoke and high temperature, while it also helps the invasion of the upper floors. Accordingly, in design, the spaces directed to the atrium must be separated with fire resistant wall, can be fire-proof glass or solid wall material. This way, if there are exhaust fans installed on the roof, then the smoke and temperature find a way to escape without causing any severe damage (Figure 4).

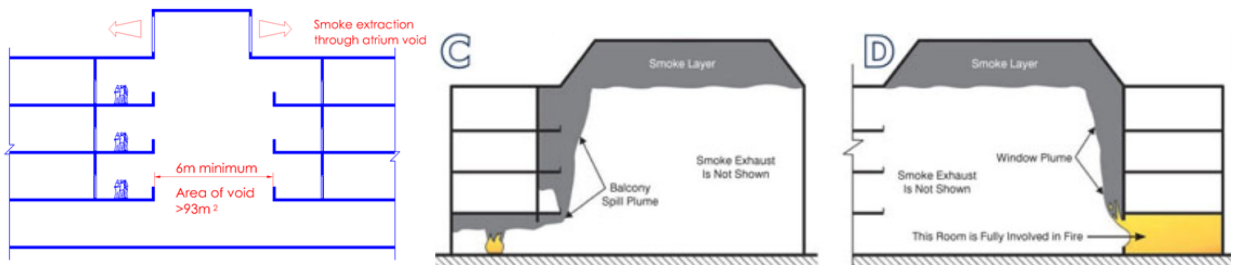


**Figure 4.** Design of atrium space according to the movement of the smoke and fire (Klote, 2012).

Additionally, for tall buildings refuge area is a requirement. This idea was firstly introduced in Asian towers, almost 40 years ago. The idea of refuge area came from the fact that not every user in a tall building necessarily evacuates the building but should wait in safe until the emergency is taken under control. Secondly, a refuge area is similar to compartmentation as it must be fire resistant and contains inflammable material and has its separate ventilation system. In Jin Mao Tower, completed in 1999, there are refuge floors designated on the 15th and 30th floors for office users (Weismantle and Antell, 2019). With a height of 828 meters, Burj Khalifa is the tallest structure in the world. It also has refuge areas on 42nd, 75th, 111th and 138th floors, counting it has 160 floors. The refuge areas are located as seen in Figure 5. The construction of this area is at least two hours fire resistant (Prasad, 2016). Besides, in Burj Khalifa there are three separate emergency elevators designated for the use of firefighters only. Two of them reach at the 111th floors, and the third reaches at 160th floor (Kinateder et al., 2014). In Shanghai World Financial Centre, with a height of 492 meters, total evacuation time was decreased by 40% with also using double-deck emergency elevators. Soltanzadeh et al. (2018) studied the significance of refuge area in combination with other emergency evacuation routes, e.g., fire escapes and emergency elevators. They analysed on a 40-storeys building scenario and found that to design a refuge area on 20th or 21st floor working together with 6 evacuation elevators and 3 staircases was the most optimal evacuation design, rather than increasing the number of the refuge areas, which resulted surprisingly slower evacuation time.

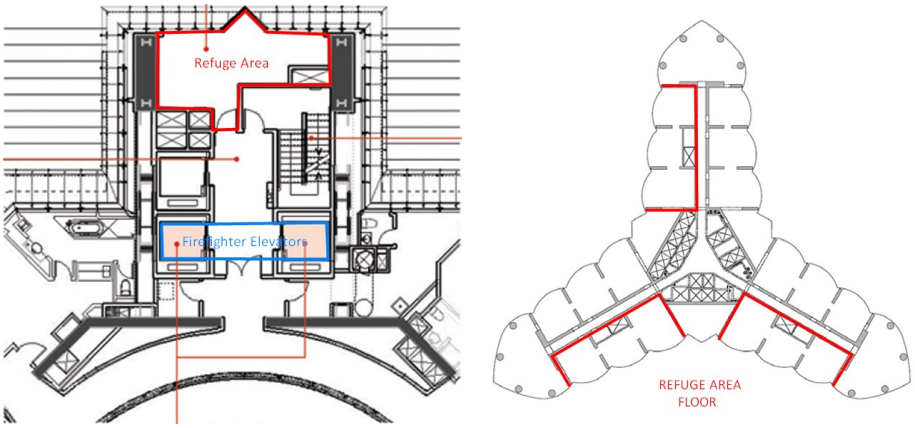


**Figure 5.** Refuge areas in Jin Mao Tower (on the left) and Burj Khalifa (on the right).

Chow and Chow (2010) found that in an 800-meter-tall building air movement through leakages in upper floors can be 1,2 times faster than a room at ground level, which creates stack effect. Abu-Zidan et al. (2022) simulated the effect of wind speed and direction on an external fire for a tall building. They tested a similar material to what was used in Grenfell Tower, aluminium composite panel with thickness of 3mm and insulation layer from PIR (polyisocyanurate). They concluded that the building geometry and the wind flow patterns shall bear in mind in modelling for possible façade fires. Wind speed and its direction have significant effect on the fire spread. Although, in their study, the case of no wind scenario had the most rapid vertical spread over the façade, whereas the horizontal spread was the smallest, which shows the vulnerability of such material use. They found side and diagonal wind most hazardous in spread for a rectangular shaped building.

**4.2 Safety Measures in Detail**

Architectural details in design of tall buildings plays a significant role in the fire safety of the building. The case of Grenfell Tower in 2017 became a disaster largely because of wrong material selection and detailing on the façade cladding. The panels were preferred aluminium instead of zinc panels, which had more resistant insulation core in honeycomb shape, only because of economic benefits. Additionally, the cladding system preferred was installed with a detail to hide fixings. The system was tested in 2005 for the first time and failed. The tests were reapplied in 2011, 2014 and 2015, and eventually failed every time and classified E. The lowest fire resistance of European classification is F. However, the same façade material and system had another installation with a detail without hiding fixings and passed the tests rather successfully with classification C (Figure 6). The fire code applied in UK requires to use materials in quality of European Class B for buildings taller than 18 meters, and in quality of European Class C for shorter buildings (Symonds, 2021). Besides, the material chosen to fill around the new windows was combustible, whereas the code strictly specified the use of rockwool material as it is non-combustible.



**Figure 6.** Grenfell Tower façade cladding system with hidden fixings (Symonds, 2021), the burnt cladding and the triangular shaped niches on the facades that pulled the smoke and heat almost like a chimney to the upper floors.

The fire case in TVCC (Television Cultural Center) on 9th February 2009 was similar to that in Grenfell tower in terms of the exterior cladding material (Figure 7). The tower had 32 storeys and a height of 159 meters. A high atrium existed between floors numbered 5th and 26th, in use as hotel and restaurant. The tower had a rectangular shape in plan and two facades with metal cladding and strips, two other facades with only glass covering. As the fire started because of fireworks flames landed on the roof, it melted the metal panels, which was titanium-zinc alloy, and walked through the insulation layer inside the panels, which was Extruded Polystyrene (XPS) foam. Mainly because of such façade material, the fire was able to cover all the building in nearly 20 minutes. The building was not completed by then, so through the window openings, the smoke and heat moved inside the building. The atrium made a stack effect, making it easier to move upwards and downwards inside. One firefighter died and seven workers injured in this case (Peng et al., 2013).



**Figure 7.** TVCC Tower after and before fire (Terri Meyer Boake via CTBUH)

Colic and Pecur (2020) examined the metal facades with combustible and non-combustible insulation layer and the effect of vertical and horizontal fire barriers. They concluded that the number of fire barriers were the actual fire retarders in cladding. with the combustible cladding material, they reached easily above the 900C temperature. The façade with combustible insulation was successful under fire loading only in the sample that had four horizontal barriers, which resulted in temperatures similar to the cladding with non-combustible insulation. However, the cladding sample with non-combustible insulation layer and with two horizontal fire barriers resulted nearly one this of the temperature of the cladding with combustible insulation and with four horizontal fire barriers. This proves how significant to prefer non-combustible materials in building. Pershakov et al. (2016) also highlighted the absence of horizontal barriers in the façade of a tall building could lead the fire spread to the entire façade in 15-20 minutes through window openings, balconies etc.

Another earlier fire disaster in UK caused a serious change in the fire code. Shirley Towers in Southampton was on fire on 6th April 2010. Two firefighters died in the case, as the reports stated they had entangled in the cables fell

from the ceiling that were supported by plastic cable trunks, which deformed and melted under the high temperature and eventually fell on the stairs and corridors that hampered the progress in the fighting. The case was in 2010, but the investigation over the death of the firefighters was completed in 2013. Thus, the related part of the code was updated by stating clearly that electrical installations of the buildings to be fixed in metal trunks instead of plastic (Hampshire Fire and Rescue Service, 2013).

Exterior façade is often the way the fire finds channel to spread. Windows are critical in this regard. An indoor fire can quickly reach up to 600 to 1000C and this can cause the windows to crack and burst. This way, fire spreads directly to the upper floors. Façade windows are often selected by architects based on the energy saving concerns, but also fire -proof of glass for windows must be bear in mind. Fire-proof glass can be categorised into three. The first one is tempered glass, or fire-rated glass. This can be high borosilicate fire-resistant glass, which can resist to temperatures from 520C to 850C. Either, it can be monolithic potassium cesium fire-resistant glass, which can resist fire up to one hour. The other category is laminated glass. PVB laminated glass (Polyvinyl butyral) and SGP interlayer glass (Sentryglas Plus) are two products in use. Both are fire-resistant type of glass, but SGP performs better, which comes with a cost. For façade enveloping such fire-proof glass material must be chosen. Zhou (2014) pointed at two fire cases in China. In Shenyang, a hotel building with two blocks, Tower A and B. Fireworks flames started a fire on the Tower B, which had ordinary glass and windows. But the fire spread to the façade of Tower A, which was built with fire-proof monolithic caesium and potassium glass. Eventually, the façade did not get as damaged seriously as Tower B, which had severe exterior and interior damage.

**4.3 Safety Measures in Structure**

Fire safety measures are crucial for the structural elements of the building. The interior and exterior finishing materials are significant in the prevention of fire spread. However, if the fire spreads rapidly and the temperature increases to the level that can damage the columns and beams of a frame structure, then the whole building can collapse, which is the worst-case scenario for the users and firefighters. The structural safety is crucial to ensure the users to flee the building on time and to enable the building to continue its function after plausible post-fire renovation and refurbishment. There are deadly fire cases that ended up with total structural collapse. Plasco Building in Tehran, Iran, is one of them. On 19th January 2017, a fire began on the 10$^{th}$ floor of the 17-storey steel frame building, which was the first tall steel building of the city, constructed as a landmark in 1960s (Weinberg, 2018, Aziz Amen & Nia, 2017). When the building was constructed, there was no fire code to fulfil. Thus, the building was lack of fire escapes, sprinklers, and additional coating for steel structural elements. Rectangular columns of the building were only protected with gypsum boards and light concrete. Suspended ceiling was applied obviously without fire leak details. There was only some type of water hosing system on each floor but malfunctioned in the case when firefighters wanted to activate. As the fire load increased over time, the structure weakened, and the partial collapse began. The first collapse took place on the 10$^{th}$ and 11$^{th}$ floors as the fire started here. Following this, 12$^{th}$ and 13$^{th}$ floors also collapsed. This affected the structural stability of the building as the fire load kept increasing. Therefore, nearly 3,5 hours of fire was enough the building's steel to lose its resistance and eventually 16 firefighters and 6 users lost their lives due to the total collapse of the building as seen in Figure 8 (Ahmadi, et al. 2019).



**Figure 8.** Plasco Tower structural steel plan, the damaged rectangular columns, and the view after the total collapse (Ahmadi, et al. 2019; Macguire, 2017).

Steel and concrete structural combination advances the construction technology for tall and supertall buildings. However, steel is known with its low capacity of resistance under fire loading. The collapse of Plasco Tower represents an example to the fact. Therefore, fire load is another dynamic stress on tall structures and can cause to total collapse. A fire loading simulation was studied for Shanghai Tower by Jiang et al. (2015) and they found that the structure of the building has a three hours of fire resistance before progressive collapse. The concrete beam and core had a deformation ranged from 15 to 25 mm under six hours of loading. However, steel belt truss had a

deformation of 90 mm under five hours of fire loading. As seen, steel structures need particular attention in the fire protection. The methods are generally applicable in the design and detailing stage, such as wrapping the steel columns with fire-proof boards materials and encasement in poured concrete. Board materials can be made from calcium silicate or gypsum plaster. Spraying fire-proof material is deemed the easiest way. The fire-proof material can be glass or cellulosic fibrous usually mixed with cement. However, not usually preferred by architects since it displays non-decorative finishing (Buchanan and Abu, 2017). Detailing of board wrapping can be seen in Figure9.

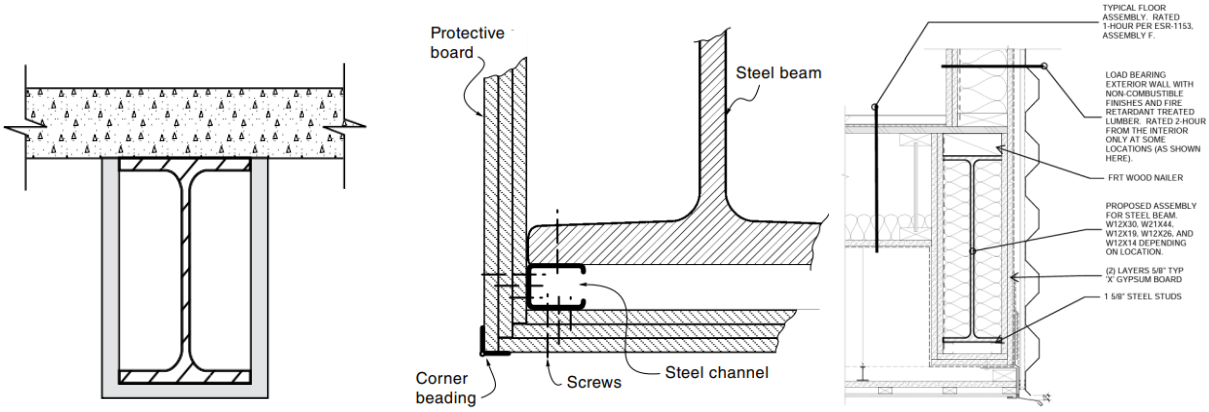


**Figure 9.** Board wrapping for fire protection of steel H columns with at least two layers of gypsum boards (Buchanan and Abu, 2017; Code Unlimited LLC, 2015).

**4.4 Safety Elements for Active Protection**

On 23rd February 1991, a fire took place in One Meridian Plaza Tower in Philadelphia, USA. The building had 38 storeys and the fire started on the 22nd floor and lasted 19 hours. The fire fully destroyed eight floors. It took more than 300 firefighters' effort and three firefighters lost their lives during the intervention. The building was completed in 1972, when there were no specific requirements for tall buildings. A requirement of installation of automatic sprinkler system was enforced with the adoption of new code in 1984, in which a specification was made for the tall new buildings, leaving the existing tall buildings out of the code. Despite the fact, the builders decided to retrofit the building with sprinkler systems on some floors; four floors were fully, and three floors were partially installed in the entire building. On the disaster day, the fire reached at the 30th floor and the floor was one of the fully installed with automatic sprinklers, which extensively helped the fight to end the fire. The case was a big lesson for the city and was a proof how the active systems were significant for the fire safety, not only for the residents but also for the fighters. A new code was enforced by the end of the year, in December 1991, which clearly stated to retrofit the existing non-residential buildings taller than 75 feet (22.86 meters) by the end of 1997 (Ellis, 2021; Hensler, 2022). The Grenfell Tower was completed in 1974, when no strict fire code enforced to the construction companies. The building had no sprinkler to extinguish and no centralised smoke alarming.

The active extinguishing systems are crucial for a successful firefighting. Similar to sprinkler system, water-mist system also preferable for special buildings as well as tall buildings. Water-mist system uses 90% less water than conventional sprinkler system and prevents the temperature rise and decreases the risk of flammability of the materials around the fire source. In Elbphilharmonie Concert Building, water-mist system was preferred (Figure 10). The whole building has 108 meters of height, and the main concert hall has a ceiling height of 25 meters. While the rest of the building was actively protected by sprinkler systems, the main concert area was installed with high pressure water-mist systems as a deliberate choice regarding the architectural details inside. The simulations of the area pointed the possible fire load on the floor and the seating area around the stage. Accordingly, in contrast to the conventional sprinkler system, high pressure water-mist system was installed under the floor (Kopp, 2021).

Water-mist system gained popularity over the years, although it has been the technology in use for the past two decades, and today some fire codes and regulations cover the guidance. For example, Welsh Government published a guidance in August 2021 for "Automatic water mist systems for domestic and residential premises", which refers to new buildings and conversion for existing buildings.

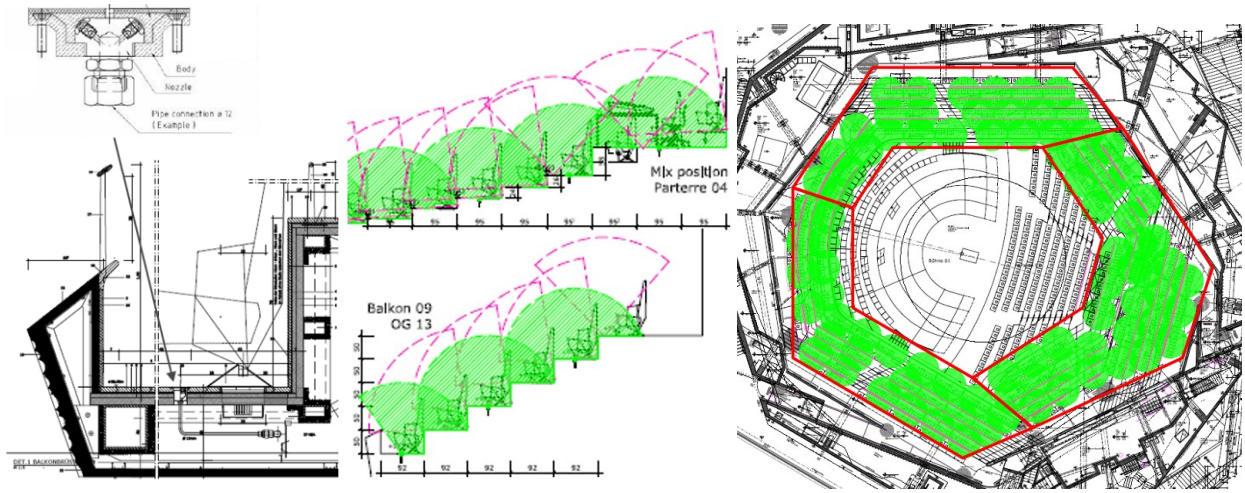


**Figure 10.** Elbphilharmonie Concert Building, the water-mist system installed on the floor and technical detailing (Kopp, 2021).

As a part of active fire protection systems, fire curtains or smoke curtains are applicable in many projects including large span and tall buildings. Fire/smoke curtains are part of fire management systems. In hotel buildings, they are widely applied to the lobbies, indoor pools, and atriums as well. Atriums or smaller voids in floor are preferable for natural lighting and ventilating. But, as explained earlier, these areas can contribute the fire to spread. To prevent the spread and to make it easier for firefighters to intervene, fire curtains can cover such areas as seen in Figure 11. It helps to block the smoke and temperature in a volume. The system can be established vertically, e.g., for stairwells and mezzanine spaces. Horizontal systems can be installed for shopping mall atriums and galleries, and small lighting atriums in libraries and office buildings. To give another example, the curtain system is effective for multipurpose halls as well. It can be installed vertically above the stage to separate the seating area and the stage, including screen and lighting electrical equipment. So, if the fire begins from the stage area, it will remain blocked as the curtains shut the area.



**Figure 11.** Fire curtains horizontally applies, and vertically applied.

**5. Discussion**

Modern tall buildings are more likely to have fire protection systems that makes them safe on one hand. On the other hand, there are more occupants and there is often a longer route to exit the building. The evacuation route of a 30-storey building and 150-strorey building cannot be the same. So, they must have different fire safety measures to adopt in the plan and the section. The measures start at the design stage as the passive fire protection systems and the architectural process is completed with the active fire protection systems in mechanical terms. The examples of fire cases proved that particularly existing old tall buildings pose a great danger in fire as they mostly were built with a lack of fire protection systems, i.e., with single common-use stairwell, no evacuation elevator and so on. Moreover, today we use more synthetic and polyester-based materials in the construction sector that increases the risk of fire. Preferring the appropriate material is the key to fire safety, particularly for the exterior fire spread. When doing the selection of the façade cladding material, an architect must check the fire performance classification of the material and make sure to fulfil with the fire code requirement. If the design includes steel structural elements, then necessary safety measures must be taken to ensure the structural safety of the building.

Active fire protection systems are complementary part of the fire safety and plays a significant role in the firefighting as the real cases proved. It must be consulted with an expert to discuss the most suitable system based on the function of the building.

**6. Conclusions**

The paper aimed to explore the fire cases and their causes through the discussion of the fire protection systems for tall buildings. This type of structures requires particular attention in design, in material selection and the utilization of active systems. The fire case studies explored included Grenfell Tower, Twin Park North West, Plasco Tower, One Meridian Plaza, Shirley Tower and TVCC. Fire safety measures are outlined as safety measures in design, in detailing, in structure and active protection. It is hoped that the paper successfully shed light on the issue of fire safety of tall building from the architectural perspective.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Energy Efficiency Benchmarking: Review of Key Policies, Agencies, Program Developments in North Africa, Case of Algeria

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**Abstract**
The energy efficiency benchmarking is an approved solution to achieve sustainability. Although the universal common challenges, North African countries still generate policies and frameworks governing energy efficiency in the building sector. This paper examines the key players in the energy efficiency benchmarking by diagnosing the existing energy agencies and institutions which contribute to that. The samples are from Algeria. The key programs in energy development are discussed with gaps in the timeline of the programs compared to the Malaysian key players in energy development. This work indicates the lack of continuity in such fields in R&D agencies, explains the gap in the regularities and the existence of protocols, and the absence of testing authorities for evaluation tasks, which guarantees compliance. This type of research will unveil another portal in building's energy efficiency benchmarking field in Algeria and transpose it to all North African countries.
**Keywords**: Energy development; Energy efficiency; Energy policy; Energy agency; Building sector; Benchmarking.

## 1. Introduction

Since the very beginning of the construction industry, the environmental indicators began to take lower ranges to flow in. The proportion of threats recorded in each category for populations in Africa and the Asia Pacific in the WWE- Living Planet Report 2020, considered the threats percentage of changes in land use, as the higher recorded threat (Fig.1). Moreover, the same report presented the statistics of the ecological Footprint of humanity per land use, which considered the activity of housing in second place after the food activity with a percentage of 25%, faced to a 60% of global activities responsible for carbon footprint (Fig.2)(WWF, 2020)

The countries of Africa and Asia tend to be countries undergoing rapid urbanization and industrialization, and due to the series of crises and circumstances, unfortunately, the fast growth of the construction field ignores in most cases the environmental dimension, which effected the environmental indicators. The global built environment energy consumption attended 36% between the Construction industry and buildings sector, where the residential type has the highest final energy consumption of 22% face to 8% for non-residential building type..(Fahmy et al., 2019; IEA, 2019, Amen,2021)

The energy efficiency benchmarking is provided as an approved solution to achieve sustainability, by the collaboration of researchers and engineers' developers in the R&D governmental and private agencies in developed countries. Although the universal common challenges(IRENA, 2020), North African countries are still on the way to generating their energy policies and frameworks governing energy efficiency(IEA, 2019; Kangas & Kivimaa, 2017), to implement sustainability in the building sector, and overthrow part of those challenges(Bencheikh & Bederina, 2020; Kaoula & Bouchair, 2019)

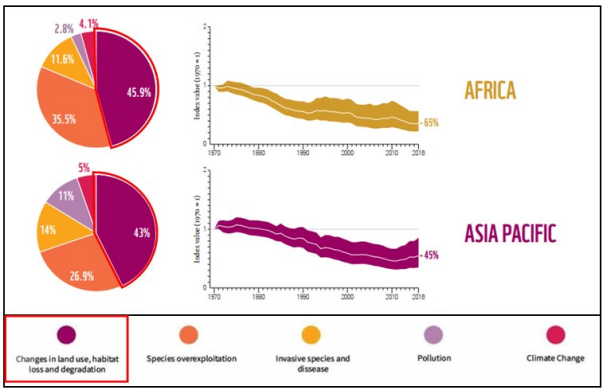



**Figure 1:** The proportion of threats recorded in each category for populations in each IPBES region: Africa, Asia Pacific

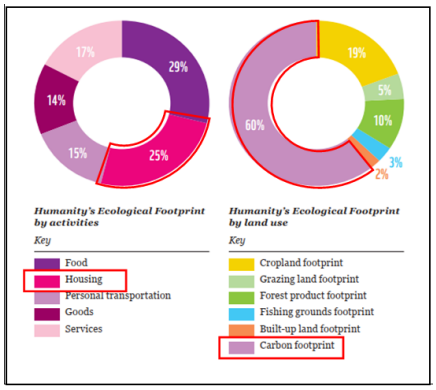



**Figure 2:** Humanity's Ecological Footprint by land use and by activities

Data Sources: WWF (2020) Living Planet Report 2020 - Bending the curve of biodiversity loss. Almond, R.E.A., Grooten M. and Petersen, T. (Eds). WWF, Gland, Switzerland.

Algeria is the chosen sample for an investigation about the authority role in implementing sustainability in the building sector in public community, and its tools also cores that are related to achieve such international goals whether in research or in the R&D sector, in comparison to the Malaysian institutional system.
At the time of independence of Algeria, the break with the market economy, inherited from the colonial period, in favour of an egalitarian economic policy of a socialist type was the only acceptable option for the leaders of the National Liberation Front [6]. After the financial crises, the unpredictable economic after-shocks come quickly to clarify the situation of the national economy in front of foreign strategies. The energy market was the most remarkable draining sector in Algeria, while the creation of any agency or high impacted institution of sustainability in the private sector is quiet absent comparing to the international field. [7][8]
There was therefore the raison to instigate a strategy of nationalization of the use of energy. Which has pushed the ministerial authorities concerned to develop a regulation and a preliminary framework to control the energy efficiency in buildings.
That's why this research is held to diagnosis the agencies and institutions of energy efficiency and energy benchmarking in Algeria, clarify their missions and charges to the energy sector. The aim of this paper is to pinpoint the authority institutions and agencies that are held to implement the energy efficiency in the national building's field and find the gaps that contribute to the delay of Algerian building's efficiency to the international way to sustainability.

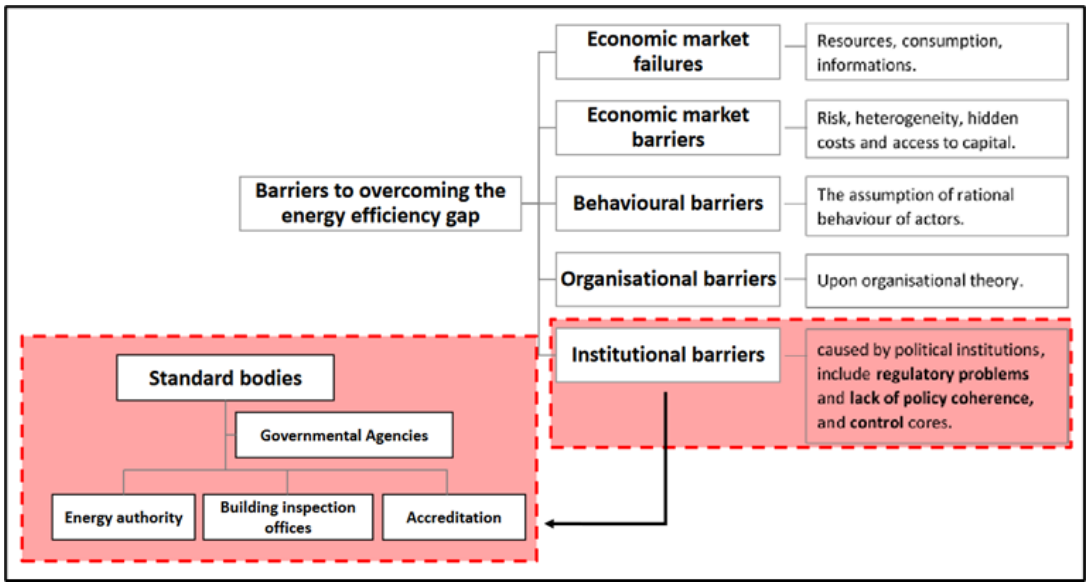



**Figure 3.** Gaps map demonstration & Barriers to overcoming the energy efficiency gap

The first aim of this study is to diagnose the agencies and institutions of energy efficiency and energy benchmarking in Algeria, then clarify their missions and charges to the energy sector, and at last, define the gaps that contribute to the delay of Algerian building's efficiency. (Figure 4)

**2. Material and Methods**

In this paper we have chosen to give a brief review on the agencies and programs that held the responsibility of creating and organizing the regulatory part of energy efficiency in Algeria which is quit slow development sector according to the coming diagnosis and comparison. We analyse energy efficiency barriers to overcoming the energy efficiency gap in building sector. The pinpoint of the authority institutions and agencies that are held to implement the energy efficiency in the national building's field and find the gaps that contribute to the delay of Algerian building's efficiency to the international railway to sustainability.

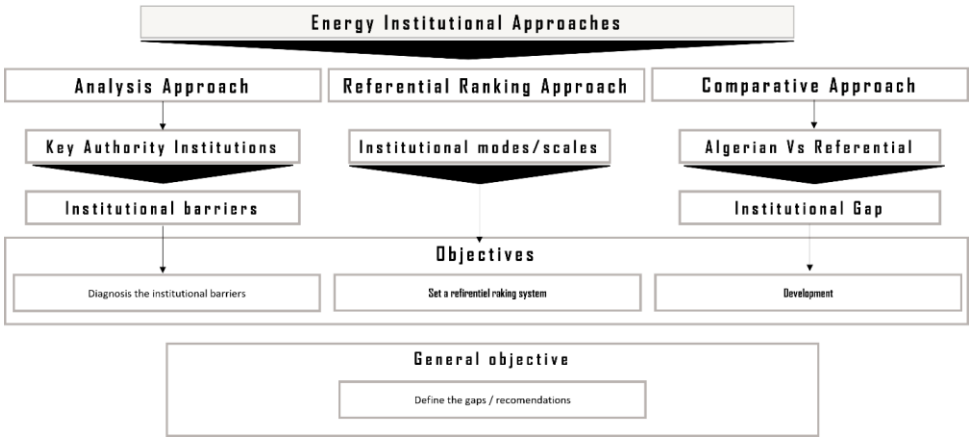



**Figure 4.** Structure of the Study (Developed by Author)

### 3. Study case

The chosen sample is from Africa, Algeria as a developing country, we held an analysis approach to another country with similar historical background (politically-colonisation-, economically and same religion), from Asia, which is Malaysia, that reveals the challenges and jumped from a developing to a developed country, according to the world bank report.

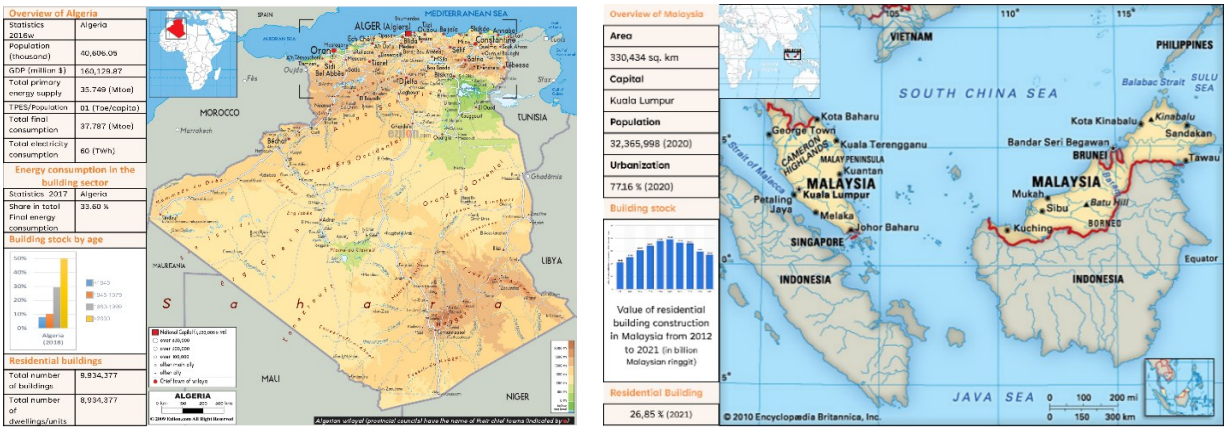
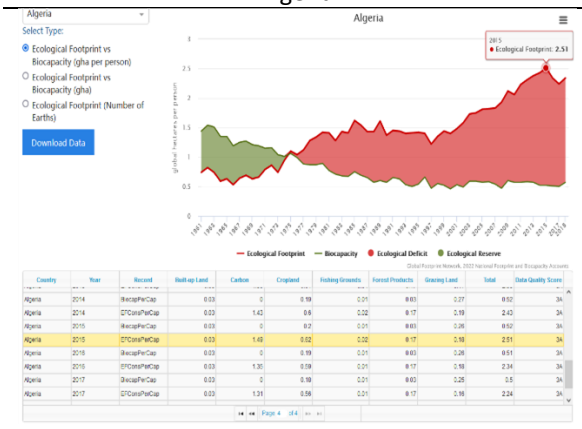
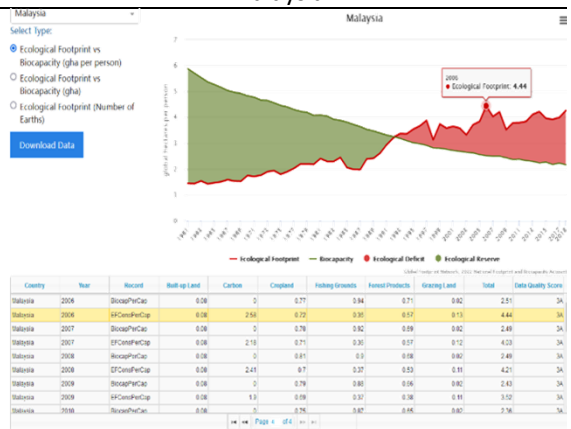



**Figure 5.** Case study presentation ALGERIA and referential cas (Malaysia)

**Table 1.** Ecological footprint vs Biocapacity (gha per person) for Algeria & Malaysia.

| **Ecological footprint vs Biocapacity (gha per person) for Algeria & Malaysia** | |
|---|---|
| Algeria | Malaysia |
|  |  |
| **Figure 6.** Ecological footprint VS Biocapacity for Algeria | **Figure 7.** Ecological footprint VS Biocapacity for Malaysia |

Data Sources: National Footprint and Biocapacity Accounts 2022 edition (Data Year 2018); GDP, World Development Indicators, The World Bank 2020; Population, U.N. Food and Agriculture Organization.

**4. Analysis approach**

**a. Institutional modes and scales: an analytical framework**

Due to the economic/political nature of the Algerian government and the lake of the private resources beside the national petroleum fortune, the creation of any agency or high impacted institution of sustainability in the private sector is quiet absent comparing to the international field. Since more than a decade, the financial crisis touched Algeria, there was therefore the raison to instigate a strategy of nationalization of the energy use. Which has pushed the ministerial authorities concerned to develop a regulation aims at ensuring a satisfactory level of comfort, while reducing energy needs: heating, air conditioning.

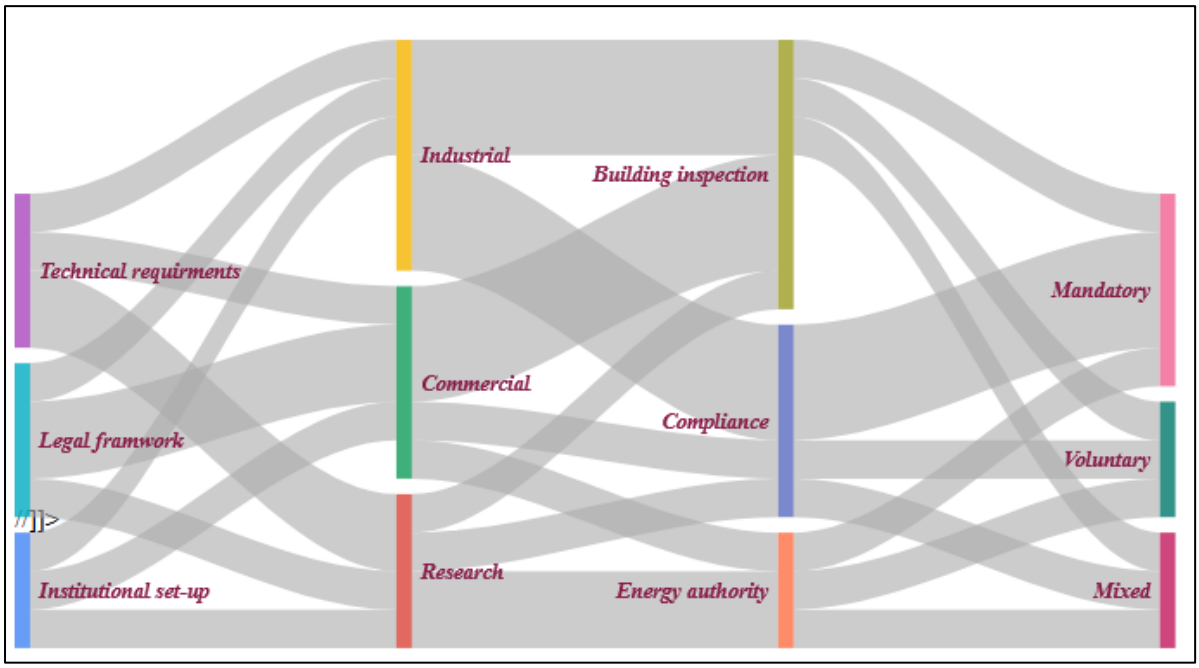



**Figure 8:** Sankey Diagram, analytical framework of institutions. Source: Author, 2022

**a. Algerian approach of setting-up authority institution and agencies to implement energy efficiency in the national field (Diagnosis and missions)**

Diagnosis of Authority institutions and agencies the setting-up of the first official institutions in charge of research development and monitoring: The Center for the Development of Renewable Energies (CDER) in 1988 and the National Agency for the Promotion and Rationalization of Energy Use (APRUE) in 1985, to the latest institution: The Commission for Renewable Energies and Energy Efficiency (CEREFE) in 2019.

- CDER : The Center for the Development of Renewable Energies (CDER) is a Research Centre, resulting from the restructuring of the High Commission for Research, created on 22 March 1988. It is a Public Establishment of Scientific and Technological Character (EPST) in charge of elaborating and implementing research and development programs, scientific and technological, of energy systems exploiting solar, wind, geothermal and biomass energy.
- CEREFE : is a public institution with legal status and financial autonomy. It is created under the Prime Minister by Executive Decree No. 19-280 of 21 Safar 1441 corresponding to October 20, 2019. As a cross-sectoral coordinating body, CEREFE's mission is to assist in the design, implementation and evaluation of the national strategy for the development of renewable energy and energy efficiency. It is also a center of expertise and an interface between policy, industry and research in the field of renewable energy and energy efficiency. CEREFE has a board of directors composed of representatives of 15 ministerial departments and 4 public institutions, in addition to an advisory board composed of recognized national expertise in the field, economic operators and representatives of civil society.[9]
- APRUE : The national agency for the promotion and rationalization of energy use is a public institution with an industrial and commercial character created by presidential decree in 1985, supervised by the Ministry of Energy and Mines. Its main mission is the implementation of the national policy of energy mastery through the promotion of energy efficiency.[10]

The Sectoral Committee for Energy Management (CIME). The National Fund for Energy Management and for Renewable Energies and Cogeneration (FNMEERC): which is the specific public instrument to encourage the policy of energy management and renewable energies. In two lines: Renewable energies and cogeneration, and the second is Energy management.

The National Energy Management Program (PNME): It provides the framework for the implementation of energy management at the national level, beside The Energy Efficiency Action Plan (PAMEE).

**Table 1.** Details about energy agencies of Algeria

| N° | Agency | | Setting-up | Unit |
|---|---|---|---|---|
| **01** | **APRUE** | | 1985 | The National Agency for the Promotion and Rationalization of Energy Use |
| **02** | **CDER** | CDER | 1988 Bouzareah | The Center for the Development of Renewable Energies |
| | | UDES | 1988 Tipaza | Solar Equipment Development Unit |
| | | URAER | 2002 Ghardaia | Unit of Applied Research in Renewable Energies |
| | | URERMS | 2004 Adrar | Research Unit for Renewable Energies in the Saharan Environment |
| **03** | **CEREFE** | | 2019 | The Commission for Renewable Energies and Energy Efficiency |

Thus, a first regulatory has been developed at CNERIB for the problem related to the thermal building in winter, and which proposes a simplified method of calculating losses. This method takes into account the losses by transmission and air renewal, as well as the losses at the level of thermal bridges. It also allows to estimate the heating power needs through the calculation of basic losses. In addition, this text allows the use of dynamic tools in a regulatory framework.

**b. Algerian institutions dedicated to energy performance**

**Table 2:** Type, character, units & zone of the key energy agencies in Algeria

| **AGENCY** | **APRUE** | **CDER** | **CEREFE** |
|---|---|---|---|
| **TYPE** | EPST<br>Public Scientific and Technological Institution | EPST<br>Public Scientific and Technological Institution | EPST<br>Public Scientific and Technological Institution |
| **CHARACTER** | Industrial/ commercial | Research Centre | Industrial/ commercial |
| **UNITS** | 01 | 04 | 01 |
| **ZONE** | North | North/South | North |
| **MISSION** | - The implementation of the national policy of energy mastery through the promotion of energy efficiency | - In charge of elaborating and implementing research and development programs, scientific and technological, of energy systems exploiting solar, wind, geothermal and biomass energy | - Assist in the design, implementation and evaluation of the national strategy for the development<br>- Center of expertise and an interface between policy, industry and research. |

**c. Malaysia's energy performance institutions**

| **Policy** | **Year of set up** | **Key Emphasis** |
|---|---|---|
| **National Petroleum Policy** | 1975 | Introduced to ensure optimal use of petroleum resources and regulation of ownership, management and operation, and economic, social, and environmental safeguards in the exploitation of petroleum due to fast growing petroleum industry in Malaysia |
| **National Energy Policy** | 1979 | Formulated with broad guidelines on long-term energy objectives and strategies to ensure efficient, secure and environmentally sustainable supplies of energy. |
| **National Depletion Policy** | 1980 | introduced to safeguard against over exploitation of oil and gas reserves. Thus, it is production control policy |

| | | |
|---|---|---|
| **Four Fuel Diversification Policy** | 1981 | Fuel diversification was designed to avoid over-dependence on oil as main energy supply and aimed at placing increased emphasis on gas, hydro and coal in the energy mix |
| **Electricity Supply Act** | 1990 | Regulates the licensing of electricity generation, transmission and distribution Gas |
| **Gas Supply Act** | 1993 | Regulates the licensing of the supply of gas to consumers through pipelines, prices, the control of gas supply pipelines, installations and appliances as well as safety |
| **Fifth Fuel Policy** | 2000 | introduced in recognition of the potential of biomass, biogas, municipal waste, solar and mini hydro as potential renewable energy resources for electricity generation |
| **Energy Commission Act** | 2001 | was established to provide technical and performance regulation for the electricity and piped gas supply industries, as the safety regulator for electricity and piped gas and to advise the government on matters relating to electricity and piped |
| **National Biofuel Policy** | 2006 | Supports the five fuels diversification policy. Aimed at reducing the country's dependence on depleting fossil fuels, promoting the demand for palm oil. Five key thrusts: transport, industry, technologies, export and cleaner environment. |

**5. RESULTS & DISCUSSION**

The samples were typically governmental in both sectors whether research or development as shown in table1 a review of energy efficiency agencies that was held in this paper, clearly indicate the slow grow up, and long intervals that summarize the development gap as in figure 1; compared to the international fast-grow agencies in energy efficiency for the case of Malaysia[11] (as a developing country too) figure 2; which shows that short period between each national program helped in fast development in results. [11]

The Gaps:

- The remarkable gap in timeline
- the slow grow-up of the existing agencies
- the development of control and compliance cores

Supervision cores to apply regularities/developpe

Also, the gap in time evolution that captivate the attention to the lake of continuity in such field whether it is in research agencies or R&D agencies, that explained the gap in the regularities in the earlier stages of this research thematic.

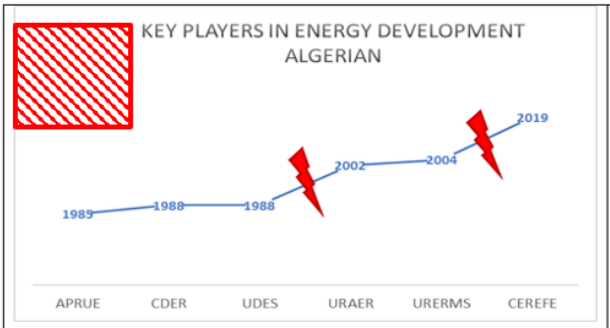



Figure 1: Key players in energy development Algerian

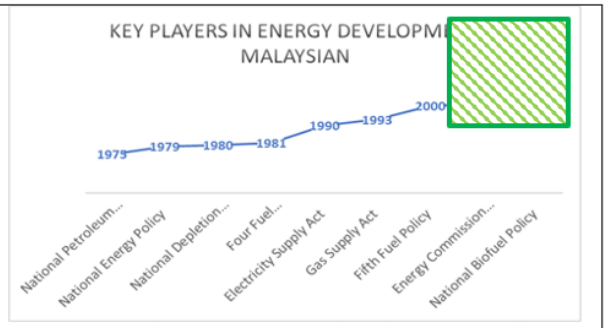



Figure 2: Key players in energy development Malaysian

**Figure 4**. key players in energy developpment Malaysia

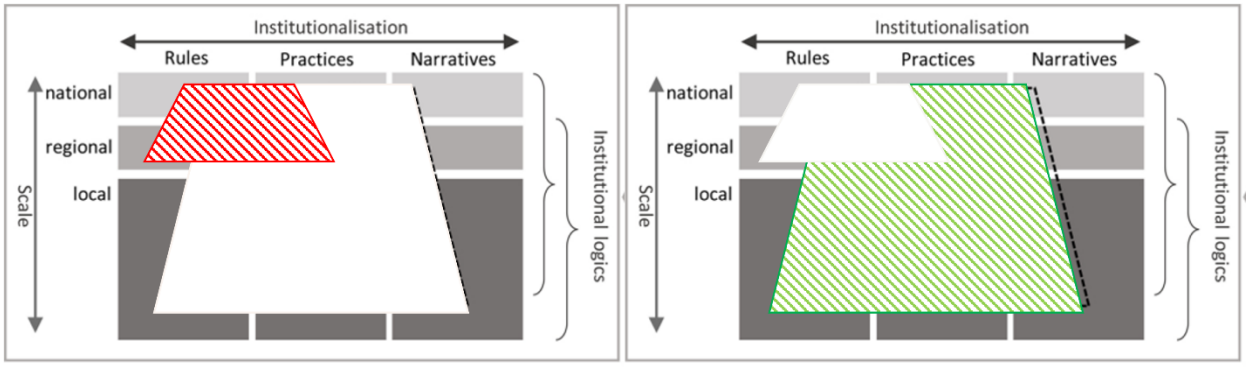



**Figure 5.** institutionalisation theory application on Algeria & Malaysia

For the institutionalisation, the Algerian constitution are situated in the red spot, and the referential country - Malaysia- is situated in the green one, gathering all scales and modes of institualisation. This confirms the gaps related to the regulatory framework and legislation. Also, serves the aim of this work, which is Diagnosis the agencies and institutions of energy efficiency and energy benchmarking in Algeria, and clarify their missions and charges. Extract the institutional modes and scales through an analytical framework. And finally, define the gaps that contribute to the delay of African countries building's efficiency (Figure 10).

**6. Conclusions**

To conclude, the brief review on agencies that held the responsibility of organizing the regulatory of energy efficiency in Algeria shown that the development line of this sector is quite slow according to the chronologic diagnosis. The pinpoint of authority institutions and agencies that are held to implement the energy efficiency in the national building's field, clarified that we have in Algeria a poor energy field cores according to foreign experiences in energy efficiency and benchmarking that assure the control and compliance of the regularities. The remarkable gap in time and results that contribute to the delay of Algerian building's efficiency to the international railway to sustainability is resumed in the slow grow-up of the existing agencies and cores also in the development of other cores that contribute in applying such regularities and developpe new once to accomplish the national and international goals to remain sustainability and protect the planet.

It is frequently suggested that the cores of control and compliance should be injected in the energy efficiency regularity sector, so the existed regularities see the light according to the protocols. The normative research in energy efficiency sector rely on the evaluation of the applicable regularities, so it could be developed and walk along to better results.

**Acknowledgement**

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# Enhancing Security in Affordable Housing: The Case of Prince Fawaz Project

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**Abstract**
At a time when the world is passing through a climate change crisis, the mosque reveals how sustainable developments can help in mitigating global warming. This paper presents a case study of a suggested renovation project for a mosque in Sudan. The aim is to present numerical predictions of energy consumption before and after renovation. Comprehensive field measurements were carried out to be used as input data in the building energy simulation tool. The mosque suggested renovation project has resulted in a 23% reduction in energy demand and 38% of the total energy consumption covered by solar energy generation. The results also show that the choice of renovation measures, such as level of insulation, U value used for openings, and efficiency of the cooling system need careful consideration. Choice of lighting system also has a major effect.
**Keywords:** Renovation, Mosque, Simulation, Energy saving, Solar energy.

## 1. Introduction

The building sector consumes approximately 40% of total energy in the world. Governments accordingly setting codes that will help to reduce diminishing energy sources (Marie, 2012). It is recommended that buildings should be designed to provide good environment for users, but at the same time reduce energy consumption. According to the concept of the Zero Energy Buildings, buildings can also generate more energy than they consume (Ding, 2013).

A project studied in this research has provided case study evidence that the backbone of the design process of successful low energy building is the use of building performance software. It has also been noted that design decisions made in the very early stages of design have the greatest effect on performance. Performance simulation software permits an analyst to make a detailed model of the building and to examine the details of its performance. Exploring the feasibility of suggested renovation requirements for the model to enhance energy performance. For the purpose of this study, the researcher has chosen the project in Khartoum (Masjid Al-Sahaba in Al-Nakheel City).

The goal of this study is to renovate the mosque to become one of the first developments in Sudan to be low energy building; to achieve this, the energy strategy selected uses a combination of energy efficiency in buildings as well as strategy to improve the generation of renewable energy produced by photovoltaic panels integrated in the mosque envelop.

## 2. Material and Methods

The application of solar energy and building integration technology in buildings, mainly has three aspect: solar thermal technology, solar photovoltaic technology, solar optical technology, and mainly set on roofs, balconies, exterior walls and somewhere with ample sunshine.

### 2.1 Solar Thermal Technology

Solar energy is mainly used to supply domestic hot water, heating and refrigeration. In designing the integration of solar hot water system in buildings, the need is not only for considering the layout of solar hot water system, but also to improve the form of the system itself. Traditional solar hot water system with vacuum tube cannot meet the needs of the ever-changing layout and style of the buildings (Baon, 2011). Beyond that, it has other deficiencies, such as the difficult installation, easy destruction of waterproof layer of the roof, security risks if the lightning protection and draught exclusion devices are not in place, vacuum tube wear quickly, and water pipes that exposed to the outdoor cause large heat loss, etc. In short, the traditional solar hot water system with vacuum tube cannot meet the need of integration of solar energy in buildings either in quality or in performance. Now, the flat plate solar collector system is gradually replacing the solar hot water system with vacuum tube, for, it has higher adaptability, and the its installation can better achieve the perfect combination with the construction (Wang,2010). Solar collector system mainly operates on the split double-cycle under pressure. The hot water tank can be located in the basement, attic, staircase room, balcony and/or any other adequate places. In order to achieve a large amount of water, water tank can be a single one, double or even a multi-tank. If the tank capacity is increased, the installation area will corresponds to meet the hot water needs. Hot water is not only used in

bathrooms, but also used for heating and cleaning kitchen utensils. The water quality should be clean to meet the drinking water standards. Integrating solar collector with the roofs, balcony rails of the south façade, bay windows and walls, can make the appearance of buildings be overall unified, and have rich hierarchies (Dagne, 2010). When installed on the sloping roof, the solar collector can be embedded in the roof like a sunroof or flat out on the roof, integrating with the construction to increase the building beauty. When installed on the flat roof, the flat-plate solar collector can act as roof covering or insulation layer, not only conforms to the residential modelling requirements, but also avoids the repeated investment and reduce the cost. In addition, the flat-plate solar collector can be combined with balconies, bay windows, outside walls of buildings, to maximize the use of solar energy and provide new ways and means to the residential façade design, and achieve the aim of multi-purpose as well.

**2.2 Solar Photovoltaic Technology**

Solar photovoltaic technology applying in buildings is mainly used for photovoltaic conversion and lighting. Building Integrated Photovoltaic (BIPV) is a new concept for the application of solar power. In short, it is installing the solar photovoltaic phalanx on the surface of the maintenance structure of the building to provide electricity (hang, 2011). Photovoltaic arrays do not take up additional floor space when integrate with the construction. It is the best installation way of photovoltaic generation system, thus attracting much attention. BIPV can be divided into two categories according to the forms that photovoltaic array integrated with the buildings (Jin, 2011). One is the combination of photovoltaic array with building, installing the PV array on the building, and the building plays a supportive role as a photovoltaic carrier. The other is the integration of photovoltaic array with building, PV modules appears as a building material, and the photovoltaic array becomes the integral part of the construction. Such as photoelectric tile roof, photoelectric curtain wall and photoelectric lighting roof, etc.

**2.3 Solar Optical Technology**

The main use of the solar optical technology in buildings is for lighting, natural light can enter into the function rooms through the light guide tube, thus improve the indoor daylighting situation, such as underground garage, equipment room and storage room. Because utilization of solar optical system is also subjected to the impact of the climate, this technology is suitable for the regions that have abundant natural light and less cloudy sky (Wang, 2003). The light guide tube is mainly composed of three parts: a light collector for collecting the daylight; tubing portion for transmitting light, and the light exit portion for controlling the distribution of the light in the room. Using the light guide tube on the roof must ensure that there have no obstructions, and well water treatment to avoid leaking during the installation (Qin, 2012). Moreover, as the instability of the natural light, the light guild tubes must in combination with the adjustable artificial light, to be an effective supplement when the daylight is insufficient (Peter, 2008).

**3. Methodology**

The main objective of this research is to reach better building energy performance for the nominated case study (Al-Sahabah Mosque) in Sudan, and to enhance the performance of the suggested solar photovoltaic system and provide proposal to increase solar energy produces on site to run the building systems. To reach the aims stated, the research applies the (Generated and Test Technique), where the researcher makes suggested ideas under test to perform them using the Autodesk Ecotect Analysis software. Initially the researcher constructs energy consumption models that simulate a building for energy consumption prediction or energy saving estimates, and simulate the existing situation as it is. Then starting simulating the different techniques of sustainable and environmental architecture. The researcher studied several scenarios to choose the best. Finally, a model was created for the mosque, which has a better energy performance than the first option (Figure. 1).

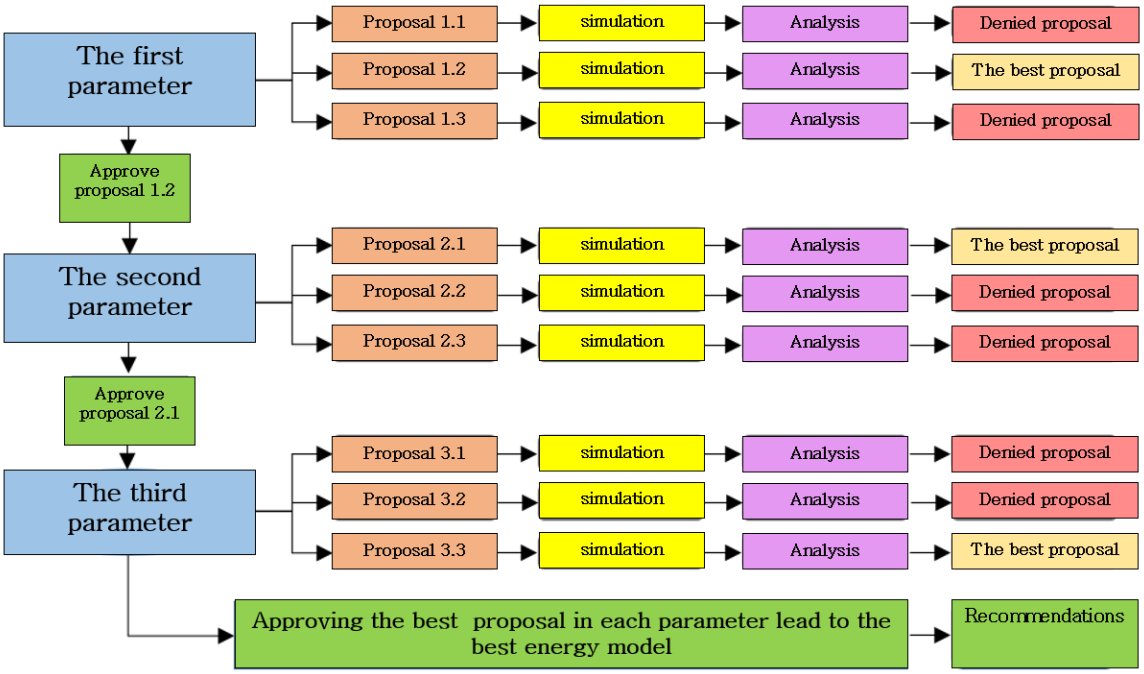



**Figure 1.** Methodology to reah the best energy model of the case study

**4. Case Study Project Description**

The case study shown below depicts the efforts done to create energy-efficient buildings integrated solar cells with its construction. The short project summary describes key features and lessons learned from the project. Masjid Al-Sahabah is a mosque in Khartoum, Sudan. The two story building finished in 2009. Its construction began in 2005. The ground floor Area is 1100 square meters. The total plot area is 3000 square meters. The total number of floors is two floors with a total height of 11 meters in addition to the minaret, which is 30 meters high.

**4.1 Al-Sahabah Mosque Characteristic**

Al-Sahabah Mosque has the following characteristics:

- Thick walls of concrete blocks plastered from both sides with a mixture of cement and sand.
- The finishing for the wall doesn't include thermal insulation only 2 layers of smooth paint.
- The roof is 20 cm thick concrete slab with an upper level of damp roofing coat.
- All windows are single glazing windows with a steel frame of 3 cm thickness.
- Interior finishing materials: The floors were finished with natural stone in addition to the plain concrete and carpet; no false ceiling was used only 2 coats of paint over plastered concrete slab.
- All light bulbs are florescent with 28% of halogen bulbs added to the main wall.

As shown in figure 2 below the exterior of the building has been finished with plaster and paint, in addition to single glass with steel frame for the windows.




**Figure 2.** Al-Sahabah Mosque aerial photo and elevations.

### 4.2 Prepare a Model for The Mosque to Be Analysed

The simulation work begins by building a model that conforms to the specifications of the existing building using Autodesk - Revit 2016 software. The construction is done step by step, taking into account all the openings, internal divisions and materials. Energy setting is adjusted and entered accurately to the program. Then starting simulating the existing situation and the different proposals to study several scenarios and choose the best. The following table (Table 1) shows the nine design parameters which fall under three main categorize (HVAC, Lighting and Solar cells), the table also shows the specification for the existing situation and the three options simulated:

**Table 1.** The Design parameters specification

| | Design Parameters | The existing situation | The first proposal | The second proposal | The third proposal |
|---|---|---|---|---|---|
| HVAC | Thermal Insulation | Only one layer of polystyrene polyurethane Insulation on the roof. | 2 layers of polystyrene polyurethane Insulation on the exterior walls and the roof. | One layer of polystyrene polyurethane Insulation in the middle of the block walls + one layer of Nano technology insulation on the exterior walls and roof. | 2 layers of polystyrene polyurethane Insulation on the exterior walls + one layer of polystyrene polyurethane Insulation on the interior walls and roof. |
| | U- Value | Opening is 34% of the total are of the building envelop, with U – Value 0.85 | Opening is 34% of the total are of the building envelop, with U – Value 0.45 | Opening is 34% of the total are of the building envelop, with U – Value 0.55 | Opening is 34% of the total are of the building envelop, with U – Value 0.65 |
| | Colors | Light orange color | Dark brown color | White color | Dark green color |
| Lighting | bulb type | 72% used in the building is florescent bulbs and 28% halogen bulbs. | 100% of florescent bulbs. | 100% of compacted florescent bulbs | 100% of LED bulbs |
| Solar energy | Inclined Degree of the solar cells | Vertical, inclined 0◦ degree. | Inclined 30◦ degree. see Fig.6, a | Inclined 20◦ degree. see Fig.6, b | Inclined 10◦ degree. see Fig.6, c |
| | Additional options for production | None | Integrate 260 square meters of solar cells in the south western elevation. | Integrate 260 square meters of solar cells in the north eastern elevation. | Additional 450 square meters of solar cells on the roof |

The Inclined Degree of the solar cells is identified to get 90 Angle, as shown in figure 3, by applying the equation (Angle of Optimal tilt = 90 – Angel of the Sun, this ensure that sun rays will always be perpendicular to the solar cells:

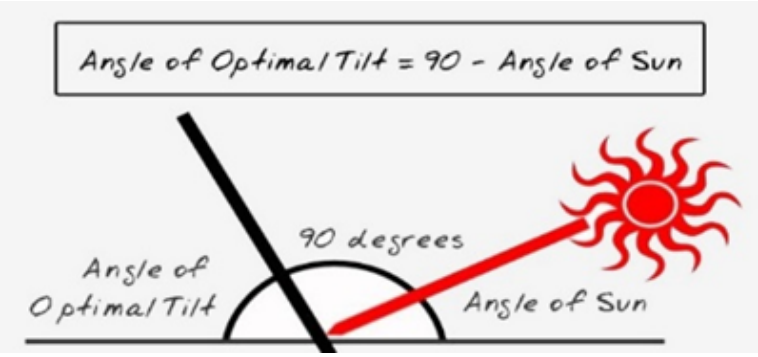
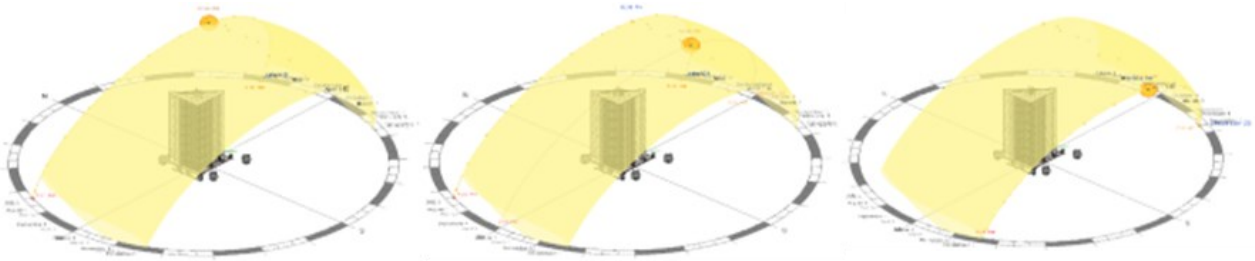



**Figure 3**. Identification of the Angle of the solar cells

The study tested 3 options of the inclined degree:

- 30°, it considers sun angle equal 60° (maximum degree toward the South on 23rd December).
- 20°, it considers sun angle equal 70° (on 23rd December).
- 10°, it considers sun angle equal 80° (maximum degree toward the North on 16th June).

As shown in figure 4.



**a**: 10°, it considers sun angle equal 80° **b:** 20°, it considers sun angle equal 70° **c:** 30°, it considers sun angle equal 60°

**Figure 4**. Identification of the Angle of the solar cells

**5. Alternative simulation result**

- **First:** Design Parameter: (Thermal Insulation):

Three alternatives will be tested for insulation as shown in Table 1; internal temperatures are also derived from the simulations of the three alternatives in the hot period. The researchers notice that the second alternative which uses nanotechnology was the lowest temperature in the warm season with a slight difference of 1°, while the worst was option 1 which achieves the highest internal temperature, figure 5.

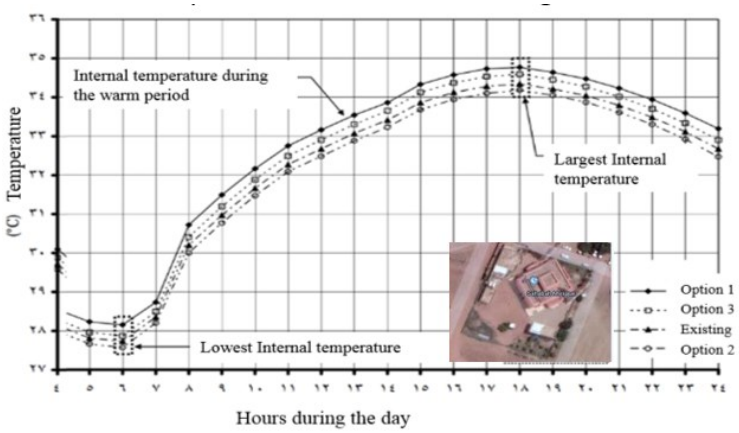



**Figure 5.** Internal temperatures in the different alternatives of thermal insulation

- **Second:** Design Parameter: (U-Value for glass of openings):

One of the most important components of the building's envelop is the openings, so designers have to consider the use of glass with good thermal properties. This is determined by the U-value of the glass used, where it represents the coefficient of heat transfer and its absorption and emission of the solar radiation falling on it. The window should reduce the heat passing from outside to inside by:

- Preventing direct solar radiation by improving the type of glass, noting the direct effect of solar radiation on thermal comfort. (U- Value) will be tested by 0.85 for the current situation and compared to other amounts (0.65, 0.55, and 0.45).

The result shows that there is a clear discrepancy between the internal temperature in each case, lower degree was registered in option one (U- Value=0.45).

- **Third:** Design Parameter: (External colors):

In this section, the effect of the colours of the external facades of the mosque was studied. The current situation in addition to four options (dark green, white, dark brown, light orange). Figure 6 shows the results of the simulations with the internal temperature values of the mosque in each case. It shows that there is a difference in temperature in the warm period between the colours, with increasing the difference from 8 am to midnight until the it reaches two degrees Celsius, while for the rest of the day the graph shows convergence in temperature Up to 1 ° C, maximum internal temperature at 6pm and lowest temperature at 6 am.

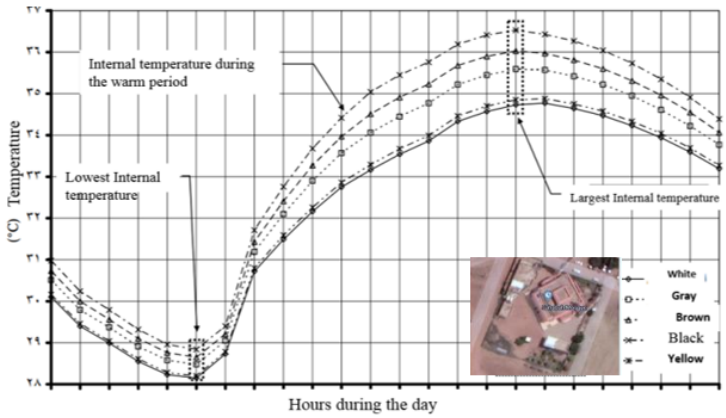



**Figure 6.** Internal temperatures in the different alternatives of façade colour

- **Fourth:** Design Parameter: (Bulb type):

The standard (incandescent) bulbs are replaced with Fluorescent Lamp. The standard incandescent bulbs are replaced with Compact Fluorescent Lamp (CFL). The last alternative is to replace all lamps used with energy-saving LED bulbs, while maintaining the same intensity of light. The following table shows a comparative study of the advantages of using energy saving lamps, incandescent bulbs and LED lamps, table 2.

**Table 2.** Comparison of electricity consumption for three options of lighting

| | Third option | Second option | First option | Existing situation | unit |
|---|---|---|---|---|---|
| Electrical consumption / each bulb | 8 | 15 | 60 | 100 | Watt/Hour |
| Number of bulbs in each floor | 210 | | | | bulb |
| Operation time for each bulb | 12 | | | | hour |
| Total Electrical consumption for all bulbs | 20 | 37.8 | 151 | 252 | Watt/Hour |
| Saving Percentage compared to existing situation | %92 | %85 | %40 | %100 | |

- **Fifth:** Design Parameter: (Inclined Degree of the Solar cells):

Solar energy systems perform best when sunlight directly fall on them, regardless of the technology used. Any partial shading of their matrices can result in a significant reduction in the rate of electricity generated. Fortunately, the studied site has no obstructions to the sun; it is on a main street. But the question remains (which angle should the solar panels be directed to?). The question is simple, but in fact the answer is a bit complicated. For example, if we talk about a city on the equator, the direct answer would be to make the solar panels look straight up directly. If we talk about a place on the southern continent, the answer would be to make solar panels vertical. But in the case of middle countries, as in the case of Sudan, we installed the solar panels depending on the angle of the Sun.

This leads us to the fact that the angle of inclination must vary in each season from the other in order to achieve maximum benefit in each season. But this will not happen often due to the high cost of moving all this quantity of panels. The paper reviews the simulation results for the three angles under study and see what will be the best solution.The result shows that there is a clear discrepancy between the levels of generation of energy from the solar system adopted at the installation at a specific tilt angle and was above angle 20 and exceeded angles by approximately 0.5 kW at peak hour. The slanted structure gives a better result than vertical stabilization. In all cases, generation is more than generation in the vertical position of more than 10%.

- **Sixth:** Design Parameter: (Additional Solutions for Solar Energy):

There are additional solutions worthy of experimentation, including:

- Adding solar cells to the roof where there are 800 square metre available.

Expected power to add = 110 x 800 = 88,000 watts Approx. 88 kW.

The total expected power will be = 365 x 88 = 32,120 kW.

The optimal orientation of the tower from previous findings of the evaluation matrix is the south-west orientation, other 2 options will not be added, because the north-east and south-east elevations do not receive enough direct solar radiation and it is useless to add solar cells.

(Figure 7) shows the generation values of solar radiation and their percentage in each of the seven orientation alternatives. It shows that the optimal orientation for obtaining the highest percentage of solar energy generation is the south followed by south-west.

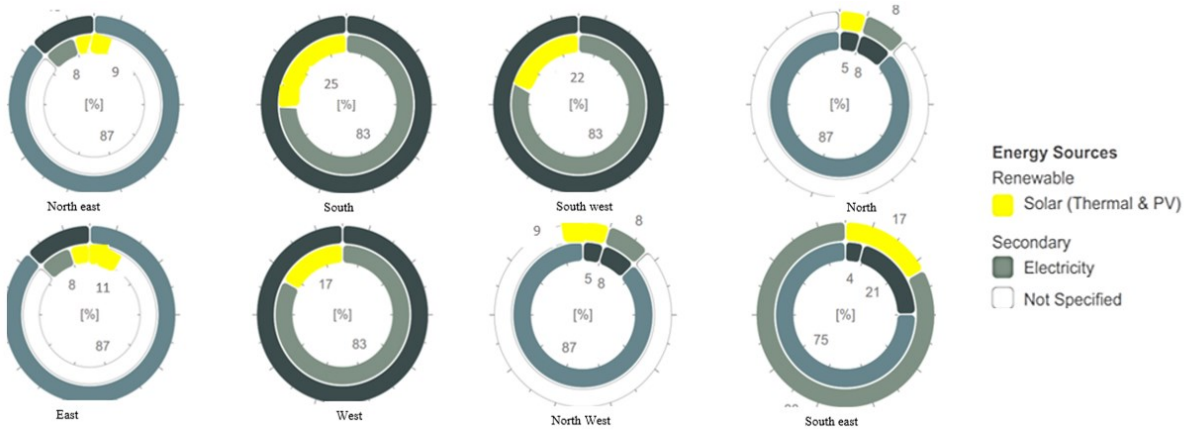



**Figure 7**. Result of energy generation values of solar cells in each of the seven orientation alternatives.

**6. Recommendations to Modify the Current Situation Of The Mosque To Improve Energy Efficiency**

Then several scenarios have been tested and the paper recommend the best solution in each of the design parameters studies (HVAC, Lighting and Solar system), the following table 3 shows the existing situation and the recommended modification to improve energy efficiency in the tower as follows.

**Table 3.** Details of the revised default model specifications

| Categories | Design Parameters | Existing situation | Modified ideal model specifications |
|---|---|---|---|
| (HVAC) | Thermal Insulation | Polyurethane insulation has been applied as one outer layer in the outer block walls | Insulation of polystyrene as an intermediate layer in the walls of the external block, in addition to the outer surface of the walls with a nanotechnology insulating material |
| | The U-Value | The test will start for the actual and represent 43% and the U-Value of the glass used is 0.65. | U-Value of the glass used is 0.35 |
| | Colors | Current Mode (Light Grey) | Use colors with a different reflective effect better than Grey User Alternative II (White) |
| (Lighting) | Bulbs type | Lamps used are halogen and fluorescent | . The option of halogen bulbs will be cancelled and only LED bulbs will be used for the entire tower. |
| (Solar System) | Inclined Degree | The current status of vertical solar cells is mounted along the height of the façade. | Angle of 20 ° C (in warm period) Cells are installed on 30° mode in cold period.<br>See Figure 8-25. |
| | Additional options | None | Additional solar cells in the roof with an area of 800 $m^2$<br>Additional options for generating / additional options<br>The solar cells are installed on the southwest facade. |

**7. Conclusion**

Solar energy and building integration technology has broad application prospects, using simulation program will play a significant role in applying the use of solar energy in an efficient way, in the case shown for Al-Sahabah Mosque, the researcher was able to increase the percentage of energy consumption covered by the solar energy by approximately 40%. Finding an accurate and efficient way to model and simulate the building to evaluate the energy consumption is of upmost importance. Many future areas can be taken with this model. Use of real data should be used to refine the assumptions made and parameter calculations performed.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# A Parametric Analysis of Interior Space Organization for Improving Thermal Comfort Conditions in Office Buildings

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**Abstract**
The interior planning organization in office buildings varies depending on the depth of the space and the plan layout. The thermal comfort of the space and the comfort conditions of the individuals are affected by different depth of the space. The aims of this parametric study are to examine the effects of the interior organization, window sizes, and the selection of building envelope elements on the design efficiency and the percentage of comfortable space in the buildings designed climate-conscious. In this study, the analysis is carried out for the offices located on the 3rd floor of the five-storey reference virtual building sensitive to climate. Calculations are made for a reference province in a hot-mild climate using Rhinoceros/Grasshopper simulation. Thermal comfort results in medium-depth office spaces and open-plan work areas will be given and evaluated comparatively for December 21 and June 21. Handling the interior planning organization and analysis process together at the design stage of the building will contribute to the development of thermally comfortable spaces.
**Keywords:** Parametric Design; Interior Organization; Office Planning; Thermal Comfort.

# Ofis Yapılarında Isıl Konfor Koşullarının İyileştirilmesi İçin İç Mekân Organizasyonunun Parametrik Analizi

**Özet**
Ofis yapılarında iç mekân organizasyonu, mekânın derinliğine ve plan düzenine bağlı olarak değişiklik gösterir. Farklı mekân derinlikleri, mekânın ısıl konforunu ve bireylerin konfor koşullarını etkilemektedir. Parametrik çalışmanın amacı iklime duyarlı tasarlanan binalarda iç mekan organizasyonu, pencere boyutları ve yapı kabuğu elemanları seçiminin tasarım verimliliği ve konforlu alan üzerindeki etkilerini incelemektir. Bu çalışmada iklime duyarlı beş katlı referans sanal binanın 3. Katında yer alan ofisler için analiz gerçekleştirilmiştir. Hesaplamalar ılıman-kuru bir iklimde yer alan referans bir il için Rhinoceros/Grasshopper simülasyonu kullanılarak gerçekleştirilmiştir. Orta derinlikte ofis mekânları ve açık planlı çalışma alanlarında 21 Aralık ve 21 Haziran günleri için ısıl konforu hesaplanarak sonuçlar karşılaştırmalı olarak verilecek ve değerlendirilecektir. Yapının tasarım aşamasında iç mekân organizasyonu ve analiz sürecinin birlikte ele alınması ısıl anlamda konforlu mekânların geliştirilmesine katkı sağlayacaktır.
**Anahtar Kelimeler:** Parametrik Tasarım; İç Mekân Organizasyonu; Ofis Planlaması; Isıl Konfor.

## 1. Giriş

Farklı mekan organizasyonlarına ve kullanımlarına sahip ofis yapılarının üretimi gün geçtikçe artış göstermektedir. Günümüzde pandemi gibi küresel sorunlar nedeniyle ev-ofis kullanımları ön plana çıkmasına rağmen pandeminin bitişi ve hayat koşullarının normale dönmesi ile birlikte ofis yapılarının kullanımları yeniden artış gösterme eğilimindedir.

Bireyler zamanlarının büyük bir kısmını kapalı hacimlerde bulunarak geçirirler. Günlük yaşamının sekiz veya dokuz saatini ofis alanlarında geçiren bireyler için ofis mekanlarının konfor koşulları da önem kazanmaktadır. Ofis alanlarında iç mekan konfor koşulları, bireylerin çalışma verimine olumlu yönde katkı sağlayacağı gibi uygun ısıl koşullara sahip olmayan çok sıcak ya da çok soğuk ofis alanlarında dikkat dağınıklığı meydana geldiği ve çalışma veriminin olumsuz olarak etkilendiği gözlemlenmektedir.

Ofis yapılarının ısıl konfor koşulları üzerine gerçekleştirilmiş çok sayıda çalışma bulunmaktadır. Çalışmaların bir çoğu, tasarımı ve üretimi tamamlanmış, mevcut kullanım aşamasındaki ofis alanlarında gerçekleştirilen ölçme ve değerlendirme çalışmalarıdır. Ancak tasarım aşamasında iç mekan organizasyonu ve dış ortam koşullarına bağlı olarak kullanılacak hacim içerisindeki ısıl konfor koşullarının değerlendirildiği çalışma sayısı azdır.

Bu çalışma kapsamında, inşa edilmesi ve kullanılması planlanan yapılar için parametrik simülasyon çalışması ile tasarım ve analiz süreci birlikte ele alınacak ve ısıl konfor koşullarına ilişkin elde edilen veriler değerlendirilecektir. Isıl konfor koşullarının ve yapı elemanları seçiminin tasarım aşamasında ele alınması, ısıl anlamda konforlu mekanların geliştirilmesine katkı sağlayacaktır.

### 1.1 Ofis Yapılarında İç Mekan Organizasyonu ve İç Mekan Konforu

Ofis yapılarında iç mekan organizasyonu mekanın derinliğine ve plan düzenine bağlı olarak değişiklik göstermektedir. Mekan düzeni türleri, derinliğine göre ve iç mekan düzenine göre çeşitlilik gösterir (Sakallı, 1997).

Mekan derinliği, sirkülasyon alanının duvarı ile yapı kabuğu arasındaki mesafeyi tanımlamaktadır. Az derin mekanlar (4-5m), orta derinlikte mekanlar (8-10m) ve derin mekanlar (11-19m) olmak üzere farklı mekan derinliklere sahip çeşitli

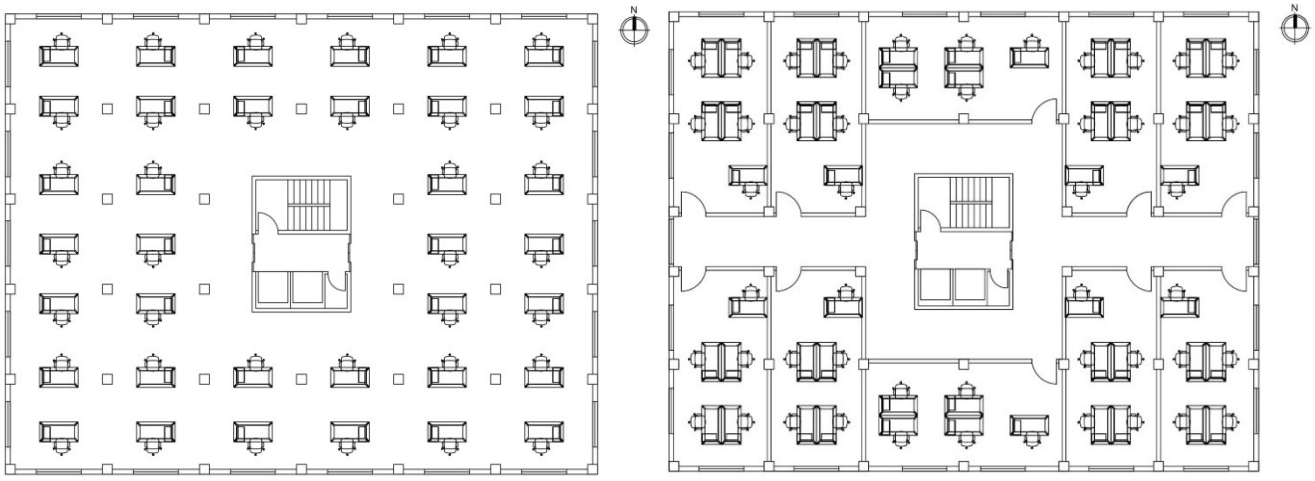
bölünmüş plan düzenleri mevcuttur (Sakallı,1997). Bunun yanı sıra açık planlı ofis alanları da tasarım ve kullanım anlamında günümüzde oldukça sık karşılaşılan ofis plan düzenidir. Açık planlı ofis alanlarında sirkülasyon alanı ya da çekirdek haricinde ofis alanını bölen ya da sınırlayan bölücü elemanlar bulunmamaktadır. Bu nedenle açık planlı ofis alanları kullanıcılara daha esnek kullanım koşulları sağlamaktadır.
Farklı mekan derinlikleri, kullanıcıların mekanları kullanım şekilllerini, iç ortam sıcaklığını değiştirecektir. Bu nedenle kapalı ve açık ofis planlamalarının bireylerin konfor koşullarını önemli ölçüde etkileyeceği ön görülmektedir.

**2. Çalışmanın Yöntemi**

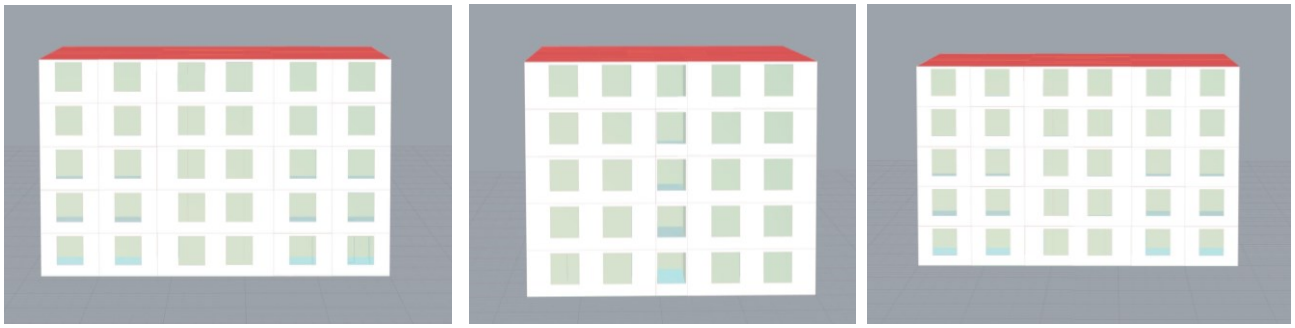
İklime duyarlı tasarlanmış ofis binalarında, iç mekan organizasyonu, pencere boyutları ve yapı kabuğu elemanları seçiminin tasarım verimliliği ve konforlu alana etkileri üzerinden değerlendiren bir yaklaşım oluşturulmuştur. Analizler için Rhinoceros/Grasshopper simülasyonu Ladybug ve Honeybee eklentileri kullanılmıştır. Oluşturulan yaklaşımın uygulama çalışması iklime duyarlı tasarlanmış referans sanal bir binada ılıman-kuru iklimde yer alan Ankara ili için gerçekleştirilmiştir (Kısa Ovalı, 2019).
Simülasyon çalışması ISO 7730 ve ASHRAE standartlarında yer alan kabuller doğrultusunda mevcut fiziksel veriler ile her iki plan düzeni için gerçekleştirilen ısıtma ve soğutma dönemini temsil eden 21 Aralık ve 21 Haziran günlerinin simülasyon analizlerini içerir. Ofis kullanım saatleri içerisinde mekanik sistemle iç ortam koşullandırılmıştır. Doğal havalandırma kapalı tutulmuştur.

**2.1 Referans Sanal Bina ve Plan Düzenlerinin Oluşturulması**

Çalışma kapsamında gerçekleştirilecek simülasyon çalışması için Olgyay'ın iklimle dengeli tasarım parametrelerine uygun en boy oranlarından yararlanılmıştır (Olgyay, 1963). Yapının en boy oranı için 1'e 1.3 oranı kabul edilmiştir. Ofis tasarımında dikdörtgen biçimli plan düzeni tercih edilmiştir. Her cephede yerden 0.8m yükseklikten başlayan, 1.82m genişliğinde ve 2m yüksekliğinde eş pencereler bulunmaktadır.
Ofis alanları tasarımında mekan derinliğinin farklılığı dikkate alınmıştır. Ofis yapılarında mekan derinliği, sirkülasyon alan sınırından ofis alanını sınırlayan bina dış cephesine kadar ölçülen mesafe olarak tanımlanır (Sakallı,1997). Çalışma kapsamında büyük açık alanlara sahip ofis mekanlarının ısıl konforu ile küçük alanlara bölünmüş ofis mekanlarının ısıl konfor açısından karşılaştırılarak değerlendirilmesi amacıyla bölünmüş orta derinlikte ofis plan düzeni ve açık planlı ofis plan düzeni olmak üzere iki farklı plan düzeni oluşturulmuştur (Şekil 1).
Bölünmüş ofis plan düzeninde; ofis alanının derinliği 8.225m'dir. Açık planlı ofis plan düzeninde ofis alanları; merkezde yer alan çekirdek alanının haricinde kalan alanda bulunmaktadır. Her iki plan düzeninde çekirdek ortada konumlandırılmıştır. Simülasyon çalışması her iki plan düzeni için 5 katlı bir binanın 3. katında yer alacak şekilde tasarlanan referans sanal bina ile gerçekleştirilmiştir. Çalışma kapsamında, referans sanal binanın kuzey ve güney cephesinde %30, doğu ve batı cephelerinde %32 saydamlık oranı kullanılmıştır. Şekil 2.'de referans sanal binanın ön (güney), yan (doğu/batı) ve arka (kuzey) cepheleri gösterilmiştir.
Referans sanal ofis binasının kullanım aralığı, Türkiye şartlarına uygun olması amacıyla haftaiçi günleri 08:00 ve 18:00 arası kullanıma sahip olacak şekilde kabul edilmiştir. Analizler ısıtma dönemi için 21 Aralık, soğutma dönemi için 21 Haziran tarihlerinde gerçekleştirilmiştir.



**Şekil 1.** Açık planlı ofis plan düzeni ve bölünmüş orta derinlikte ofis plan düzeni



**Şekil 2.** Referans sanal bina ön (güney), yan (doğu/batı), arka (kuzey) cepeheleri

**2.2 Konfor Koşullarına Yönelik Kabullerin Belirlenmesi**

Referans sanal ofis binasının, parametrik simülasyon çalışması için bölünmüş plan düzeni ve açık planlı ofis plan düzenleri için tanımlanan etkinlik değerleri belirlenmiştir. Kullanıcıların giysi yalıtım değerleri 21 Aralık için 1.0 clo, 21 Haziran için 0.5 clo olarak kabul edilmiştir. Etkinlik çeşidi ISO 7730 ve ASHRAE standardında verilen durgun aktivite (ofis), etkinlik düzeyi 1.2 met olarak kabul edilmiştir.

Referans sanal bina ayar sıcaklıkları, ısıtma için en üst sınır 21 $^{o}$C, soğutma için en alt sınır 26 $^{o}$C olarak kabul edilmiştir (Cengiz,2021). Isıtma, havalandırma ve iklimlendirme sistemi (HVAC) seçimi için tek dış ünite ile birden fazla iç ünitenin kontrol edildiği klima sistemi olan VRF+DOAS sistemi tercih edilmiştir.

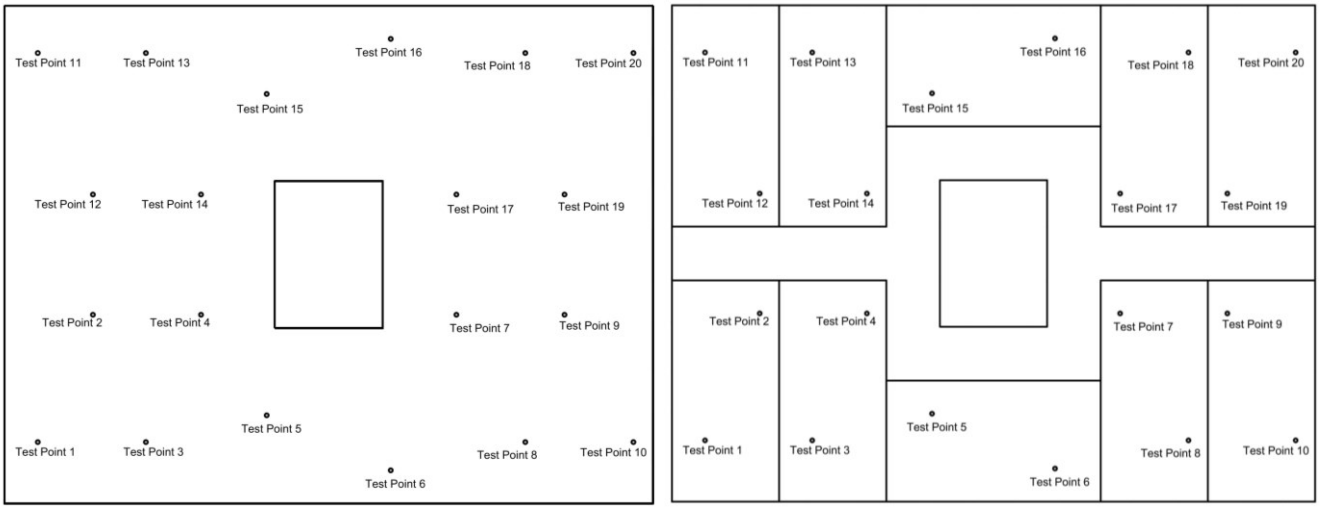
Bina kabuğu kesiti için TS825 (2013)'de illere göre derece gün bölgeleri için en fazla kabul edilmesi tavsiye edilen U değerleri kabul edilmiştir. Ankara ili 3. Derece gün bölgesinde yer almaktadır. 3. Derece gün bölgesi illeri için dış dış duvarların U değeri ($U_D$) 0.48 W/m$^2$K, tavanın U değeri ($U_T$) 0.28 W/m$^2$K, zemine oturan döşemenin U değeri (Ut) 0.43 W/m$^2$K ve pencerelerin U değeri (Up) 1,8 W/m$^2$K önerilmektedir. Ankara ili için etkinlik değişkenleri ve bina kabuğu kesiti ısıl geçirgenlik değerleri (U) Tablo 1'de gösterilmektedir.

**Tablo 1.** Bölünmüş orta derinlikte ofis / açık planlı ofis plan düzeni etkinlik değişkenleri

| **Parametreler** | **Değerler** | **Bina Kabuğu Kesiti** | **Değerler** |
|---|---|---|---|
| **Kullanıcı Yoğunluğu** | | Dış Duvar | U Değeri: 0.48 W/m$^2$K |
| Bölünmüş Orta Derinlikte Ofis Plan Düzeni | 0.16 kişi / m$^2$ | Tavan | U Değeri: 0.28 W/m$^2$K |
| Açık Planlı Ofis Plan Düzeni | 0.08 kişi / m$^2$ | Zemin | U Değeri: 0.43 W/m$^2$K |
| **Metabolik Etkinlik** | | İç Duvar | U Değeri: 0.507 W/m$^2$K |
| Etkinlik Türü | Durgun aktivite (ofis) | Pencere | U Değeri: 1.8 W/m$^2$K |
| Etkinlik Düzeyi | 1.2 met | | SHGC: 0.40 |
| Giysi Yalıtım Değeri | Kış 1.0 clo, Yaz 0.5 clo | | VT: 0.60 |
| **Çevresel Kontrol** | | | |
| Isıtma Ayar Noktası Sıcaklığı | 21 $^{o}$C | | |
| Soğutma Ayar Noktası Sıcaklığı | 26 $^{o}$C | | |

**2.3 Isıl Konfor Analizleri**

Isıl konfor simülasyonu, kapalı ve açık ofis mekanlarında ısıl konfor koşullarının karşılaştırılması amacıyla gerçekleştirilmiştir. Simülasyon çalışması için tanımlanan test noktaları, bir bireyin oturma yüksekliği esas alınarak zeminden 1.1m yüksekliğe yerleştirilmiştir. Plan düzleminde 0.50m ızgara boyutuna göre gridal sistem oluşturulmuştur (Şekil 3). Test noktalarının yerleşiminde, bölünmüş orta derinlikte ofis plan düzeni dikkate alınmıştır. Her bir ofis alanı için 1 adet pencere yanı ve 1 adet iç duvar yanı olmak üzere 2 adet test noktası bulunmaktadır. Analizler aynı test noktaları kullanılarak açık planlı ofis ve bölünmüş orta derinlikte ofis plan düzenleri için gerçekleştirilmiştir.




**Şekil 3.** Açık planlı ofis ve bölünmüş orta derinlikte ofis test noktalarının yerleşimi

Belirlenen analiz periyodu ve iklim verileri için Tahmini Ortalama Oy, PMV (Predicted Mean Vote) hesaplanmıştır. Her bir ofis alanı için PMV değerleri hesaplanırlen; iç hava sıcaklığı, ortalama ışınımsal sıcaklık, bağıl nem, hava akımı, metabolik aktivite düzeyi ve giysilerin yalıtım değerleri hesaba katılmıştır. Hesaplama sonucunda elde edilen veriler 5 katlı referans sanal binanın 3. Katında yer alan ofisler için değerlendirilmiştir.

## 3. Bulgular

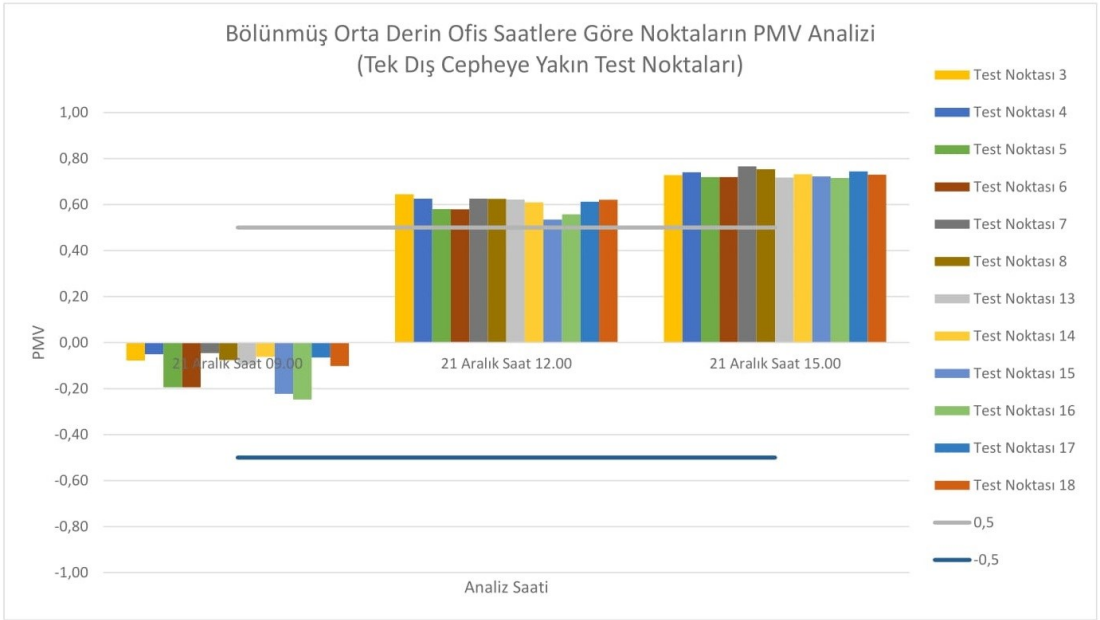
Isıtma dönemi temsil günü için simülasyon çalışması 21 Aralık tarihinde, soğutma dönemi temsil günü için simülasyon çalışması 21 Haziran tarihinde saat 09.00, saat 12.00 ve saat 15.00 için gerçekleştirilmiştir.
Simülasyon analiz sonuçlarının değerlendirilmesinde ISO 7730 ve ASHRAE standartlarına göre -0,5<PMV<+0,5 konfor aralığı kabul edilmiştir. Elde edilen PMV değerleri 0'a ne kadar yakınsa ortam o kadar konforlu kabul edilmektedir. Analiz sonuçlarına ilişkin grafikler her iki plan düzeninde yer alan ofis alanları için karşılaştırmalı olarak verilmiştir.

### 3.1 Isıl Konfor Simülasyon Analiz Sonuçları

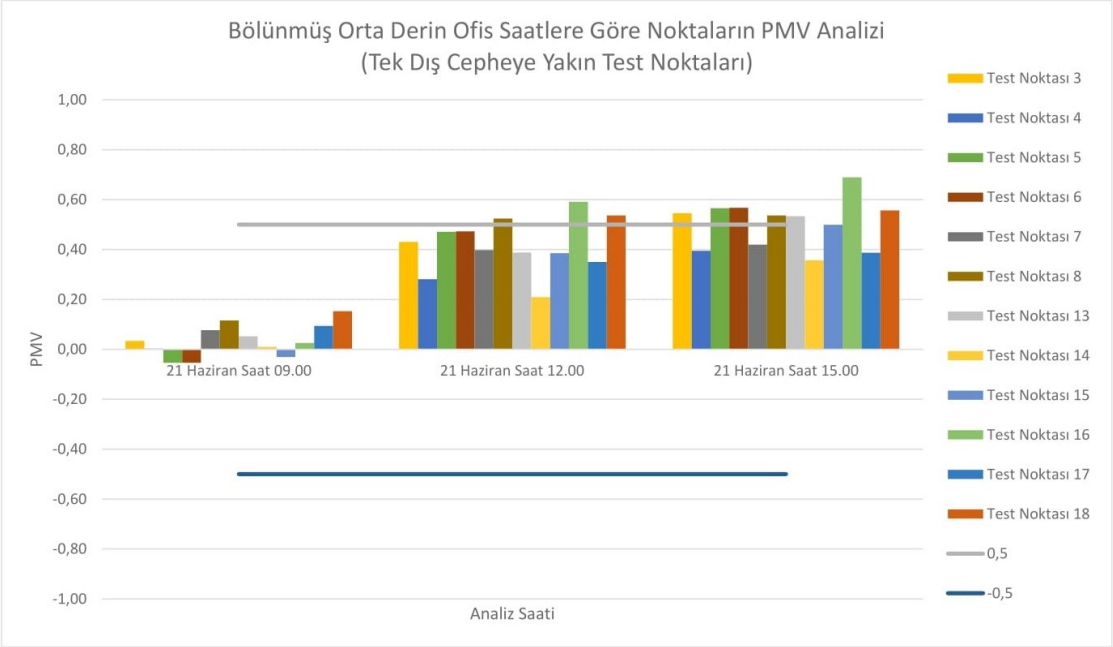
Bölünmüş orta derinlikte ofis plan düzeni için elde edilen analizler sonucunda tek dış cepheye yakın test noktaları ve çift dış cepheye yakın test noktaları 21 Aralık (ısıtma günü) ve 21 Haziran (soğutma günü) için ayrı ayrı değerlendirilmiştir.

#### 3.1.1 Bölünmüş Orta Derinlikte Ofis Düzeni Analiz Sonuçları

Bölünmüş orta derinlikte ofis plan düzeni için elde edilen analizler sonucunda dışa bakan tek cepheye yakın test noktaları ve dışa bakan çift cepheye yakın test noktaları 21 Aralık ve 21 Haziran için ayrı ayrı değerlendirilmiştir.



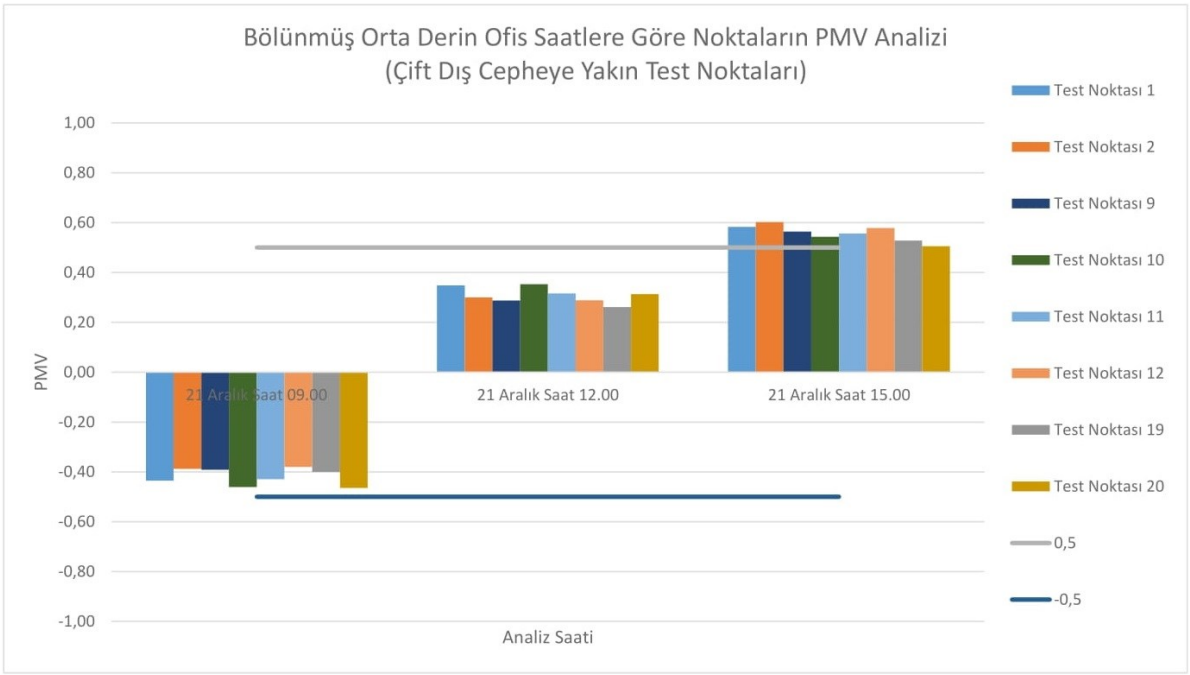

**Şekil 4(a).** Bölünmüş orta derinlikte tek dış cepheye yakın test noktaları 21 Aralık PMV grafiği



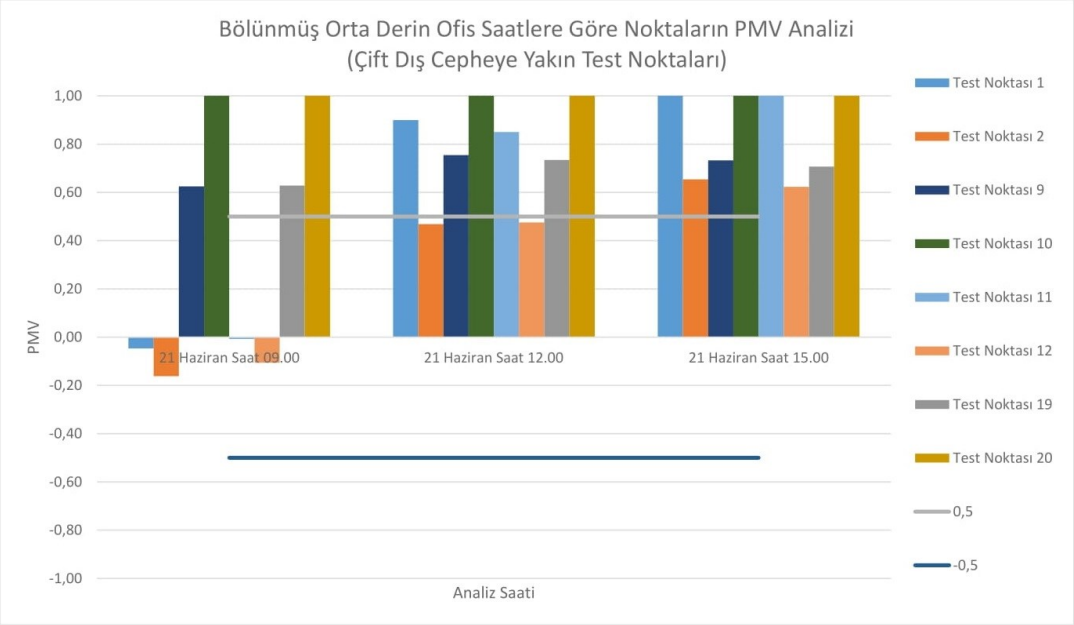

**Şekil 4(b).** Bölünmüş orta derinlikte tek dış cepheye yakın test noktaları 21 Haziran PMV grafiği

Tek dış cepheye yakın test noktaları için PMV değerleri ayrı ayrı değerlendirildiğinde;

- 21 Aralık için yalnızca saat 09.00'da elde edilen PMV değerleri konfor sınırları içerisindedir.
- 21 Aralıkta saat 12.00 ve saat 15.00'da elde edilen PMV sonuçları ısıl anlamda sıcak yönde çıkmıştır. Ofislerin gereğinden fazla ısıtıldığı görülmektedir.
- 21 Haziran için yalnızca saat 09.00'da tek dış cepheli ofis alanlarında yer alan tüm noktalar ısıl konfor sınırları içerisindedir.
- 21 Haziranda saat 12.00 ve 15.00'de test noktası 8, test noktası 16 ve test noktası 18 konforsuz alana düşmektedir.




**Şekil 5(a).** Bölünmüş orta derinlikte çift dış cepheye yakın test noktaları 21 Aralık PMV grafiği



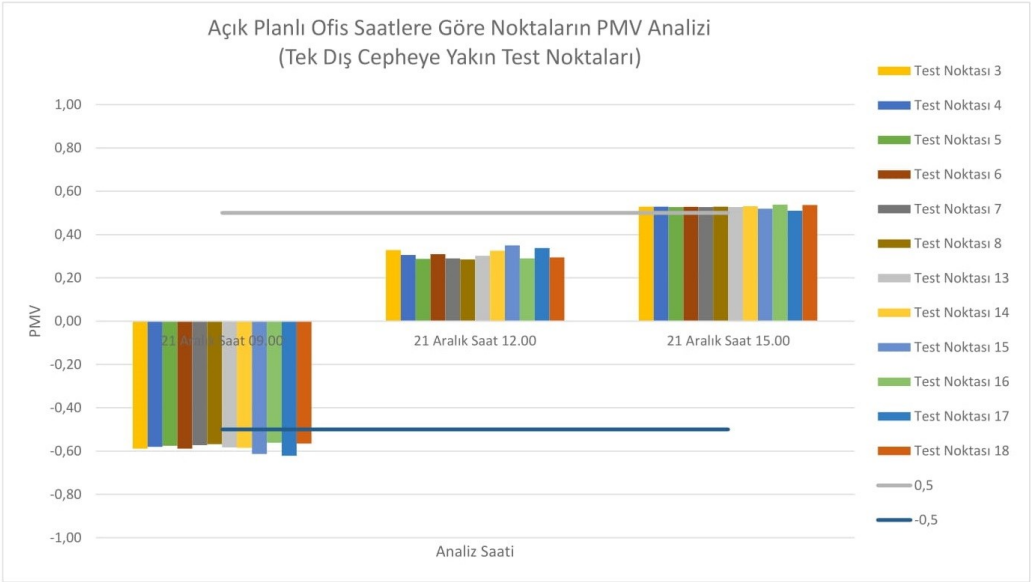

**Şekil 5(b).** Bölünmüş orta derinlikte ofis çift dış cepheye yakın test noktaları 21 Haziran PMV grafiği

Çift dış cepheye yakın test noktaları için PMV değerleri ayrı ayrı değerlendirildiğinde;

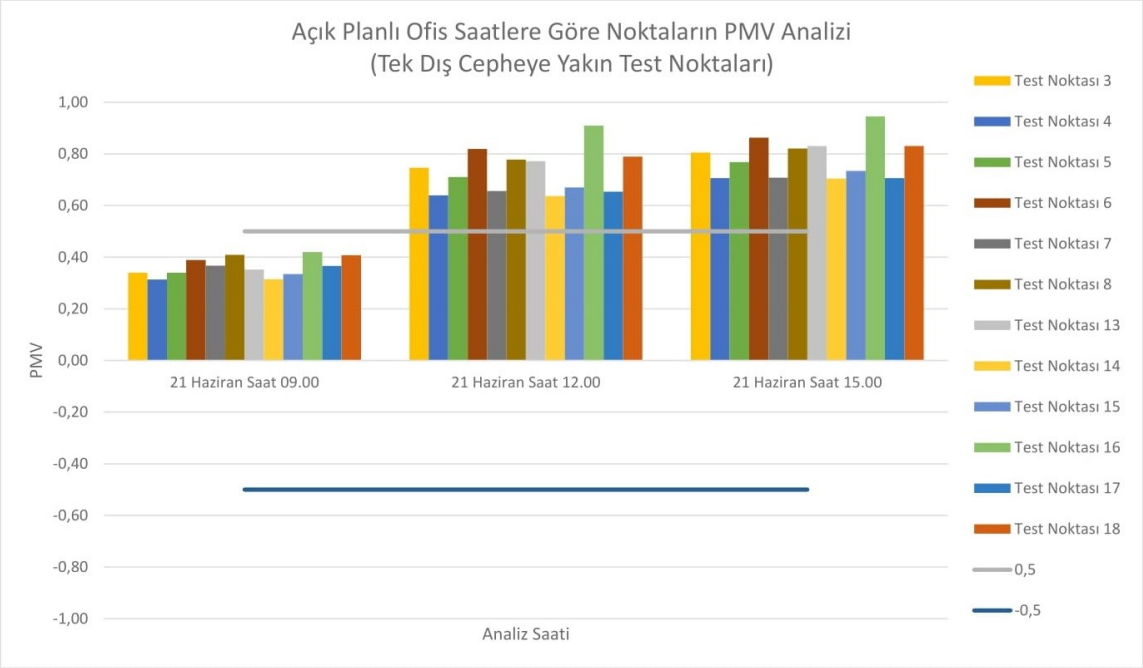
- 21 Aralık için saat 09.00 ve saat 12.00'da elde edilen PMV sonuçları konfor sınırları içerisindedir.
- 21 Aralıkta saat 09.00'da elde edilen PMV sonuçları konforda ve soğuk yönde çıkmıştır. Saat 12.00'da elde edilen PMV sonuçları yine konforda ve sıcak yönde çıkmıştır.
- 21 Aralıkta saat 15.00'da elde edilen PMV sonuçları konfor sınırının biraz üzerindedir.
- 21 Aralıkta çift cephesi dışa bakan hacimlerde, tek cephesi dışa bakan hacimlere göre güneş ışınımları etkisiyle konforlu saatler ve alanlar çok daha fazladır.
- 21 Haziran saat 09.00'da test noktası 9, test noktası 10, test noktası 19 ve test noktası 20 konfor sınırı üzerindedir. Diğerleri konfor aralığındadır.
- 21 Haziran saat 12.00'da yalnızca test noktası 2 ve test noktası 12 konfor aralığındadır. Diğerleri konfor sınırının üzerindedir. Saat 15.00'da bütün noktalar konfor sınırının üzerindedir.
- 21 Haziran için sabah saatlerinde doğu cephesinin daha fazla ısındığı görülmektedir.

### 3.1.2 Açık Planlı Ofis Düzeni Analiz Sonuçları

Açık planlı ofis plan düzeni için elde edilen analizler sonucunda dışa bakan tek cepheye yakın test noktaları ve dışa bakan çift cepheye yakın test noktaları 21 Aralık ve 21 Haziran günleri için ayrı ayrı değerlendirilmiştir.



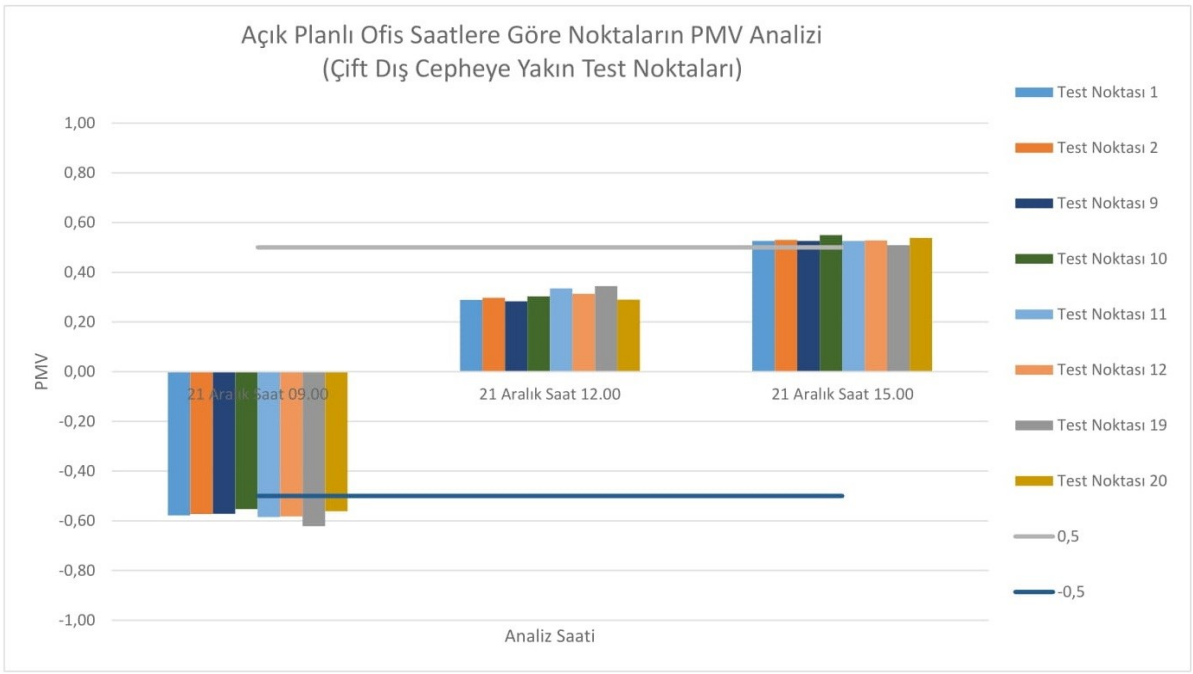

**Şekil 6(a).** Açık planlı ofis tek dış cepheye yakın test noktaları 21 Aralık PMV grafiği



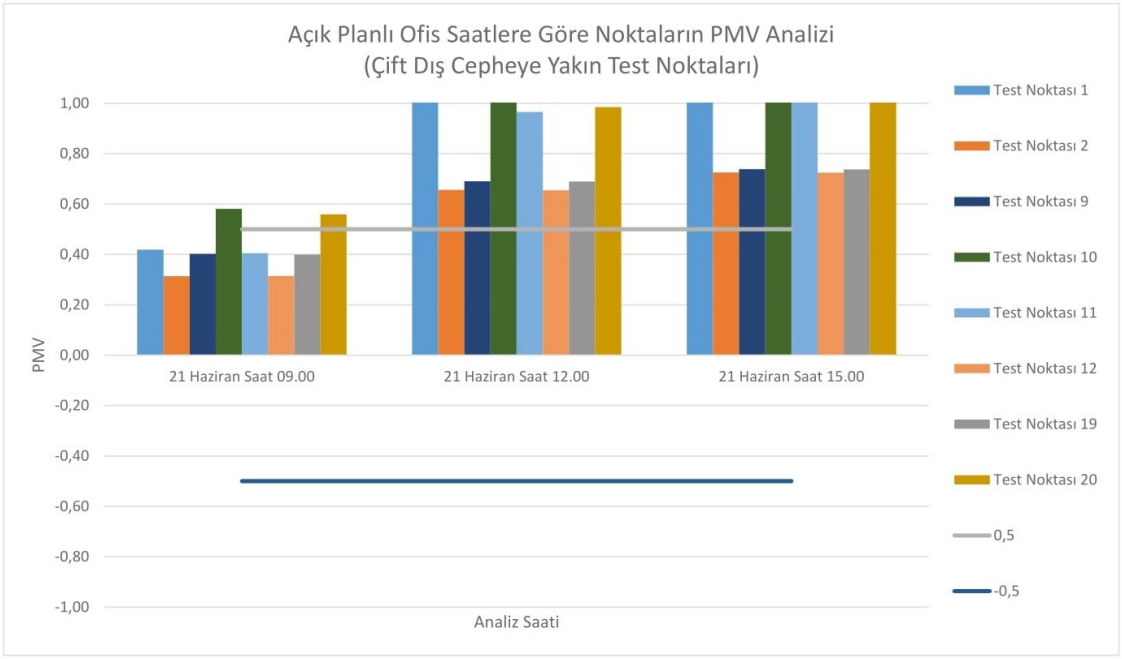

**Şekil 6(b).** Açık planlı tek dış cepheye yakın test noktaları 21 Haziran PMV grafiği

Tek dış cepheye yakın test noktaları için PMV değerleri ayrı ayrı değerlendirildiğinde;

- 21 Aralık için yalnızca saat 12.00'da elde edilen PMV sonuçları konfor sınırları içerisindedir.
- Saat 09.00'da bütün test noktaları için elde edilen PMV değerleri ısıl anlamda konforsuz ve soğuk yöndedir.
- Saat 15.00'da bütün test noktaları için elde edilen PMV değerleri ısıl anlamda sıcak yönde konfor sınırının biraz üzerindedir.
- 21 Haziran için yalnızca saat 09.00'da elde edilen PMV değerleri ısıl konfor sınırları içerisindedir.
- Saat 12.00 ve 15.00'da elde edilen PMV değerleri ısıl anlamda sıcak yönde oldukça konforsuzdur.




**Şekil 7(a).** Açık planlı ofis çift dış cepheye yakın test noktaları 21 Aralık PMV grafiği




**Şekil 7(b).** Açık planlı ofis çift dış cepheye yakın test noktaları 21 Haziran PMV grafiği

Çift dış cepheye yakın test noktaları için PMV değerleri ayrı ayrı değerlendirildiğinde;

- 21 Aralık günü yalnızca saat 12.00'da elde edilen PMV değerleri konfor sınırları içerisindedir.
- Saat 09.00'da elde edilen PMV sonuçları ısıl anlamda konforsuz ve soğuk yönde çıkmıştır. Saat 15.00'da elde edilen PMV sonuçları ısıl anlamda sıcak yöndedir ve konfor sınırının biraz üzerindedir.
- 21 Haziran günü, yalnızca saat 09.00'da doğu cepheye yakın alandaki ofislerde pencere kenarlarında bulunan test noktası 10 ve test noktası 20 haricindeki diğer test noktaları konfor sınırları içerisindedir. Test noktası 10 ve test noktası 20 ısıl anlamda sıcak yönde konfor sınırları üzerindedir.
- Açık planlı ofislerde 21 Aralık gününde tek ve çift dış cepheye yakın noktalar arasında grafikler karşılaştırıldığında önemli bir fark görülmezken, 21 haziran günü çift dış cepheye yakın noktalar tek dış cepheye yakın noktalara göre daha konforludur.

Her iki plan düzenine ait PMV değerleri karşılaştırmalı değerlendirildiğinde;

- 21 Aralık ve 21 Haziran günü açık planlı ofisler, bölünmüş planlamaya göre daha çok noktada ve saatte konforsuzdur.
- Bölünmüş ofis planlamasında tek dış cepheli hacimlerde, dış cepheye yakın test noktalarında, 21 Haziran günü iç mekan konforu 21 Aralığa göre daha konforludur.
- Bölünmüş ofis planlamasında çift dış cepheli hacimlerde, dış cepheye yakın test noktalarında 21 Aralık günü iç mekan konforu 21 Hazirana göre daha konforludur.
- Açık ofis planlamasında hem çift dış cepheye yakın test noktalarında hem de tek dış cepheye yakın test noktalarında 21 Aralık günü iç mekan konforu 21 Hazirana göre daha konforludur.
- Bölünmüş ofis planlamasında, benzer mekanların gruplanarak bölgeleme yapılması, hacmin büyük oranda konforlu hissedilmesine katkı sağlamaktadır.

**4. Sonuç**

İnsanlar yaşamları süresince içinde bulundukları yapılı çevre ile sürekli etkileşim içerisindedir. Yetişkin bireyler, bir gününün yaklaşık sekiz veya dokuz saatini çalışma ve ofis alanlarında geçirmektedir. Bu nedenle ofis alanlarında ısıl konforun sağlanması, sağlıklı bir çalışma ortamı sağlanmasına ve bireylerin çalışma verimlerinin artmasına katkı sağlayacaktır. İç mekan planlamasına ilişkin mekan derinliklerinin, ofis alanlarının konfor koşullarına önemli etkilere sahiptir.

Çalışma kapsamında elde edilen verilerin analizi ve değerlendirilmesi ile bölünmüş ofis planlamasının 21 Aralık ve 21 Haziran gününde açık planlı ofis alanına göre genel olarak daha konforlu olduğu sonucuna ulaşılmıştır.

Veriler sonucunda her iki plan düzeni için ısıtma dönemini temsil eden 21 Aralık gününde ofisler daha konforludur. Standartlara göre seçilen yalıtımlı yapı kabuğu bu durumu sağlamaktadır.

Isıtma dönemini temsil eden 21 Aralık gününde açık planlı ofis alanı için yalnızca saat 09.00'da elde edilen PMV değerleri ısıl anlamda soğuk yönde konfor aralığının dışındadır.

Açık planlı ofis alanında ısı, hacim içerisinde daha homojen yayılım göstermektedir. Bu nedenle ofis alanının tamamı soğuk yönde ya da tamamı sıcak yönde konforsuzluğa yakın olmaktadır.

Soğutma dönemini temsil eden 21 Haziran günü için bölünmüş ofis plan düzeni ve açık ofis plan düzeni karşılaştırıldığında, açık planlı ofis alanında pencere kenarlarından başlayarak çekirdek çeperine kadar alanın tamamı sıcak yönde konforsuzdur. Ancak bölünmüş orta derinlikte ofis alanlarında yalnızca çift dış cepheli ofis alanlarının geneli ısıl yönde konforsuzdur. Bölünmüş orta derinlikte tek dış cepheli ofis alanlarının yalnızca pencere kenarları ısıl anlamda sıcak yönde konforsuzdur. Çekirdek ceperine yakın alanlar konfor aralığındadır.

Kullanıcı yoğunluğuna bağlı olarak ısıl konforda değişiklikler de gözlenmiştir. 21 Aralık günü bölünmüş ofis planlamasında kullanıcı sayısının fazla olması, gün içerisinde öğleden sonraki saatlerde hacmin ısıl anlamda açık planlı ofis alanına göre özellikle tek dış cepheli hacimlerde sıcak yönde konforsuz hissedilmesine neden olmaktadır.

21 Haziran günü pencere boyutlarının büyük olması hacim içerisinde ser etkisi yaratmakta, biriken ısının artmasına neden olmaktadır. Dolayısıyla soğutma dönemini temsil eden 21 Haziran günü için her iki plan düzeninde, saat 12.00 ve saat 15.00'da pencere kenarlarında yer alan test noktalarının PMV değerleri yüksektir. Isıl anlamda sıcak yönde konforsuzdur.

Sonuç olarak, iç planlamaya ilişkin kararlarda büyük açıklığa sahip ofis alanlarını ısıl açıdan denetlemek güçtür. Küçük ofis alanlarına bölünmüş planlamalarda ısıl konfor koşulları açısından daha konforlu alanlar elde edilmektedir. Bu nedenle bölünmüş orta derinlikte ofis alanlarına sahip plan düzeninde, ısıl konfor sağlanan alan yüzdesi açık planlı ofis göre fazladır. Bu çalışmada mekanik sistemle iklimlendirilmiş ofisler karşılaştırılmıştır. İlerideki çalışmalarda; doğal havalandırmalı ofisler karşılaştırılacak ve enerji yükleri kapsamında çalışma ilerletilecektir.

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# The Photovoltaic Facade and its Impact on the Energy Economy of Buildings Located in Semi-arid Areas

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**Abstract**
This article presents the application of a complete methodology to predict the photovoltaic potential using solar panels on the facades of residential buildings in Biskra (Algeria). A theoretical study conducted on a representative urban residential area in Biskra is discussed as an example of the applicability of the methodology.It is based on the determination of the PV installations for the typical facade of the buildings, taking into account the architectural and technical aspects, the solar radiation on each facade is calculated by simulating the path of the sun throughout the year.The proposed solutions are then evaluated using a dynamic energy simulation to determine the most efficient ones, resulting in the potential to exploit PV and solar energy generation. One interesting finding is the gap between the architectural availability and the overall solar suitability of the facade surfaces, and this difference is based on the following main factors: on the one hand, the high density of the built environment composed of high-rise street canyons. Aspect ratio, on the other hand, the changing direction of buildings, and finally classified buildings, with complex geometry.The aim of this work is to discuss the potential of facades and other vertical elements for the photovoltaic potential of solar panels on buildings located in semi-arid regions.
**Keywords:** energy production; solar radiation on facades; photovoltaic façade; semi-arid areas.

# الواجهة الكهروضوئية وتأثيرها على اقتصاد الطاقة للمباني الواقعة في المناطق شبه الجافة

**الملخص**
يقدم هذا المقال تطبيق منهجية كاملة للتنبؤ بالإمكانات الكهروضوئية باستعمال لالواح الشمسية في أسطح واجهات المباني السكنية في بسكرة (الجزائر). تمت مناقشة دراسة نظرية أجريت على منطقة سكنية حضرية تمثيلية في بسكرة كمثال على قابلية تطبيق المنهجية. يعتمد ذلك على تحديد التركيبات الكهروضوئية للواجهة النموذجية للمباني ، مع مراعاة الجوانب المعمارية والتقنية ، يتم حساب الإشعاع الشمسي على كل واجهة عن طريق محاكاة مسار الشمس على مدار العام. يتم بعد ذلك تقييم الحلول المقترحة باستخدام محاكاة ديناميكية للطاقة لتحديد أكثرها كفاءة ، مما أدى إلى إمكانية استغلال الطاقة الكهروضوئية وتوليد الطاقة الشمسية. تتمثل إحدى النتائج المثيرة للاهتمام في الفجوة بين التوافر المعماري والملاءمة الشمسية الإجمالية لأسطح الواجهات ، ويستند هذا الاختلاف إلى العوامل الرئيسية التالية: من ناحية ، الكثافة العالية للبيئة المبنية المكونة من أخاديد شوارع ذات ارتفاع عالٍ. نسبة الارتفاع إلى العرض ، من ناحية أخرى ، الاتجاه المتغير للمباني ، وأخيراً المباني المصنفة ، مع الهندسة المعقدة. الهدف من هذا العمل هو مناقشة إمكانات الواجهات والعناصر الرأسية الأخرى للإمكانات الكهروضوئية للالواح الشمسية على المباني الواقعة في المناطق شبه الجافة.
**الكلمات الدالة**: إنتاج الطاقة ؛ الإشعاع الشمسي على الواجهات ؛ الواجهات الكهروضوئية ؛ المناطق شبه الجافة

## ١. المقدمة

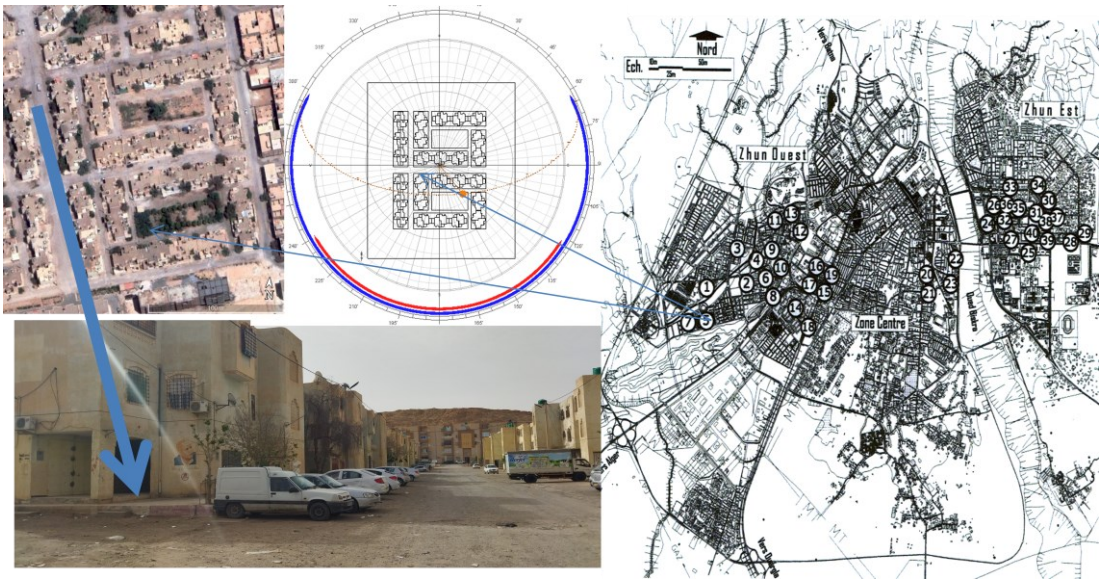
الموارد العالمية من النفط والغاز والفحم واليورانيوم إلخ. تختفي بسرعة. خلال ما لا يزيد عن 50 عامًا ، لن نتحدث عن هذه الطاقات لأن احتياطياتها ستنفد تمامًا وفقًا لتحليلات علمية متخصصة. ليس فقط مشكلة استنفاد هذه الموارد التي تقلق ، ولكن أيضًا من مخاطر الآثار الضارة لغاز ثاني أكسيد الكربون المنبعث في الغلاف الجوي الذي يلوث كوكب الأرض ويهدده بشكل خطير. بدأ سباق مع الزمن بهدف استبدال هذه الطاقات غير المتجددة ومواجهة التحدي المتمثل في هذا الإنذار من الآن فصاعدًا ، أصبح تفاقم البحث العلمي في مجال تطوير الطاقات المتجددة أولوية عالمية كبرى. هذه المصادر متنوعة تمامًا: الطاقة الشمسية وطاقة الرياح والطاقة الحرارية الجوية والطاقة الحرارية المائية والطاقة الحرارية الأرضية والطاقة البحرية والهيدروليكية وتلك من الكتلة الحيوية وغاز الصرف الصحي وغاز مكبات النفايات والغاز الحيوي. تم قطع أشواط عملاقة في مجال الطاقة الشمسية النشطة والسلبية. تعد الطاقة الشمسية الكهروضوئية النشطة (Karakilcik, et al., 2013)واحدة من أكثر الأنظمة تقدمًا في هذه التكنولوجيا ، إن لم تكن الأكثر أهمية. ومع ذلك ، لا يزال يتعين مناقشة فعاليتها ، لا سيما في مجال البناء يعتمد العائد من تحويل الطاقة الكهربائية من أنظمة الألواح الكهروضوئية المدمجة في المباني (L. El Chaar; L.A. lamont; N. El Zein, 2011) سواء على السطح أو على الواجهات على عدة عوامل مثل المجال الشمسي أو توافر الإشعاع الشمسي فيما يتعلق بالمنطقة المناخية ، الطبوغرافيا والتظليل المتبادل للمباني المجاورة. كما يعتمد أيضًا على الخصائص المتعلقة بالمواد المكونة للألواح الكهروضوئية وأبعادها وهندستها وخاصة ميلها واتجاهها فيما يتعلق بالنقاط الأساسية (Balo, Figen; Şağbanşua, Lütfü, 2016).

. فيما يتعلق بتراكم الطاقة ، فإن الإشعاع الشمسي المباشر على الألواح الكهروضوئية يتجاوز بكثير الإشعاع المنتشر في السماء. هذا هو السبب في أنه من الضروري دراسة كل هذه العوامل والخصائص من أجل تحقيق أقصى قدر من التحسين لتطبيقها في ظل ظروف محددة.

في هذه الورقة البحثية ، نحاول أن نظهر إلى أي حدود يمكن أن يكون النظام الكهروضوئي فعالاً في إنتاج الكهرباء من خلال تطبيق ما بعد المهني لنوع تم اختياره جيدًا من الألواح الكهروضوئية على واجهات وأسطح المباني. مثال حقيقي على البنايات. يتضمن الاختبار تحليلًا تقييميًا لما بعد المهنة يقارن الطاقة الناتجة عن الإشعاع المباشر للشمس على الأسطح وأسطح الواجهة مع تلك الناتجة عن التحويل إلى كهرباء من الألواح الكهروضوئية المستخدمة تقريبًا باستخدام البرامج المناسبة (Trisnawan, D. , 2018) في ظل الظروف المثلى المفترض بمقارنة الكل بالمتوسط الحقيقي لاستهلاك الكهرباء للمنازل.

**٢. عرض دراسة الحالة**

تمثل دراسة الحالة من مجموعة من المساكن شبه الجماعية 350/104 تتكون من طابق الى طابقين R + 2 و R + 1 تقع في واحدة من أهم رواسب الطاقة الشمسية في العالم. و هي الصحراء الكبرى للجزائر ، وبالتحديد منطقة بسكرة ذات المناخ شبه الجاف: مدينة في جنوب شرق الجزائر. إنها مجموعة من المباني تتكون من التخطيط المتكرر لمتغيرين كتلتين كما هو موضح في الشكل 1



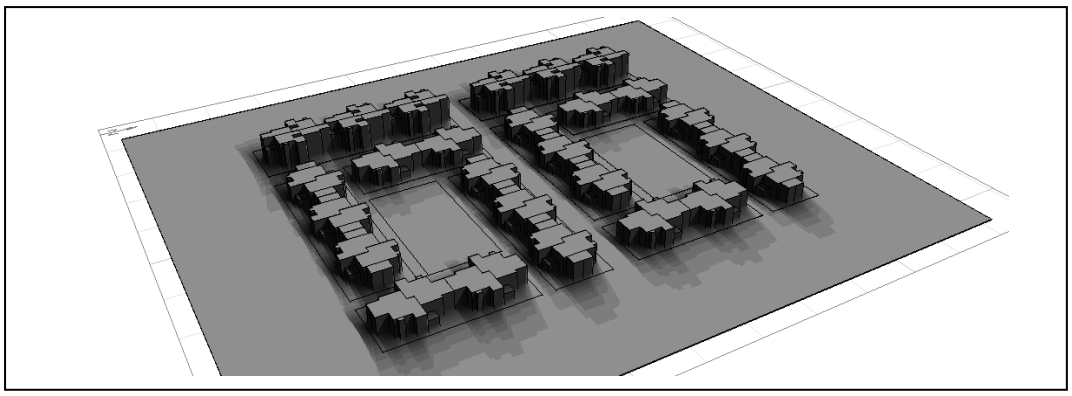

**الشكل 1** عرض تقديمي لدراسة الحالة.

يعتبر استخدام الطاقة الشمسية وتكنولوجيا استخلاصها باستخدام نظام الألواح الكهروضوئية في صميم بحثنا. فيما يلي سوف ندرس استخراج الطاقة باستخدام الخلايا الشمسية. بدأ تصنيع هذه الخلايا في الخمسينيات من القرن الماضي ، وكانت أول خلية شمسية مصنوعة من السيليكون (Tareq S. et al, 2021)، ومنذ ذلك الحين وحتى الآن ، تم إجراء العديد من التعديلات على تصنيع هذه الخلايا ، وكذلك في توسيع قاعدة مواد مناسبة لهذه الخلايا. لا تزال الأبحاث جارية في هذا المجال لتقليل تكلفة هذه الخلايا وزيادة أدائها. حاليًا ، نبحث عن نماذج أخرى غير خلايا السيليكون ، مثل: سيلينيوم الكادميوم ، كبريتيد النحاس ، كبريتيد الكادميوم ، إلخ. يستمر البحث في تحسين فعاليتها باستمرار.

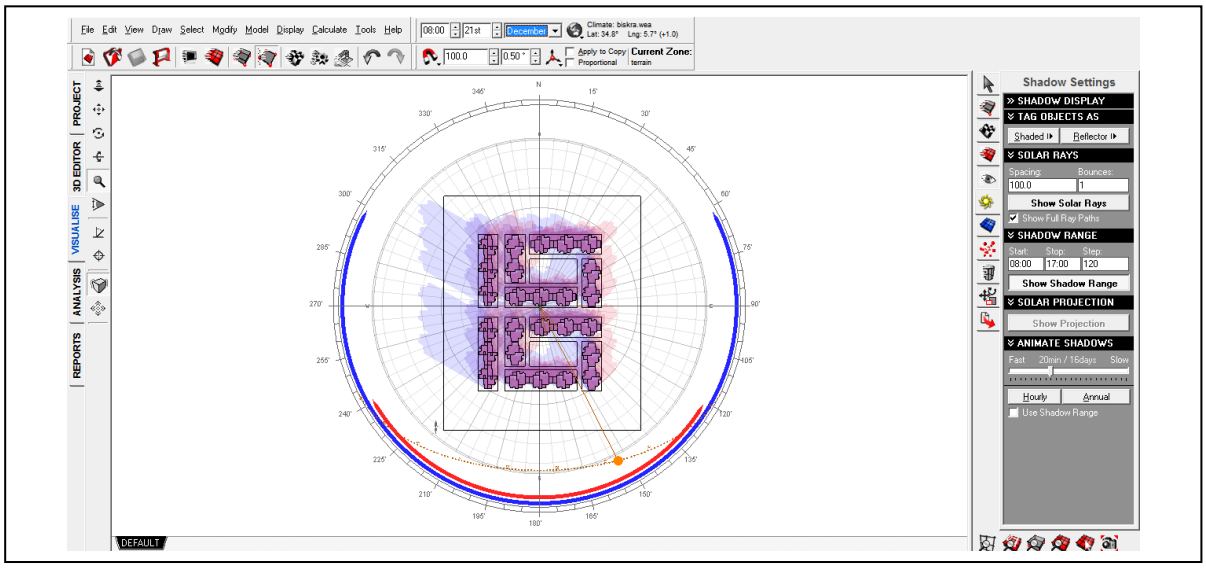
يوجد نموذجان رئيسيان للألواح الشمسية: الألواح الشمسية أحادية البلورية و متعددة الكريستالات (Eke, Rustu; Demircan, Huseyin, 2013)وهي أكثر أجهزة استقبال الطاقة الشمسية شيوعًا. هذان النوعان من الألواح الشمسية لهما نفس الغرض والوظيفة. ومع ذلك ، فإن الاختلاف بين الاثنين يكمن في تكوين مادة السيليكون. الأبعاد النموذجية هي 165.1 × 99.06 سم ، أي ما يعادل 536.5 سم² لكل لوح ، لكن الألواح أحادية البلورية توفر المزيد من الكهرباء. يمكن أن تنتج الألواح متعددة الكريستالات 300 واط ، بينما تنتج الألواح أحادية البلورية من نفس الحجم 350 واط .(Waqar Akram et al. , 2019)

**٣. المنهجية**

يتضمن هذا البحث تحليلًا تقييميًا بمقارنة متوسط استهلاك الكهرباء المباشر للمنازل مع متوسط التحويل إلى كهرباء للألواح الكهروضوئية المستخدمة فعليًا باستخدام برامج مناسبة في ظل الظروف المثلى المفترضة. كل هذا في مواجهة مساهمة الطاقة الشمسية الطبيعية التي تستفيد منها الاغلفة الخارجية وسطح المباني للقيام بذلك ، اشتملت المرحلة الأولى من العمل في الموقع على جمع البيانات المقابلة لمتوسط الاستهلاك السنوي الفعلي لـ 104 مسكنًا معنيًا بالدراسة باستخدام مراجعة الفواتير المسجلة فعليًا خلال عام 2021. في المرحلة الثانية ، تم تمكين الكشف عن مساحات غلاف المباني الأكثر تعرضًا للإشعاع المباشر من الشمس باستخدام برنامج محاكاة .ECOTECT يتكون هذا العمل من إدخال النموذج الرقمي ثلاثي الأبعاد لجميع المساكن التي تمت دراستها. انظر الشكل 2 و 3. للسماح لهذه المحاكاة بالواقع ، تم إنجاز عمل لربط الإحداثيات الدولية والبيانات المناخية (Sommerfeldt, Nelson; Madani, Hatef, 2019) . المتعلقة ببدايات الفصول: 21 سبتمبر ، 21 ديسمبر ، 21 مارس و 21 يونيو 2021 . في الخطوة الثالثة ، بناءً على النتائج التي تم الحصول عليها من خلال هذه المحاكاة ، تم السماح بإجراء تحليل تقييمي ومقارن بين ما تحوله اللوحة الكهروضوئية المعتمدة إلى طاقة كهربائية وتلك المستهلكة بالفعل.



**الشكل 2.** نموذج رقمي ثلاثي الأبعاد يحاكي دراسة الحالة.




**الشكل 3.** محاكاة للإشعاع الشمسي الساقط بواسطة برنامج ECOTECT.

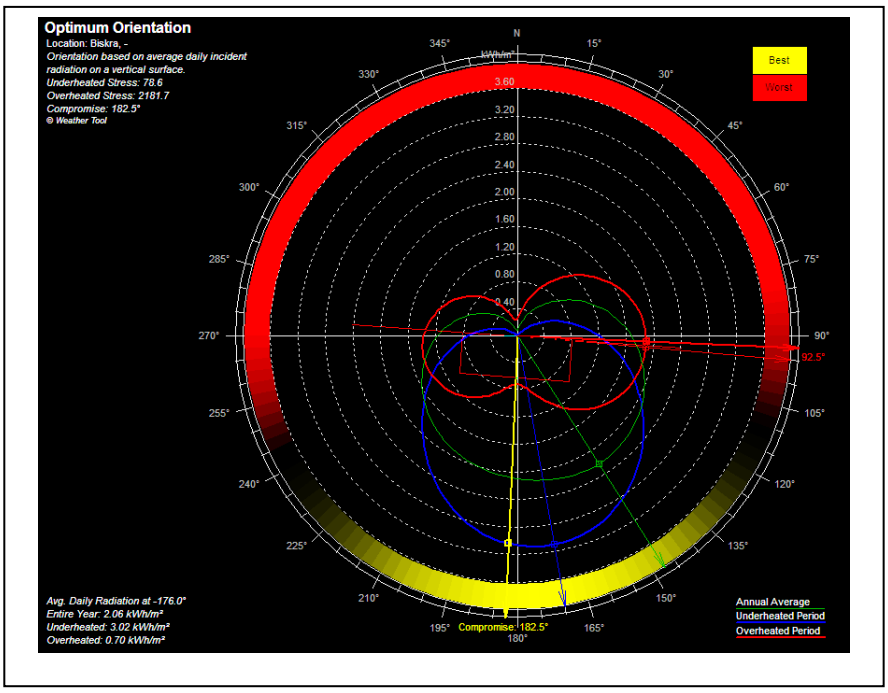
### ٤. النتائج مع تحليلها

لقد قمنا بجمع البيانات ميدانيا لمتوسط 04 فواتير للاستهلاك الكهربائي السنوية على اربع فترات لدراسة الحالة الخاصة بنا المتعلقة بعام 2021 كماهو موضح بالجدول 1.

الجدول 1: متوسط استهلاك الطاقة الكهربائية سنويًا على اربع فترات للمجموعة السكنية المكونة من 350/104 من المساكن شبه الجماعية

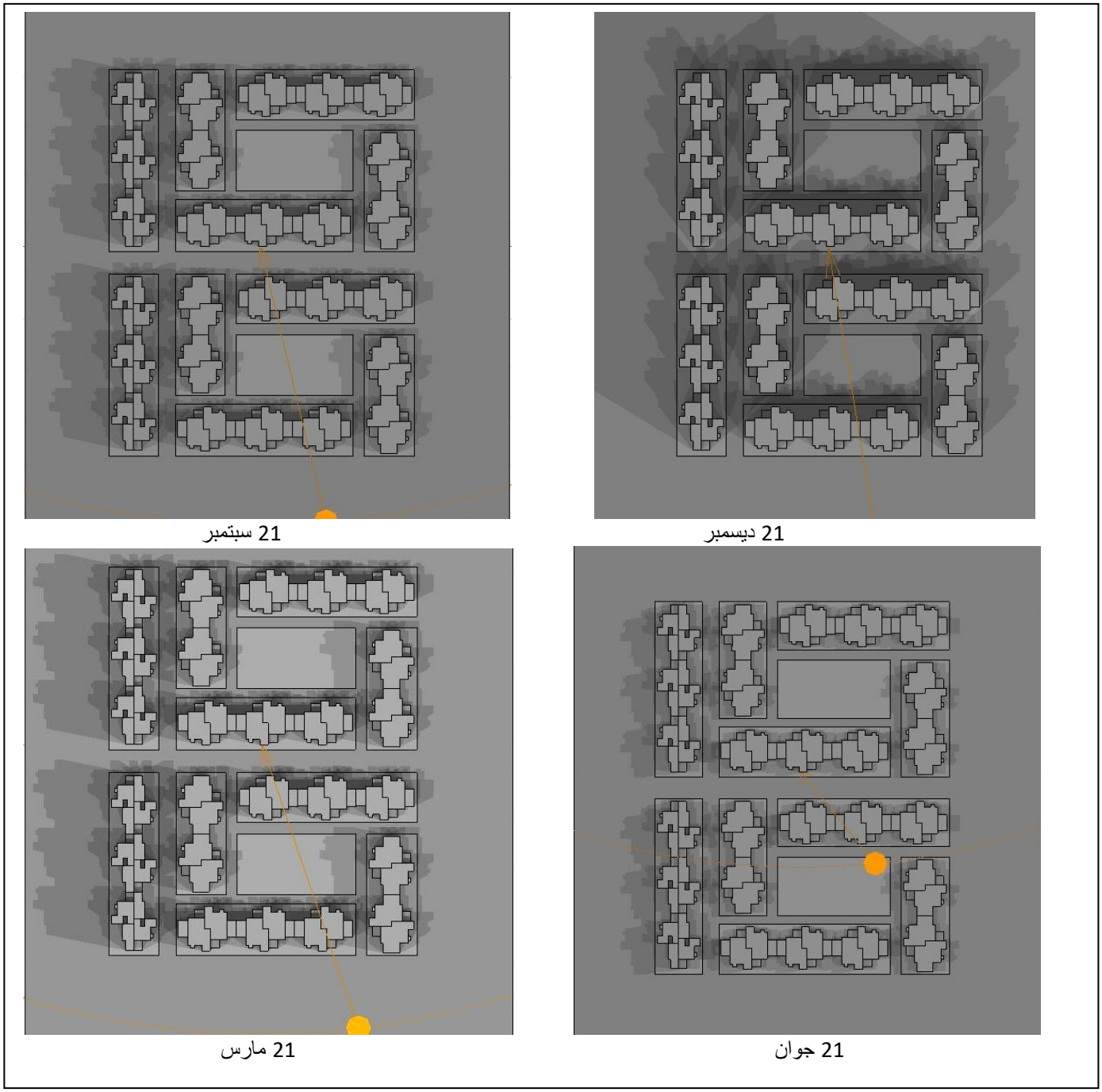
| الفترة التي نم فيها استهلاك الطاقة الكهربائية | الكمية المستهلكة Kwh ب |
|---|---|
| الربع الأول من 01 يناير 2021 إلى 31 مارس 2021 | 823 |
| الربع الثاني من 1 أبريل 2021 إلى 30 يونيو 2021 | 770 |
| الربع الثالث من 1 يوليو 2021 إلى 30 سبتمبر 2021 | 2314 |
| الربع الرابع من 1 أكتوبر إلى 31 ديسمبر 2021 | 946 |
| المجموع السنوي لعام 2021 ..... | 504712 |

سمح لنا استخدام برنامج ECOTECT. (Amani, N. , 2018) باكتشاف أفضل اتجاه لغلاف المباني الواقعة في المنطقة المعنية بالدراسة لاستقبال الأشعة الشمسية المباشرة ، وهي الزاوية المفتوحة من الجنوب إلى الجنوب الغربي كما هو موضح باللون الأصفر في الشكل. أدناه (الشكل 4).

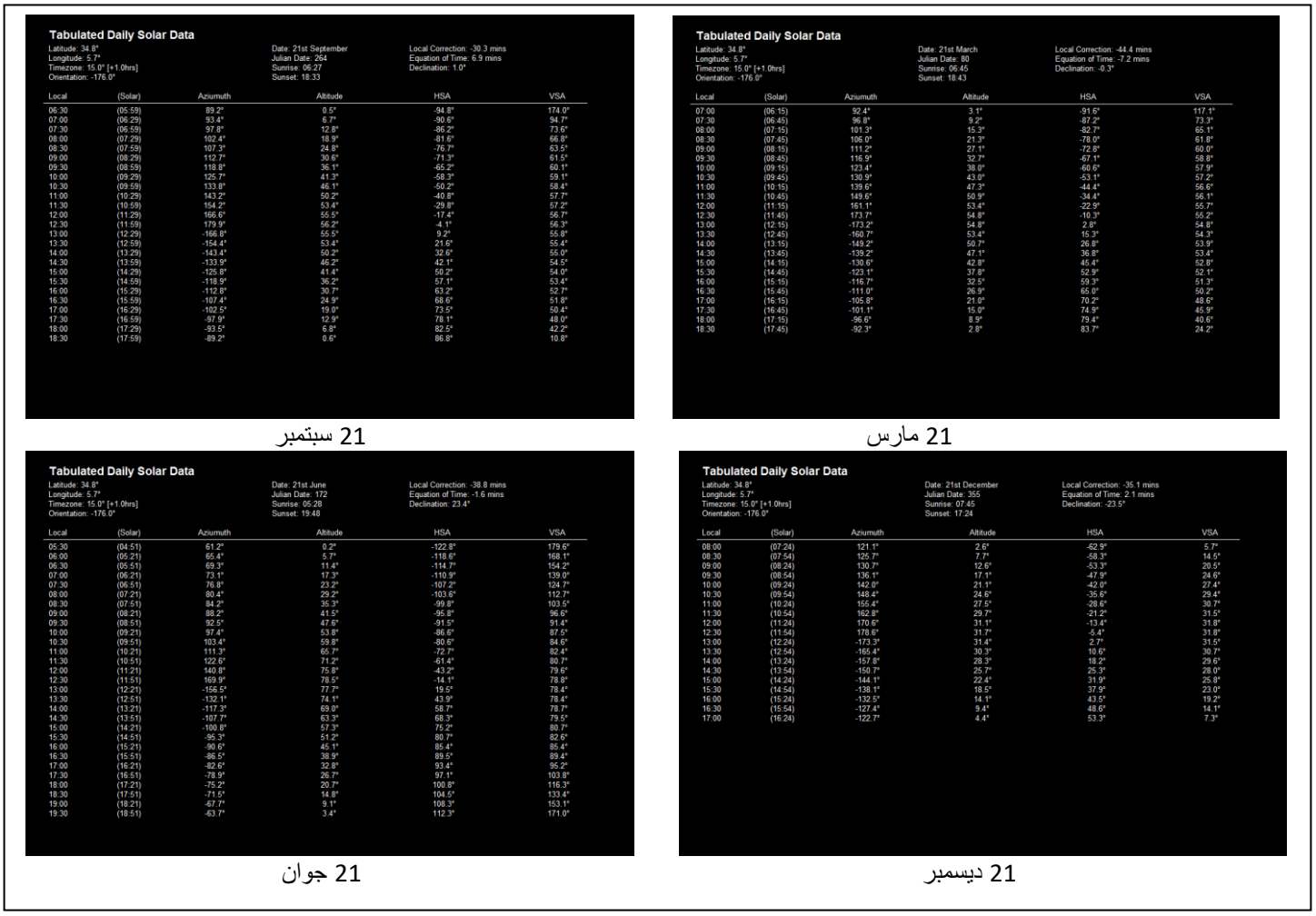



**الشكل 4.** الاتجاه الأمثل لغلاف المباني المعنية بالدراسة لتحقيق أقصى مساهمة للطاقة الشمسية.

وبعدها قمنابعمل نمذجة ثلاثية الأبعاد لدراسة الحالة باستخدام Archicad ثم تصديره كنموذج رقمي إلى ECOTECT من أجل إكمال المحاكاة مع مراعاة البيانات المناخية والموقع فيما يتعلق بالإحداثيات الدولية. لقد اخترنا اليوم الأول من كل فصل من عام 2021. تم قياس التأثير المحلل للإشعاع الشمسي من الساعة 8 صباحًا حتى الساعة 5 مساءً. كل ساعتين بين القياس والساعة التي تليها. تم تمثيل التأثير من خلال الظل الخاص ، الظل المسقط على الأرض (أفقيًا تقريبًا لهذا الجزء من المدينة) والظل الذي تم عرضه بشكل متبادل بين الواجهات (Karakilcik, Mehmet et al., 2013). يشير التمثيل إلى تراكب 05 رسومات تحاكي هذه الظلال. انظر الشكل 5.والشكل 6.




**الشكل 5.** محاكاة لتأثير الإشعاع الشمسي عن طريق التمثيل البياني للظل



**Tabulated Daily Solar Data**

Latitude: 34.8° | Longitude: 5.7° | Timezone: 15.0° [+1.0hrs] | Orientation: -176.0°
Date: 21st March | Julian Date: 80 | Sunrise: 06:45 | Sunset: 18:43
Local Correction: -44.4 mins | Equation of Time: -7.2 mins | Declination: -0.3°

| Local | (Solar) | Aziumuth | Altitude | HSA | VSA |
|---|---|---|---|---|---|
| 07:00 | (06:15) | 92.4° | 3.1° | -91.6° | 117.1° |
| 07:30 | (06:45) | 96.8° | 9.2° | -87.2° | 73.3° |
| 08:00 | (07:15) | 101.3° | 15.3° | -82.7° | 65.1° |
| 08:30 | (07:45) | 106.0° | 21.3° | -78.0° | 61.8° |
| 09:00 | (08:15) | 111.2° | 27.1° | -72.8° | 60.0° |
| 09:30 | (08:45) | 116.9° | 32.7° | -67.1° | 58.8° |
| 10:00 | (09:15) | 123.4° | 38.0° | -60.6° | 57.9° |
| 10:30 | (09:45) | 130.9° | 43.0° | -53.1° | 57.2° |
| 11:00 | (10:15) | 139.6° | 47.3° | -44.4° | 56.6° |
| 11:30 | (10:45) | 149.6° | 50.9° | -34.4° | 56.1° |
| 12:00 | (11:15) | 161.1° | 53.4° | -22.9° | 55.7° |
| 12:30 | (11:45) | 173.7° | 54.8° | -10.3° | 55.2° |
| 13:00 | (12:15) | -173.2° | 54.8° | 2.8° | 54.8° |
| 13:30 | (12:45) | -160.7° | 53.4° | 15.3° | 54.3° |
| 14:00 | (13:15) | -149.2° | 50.7° | 26.8° | 53.9° |
| 14:30 | (13:45) | -139.2° | 47.1° | 36.8° | 53.4° |
| 15:00 | (14:15) | -130.6° | 42.8° | 45.4° | 52.8° |
| 15:30 | (14:45) | -123.1° | 37.8° | 52.9° | 52.1° |
| 16:00 | (15:15) | -116.7° | 32.5° | 59.3° | 51.3° |
| 16:30 | (15:45) | -111.0° | 26.9° | 65.0° | 50.2° |
| 17:00 | (16:15) | -105.8° | 21.0° | 70.2° | 48.6° |
| 17:30 | (16:45) | -101.1° | 15.0° | 74.9° | 45.9° |
| 18:00 | (17:15) | -96.6° | 8.9° | 79.4° | 40.6° |
| 18:30 | (17:45) | -92.3° | 2.8° | 83.7° | 24.2° |

21 مارس

**Tabulated Daily Solar Data**

Latitude: 34.8° | Longitude: 5.7° | Timezone: 15.0° [+1.0hrs] | Orientation: -176.0°
Date: 21st September | Julian Date: 264 | Sunrise: 06:27 | Sunset: 18:33
Local Correction: -30.3 mins | Equation of Time: 6.9 mins | Declination: 1.0°

| Local | (Solar) | Aziumuth | Altitude | HSA | VSA |
|---|---|---|---|---|---|
| 06:30 | (05:59) | 89.2° | 0.5° | -94.8° | 174.0° |
| 07:00 | (06:29) | 93.4° | 6.7° | -90.6° | 94.7° |
| 07:30 | (06:59) | 97.8° | 12.8° | -86.2° | 73.6° |
| 08:00 | (07:29) | 102.4° | 18.9° | -81.6° | 66.8° |
| 08:30 | (07:59) | 107.3° | 24.8° | -76.7° | 63.5° |
| 09:00 | (08:29) | 112.7° | 30.6° | -71.3° | 61.5° |
| 09:30 | (08:59) | 118.8° | 36.1° | -65.2° | 60.1° |
| 10:00 | (09:29) | 125.7° | 41.3° | -58.3° | 59.1° |
| 10:30 | (09:59) | 133.8° | 46.1° | -50.2° | 58.4° |
| 11:00 | (10:29) | 143.2° | 50.2° | -40.8° | 57.7° |
| 11:30 | (10:59) | 154.2° | 53.4° | -29.8° | 57.2° |
| 12:00 | (11:29) | 166.6° | 55.5° | -17.4° | 56.7° |
| 12:30 | (11:59) | 179.9° | 56.2° | -4.1° | 56.3° |
| 13:00 | (12:29) | -166.8° | 55.5° | 9.2° | 55.8° |
| 13:30 | (12:59) | -154.4° | 53.4° | 21.6° | 55.4° |
| 14:00 | (13:29) | -143.4° | 50.2° | 32.6° | 55.0° |
| 14:30 | (13:59) | -133.9° | 46.2° | 42.1° | 54.5° |
| 15:00 | (14:29) | -125.8° | 41.4° | 50.2° | 54.0° |
| 15:30 | (14:59) | -118.9° | 36.2° | 57.1° | 53.4° |
| 16:00 | (15:29) | -112.8° | 30.7° | 63.2° | 52.7° |
| 16:30 | (15:59) | -107.4° | 24.9° | 68.6° | 51.8° |
| 17:00 | (16:29) | -102.5° | 19.0° | 73.5° | 50.4° |
| 17:30 | (16:59) | -97.9° | 12.9° | 78.1° | 48.0° |
| 18:00 | (17:29) | -93.5° | 6.8° | 82.5° | 42.2° |
| 18:30 | (17:59) | -89.2° | 0.6° | 86.8° | 10.8° |

21 سبتمبر

**Tabulated Daily Solar Data**

Latitude: 34.8° | Longitude: 5.7° | Timezone: 15.0° [+1.0hrs] | Orientation: -176.0°
Date: 21st December | Julian Date: 355 | Sunrise: 07:45 | Sunset: 17:24
Local Correction: -35.1 mins | Equation of Time: 2.1 mins | Declination: -23.5°

| Local | (Solar) | Aziumuth | Altitude | HSA | VSA |
|---|---|---|---|---|---|
| 08:00 | (07:24) | 121.1° | 2.6° | -52.9° | 5.7° |
| 08:30 | (07:54) | 125.7° | 7.7° | -58.3° | 14.5° |
| 09:00 | (08:24) | 130.7° | 12.6° | -53.3° | 20.5° |
| 09:30 | (08:54) | 136.1° | 17.1° | -47.9° | 24.6° |
| 10:00 | (09:24) | 142.8° | 21.1° | -42.0° | 27.4° |
| 10:30 | (09:54) | 148.4° | 24.6° | -35.6° | 29.4° |
| 11:00 | (10:24) | 155.4° | 27.5° | -28.6° | 30.7° |
| 11:30 | (10:54) | 162.8° | 29.7° | -21.2° | 31.5° |
| 12:00 | (11:24) | 170.6° | 31.1° | -13.4° | 31.8° |
| 12:30 | (11:54) | 178.6° | 31.7° | -5.4° | 31.8° |
| 13:00 | (12:24) | -173.3° | 31.4° | 2.7° | 31.5° |
| 13:30 | (12:54) | -165.4° | 30.3° | 10.6° | 30.7° |
| 14:00 | (13:24) | -157.8° | 28.3° | 18.2° | 29.6° |
| 14:30 | (13:54) | -150.7° | 25.7° | 25.3° | 28.0° |
| 15:00 | (14:24) | -144.1° | 22.4° | 31.9° | 25.8° |
| 15:30 | (14:54) | -138.1° | 18.5° | 37.9° | 23.0° |
| 16:00 | (15:24) | -132.5° | 14.1° | 43.5° | 19.2° |
| 16:30 | (15:54) | -127.4° | 9.4° | 48.6° | 14.1° |
| 17:00 | (16:24) | -122.7° | 4.4° | 53.3° | 7.3° |

21 ديسمبر

**Tabulated Daily Solar Data**

Latitude: 34.8° | Longitude: 5.7° | Timezone: 15.0° [+1.0hrs] | Orientation: -176.0°
Date: 21st June | Julian Date: 172 | Sunrise: 05:28 | Sunset: 19:48
Local Correction: -38.8 mins | Equation of Time: -1.6 mins | Declination: 23.4°

| Local | (Solar) | Aziumuth | Altitude | HSA | VSA |
|---|---|---|---|---|---|
| 05:30 | (04:51) | 61.2° | 0.2° | -122.8° | 179.6° |
| 06:00 | (05:21) | 65.4° | 5.7° | -118.6° | 168.1° |
| 06:30 | (05:51) | 69.3° | 11.4° | -114.7° | 154.2° |
| 07:00 | (06:21) | 73.1° | 17.3° | -110.9° | 139.0° |
| 07:30 | (06:51) | 76.8° | 23.2° | -107.2° | 124.7° |
| 08:00 | (07:21) | 80.4° | 29.2° | -103.6° | 112.7° |
| 08:30 | (07:51) | 84.2° | 35.3° | -99.8° | 103.5° |
| 09:00 | (08:21) | 88.2° | 41.5° | -95.8° | 96.6° |
| 09:30 | (08:51) | 92.5° | 47.6° | -91.5° | 91.4° |
| 10:00 | (09:21) | 97.4° | 53.8° | -86.6° | 87.5° |
| 10:30 | (09:51) | 103.4° | 59.8° | -80.6° | 84.6° |
| 11:00 | (10:21) | 111.3° | 65.7° | -72.7° | 82.4° |
| 11:30 | (10:51) | 122.6° | 71.2° | -61.4° | 80.7° |
| 12:00 | (11:21) | 140.8° | 75.8° | -43.2° | 79.6° |
| 12:30 | (11:51) | 169.9° | 78.5° | -14.1° | 78.8° |
| 13:00 | (12:21) | -156.5° | 77.7° | 19.5° | 78.4° |
| 13:30 | (12:51) | -132.1° | 74.1° | 43.9° | 78.4° |
| 14:00 | (13:21) | -117.3° | 69.0° | 58.7° | 78.7° |
| 14:30 | (13:51) | -107.7° | 63.3° | 68.3° | 79.5° |
| 15:00 | (14:21) | -100.8° | 57.3° | 75.2° | 80.7° |
| 15:30 | (14:51) | -95.3° | 51.2° | 80.7° | 82.6° |
| 16:00 | (15:21) | -90.6° | 45.1° | 85.4° | 85.4° |
| 16:30 | (15:51) | -86.5° | 38.9° | 89.5° | 89.4° |
| 17:00 | (16:21) | -82.6° | 32.8° | 93.4° | 95.2° |
| 17:30 | (16:51) | -78.9° | 26.7° | 97.1° | 103.8° |
| 18:00 | (17:21) | -75.2° | 20.7° | 100.8° | 116.3° |
| 18:30 | (17:51) | -71.5° | 14.8° | 104.5° | 133.4° |
| 19:00 | (18:21) | -67.7° | 9.1° | 108.3° | 153.1° |
| 19:30 | (18:51) | -63.7° | 3.4° | 112.3° | 171.0° |

21 جوان

**الشكل 6.** تمثيل البيانات الشمسية اليومية من شروق الشمس إلى غروبها مقارنة بدراسة الحالة لبدايات الفصول الأربعة من السنة

يوضح الشكل أعلاه ، في المقام الأول ، مع الأدلة ، حدوث سقوط دائم على السطح الأفقي للمباني. هذا ليس هو الحال بالنسبة لمختلف الاغلفة للمباني. في الواقع ، فإن الواجهات الجنوبية والجنوبية الغربية هي التي تتلقى الحد الأقصى من الإشعاع الشمسي المباشر. تم عمل تلخيص لأسطح الاغلفة التي لها هذا الاتجاه وتلخيصها في الجدول 2 التالي. من أجل تثبيت الالواح الكهروضوئية تقريبًا (Sharma, et al. , 2013)، نأخذ أسطح الواجهات الأكثر تعرضًا للإشعاع الشمسي المباشر ، والمتمثلة في السطح والواجهة الجنوبية و الواجهة الجنوبية الغربية.

**جدول 02.** مساحة الاغلفة وسطح المباني في دراسة الحالة حسب اتجاهها.

| الواجهات | الواجهة الغربية(م2) | الواجهة الشرقية (م2 ) | الواجهة الجنوبية (م2) | الواجهة الشمالية(م2) | السطح (م2) |
|---|---|---|---|---|---|
| المساحة ب (م2) | 2736 | 2736 | 2232 | 2232 | 7488 |

لقد اخترنا الألواح الكهروضوئية فئة أحادية البلورية بسطح خلية كهروضوئية تبلغ 536.5 سم 2 وهي الأكثر انتشارًا وذات كفاءة عالية (attaqa.net/2021) و (Bogacka, M.; Pikoń, K.; Landrat, M., 2017). تنتج 536.5/350 (واط/ سم2) . انظر الجدول 3.

.

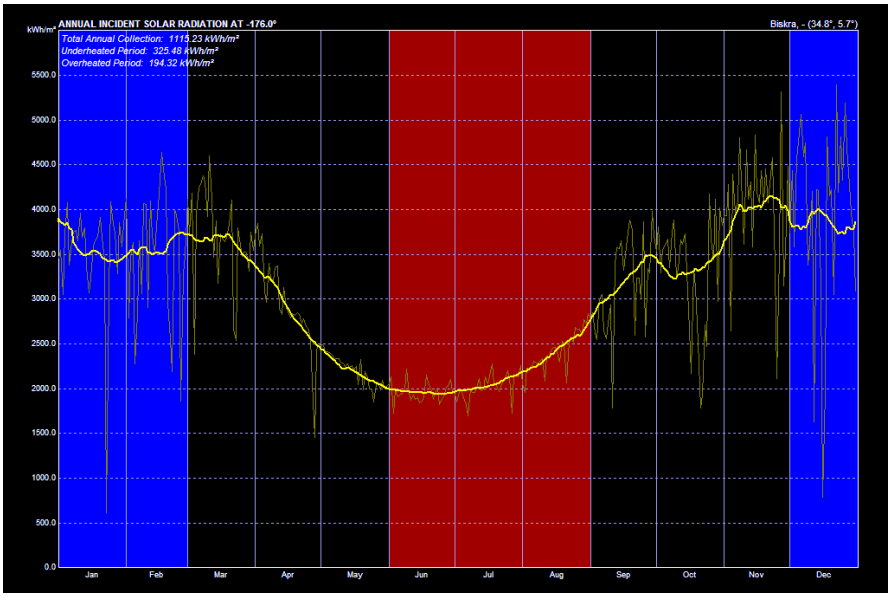
**الجدول 3.** أسطح المغلف وسقف المباني في دراسة الحالة حسب اتجاهها.

| الواجهات | الواجهة الغربية | الواجهة الجنوبية | السطح |
|---|---|---|---|
| المساحة ب (م2) | 2736 | 2232 | 7488 |
| المساحة الاجمالية للالواح الكهروضوئية | 12456 م2 | | |
| انتاج الطاقة الكهربائية حسب اتجاه الواجهات ( مساحة الخلية الضوئية 536.5 سم2 تنتج 350 واط ) | 17865671.64 واط | 14568097.01 واط | 48849953.40 واط |
| الانتاج الاجمالي للطاقة بواسطة الالواح الكهرضوئية المركبة .....81283722.05 واط | | | |

إذا كان متوسط فاتورة استهلاك الكهرباء السنوية الفعلية لدراسة الحالة هو

504712000.00 واط وكان التحويل إلى طاقة كهربائية من الألواح الكهروضوئية المقترحة هو 81283722.05 واط ، فسيكون من الواضح أن هذا التحويل يمثل 16٪ فقط من هذه الفاتورة.

أعطت محاكاة كسب الطاقة الشمسية على الغلاف وسطح المباني المدروسة ، مع مراعاة الإحداثيات الجغرافية لدراسة الحالة ، القيم التالية: التجميع السنوي 1115.23 كيلووات ساعة / متر مربع. انظر الشكل 7.




**الشكل 7.** الإشعاع الشمسي السنوي الساقط على الواجهات وسطح المباني في دراسة الحالة.

سجلت نفس الأسطح المعرضة سنويًا للطاقة الشمسية الطبيعية المباشرة ، ومع ذلك ، فإن إجمالي مساهمة الطاقة هو 13891304900.00 واط يمثل هذا فرقًا قدره 13891304900.00 – 81283722.05 = 13810021177.95 واط مهدرة في الغلاف الجوي. النسبة المئوية للتحويل بواسطة PV ضئيلة للغاية تمثل (0.58٪).

### ٥. الخلاصة

اقترحت هذه الدراسة منهجية محاكاة عملية وذلك بمقارنة بين كمية الطاقة الكهربائية المستهلكة في المساكن التي تم تحليلها والتي تم تحويلها بواسطة نظام الطاقة الكهروضوئية المثبت فعليًا على سطح المباني ومغلفها. كل هذا واجهه مساهمة الطاقة للشمس في نفس المنطقة وبنفس الظروف المناخية. أظهر تحليل النتائج وتفسيرها أن كمية الطاقة المحولة إلى كهرباء بواسطة الخلايا الكهروضوئية المعتمدة لا تزال بعيدة جدًا عن الكمية المستهلكة فعليًا وتمثل 16٪ فقط. وهو أمر غير معتبر. من ناحية أخرى ، ومقارنة بالمساهمة المباشرة للطاقة الشمسية الطبيعية ، الالواح الكهرضوئية المستعملة يمكن أن تحول من الطاقة الشمسية الى طاقة كهروضوئية مانسبته 0.585٪ فقط من الطاقة الشمسية هذا في المناطق الجافة وشبه الجافة ، وهو أمر ضئيل للغاية ويتبدد الجزء الأكبر المتبقي من هذه المساهمة الطبيعية في الغلاف الجوي.

وهذا يقودنا إلى المطالبة بالمزيد من تشجيع البحث العلمي في هذا المجال وتعزيز تطوير التقنيات الجديدة المتعلقة بتصنيع الخلايا الكهروضوئية التي ستكون أرخص وأكثر كفاءة وأكثر دواما وقبل كل شيء في متناول الجميع.

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# Elements of Biophilic Interior Design in Healthcare Environments Case Study: The Libyan European Hospital (LEH), Benghazi.

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**Abstract**
Natural environments are instrumental in increasing the chances of recovery due to their positive improvement in the cognitive, physical, and social performance of humans. It also reduces stress levels because of its ability to provide a sense of control and privacy, provide opportunities for social interaction and physical activities and promote positive responses to public health through association with natural systems. The study aims to develop evidence-based biophilic interior design solutions in healthcare environments. Multiple disciplines and proposed guidelines are hypotheses on how to design more with nature for human well-being. They provide support and design considerations for psychological responses to nature in the interior healthcare environment. The study will proceed in applying the biophilic patterns on LEH hospital in Benghzi as a restoration project. The paper therefore concludes the possibility of incorporating biophilic design to integrate nature in hospitals environments.
**Keywords:** Biophilia; Biophilic design; Wellbeing; Nature, Hospital.

# عناصر التصميم الداخلي البايوفيلي وتطبيقاتها في بيئات الرعاية الصحية (المستشفي الليبي الأوروبي - بنغازي أنموذجا)

**الملخص**
إن البيئات الطبيعية لها دور فعال في زيادة فرص التعافي لما تحققه من تحسن ايجابي في الأداء الإدراكي و البدني و الاجتماعي للبشر. كما أنها تخفف من مستويات التوتر النفسي لما لها من قدرة علي توفير الإحساس بالتحكم و الخصوصية، و توفير فرص التفاعل الاجتماعي و النشاطات البدنية و تعزيز الاستجابات الإيجابية في الصحة العامة من خلال الارتباط بالنظم الطبيعية. يمكن تلبية هذه الحاجات للمرضي و العاملين من خلال الاتصال الحسي مع الطبيعة داخل أبنية المستشفيات باستخدام العناصر البايوفيلية في عملية تصميم البيئة المبنية للتكيف مع البيئة المحيطة. هدف الدراسة تطوير حلول التصميم الداخلي البايوفيلي القائمة على الأدلة في بيئات الرعاية الصحية. منهج الدراسة مقاربة متعددة ودراسة حالة عالمية للوصول إلي اعتبارات التصميم البايوفيلي الذي يحقق الرفاهية للإنسان. سيتبع الإطار النظري للدراسة تطبيق هذه الأنماط التصميمية علي المستشفي الليبي الأوروبي في بنغازي كمشروع ترميم مبني قائم. تخلص الدراسة إلي أهمية التصميم البايوفيلي و إمكانية دمج عناصره في بيئات المستشفيات.
**الكلمات الدالة**: البايوفيليا؛ التصميم البايوفيلي؛ الرفاهية؛ الطبيعة، المستشفي.

## 1. المقدمة

إن طفرة البناء الحديثة في صناعة الرعاية الصحية ستشكل مرافق المستشفيات لأجيال قادمة (Ulrich and Zimring 2004 Zimring and Bosch 2008). تشترط مشاريع المرافق الصحية الحكومية إتباع أحدث ابتكارات الاستدامة في التصميم، في حين أن العديد من مالكي المستشفيات الخاصة يشترطون حلولا تصميمية مؤهلة وصالحة ومدعومة بالأبحاث كما هو محدد في تصميم الرعاية الصحية القائم على الأدلة، و يأخذون مؤشرات من الطب القائم على الأدلة بالتعاون مع الإداريين والأطباء (Hamilton 2003). تحول منهجية التصميم القائم علي الأدلة في مرافق الرعاية الصحية نتائج التصميم من كونها نظرة فنية ذاتية إلى عملية تتضمن نتائج علمية موضوعية وقابلة للقياس من خلال دمج العلاقة بين النتائج المعمارية والسلوكية للبيئة والمستخدم. ولم يعد ينظر المصممون إلى هذه المنهجية العملية على أنها تحد من مجال الإبداع في التصميم، وإنما تعتبر حافزا لإثراء وتحسين الحلول التصميمية (Martin 2009). على الرغم من أن التصميم القائم على الأدلة لا يشكل حلاً تصميميا إلزاميًا، إلا أنه يوفر نقطة انطلاق للحلول المبتكرة المتمحورة حول رضا المريض، والتقدم التكنولوجي، وإعادة بناء القديم (Cama 2009, Aziz Amen & Nia, 2018، Lavin 2011). بالإضافة إلى ذلك، فإن المعلومات المتعلقة بمفهوم الرعاية المتمحورة حول المريض والأسرة، وتقييم سير عمل الموظفين، وتحديد كيفية معالجة المعلومات الطبية، و قضايا الاستدامة كلها تساعد على تقوية مبادئ الرعاية الصحية القائمة على الأدلة (McCullough 2010). إن مبدأ الاتصال بالطبيعة في صميم عملية التصميم القائمة على الأدلة، والذي يستكشف كيف يمكن للبيئة المبنية وتوجيه المرضي داخل الفضاء أن يقلل من التوتر، ويخفف الألم، ويحقق رفاهية (Ulrich 1984، Smith 2007 , Aziz Amen, 2017).

أخيرا، عند النظر إلى أي مجموعة من الأبحاث التي تتعامل مع ردود الفعل البشرية على الفضاء والبيئة المبنية، من المهم النظر إلى مكونات علم النفس البيئي المشتركة مع البحوث المساهمة في التصميم القائم على الأدلة. إدراكا لحقيقة أن العلاقة المباشرة بين البيئة الداخلية والتوتر النفسي قد يكون من الصعب تحديدها، فإن المجموعة المتزايدة من الأدبيات التي تتناول الموضوع تسعى جاهدة للتركيز أكثر على الأدلة التي تربط بين الاثنين وتنظر على وجه التحديد إلى جودة البيئة المبنية والراحة. يصف البحث أيضًا كيف يمكن للأماكن الطبيعية والمعمارية أن تغير (سلبا أو إيجابا) فهمنا للبيئة وتؤثر بشكل مباشر على قدرتنا على الشفاء ( Kline 2009، Mayer et al. 2009، Park 2006). وأخيرا، فإن نظرية Biophilia، التي تعرف ببساطة بأنها انجذاب الناس الفطري للطبيعة والنظم الطبيعية، تحتاج إلى المزيد من الاستكشاف في مجال التصميم الداخلي وكيفية دمج علم النفس البيئي والعلاقات بين الناس والنباتات.

**1.1 هدف الدراسة**

الهدف من هذه الدراسة هو تجميع الأبحاث المتعلقة بعلاقة الإنسان و الطبيعة بمجالات تصميم مرافق الرعاية الصحية القائمة على الأدلة، وتصميم حدائق الشفاء، وعلم النفس البيئي للوصول إلي اعتبارات التصميم الداخلي البايوفيلي المنهجي التي يمكن أن تؤثر بشكل إيجابي على حالة الإنسان، وتزيد من اتصال المرء بالطبيعة، وتعزز الرفاهية داخل بيئات الرعاية الصحية.

**2.1 منهج الدراسة**

تعتمد هذه الدراسة بشكل كبير على مراجعة الأدبيات السابقة في إطار المجالات المحددة أعلاه. ضمن مراجعة هذه الأدبيات سيتم التركيز على الأدلة الكمية والنوعية التي تدعم الفرضيات المختبرة المتعلقة بالارتباط مع الطبيعة والرفاهية. سيتم الاعتماد علي أمثلة مشاريع ناجحة تبنت نهج تصميم الرعاية الصحية القائم على الأدلة لفهم حلول التصميم التي تعزز الاتصال بالطبيعة مع تفضيل المشاريع التي تدمج مفاهيم المناظر الطبيعية في البيئة الداخلية للمبنى.

**2. المحور الأول: نظرية البايوفيليا**

يعود الفضل إلى عالم الأحياء والحائز على جائزة بوليتزر إدوارد ويلسون في إدخال مصطلح البايوفيليا الذي عرفه بأنه "الميل الفطري البشري نحو الاندماج مع الطبيعة " (Wilson, 1984, 1). تم تفصيل الفرضية بشكل أكبر في مذكراته الشخصية تحت نفس العنوان. علميا وصف ويلسون العلاقة المتأصلة التي تربط البشر بالطبيعة بالمكون الأساسي في تركيبنا الوراثي، وأدبيا على أنه التوق نحو البيئة الطبيعية و التي هي "ملجأ الروح، والانعزال، والسكون، وإلهام الخيال الإنساني" (Wilson, 1984, 11). هذا الاعتماد والانجذاب نحو الطبيعة له تاريخ عميق الجذور في أصل البشرية وبقائها، و هو نتاج للتطور المعرفي والعاطفي المتشكل من البيئة والمؤثر في السلوك الاجتماعي والأنشطة الإنسانية. ومع تطور مجتمعاتنا الحضرية وتغير تأثير البيئة المبنية علي البيئة الطبيعية نواصل التعرف علي هذه العلاقة وتأثيرها علي صحة الإنسان، والإنتاجية، والرفاهية (Kellert, Aziz Amen, 2022 و Heerwagen و Mador، 2008). في هذه الدراسة دعمت الأبحاث التجريبية نظرية ويلسون عن البايوفيليا كما قدمت العديد من الأبحاث الأخرى شرحا عن الآثار النفسية والشفائية الناتجة عن الارتباط الحسي في البيئات الطبيعية والمبنية.

**3. المحور الثاني: مراجعة الأدبيات السابقة فيما يتعلق بالبايوفيليا والبيئة المبنية**

**1.3 علم النفس البيئي**

**1.1.3 نظريات التوتر النفسي والسلوك**

التوتر هو استجابة نفسية أو فسيولوجية للتعرض لمواقف جسدية أو اجتماعية أو بيولوجية والتي تظهر كرد فعل سلبي و تتراكم مسببة مرضا جسديا (Ulrich and Parsons, 1992, 98).إن المستشفيات وأماكن الرعاية الصحية هي أكثر البيئات المجهدة والتي تسبب للمرضي مجموعة من المشاعر المختلطة كالمخاوف، والقلق. كما أن فقدان المرضى للاستقلالية والسيطرة النفسية الناجم عن فقدانهم للخصوصية و عجزهم عن صنع القرار له تأثير مباشر علي دورهم في عملية التعافي مما يؤدي إلي زيادة التوتر النفسي وتأخير الشفاء. بالإضافة إلى هذه الضغوطات، يمكن أن يؤدي الخوف من نتائج التشخيص غير المعروفة وانفصال المريض عن أسرته، خاصة بالنسبة للأطفال إلى زيادة توتر دخول المستشفى. ومع زيادة التوتر الناتج عن فقدان السيطرة تنخفض القدرة علي التركيز ومقاومة الألم، وعليه فإن السيطرة النفسية جزء لا يتجزأ من الصحة النفسية والتحكم بالتوتر لجميع فئات المرضى Delvin). (and Arneill, 2003, 672; Kopec, 2006, 214 أصبح التدخل في العلاج النفسي من الوسائل الأساسية للحد من التوتر داخل بيئة المستشفيات، وزاد الاهتمام بالاستفادة من الفوائد النفسية للطبيعة في التحكم بالتوتر(Marcus and Barnes, 1999, 32; Vincent, 2009, 41).

**2.1.3 الفوائد النفسية للطبيعة المجاورة**

تصنف نظرية إعادة الانتباه على أنها نظرية تحفيز، تركز علي أهمية الطبيعة و النباتات المجاورة وسهلة الوصول كوسيلة محفزة للحفاظ على الانتباه أو استعادته. أحد المفاهيم الرئيسية للنظرية هو الاهتمام اللاإرادي في استعادة النفس. أكد كابلان أن الطبيعة هي من أكثر العناصر التي تشد الانتباه، وتوفر استراحة ذهنية من التركيز علي مسببات الإجهاد العقلي(Park, 2006, 11-12; Ulrich and Parson, 92; Vincent, 2009, 47) . كما حدد أربعة خصائص للبيئة الشفائية :

1. الابتعاد: بيئة توفر الانعزال النفسي و المكاني عن المخاوف اليومية والروتين اليومي.
2. الاتصال: بيئة مرحبة و غنية بما يدعو لاستكشافها وكأنها عالم آخر مختلف و خاص.
3. الإبهار: بيئة بسيطة، سحرها آسر بسهولة دون عناء (على سبيل المثال النظر إلي الغيوم، غروب الشمس، الأوراق التي يحركها النسيم).
4. التوافق: بيئة طبيعية تخلق الحس بالانتماء و تشبع أنشطتها الاهتمامات المختلفة بأقل جهد.

**2.3 المناظر الطبيعية الشفائية**

تبرز الأدلة فوائد جمة لمشاهدة الطبيعة كالتغيرات النفسية و العاطفية التي تظهر علي المرضي في غضون ثلاث إلى خمس دقائق (Ulrich and Parson, 1992, 100; Ulrich, 2002, 4). إن مشاهدة الطبيعة الخارجية ليست مهمة فقط لتحقيق الرفاهية أو الراحة في مرافق الرعاية الصحية، ولكنها مهمة في بيئات العمل أيضا. وجدت دراسة كابلان عام 1988 أن مشاهدة الطبيعة أدت إلى تحقيق ضغط عمل أقل ومعدلات رضا أعلى وانخفاض الصداع والأمراض مقارنة بالموظفين الذين لم يكن لديهم إطلالة طبيعية علي الخارج و كانت نوافذهم تطل علي المباني فقط (Kaplan, R., 1992, 129). دفع التحول في مجالات التقدم التكنولوجي في القرن العشرين نحو السعي خلف تحقيق الكفاءة والربح المادي في العلوم الطبية والاتصالات، والبناء، كما هو الحال مع جميع المجالات الأخرى. أدي هذا التحول إلى بناء مستشفيات أكثر كفاءة، فاستبدلت الأنماط الكتلية الأفقية بأنماط رأسية شاهقة تعتمد علي الحركة الرأسية الآلية كالمصاعد و أصبحت المباني ذات مظهر إداري جامد مع التخلي عن الفتحات و الشرفات واستبدالها بالواجهات المصمتة وذلك مع التطور في تكنولوجيا التهوية والتبريد. كما استبدلت الحدائق بمواقف السيارات سعيا لتحقيق بيئة أكثر كفاءة لحركة الأطباء و التمريض والخدمة بينما قل الاهتمام بتجربة المريض والتصميم المتمحور حول رضي المريض (Marcus, 2007, 1; Marcus and Barnes, 1999, 13-14) . بدأ الاهتمام بالطب البديل والتكميلي مع تزايد قدرة مؤسسات الرعاية الصحية على المنافسة ومع ارتفاع تكلفة الرعاية الصحية. ومن المسلم به الآن أن البيئة هي أداة لدعم الشفاء عن طريق الحد من التوتر والقلق، وخفض ضغط الدم، وتقليل مدة الإقامة، ويستجيب المزيد من المصممون للتوصيات البحثية المتعلقة بالرعاية المتمحورة حول المريض، بما في ذلك البيئات الداعمة للموظفين والزوار، ويعيدون إدخال الحدائق في متطلبات مرافق الرعاية الصحية لأغراض علاجية على مستوي دولي (Marcus, 2007, 2; Marcus and Barnes, 1999, 17, 27-28).

**1.2.3الحدائق الشفائية**

الحديقة الشفائية يجب أن تتجاوز قيمة مشاهدتها من الداخل، إلي كونها تشجع الناس على الخروج من خلال توفير الأنشطة البدنية مثل المشي أو ممارسة التمارين الرياضية وتوفير خيارات للمستخدم كاختيار مستوى التعرض للشمس أو الظل والتواصل الاجتماعي والخصوصية. يمكن أن توفر الحديقة فوائد علاجية تكميلية غير العلاج داخل مبني الرعاية الصحية(Larson, 2004, 3; Marcus, 2007; 8-9; Marcus and Barnes, 1999, 4) .

**3.3 تصميم الرعاية الصحية القائم على الأدلة**

**1.3.3التصميم البايوفيلي الداخلي لبيئات الشفاء**

هناك تسع طرق تتعلق بكيفية تقدير البشر للطبيعة المؤثرة في الرفاه البدني والمادي والعاطفي والنفسي والروحي:

1. الجمالية - جاذبية الطبيعة
2. التحكم - سيطرة على الطبيعة
3. التعلق الإنساني - العاطفي بالطبيعة
4. الأخلاقية - الارتباط الروحي بالطبيعة
5. طبيعي- تجارب مباشرة مع الطبيعة
6. السلبية - الخوف من الطبيعة
7. الملاحظة العلمية – التجريبية ودراسة الطبيعة
8. الرمزية – القيمة المجازية للطبيعة
9. النفعية - المنفعة المادية للطبيعة (Kellert, 2005, 34, 50)

**4 . عناصر التصميم البايوفيلي**

هناك عنصران أساسيان للتصميم البايوفيلي: العنصر العضوي أو الطبيعي والعنصر المحلي(Kellert, Heerwagen, and Mador, 2008, 5-6) . يعرف العنصر الأول العضوي أو الطبيعي أنه "أشكال و تكوينات في البيئة المبنية تعكس بشكل مباشر أو غير مباشر أو رمزي تقارب البشر الفطري مع الطبيعة . " (Kellert, et. al., 2008, 5)من العناصر الجذابة بشكل مباشر المكونات الطبيعية المستدامة مثل النباتات والحيوانات وضوء النهار والموئل الطبيعي. أما العناصر الغير مباشرة هي التي تعتمد علي البشر للبقاء حية مثل أحواض السمك ونافورة المياه ونباتات الأصيص. ويشمل البعد الرمزي الزخارف الطبيعية و عرض الصور و الفيديوهات المستوحاة من الطبيعة علي الواجهات الخارجية و الداخلية وإدخال روائح الطبيعة. يعرف العنصر الثاني المحلي أنه "المباني والمناظر الطبيعية التي تتصل بثقافة وبيئة منطقة محلية أو جغرافية معينة (Kellert, et. al., 2008, 6) .

**5. اعتبارات و إرشادات التصميم الداخلي البايوفيلي في بيئات الرعاية الصحية**

يقترح هذا الجزء فرضيات التصميم المبنية على الأبحاث السابقة من علم النفس البيئي والمناظر الطبيعية العلاجية، وتصميم الرعاية الصحية القائم على الأدلة. اختبرت هذه الاعتبارات علي مدي دعمها لقيم البايوفيليا ونواحيها الحسية من أجل التمكن من التنبؤ بالنتائج السلوكية وخصائص الشفاء ودعم رفاهية المرضى والزوار والموظفين. هدف الإرشادات أن تكون إطار تصميم يسمح بالإبداع والابتكار لمشاريع متعددة التخصصات.

**1.5 اتصال البيئة الداخلية مع الخارجية**

**1. استمرارية الحدائق الخارجية لتمتد إلى الردهات ومناطق الانتظار في الداخل.**

**الوصف:** من أجل زيادة الارتباط بالطبيعة في المساحات التي يستخدمها المرضى والزوار والموظفون، تستمر الحديقة من الخارج إلى الداخل بنفس المواد والترتيبات والأنسجة والأنماط والأشكال.

**اعتبارات التصميم:**

- ربط المساحات الداخلية بميزات تتعلق بالفضاء الخارجي.
- تكوين فضاءات داخلية رئيسية تحتوي فضاءات ثانوية.
- تكوين اختلاف في ارتفاعات السقف لتوفير مناطق عامة مفتوحة ومضاءة بضوء النهار ومناطق بارتفاعات سقف أقل وأكثر خصوصية.
- استمرار استعمال أنماط ومواد الحديقة الخارجية في الردهة أو مناطق الانتظار.



الشكل 1: مستشفى فرانكلين وودز المجتمعي،
Johnson City, TN, Karlsberger

**2. توفير شرفات ومقصورات تشميس مجاورة لغرف المرضى**

**الوصف**: توفر الشرفات المشمسة الخصوصية وسهولة الاتصال بالطبيعة كما توفر التهوية الطبيعية للمرضى والزائرين والموظفين.* قد لا يكون توفير التهوية الطبيعية مناسبا للجميع وذلك حسب الموقع أو التلوث الحضري أو حدة المرض.

**اعتبارات التصميم:**

- توفير شرفات في المناطق المعتدلة.
- توفير مقصورات زجاجية للتشميس الصناعي في المناطق ذات المناخ الأكثر تطرفا.
- يفضل استخدام مقصورات زجاجية للتشميس الصناعي من أجل التدفئة والتبريد الغير مباشر لغرف المرضى.
- استخدام أنواع الأثاث و النباتات المحلية.
- استخدام عناصر التظليل للتحكم في معدل التشميس من الخارج و لضمان الخصوصية من الداخل.
- ضمان سهولة الوصول و الأمان لحركة حوامل التغذية ونقل الدم ذات العجلات لمستخدمي الكراسي المتحركة من خلال توفير أرضيات مستوية الارتفاع ومساحة مناسبة للشرفات والمقصورات.



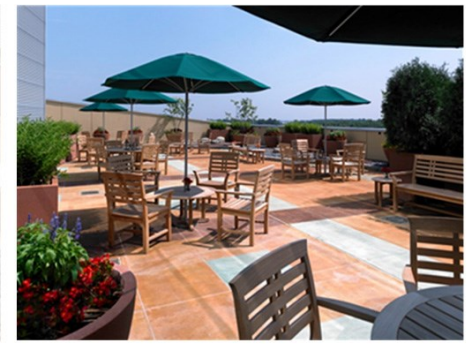
الشكل 2: مختبر المريض الأخضر 3.0 ، نموذج غرفة افتراضي ، Anshen + Allenn

**3. توفير شرفات ومقصورات تشميس مجاورة لردهات الانتظار العائلية**

**الوصف:** توفر الشرفات المشمسة الخصوصية وسهولة الاتصال بالطبيعة كما توفر التهوية الطبيعية للمرضى والزائرين والموظفين.* قد لا يكون توفير التهوية الطبيعية مناسبا للجميع وذلك حسب الموقع أو التلوث الحضري أو حدة المرض.

**اعتبارات التصميم:**

- توفير شرفات في المناطق المعتدلة.
- توفير مقصورات زجاجية للتشميس الصناعي في المناطق ذات المناخ الأكثر تطرف.
- استخدام أنواع الأثاث و النباتات المحلية.
- استخدام عناصر التظليل للتحكم في معدل التشميس من الخارج و لضمان الخصوصية من الداخل.
- ضمان سهولة الوصول و الأمان لحركة حوامل التغذية ونقل الدم ذات العجلات لمستخدمي الكراسي المتحركة من خلال توفير أرضيات مستوية الارتفاع ومساحة مناسبة للشرفات والمقصورات.
- ضمان خلو المساحات الخارجية من التلوث بدخان السجائر.



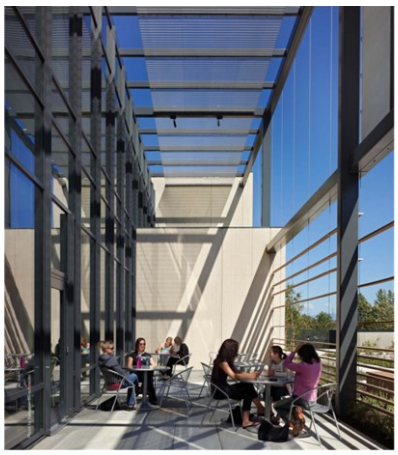
الشكل 3: مستشفى المجتمع الشمالي ، إنديانابوليس ، إن ،
RTKL Associates ،Inc. Indianapolis, IN, RTKL Associates, Inc.

**4. توفير مناطق خارجية خاصة بالموظفين قريبة من غرف الاستراحة و الردهات**

**الوصف:** توفر الشرفات المشمسة الخصوصية وسهولة الاتصال بالطبيعة كما توفر التهوية الطبيعية للمرضى والزائرين والموظفين.* قد لا يكون توفير التهوية الطبيعية مناسبا للجميع وذلك حسب الموقع أو التلوث الحضري أو حدة المرض.

**اعتبارات التصميم:**

- توفير شرفات في المناطق المعتدلة.
- توفير مقصورات زجاجية للتشميس الصناعي في المناطق ذات المناخ الأكثر تطرف.
- استخدام أنواع الأثاث و النباتات المحلية.
- استخدام عناصر التظليل للتحكم في معدل التشميس من الخارج و لضمان الخصوصية من الداخل.
- ضمان سهولة الوصول و الأمان لحركة حوامل التغذية ونقل الدم ذات العجلات لمستخدمي الكراسي المتحركة من خلال توفير أرضيات مستوية الارتفاع ومساحة مناسبة للشرفات والمقصورات.
- ضمان خلو المساحات الخارجية من التلوث بدخان السجائر.



الشكل 4: عيادة بلفيو للأطفال، سياتل
Bellevue Clinic, Seattle, WA, NBBJ

**5. توفير سهولة الوصول إلى الطبيعة من مناطق تناول الطعام**

**الوصف:** مناطق تناول الطعام هي أماكن مستخدمة من قبل الزوار والموظفين. تناول الطعام في الهواء الطلق يزيد من الاتصال بالطبيعة بين البيئة الداخلية والخارجية.

**اعتبارات التصميم:**

- تكوين منطقة محددة يمكن الوصول إليها لتناول الطعام في الهواء الطلق.
- توفير خيارات للجلوس بمستويات تظليل وتشميس مختلفة.
- إحاطة المكان بالنباتات مثل الأعشاب العطرية أو إدخال عنصر الجدار الأخضر.
- الاستفادة من المساحات الغير علاجية و إدخال عناصر مائية في البيئة الخارجية.
- ضمان سهولة الوصول والأمان لحركة حوامل التغذية ونقل الدم ذات العجلات لمستخدمي الكراسي المتحركة من خلال توفير أرضيات مستوية الارتفاع ومساحة مناسبة.



الشكل 5: مطاعم فابيانو
Munich and various international locations

**6. توفير حدائق التأمل بالقرب من المصليات**

**الوصف**: للطبيعة والمناظر الطبيعية آثر روحي وشفائي يمكن تحقيقها بحدائق التأمل الصغيرة خارج المصليات.

**اعتبارات التصميم:**

- تكوين مساحة محمية وخاصة.
- توفير تصاميم مميزة لجلسات بين النباتات والزهور.
- توفير الخصوصية البصرية بين الداخل و الخارج.
- وضع عناصر تصميم تشجع على الهدوء والتأمل.
- ضمان سهولة الوصول و الأمان لحركة حوامل التغذية ونقل الدم ذات العجلات لمستخدمي الكراسي المتحركة من خلال توفير أرضيات مستوية الارتفاع ومساحة مناسبة عند المدخل و جميع المسارات.
- توفير مكان لمستخدمي الكراسي المتحركة بين المقاعد الثابتة محاطة بالنباتات.



الشكل 6: مستشفى لوسيل باكارد للأطفال، جامعة ستانفورد
Palo Alto, CA, Perkins + Will

**7. استخدام الأفنية في أماكن تسهل عملية فهم وتنظيم الحركة الداخلية**

**الوصف:** إن العناصر الخضراء تسهل علي المستخدم فهم الحركة الداخلية، لذلك يفضل وضع عناصر الحركة الرأسية و الممرات بالقرب من الأفنية والسماح بدخول الإضاءة الطبيعية.

**اعتبارات التصميم:**

- توفير الوصول إلى الفناء من المستويات الأعلى.
- التركيز على نقطة مركزية في الفناء لتكون علامة دالة يمكن التعرف عليها سواء داخل الفضاء أو حوله.
- اعتبار الجدران المحيطة جزء من تصميم الفناء.
- توفير التغطية المناسب و التحكم في أشعة الشمس عند الحاجة.



الشكل 7: مستشفى فرانكلين وودز المجتمعي
Johnson City, TN, Karlsberger

8. **توفير حدائق داخلية في الصحن المسقوف ( الأتريوم)**

**الوصف:** تسمح ردهة الصحن المسقوف بدخول الضوء الطبيعي اللازم للنباتات في المساحات الداخلية. كما أن العناصر الخضراء تسهل علي المستخدم فهم الحركة الداخلية.

**اعتبارات التصميم:**

- توفير الوصول إلى ردهة الأتريوم من المستويات الأعلى.
- استخدام ردهة الأتريوم لربط المساحات المجاورة
- وضع ردهة الأتريوم بجوار غرف الانتظار الداخلية لتكون مشتتات إيجابية للتوتر.
- مراعاة الخصوصية للغرف المجاورة.
- ضمان سهولة الوصول والأمان لحركة حوامل التغذية ونقل الدم ذات العجلات لمستخدمي الكراسي المتحركة من خلال توفير أرضيات مستوية الارتفاع ومساحة مناسبة عند المدخل و جميع المسارات.



الشكل 8: مستشفى المجتمع الشمالي، إنديانابوليس
Indianapolis, IN, RTKL Associates, Inc

9. **استخدام واجهات ستائرية للتحكم في الضوء والإطلالة**

**الوصف:** استخدام ستائر وشاشات تغطية الواجهات للتحكم بمقدار الضوء النافذ والتلاعب بشكل الإنارة الطبيعية.

**اعتبارات التصميم:**

- التغطية تشمل الأعمدة والشرفات.
- تغطية المناظر الغير مرغوب فيها كمعدات التهوية و الصرف و حركة المرور.
- إدخال شاشات أو ستائر لزيادة مستوى الخصوصية.



الشكل 9: المركز الوطني للقلب، سنغافورة

Broadway Malyan and Ong & Ong Architects

**10. التكوينات - محاكاة العناصر الطبيعية بدلا من نسخها**

**الوصف:** استخدام محاكاة مستوحاة من التكوينات الطبيعية من خلال الأشكال والأنماط والملمس والتفاصيل بدلا من تقليدها

**اعتبارات التصميم:**

- استخدام أشكال نباتية كأوراق الشجر أو أشكال الصدف أو الحلزوني أو البيضاوي.
- الإستيحاء من الطبيعة المحلية و الإقليمية الجيولوجية للمنطقة.
- التفكير باستغلال الأعمدة كرمزية للأشجار في الطبيعة.
- انتهاج نمط التباين المنتظم في نسيج الأسطح.
- استخدام مبدأ التباين المنتظم عن النمط الأساسي.
- استخدام النسبة الذهبية والتسلسل الهرمي.



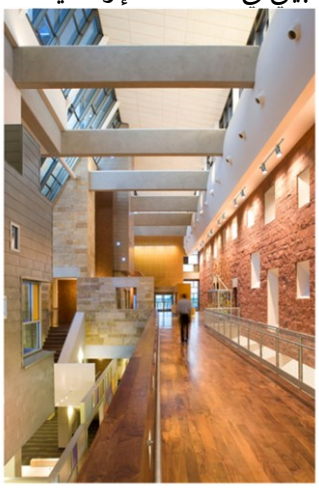
الشكل 10: مركز دوبيج المركزي للسرطان
Warrenville, IL, RTKL Associates, Inc.

**11. التأثيث والتشطيبات واللافتات الإرشادية**

**الوصف:** دمج المواد الطبيعية التي تحاكي الطبيعية في البيئة الداخلية. تنسيق طرق جلوس مختلفة. دمج تكوينات طبيعية في تصميم اللافتات الإرشادية.

**اعتبارات التصميم:**

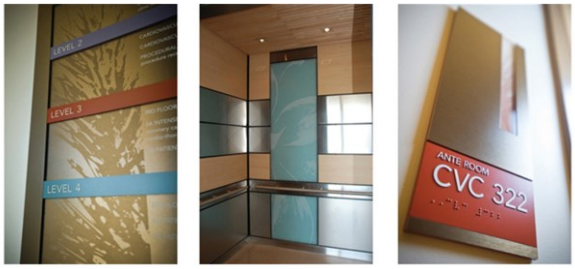
- استخدام المواد المحلية قدر الإمكان لزيادة الشعور بالانتماء للمكان.
- استخدام المواد التي تعكس مظهر عامل الزمن مثل المعادن والخشب والحجر وما إلى ذلك.
- وضع مقاعد الجلوس الداخلية في مناطق مختلفة تتلقى الشمس والظل بشكل متباين.
- المساهمة في تعزيز الدعم الاجتماعي للمرضي و أسرهم باستخدام مقاعد مختلفة الحجم ضمن كل مجموعة من الجلسات.
- تكوين اختلاف في ارتفاعات السقف لتوفير مناطق عامة مفتوحة ومضاءة بضوء النهار ومناطق بارتفاعات سقف أقل وأكثر خصوصية.
- دمج تكوينات طبيعية محلية في تصميم اللافتات الإرشادية.
- إدخال الألوان ذات البعد الثقافي والبيئي في اللافتات الإرشادية.



الشكل 11: مركز ديل الطبي للأطفال
Texas, Austin, TX, Karlsberger



الشكل 12: مركز دوبيج المركزي للسرطان
Warrenville, IL, RTKL Associates, Inc.




الشكل 13 :
UCSD Sulpizio Family CVC, San Diego, CA, RTKL Associates, Inc

**6. دراسة حالة: المستشفي الليبي الأوروبي (LEH)، بنغازي، 2005**




الشكل 14: موقع المستشفي الليبي الأوروبي، بنغازي .LEH

**1.6 وصف المستشفي**

المستشفى قيد الإنشاء جاري تنفيذه منذ عام 2005 حيث تم استكمال أعمال الهيكل الإنشائي وبعض من أعمال التشطيب ولم يدخل الخدمة. يتميز حرم المستشفى الذي تبلغ مساحته 25000 متر مربع بأربع كتل بناء مترابطة، و بارتفاع ثلاثة وأربعة طوابق. ومن المقرر افتتاح المستشفي على مرحلتين. وستحتوي الوحدة الأولى على 48 سريرا في الجناح وقسما للمرضى الخارجيين، وفي المرحلة الثانية سيتم إضافة 148 سريرا إضافيا. وسيوفر فندقا للمرضى بسعة 60 سريرا كجزء من المرافق التي توفر أماكن إقامة مريحة للمرضى والزوار. التصميم الواسع لغرف الأجنحة المفردة مكيفة بالكامل ومكتملة بحمامات داخلية. تم تجهيز الوحدات بكميات كبيرة من الغازات الطبية والمعدات العلاجية المتقدمة اللازمة للعلاج والنقاهة. ويتوفر بها الحد الأدنى من المعايير مثل الهاتف والتلفزيون والراديو والوصول إلى الإنترنت ونظام استدعاء الممرضات. تتوفر ثماني غرف إيواء كبيرة لكبار الشخصيات، بما في ذلك ردهات خاصة

ووسائل راحة حصرية. يقدم المستشفى الرعاية الطبية على المستوى الثانوي مع جميع التخصصات الطبية المشتركة مثل الطب الباطني والجراحة العامة وأمراض القلب وأمراض النساء / التوليد وطب الأطفال والأنف والأذن والحنجرة وطب العيون والمسالك البولية والعلاج الطبيعي وإعادة التأهيل والأمراض الجلدية والجراحة التجميلية والترميمية والأعصاب وطب الأسنان والأورام وجراحة العظام. سيتم دعم جميع الأقسام الطبية من قبل الصيدلية ومركز التشخيص (بما في ذلك التصوير التشخيصي) والمختبر. www.leh.com.ly .

### 2.6 خطة إعادة الإعمار بعد الحرب 2014

قبل الاشتباكات التي وقعت عام 2014 كان المستشفى بمرحلة متقدمة من التشطيبات وبعد الاشتباكات أصبح بمرحلة أعمال الهيكل الإنشائي و كان به أضرار بليغة حيث تعرض المستشفى لنوعين من الأضرار الرئيسية الناتجة عن الاشتباكات وهي كالتالي:

أضرار ناتجة عن الإصابات بالقذائف المباشرة وأضرار ناتجة عن الحريق . وخلال هذه المراحل تمت أعمال الترميم والتقوية عام 2018 حيث تم معالجة كل نوع بطريقة خاصة به بما يضمن سلامة العناصر الإنشائية المتضررة وقيامها بوظيفتها بشكل آمن بعد إتمام إجراءات المعاينة والاختبار وتحليل البيانات وتحديد طريقة المعالجة والتقوية لإعادة التأهيل. بعد الانتهاء من أعمال الترميم والتقوية تم معاينة الأعمال على فترات زمنية متواصلة للتأكد من سلامة العناصر الإنشائية وجودة تنفيذها ولم تظهر عيوب تشير إلى ضعفها. ومنذ عام 2020 والمشروع جاهز لبدء أعمال التشطيبات والأعمال الكهروميكانيكي. وتم تزويد فريق البحث بتقرير الترميم من قبل د.عبد الله بن زحيليق. ( المسؤول عن أعمال الترميم وهو أحد أعضاء هيئة التدريس بكلية الهندسة، جامعة بنغازي).



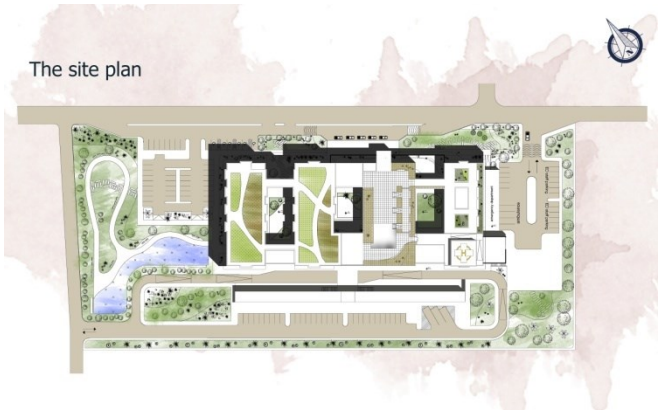
الشكل 15: مرحلة تقييم الأضرار 2018م و مرحلة الترميم 2020م. د عبد الله بن زحيليق.

### 3.6 تطبيق نظرية التصميم الداخلي البايوفيلي

خلال أستوديو تصميم مستشفي ربيع 2018 بقسم العمارة وتخطيط المدن، جامعة بنغازي، ومن منطلق مفهوم الإستدامة تم العمل علي مقترح إعادة تصميم المستشفي الليبي الأوروبي في بنغازي كمشروع ترميم مبني قائم وذلك بتطبيق الأنماط التصميمية البايوفيلية. وحاز المشروع علي أعلي درجة في الأستوديو كأفضل مشروع تصميم مستشفي عام، مقدم من المعمارية: لين لطيوش، و تحت إشراف المرشد: أ. هيلانة بن علي.



الشكل 16: الموقع العام للوضع الراهن. خريطة جوجل 2022




الشكل 17: المخطط العام - بعد تطبيق نظرية التصميم البايوفيلي.

**لماذا المستشفى الليبي الأوربي؟**

إن الهدف الذي وضعه الطاقم الطبي والإداري هو تقديم خدمات طبية علاجية عالية الجودة، وفقا لأعلى المعايير الدولية، وإن المستشفى سيستجيب لاحتياجات سوق الرعاية الصحية في بنغازي والمناطق المحيطة بها وليبيا عامة.

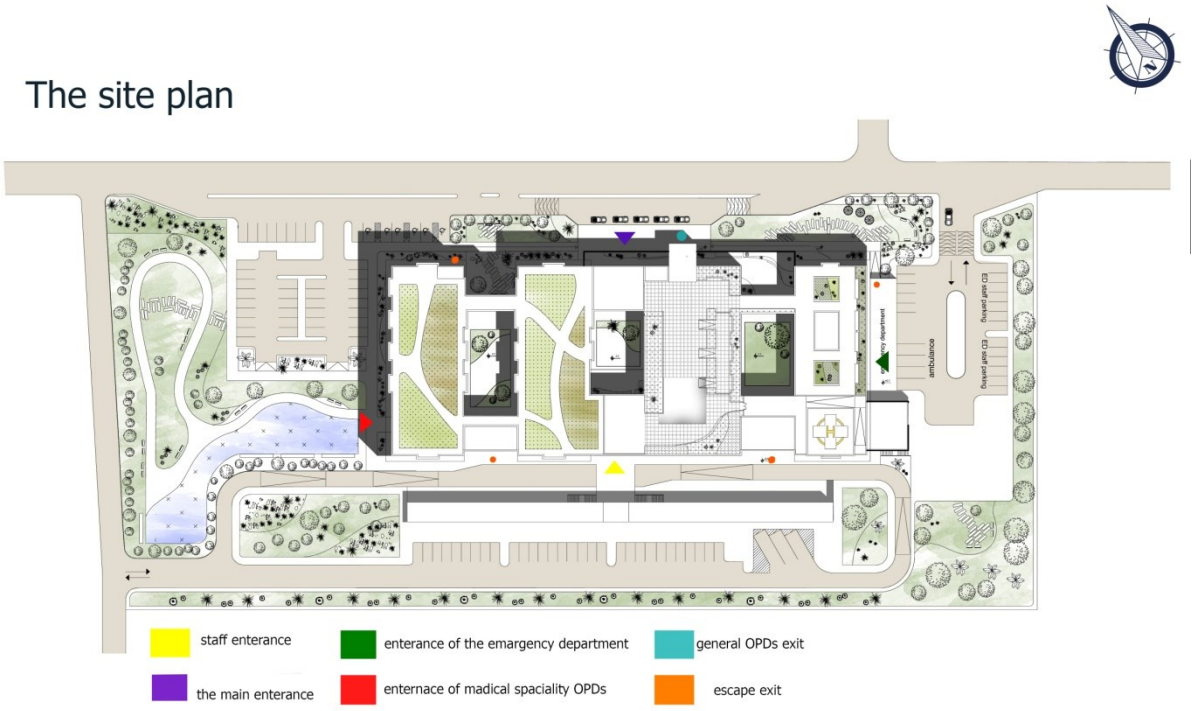
انطلاقا من هذه الرؤية، وبناء على المؤهلات الجيدة للمبنى القائم والتصميم القابل لإضافة أنواع مختلفة من الحدائق والمساحات الخضراء بداية من الموقع إلي أعلي مستوي من المبني، قام فريق العمل بتطوير المستشفى ليصبح مركزا مستداما ينظر للصحة بتعريفها الشامل ويوفر بيئة عمل نموذجية تؤهل المستشفى للحصول على اعتماد من مؤسسات عالمية مثل مؤسسة JCI ومن ثم JCI Award.

**الرؤية:**

دمج تقنية العلاج الحديثة مع القوى العلاجية القديمة للطبيعة ( التصميم البايوفيلي)، وإعادة تقديمها كمساحة مشتركة يمكن من خلالها الوصول لمفهوم الشفاء الشامل. نحن كبشر نستمد قوة هائلة من الأرض والطبيعة؛ تساعدنا على الاستمرار والوقوف بوجه معاناة المرض، والضغوطات النفسية. أي أن الطبيعة يجب أن تقف جنبا إلي جنب مع العلاج الطبي الحديث كداعم أساسي له.

**المهمة والأهداف:**

1. توفير بيئة مريحة للعمل، تخفف الضغط عن العاملين وتقدم الدعم للمرضى وأقاربهم.
2. توسيع نطاق العلاج الطبي من استخدام أكثر التقنيات تقدما ودقة، إلى تأمل الحركة البسيطة للأغصان بفعل نسيم الرياح.




الشكل 18: المخطط العام - بعد تطبيق نظرية التصميم البايوفيلي .

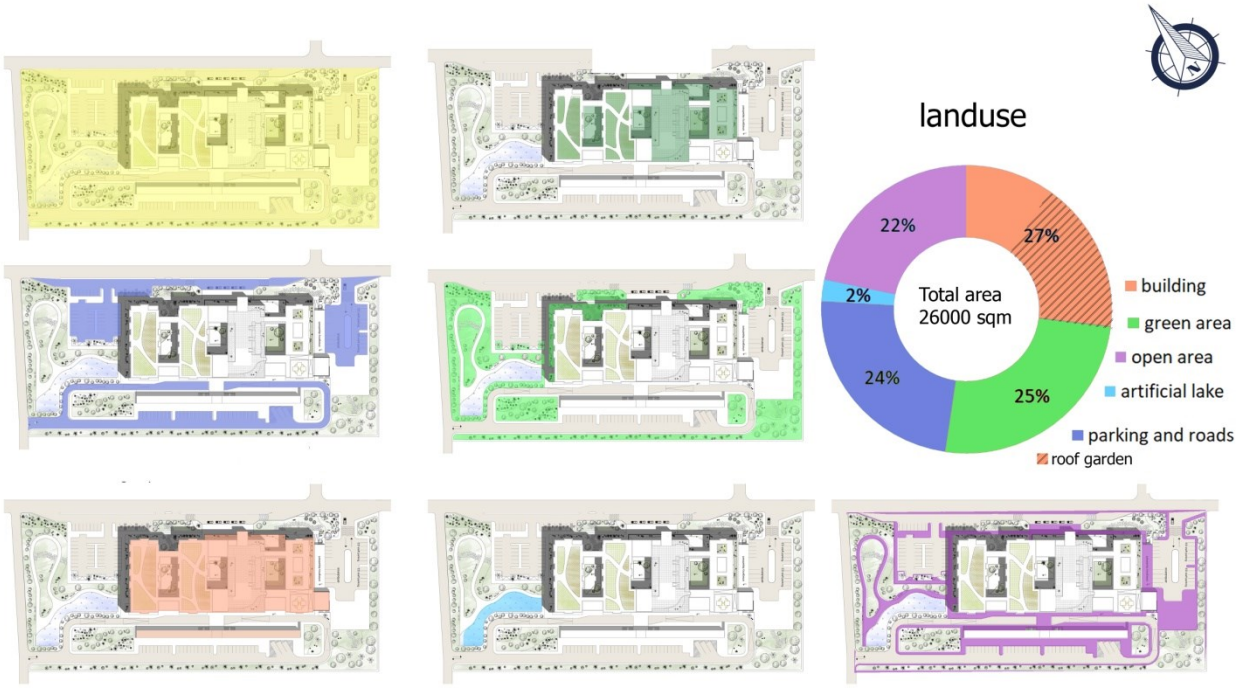
1. الاستفادة من المساحات الغير علاجية و إدخال عناصر مائية في البيئة الخارجية.



الشكل 19: منظور عين الطائر - بعد تطبيق نظرية التصميم البايوفيلي .
1. الاستفادة من المساحات الغير علاجية و إدخال عناصر مائية في البيئة الخارجية.




الشكل 20: مخطط الحركة في الموقع بعد تطبيق نظرية التصميم البايوفيلي




الشكل 21: مخطط استعمالات الموقع بعد تطبيق نظرية التصميم البايوفيلي

1. تمثل المناطق الزرقاء والخضراء 27٪ من استعمالات الموقع.
2. تم تصميم الموقع ليكون صديقا للمريض، يقدم علاجا طبيعيا من خلال جاذبية البيئة للحواس ومشاهدة المناظر الطبيعية الوفيرة حيث صوت خرير الماء وروائح النباتات المختلفة.




الشكل 22: استعمالات الدور الأرضي قبل وبعد التصميم البايوفيلي




**الشكل 23:** مسقط الدور الأرضي بعد تطبيق نظرية التصميم البايوفيلي

1. استمرارية الحدائق الخارجية لتمتد إلى الردهات ومناطق الانتظار في الداخل
2. استخدام الأفنية في أماكن تسهل عملية فهم وتنظيم الحركة الداخلية
3. توفير مناطق خارجية خاصة بالموظفين قريبة من غرف الاستراحة و الردهات




**الشكل 24:** مسقط السرداب بعد تطبيق نظرية التصميم البايوفيلي

1. توفير سهولة الوصول إلى الطبيعة من مناطق تناول الطعام
2. استخدام الأفنية في أماكن تسهل عملية فهم وتنظيم الحركة الداخلية
3. توفير مناطق خارجية خاصة بالموظفين قريبة من غرف الاستراحة و الردهات



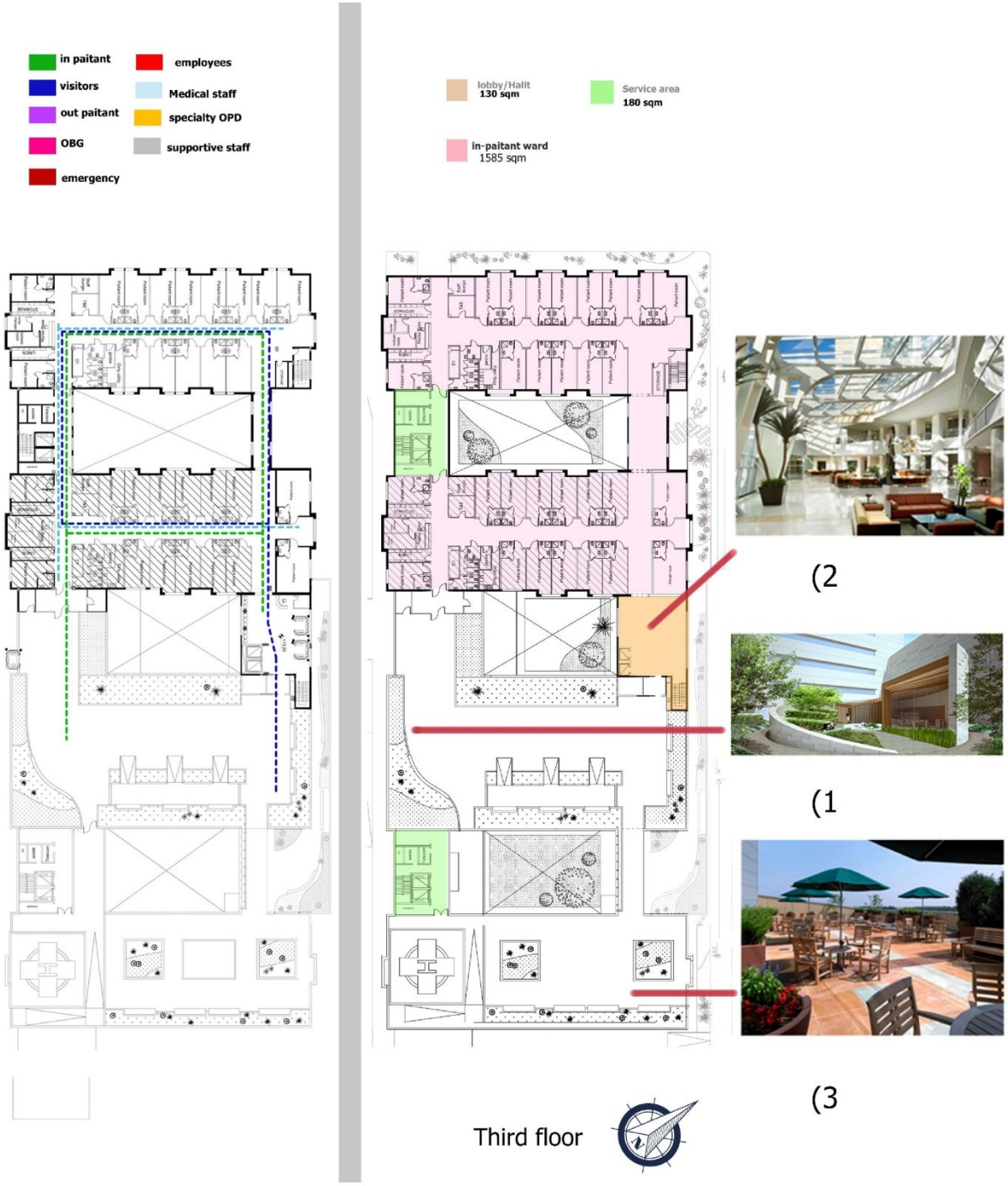

الشكل 25: مسقط الدور الأول بعد تطبيق نظرية التصميم البايوفيلي

1. توفير شرفات ومقصورات تشميس مجاورة لردهات الانتظار العائلية
2. توفير تصاميم مميزة لجلسات بين النباتات والزهور.
3. توفير مناطق خارجية خاصة بالموظفين قريبة من غرف الاستراحة و الردهات




الشكل 26: مسقط الدور الثاني بعد تطبيق نظرية التصميم البايوفيلي

1. وضع مقاعد الجلوس الداخلية في مناطق مختلفة تتلقى الشمس والظل بشكل متباين
2. توفير تصاميم مميزة لجلسات بين النباتات والزهور.
3. توفير شرفات ومقصورات تشميس مجاورة لردهات الانتظار العائلية




الشكل 27: مسقط الدور الثالث بعد تطبيق نظرية التصميم البايوفيلي

1. توفير حدائق التأمل بالقرب من المصليات
2. توفير حدائق داخلية في الصحن المسقوف ( الأتريوم)
3. توفير شرفات ومقصورات تشميس مجاورة لردهات الانتظار العائلية




الشكل 28: الواجهات الخارجية بعد تطبيق نظرية التصميم البايوفيلي

1. استخدام واجهات ستائرية للتحكم في الضوء والإطلالة

**7 . الخلاصة**

يرتكز هذا البحث علي نظرية البايوفيليا التي تعرف بالميل الفطري البشري نحو الاندماج مع الطبيعة. وتقترح فرضية علمية للاستجابات السلوكية البيئية في نطاق المجالات الإبداعية للهندسة المعمارية.إن اختبار العلاقة بين الإنسان والبيئة اكتسب اهتماما كبيرا في تخصصات متنوعة تعني بالاستجابات النفسية والفسيولوجية الإيجابية الناتجة عن اتصال الإنسان مع الطبيعة و المؤثرة في صحة الإنسان ورفاهيته. على الرغم من اختلاف التجارب الفردية مع الطبيعة، إلا أن غالبية الناس يؤمنون بقيمة الطبيعة في عملية الشفاء ولديهم تفضيلات متشابهة للبيئات الطبيعية. بالإضافة إلى هذه التفضيلات، فإن فوائد تخفيف التوتر من خلال الاتصال بالبيئات الطبيعية معترف بها أيضا على نطاق واسع لقدرتها على توفير شعور بالتحكم والخصوصية، كما أنها وسيلة للدعم الاجتماعي و تزيد من فرص التفاعل و ممارسة الرياضة البدنية و الحركة.

**8 . الإستنتاجات**

من أجل تحقيق الرفاهية يجب أن تساهم الفضاءات المبنية في خلق البيئات الشفائية التي تصل العقل و الجسد و تعزز الإحساس بالمكان من خلال التواصل الحسي مع عناصر البايوفيليا داخل المبني. يمكن البدء في إعادة مفهوم البيئات الداخلية الشفائية من خلال التركيز أكثر على أبحاث الاستجابة السلوكية البيئية من علم النفس البيئي، وهندسة المناظر الطبيعية الشفائية، والتركيز علي مبدأ الاتصال بالطبيعة في تصميم الرعاية الصحية القائم على الأدلة. تساهم مفاهيم واعتبارات التصميم البايوفيلي المصممين في تكوين قرارات التصميم الداخلي لبيئات الشفاء لتعزيز التواصل بالأنظمة الطبيعية. ومن خلال البحث المستمر والمبتكر ومنهج المقاربة متعددة التخصصات، يمكن أن تتحقق حلول تصميمية جديدة تزيد من التكامل مع عناصر الطبيعة داخل المبني تحسن من صحة الإنسان ورفاهيته.

**التوصيات**

1. يمكن اعتماد التصميم البايوفيلي في مناطق البلدان الحارة، وخاصة في ليبيا ، حيث يمكن لعنصر الفناء المساهمة بنجاح في هذا النوع من التصميم، خاصة في المستشفيات.
2. يمكن وضع قائمة مرجعية بالنباتات المناسبة من حيث البيئة والاقتصاد من أجل تحقيق تصميم فعال بيولوجي.
3. إجراء دراسات أكثر شمولا وعمقا للوصول إلى الحلول البيئية الأنسب للبيئة الليبية.
4. إقامة مسابقات على مستوى البلاد للخروج بحلول وأفكار جديدة تطبق مبادئ التصميم البايوفيلي وتتناسب مع المجتمع والبيئة الليبية.

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# Influence of the Hinduism Religion on Architectural Identity of Hindu Temple

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**Abstract**
Architecture is a process, result of design and conception of needs and means. Chronicles demonstrate religious architecture has been beginning many centuries ago. Religion indirect ways impact every single part of the supporters' architecture life. In Hinduism , devotee has natural connection to the divine, so Hindu architecture temples are based on this standard, have constant plan from existence which is called mandala diagram , made of one square divided into eighty-one smaller squares, describes environmental negative and positive energy and God is middle of big square, each part of God shows different energy and related to the special architectural space, and elements position which is effect on circulation space of the temple , Aim of this paper tries to figure out effect of Hinduism religion on architectural identity of Hindu temple. The study will show how Hindu temples are shaped by Hinduism God from architectural point of view.
Keywords: Religion, Hinduism, Architectural Identity, Temple, Hindu, Mandala.

## 1. Introduction

History shows that architecture of Hindu temples in India comes from more than 2000 years with noble architecture. Hindu temple has various forms and sizes such as rectangular, octagonal, and semicircular with special styles of domes and gates. Temples in all over India have different style (Amerlinck, Mari-Jose, 2001). Therefore, the Hindu temples architecture, have similar basic elements in common. Such as mandala diagram as a basic plan for each Hindu temple, Sikhara, Garbhargriha and etc.

Hinduism has regularly been known as polytheistic, that means, there are numerous Gods. But all believed that there is a humblest one genuine God in Hinduism, known as the Brahman (Vidya Dehejia 1997), (Geertz, Clifford, 1973). The Brahman can appear itself in numerous forms, which includes human. In Hindu architecture of temple most important part is focus on connecting positive energy so the best idea was built temple base on God structure as human shape to understand how and where they can connect positive energy so they created Mandala diagram and god in middle of it (Amerlinck, Mari-Jose, 2001). The square divided in to the small squares and every parts have different energies and meaning. mandala is a cosmic diagram based on moon, sun, and nature to connected with universe.

The Upanishad (Hindu philosophy) defined temple as an area at the heart of this ordinary world. Most Hindu people love to have alters in their houses and at temples. Family use alters every day for pray (Gavin Flood, 1996). Hindu temples are artificial altitudes as gadget which prayers built it and decorated with picture of a delegated gods. Hindu temple architecture combines harmony and symmetry with an excessive amount of outer decoration. Elements are designed to have accurate proportions and exert an amusing and impact on their surroundings. Temple Structure is so stunning in such way that, the small information harmonizes and combine with the massive architecture (Susan L. Huntington elc, 1985). The ancient science of Sthapatya Veda illustrates great expertise about existence of construction, design and principles. It was believed that a suitable designed temple will rise higher physical health, Thus Sthapatya Veda method is the expertise of setting up a relationship among the devotees, human body, temple structure and the cosmic order (Geertz, Clifford, 1973). In the area of historical temple construction, there may be sufficient proof of sizeable utilizing of Sthapatya Veda's design, principles which is body structure of God. In addition to the spiritual activities at those temples, there are specific mathematical and astrological calculations, proportions of building plan, unique orientation of physical health in temple which inducts the sense of wellbeing.

## 2. Methodology

This research is based on understanding god in Hindu and how they used god as architectural plan for temple. Methodology used secondary data collection from books journals which were related to Hindu art and religion and temple architecture, books and journals were important for this research I can mention Vidya Dehejia Indian art book which is philosophy of Hindu thinking background of gods and art, also Michell G , Hindu temple book which described Hindu temples foundation structure and journal of Deli,E, Hindu culture, religion and history of the Hindu god. For

understanding energy and universe connect with a yoga and meditation center in Coimbatore in India based on the information they gave , I found articles related with cosmic and universe such as Rian, Fractal Geometry as The Synthon Sis of Hindu, and Richard Maurice bucke, cosmic consciousness, a study in the evolution of human mind, all data for this paper collected, help to understand cosmic in Hinduism and role of god in architecture temple plan to connected universe and nature is part of Hindu believes.

**3. Literature Review**

Hindu temple plan is based on diagrams of the universe (mandala) which is part of geometric pattern and symbols. Mandala has special meaning in spiritual performance, is way the person focused on himself or herself to improve power of mind. (Gavin Flood, 1996). The Hindu design that attempts to reach the universe energies which called Vaastu Shastra, Vaastu a building or structure, according to this Hindu temple architecture is based on the structure body of the God which comes from the mandala (Vidya Dehejia 1997). It is connection between human, gods and universal in holy space. It represents the triple knowledge of the Vedic (ancient Hindu philosophy) image by illustration the relationships between the universe (Brahmana) and the cell (pinda) by a completely unique plan based on astronomical facts (Danielou Alain, 2001).

Hindu temples are based on God structure so always design in structure to make ensure will create peace, health, and prosperity in life also help people to find out their guidance without demolition other creature's life (Danielou Alain, 2001) this is basic of Hindu architecture A massive design of details (kramrisch stella, 2002). In historic Indian text a temple recognized as holly place (Elgood Heather, 1999). All the cosmic fundamentals that create and continue lifestyle are present in a Hindu temple from fire to water, from images of nature to gads, from feminine to masculine, from fleeting to sound and incense smells to eternality and universality at the core of the temple (Kramrisch stella, 2002). Hindu temple architecture combines concord and balance with excessive point of external decoration. Elements of Hindu temple designed to have impeccable proportion and apply with excellent impact on their surrounding (Amerlinck Mari Jose, 2001). The fundamental form of the temple in India is a square cell, orientated to the four principals' instructions, having platform with image of the gods in center, a flat roof above, and entrance on the east side also with ten Major elements of temple and special architecture (Heidegger, Martin, 1997). In front of the entrance is porch covered by a roof sustained by columns in which worshipers accrue before approaching the God.

Several temples sit on top of a crossover platform, with a tall spire called sakhira or spires, the north over the sanctuary (Elgood Heather, 1999), broad gate towers, or gapers, leading into the temple grounds, inside the south. Multipart of temples have antechambers and galleries built off in the sanctuaries. Those are normally set on platforms with stairs and connecting distinctive levels. Huge temples sometimes have separate building for meditation halls, offices and different purposes, and intricate porches, an attempt made to make all of the of the structures balance and peace, with the Hindu universe (Setha M, 2003). A Hindu temple is combination of arts of dharma (Hindu religion mortal life), beliefs, values, and the way of lifestyle.

**3.1 Philosophical architecture of Hindu temple (Creation of Hindu God)**

Universe is whole things which is include space all the properties of space and energy and human. The age of universe is 13.8 billion years old (National Aeronautics and Space Administration). Cosmology is science of source and development of universe and the study of cosmos started with the creation of mankind itself. Our ancestors started observing night and cosmology, slowly over long process of observation and made the structure of solar system came in to attention (Richard Maurice, 1901). India made huge helps which were further studied and applied in various theories in astrophysics. The everyday data observed from the wonder for the events that occur in the sky such as stars, moon, and sun were used in every part of the live of that period, they did not use science to understand where those come from, they used in religions to see astronomic bodies as gods in Paleolithic era (Richard Maurice, 1901) and used as cultural events like festivals to celebrate the harvesting of crops. etc. the most important elements for Hindu god creation were:

- Earth

  Earth was important because they (Hindu people) lived in it and has natural source for living and The other main effect on the life of earth can be seen in the change of season, Earth axis is tilted at an angle 23.4 causing changes in the season in north as well as south hemispheres, the northern hemisphere is tilted towards sun in June solstice causing summer in north hemisphere and southern hemisphere is winter time ( Deli.E, 2016) .
- Sun

  Ancient Indian theory of vastupursha mandala (diagram) has circulation which totally depends upon sun path of that particular district, sun rise from east so all the morning activities are east oriented so that the occupant of the building

can get maximum benefits from the suns eastern rays, the morning sun has more light and less heat also body can get vitamin D and killing disease caring bacteria ( Deli.E, 2016),

- Moon

The moon is celestial body orbiting earth and is the planet's natural satellite. Moon is not an actual satellite of the earth but the gravitational pull is the reason of the high and low tide in the oceans and sea, the highest tide happens in full moon. Human body is made of 70% of water so the moon gravity has an effect on the earth's fluids it may also have an effect on human body (Richard Maurice bucke, 1901).

Hindu people used those elements to create plan for temple. The primary plan of a Hindu temple is holy geometry where the temple imagined as a grand mandala. By sacred geometry, which means it is the reasons that the temple floor plan is basic guidelines and heavens (Rao, 1997. Susan, 1985). Typically, a mandala is a holy form so used square as symbol of heaven. The Hindu philosophy is the first to describe the human as the basis, In Hindu philosophy, the form of Purusha (god with human body) body was made to suit imperceptible concept in square (figure 1), as perfect geometric form (Groover, 1980).

The Vastupurasha mandala (figure 2) is resulting from three separate words each having specific meaning where Vastu mentions to the physical environment, Purusha refers to energy, power or cosmic being, and mandala is the diagram or chart (Rian, 2007).2The first form of the vastupurashamandala is square because they believe is holy shape so it is the important and perfect geometric form in Hindu philosophy, which is indicates the earth. All the essential forms like that triangle, hexagon, octagon, and circle can be copied from the square. every sides of the square symbolize four fundamental guidelines also symbols of limitless life and the perfectness of life and dead (Michell, 1988). According to Hindu believe, man life everyday ruled by the number four (exoticindiaart, 2003). typically the mandala is a square split into slighter squares in the shape of a grid with each square part obviously making the areas of particular Gods (Michell, 1988).

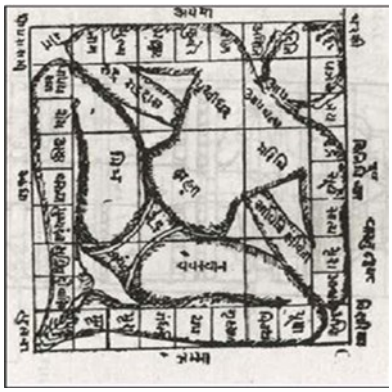


Figure 1. The diagram of Vastupurashamandala, with the god body ( www.gosai.com)

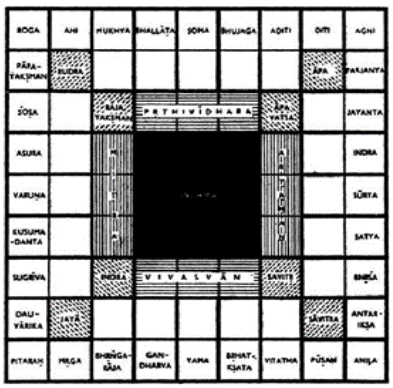



Figure 2 .The Vastupurashamandala (Temple Tech A Book)

The Vastupurasha mandala, have all of the geometrical, cosmic, and human residences so use them as the foundation of the ground floor plan for all Hindu temples. The fundamental shape developed by the temple plan is the outside square of mandala forms and the width of the walls of the main shrine (Grover, 1980). The important four squares get the place of the main God and internal twelve squares forms and the walls of the garbhargriha (table 1, element 2) and the next sixteen to twenty-eight shape in the pradkshina patha (table 1, element 3).

squares had many changes and combinations in the base, the structures of the temple, based on the shape of plans temple squares of mandala divided into thousand squares which almost forming a graph paper for architects (figure 3) to help them to add item at one part and setting back at the other (Grover, 1980).

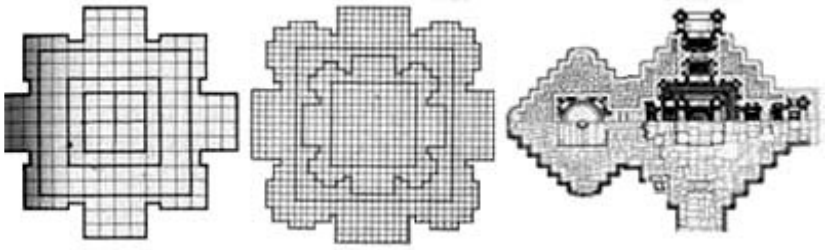


Figure 3. The vastupurashamandala architectural plan (Grover, 1980.)

**3.2 Layout of Hindu temples**

The Vastupurasha mandala is earliest drew on the planning sheets and mentioned the earth and energies in temple building site and constructed temple is based on cosmic energy achievement in positive way because of that selected square as main plan and elements of universe (Richard Maurice, 1901) which in pervious I referred them made a marvelous diagram (figure 4). Center of mandala generates energy to the physical words. The square of the mandala significantly involves the energy balance. Each side of square applies force to center and return to the sides this is calling balance (Rian. 2007). So increasing the number of the squares in the marvelous diagram supports to hold more energies and produce them out to physical world though the center. So, the center of mandala is the place for the main god in the temple.

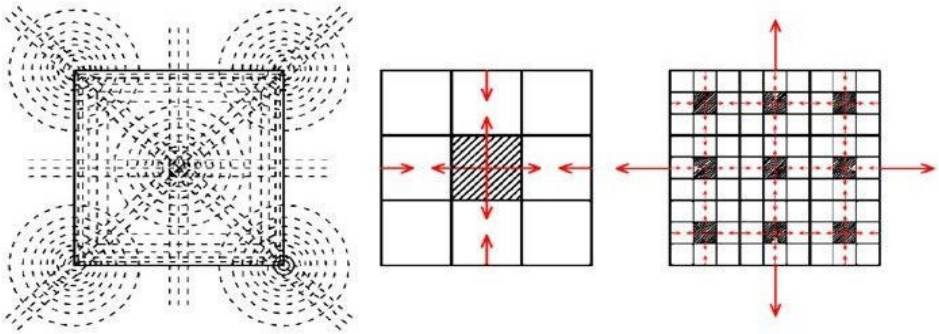


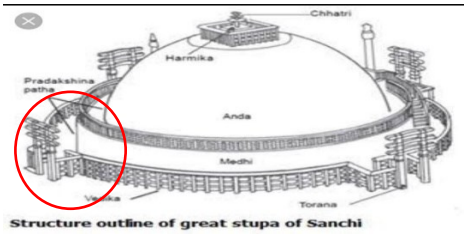
Figure 4. Fields of forces in the square, radiation of forces in square , energy from center going to side from side come back to center (Rian. 2007)

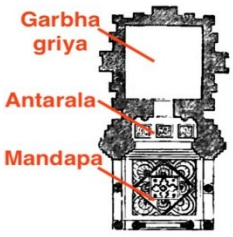
**3.3 Elements of Hindu Temple**

The structure of the temple impact on environment architecture styles and the material such as houses, markets and etc. The main shape and style of the Hindu temple comes from 600 to 800 AD. The architecture of temples has varied style around India, but indicators elements of temple are same because all elements represent god of Hindu, just the shape and scale are different. In the case of the architecture indicators elements (table 1) shows all elements of Hindu temple:

Table 1. Major elements of the Hindu temple identity (source: Fletcher, 1952)

| Number | Picture of Hindu temple elements | Elements of Hindu temple |
|---|---|---|
| 1 |  | ıara: meaning is tower and shape like ımidal and decorated with mythological. pe and size of the tower is depending on ons. |
| 2 | | |

| | | |
|---|---|---|
| |  | bhargriha: meaning womb chamber, this is re image of god is placed. This part mostly is are in plan and entrance connect with small on eastern part, the visitors cannot go to this e this place is for priests to perform the als. |
| 3 | <br>Structure outline of great stupa of Sanchi | dakshina patha: is corridor foe people king around gods' place meaning moving nway for circumambulation. This place is und the outside of garbhargriha which otees walk around and respect gods. |
| 4 |  | ndapa: is the pillared hall in front of the bhargriha for meeting visitors to pray ,sit, ditation and watch the priests performance ceremonies and sometimes is separated n the temples. |
| 5 |  | hamandapa: meaning front porch or rance which connected to the mandapa. |
| 6 |  | urams: is monumental and tower which tell about gods in the entrance of temple. |
| 7 | | |

| | | |
|---|---|---|
| |  | a: is platform of the temple the other words base of temple. |
| 8 |  | anas : is common gateway of temple which tly found in north India. |
| 9 |  | alaka: is stone placed on sikhara. |
| 10 |  | arala: meaning the hall or the middle hall. It nects the main sanctuary and pillared hall of ple. |

**4. Architectural of Hindu Temples based on Mandala as Fundamental Plan in Every Century**

Plan of the temple during different prides had changed but foundations (All of them built based on the mandala diagram) and elements didn't change except in architectural design and sizes which different governments influence on the design of the temples. in below compares three famous temples in 5th, 10th and 15th centuries. temples in north style of India the characteristic temples plan were changed in 5th century, the temples consisted of all the basic elements; the garbhargriha surrounded by an ambulatory pathway, an outside porch with columns in front, and a flat roof with stone. The temples in this era were so simple. Examples of this period can be Sanchi (figure 5) also the improvement of sikhara of these temples started in 8th century (Brown, 1942).




Figure 5. Sanchi temple view of temple in plan and outside ( vedicfeed.com/dashavatara-temple*)*

A wonderful architecture style developed in the temples of Orissa (state in east of India) 7th to 11th century the elliptic arc of sikhara from the earlier periods improved and shape of tower converged near the peak. This period had special attention to the mandapa structure, the roof of mandapa was pyramidal shape on the top and lower than sikhara. The greatest example of this period is Kandaria Mhandeo (figure 6). temple khajuraho is famous for conical tower which made of piles of stone with organize miniature tower called sikhara (Grover, 1980), temple has porch in entrance hall of temple also the roof has different section and wonderful form, wall and roof both decorated with figures form of mythology and history. The greatest example is the Khandriya Mahadev temple.

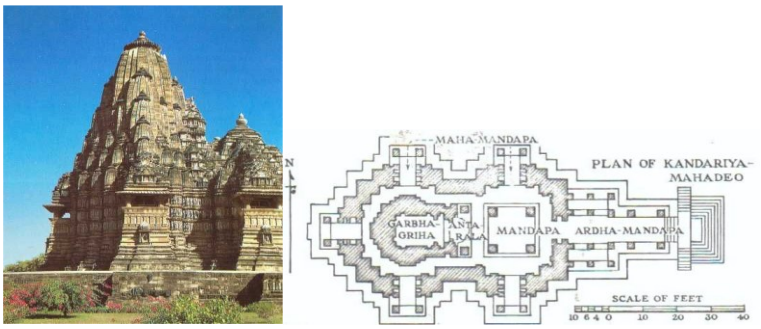



Figure 6.figures of the wall and Plan and view of the Kandariya Mahadeo Temple ( www.indoarch.org*)*

In 15th centuries the mandpa (the pillared hall) in temples started to change also different separated structure of this period, rectangular wall around temple with lower tombs at every corner. The most common examples of temple in this period can refer to the cluster of Jain (figure 7) which has Buddhist structure with square plan with arch roofs.

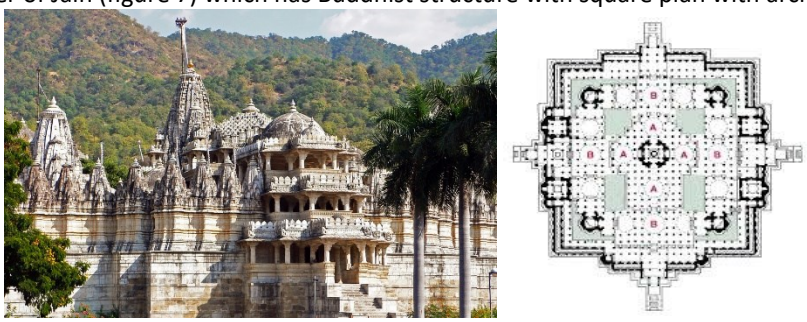


Figure 7. Jain temple plan and entrance view (archi-monarch.com/jain-temple-architecture*)*

The plans of temple are base Vastupurashamandala, the grids of the square in which the cella is two times the size of the walls of the cella (figure 8). the square grid has changed by extending two times on each side out and later in 11th (figure 9) and 15th (figure 10) century the Hindu temple got final form this time square changed by extending on each sides, the khandriya and Madhya and Jain temple are best examples of those periods. According below figures shows that all Hindu temples changed during centuries this because different

condition effect on them and changed structure of temples and design but all temples hold basic (structure of god in plan) plan and didn't changed.



Figure 6. Plan of Sanchi temple in India during 5th century with god structure (Rian, 2007)

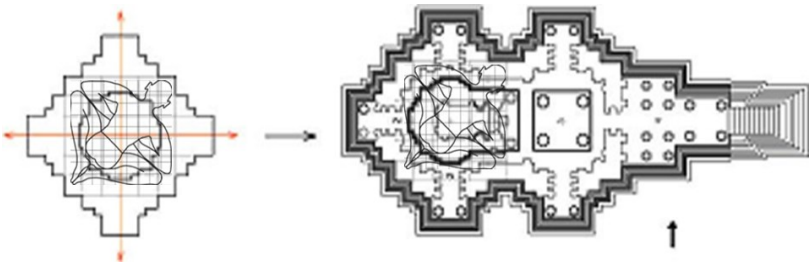


Figure 9. Plan of kandariya mahadeo temple during 11th Century ( Rian,2007)

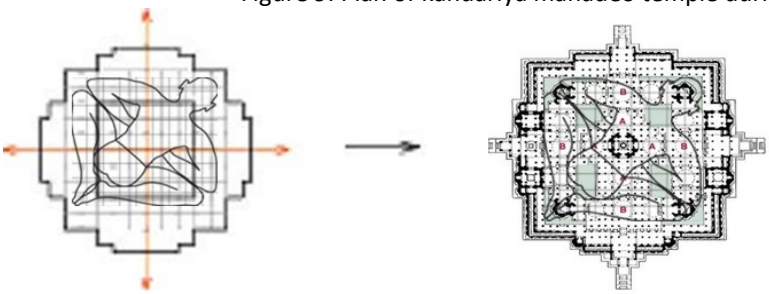


Figure 10. Plan of Jain temple during 15th century with god structure with god structure ( Rian, 2007)

**5. Conclusion**

Vastu Shastra offers the command principles concerning the construction of the building. Those principles explain and help the diagram which referred to the Vastu Purusha mandala. The shapes of temples assumed different forms depend on the functions of the buildings. The structures are numerous for different classes of building and to content different purpose) and identical. Hindu still live base on their religious and their believes is(consists of astronomy, astrology, grammar, mathematics, low, medicine, politics, diplomacy, war, love, architecture and many other branches of knowledge).in this way Hinduism is holistic and It is not just about theology. Hindu traditional inform us that there are positive energy and negative around us all the time same as Chinese system of Feng shui , which explain how we can reach positive energy and stay far from negative energy , This include temples too . In Hindu; religion believe that a temple brings god and human together, and giving them the opportunity to help others. Base on that they imaging God as human structure and use that to build their temples. To connect universe and positive energy and have an (ecofriendly connection with nature. The technology used for Hindu temples is special methods which is based on arts, science and philosophy. This study profoundly describes mandala diagram as constant plan of Hindu temple even if in during different century other features have been changed but basic plan staid unchanged.

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**Conflict of Interests**

The authors declare no conflict of interest

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# The Impact of Urban Management on Crowd Movement and User Experience through the Pilgrimage of Hajj (Frequent Temporary Mega-Events)

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**Abstract**
The research looks at the impact of urban management on crowd movement and user experience during the Islamic pilgrimage of Hajj. This study investigates and develops an urban management framework for crowd movement and user experience at frequent temporary mega-events. The thesis uses a mixed-methods approach to address a complex urban context during the annual pilgrimage in Makkah, Saudi Arabia. Hajj is a unique event that hosts millions of pilgrims; nevertheless, it has many constraints and rituals. The current management system of Hajj suffers from a significant overlap of stakeholders' roles and responsibilities and the absence of user-centricity during the planning and operation of the crowd movement. Thus, Hajj needs a new governance system to establish a framework that addresses the users' needs and expectations. This investigation aims to identify the main touchpoints of the crowd movement toward Al-Masjid Al-Haram from the Jamarat Bridge in Mina to address the following aspects: event management, crowd movement, and user experience.

## 1. Introduction

Mega-events and mass gatherings worldwide have to plan for crowd movements before, during, and after the event time. The planning for such movements usually requires a well-thought strategy to utilize and develop existing services and infrastructure. Complex crowd movements can be found in different practices, whether it is a daily activity, such as metro terminals, train stations, and Disney World, or seasonal events, such as concerts, festivals, and mega sales, or cyclic events, such as pilgrimages, the Olympic games, and the world cup. However, the planning strategy for these events varies depending on whether it is a permanent or a temporary activity.

Permanent events can be described as specific activities that run regularly and are linked to a designated geographic location, for example, football games, public transportation, and praying at the Holy Mosque (Al-Masjid Al-Haram). Planning for this type of activity is a part of the city master plan and usually falls under the city management strategy. In contrast, temporary events can be described as a cyclic event that is not linked to a specific location and rarely occurs at the exact location more than once in a few decades, for instance, the Olympics and the world cup. This type of event requires a unique management strategy to utilize existing urban settings and develop temporary services, which sometimes leads to permanent development. Nevertheless, there is a third type of event that is a mix of permanent and temporary. This means that the event has a designated location and occurs annually only for a few days, leaving that area deserted for the rest of the year. It is the case with the Islamic pilgrimage of Hajj, for example. This type of event is difficult to plan and manage since any permanent developments will only be used for a few days; also, it is not appropriate to apply temporary developments.

By applying the concept of urban consolidation through transit-oriented development (TOD), the urban planning strategy could avoid the poor outcome of overcrowding and congestion. TOD uses different mechanisms to encourage development around activity centers or existing transport, consistent with many urban consolidation strategies across the world (Mobaraki & Oktay Vehbi, 2022; Gillen, 2006). Although the TOD approach seems an excellent solution to implement an urban consolidation system, there is the issue of privileging cars at the existing urban infrastructure, which is more likely to affect urban liveability without proper planning negatively (McCrea, R. & Walters, P., 2012, Aziz Amen, 2022). More importantly, planning for a new urban management system should integrate the social behavior of its intended users. In addition to the management practices, local regulations, and event restrictions to ensure the consolidation of all urban systems to the existing urban fabric, which can be defined as an urban management system. Urban Management is a broad term covering a large set of functions. In general terms, urban management combines all streams converging together to provide inhabitants with a liveable environment. Williams (1978) defined urban management as a framework for the study. Urban management is tackling the demands of cities and towns, which are expanding and rebuilding with policies for land use, structures, and service networks (Aziz Amen & Nia, 2020). Hajj is a complex system in which one aspect cannot be managed or developed without affecting the other elements. When dealing with elements of the Hajj systems, they will impact one another (Aziz Amen, 2021). For example, when developing crowd management plans, they must be aligned with plans for transportation, housing, security, safety, and their impact on the guests' experience (Makkah Region

Development Authority, 2019). Therefore, all systems must be consolidated and integrated to develop a comprehensive operation and development strategy. Hence establishing a new urban management approach for the pilgrimage is pressing and necessary.

**2. The Islamic Pilgrimage of Hajj**

The Islamic pilgrimage is significant for Muslims worldwide and takes place in the holy sites of Makkah, Saudi Arabia. Thus, the research concerns enhancing the built urban environment of the pilgrimage journey by developing a new framework for Hajj generally and crowed movement toward Al-Masjid Al-Haram in particular. The study aims to explore the main variables of crowd movements to identify all touchpoints to evaluate the current situation and put forward an urban management scheme that fits the local context for future development and operation. There are many aspects to incorporate in order to find a solution in such a complex holy journey. The new development strategy should revolve around the pilgrims' (users) needs and expectations. The new urban management framework should address the issue of overlapping systems by analyzing and composing a strategy for planning and operations.

**2.1. City of Makkah**

Makkah is regarded as the holiest city in the Islam faith. It is located on the west side of Saudi Arabia. Al-Masjid Al-Haram (The Holy/Grand Mosque) is situated in the central region of Makkah city. The Holy Sites of Hajj (Al-Mashaeer Al-Moqadasah) consist of three areas; Arafat, Muzdalifah, and Mina, which are located in the eastern area of Makkah city. The area of the holy sites is restricted according to Islamic instruction and cannot be expanded. The city of Makkah has been the core geographic location of the annual Islamic pilgrimage of Hajj for more than 1400 years (Othaimeen, 2000). Makkah has unique characteristics. For instance, according to the Islamic teachings, every good deed performed in Makkah is equivalent to a hundred thousand deeds performed elsewhere, and conversely, punitive measures are doubled for misbehavior. Thus, Muslims are eager to visit Makkah as much as they can and love to stay for as long as possible. Makkah is not open to non-Muslims and restricted to pilgrims during Hajj and high-demand seasons to manage and accommodate the high density of visitors. Many areas in Makkah have been designed to induct a specific function for a limited time, making it difficult to establish permanent urban development of infrastructure and services.

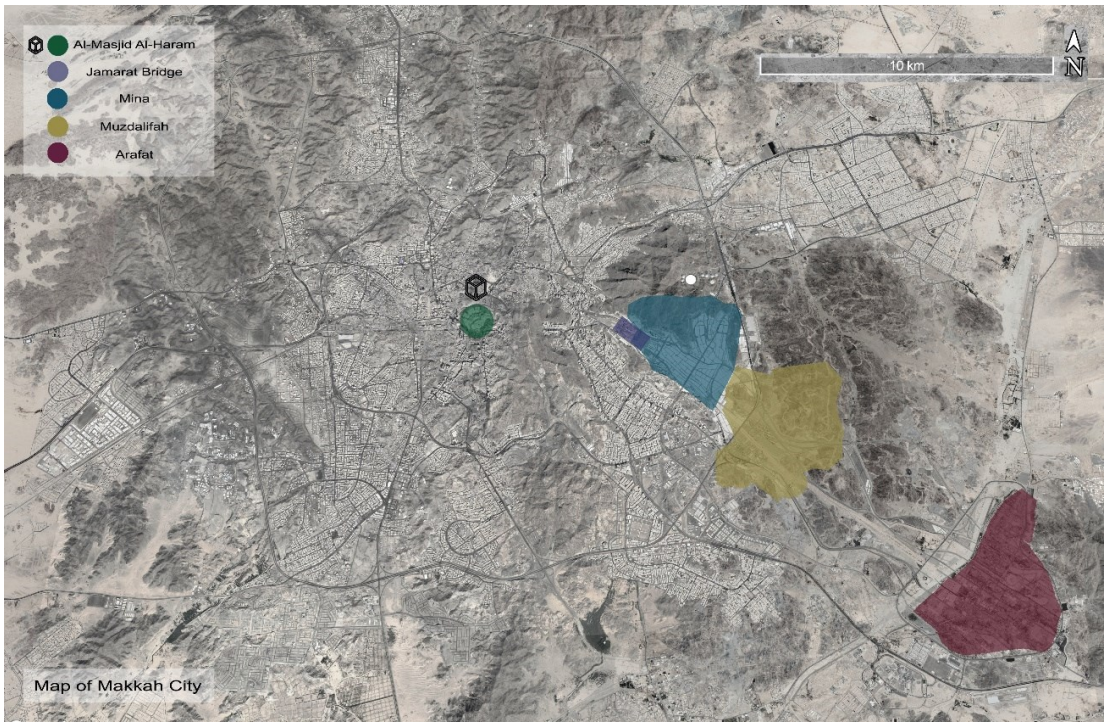


**Figure1.** Map of Makkah, including the Holy Sites (Google earth, 2020, modified by author)

**2.2. History of the Islamic Pilgrimage**

Hajj was assigned as an obligation during the time of the Prophet Ibrahim based on God's command. Indeed, Prophet Ibrahim was the Prophet who built the Kaaba in Makkah, which became the destination of Hajj. The Islamic pilgrimage has started by Prophet Muhammad around 632 AD. *"And proclaim to the people the Hajj [pilgrimage]; they will come to you on foot and on every lean camel; they will come from every distant pass",* Verse 27, Surat Alhajj,

Holy Quran. On average, about 2.3 million Muslims perform pilgrimage (Hajj) every year, and this number is expected to increase to reach up to 4.5 million by 2030 (KSA 2030 Vision, 2016). The Holy Sites host the Islamic pilgrimage of Hajj for six days yearly, i.e., from the 8th to 13th of Dhul-Hijjah. The borders of the Holy Sites are determined by Islamic teachings and cannot be changed (Othaimeen, 2000). These spatial constraints and a large number of pilgrims create densities that reach up to 5 or 6 people per square meter during the crowd's movements. Moreover, it creates a significant challenge in terms of transportation and crowd movement.

**2.3. Pilgrimage Population**

The number of Muslims, according to the latest census of 2020, is about 1.9 billion Muslims worldwide, representing approximately 24.8% of the world's total population (Mhtwyat, 2020). Over the past decades, the number of pilgrims has increased dramatically (General Authority for Statistics, 2019). In the 1930s, the number of pilgrims over a decade was around 500,000 pilgrims and had been growing since then to reach over 16,000,000 pilgrims over the last decade (Figure 2).

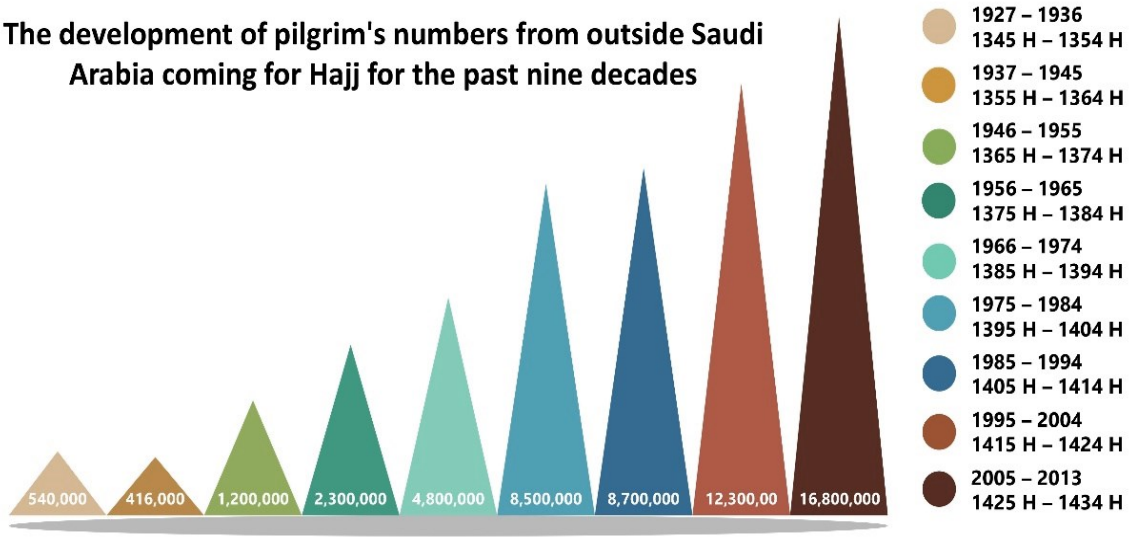


**Figure 2.** The development of pilgrim's numbers from outside Saudi Arabia coming for Hajj for the past nine decades (Developed by Author).

According to General Authority for Statistics in Saudi Arabia, the Islamic pilgrimage (Hajj) population has been increasing steadily during the last twenty years, starting from 1,839,154 pilgrims in 2000 (1420 H) to reach 2,489, 406 pilgrims and kept growing steadily. In 2012 (1433 H), the number of pilgrims reached 3,161,573, the highest number of all time. That year was considered the baseline for the maximum capacity of the Hajj's infrastructure, which ignited the sequence of developments for Al-Masjid Al-Haram and the pilgrimage sites.

**2.4. Service Providers**

In such a significant event that over 2.3 million pilgrims attend, it is difficult to provide all the necessary services. Nevertheless, the Saudi government spares no effort or personnel to meet these guests' expectations. In Hajj, hundreds of thousands of people are working behind the seen to manage and provide the essential services for pilgrims and go the extra mile to enhance the pilgrim's experience. The concept of hospitality is rooted deep in the local customs and traditions, making the hosts go out of their way to meet God's guests' needs. "The real concept of hospitality or Dhiyafah can be described as doing good deeds to provide guests' needs … In Muslim belief, Prophet Ibrahim (PBUH) was the first man who provided hospitality to the guests in Makkah. Since then, hospitality became a great ethnic-religious culture that Muslims and Arab have been practicing over centuries." (Karban et al. 2018). According to Mathabh (2017), during Hajj time, there are over 100,000 policemen, 86,987 public servants, 35,938 workers in the transportation sector, 30,870 workers in the health sector, 3,743 workers in communication services, 18,000 firemen, 10,500 volunteers and many more in secondary services. Hence, Hajj does not only host the average number of 2.3 million pilgrims, but it also accommodates all those service providers in addition to the residents of Makkah (approximately 2 million). Therefore, when planning for an urban solution, the strategy should consider all these groups of people directly or indirectly involved in the Hajj process.

**3. The Correlation between Event Management, Crowd Movement and User-Centricity; An Urban Management Framework**

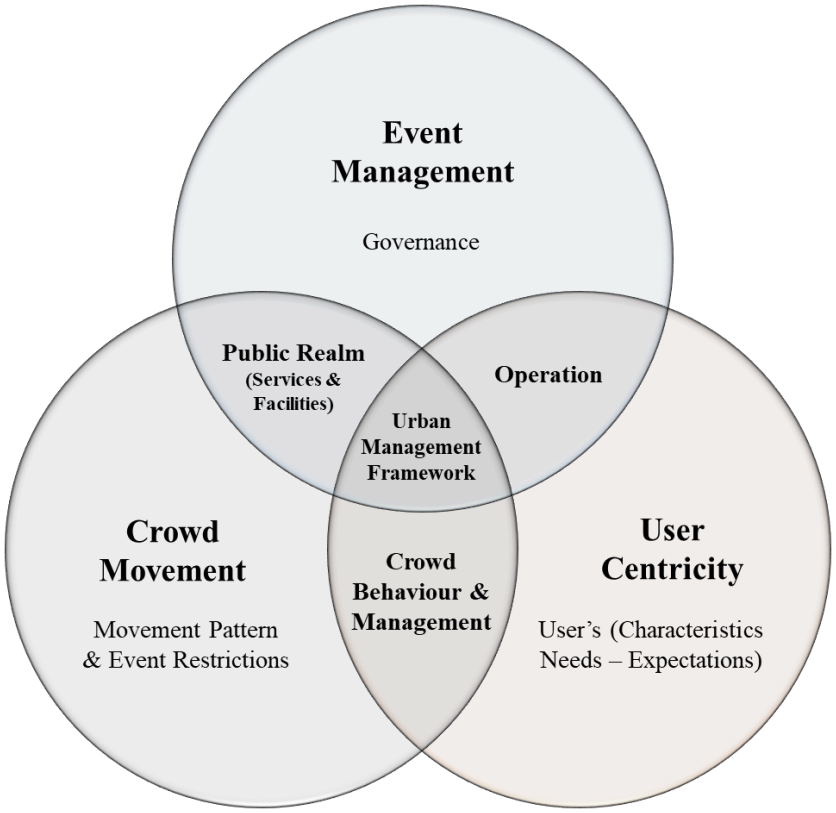


**Figure 3.** The urban management theoretical framework (Developed by Author).

**3.1. Event Management**

Mass gatherings are an event where the number of people attending is sufficient to strain the planning and response resources of the host. The mass gathering may include sports events such as the Olympic Games or FIFA World Cup, religious events such as the Islamic pilgrimage of Hajj or the World Youth Day, and cultural and music festivals. Mass gatherings can also occur at train stations, shopping complexes, business precincts, and tourist attractions (Raineri, A., 2016). According to the English dictionary, a crowd as a noun is defined as A group of people assembled or collected into a compact body without order. As a verb, it means to press together or collect in numbers; to swarm; to throng. Whereas gathering as a noun is A meeting or get-together, a party or social function, and as a verb, the present continuous of gather means collecting or bringing together. World Health Organization (WHO) defines an event as a mass gathering if the number of people it brings together is so large that it has the potential to strain the planning and response resources of the health system in the community where it takes place. Mega-events are usually organized on an international level and attended by mass gatherings, creating high-density crowds. Nieto, P., González-Alcaide, G. & Ramos, J. (2017) stated that the concentrations of more than 1,000 people in a specific location and for a particular purpose are considered to be a mass gathering. As well as they noted that most of the literature refers to multitudinous acts that exceed 25,000 people as mass gatherings.

If a single aspect goes without serious consideration in mass gatherings, this can lead to significant stampedes (Gayathri, H., Aparna, P.M. & Verma, A., 2017). Also, Al-Kodmany, K. (2011) suggested that decision-makers should fully realize the intricacies of the interplay of power. There is some evidence suggesting that cities host mega-events and can be subjected to significant pressure to develop their infrastructure for the sole purpose of a temporary event, not considering the long-term uses and effect on the residents. The findings of Kassens-Noor, E. (2010) suggest that it is essential for city governments to align momentous transport needs with sustainable transportation developments. During a mega-event efficiency of the transport agencies could be improved by implementing the best practices, cooperation experienced, and removing bureaucratic barriers. Many cities that host a temporary major event suffer from transportation over peak during the event time, which requires overloading the transportation systems to accommodate the demand. Al-Rugaiba, A. (2008) studied the temporary public transportation system in that area and its impact on crowd accessibility and Al-Masjid Al-Haram. He concluded that the main issue of the current transit system is that it does not have enough capacity for roads and vehicles to

accommodate the high density of pilgrims. For example, during mass gatherings, the host city replans its transportations to perform over the intended capacity to deliver or evacuate the visitors from and to the event area, which is only possible due to their solid infrastructure. One good example of mass gathering events is the Olympics, which is hosted in different cities every four years, and rarely the same city hosts twice. So, it is almost inevitable that when planning or repurposing the host city's infrastructure and utilities, all changes will be in some form of temporary state. The Summer Olympic Games present (SOGs) with a significant challenge for the host city regarding transportation and services. Authorities must operate an entirely new transport system for participants, visitors, and residents to cope with the dramatic increase in the event capacity (Currie, G. & Shalaby, A., 2012). One crucial aspect of event management is addressing the continuous and changeable needs of the event's participants, determining how to plan and manage several elements, such as crowd movement, dwelling, and service distribution. "Crowd management is a critical part of any event and can be totaled as providing a safe, well-planned and organized event for patrons." Williams, V. (2014, p. 3). Special events with increasing numbers and complexity increase risk dramatically.

**3.2. Crowd Movement**

Crowd science is a study of the effect of density, dynamics, and behavior (individual and collective) on a crowd. Whereas crowd density is a physical condition of the environment considered an antecedent of crowding. In contrast, crowd dynamics relate to crowds' movement and individuals within that crowd. Finally, crowd behavior is a wide variety of behaviors that arise spontaneously from the collective motion of unconnected individuals, which stems from different types of individual and group motivation. (Raineri, A., 2016). Abbott, J. & Geddie, M. (2000) defined crowd management as effectively organizing the movement of crowds. A crowd can be defined as a large number of people collected into a compact body without a specific order. In other words, crowds contain many faceless individuals that follow a particular lead. It is essential to understand that no two crowds are the same. Generally speaking, crowd control represents the steps and procedures that should be taken once a crowd has lost control. A successful crowd control plan involves measures that should be implemented at certain event stages. The reflection of David, A. (2012) on the annual festival of Hindu Ritual Practices in London and its impact on movement and space that the Hindu festival takes place in the streets of London forming a unique movement pattern following the rituals and activities of the festival. Over many years, the Hindu festival has attracted thousands of participants looking for memories and practices in lands of origin. It is a place for future imaginings. "Religious practices are not only about being in place (or emplaced) but also about the moving and transnational journeys of people, objects, traditions, memories and the deities themselves" (David, A., 2012). According to Farhi F. & Mohamed M.M.A. (2020), modern technology is essential to educate visitors about their services and provide various centers for guidance.

In Hajj, there is one noticeable act of crowd management; crowd organizers urge pilgrims to be in a constant motion state during rituals performed to avoid breaking the crowd flow. However, Currie, G. & Shalaby, A. (2012) suggested that the significant outcome of being patient and allowing extra time for journeys during SOGs resulted in the lower expectation of the transportation system during games time and peak demand spread as travelers left. Abbott, J. & Geddie, M. (2000) argued that effective communication among employees, management staff, and guests should lead to successful coordination between these parties, which is an essential element of effective crowd management. In addition, from an event manager's perspective, signage is another form of communication that is effective and useful. Thus, certain techniques or approaches can enhance the operation performance by affecting user behavior. A reasonable approach to tackle this issue could be the customer journey, improving a specific service, or company sales. To truly design a service or an operating system that revolves around its users or customers, a customer journey needs to be mapped out to identify motivations, critical points, and touchpoints (Lemon, K. & Verhoef, P., 2016).

Crowd safety is an emerging concern of local authorities, Johansson A. et al. (2008) discussed the results of relevant video data of high-density conditions during the ritual of Ramy Al-Jamarat at Jamarat Bridge in Mina. These data revealed unexpected pattern formation phenomena. The average individual speed does not go to zero even at ten persons per square meter localities, as an example of pilgrim flows entering the previous Jamarat Bridge in Mina. Haase K. et al. (2019) developed an optimized schedule for pilgrims performing the ritual of Ramy Al-Jamarat. The pilgrim schedule prescribes specific routes and time slots for all registered pilgrim groups. Also, Rehman Felemban (2019) introduced a tool for an interactive visualization rescheduling of groups based on pilgrims' Islamic school of Jurisprudence for performing the ritual of Ramy Al-Jamarat. Additionally, critical crowd conditions such as crowd turbulence can occur due to crowd congestions resulting from significant flow drops, which can cause stop-and-go waves followed by an increase in crowd density. Al-Halabi W. (2018) holds the view that the main issue for pilgrims' accessibility during the movement between Jamarat Bridge and toward Al-Masjid Al-Haram through the southern area is the mixture of pedestrians and vehicle traffic, accompanied by the absence of passenger stations for public transport, and traffic congestion and disruption. That is due to the limited movement axes, high pedestrian density,

and the lack of spaces that can be used for establishing public transportation stations. Multiple technologies for crowd management are currently used in Hajj. For example, Fourati, J., Issaoui, B., & Zidi, K. (2017) argued that some crowd management issues can be solved by applying the principles of the Theory of Inventive Problem Solving (TRIZ). For instance, the principle of segmentation involves dividing an object into independent parts, making an object easy to disassemble, and increasing the degree of its fragmentation or segmentation.

**3.3. User-Centricity and Experience**

Contrary to common belief, the Hajj journey starts when pilgrims begin the trip to Makkah from their home country and continues through the performance of the ritual itself, to eventually ends where it began. In order to apply the concept of the guest's experience in the pilgrimage sequence, a set of the journey's touchpoints is identified. Currently, there are many challenges in the pilgrimage journey, especially the issue concerned with crowd management. The pilgrims' movement and circulation are unique and restricted by the Islamic teachings and directions regarding competition and performance of rituals. Thus, this is likely to put a heavy load on the current management and operation system. Guest experience is a derived term for customer experience in the hospitality industry. So, it applies to any entity that considers its customers as guests. It is the interaction of the guest with the host or brand. It is hard to imagine the scope of what guests experience when applied to the pilgrimage journey. Guest experience is a collective of various touchpoints, feelings, emotions, and thoughts associated with your brand at any time, way before arrival. Guest experience does not fit neatly into a real-world physical model that is easy to conceptualize. It begins as the first spark of awareness of the brand, and it never really ends. So, the guest experience is inextricably linked to brand quality. Hence, to truly understand the guest experience, it can be radically improved across the board at all touchpoints during the pilgrimage journey, such as accommodation, infrastructure, and transportation. Excellent guest experience is a mindset that needs to be adopted by everyone and everything in the pilgrimage journey. It is all-encompassing and omnipresent (Lemon, K. & Verhoef, P., 2016).

Lefebvre, H. (1991) believed that the human experience of any space is a reflection of the history and key events of that space, "lived experience already possessed its internal rationality; this experience was producing long before thought space, and spatial thought, began reproducing the projection, explosion, image and orientation of the body". Also, Lefebvre, H. (1991) argued that "Nothing disappears completely ... In space, what came earlier continues to underpin what follows ... Pre-existing space underpins not only durable spatial arrangements but also representational spaces and their attendant imagery and mythic narratives." Lefebvre, H. (1991). Lefebvre's statement indicates the importance of the relationship between the use of space and social interaction. Christou, et al. (2018) believed that emotions and satisfaction are linked since the visitor satisfaction is an indication of a successful event, "...the mere fact of being categorized as a group member seems to be necessary and sufficient to produce ethnocentrism and competitive intergroup behavior." (Hogg & Vaughan, 2002, p.400). Thus, a crowd consists of individuals' collective behavior based on their background and culture. "A crowd is a compact gathering or collection of people with connotations of homogeneity of characteristics and unanimity of behavior." (Brown & Lewis, 1998, p.649). Kaysi, I. et al. (2013) suggested that users' evaluation and experience can clearly illustrate the quality of service and reveal its shortcoming. Therefore, the relationship between the urban context and the guest experience directly correlates, which is the leading cause of a thriving urban management system around user needs. In contrast, the current managing system of Hajj can be described as a systemic reactive practice for operation procedures to the existing infrastructure and resources.

**4. Data Collection and Fieldwork**

This research uses an explanatory mixed methods approach that begins with a qualitative phase for collecting and analyzing the data. This mixed-method research uses multiple methods and techniques for gathering data, including surveys, interviews, and observational studies. First, the surveys were conducted amongst pilgrims during their respective movements to measure the satisfaction rate of the pilgrimage journey's touchpoints and map the crowd movement pattern. The survey primarily focused on the urban settings and the user experience during their movement. The survey is conducted online during the pilgrimage season. The questionnaire included the following topics: availability, quality, and accessibility of services, guidance, and directional systems, and movement conditions and satisfaction rate. These data have resulted in qualitative and quantitative data; each will be analyzed separately. The quantitative data is the primary outcome of the surveys, reflecting the pilgrims' demographics, trip conditions, and satisfaction rate. In contrast, the qualitative data presents the user's opinion and overall experience. Second, the interviews were held with the main stakeholders of the pilgrimage to collect data from several entities to acquire the necessary information regarding Hajj's governance system and operation, which included: regulations and legislation for the pilgrimage of Hajj, general statistics on the pilgrimage of Hajj, crowd numbers, durations, and management system, and future developments. The interviews focused on various aspects, such as user experience, urban management, crowd accessibility, crowd movement, governance regulations, operation practices (services,

resources, human resources), and crowd behavior. Third, the observational study of the crowd movement took place during the pilgrimage, specifically during the pilgrim's movement toward and throughout Al-Masjid Al-Haram. That provided an overview of the crowd movement pattern and operation management. The observational study uses two approaches to collect data. One approach is to visit and document the current situations to observe the movement and operations from the operator's point of view, assuming the service provider role. The other approach is to assume the user role (using the secret shopper approach) during the actual events to gain a similar experience to determine the main touchpoints of the pilgrimage journey.

**5. Urban Management Framework**

Urban Management primarily regards the co-management system of all urban systems, which directly looks at multiple aspects: space (public realm), governance, activity, and user. Although an urban management framework should incorporate the previous aspects, in this case, the aspects of space and governance can be combined as management, which means the control of space, including assets, resources, and operations, and the governance of the event. Hence, the urban management framework can consist of management, activity, and user. Moreover, the urban management framework identifies various themes, categories, and approaches. Based on that, mixed with the fieldwork findings, the new urban management framework for crowd movements in mega-gathering events has been formed. The analysis process identifies the framework's central themes, sub-themes, and elements. This process has resulted in 59 elements for the new urban management framework; each element is projected on the current situation of the pilgrims' movement in the area.

The data analysis process accrued as follows; After developing the variables of the research framework into the three analysis themes of event management, crowd movement, and user-centricity, which represents the central aspect of organizing frequent temporary mega-events. Next, each theme is divided into three sub-themes, resulting in several sub-themes: public realm (services & facilities), operation, and governance, for the event management theme, which reflects the management aspect, and movement pattern, crowd management, and crowd behavior, for the crowd movement theme, which reflects the activity aspect, and user needs, user characteristics, and expectations (user experience), for the user-centricity theme, which reflect the user aspect**.** Then the following analysis categories of assets & resources, mechanisms, controls, critical points, enablers, directives, requirements, constraints, and objectives are matched respectively with the sub-themes (Figure 4). Lastly, Hajj's customized urban management framework resulted in 59 elements that emerged from the fieldwork data collection and were grouped into the themes and sup-themes of the urban management framework.

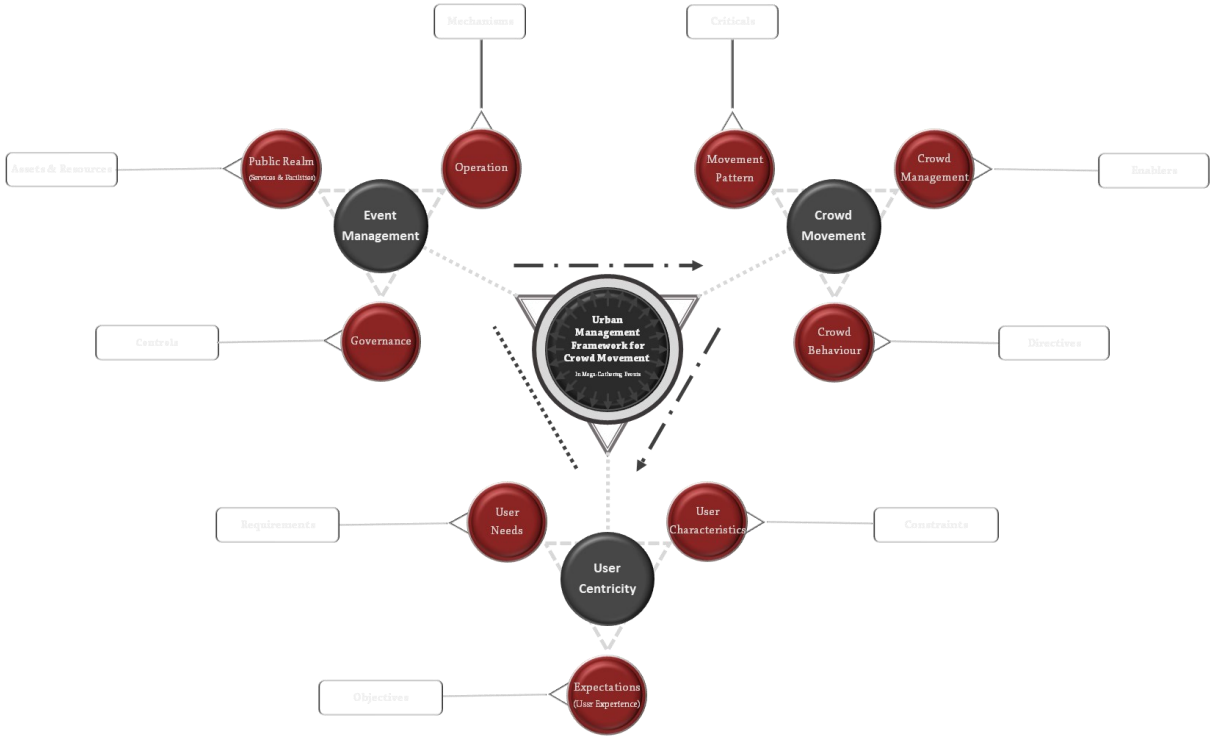


**Figure 4.** The urban management framework, themes, sub-themes, and analysis categories (Developed by Author).

First, the "Management" aspect of the framework is represented by the event management theme, which includes 21 elements. The first group of elements falls under the sub-theme of the public realm (services & facilities) as follows: infrastructure, developments, transportations, pedestrian pathways, public utilities, temporary usage, cost, urban consolidation, and urban liveability. The second group of elements falls under the sub-theme of operation: human resources, supplies, operation models/practices, standers & guidelines, maintenance, and knowledge transfer. The third group of elements falls under the sub-theme of governance: legislation & regulations, event theme, jurisdiction & responsibilities, supervision & oversight, stakeholders management, and emergency procedures (Figure 5).

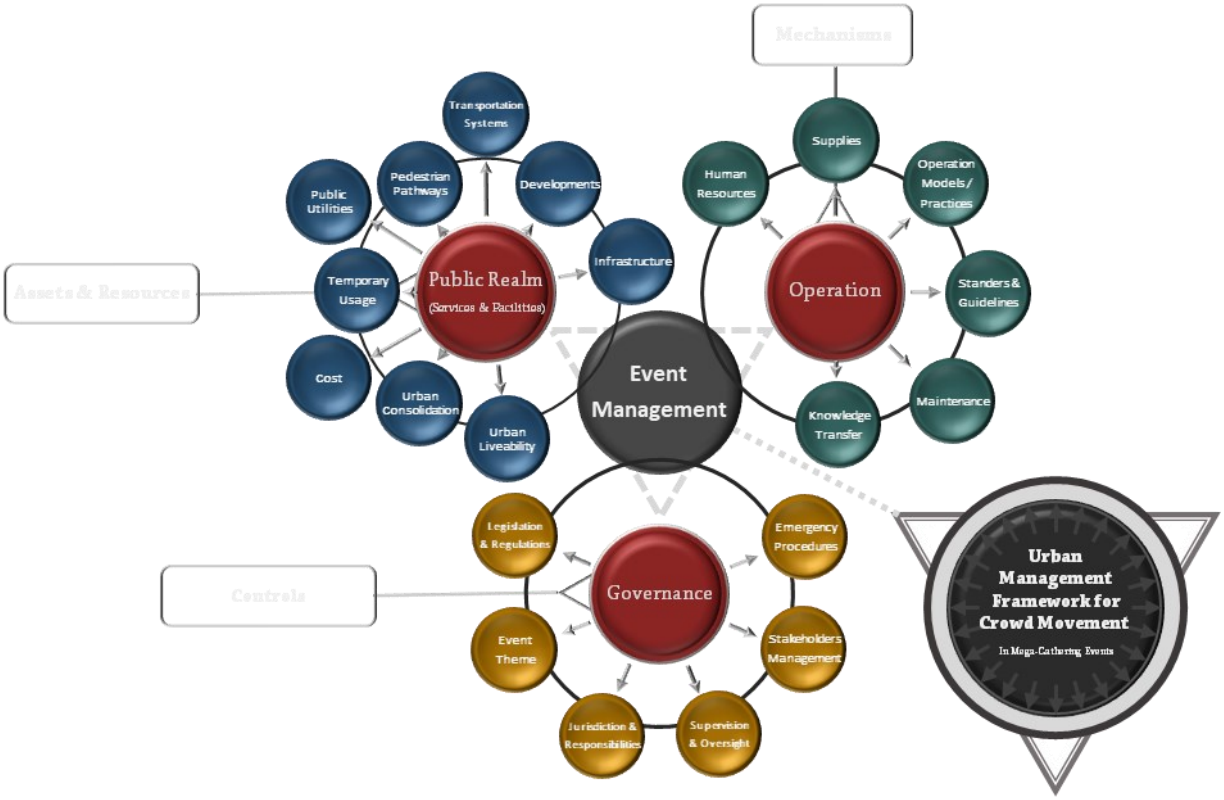


**Figure 5.** The urban management framework, the theme of urban management (Developed by Author).

Second, the "Activity" aspect of the framework is represented by the theme of crowd movement, which includes 21 elements. The first group of elements falls under the sub-theme of movement pattern: weather hazards, crowd size & density, crowd flow & speed, event restrictions, destinations & routes, peak times, and bottlenecks. The second group of elements falls under the sub-theme of crowd management as follows: management approach & techniques, movement scheduling, safety & security, direction system (signage & navigation system), tools & technology, movement sources, crowd control approach, and guidance approach. The third group of elements falls under the sub-theme of crowd behavior as follows: individual awareness, movement flexibility, sense of security, individual behavior, penalties & incentives, and spirituality (Figure 6).

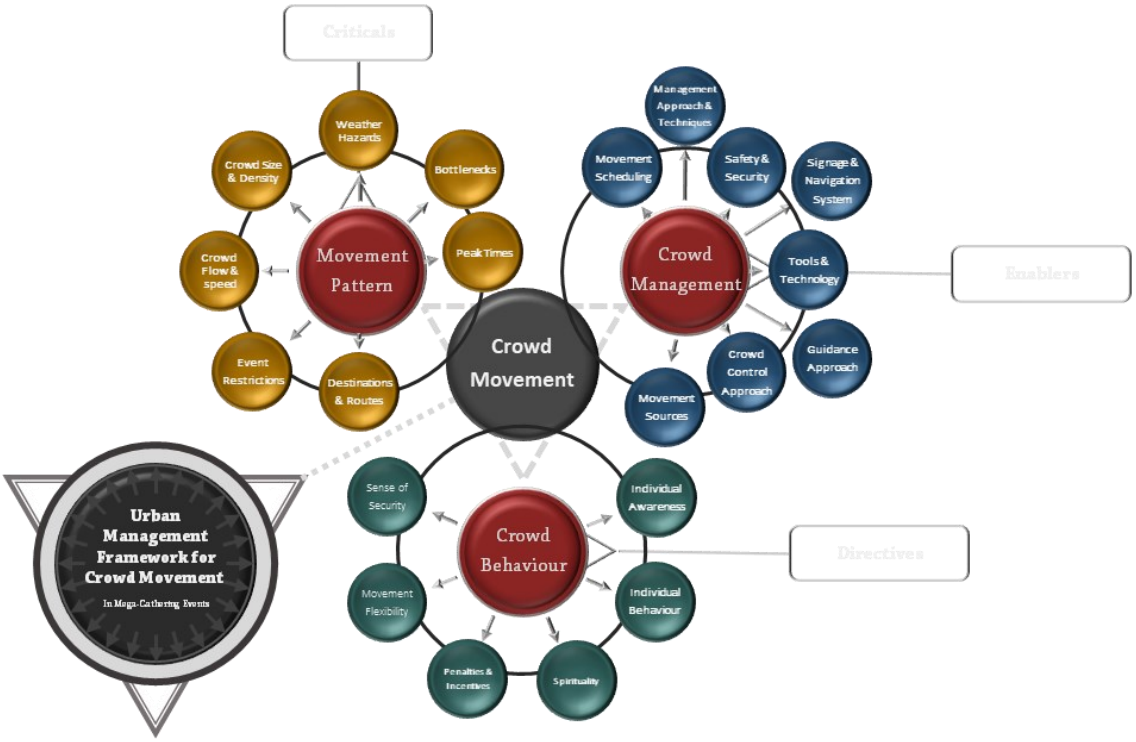


**Figure 6.** The urban management framework, the theme of crowd movement (Developed by Author).

Third, the "User" aspect of the framework is represented by the theme of "User-Centricity", which includes 17 elements. The first group of elements falls under the sub-theme of user needs as follows: ritual completion, essential services, direct communication, universal access, and targeted services. The second group of elements falls under the sub-theme of user characteristics as follows: ethnicity, culture, belief, health, and costumes & habits. The third group of elements fall under the sub-theme of expectations (user experience) as follows: mobility, service quality, enriched experience, satisfaction, affordability, and options availability (Figure 07).




**Figure 7.** The urban management framework, the theme of user-centricity (Developed by Author).

**6. Conclusions**

The study emphasizes the necessity of establishing a new urban management approach for frequent temporary mega-events as a holistic framework that combines and addresses all aspects of management, operations, and activities as one system. On a theoretical level, the research identifies an initial set of learner factors that arise from applying a holistic framework that companies the three themes of event management, crowd movement, and user-centricity. On a practical level, the study will outline a governance strategy for crowd movement during the Islamic pilgrimage of Hajj. This research is expected to enrich the pilgrims' (guest) experience by articulating a set of multi-level touchpoints on that route journey to design guidelines tailored for individuals and groups of pilgrims. These guidelines are expected to realize pilgrims' satisfaction with availability, accessibility, and quality of services. **This study shows the** significant benefit of outlining a strategy for establishing an urban management system to ease crowd accessibility for the Islamic pilgrimage of Hajj in Makkah. This comes in addition to its impact on enhancing the current quality of services and pilgrims' experience. All that can be achieved through policy reform, leading to change in practice. Thus, establishing an urban management framework will accomplish the goal of easing the crowd's movement and enhancing the pilgrims' experience. Finally, a further concern in the research is to provide a base for future research, as some of the subject's data are difficult to acquire. However, it is challenging to develop an urban management framework for a complex urban context with many constraints and ritual customs that should fit the needs for management, operation, and users to achieve the maximum capacity and quality in a well-built environment that hosts millions of pilgrims every year. This requires examining different urban systems that might work as an integrated system. These systems include transportation systems, direction systems, pedestrians' services, and most importantly, the governance guidelines of pilgrimage management. The process should also consider different aspects such as circulation, crowd accessibility, services, regulations, safety, and users' experience to find solutions for such a complex journey.

**Acknowledgments**

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**Conflict of Interests**

The authors declare no conflict of interest.

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# What Is Posthuman Architecture/Cities as A Potential and Emerging Term of Post-Pandemic World

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**Abstract**
The term posthuman reminds agencies like robots or transhumans that will possibly steal the central role of human beings by defeating the humanities. As technology is linked to posthumanism, smart cities are usually interpreted as posthuman architecture and urban structures. However, what posthuman subjects and actors mean in terms of the architectural and urban realm is not clear yet since it is a pretty new term for architecture. This paper takes Rosi Braidotti's posthuman approach to define and discuss the meaning of posthuman in terms of architecture and cities while developing new alternative meanings.
**Keywords:** Posthuman Architecture, Posthuman city, Architectural and Urban Theory, Post-Pandemic Era.

## 1. Introduction

By the end of 2019, humanity has understood that human beings are not the world's most essential and powerful occupants. Since covid created a pandemic era, the fragility and weakness of the human body could easily be defeated by the virus. Nevertheless, the pandemic is not the only threat to the extinction of humanity; climate change and scarcity of food are the new danger to the world, even though some countries prepare themselves by building stores like Doomsday Vault (Fava, 2013). Moreover, covid has not ended yet, and according to scientists, some new viruses are expected soon. All these threats can be the end of humanity. Therefore, this research springs from these unknowns of humankind. What could be the occupants and subjects of the world if humanity disappears? What do other subjects already exist who are waiting to collaborate with human beings to postpone the end of the world or human beings? These actors who came after humans are the posthuman subjects already dwelling in the world with human beings. However, because of the centrality of human beings and anthropocentric designs, these posthuman subjects are not as visible as humans (Amen & Nia, 2020). Also, the word posthuman is not widely known, and it is not clear what posthuman means. So, what is posthuman, then? What are posthuman spaces, and how can posthumans form architectural space. This paper will try to answer these questions. It aims to teach the term posthumanism with a point of architecture and spatial design by taking the posthumanism of Rosi Broidotti at the centre of this paper.

## 2. Material and Methods

Discovering this problem creates the following questions what are human or humanist spaces? What are those spaces that are not used by a human then? How should they be called if there were not designed for humans or not used by a human?
Coronavirus thought us that, a human being is not the most powerful subject in the world anymore. Since the central role of human beings has been changing by the development of technologies, there are more alternative actors and actants threatening the anthropocentric role of humans. Those alternative actors are posthuman.
Given these questions, this paper will take the posthumanist theory of Rosi Braidotti as a methodological approach to reveal what posthuman spaces are. Rosi Braidotti, a posthumanist theorist developed various interrelated fields of post-anthropocentric enquiry. She believes that becoming posthuman is a process of being. She categorises this process into three groups and labels them as "becoming-animal, becoming earth, and becoming machine" (Braidotti, 2013). Consequently, this paper first briefly presents these actors. Then, since the parameters of humans' design humanist spaces, this paper will consider and interpret posthumanist spaces that should be designed according to the parameters of posthuman subjects above. Thus, different posthuman spaces will be illustrated and exemplified by the various designs.

## 3. Posthuman Theory

The heart of the discussion about posthumans started with the classic ideal man of Protagoras (Berkel, 2013). He formulated "The man" as "the measure of all things". After that during the Italian Renaissance, Leonardo Da Vinci reintroduced the Vitruvian man as a universal model (Figure 1). This ideal and perfect body had mental, spiritual and discursive values. His physical and mental perfection advocate the definition of what a human is (Creed, 1986).

However, this figure set some standards for cultures as well as individuals. Because of this model, humanism become a civilizational model was formed European ideas and ideals.

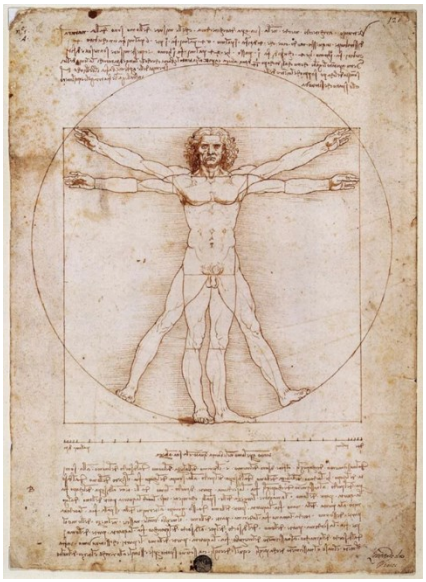

**Figure 1.** Vitruvian Man by Leonardo da Vinci (URL 1)

The ideal man was European. Therefore, its euro-centric paradigm created a separation from other civilizations by creating by emphasising the difference. Differences caused many people to get labelled as "the others". They are naturalized, racialized, and sexualized others. They were disposable bodies that were reduced to less than human status (Braidotti, 2013). This segregation is the beginning of the posthuman discussion. Posthumanism aims to end this opposition between humanism and anti-humanism. It assumes the historical decline of the humanism, and explores alternative ways of conceptualising the human subject rather than "The Vitruvian Man"

Posthuman covers disciplinary fields such as; cultural study, history, philosophy, and classical humanity. The key question here is what comes after the anthropocentric subject?

Rosi Braidotti, a posthumanist theorist developed various interrelated fields of post-anthropocentric enquiry. She believes that becoming posthuman is a process of being. She categorises this process into three groups and labels them as becoming-animal, becoming earth, and becoming machine (Butler, 2014). Becoming animal transforms and displaces anthropocentrism and it recognizes trans-species solidarity based on our being environmentally based (Sagan and Margulis, 1999). Becoming earth has a planetary dimension, and it underlines ecology and climate change issues. The becoming machine re-evaluates the division between technology and human to introduce biotechnologically mediated relations as initial for the construction of the subject.

**3.1 Posthuman as Becoming Animal**

Post anthropocentrism dislocates the single hierarchical and central role of "man" as he is the measure of all things. This displacement creates an ontological gap and this gap is filled with other species. As the perfect man is expected to have a perfect functional physical body that implies, health, normality, and youth in white masculinity. Thus, all other bodies were cast out of the subject position even though some of them are anthropomorphic other such as non-young, non-normal, non-white, disabled, non-masculine, non-healthy, malformed, and enhanced people along with zoo-morphic, earth and organic others. Moral and aesthetic ideals were based on white, masculine and heterosexual Europeans. Nonetheless, all these others are rendered as anomalies, deviance and monstrosity (Braidotti, 2013).

For the Anthropos, the animals are necessary, familiar and appreciated other. There is fantastic interaction between animals and humans gains another dimension in posthumanism (Beckman, 2013). For example, in the movie Avatar, the blue human-animal hybrid creature represents a non-anthropomorphic subject as a lead role. In these Posthuman days, animals have some surprising proximity to humans such as having equivalence life-forms with animals as in pet diet clinics and pet grooming places. The familiarity between human and animals are linked to the economy and labour force (Schmeink, 2017). The bodies of animals while the tusk of an elephant, the silk of a caterpillar, and the cool of sheep have been industrial sources.

By the time and development of technology today, animals are the actors in experiments for biotechnological agriculture, the cosmetics industry, drugs and other parts of the economy. Some animals like mice or pigs are now

genetically modified to produce organs for humans. As it can be remembered from Dolly the sheep and Onco-mouse, capitalism already took those animals as tradable and disposable bodies and post-anthropocentric disposable. Similarly, some dogs and monkeys replaced human beings and they were sent to space as part of space exploration programmes.



**Figure 2.** Dolly the sheep (1996-2003) (URL 2).

As can be seen in many science fiction movies, human beings will be cloned soon like Dolly (Figure 2). However, these cloned bodies are not natural bodies but a heterogeneous mix of organisms and machines. Therefore, Dolly was neither a machine nor an animal but a posthuman icon. Similar to Dolly, Onko-mouse is a posthuman, a transgenic organism created to sacrifice herself to cure breast cancer and save the lives of women. Establishing a new interaction with human beings these animals construct themselves as posthuman subjects.



**Figure 3.** Dog Groomer (URL 3).

As their construction process is not natural, architectural spaces were designed by the parameters of these subjects. For example, the scale of a dog beauty clinic focuses on the size and breed of its prospected customers (Figure 3). Laboratories or science buildings are arranged at the ideal temperature and formed according to the size of the targeted animals. Therefore, the Vitruvian man has been removed from the chart and replaced by these posthuman subjects.

**3.2 The Posthuman as Becoming Earth**

The meaning of nature today is not as positive as it was in the past because humans damaged the earth for years (Amen, 2021). Anthropocene created geo-morphism that includes severe problems related to climatic change, ecological sustainability, or environmental crisis. Coronivus is a posthuman subject and it is a good example of posthuman earth because none of the ecological and geographical problems is local anymore but global.

Posthuman as becoming earth is a process to have a different planetary relation. Therefore, dominant party, Anthropos, should negotiate and have goodwill to other non-human others. The best method will be de-familiarization from their dominant subjectivity. They need the action of “deterritorialization”. Hence becoming earth is taking nature as a positive subject to heal to get what it was in the past (Braidotti, 2017).

Therefore, the position of human subjects and location should be considered fluid, almost homeless rather than settled, multi-gendered rather than man, and finally, they should be the human of the planet. Therefore, Broidotti calls them nomadic subjects (Hanafin, 2014). As Human and non-human occupants living on the same planet, the question of what could be a geo-centred subject look like to have alternative renewable subjectivity.



**Figure 4.** Mel Chin, The Revival Field, Minnesota (URL 3).

Non-human situations appear due to ethical crises such as natural disasters, racism, colonialism, genocide, misogynism, and violence. It causes poverty, starvation, homelessness, and biopiracy that push women, children, animals and others off the stage. While smart, technological habitation is heaven for some subjects, it also determines who could live in this habitat. Nonetheless, human beings should create a vital link with Zoe and create spaces related to Zoe to have a hominid line in the future.

In The Revival Field, Mel Chin represents this goodwill to non-human others for the future of the planet. He created and implemented *Revival Field* (1990), a project that was a pioneer in the field of "green remediation". He used plants to remove toxic, heavy metals from the soil (Figure 4). It was a conceptual artwork intending to sculpt a site's ecology in Minnesota. The area was implanted with unique hyperaccumulator plants to extract heavy metals from contaminated soil. Scientific analysis of biomass examples from this area proved the prospect of "Green Remediation" as an on-site, low-tech option to existing expensive and inadequate remediation techniques (Cieri and Peeps, 2000). As in Mel Chin's work, Posthuman spaces of becoming earth concern sustainability and renewability of nature.

### 3.3 The Posthuman as Becoming Machine

The issue of technology is at the heart of posthuman. The posthuman displaces the relationship between, machine and organism, metal and flesh, organic, inorganic, born and manufactured, organic nervous system and electronic circuits (Braidotti, 2013). Machines do not represent something but deliver the information. Human beings become bio-mediated in this era. Vitruvian man has transformed into cyborgs that are not only the appealing high-tech bodies, or film stars but also masses of the underpaid, digital proletariat.

Human beings have created a new relationship with technology. This dependency gives a protagonist role to technology by developing new software and devices (Dinello, 2021). At some point, humans cannot think about everyday lives without technology. Becoming machine is the biomediated others. It merges with a technologically mediated planetary environment. Autopoiesis creates a link between organic matter and technology or machine (Figure 5). Schumacher believes that Autopoiesis architecture organises itself besides creating a new connection with its occupants (Schumacher and Flores, 2011).



**Figure 5.** Smart Cities (URL 4).

It promises new proximity to animals, technology and planetary along with high-tech mediation. Therefore, becoming machine can be seen in smart buildings and cities that are built with the latest technology. Buildings that deliver their information, does not depend on human subject to sustain themselves. Also, they promise a new lifestyle that merges human, animal, earth, nature and technology within the same constitution (Aziz Amen, 2022). The technological devices and equipment do not represent something because they deliver the information as a nervous system. Therefore, posthuman spaces of machine beings are like cyborg cities and buildings that were equipped with technology.

**4. Discussion**

Architecture might answer the needs of different subjects rather than seeing them as problems. However, considering the description of the human as a subject is already problematic itself, as was explained previously.
Therefore, design has become a matter.
Throughout this presentation, I tried to illustrate three different posthuman becoming processes. In each process, many possible alternative subjects can emerge. Therefore, there is neither one unique posthuman subject nor posthuman space as each of them creates and needs its own space. I tried to take attention that, human beings are not the only subject of architectural and environmental design as it was in the renaissance. Therefore, today's world and technology need architects who are aware of that.

**5. Conclusions**

As the prefix "-post" means after, posthumans can be received as subjects that come after humanity. The term posthuman is usually associated with robots that will take priority over human beings. Therefore, it is linked to technological developments. Nonetheless, its relationship with technology is not as shallow as monstrous robots or technologically equipped or updated bodies that are transhumans. The relationship between technology and posthumans is deeper than cyborgs and robots because it has economic, cultural, and climatic aspects. According to Braidotti, posthuman does not mean species that defeat humans or came after when human beings are erased from the earth. Instead, they are the subjects of design and actors of the planet who appear to question the central role of Vitrivuan's perfect man. Therefore, post- means alternative actors to Vitriuan man. Thus, the posthuman does not address "getting rid of humans" but rather "moving humans away from the centre of our inquiry." Therefore, Anthropocene can be an opportunity for architects to think about how to build for multiple species, creating a broader idea of what life forms should be given to inhabitants. Therefore, architects should take every possible occupant as their client. For example, Shangai has been locked down again because of having a new virus. In England, lots of kids are infected by mysterious hepatitis and now it spread to Canada and Japan. Moreover, scientists are warning us of solar flares because of global warming. All those visible and invisible posthuman subjects already shifted the central role of humanity in the world also they can be the end of humanity. So, what should be an architectural design for the future environment in an extremely hot environment that is also full of fatal diseases? Or what kind of design should be given to human and non-human subjects for the continuity of their species?

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Gender Quota and Women's Needs in Urban Planning Practices by Local Councils: The Case of Ramallah Governorate in Palestine

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**Abstract**
The aim of this study is to investigate the relationship between gender quota and women's needs in urban planning practices by local councils in Palestine which is considered to be a developed country, with a particular attention to Ramallah governorate. Most of the existing studies concerning this topic focus on the importance of gender quota in providing access for women to decision making process without considering well enough the role of gender quota in women's effective participation in fulfillment of their needs and how this influences sustainability of the urban environment. Observations and interviews are used as two main methods. The result of this study showed that although gender quota supports women's access to decision-making process, it is not enough to guarantee the fulfillment of their needs, which restricted their use of the urban environment. Women's awareness of their needs in addition to other obstacles, should be considered for the effectiveness of gender quota.
**Keywords:** Gender Quota, women's needs, sustainability, Urban Environment, Planning practices, local councils, Ramallah, Palestine.

## 1. Introduction

Quota is defined as setting up a percentage or number for the representation of a certain group most often in the form of a minimum percentage, for instance 20, 30 or 40 percent. Quotas are used as a measure to increase the representation of historically excluded or under-represented groups in politics. Quota regulations may target women or may be gender neutral, e.g., 'no more than 60% of either sex'., but gender quota in politics always means women's quota. Women are globally under-represented at all levels of governance in relation to their share of the population, there is an enormous demand for more representation of women in political bodies, and their political participation is now a major objective throughout the global women's movement (IDEA 2007).

Gender quota means reserving a certain number of seats for women to compete on them in elections. It is considered as a tool that led to a quantum leap in the political election system in countries around the world, because it ensures a minimum of women in political levels, including the local level.

The United Nations defines 30 per cent female representation as the minimum required in a governmental body. The 30 per cent figure was deemed as a minimum necessary if quotas were to have any impact on existing power relations and mechanisms of decision-making. However, one hundred countries around the world have during the last decades introduced gender quotas for political elections (Dahlerup,2002).

Women's political representation on the local level is important as it is the nearest level to the woman's life and it affects their daily needs and the needs of their families' members on an ongoing basis. Most of charters have confirmed the need for a gender quota for women in local and political level in order to ensure the minimal threshold of the women's participation in the decision-making process in all levels of planning and daily services of the local community.

Several studies have tirelessly discussed gender quota and their types, effects in general, as well as its impact on the political level and empowerment of women (Dahlerup ,2002; Sekhon, 2006; Krook, 2004). Agenda 21, the UNCED Action Plan for sustainable development, proposed action to strengthen the role of women in sustainable development by eliminating obstacles to their equal participation, particularly in decision-making (Corral, 2002, Amen, 2021).

Concentrating on the women's participation in urban planning practices it is agreed that the best way for urban planners to understand the needs of women is to actually consult with women. It should also be noted that, in order for the planning profession to properly understand and accommodate women, planning professionals must consider women's needs to be legitimate and important. Professional urban planners and local governmental officials should not only seek women's active participation and input in planning processes, but they should also ensure that this participation and input is valued and used (Corral, 2002; Woodworth,2005; Jalalkamali & Anjomshoa, 2019; Moser ,1993). Considering women's needs in urban planning practices will decrease the cost required for adapting the urban environment for women's use and enhance women's urban life which contributes to sustainability of the urban environment (Aslaksen *et al.*, 1997; Moser, 1993).

The above literature maintains the role of gender quota in enhancing women's access to decision making process and raise the question: is it true that gender quota guarantees women's effective participation and fulfillments of their needs

when they are decision makers, especially several studies have revealed that women are still facing problems in using their urban environments?

Therefore, this study aims at investigating whether or not gender quota guarantees women's effective participation in decision making process and fulfillments of their needs in the urban environment, and if not, what are the obstacles which control women's effective participation. This will contribute to the effectiveness of gender quota in local councils and to the sustainability of urban environment through fulfillments of women's needs and enhancing their participation in urban life. The focus will be on the Palestinian context which is considered to be one of the developed countries where gender quota has been legalized and approved in local bodies by the Palestinian National Authority at 2004.

## 2. Material and Methods

In this section, several topics which are related to gender quota, urban planning practices by local councils, women's needs and sustainability of urban environment are explained in general and in the Palestinian context in particular. Ramallah governorate in Palestine was taken as a case study for investigating the relationship between gender quota, women's needs and sustainability of the urban environment using statistical analysis, observations and interviews as main methods for collection of the required data.

### 2.1 Gender Quota, Local Governance and Urban Planning Practices

Local government is in a unique position to contribute to the global struggle for gender equality and can have a great impact on the status of women and the status of gender equality around the world in its capacities since the level of governance closest to the citizens, as a service provider and as an employer. In order to create sustainable, equal and democratic local governments, where women and men have equal access to decision-making, equal access to services and equal treatment in these services, the gender perspective must be mainstreamed into all areas of policy making and management in local government (Purushothaman,2001).

Through quotas, women have been elected to local government in many countries around the world, while quotas have enabled many women to enter local politics; implementation has caused a number of problems. In certain places, quotas have given women the opportunity to change local government policies, by bringing gender priorities into decision making. In many places, quotas have not lived up to expectations and continue to disadvantage women. For instance, Uganda's first local government election after the establishment of quotas in 1997 proved to be less of a success for women (UN,2008).

Although gender quota is a very important tool in reserving seats for women in Local councils and reaching decision making positions, many obstacles and different factors are facing these women and control their effective participation. In a study conducted by Sekhon (2006) about women's participation in local councils in India, Sekhon's found that women are constrained by a variety of social, cultural, economic, and political factors, for instance traditional gendered believes of the role and position of women in family and community, caste and class inequalities, lack of education, and lack of legal knowledge. Accordingly, women cannot take part in decision making process with full freedom. Moreover, they can get a political position by reservation but may work merely as proxies for their husbands or other family members. Sekhon's explains how men frequently take the initiative to convince the women to contest the election. He adds this does not necessarily reflect a wish promote women's participation in political system. It may rather be connected to a wish to keep the seat in the family or to maintain their control over the local councils by proxies. In addition, socio-economic, psychological/ideological and political/institutional obstacles influence women's effective participation as explained by Shedova´sa (2005). She discussed the masculine model of politics, a dual burden of domestic chores and professional obligations, lack of support from party and a lack of confidence and self-esteem.

However, women's awareness of their needs and how it influences their effective participation was not in the focus of the previous studies.

### 2.2 Women's Involvement in Urban Planning Practices and Fulfillment of their Needs

Meeting women's needs in urban environments requires their effective participation in decision-making about the design and planning of these environments (The World Commission on Environment and Development, 1987). During the 1980s there was an emphasis on involving women in design and management of cities as a means of reflecting their needs (Lansley et al., 1989), and several studies were done on this topic. UN-HABITAT realized the importance of women's participation in urban planning and this showed by many cases of urban planning projects executed by UN. For example; St. Johann Park- Fair Shared City: Gender Mainstreaming Planning Strategy in Vienna, Harass map, Egypt -2010 (UN-HABITAT, 2010).

The United Nations Conference on Environment and Development, which was held in Rio de Janeiro in 1992, affirmed women's critical contributions to environmental management. Moser (1993) points out that involvement of women in development and planning processes is a mean towards improving project results. The exclusion of women can negatively affect the outcome of a project. According to Moser, the need to acknowledge women's needs in planning not only

creates better solutions but also more effective ones. In his paper "Women and the Conserver Society", Peterson (1979) notes the hazards associated with having too few women involved in decision-making with regard to new technologies and in the related area of policy-making. He claims that the lack of female perspective in decision-making may lead to a neglect of basic aspects of women's lives essential to analyzing the impact of new technology. Greed (2005) has investigated the effectiveness of gender mainstreaming as a mean of integrating the needs of women into spatial planning in the United Kingdom. She explains that although equalities mainstreaming is widespread within local government, much of the emphasis is upon approaches in which gender is given limited attention.

However, women's needs are not explained or defined well enough, and spatial planning fails to integrate women's actual needs into substantive, spatial policy considerations. This was reflected in the results of several research showed that women continue to face problems in using urban environment. Worpole (1992) wrote about problems facing women in British towns at night. A study in Woolwich shows that 65% of women are afraid of going out at night for fear of assault. 36% of women are afraid of mugging and robbery during daytime. Another study in Edinburgh shows that women feel dissatisfied with the town centre because the streets are dirty and poorly lit, bus services and childcare facilities are inadequate, and the women fear sexual harassment. A study of night life in twelve British towns and cities found that women's view of urban life was completely different from that of men.

The results of previous studies maintain that women's needs in general are not met properly in urban environments even though gender quota has given the opportunity for women to gain access to decision-making process in designing and managing their urban environment.

**2.3 Women's Needs and Sustainability of Urban Environment**

Fulfillment of women's need is important for achieving both of economic and social components of sustainability. On the one hand it reduces the cost requires for adaptation of different public and urban spaces while on the other hand, it enhances social equity in access to public and urban life. According to Aslaksen *et al.* (1997: 5), sustainable urban environment is that environment which meets the needs of all individuals of all ages, sizes, genders and abilities in different socio-cultural contexts and for different purposes, "without a need for adaptation or specialized design", which complies with the principles of universal design. Involving women and their needs in urban design and planning contributes to its sustainability. It encourages women's access to urban spaces which increases the efficiency of these spaces and reduces the costs required for adapting these spaces for women's use (Moser, 1993; Parfect and Power 1997, Amen & Nia, 2020, Aziz Amen, 2022).

Also, accessibility of services for women helps them balance the multiple roles related to work, household and children by reducing their need to travel and reducing money for transportation, which contributes to sustainability of the urban environment. In addition, providing equal access for all individuals (males and females) to urban spaces and services contributes to sustainability of urban life (Welch, 1995; Community & Public Health ,2019).

Based on the focus of the above-mentioned studies, the scholars of these studies were concerned with the relationship between gender quota and women's effective participation or the relationship between women's involvement in decision making process and fulfillment of their needs or the relationship between women's needs and sustainability of the urban environment. However, the relationship between gender quota, women's needs and sustainability of the urban environment has not been explained well enough.

**2.4 Gender Quota, Local Governance and Urban Planning Practices in Palestine**

The administrative divisions of the State of Palestine are known as Governorates of Palestine. After the signing of the Oslo Accords, the Israeli-occupied West Bank and Gaza Strip were divided into three areas (Area A, Area B, and Area C) and 16 governorates under the jurisdiction of the Palestinian National Authority; 11 governorates are located in the West Bank while 5 governorates are located in Gaza Strip . Since 2007, there were two governments claiming to be the legitimate government of the Palestinian National Authority, one based in the West Bank and one based in the Gaza Strip. Palestine is considered one of the developed countries in applying the legal type of gender quota. The Palestinian National Authority has legalized and approved the application of gender quota in local bodies at 2004.

Palestinian Legislative Council approved on gender quota according to the faith of the government that gender quota is considered as interim measure which resorted to ensure the participation of women in decision-making positions, and by allocating a number of secured seats or a specific percentage by which women reaches to decision-making positions. Palestinian National Authority resorted gender quota to embrace women's participation in the event of lack of readiness of the community to elect a woman without legal intervention because of discrimination on the basis of sex, the use of the gender quota will be dispensed at the demise of the reasons (MoLG[1] , 2013).

Women shared in municipal councils through recruitment policy and it was asked by the Minister of Local Government in the year 1998 to appoint one woman at least in all the local and municipal councils. Circular was not phrased binding

[1] Ministry of Local Governance

and has been dealing with temperament of heads of councils and their members in the majority of the sites. The outcome percentage of these women has been (1.6%) only and concentrated in the West Bank (Muftah ,2006).
Palestinian National Authority has conducted local elections three times: the first one was in 2004-2005 and the second one was in 2012 in the West Bank only as a result of the existing political division, while the third one was in 2017 (MoLG, 2005,2012, 2017).
The electoral process in Palestine is organized through a set of laws, decrees and regulations. The Palestinian basic law which was amended in 2003 is considered the legal and constitutional framework for the local government system in Palestine. The election's laws which follow the basic law regulate the electoral process in all its stages. It sets the importance of voters, candidates and time frame that govern the various stages of the electoral process.
Based on a complete proportional representation system (menus), the local elections were conducted through the declared electoral lists only, and the voter can only vote for one electoral list. Only the names of the electoral lists appear on the ballot without the names of the candidates. Results of the elections showed that the proportion of winner women is ranging from 19% -22% in all governorates and the reason for this is that the election law committed electoral lists to represent the minimum number of women (tables 1, 2, 3).

**Table1.** Election Results in 2004-2005 (www. elections.ps)

| Governorate | No. of councils | N0. of seats | Male | Female |
|---|---|---|---|---|
| Jerusalem | 23 | 235 | 189 | 46 |
| Jenin | 38 | 344 | 280 | 64 |
| Tulkarem | 35 | 216 | 171 | 45 |
| Tubas | 4 | 50 | 42 | 8 |
| Nablus | 40 | 348 | 274 | 74 |
| Qalqilia | 17 | 167 | 133 | 34 |
| Salfit | 18 | 180 | 144 | 36 |
| Ramallah | 44 | 427 | 344 | 83 |
| Jericho | 4 | 42 | 34 | 8 |
| Beitlahm | 24 | 256 | 212 | 44 |
| Hebron | 18 | 208 | 172 | 36 |
| **Total** | **265** | **2473** | **1995** | **478** |
| **Percentage** | | | **80.6%** | **19.4%** |

**Table 2.** Election Results in 2012 (www. elections.ps)

| Governorate | No. of councils | N0. of seats | Male | Female |
|---|---|---|---|---|
| Jerusalem | 28 | 286 | 226 | 60 |
| Jenin | 48 | 498 | 403 | 95 |
| Tulkarem | 20 | 210 | 168 | 42 |
| Tubas | 11 | 117 | 95 | 22 |
| Nablus | 53 | 513 | 410 | 103 |
| Qalqilia | 22 | 222 | 180 | 42 |
| Salfit | 18 | 190 | 152 | 38 |
| Ramallah | 66 | 664 | 522 | 142 |
| Jericho | 8 | 88 | 70 | 18 |
| Beitlahm | 34 | 356 | 281 | 75 |
| Hebron | 45 | 398 | 322 | 76 |
| **Total** | **354** | **3542** | **2811** | **731** |
| **Percentage** | | | **79.4%** | **20.6%** |

**Table 3.** Election Results in 2017 (www. elections.ps)

| Governorate | No. of councils | N0. of seats | Male | Female |
|---|---|---|---|---|
| Jerusalem | 28 | 286 | 223 | 57 |
| Jenin | 48 | 498 | 464 | 127 |
| Tulkarem | 20 | 210 | 215 | 56 |
| Tubas | 11 | 117 | 80 | 22 |
| Nablus | 53 | 513 | 349 | 100 |
| Qalqilia | 22 | 222 | 153 | 41 |

| | | | | |
|---|---|---|---|---|
| Salfit | 18 | 190 | 146 | 38 |
| Ramallah | 66 | 664 | 473 | 132 |
| Jericho | 8 | 88 | 62 | 18 |
| Beitlahm | 34 | 356 | 236 | 62 |
| Hebron | 45 | 398 | 391 | 98 |
| **Total** | **354** | **3542** | **2811** | **731** |
| **Percentage** | | | **78.2%** | **21.8%** |

Taking into consideration the relationship between local councils and urban planning, it should be differentiated between two types of local councils:

**First; municipal council:** It is the first local authority from three authorities according to the law, it has extensive powers in urban planning process in addition, it regulates and organizes buildings licenses and construction, in addition to the projects of road networks and land use.

The powers of the local committee, according to Law No. 79 of 1966 (the law regulating the towns and villages) in Palestine related to urban planning practices can be summarized as follow:

- Preparation of master and detailed plans and everything related to regulating, organizing and layout of the city.
- Proven of subdivision plans and projects for land.
- Issuance of licenses of buildings, according to the law.
- Control of reconstruction and construction works within the region and to ensure compliance with the terms and provisions of this licensed law.
- Overseeing the establishment and expansion of roads and all public utilities to serve the citizens.

**Second; village council:** It conducts the daily affairs of the people, and supervision on community services, but most of urban planning issues that granted to the municipal council as previously mentioned, in the case of the village council all these powers refer to the Regional Committee of MoLG in each governorate, the role of the village council is concentrated in coordination with this committee in urban planning issues.

Based on reviewing the strategic plans for different local councils, urban planning priorities can be classified into two major aspects which are master plan and infrastructure projects especially for roads.

As for the satisfaction of gender quota in Palestine in general, it can be said that it received acceptance from many political parties and families, in addition to full support from civil institutions, non-governmental organizations.

Civil institutions and NGOs, in collaboration with the Ministry of Local Government hold training workshops for women members of local councils about related topics included the laws of the local councils, financial management, effective communication skills, advocacy, networking, public relations and women's rights. However, based on reviewing the agenda of the training workshops, urban planning issues and women needs were not in the focus of these workshops.

Regarding the nomination of women in local councils, it is not separated from the structure of society. Sometimes families had controlled the process of nomination of their members and had intervened in the electoral behavior. In addition, political forces and parties had also play an important role in the formation of the lists for local elections. As an inevitable result most of women in these lists had been representing families or political parties (Muftah ,2006)

**2.5 Case Study: The Ramallah Governorate**

The Ramallah Governorate is one of 11 governorates of Palestine which are located in the West Bank. It covers a large part of the central West Bank, on the northern border of the Jerusalem Governorate (Fig. 1). According to the Palestinian Central Bureau of Statistics (PCBS), the governorate had a population of 279,730 in 2007. Since the inception of the Palestinian National Authority, Ramallah has acted as the de facto capital city of the Palestinian administration.

According to PCBS, the governorate has 78 localities, including refugee camps in its jurisdiction. 13 localities have the status of municipality.




**Figure 1**. Map of Palestine showing the location of Ramallah Governorate (www.istockphoto.com)

Ramallah governorate in its multiculturalism also contains religious pluralism among Christians and Islamists with a diversity of citizens from all other governorates. Therefore, the political activity in the Ramallah governorate is considered one of its important features. The statistical indicators point to the high percentage of women who are educated and employed here. All these facts give women a wider margin of freedom of expression and participation than other provinces (tables 1, 2, 3). Therefore, Ramallah will be a suitable case for studying the relationship between gender quota and effective participation of elected women.

**2.6 Methodology**

To investigate the effectiveness of gender quota and fulfillment of women's needs in decision making process, the research design is based on two sections:

- The theoretical section includes a theoretical discussion of the main topic (gender quota, women's needs and urban planning practices).
- The practical section is a case study in Palestine to clarify issues related to the topic of the research as they are discussed in the theoretical section.

For data collection the following methods were used:

***2.6.1 Statistical data***

These data were used and analyzed to investigate women's participation in public activities.

***2.6.2 Observation***

The observations were conducted by the researchers in different urban spaces in Ramallah governorate to investigate how women's needs influences both of physical form of urban spaces and women's behavior in these spaces. Photos and written notes were used to document these observations.

***2.6.3 Interviews***

The interviews were conducted to support the observations and understand the obstacles which control the effectiveness of gender quota, interviews were carried out by the researchers with women and different target groups who are relevant to planning practices as follows:

**Interviews with women**; these interviews were carried out by the researchers with two groups of women:

*The first group* includes women where the observations were conducted. These interviews were carried out face to face with women without a prior arrangement. The time spent in these interviews was dependent on the situation. The objective of these interviews was to investigate how women's needs influence their access to public sphere and different

employment fields. The women were asked to explain how they use their urban environments, problems they face in public sphere. Also, if they participate in different events which take place in the streets or cities' centers and if they do not participate in these activities, they were asked to explain why. In addition, women were asked if they were employed in any field or not, if not why and if yes, are they comfortable or not, and if not why. The sets of information were recorded on separate sheets. However, after conducting twenty interviews, the process was stopped because most of the information proved repetitive at this point.

*The second group* includes women members from the two types of local councils (municipal, village) in Ramallah governorate. The interviews were conducted to collect data about four components: the first is about social status of women such as age, education, political affiliation and marital status. The second is about the attitude of these women towards participation in local councils in general, taking the presence in periodic meetings of the municipal council as indicator. The third is about women's awareness of urban planning process and its relation with women needs, taking any sharing for these women in new concepts or projects that focus on women's need as indicator. The fourth is about the obstacles caused by the society, whether they are social or institutional or external factors which hinder the full participation of these women in local councils.

**Selection of the sample**

Ramallah governorate consist of 78 local councils, 13 of them are municipal ones. The sample for interview was selected as follow: (from winner candidates in 2004 - long experience period)

- 3 women mayors because the mayor is the top of decision-making process.
- 6 women councilors from municipal councils. (In this way half of municipalities will be interviewed - 9 from 18).
- 6 women councilors from village councils.
- 5 women councilors (from winner candidates in 2012- short experience period)

These 20 interviews have been distributed geographically on most parts of Ramallah governorate because of the existence of some minor social, cultural and political differences between villages and cities of the governorate.

**Interviews with managers** of different public spaces and services (restaurants, coffee shops…etc.). The aim of these interviews was to understand their attitudes towards women's needs and how this influenced the physical form of the spaces which they manage.

**Interviews with planners and architects** (both males and females) in different local councils. The aim of these interviews was to understand how women's needs are considered by planners and architects who are responsible for the design and development of urban environment. Also, to find out if there is a difference between males and females planners towards women's needs. These interviews were conducted with six engineers: three males and three females who work in different local councils.

## 3. Results

The implemented methods (observations, interviews, Statistical analysis) provided sufficient data regarding the effectiveness of gender quota and fulfillment of women's needs, particularly concerning women's use of different urban spaces and physical form of these spaces, in addition to the obstacles that control the effectiveness of gender quota

### 3.1 Women's Use of Urban Environment

Collected data from the observations and interviews with women in different situations showed that many women do not use their urban areas comfortably because these areas do not comply with their needs, especially concerning comfort, safety, security and privacy. For example, in many situations as in crowded sidewalks, females are obliged to walk in one row behind each other to achieve their privacy and avoid physical contact with males (Figure 2a). Also, in streets where men's coffee houses exist and men usually sit on the sidewalks sit in front of these coffee houses, females are obliged to walk in the street and exposed their lives to danger (Figure 2b) or avoid passing by in these streets and use other alternative one (Figure 2c).



2a). females walked in one line behind each other to avoid direct contact with males



2b). Men are sitting on the sidewalk of the commercial street and women are coming towards them.



2c). Women left the sidewalk and walked in the street avoid passing by in front of men.

**Figure 2.** Examples of women's use of public sphere uncomfortably

In other situations, women are completely withdrawn from public sphere when it is dominant by males (Figures 3a&3b)



3a): Palestinians, mainly males, help themselves to a piece from the world's largest knafeh



3b): males sit in the street in front of coffee house. Women usually avoid passing by in this street

**Figure 3.** Examples of women's withdrawal from public

Statistical data about individuals participating in different activities in relation to gender in Palestinian governorates located in the West Bank (including Ramallah), issued by Palestinian Central Bureau of Statistics during the year 2012 shows that percentage of females participating in employments is less than males. Also, the average time spent by females in participating activities outside is less than males (Table, 4). However, the table shows that women's participating activities are mainly concerns with household rather than employments.

**Table 4.** Percentage of individuals practicing and average time spent in performing activities in hours (H) and minutes (M) by sex and activity for the year 2012 (Palestinian Central Bureau of Statistics (PCBS))

| Activity | Percentage of individuals participating activities (%) | | | Average time spent in participating activities | | |
|---|---|---|---|---|---|---|
| | Males | Females | Both sexes | Males H M | Females H M | Both sexes H M |
| Employment in establishments | 43.9 | 5.2 | 24.6 | 7. 39 | 6. 17 | 7. 31 |
| Primary production not in establishments | 9.3 | 5.9 | 7.6 | 4.16 | 2.01 | 3.24 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Services for income and other production of goods not in establishments | 17.1 | 4.4 | 10.8 | 4. 00 | 2. 18 | 6.50 |
| Household maintenance, management and shopping for own household | 39.8 | 90.9 | 65.2 | 1. 20 | 4. 07 | 3. 16 |
| Care for children, the sick, elderly, and disabled for own household | 20.8 | 50.3 | 35.4 | 0. 59 | 2. 12 | 1. 51 |
| Community services and help to other household | 7.2 | 10.4 | 8.8 | 2. 13 | 1. 35 | 1. 51 |
| Learning | 23.6 | 22.7 | 23.2 | 6. 47 | 7. 08 | 6. 57 |
| Social and cultural activities | 89.5 | 88.8 | 89.2 | 3. 50 | 3. 14 | 3. 32 |
| Mass media use | 84.7 | 87.3 | 86.0 | 2. 28 | 2. 47 | 2. 37 |
| Personal care and self-maintenance | 99.9 | 100.0 | 100.0 | 10. 50 | 11. 25 | 11. 07 |
| Other activities in the group | 9.6 | 25.2 | 17.3 | 0. 26 | 0. 26 | 0. 26 |

Therefore, it seems that women's access to urban environment and public sphere is still restricted, which indicates women's needs are still not fulfilled well enough in the urban environment.

**3.2 Fulfillment of Women's Needs in the Design and Planning of the Urban Environment**

Results of observations and interviews with managers of public spaces as restaurants and public baths (Figure 4) showed that many of them designate or adapt spaces (Figure 4a) or times (Figure 4b) for the use of women in addition to men. They did this to encourage women's use of these spaces and improve their profits. Therefore, it seems women's needs are fulfilled in the public sphere for economic reason.



**4a).** A screened wall inside a coffee shop is created by the manager to provide comfort and privacy for women while sitting.




**4b).** The written sign says that the public bath is reserved for women's use on Tuesday only.

**Figure 4**. Examples of women's needs and attitudes of managers of public spaces towards women's need

Interviews with decision makers (planners and architects) in local councils showed that women's needs influenced the decision-making process regarding the physical form of public and urban spaces, despite the fact that building codes and regulations do not mention anything about women's needs. The interviews showed that architects and planners consider women's needs in public spaces designed for children. They explained that when they design any space for children, they think about women's use of this space. Also, when they design public toilets, they always separate between males' and females' spaces to provide comfortable spaces for women.

Therefore, it can be said that few of women's needs, particularly those related to culture (women's traditional role in the family in raising children and privacy which is built on the culture of gender separation) are considered informally by decision makers in local councils. In addition, Interviews with female planners and architects showed that they have the same attitudes as males towards their needs. In other words, women do not reflect their needs in professional practice, although they are involved in the design and planning process.

### 3.3 Obstacles Controlling the Effectiveness of Gender Quota

Results of interviews with the elected women in local councils were classified into four categories according to the types of obstacles as follows:

#### *3.3.1 Gender quota and social status of women*

The results showed women's effective participation is influenced by their age, educational level, self-confidence, marital status and their political affiliation. For example, women who are older, more educated and single participate effectively more than other women. Also, women who have a previous experience in work and politics are found to have more self-confidence and participate in municipal council effectively more than other women. Furthermore, the political parties have a major role in forming the structure of local council's members. The interviews with two mayor women revealed that they became mayors due to the political dispute between two major parties and their getting an equal number of seats, five seats for each party. This result led to general agreement and political support for the nomination of these women for the presidency who does not belong to any of these parties.

#### *3.3.2 Gender Quota and Women's Awareness of their Needs and Urban Planning*

The results showed that women do not have enough knowledge about different components of the master plans, particularly related to their specific needs. Elected women were thinking about street network and daily services, open spaces, gardens, public facilities similarly as men and without considering their specific needs in these facilities.

#### *3.3.3 Gender Quota and Women's Attitude towards Participation in Local Councils*

The results showed that elected women in municipal councils were more careful to attend municipal meetings than women in village councils. Women in village councils did not attend these meeting regularly, and they explained that the reason is due to society as will be clarified in the following section . However, women in the village councils sign the outcome of meetings, in most situations, at home to reach the quorum without any participation.

#### *3.3.4 Gender Quota and the Society*

The results showed the following obstacles caused by society restrict the efficiency of gender quota:

- Lack of adequate financial resources for municipal councils in Ramallah governorate which does not support new concepts for development as gender issues.
- Lack of community support and awareness of women's role, in addition to the dominance of the husbands and the families on women's decisions are found to have a strong negative factor on women's efficient participation. Most of the elected women emphasized that they have got motivation from their family members and sometimes political parties to come into politics, but after winning the families and the political parties try to impose their opinions and control women's decisions to achieve their interests and visions.
- Lack of self-confidence for many elected women due to their lack of proper education and experience particularly in the village councils. This was enhanced by male dominance and unhealthy atmosphere from male members which prevent effective participation for elected women in municipal meetings, in addition to their feelings of marginalization because their opinions are not considered.
- Unsuitable time for councils' meetings prevents many women from active participation in local councils' meetings. Many of the interviewed women explained that most of the meetings are held at noon, and they have a restriction of timing as they cannot work outside after evening due to traditions of the society and also due to security reasons.
- Deliberate exclusion of women from participating in vital projects and important committees, particularly in the village councils.

## 4. Discussion

**Regarding women's use of urban environment and sustainability**, the results of observations and interviews showed that women's use of their urban environments is still restricted because the physical form of these environments does not provide enough well women with their required needs. Observations and interviews with women showed that in spaces which do not comply with their needs, women achieve their needs through behavioral components. Although behavioral components help women achieve their needs; these components are restrictions rather than motivations. For example, walking in the street instead of on the sidewalk, or walking in one row behind each other, or looking for alternative streets to pass by comfortably, are all components that act as restrictions rather than motivation for making use of urban environment and participating in public life (Al-Bishawi ,2016). This was confirmed during the interviews with women where many of them explained that when the physical layout of the space they use does not comply with their needs, they are obliged to use additional behavioral components. In other situations, women may also withdraw from public life due to privacy and security reasons. During the interviews with women, many of them explained that they do not participate in several activities and events in streets and cities' centres because they do not find spaces where

they can sit or stand up comfortably. These results comply with statistical data reflected in table (1), which indicate that women's access to public life is still limited in comparison with men despite both women and men have equal opportunities in different employment fields (Odeh & atallah, 1999). Although the reason for this could be related to women's personal factors or other reasons, neglecting of women's needs is an important factor which restricted women's access to several employment fields. This was confirmed during interviews with women, as many of them explained that they were deprived from job opportunities offered to them because of privacy and security reasons. For example, being male domain or located far away outside their cities caused restriction on women's employment. This deprived women from their right in access to public sphere without restrictions, which contradicts with the principle of sustainability regarding equity among citizens in access to their built environments (Welch, 1995; Community & Public Health ,2019;). Therefore, involving women's needs in the design and planning of urban environments enhances women's right to access these environments which contributes to the sustainability of these environments.

**Regarding the fulfillment of women's needs and sustainability of the urban environment,** results of the observations and interviews showed that few of women's needs, particularly cultural needs related to gender separation, are met indirectly (informally) in the design of urban and public spaces, since there are no written rules concerning cultural needs exist in building codes and regulations. The reason for meeting cultural needs indirectly is seen as related to planners and architects as being Palestinians, and are influenced by culture in their way of life. Therefore, they reflect women's privacy for example, which is based on the culture of gender separation, indirectly in their design works. But, in the case of other specialized needs (safety, security, comfort) informal rules (culture) will not contribute to women's needs and women will be restricted in using urban spaces. For example, due to the importance of privacy, as being a cultural women's need, for the inhabitants, decision makers in the municipalities are obliged to approve changes in the physical form of public spaces concerning women's privacy even if these changes contradict the formal rules. Meanwhile, managers of urban and public spaces, in most situations, specialize spaces for women in public spaces not only to comply with women's needs, but also to increase the number of customers.

Although few of women's needs are met informally, this influenced negatively the aesthetic quality and the sustainability of urban environment. The results showed how people make changes either in the physical layout or in the use of urban and public space to adapt it to women's needs. However, adaptation of different spaces to women's needs costs money, which contradicts with the principle of universal design concerning sustainability of the built environment, as explained by Aslaksen *et al.*, (1997).

Therefore, meeting women's needs through the informal rules does not always assure women's right in access to public sphere on the one hand, and causes degradation in the physical form of the built environment on the other hand. This reveals the importance of including women's needs in the formal rules.

**Regarding the obstacles controlling the effective participation of elected women,** results of the interviews with these women showed that not only obstacles related to women's social status and society's norms are facing the elected women and controlling their effective participation in local councils (Sekhon, 2006), but also women's awareness of their needs is found to be an important obstacle. Therefore, considering these obstacles will enhance the effective participation of elected women in decision making process. For example, women who participate in the local councils should have a proper education, knowledge, experience and self-confidence which enable them to decide without being influenced by people who try to impose their opinions. Also, appointing a suitable time during day for councils' meetings will allow for women to attend these meetings and enhance their effective participation. Many of the interviewed women explained that most of the meetings are held at noon, which controls their participation in these meetings due to traditions of the society which do not allow for women to leave their homes during night. Also increasing the awareness of elected women about their needs will enhance the effective participation of the elected women and fulfillment of their needs in the urban environment. The results showed that elected women, even if they are planners or architects, are not aware of their needs; they have the same attitudes as males towards their urban environment and do not reflect their needs well in professional practice. This could be seen as related to the standard knowledge taught to planners and architects at the universities that does not differentiate between women's and men's needs and to the exclusion of women's needs from planning regulations (Al-Bishawi, 2016), in addition to the exclusion of women's needs from the agenda of the training workshops which are held for women members of local councils about related topics concerning local councils. However, the results showed that the previous mentioned obstacles control women's effective participation in village's councils more than in municipal councils. This can be seen as related to the nature of society in villages where more restrictions are imposed on women in their works, education and decisions. Therefore, increasing public awareness of the society, including women, about the importance of women's role in decision making process in local councils, with a particular attention to villages, will enhance women's effective participation and fulfillment of their needs.

**5. Conclusion**

This study provides us with important findings to answer the major question of this research concerning the relationship between gender quota, elected women's effective participation in urban planning practiced by local councils, women's needs and sustainability of the urban environment in general, and in Ramallah governorate in Palestine in particular. Most of the existing studies concerning this topic focus on the importance of gender quota in providing access for women to decision making process in urban planning practices without considering well enough the effective participation of elected women in fulfillment of their needs and sustainability of the urban environment. The results of this study showed that although gender quota is a positive tool in supporting women's access to decision-making positions in local councils, gender quota alone is not enough to guarantee the effective participation for these women, especially concerning the fulfillments of their needs in the urban environment.

Women's awareness of their needs in addition to other obstacles facing elected women regarding their proper education, experience, self-confidence, time of local councils' meetings should be considered to enhance the effectiveness of gender quota and fulfillment of women's needs.

Including women's needs in design and planning regulations and in the knowledge taught to planners and architects at the universities, in addition to the agenda of the training workshops which are held for women members of local councils will enhance the effective participation of elected women and fulfillment of their needs.

Effective participation of elected women in decision making process and fulfillment of their needs will support women's right in access to public life and reduce the money required for adaptation of the urban environment to comply with women's needs, which enhances the sustainability of urban environment.

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# Territorial Planning Between Governance and Local Development for a Better Quality of Life

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**Abstract**
Public action in terms of urban planning and development. Striving to geographically distribute the population and economic activities, to homogenize the territory, fragile and coveted which is experiencing significant changes, particularly in one of the Algerian cities Biskra as a case study. Evoking qualitative questions in relation to urban forms and developments requires setting frameworks for reflection, in particular in relation to the vocations to be given for future developments. This is how it goes without saying to promote touristic, agricultural agro-tourism vocations and, on the other hand, to propose urban and rural developments. It is also a question of fixing the methods of intervention on the urban space to achieve the beginnings of a quality of living environment. By using the method of analysis (historic-geographical) two levels of intervention are approached at the global level of the territory of the city and at the local level of the developments. The objectives to be achieved are: To highlight the means of local development, whether human or material, to have a better quality of life inside cities. Clarify the impact of developments on the morphology of the urban space for possible use in urban planning operations.
**Keywords:** Local development; Historic-geographical approach; Urban planning; City territory; Quality of life.

## 1. Introduction

Algeria is a country that has many cities from large to small sizes (Oran, Biskra, M'chouneche…). Their urban fabrics (David M. and Philippe P., 2009) have undergone transformations, to varying degrees, whether in their spatial organizations or in terms of the morphologies of the built and the non-built. For a better quality of life.There is also a lack of knowledge of the real needs of the population and weaknesses in the consultation process. Evoking qualitative questions in relation to urban forms and developments requires setting frameworks for reflection, particularly in relation to the vocations to be given for future developments (Aziz Amen & Nia, 2018, Aziz Amen, 2022).

Quality of life can be considered as a concept covering all spheres of human life, referring both to the conditions, material and natural resources like (palm grove, deglette-nour, thermal springs), opportunities available to people. The quality of life, consisting of the result of the reports on the living conditions and activities that make up human life, the needs, the values, the human aspirations, the global diagnosis of the quality of life (Lelièvre É., Findlay A. ,1991) characterized by two types of indicators (objective and subjective) to describe people's lives. In this research, the concept of quality of life is considered a complex and multidimensional concept, which refers both to the individual and to the society in which he belongs (Bourdin A., 2007, Amen & Nia, 2020). Urban space has led to the evolution of the way of life, but its quality is an issue that deserves attention, due to its decline in the city of Biskra. Quality of life is a founding element of both political and societal concerns and is one of the current urban issues. To determine the perception of urban citizens on a fundamental set of quality of life indicators densities (Clément P., Guth S., 1995), green spaces (Michael L. and Florian S., 2012), urban forms, urban identities and mixes.

The description of the current state of the urban community according to the indicators of the quality of life selected to build an effective management of the local administration. The purpose of the data obtained translating into good community governance, for the purposes of its development and co-participation of citizens in community life.

## 2. Methodology

The scientific tools that allow us to explore and determine the types that urban spaces have undergone through local development between governance and territorial planning (Damien T., 2006).

It is also a question of fixing the methods of intervention on the urban space to achieve the beginnings of a quality of living environment. Using the methods of historical-geographical analysis according to M. R. G. Conzen.

to explain the geographical structure and character of cities by a systematic analysis of their constituent parts and development over time (Alnwick, 1969, pp. 3-5), by five general aspects:

1-site 2-function 3-urban landscape 4-social and economic context 5-development

Are applied to the different fabrics of the city of Biskra in the efferent periods of its evolution see (Figure 1).

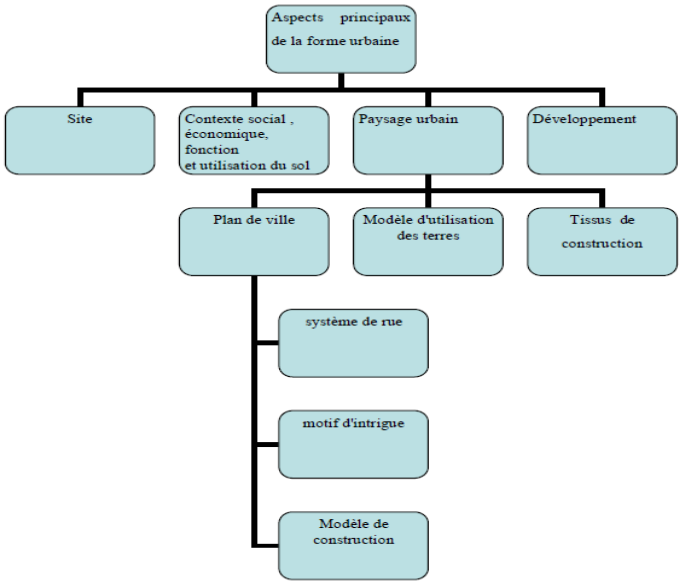


**Figure 1.** The historical-geographical approach according to M.R.G. Conzen(source: Author, 2019)

**3. Study of the urban space of Biskra**

Biskra is a city in the northeast of Algeria, capital of the wilaya of Biskra located about 400 km southeast of Algiers. The city has an area of 127.70 km². It had 218,467 inhabitants in 2010 see (Figure 2).




**Figure 1.** situation of the city of Biskra(website,2019)

Different tourist places make Biskra both a city of rest, discovery and care through spas, it is also known for the fertility of its soil. Located at the gates of the desert, it is an oasis city known for its date palms, mineral springs and for being a warm getaway during cold winters. Located at the gates of the Sahara on the part of an oasis, the city is surrounded by date plantations.

The urban space of Biskra is currently structured by transport and communication infrastructures, constituting an unfavourable material framework for the circulation of information, physical goods and individuals (Serge W., Jacques T., Yves C. and Jean- Pierre O., 2005). To appreciate these characteristics of the city of Biskra, it is necessary to study them through the different lived periods.

**3.1. The Evolution of Urban Space**

**3.1.1. Biskra Before French colonization**

The traditional urban fabric is surrounded by irrigated land and palm groves well integrated into its immediate environment. It is made up of several districts (Bâb darb, Ras el gueria, Megniche, etc.).

The three factors:

1- Social factor

2- Defensive factor

3- Water factor

have an important role in the composition and spatial organization of the traditional urban fabric see (Figure 3).

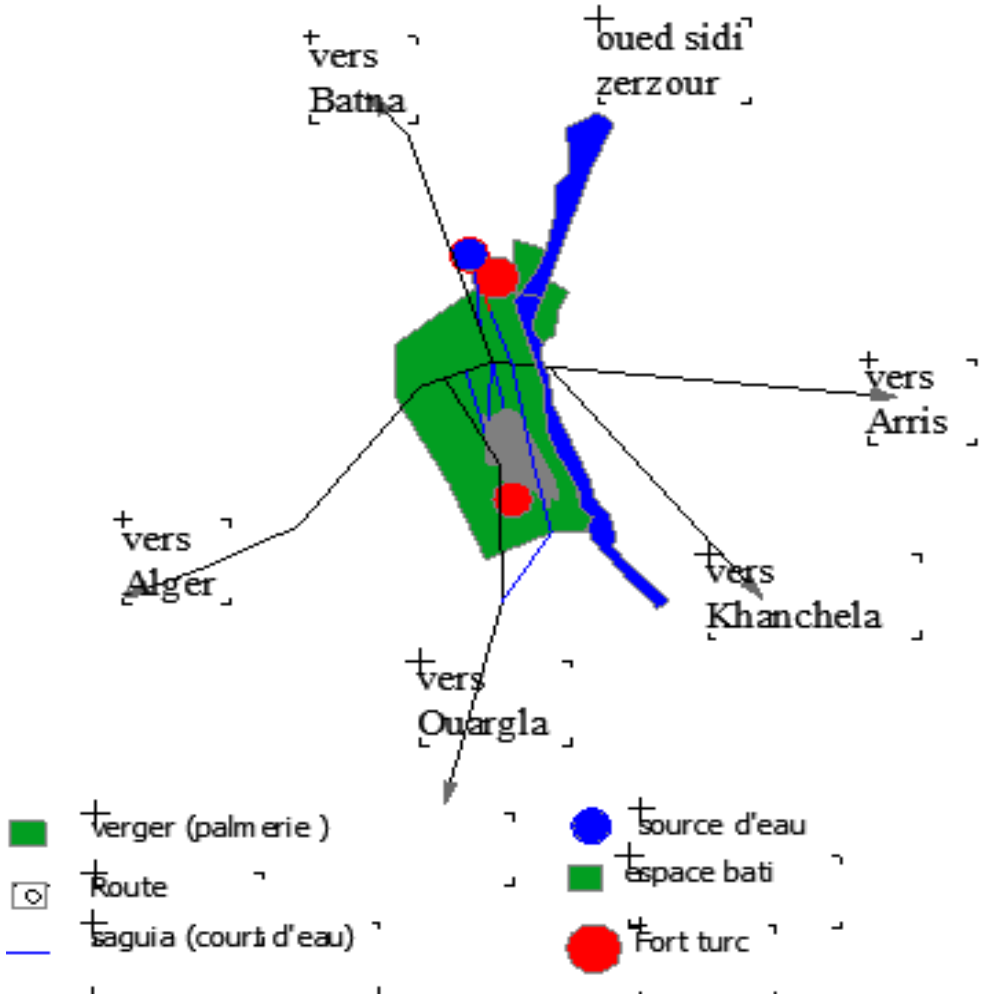


**Figure 3.** Diagram representing the city of Biskra in pre-colonial times (Source author, 2022)

The urban expansion of the traditional fabric takes place along waterways Regarding the positioning of the buildings, they have two facades, one facing the street and the other the palm grove, see (Figure 4).



**Figure 4 .** Old image and Google Earth image representing the city of Biskra in pre-colonial times (website, 2022)

### 3.1.2. Biskra during the period of French colonization

This period is distinguished by the existence of two poles which are the strong Turks and the colonial checkerboard see (Figure 5). The will of an urbanization which tends to connect them according to the North South direction limited by two constraints, one natural in this case the wadi and the other artificial namely the railway line, this evolution was mainly marked by:

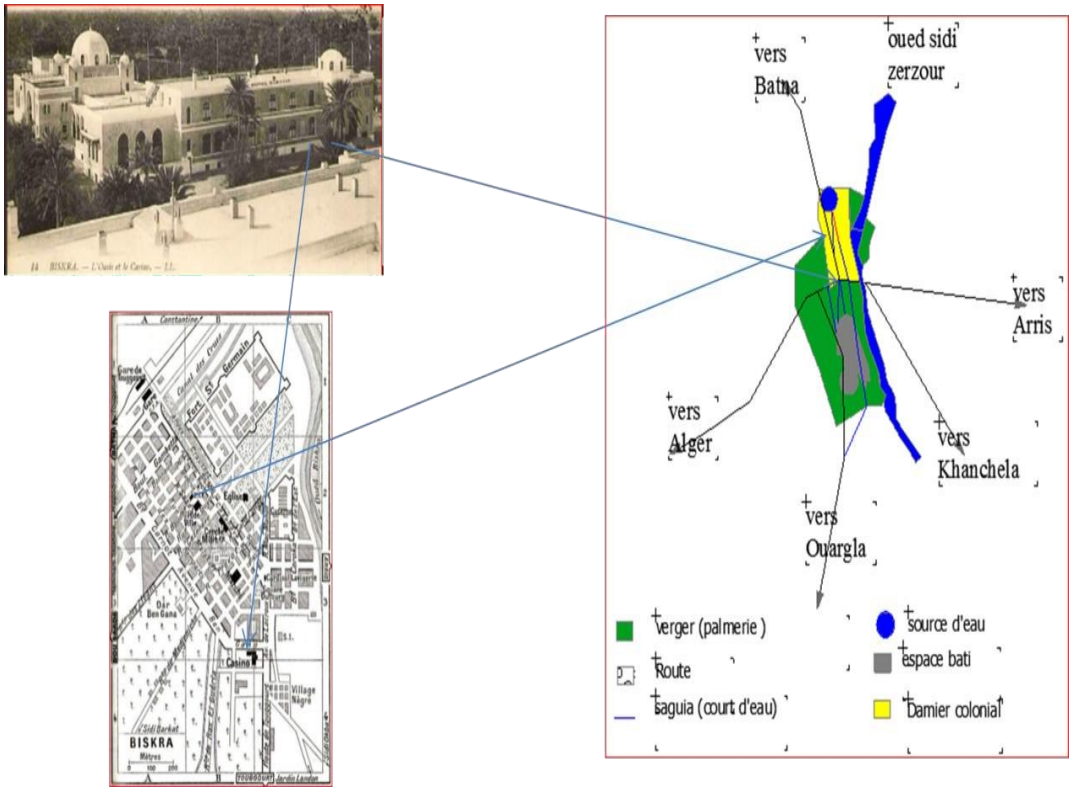


**Figure 5.** Diagram and image representing the city of Biskra during the colonial era (Source author and website, 2022)

• The connection of the two nuclei by the current Hakim Saadane way

The arrival of the French was characterized by the adoption of the same strategy as that of the Turks by the construction of Fort Saint-Germaint in the North, allowing both the control of rivers and the creation of a new city. called "the Colonial checkerboard", located slightly downstream to control the East-West and North-South traffic lanes. This then generated a development of urbanization thereafter along the North-South axis to connect the North Core to the South Core. The French city of Biskra was built outside the urban area of the indigenous population, so as to avoid any mixing between the settlers and the Algerians.

### 3.1.3. Biskra Currently

Significant extension of the city's buildings to the detriment of the palm grove and green spaces 75% Of buildings in relation to urbanizable land. The urban sprawl of the city of Biskra up to the territory of the two communes Chetma and El hajeb see (Figure 6, Figure 8 and Figure 9).

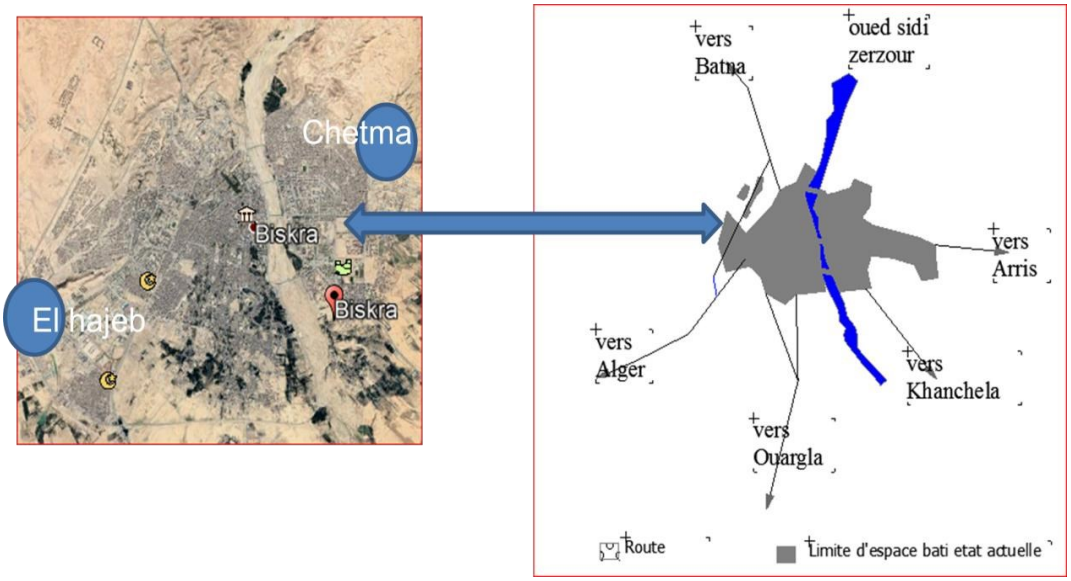


**Figure 6.** Diagram representing the currently built space of the city of Biskra (Source author, 2022)

Significant extension at the level of the western zones (industrial ZHUN) east to the north of the planned urban fabrics:

• West ZHUN, East ZHUN, Industrial Zone, University, El Alia and Equipment Zone.

• Extension by illicit urban fabrics: Sidi Ghazal, ElAlia, Ermaiche, Lebchache, Boukhari, El-haouza, Sidi Barkat, bab el derb.




**Figure 7.** Hai bab el derb Biskra illicit urban fabric (Source image Google Earth, 2022)

Extension by the East and West sides due to the allocation of land construction of individual housing (Hai assaada….)



**Figure 8.** tissue plan Hai assaada Biskra (Source image Google Earth, 2022)

**4. Discussions**

The intervention will focus on development at two levels of intervention

**4.1. Overall level of the territory of the city**

The first concerns the global scale of the city, a recommendation is made to improve the image (Tonneau, Jean Philippe,2016). and rank of the agglomeration through the development of public spaces.

important for the city, urban breakthroughs, reworking city entrances and promoting major development operations, for attractive recreational activities: urban parks, large tourist complexes, amusement parks, promoting attractive offers for the city. Provide contextualized forms of development in relation to the realities of the sites concerned, in particular in relation to their urban or rural characteristics see (Figure 9).

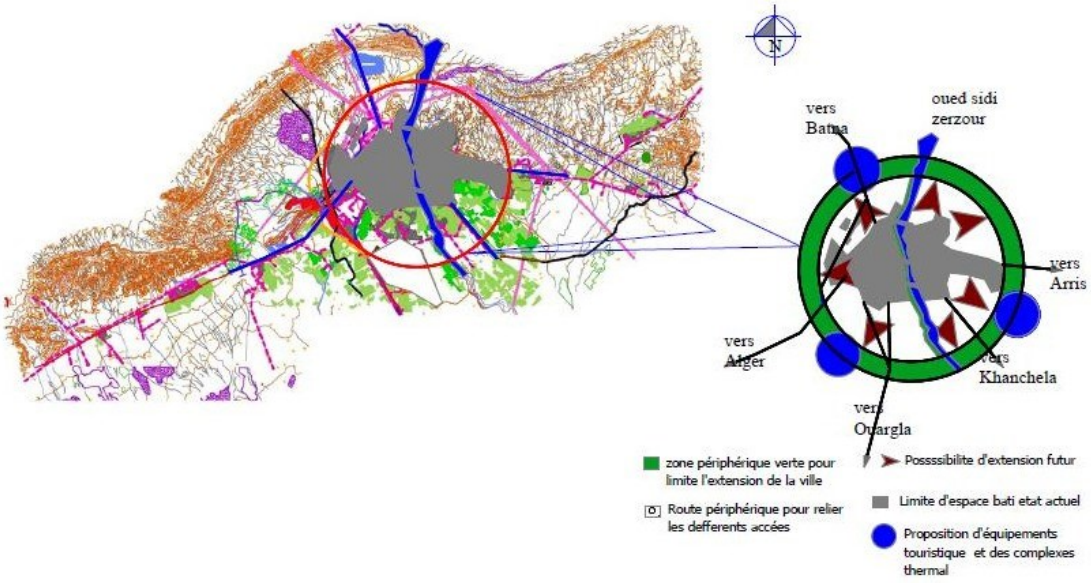


**Figure 9.** Diagram representing the intervention at the scale of the territory of the city of Biskra (Source author, 2022)

**4.2. Local level of facilities**

Rework the regulations in relation to the different ratios of public spaces, green spaces, land allocations, equipment and their ranks. This leads to the following recommendations:

1- Densities of green spaces Urban forms and identities Urban mixes (Streamline land allocations and their adequacy in relation to real programmatic needs, in particular equipment.)

2- Public spaces and green spaces (Development of public spaces and their hierarchy, through identification elements, in particular by improving urban specifications

3- Urban forms and identities (Rethinking the notion of neighborhood with its identification, its centrality, its originality).

4- Urban, functional and social diversity (Consecrate urban diversity and social diversity in developments, not by arranging the programs next to each other, but by mixing within the blocks.)
5- Local technologies (Develop local materials and technologies by promoting production and training chains: master craftsmen, training centers in local technologies, industries, construction to allow the exchange of information and the creation of knowledge. This with the aim of both preserving the environment, improving the landscape and promoting tourism).

**5. Conclusions**

The results of this work provide significant assistance to decision-makers and planners to simulate scenarios for the evolution of the city and plan interventions to combat urban sprawl in the city to the detriment of natural spaces and improve the quality of life of residents. inhabitants. It also makes it possible to monitor the impact of developments in the city. This work is nevertheless intended to be a modest starting point for the realization of a GIS of the city, which could pursue several goals:

- identify, count and model the physical components of the natural environment and the built and non-built environment of the city using analysis tools.
- provide a decision-making tool for the territory of the city, for example by allowing the development of new urban areas.
- offer a platform for knowledge of the city for the population, via a future web interface for example, as a visual and explanatory support.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Effect of A High-Density Street-Level on Air Temperature in Outdoor Space of Neighborhoods of Hot, Dry Cities

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**Abstract**
The outdoor spaces of residential neighborhoods are an important part of residents' lives the outdoor spaces in the neighborhood are fundamental for the social life due to their capacity to serve as meeting spaces and interactions among the public, here comes this search, which is based on study of the role of highdensity –street level- on air temperature in outdoor space of neighborhoods. The methodology was based on three parts, initially, determine the sample which is three downtown residential neighbourhoods according to scientific criteria. secondly, conducting a field survey of climatic factors (air temperature - relative humidity - wind speed) thirdly, make a model to simulate the built environment by using the envi-met 4.4.6 program, according to the data of the survey, the results indicated that significant variations of value of DSR, MRT, AT variables among residential neighborhoods which points the effect of high-density street-level on air temperature in outdoor space .
**Keywords:** Direct Sw Radiation (DSR); Mean Radiant Temp (MRT); Air Temperature (AT); Outdoor Spaces; envi-met Model.

## 1. Introduction

The outdoor spaces of residential neighborhoods are an important part of residents' lives the outdoor spaces in the neighborhood are fundamental for the social life due to their capacity to serve as meeting spaces and interactions among the public (Theodore, 2003). Therefore, the urban designer is always working to make a safe of the natural environmental conditions, especially in environments with high thermal loads. and well-being of urban environment for the residents within the outdoor spaces. The environmental quality is a complex issue involving. Subjective perceptions attitudes and values which vary among groups and individuals (E,L, Krüger, 2010) where the environmental conditions influencing on well-being in the built environment: thermal, visual and acoustic, as well as air quality(Chan IYS, 2018) but the air temperature in the built environment is the dominant factor while others may also contribute to the overall comfort(M, Boukhabla, 2012). In this regard, the most of the ancient cities in the desert of Middle East to North Africa are applying the technique of compact fabric in order to reduce the high temperature of the air .In this research paper, we will try to explain this phenomenon scientifically and provide a scientific understanding of it, in order to develop knowledge that can be useful for designers and urban managers for future desert cities.

## 2. Materials and Methods

### 2.1 Methods

The research methodology was based on several sequential phases. The first is choose the sample according to specific criteria in order to be sample is represents all types of building density of residential neighborhoods in the city. Hence, conducting a field survey of climatic factors (air temperature - relative humidity rate - wind speed). According to specific criteria for that, exeilty 7/25,26 where the peak of air temperature of year. and using a scientific measurement devices approved (Qaoud, R, Djamal, A, 2017; Mandal, & Byrd, 2017), (B,moufida, D,alkama, 2014). After that, we are making a model to simulate the built environment by using the Envi-met 4.4.6 program, according to the data of the survey, with a margin of error does not exceed the scientific criteria. It's in order to study the direct solar radiation variable, the average radiant temperature variable, and the air temperature variable within several building density. Finally, the discussing of the results to reaching a good understanding of the phenomenon and predicting its behavior in the future.

**2.2 Study Area**

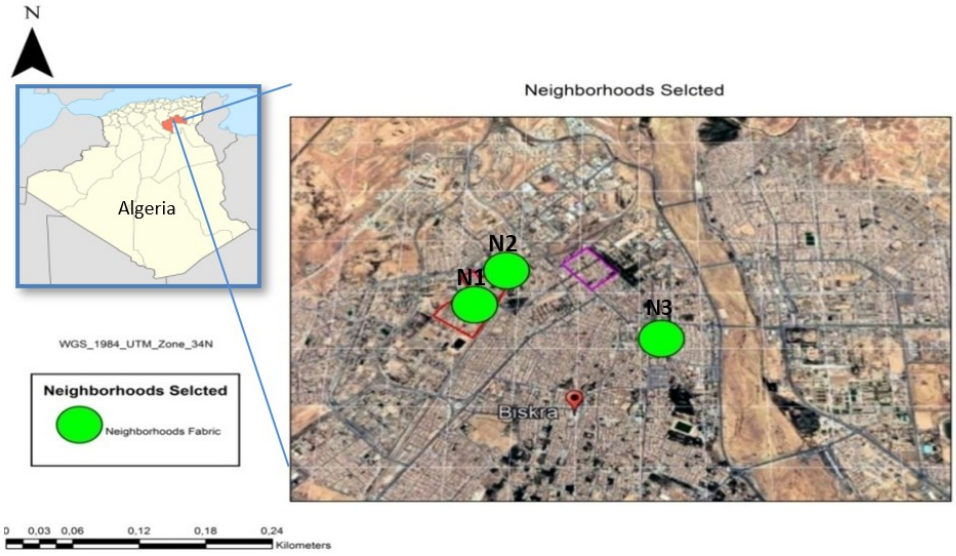



**Figure 1.** The neighborhoods selected of the sample.

The city of Biskra is located in the southeast of the country's capital with a distance of 430 km through the ages Biskra city is a link between the north and the south of Algeria, its called the gate of desert, the city is located in the northern part of the state and occupies an area estimated at 12,770 hectares, according the coordinates the city is located to the east of the green-which line, longitude 5°,43 est and northeast latitude 34,51° north (Qaoud, R, Djamal, A, 2019), where The previous figure shows the location of the city of Biskra in the state of Algeria As well as the location of the residential neighborhoods N1,N2,N3 as a sample in the city of Biskra.

**2.3 The Measuring Stations**

As shown in fig following There are 9 measuring stations of the sample, 03 stations for each neighborhood in order measure climate factors, the measuring stations were distribution in serial order a central of each neighborhood, and in different directions in order to get the average values of climate factors be correctly and confirmed from each fabric of neighborhood. The measurement was taken every two consecutive hours throughout 24 hours a day, the measurement was taken a 25-26/07/2021 at the summer season, Instruments Used for The Meteorological Measurements according to the human scale.

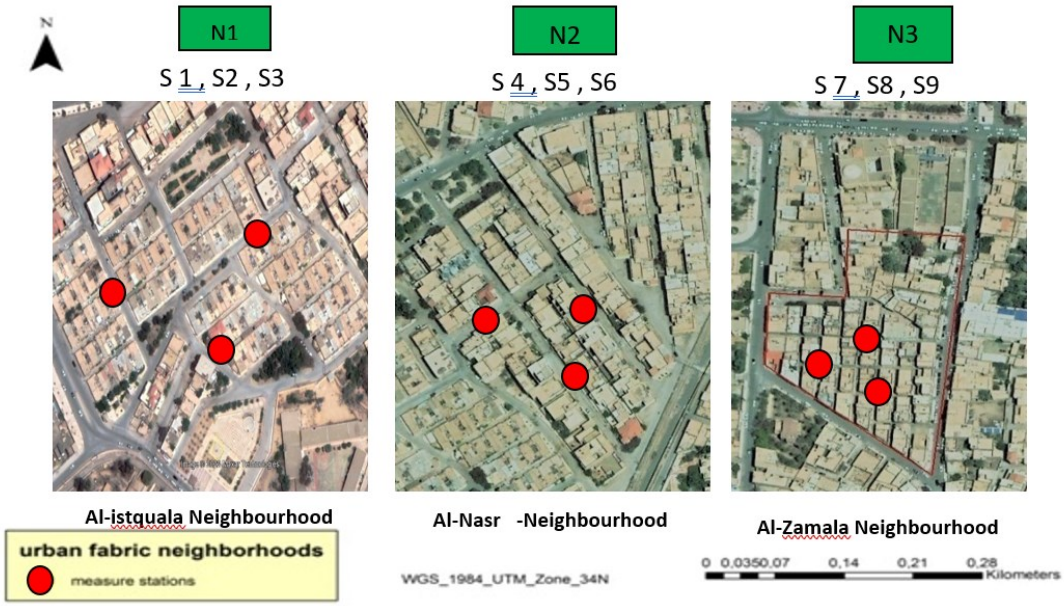



**Figure 2**. The measuring stations within urban neighborhoods

### 2.4 The Measuring Stations Technical Card

**Table 1.** Summary of Technical Card of N1, N2, N3

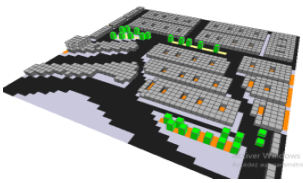
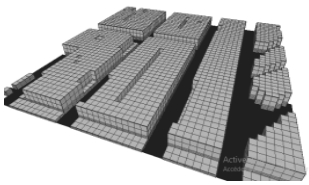
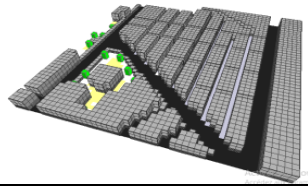
| | Al-istquala Neighbourhood N1 | | | Al-Nasr -Neighbourhood N2 | | | Al-Zamala Neighbourhood N3 | | |
|---|---|---|---|---|---|---|---|---|---|
| **N$^0$ .S** | **S1** | **S2** | **S3** | **S4** | **S5** | **S6** | **S7** | **S8** | **S9** |
| **BD** | | 12/ha | | | 35.51/ha | | | 59.52/ha | |
| **N°,etage** | 1 | 1 | 1 | 2+TR | 2 | 2 | 2+TR | *2+TR* | 2+TR |
| **H** | 3,6 | 3,6 | 3,6 | 9 | 8 | 8 | 8 | *8* | 9 |
| **W** | 9,8 | 7,3 | 9,8 | 9,5 | 7,5 | 7,5 | 3,8 | *3,8* | 3,8 |
| **H/W** | 0,36 | 0,49 | 0,36 | 0,95 | 1,06 | 1,06 | 2,1 | *2,1* | 2,36 |
| **D,STR** | Nw/Se | Nw/Sw | Ne/Se | Ne/Sw | Nw/Se | Nw/Se | N/S | *N/S* | w/e |
| **S,V,F** | 0,81 | 0,71 | 0,81 | 0,46 | 0,42 | 0,42 | 0,23 | *0,23* | 0,21 |
| **FICHE EYE** |  | | | | | | | | |

### 2.5 Simulation Settings and Validation

In this study, where we simulated using a program Envi-met v,4,4,6 in two and three-dimensional simulation this technique is often used to simulate urban built environments (Omar M, Galal, and All, 2020) this is during the period of the actual impact of the building density of neighborhoods on air temperatures (during the summer), envi-met has been also acknowledged for its ability to calculate direct, diffuse , reflected solar radiation and mean radiation temperature (Matallah, M.E, and all, 2021) all of this which significantly affect air temperature , this simulation draws upon on measurements which was taken on the 25th and July 26, 2021 for average of air temperature and relative humidity were taken at different points within Biskra's three neighborhood, hence there was no worries regarding any sort of interferences or the safety of the measuring tools, which accredited by the university of Biskra.

### 2.6 The Simulation Settings of the ENVI-Met Mode V,4,4,6

**Table 2.** Summary of the simulation settings of the ENVI-met

| **Parameters** | **Al-istqulal neighborhood (N1)** | **Al-Nassr neighborhood(N2)** | **Al-Zamala neighborhood (N3)** |
|---|---|---|---|
| 3D model |  |  |  |
| Date of Simulation | 25/07/2021 | 25/07/2021 | 26/07/2021 |
| Start time | 05:00 AM | 05:00 AM | 05:00 AM |
| Total simulation time(h) | 24 | 24 | 24 |
| Number of main area grid boundary | x-50, y-50, z-25 | | |
| Size of grid cell in meter | dx=3,00 dy=3,00 dz=3,00 base height | | |
| Wall material | Albedo 0,2 | | |
| Roof material | Albedo 0,6 | | |
| Soil profile | Albedo values as follow: pavement 0,5, asphalt 0,12, sand 0,31 | | |

| | |
|---|---|
| Wind speed at 10 m height | 1.2 m/s following weather station records of Biskra's airport |
| Wind direction | 135° from north |
| Roughness length | 0,07 |
| Simple forcing air temperature (oC) | Min 33,00 at 06:00, Max 45,00 at 14:00 |
| Simple forcing relative humidity (%) | Min 9 at 13:00, Max 21,5 at 06:00 |
| Nesting grids | None were used since no buildings are placed near the edge of the model, |

**Table 3.** Summary of the validation of the simulated models

| **Indices** | Al-istqulal neighborhood (N1) | | Al-Nasr neighborhood(N2) | | Al-Zamala neighborhood (N3) | |
|---|---|---|---|---|---|---|
| RMSE | 0,78 | 3,26% | 0,61 | 2% | 0,67 | 2,43% |
| MBE | -0,15 | -0,78% | 0,08 | 0,43% | 0,19 | 1,02% |

According to the literature review the ASHRAE guideline 14, the simulation model is considered validated if the hourly (MBE) values are within +-10%, and hourly (RMSE) values are below +- 30%, (Matallah, M.E, and all, 2020) (46), some literature mentions that used only the air temperature for the comparison between the simulated and measured data therefore, we have adopted the modeling results, this in accordance with the auditing standard.

## 3. Results

### 3.1 Aspects of Comparison

The comparisons of the simulation results are performed on three scales between the chosen samples; N1, N2, N3
1- Comparison of geometric parameters and density variables (H/W) (S.V.F) for each residential neighborhood
2- Comparison of variables of climatic parameters (DSR)(MRT)(AT)
3- Comparing the relationship between density variables and climatic variables (H/W) (S.V.F)/ (DSR)(MRT)(AT).
Through the screening of average SVF and H/W values. can be found in table 1. the neighborhood N1 had a (SVF=0.77 , H/W=0.40), N2 had a (SVF=0.43 , H/W=1.02), N3 had a (SVF=0.22 , H/W=2.18), the results of the screening which has SVF higher for N1, and less for N3. and which has H/W higher for N3 and less for N1. Hence when the screening of average DRS, MRT, AT at day hours. the neighborhood N1 had an average (DRS=726.56 W/M2) N2 had a (DRS=537 W/M2), N3 had a (DRS=195.3W/M2) can be found in table 4, the screening of MRT at day hours can be found in table 5. the neighborhood N1 had a average (MRT= 67.59c) N2 had a (MRT=50.96c), N3 had a (MRT=43.41c), when the screening of average AT at day hours the neighborhood N1 had an average (AT= 41.04c) N2 had a (AT=39.75c), N3 had a (AT=38.28c) can be found in table 6. the results of the screening which has (DRS) higher for N1=726.56 w/m2, and less for N3=195.3 W/M2, the screening which has (MRT) higher for N1=67.59c, and less for N3=43.41c and the screening which has AT higher for N1=41.04c, and less for N3=38.28c, so neighborhood N1 has a higher of DRS.MRT.AT. and the neighbrohood N3 is the less of DRS.MRT.AT.

### 3.2 Impact of High-Density Fabric on Climatic Parameters

This selection for the urban density variables scale with climatic parameters the comparisons of the simulation results is performed on three scales DRT MRT AT between the three chosen samples; N1, N2, N3.
The SVF, and H/W screening was performed of average values of the climatic variables demonstrated a noticeable sensitivity to variations in urban form It reached its highest valures in the neighborhood N1 on anther hands the climatic variables is demonstrated lessest valures in neighborhood N3 where the neighborhood N1 which has a H/W=0.40 S.V.F=0.77 notes a DSR= 726.56 w/m MRT=67.59c AT=41.04c. and neighborhood N3 which has a H/W=2.18, S.V.F=0.22 notes a DSR= 195.3 W/M w/m MRT=43.41c AT=38.28c as show in Fig. 3(a,b,c) also notes to a big differences in value of climatic parameters variables among the N1,N2,N3 neighborhoods of the sample, where the variance of the values DSR reach 531.26 W/M2 at day hours , so the hours of insolation in neighborhood N1 reach 11 hours during day hours, it was in the neighborhood N3 a 3 hours during day hours, by review the table. 4 in contrast the hours of insolation, shows too the hours of shading where value= 0 of insolation, which the variance of shading hours. where neighborhood N1 has 3 hours of shading during day hours in all directions, but N3 which has 12 hours of shading during day hours in direction N/S and 10 hours a direction E/W average shading hour (shH) 11 hours per daytime also the variance of the values of MRT=24.18c and AT=2.76 at day hours between N1 and N3, therefore, N3 is neighborhood denser than N1. the neighborhood N3 which has the lowest values of climatic factors it's also has a high percentage of H/W and also a low value of S.V.F, as shown in tables 1, 4,5,6. it seems there is a consistent impact of density on the different climatic parameters.

**Table 4.** Summary of the Direct S.W. Radiaation (DSR) values of the simulated models

| Direct SW Radiation | Al-istqulal neighborhood (N1) | | | Al-Nassr neighborhood(N2 | | | Al-Zamala neighborhood (N3) | | |
|---|---|---|---|---|---|---|---|---|---|
| measuring points / HOUR | p01 | p2 | p3 | p4 | p5 | p6 | p7 | p8 | p9 |
| 6,00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7,00 | 565 | 0 | 565 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8,00 | 805 | 805 | 805 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9,00 | 925 | 925 | 925 | 925 | 925 | 925 | 0 | 0 | 925 |
| 10,00 | 991 | 975 | 991 | 994 | 991 | 994 | 0 | 0 | 994 |
| 11,00 | 1025 | 1025 | 1025 | 1025 | 1025 | 1025 | 0 | 0 | 0 |
| 12,00 | 1040 | 1040 | 1040 | 1044 | 1040 | 1040 | 1040 | 1040 | 0 |
| 13,00 | 1040 | 1040 | 1040 | 1040 | 1040 | 1040 | 1040 | 1040 | 0 |
| 14,00 | 1038 | 1038 | 1040 | 1040 | 1040 | 1040 | 0 | 0 | 0 |
| 15,00 | 1015 | 1015 | 1015 | 1017 | 1015 | 1015 | 0 | 0 | 0 |
| 16,00 | 970 | 970 | 970 | 970 | 970 | 970 | 0 | 0 | 970 |
| 17,00 | 890 | 890 | 890 | 0 | 0 | 0 | 0 | 0 | 890 |
| 18,00 | 725 | 720 | 725 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19,00 | 325 | 0 | 325 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 5-** Summary of the Mean Radiant Temp (MRT) values of the simulated models

| Mean Radiant Temp | Al-istqulal neighborhood (N1) | | | Al-Nassr neighborhood(N2 | | | Al-Zamala neighborhood (N3) | | |
|---|---|---|---|---|---|---|---|---|---|
| measuring points / HOUR | p01 | p2 | p3 | p4 | p5 | p6 | p7 | p8 | p9 |
| 6,00 | 22,5 | 22,5 | 22,5 | 23 | 23,5 | 23,5 | 18,8 | 18,8 | 18,8 |
| 7,00 | 32,5 | 32,5 | 32,5 | 28 | 28 | 28 | 22,4 | 22,4 | 22,4 |
| 8,00 | 72,5 | 65,5 | 72,5 | 33 | 33 | 33 | 26,8 | 26,8 | 26,8 |
| 9,00 | 77,5 | 77,5 | 77,5 | 42,5 | 42,5 | 42,5 | 33,9 | 33,9 | 65,3 |
| 10,00 | 77,5 | 77,5 | 77,5 | 68,5 | 69 | 69 | 42,5 | 42,5 | 69,1 |
| 11,00 | 77,5 | 77,5 | 77,5 | 69 | 69 | 69 | 51,25 | 51,25 | 56,15 |
| 12,00 | 77,5 | 77,5 | 77,5 | 69 | 69 | 69 | 60 | 60 | 43,2 |
| 13,00 | 77,5 | 77,5 | 77,5 | 69,2 | 69,2 | 69,2 | 66,3 | 66,3 | 52,4 |
| 14,00 | 82,5 | 82,5 | 82,5 | 72,5 | 75,1 | 75,1 | 51,5 | 51,5 | 51,5 |
| 15,00 | 87,5 | 87,5 | 87,5 | 77,5 | 77,5 | 77,5 | 52 | 52 | 52 |
| 16,00 | 87,5 | 87,5 | 87,5 | 54,5 | 54,5 | 54,5 | 52,5 | 52,5 | 79,1 |
| 17,00 | 84,6 | 81,2 | 84,6 | 52,5 | 52,5 | 52,5 | 47,3 | 47,3 | 76,2 |
| 18,00 | 75,6 | 74,3 | 75,6 | 42,5 | 42,5 | 42,5 | 42,3 | 42,3 | 42,3 |
| 19,00 | 52,5 | 42,5 | 52,5 | 34,25 | 34,25 | 34,25 | 32,2 | 32,2 | 32,2 |
| 20,00 | 37,5 | 32,5 | 37,5 | 26 | 26 | 26 | 22,1 | 22,1 | 22,1 |

**Table 6-** Summary of air temperature values of the simulated models

| Air Temp | Al-istqulal neighborhood (N1) | | | Al-Nassr neighborhood(N2 | | | Al-Zamala neighborhood (N3) | | |
|---|---|---|---|---|---|---|---|---|---|
| measuring points | p01 | p2 | p3 | p4 | p5 | p6 | p7 | p8 | p9 |
| HOUR | | | | | | | | | |
| 6,00 | 33,5 | 33,5 | 33,5 | 33,5 | 32,5 | 32,5 | 33,5 | 33,5 | 33,5 |
| 7,00 | 34,5 | 34,5 | 34,5 | 33,5 | 33,5 | 33,5 | 34,5 | 34,5 | 33,5 |
| 8,00 | 36,5 | 35,5 | 36,5 | 34,5 | 34,5 | 34,5 | 34,5 | 34,5 | 34,5 |
| 9,00 | 38,5 | 38,5 | 38,5 | 37 | 36,5 | 36,5 | 36,5 | 36,5 | 35,5 |
| 10,00 | 39,5 | 39,5 | 39,5 | 38,5 | 37,5 | 37,5 | 37,5 | 37,5 | 37,5 |
| 11,00 | 41,5 | 41,5 | 41,5 | 40,5 | 39,5 | 40 | 38 | 38 | 38 |
| 12,00 | 41,5 | 41,5 | 41,5 | 41 | 42 | 41,5 | 38,5 | 38,5 | 38,5 |
| 13,00 | 43,5 | 43,5 | 43,5 | 42,5 | 43,5 | 43,5 | 40,5 | 40,5 | 40,5 |
| 14,00 | 44,5 | 44,5 | 44,5 | 43,5 | 44,5 | 44,5 | 40,5 | 40,5 | 41 |
| 15,00 | 45,5 | 45,5 | 45,5 | 43,5 | 44,5 | 44,5 | 41,5 | 41,5 | 41,5 |
| 16,00 | 45,5 | 45,5 | 45,5 | 43,5 | 44,5 | 44,5 | 41,5 | 41,5 | 41,5 |
| 17,00 | 44,5 | 44,5 | 45,5 | 43,5 | 43,5 | 43,5 | 41,5 | 41,5 | 41,5 |
| 18,00 | 43,5 | 43,5 | 44 | 42,5 | 42,5 | 42,5 | 40,5 | 40,5 | 40,5 |
| 19,00 | 42,5 | 42,5 | 42,5 | 40,4 | 40,5 | 40 | 38,5 | 38 | 38,5 |
| 20,00 | 40,5 | 40,5 | 40,5 | 37,5 | 37,5 | 37,5 | 37,5 | 37,5 | 37,5 |

### 3.3 The Variations of Climatic Parameters in The Sample N1-N2-N3

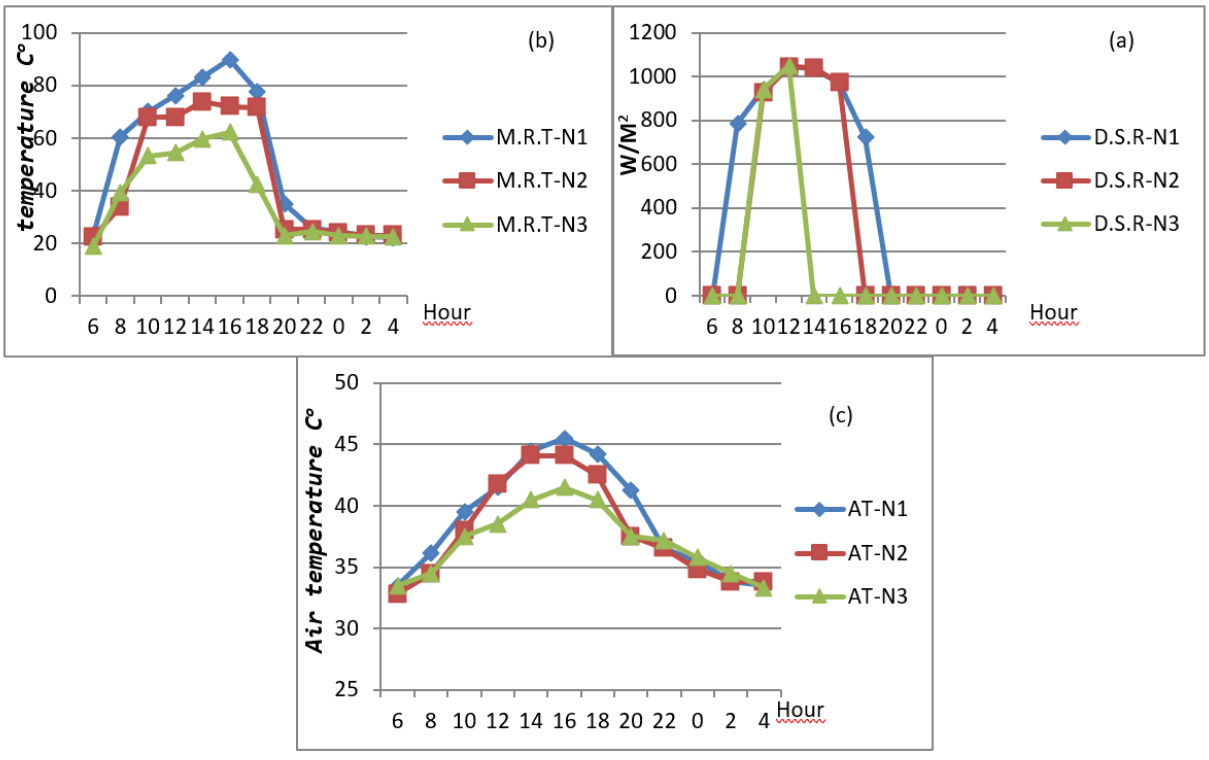



**Figure 3.** (a) The variations of DSR Variable (b) The variations of MRT Variable (c) The variations of AT Variable.

### 3.4 The Simultaneous Effects of High-Density Fabric

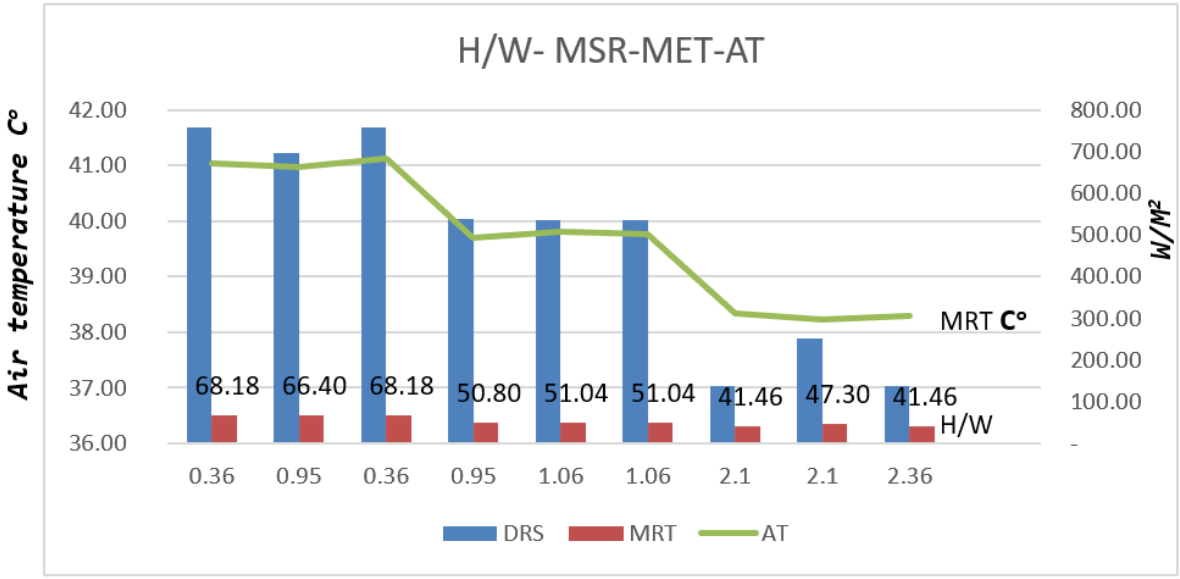



**Figure 4.** The simultaneous effects of H/Won MSR-MET-AT Variables

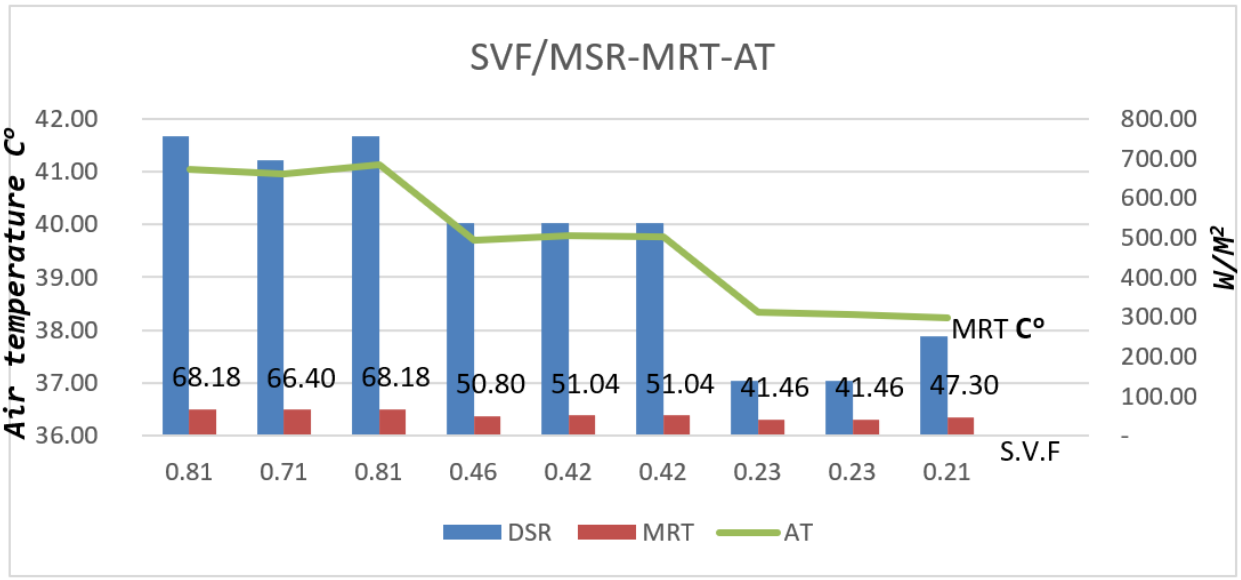



**Figure 5.** The simultaneous effects of H/Won MSR-MET-AT Variables

**4. Discussion**

The effect of the buildings density on climatic parameters occurs through simultaneous effects in terms of urban form and climatic parameters. It's directly affects on the geometry of the outdoor space by determining the values of the urban form density variables H/W, S.V.F. as a result of the it's coming the effect on the amount of solar radiation that enters to outdoor space of neighborhood , as well as the hours of insolation and shading, and thus the amount of thermal energy of the built environment stores, and finally effect on the air temperature within the outdoor space.

The air temperature is the result of the thermal interaction between the air and the built environmental temperature. Where the neighborhood N3 which higher density had values less of average S.V.F=0.22 and the values of the climate parameters were average DSR=176.42w/m, average MRT=43.41average AT=38.28. Where the neighborhood N3 which higher density had values higher of average H/W. Which is the results clearly indicated in table No 1 and Tables No 4,5,6, The neighborhood N1 which the least dense had values higher of average S.V.F=0.77 and higher than the climatic factors DSR=736.73w/m, average MRT=67.59 average AT=41.04, In this regard therefore, after examining all the results, the urban form density variables (H/W,S.V.F) has a directly affect on the climatic parameters variables (DSR,MRT,AT,suH) The literary reviews have proven that there is a correlation between

building density (H/W) /(S.V.F)on (AT)(suH)(PET), also there is an relationship and effect suH on AT so We confirm the validity of these relations and we add to it The relationship between (H/W) /(S.V.F) and (DSR,MRT). In finily, the densest urban fabric which has the higher valure of H/W and, the least of S.V.F, DRS.MRT. and AT. Therefore, the neighborhood which more dense, that lower of the air temperature within the outdoor space.

**5. Conclusion**

The shade is the technique to enables the built environment to influence the air temperature by a series of interconnected influences or simultaneous effects, Through simulation results, we conclude that the neighborhood more dense is provide the shade which provide a lower of the amount of direct radiation, also provide a lower of average radiant temperature Subsequently, the average air temperature is low, so with a surveying the results of the literature, it has been proven that shading lower the air temperature and increases the rate of thermal comfort, therefore, the increase in the density of urban fabric will lead to an increase in the number of hours of shade in the outdoor spaces of the neighborhood and lower the air temperature and increases the rate of thermal comfort. Therefore, the High-Density fabric improve by simultaneous effects on climatic parameters in outdoor space of neighborhoods of hot, dry cities.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Behavioral Analysis of Single-use Plastic Consumption in Cairo

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**Abstract**
Plastic pollution is a huge environmental and urban problem in Cairo. The overconsumption of single-use plastic bags (SUPB) and their inadequate disposal are significant contributors to it. The aim of this research is to unveil the behaviors and factors that encourage and discourage the use of SUPB among Cairenes. The research analyzed environmental awareness and the willingness to adopt pro-environmental behaviors. The methodology used is based on the Theory of Planned Behavior and S.H.I.F.T Framework. The results demonstrate that people are environmentally conscious and willing to change their behavior, yet they consume a considerable amount of SUPB. Furthermore, there is a gap between what people say and how they act. This could be changed through different factors such as Social Influence, Tangibility, Positive Emotion, and Policies. These factors can potentially influence the reduction of SUPB and encourage the adoption of pro-environmental behaviors and policies.
**Keywords:** Single-Use Plastic Bags; Behavior; Behavioral Change, Factors of Influence; Pro-Environmental Behavior; Environmental Awareness; Cairo; Egypt.

## 1. Introduction

*"Plastic isn't the problem. It's what we do with it." - Erik Solheim, Head of UN Environment*

Cities produce waste through economic growth and overconsumption of resources and goods. Often, they cannot deal with the amount of waste that is being produced, especially plastic waste. Nowadays, plastic pollution is one of the biggest environmental issues that humanity is facing (Parker, 2019). Most of it is a result of the unrestricted consumption of single-use plastics (SUP) and the inadequate disposal of it. SUP are considered convenient items for the fast rhythm of the urban lifestyle. This drives to a throw-away society where the norm is to produce and consume items that are used just once or for a short period of time and then they are discarded. This is causing a huge burden on the urban and natural environment, and the economic and social spheres. The most commonly found SUP in the environment are disposable plastic bags, cutlery and cups, cigarette butts, straws, coffee stirrers, soda and water bottles, and food packaging (UN Environment, 2018a).

Egypt is the leading contributor of plastic waste in the Arab world (Nader, 2019) and it is the biggest plastic polluter in the Mediterranean (WWF, 2019). For Cairo, this problem is proportional to its dimensions. Current policies and waste management systems do not properly address the growing problem of plastic overconsumption and waste. This is evident in the accumulation of plastic waste, especially single-use plastic bags (SUPB), on the streets, in historical and tourist places, and in waterways. SUPB are one of the most common plastic litter found on the streets, mainly because they are massively consumed on a daily basis, are for free to the consumer, and are not easy to recycle.

Currently, the country is experiencing an awakening phase of environmental awareness (Shaban & El-Bassiouny, 2015) spurred mainly by efforts from non-governmental organizations (NGOs), and civil society. Still, there is a huge need for a broader change in habits at a societal level. The results of this research indicate that there is a gap between the intention of people to change their behavior and the execution of it. However, the level of awareness and a positive attitude are predictors for a behavioral change towards a pro-environmental behavior (PEB). Additionally, there are more factors that are recommended to apply that might influence the behavior of Cairenes.

This research focused on the reasons behind the Cairenes' behavior towards SUPB and the factors that both encourage and discourage their use by analyzing their environmental awareness and their willingness to change their behaviors. There is a lack of studies about behavior towards SUP in the Middle East. This research can make a significant contribution to academia and influence the local and regional stakeholders. This study is also looking to cope with the environmental degradation of Cairo and is aligned with the Sustainable Development Goals (SDG) 12th goal, which promotes sustainable consumption and production to achieve sustainable cities (UN, 2020).

## 2. Theoretical Framework (TF)

*"The planet doesn't need money, it needs behavioral change" - Sonam Wangchuk, Engineer, Innovator and Education Reformist*

The TF was divided into background concepts related to the problem of consumption and the environmental impacts of SUPB, and into the factors that influence people to adopt PEB through behavioral changes. The latter is the main focus

of this study. Those factors are under four different aspects and theories that were adapted by the author: demographic determinants, existing measures to reduce SUPB, the theory of planned behavior (TPB), and the S.H.I.F.T framework. They will be briefly explained.

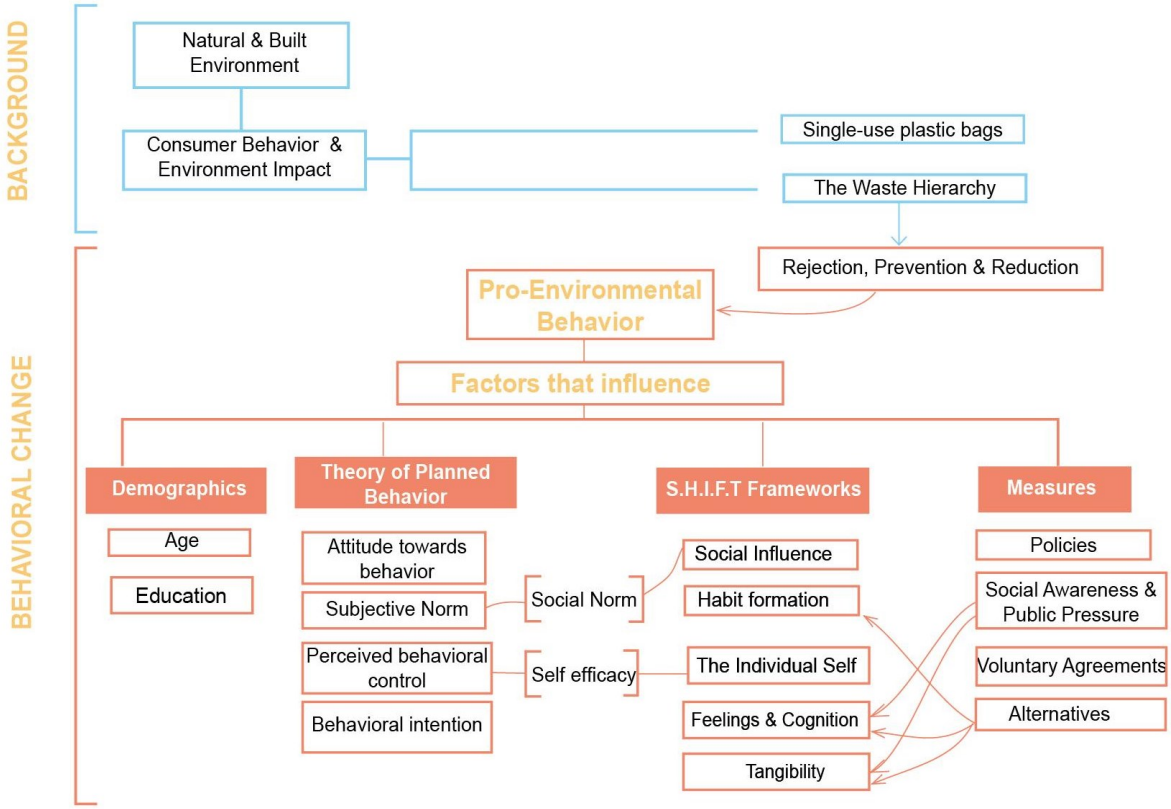


**Figure 1:** Theoretical Framework. **Source:** The Author

**2.1 Demographic Factors**

**Age:** "As people grow, their needs, knowledge, and environmental sensitivity change" (Kieżel et al, 2019 p. 5). Different authors have diverse perceptions related to the age gap and the development of the PEB. Some such as Shen & Saijo (2008)[1], argued that older people care more about the environment, others such as Kieżel et al (2019) state that young adults are the group that shows the biggest interest in environmental causes, for instance millennials[2] and Generation Z[3] are willing to pay extra for sustainable products (Nielsen, 2015 ). However, it is influenced by other determinants such as culture, social media, gender, education, and socio-economic background.

**Education:** A person's level of education can play a determinative role in the development of PEB. "More educated people tend to be more concerned for the environment and more willing to adhere to pro-environmental behaviors." (Kieżel et al, 2019).The longer the education the more extensive the knowledge about environmental issues. In contrast, Kollmuss & Agyeman(2002) state that more education is not directly correlated to increased PEB. Other demographics findings show that younger, more liberal, and educated individuals are more likely to commit to PEB (Kieżel et al, 2019; Gilg et al, 2005; Cottrell, 2003).

**2.2 Theory of Planned Behavior (TPB)**

It was created by the social psychologist Icek Ajzen in 1991. TPB is designed to explain and predict an individual's behavior in a specific context (Ajzen, 1991). It proposes that the individual's behavioral intentions and actions are influenced by their attitude towards a behavior, subject norms, and perceived behavioral control (PBC) (Ibid). It states that the best way to predict behavior is by asking people if they are willing to behave in the desired way. As Macovei (2015a) explains

[1] Cited in Kieżel et al, 2019, p.5

[2] People between 21 and 38 years old

[3] People under 20 years old

better "The intention expresses itself in behavior providing that it is physically possible to perform the behavior or if unexpected barriers do not stand in the way".

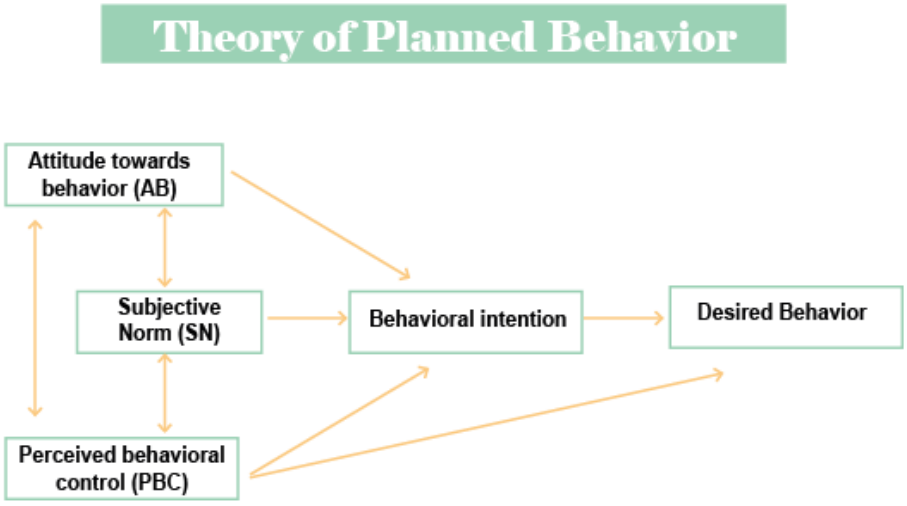


**Figure 2:** Theory of Planned Behavior – TPB. **Source:** Ajzen, 1991. Adapted by Author

**Determinants of TPB**

**Attitude Towards Behavior**

*What does an individual think about performing a certain behavior?*

"The degree to which a person has a favorable or unfavorable evaluation of the behavior in question." (Ajzen, 1991, p.188). This means that the individual's behavior intention is influenced by their attitude towards it. Attitude and behavior can be interpreted as what people say and believe, and the actions they take.

**Subjective Norm**

*What do others think about an individual performing a certain behavior?*

"The perceived social pressure to perform or not to perform the behavior." (Ajzen, 1991, p.188). Subjective norm is related to the individual's belief about engaging in a certain behavior based on the approval, disapproval, and opinion of the people in their immediate social network (Macovei, 2015b). The functions of the subjective norm are social pressure and compliance motivation (Ajzen, 1991). Subjective norms can also be understood as the social norms that govern within a specific cultural context. Those are also shared with the S.H.I.F.T framework

**Perceived Behavioral Control (PBC)**

*Can an individual perform a certain behavior?*

Ajzen (1991) refers to the PBC as the ease or the difficulty to engage in certain behavior. It is determined both by past experience and anticipated impediments or obstacles. The PBC involves non-motivational or situational factors, such as the availability of opportunities and resources i.e., money, knowledge, time, and collaboration from others. According to Macovei (2015b, p.18) this determines "...the real degree of control over behavior." Macovei (2015b) states that people with a high PBC are more inclined to adopt a sustainable behavior. Although, if the effort related to performing the behavior is high it can become a barrier to adoption.

**Behavioral Intention**

It is the willingness of an individual to perform a behavior. It is influenced by the above factors: attitude toward the behavior, subjective norm, and PBC. Ajzen (1991, p.4) states as a rule, "...the more favorable the attitude and subjective norm with respect to a behavior, and the greater the perceived behavioral control, the stronger should be an individual's intention to perform the behavior under consideration".

Arbuthnott, 2009, affirms that as more personal and specific the intention is, the more likely the behavior is to be implemented. However, humans are more oriented to act consistently with attitudes aligned with their own interests rather than the needs of others or the environment.

However, there is a gap between the behavioral intention and the performance of the behavior that is not covered inside the TPB. A person that is influenced by the above factors can state they intend to or will do something, for example, reduce the use of plastic bags in the upcoming weeks. How they make this happen is missing.

The gap is filled with the concept of implementation intentions by the psychologist Peter Gollwitzer (Orbell et al, 1997). After the intention, a plan should be made to accomplish the desired behavior that specifies the necessary action to

implement the intention and when and where to take it (Ibid). This concept is also used in the S.H.I.F.T framework. If the intention is to reduce the use of plastic, a plan to implement it could involve bringing a reusable bag (RB) to the supermarket every time. Then the performance of the desired behavior will be executed.

**2.3 S.H.I.F.T. Framework**

It was created by White, K., Habib, R., & Hardisty, D. J. in 2019 and is based on the review of existing literature on sustainable consumption. It proposes that consumers are more inclined to engage in PEB when strategies include the following psychological factors: social influence, habit formation, individual self, feelings and cognition, and tangibility. This framework focuses on the marketing perspective related to behavior and message framing and has been adapted within the scope of this research. The study focused on the highlighted concepts that will be explained.

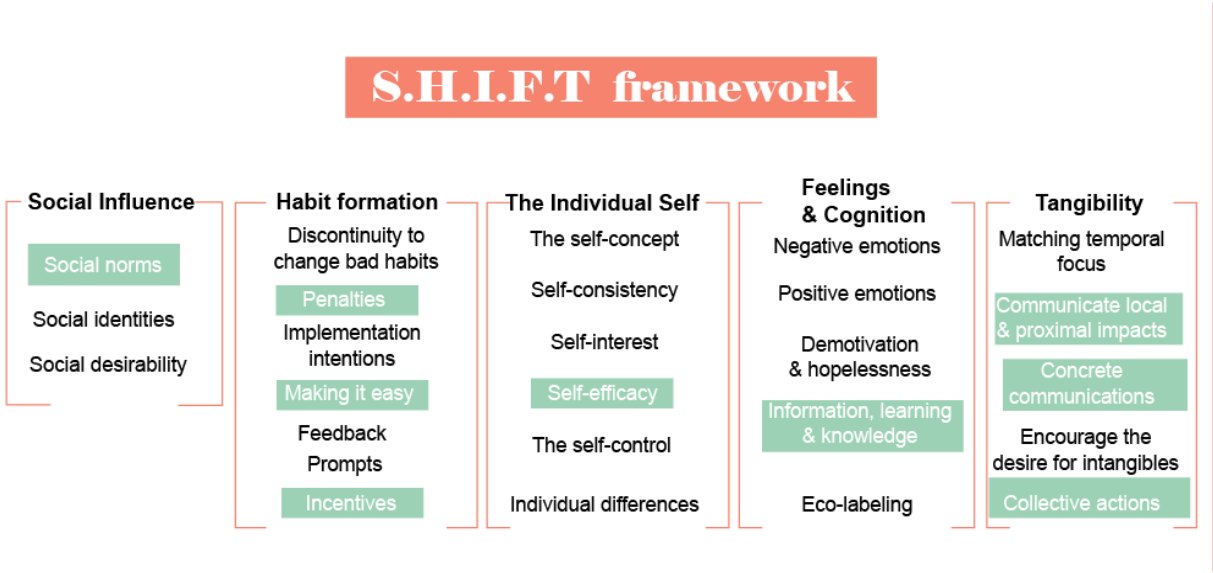


**Table 1:** S.H.I.F.T Framework. **Source:** White, K. et al, 2019. Adapted by Author

**Social Influence**

People's behavior is highly affected by social factors such as the presence, behaviors, and expectations of others. According to Abrahamse & Steg (2013) social aspects are the most influential ones to encourage change towards PEB. This is measured by different social groups such as the family, colleagues, and friends. Social influence has three aspects: social norms, social identities and social desirability.

- **Social norms:** "Beliefs about what is socially appropriate and approved of in a given context, can have a powerful influence on sustainable consumer behaviors" (White, K. et al, 2019, p. 24). Additionally, social norms encourage policy intervention "...that try to change behavior rather than just creating awareness: It implies that others will follow if some people can be persuaded." (Nigbur et al, 2010).

**Habit Formation**

Habits are persistent behaviors that have become an automatic response to a specific situation as a result of the regular execution of these behaviors (Kurz et al, 2015). Changes that lead to the formation of new sustainable habits are needed to encourage PEB. This can be achieved, according to White et al,(2009) by "...replacing relatively automatic behavioral responses with more effortful new responses" (p.35). Becker et al (2014) claims that habits are more powerful than intentions. Therefore, incentives, institutional regulations, and penalties, encourage behavioral change by "...altering the value and intention of the behavior." Kollmuss & Agyeman (2002) empathise that old habits are a strong barrier to habit changes.

To create new habits it is necessary to first break the bad habits through interventions, then enforce new habits with actions that foster repetition, making sustainable action easy, incentivized, using prompts and providing feedback. Those should be combined with another measure such as awareness campaigns in order to have an effective and long-term impact. That results in people understanding why it is important to create sustainable habits.

- **Penalties:** are sanctions that work to decrease the motivation to be involved in undesirable behavior. This can be a tax, a fine, or a fee on an unsustainable habit. According to the study made by Muralidharan and Sheehan (2016) "paying a tax" can be framed as a loss for the consumers and can encourage them to bring their own bag. "Avoiding" a fee can be perceived as a gain and also a decision made by the consumer. The desire of people to "avoid a loss," even if it is a small charge, can influence their behavior (Schwartz, 2020).

However, these actions can also bring some counterproductive effects. If the penalty seems unreasonable (Fullerton & Kinnaman, 1995) or not strong enough it can lead to a negative impact and a defensive response (Bolderdijk et al, 2012). Later, if the penalty is removed, individuals could resume old habits.

- **Making It Easy:** Two of the barriers that prevent people from getting involved in pro-environmental actions are related to the difficulty and time consumption of those actions (McKenzie-Mohr, 2000). Making things simple, easy, and convenient is a useful strategy for sustainable behavioral change.
- **Incentives:** are stimulations that increase positive habit formation and motivate people to adopt and maintain PEB. Incentives can be gifts, social praise, economical instruments such as rewards, discounts and monetary incentives, among other things (Homonoff, 2015; White, K. et al, 2019). However, incentives can also have some disadvantages. For example, there may be less motivation when there is a smaller monetary reward in contrast with other kinds of incentives such as free gifts or social praise (Handgraaf et al, 2013). Another drawback to incentives is when it is removed the sustainable behavior tends to vanish with it.

**The Individual Self**

Components related to the individual self can have a strong influence on behavioral change.

Factors such as self-concept, self-interest, self-consistency, self-efficacy, self-control, and individual differences are the most relevant.

- **Self-Efficacy:** It is considered to be the conviction that a certain behavior is achievable (Ajzen, 1991). It can predict pro-environmental attitudes and tendencies that will continue with sustainable behavior over time (Armitage & Conner 2001). Individuals tend to choose a sustainable option when the commitment is low and they have high confidence that their behavior is having a positive impact (White, K. et al, 2019). It can provide people a sense of agency, "allowing individuals to perceive themselves as the causal agents of behavioral outcomes, offers them a perception of empowerment and the ability to actually effect change" (White, K. et al, 2019, p.32).

**Feelings and Cognition**

Decision making is driving and dominated by the following factors: intuition and affection or cognition and knowledge (Epstein 2003). This is significantly relevant regarding information about the environment. The factors that influence decision making are related to positive and negative emotions, and feelings of demotivation and hopelessness; cognition is determined by information, learning, and knowledge.

- **Information, Learning, and Knowledge:** Presenting clear information about the desired behavior and its consequences is key for the individuals to understand why they should change the behavior. People are not likely to engage in a PEB if they do not have the proper information about the problems, the impact of their behaviors and actions, the alternatives that can be taken, and the consequences (Gifford & Nilsson, 2014). However, there are some factors that contribute to the low acceptance of sustainable behaviors. These include the lack of exposure to the information, overloading of information, and confusion (White, K. et al, 2019). However, as Johnson and Saylor et al (2011) supported by Kollmuss & Agyeman (2002), state that strategies and campaigns providing information, and understanding of the environmental issues are not enough to stimulate significant and long-term sustainable behavioral changes. In consequence, information can be effective if it is combined with other tactics like social awareness and presenting alternatives.

**Tangibility**

A particularity of the PEB outcomes is that they can seem abstract, vague, and distant from the self (Reczek et al, 2018) and are difficult to grasp. The results of the PEB are not easy to evaluate or track because they take time, develop slowly, and some of the solutions to the issues are still uncertain. Griskevicius et al (2012), highlights that individuals do not often tend to take action on situations that are impalpable in nature. The following are strategies that can help to cope with issues of tangibility: Matching Temporal Focus, Communicate Local and Proximal Impacts,

Concrete Communications, Encourage the Desire for Intangibles and Collective Actions.

- **Communicate Local and Proximal Impacts:** Consists of making visible the direct outcomes of sustainable behavior for a city or neighborhood so it feels more real and concrete (Leiserowitz, 2006). The tactics can be focusing on environmental issues, such as extreme weather phenomena and air pollution, and show how local biodiversity and the people are affected by those. When sustainable behavior occurs the impact will be more tangible related to the highlighted problem.
- **Concrete Communications:** Make the sustainability topics clear, relevant, and specific. For instance, conveying the immediate impacts of environmental issues and giving clear alternatives to tackle them. For delivering an effective message it is recommended to use communications techniques that include metaphors, analogies, vivid images, and narratives (White, K. et al, 2019).
- **Collective Actions:** In order to have a big impact, PEB needs collective effort. Spreading knowledge about what can be achieved when there is collective action can encourage sustainable behavior. A common use in communication is to highlight the possible impact of a collective action with messages like this, "If everyone in

the United States switched to reusable shopping bags and rejected plastic bags we would avoid throwing away to the environment 100 billion plastic bags annually" (Earth day, 2018). This kind of message can have two outcomes, on one side it is the incredulity by the people that everyone would do that. On the other side "it scales up the perceived size of the impact, which could increase sustainable behavior" (White, K. et al 2019, p.35).

**2.4 Measures to Reduce SUPBs**

Different strategies and alternatives to restrict or eliminate the production and consumption of SUPB were reviewed from legislation to alternatives to awareness campaigns. The measures come from the efforts of different stakeholders e.g., governments, scholars, NGOs, and ordinary citizens.

- **Policies:** Their objective is to disincentivize and reduce, partly or completely, the use and production of SUPB (Clapp & Swanston, 2009) before it enters the environment (Willis, K., et al, 2018). The most common ways are bans, taxes, and fees. According to the UN Environment (2018b) by 2018, 127 countries have implemented some form of legislation to reduce the SUPB consumption.
- **Ban On Plastic Bags:** It works as a regulatory instrument that prohibits retailers from giving out SUPB (Lopez, J., 2015). This affects the behavior of the people where their usual habit of having SUPB for groceries is disrupted[4].
- **Taxation:** A tax can be levied on the supplier (producers and importers) and retailers such as supermarkets. The cost of the tax is often passed on to the consumers (Lopez, J., 2015; UN Environment, 2018a)[5]. The tax on plastic bags is framed within the Pigovian tax on pollution, which is a tax that is imposed on industries that harm the wellbeing of the society, such as polluting the environment (Kagan, 2020). By shifting responsibility to the industry, it encourages them to find more profitable and sustainable alternatives.
- **Economical Instruments:** Monetary tools that "encourage desirable behaviors or discourage harmful behaviors will be effective only if the magnitude of the incentive exceeds the costs an individual associates with changing his/her behavior."(Homonoff, 2015 p.1). It can be a fee or penalty when discouraging bad behavior. It can be a reward or incentive for good behavior. Fees are also known as a levy on consumers, because shop owners charge directly to the consumer for the plastic bags (Lopez, J., 2015) instead of giving them out for free. This allows the customer to make their own decision about whether to pay for a bag or not. Fees can be more effective than other policies because they are linked to "loss aversion".
- **Voluntary Agreements:** They are arrangements and negotiations between the government, the producers, and retailers and social partner organisations to facilitate voluntary action to have a specific outcome (UN Environment, 2018a; Tough, 2007). Retailers can be encouraged to lead a voluntary agreement by factors such as corporate social responsibility or marketing purposes (UN Environment & Mediterranean Action Plan, 2019). The most common voluntary agreements work as an economic discouraging tool for the consumer, which leads to a reduction of SUPB consumption. These are: the non-distribution of plastic bags and make available alternatives where most of the time the consumers assume the cost of them or paying for the plastic bag itself, as well having the option to buy a RB (UN Environment & Mediterranean Action Plan, 2019)[6].
- **Social Awareness and Public Pressure** These strategies can result in gradual behavioral changes and furthermore in implementation of laws. According to the UN environment (2018a) awareness campaigns are designed to persuade and educate in topics such as proper disposal, reuse, recycling, and the responsible use and impacts of SUPB. These strategies should serve as a support for measures such as taxation and banning to reinforce and make them more effective. Willis et al (2018) refers to education as an effective way to raise public awareness to reduce plastic waste, and it also creates a sense of "environmental responsibility in participants". Additionally, to achieve a long term change, environmental awareness in educational institutions should be integrated as well as messages framed in "regular didactic practices" (UN environment, 2018a). For instance, clean up campaigns in beaches or rivers motivate participants to question their own consumption and littering behavior, and can create as well as a sense of "custodianship" (Willis et al, 2018). In addition, the expert in social behavior Les Robinson, states that public awareness should be focused on positive emotions, rather than negative feelings, therefore making new behaviors easy to follow and make people feel that they are supported by the community (Kolff, 2018). Public or social pressure is defined as the influence exercised on a person or group by another

[4] In 2009 South Australia was the first state in Australia to ban "lightweight checkout style plastic bags", effectively eliminating around 400 million of SUPBs and changing consumer behavior to have alternatives such as reusable bags (Green Industries SA, 2019).

[5] In 1993, Denmark was the first country to introduce a tax based on the bag's weight on the manufacturing or import of SUPB. The retailers were allowed to pass the cost on to consumers. As an initial result, the use of plastic bags drop by 60% (Larsen, J., & Venkova, S.,2014). Nowadays, the average use of plastic bags in the country is 4 per person per year; the lowest in Europe (Gunn, K. 2018).

[6] In 2017 in Switzerland the biggest retailer associations signed a voluntary agreement to not provide SUPB for free with some exceptions (bags used for vegetables and fruits). The retailers charge CHF 0.05 per lightweight plastic bag. This resulted in a decrease by the 84% of SUPB consumption in the first year of the implementation.

person or group. (M.S, 2013)[7]. It can work as collaborative empowerment (Kolff, 2018) [8]. Raising social pressure can serve as a trigger for policy decision making (UN environment, 2018a).

**2.5 Alternatives**

There are a significant number of alternatives to SUPB. From basket to cardboard boxes and backpacks. However, this study is focused on three widespread and popular types of bags. Every material and manufacturing of these bags has a different carbon footprint and environmental impact. The key for a bag to be a better option is to be reused several times. This is supported by the study made by the environment agency of the UK (2011) that found that durable carrier bags are being reused, the impact reduces "Whether this reuse is achieved depends both on the physical properties of the bag and consumer behavior." (Great Britain, & Environment Agency, 2011, p.57). The main alternatives to SUPB are: Reusable or Durable CarrierBags made mainly of different materials from natural fibers to synthetic ones, Paper Bags, and Bioplastics: Biodegradable and Oxo-Biodegradable Bags. The latter being controversial due to tend to have similar effect that the conventional SUP (European Commission, 2018)

**3. Material and Methods**

The research was carried out in different stages using a non-linear process. The TF was created based on the literature review and parallelly the research questions were formulated.

The Qualitative and quantitative data were collected to form a broad view of the SUPB situation in Cairo, through online surveys, interviews with stakeholders, and participation observation. Concepts from the TF such as Theory of Planned Behavior and S.H.I.F.T Framework were applied to the data collection methods. The discussion took form analyzing the findings through the lens of the TF and the concepts related to behavioral change. Lastly, recommendations and conclusions were developed.

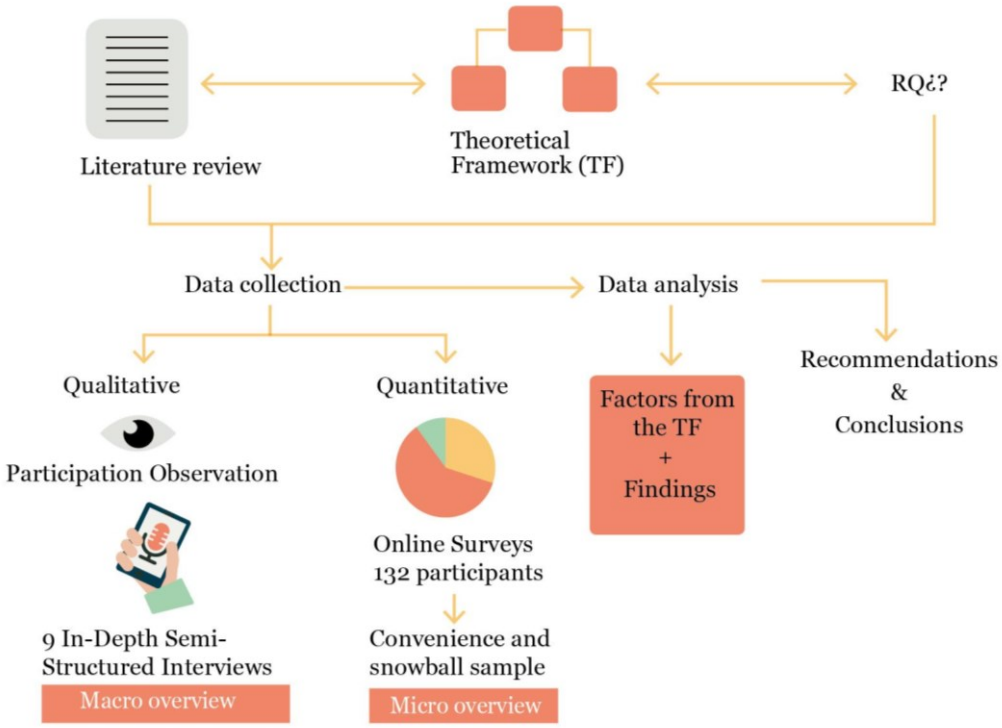


**Figure 3.** Research Methodology framework. Source**:** The Author

[7] "Bye Bye Plastic Bags" a young initiative in Bali, Indonesia, with the purpose to encourage people to say no to plastic bags and at the same time ban them (Rosane, 2018). The teenagers have campaigned for years starting with a beach clean-up and a signature-gathering campaign that collected over 100,000 signatures (UN environment, 2018a). This influenced the governor to sign a memorandum of understanding to phase out plastic bags by 2018 and they have achieved those businesses such as hotels and restaurants engaged in the campaign and committed to reducing plastic waste. (Ibis).

[8] An example of collective empowerment and pressure onto retailers is the campaign by Greenpeace, which encourages people to make pressure on the overpacking of vegetables and fruits through stickers that state "I'd like this product to be plastic-free" and "We love plastic-free fruit and veg". Moreover, sharing pictures in social networks with the hashtag #RidiculousPackaging. This is an easy and effective way to motivate consumers to push for environmental alternatives in supermarkets. (Kolff, 2018)

## 4. An overview of the SUP in Egypt and Cairo



**Figure 4.** Informal nodes of plastic pollution on Cairo's streets

### 4.1 Plastic Consumption Background in Egypt

In the middle of the 80's plastic bags use was slowly spread as well the use of plastic bottles (Abaza 2006). Also, people used to buy stuff to keep, to use and to fix[9]. In the 90's globalization started to permeate Egyptian society and consumers started to follow the western trends, as evidence a large number of malls were built in Cairo (Abaza, 2006). Therefore, the production and use of SUP became common and socially accepted practice[10]. The plastic pollution started to be a visible issue in the country.

In the last two decades, the number of hypermarkets and supermarkets have increased. This changed the way Egyptians make grocery shopping and have encouraged the consumption of plastic thought packaging and SUPB. (Gressel et al, 2010). Thus, the plastic pollution in the country exploited, becoming a visual and a real problem. "Egypt only got this plastic craziness only in the past 18-19 years. It starts from 2000's" Kamal[11]. The problem of plastic has been intensified by the lack of a proper solid waste management (SWM) and the throw-away society which make very convenient and accessible the use of SUP[12] [13]. This led to Cairenes to have a strong reliance on SUP items (El-Sayed, 2018). The way they consume, use, and dispose of them is having a significant negative impact, not just on the environment but also affecting the dynamics of the city itself.

### 4.2 The Current Situation

Egypt is struggling with two main problems related to plastics, the overconsumption of it and the mismanagement of waste such as SUP that is massively consumed and not properly disposed of. The plastic consumption level in Egypt is a local problem with regional and global implications. The country is ranked as the biggest plastic polluter in the Mediterranean (WWF, 2019) and it is the main source of plastic waste in the Arab region (Nader, 2019). Egypt consumes around 5.4 million tons of plastic per year (Ritchie & Roser, 2020), and approximately 14 billion plastic bags (CEDARE, 2019). 67% of the plastic waste is mismanaged, resulting in incineration and in the disposal of in open and illegal landfills where it is most likely to make its way into water bodies through winds and streams (WWF, 2019). It is not just affecting the country, but at a worldwide level its contribution is significant.

The overconsumption of plastic has impacts that range from pollution on the streets and heritage landmarks to clogging sewers, and pollution of beaches, water and land ecosystems, affecting the natural and urban environment, the socio-economic sector, for instance tourism and fisheries sector, and the health of the population. Furthermore, the plastic sector is an import dependent on raw material (CEDARE, 2019), that is also a burden for the country's economy. SUPB are consumed the most in the groceries shops, fruits and vegetables kiosks, stores and shops and large supermarkets (CEDARE, 2019).

Egypt is slowly becoming more environmentally aware (Shaban & El-Bassiouny, 2015) influenced mostly by NGOs, civil society and research centers that work actively. They work to raise awareness, to create alternatives to SUP, to research, to propose policies, and to push the government for laws to ban these items.

[9] Khalil personal communication, April 30, 2020

[10] Khalil personal communication, April 30, 2020

[11] Researcher on plastic leakage, personal communication, March 15, 2020

[12] Abaza, Counselor for the State Minister of the Environment. Director of the Association for Environmental and Community Development, the Centre for Sustainable Development Solutions and works with UN environment programme, personal communication, April 09, 2020

[13] Khalil, Co-Founder of Greenish (Environmental organization), personal communication, April 30, 2020

In 2019 a policy measures to address SUPB in Egypt was presented by CEDARE[14] with the support of different stakeholders. They are pushing hard for a law implementation on banning free distribution of SUPB. However, the drawback they found is the difficulty to monitor and evaluate the enforcement of the law, and the willingness of the government to implement such a law (CEDARE, 2019). However, in the Red Sea province a similar initiative took place as a decree and the use of SUP was banned in commercial facilities (El-Gundy, 2019). Particularly, because the environment is important for tourism. Additionally, awareness campaigns were supporting the implementation of the ban and eco-friendly alternatives sprout in the region (Ibid). Nevertheless, the new governor withdrew the ban[15], but it is still implemented by the community. Despites of that, the ban on SUP in the Red Sea governorate indicates that strategies that focus on reducing consumption of SUP can succeed in Egypt.

### 4.3 Cairo A City That Drowns in SUPB

The capital of Egypt is one of the biggest cities in the world with a population of over 20 million people (CAPMAS)[16]. It produces more than 15,000 tons of waste per day of which only 60% is properly disposed of and recycled. The remaining 40% of waste goes to the streets and illegal landfills (Zafar, 2019). This leads to a huge environmental strain. Cairo's SWM system is managed by formal and informal waste collectors *Zabbaleen*. The latter being the most important actor in waste collection in the city. Around 60% of the solid waste produced in Cairo is collected by Zabbaleen, of which 80% of it is recycled and recovered (Ibid). They are in charge of processing and recycling a large quantity of plastic. Even though the lack of a proper SWM leads to people to throw away the garbage on the streets and water bodies or to incinerate it.

Plastic pollution makes a considerable contribution to the waste problem that Cairo faces. Plastic waste can be seen everywhere in the city. Litter covers streets in the neighborhoods, it accumulates in the Nile river and is even present at the Giza Pyramids. Around Cairo, it is common to find huge piles of plastic and other types of waste on sidewalks, streets, and corners.

This is also related to the lack of education and infrastructure for the prevention and proper disposal of the waste. Around the city it is not easy to find a trash bin or places to properly dispose of the waste. Additionally, the massive consumption of SUP items that are used briefly has significantly increased the amount of litter. Even if waste management improves, not all plastic material is suitable for recycling. For instance, SUPB are not easy nor cheap to recycle. It can be inferred that improving SWM probably will not reduce consumption.

## 5. Discussion: Current Behavior and predictors of change

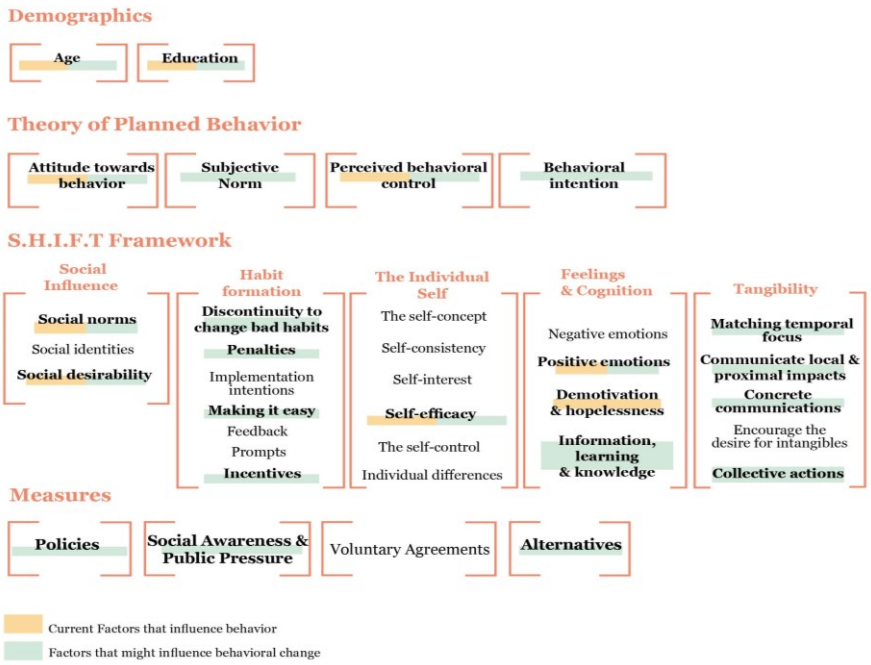


**Figure 5:** Factors that influence the current behavior and factor that might influence behavioral change in Cairo
Source: The Author

[14] Center for Environment and Development for the Arab Region and Europe
[15] Khalil, personal communication, March 30, 2020
[16] CAPMAS The Central Agency for Public Mobilization and Statistics in Egypt

### 5.1 Factors that Influence the current Behavior of Cairenes Towards SUPB

#### 5.1.1 Demographic Factors & Environmental Awareness

Most of the participants of the online survey were young and young adults, well educated and from middle-upper and upper class. They show a proper level of awareness and knowledge about the environment. This can be influenced by the educational level and also by the NGOs that often target this segment of the population. According to Cottrell (2003) and Kieżel et al (2019) this age frame is more sensible and has more interest in environmental issues. Regarding the theory of planned behavior (TPB) a proper level of awareness can be a predictor factor that leads to the intention to manifest a sustainable behavior.

In contrast, the general population is lacking environmental education. This includes an absence of contextual information and communication in the local language. That means that people do not relate to the local environmental problems and those who do not know English cannot easily access the information. This creates a lack of tangibility, where the information related to the environment is not communicated concretely, in a clear, relevant, and contextual way. At the same time the environmental awareness can be also related with the socio-economic background taking in account that the middle-upper and upper class population can have the choice to adjust their consumption. "The higher the income the more understanding of the use and the reuse of SUPB. The people from lower income are struggling too much to get bread and butter" state Shaat[17]. However, it is stated for other stakeholders that the level of awareness is not related to it.

Even if the participants show a positive perception regarding the consequences that their behavioral changes can have and they are environmentally aware, they are not reducing their SUPB consumption. The reason can be related to the consequences of the PEB are distant and not tangible, demotivation and hopelessness factor, where they feel their actions are too small to generate a big change, or they do not have enough motivation to do it, and additionally the social norms do not encourage to adopt a PEB.

Change-makers, (NGOs, civil movements, and expats) have made efforts to influence behavioral change and raise environmental concern through campaigns and behaviors. They are setting a trend influencing the social norms through the descriptive norms where people start to follow these actions. Thus, the factors of information, learning, and knowledge are also active throughout the clear information given to the people and the shop owners to understand why they should be reduced SUPB. This also suggests that people can easily follow behaviors that are coming from external influencers. Strategies such as campaigns, workshops, and clean ups, make people witness the impacts of plastics first hand, creating environmental responsibility, and engaging people in a PEB. Factors such as communicating local impact and positive emotions are linked to these strategies.

However, these efforts are limited and are not fully supported by the government, due to the environment not being a priority. There are active Egyptians, but not enough to pressure the government and influence the society on a larger scale.

#### 5.1.2 Socio-cultural and Consumption Behavior

The consumption patterns of the sample from the survey are contradictory to their level of awareness and attitude. It can be inferred that they have a strong perceived behavioral control (PBC). This means they have the tools to change their behavior (knowledge, economical capacity, etc). However, the behavioral intention is not strong enough to trigger the PEB. More education does not necessarily lead to a PEB and a favorable attitude does not mean behavioral change. (Kollmuss & Agyeman 2002).

People recieve SUPB without complaint and supermarkets show appreciation by giving extra SUPB. In contrast, some people are also asking for less bags, but it is not clear what their motivation is. The use of SUPB is related to the convenience of these items owing to they are easy to get and carry, and they are for free.

The tendency to store SUPB leads to people asking for more even if they already have some at home. The SUPB will be reused at least once and often as a bin liner. Due to the oversupply of SUPB by the supermarkets and the industry, not all SUPB are reused and they are trashed. SUPB that are received in fast food are not likely to be stored and reused. Instead, they are trashed within a few minutes of use because often the destination is not home as it is with the bags from the supermarket. There is also a belief that black plastic bags should not be used for food while transparent ones are, because they are linked to the concept of cleanliness and hygiene. This would indicate that Cairenes are not aware of the health problems of plastics.

The global tendency of buy, use briefly, and dispose is followed also by Cairenes especially with SUP items due to their convenience. It is also influenced by the fast life rhythm of Cairo where a throw- away society has become a socially accepted norm. This led to the normalization of the use of SUP and plastic pollution. This phenomenon is created because people follow the comportament of others. It is also inside the social desirability factor, due to people following the pattern of consumption in order to be socially accepted.

[17] Shaat, advisor for the governor and at GIZ, personal communication, April 20, 2020

In general, these unsustainable actions permeate the culture becoming socially accepted, repetitive, encouraged and they are highly habitual. These habits are difficult to break and the behaviors are governed by beliefs and social norms that exist in the context.

**5.1.3 Normalization of the Plastic and External Factors**

Most cairenes are not sensitive to the littering problem, they do not dispose of the waste in a proper way. This is directly related to the contextual factor of the lack of proper SWM that results in the normalization of plastic pollution. This led to the disposal of plastic on the streets becoming socially accepted. Another factor is the belief that all the plastic, including SUPB, can be recycled and is collected by *Zabbaleen.* This is a wrong assumption due to the fact that the SUPB are not recycled and not likely to be collected because SUPB do not have any monetary value for the pickers.

Therefore, SUPB are mass produced and often are thin and low quality. SUPB has to be a cheap asset for supermarkets to provide them for free. This brings a supply of low quality bags that need to be replaced often. Additionally, the data related to plastic in the context is limited and not easy to find, and the implementation of laws and policies is a complex process.

**5.1.4 Application of the Theory of Planned Behavior (TPB)**

TPB is applied to two tendencies. One has a strong PBC and the other one has a weak one. Both have a positive attitude towards PEB. The first one has a strong PBC, such as knowledge, access to the alternatives, and economical capacity which has driven some people to manifest the intention to have a PEB and it can lead to the implementation of the behavior. However, behavioral intention does not necessarily lead to the execution of the behavior. There is a gap between what people say and how they act. The intention needs to be implemented to achieve the PEB.

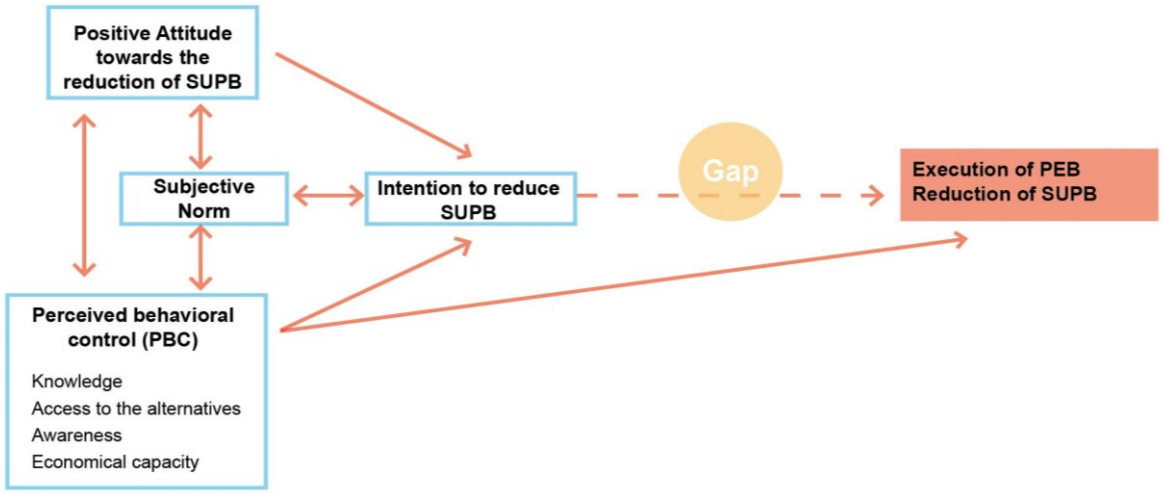


**Figure 6.** Strong PBC, favorable attitude and the gap

In the second tendency, a significant number of people are aware of RBs as an alternative to SUPB but the use of RBs can be influenced by different reasons, such as they forget the bag at home, they do not know where to get them, or they do not have enough knowledge about them. In this case, the intention and adoption of the PEB is weak. This is also related to the context (subjective norm), where the use of RBs is not so common or socially desirable (Figure 7). Although there are some shops and supermarkets that promote and sell RBs, expanding store participation in this can serve as a way to reduce the impediments listed above and serve as a reminder for people to reduce their consumption of SUPB while encouraging sustainable behavior. Subjective norms are taken as the social norms that influence the context. The influence of the social networks as friends or family are not taken into consideration.

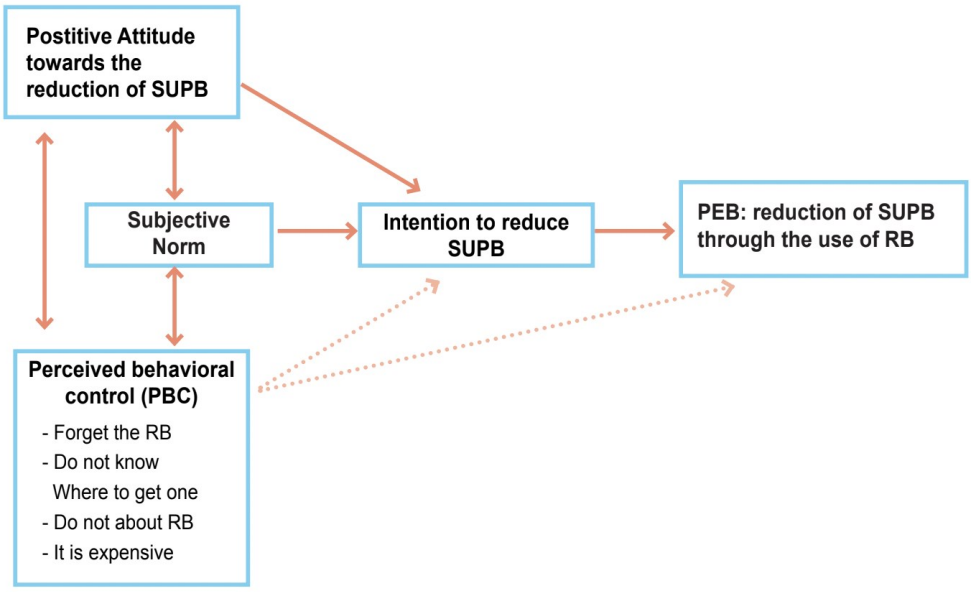


**Figure 7.** Weak PBC and subjective norm impediment.

As Macovei (2015b) states, people with a high PBC are more inclined to adopt that behavior, although if the effort related to performing the behavior is high it can become a barrier for adoption, as can be seen in the figure 7.

**5.2 Factor that Can Influence Behavioral Change Towards A PEB Through the Reduction of SUPB**

People in Cairo are willing to change. Willingness and awareness can suggest the inclination to implement behavioral intention, but that is not enough to trigger a change. The gap between intention and execution can be triggered through social influence, tangibility, positive emotion, and policies.

**5.2.1 Willingness and Breaking Habits**

According to the TPB, the best way to predict behavior is by asking the people if they are willing to have a PEB. Actually, Cairenes are willing to reduce their consumption of SUPB if there are environmental benefits and a ban of free distribution of SUPB. However, environmental benefits are not easy to see and take time to be realized. Tangibility plays a key role in visualizing in a concrete and contextual way the positive impacts that PEB can bring and how to implement the behavior. This can trigger the participants to move from saying to the action.

A regulatory framework is needed in Cairo to break unsustainable habits. This can come in the shape of a ban, taxes or economical instruments to discourage the consumption of SUPB or incentives that motivate the PEB. This goes in concordance with the policy proposal of banning free retail distribution of SUPB by CEDARE[18]. This can drastically and fast change the consumer behavior of people because it breaks an habitual behavior through the loss aversion concept.

Policies should work with social awareness campaigns that involve information, learning, and knowledge factors for people to understand why they should change their behavior and the positive impacts of that change. Communicating the local and proximal impacts will relate the outcomes for the city to the population. Alternatives should be provided to people, and in the case of RB, they should be affordable and easy to find. These factors can strengthen the policy measures, and in the case that the policy is removed, the behavior could remain.

These initiatives should have the support from different NGOs and the government. The government is necessary for the achievement of a regulatory framework as well the will of the commercial sector. Those can represent a challenge for the policy implementation.

**5.2.2 Tangibility, Feelings and Cognition**

Providing proper and clear information about the contextual problem of SUP by explaining the economical, health, and environmental impacts. Information, learning, and knowledge factors should be applied to make people relate to the issues of SUPB in Cairo and stop the normalization of those and plastic pollution. Bringing the benefits of the PEB more palpable and understandable for the population can influence the behavior and improve the lack of environmental

[18] Centre for Environment and Development for the Arab Region & Europe

education and enhance the level of awareness through factors such as matching temporal focus, communication local and proximal, and concrete communications in the local language, Egyptian Arabic. Additionally, displaying what can be achieved through collective actions can trigger the adoption of a sustainable behavior oriented to a common and collective goal.

Workshops, activities, and strategies should bring a great and enjoyable atmosphere, positive emotions and self-efficacy factors can be applied in order for the people to easily engage and have the perception that they are contributing to the change even if the action is small, this can offer them a sense of empowerment. Activities, such as clean-ups, are didactic practices that make people face the problem first hand, generate a warm glow, and give a sense of agency.

New habits should be easy to adopt, undemanding, and should be convenient. Then when individuals understand the problem, have alternatives, and easy ways to do it they might easily start to change their behavior.

**6. Recommendations**

The following factors can trigger behavioral performance. Therefore some variables should be taken into consideration such as age, social-economic background, and level of awareness and knowledge about the SUPB and the environment.

- PEB should be promoted and made socially desirable by NGOs and the authorities in order to encourage a positive perception towards sustainable behaviors and the executions of them. The use of social networks and mass media can have a huge influence and reach a large part of society.
- Make information clear and engaging. Some people should act as “the precursors” in performing the PEB to help stimulate the crowd to follow the behavior.
- Strategies to reduce plastic consumption should be tailored to each segment of the society. Factors such as information, learning, and knowledge, combined with positive emotions and enjoyment environments are important to influence people from different backgrounds.
- Message framing: messages should communicate that others are already behaving in a sustainable way. This could result in people following these behaviors.
- Environmental education should be included in both private and public schools. Regular didactic practices should be applied.
- Policies such as banning the free distribution of SUPB should be implemented by the government by a law or decree. However, policies are not so easy to implement in Egypt and it can take a long time. An alternative, can be a voluntary agreement between NGOs and retailers, also the government can be involved.
- If an economical instrument is proposed, stakeholders should be aware of how much can be charged per SUPB. Verbal reminders from cashiers can also help to increase the awareness and the adoption of the reduction of SUPB. Therefore, those measures should be accompanied by awareness campaigns.
- Take into account the low income population because they rely on free assets and use plastic to sell vegetables and food.
- In order to have supermarkets on board, it is recommended to show them how they can save money and have a better image if they reduce the distribution of SUPB and how the selling of alternatives could lead to new profits.
- Data about plastic should be more accessible. It is recommendable that data can be shared and open for research, policymaking, and awareness campaigns.

**7. Conclusion**

Based on the qualitative and quantitative analysis of Cairenes behavior, most of them have a proper level of awareness and the willingness to change, especially in the middle and middle-upper class. Yet they consume a considerable quantity of SUPB. These behaviors are still normalized inside the context through the overconsumption of these items. Mainly, because of the consumption habits combined with the excessive distribution of SUPB and the throw-away society that govern Cairo’s society. Despite that, environmental concern is gradually increasing in Cairo’s society. This can result as a strong predictor towards the reduction of SUPB together with willingness and behavioral intention.

However, this is just showing the intention to implement the desired behavior. There is a gap between intention and action. To have the intention to change the behavior is not enough to execute it. The findings suggest that something is missing to trigger and motivate the PEB. The gap between intention and execution can be triggered through social influence, tangibility, positive emotion, and policies to help to increase awareness, to break unsustainable habits, and lead to the execution of a PEB through the reduced consumption of SUPB and plastic pollution in Cairo. This can bring a beneficial impact in the local and global environment including the improvement of SWM. Ideally, to achieve a visible reduction of the consumption of plastic bags in Cairo and reduction of pollution, a significant percentage of the population should adopt a PEB.

There are also different factors that are affecting the current behavior of people in Cairo not just related to the environmental awareness and the social-cultural settings but external forces like the quality and cost of plastic bags production, the lack of SWM, and government willingness.

The result of the research can contribute to understanding a piece of the behavior and the perception from a sector of the society in Cairo towards SUPB and the environment, and shed light on how to influence behavioral change to cope with the environmental degradation of Cairo, Egypt, and the region. Moreover, these issues have not been well documented in Middle East academia and can have a considerable contribution to the region for the improvement of sustainable practices in the societies, enhancing the environmental education and adoption of PEB through the reduction of not just SUPB but plastic in general that leads to improvement of the urban and natural environment, as well to the health and the economy of the cities.

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**Conflict of Interests**

The authors declare no conflict of interest.

**List of Acronyms**

**NGOs:** Non-Governmental Organizations
**RB:** Reusable Bag
**PBC:** Perceived behavioral control
**PEB** pro-environmental behavior
**SUP:** Single-Use Plastics
**SUPB:** Single-Use Plastic Bags
**SWM**: Solid Waste Management
**TF:** Theoretical framework
**TPB:** Theory of Planned Behavior

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# SIMURG: Performance-based Model for the Assessment of Sustainability: Synthesis of the Paradigmatic and Frame Models

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**Abstract**
Today decision-making processes of public authorities, who have the responsibility of developing sustainable policies for their built environment entities, do not support transparency, accountability, and consistency of their decisions. What societies require is a human-centric vision, a consistent philosophical/paradigmatic model that supports this vision, and the tools that increase the legitimacy of the whole decision-making process. The problem is the lack of these visions and tools that allow the citizens to meet their priorities in their lives with the identities of built environment entities and public authorities to accept/propose suitable projects by using “layers” such as historical/smart/ green/slow/safe, etc. Most of the studies in the literature deal with the sustainability assessment problem at only one environmental dimension of sustainability without considering interactions among the dimensions of 3D Cartesian system and their levels. A paradigmatic model and frame model, which will be used as a guide for developing further conceptual and practical models must be developed from scratch. The conceptual and practical models can only be developed in an iterative process by considering the interactions among these components. In this study, a bottom-up approach in an iterative process was adopted and practiced in the development process of the relationships among the components to propose the above-stated parts of the model of the research.
**Keywords** Simurg; sustainability assessment; framework model; philosophical model; conceptual model, performance-based assessment; certification-based assessment; 3D Cartesian system of sustainability.

## 1. Introduction
Traditional planning, design, and production processes of the built environment have their difficulties and limitations such as conflict of interests of shareholders, incomplete documentation, lack of coordination among the organizations at different phases of the production process, lack of control in the construction phase, etc., and for this reason, the outputs of this processes have serious problems. While the clients/entrepreneurs are taking all the critical decisions to increase their profits, the end-users, especially in developing countries, become aggrieved because of certain reasons such as inadequate codes and regulations, lack of information about standard performances that must be provided by-products, weakness of the mechanisms that are supposed to protect the society; moreover, losses at national and global scales of economy arise, limited resources are wasted and difficulties in terms of sustainable development process increase. Therefore, this process must be re-thought and replaced by alternative approaches, particularly with the support of computer-based tools to increase transparency and accountability of the decision-making process, primarily in developing countries.

## 2. Problem Statement
Today it is not adequate that the transparency, accountability, and consistency of the decisions of public authorities, who have the responsibility of developing sustainable policies for their built environment entities at all hierarchical levels. What the individuals, public institutions, private companies, and societies require in the world is a new human-centric vision, a consistent philosophical/paradigmatic model that supports this vision, and the tools that increase the accountability/transparency/legitimacy of the whole decision-making process. The problem is the lack of these visions and tools that allow (a) the citizens to meet their priorities in life with the identities of built environment entities, (b) public authorities and entrepreneurs to accept/propose suitable projects that have consistent identities by using “concepts/layers/labels” such as historical/smart/green/slow/ safe, etc., that are presented by specific KPIs and associated weights, for the built environment entities at all hierarchical levels. A comprehensive model can be used for the assessment of the entities' sustainability on the built environment dimension by considering the impacts of the other two dimensions, i.e., economic and social dimensions, on the built environment dimension of sustainability. There are numerous related studies and models in the literature;

however, they only deal with only one single or limited part of the problem and none of them proposes a holistic approach for the solution.

Most of the studies in the literature deal with the sustainability problem at only one dimension of environmental components of sustainability. Similarly, these studies deal with the entities in only one level on selected dimensions such as a. product-related dimension cities level, b. product-related dimension_ buildings level, c. process-related dimension_companies level, d. process-related dimension projects level, e. etc. Certainly, some studies deal with only one layer/label/concept for the assessment of selected entities such as a. green, b. smart, c. resilience, d. etc. A comprehensive list which is the output of a meta-data analysis of the studies on the subject was presented by Ulker et al. (2021) in the SIMURG project to be able to see the state-of-the-art regarding the problem area. Examples can be extended to all of three environmental dimensions of sustainability in the 3D Cartesian system and dozens of entities/facts on these dimensions; however, they are focused on a single or a limited number of entities/facts, although the definition of a comprehensive framework model must be the first step before focusing on specific parts of the whole system.

**3. The Aim and Objectives of the Research**

As a result of the assessments conducted by the project team, it has been concluded that a framework model, which will be used as a guide for developing the conceptual and practical models of the solution must be picked up from currently proposed models in the literature or developed from scratch. Then, the components of the conceptual model, i.e., philosophical model, framework model, organizational model, integrational model, and computational model can be developed in an iterative process by considering the interactions among these components.

**4. Methodology**

Model development studies require mostly iterative processes. Comprehensive models increase the complexity of these processes. Before attempting to develop a framework model it is concluded that the relationships among the components and the relationships between each component and the whole system must be understood very well. Thus, according to the draft version of the framework model proposed components of the system were studied in various research projects and master theses and Ph.D. dissertations. During these studies, lessons learned from the development processes of sub-models that are supposed to work with the main system, have been used for the design of the core part of the model that integrates the components. This way, a bottom-up approach in an iterative process was adopted and practiced in the development/investigation processes of the relationships among the components and core part of the model.

There is a limited number of studies, which have a holistic perception of the nature of the problem and attempts to propose an integrated solution of the complementary components, i.e. conceptual and practical dimensions. A comprehensive “systems approach” is essential for effective decision-making regarding global sustainability, since industrial, social, and ecological systems are linked (Mobaraki & Oktay Vehbi, 2022; Fiksel, 2006).

Several methods have been proposed for the determination of information requirements (Sey et al. 2002):

Normative analysis methods are based on the fundamental similarity of classes in objects systems, these fundamental characteristics load to a prescribed or normative set of requirements (Carlson, 1979). *Strategy set transformation* methodology is primarily for obtaining organization-level information requirements that are derived from the objectives of the organization (King, 1978). *Critical factors analysis* is a method for eliciting significant decisions or other factors that can be used in deriving information requirements (Rockard, 1979). *Process analysis* focuses on business processes (groups of decisions and activities required to manage each of the resources in the organization). An example of this methodology is the Business System Planning (IBM Corporation, 1981). *Decision analysis* is very useful in clarifying the information requirements with users in cases where the decision process is fairly well defined (Munro and Davis, 1977). *The socio-technical analysis* is oriented to application-level analysis and consists of two parts: social and technical analysis (Bostrom and Heinen, 1977). *The input-process-output analysis* is a system approach. The advantage of analysis based on inputs, processes, and outputs of systems is that it is systematic and comprehensive. Examples are ISAC - Information Systems Work and Analysis of Changes, DFD - Data Flow Diagrams and ADS - Accurately Defined Systems, ISASA – IS Analysis by System Approach (McLeod, 1993; Dressel, 1973).

The studies managing key components of the problem and its solution at different dimensions, i.e., product/process/social dimensions for different entities at various levels of the built environment from “components” to “cities” levels are being conducted as the sub-projects of the master project entitled as “SIMURG: A performance-based and **S**ustainability-oriented **I**ntegration **M**odel **U**sing **R**elational database architecture to increase **G**lobal competitiveness of Turkish construction industry in industry 5.0 era” while some of these projects are the subjects of dissertations and master theses, some of them are being studied in research and development

projects funded by the ITU Scientific Research Funding Unit and private manufacturing/design/construction companies in the construction industry.

SIMURG is the title of a Persian tale, which has corresponding versions in Turkish and western cultures as well. It means "*30 birds*" searching for their leader, named SIMURG. At the end of their journey, they eventually explore that there is no such bird named SIMURG; however, they are all SIMURG as a whole. Governance of the cities and the entities at all scales and levels of the built environment needs to use the language of human-centric approaches by locating the sustainability concept into the center of all problems and solutions.

SIMURG_ALKU & ITU Virtual Lab was established and announced in 2018. The lab aims to provide a scientific research and development platform for the research projects, master theses, and dissertations, which aims to develop conceptual and practical models for increasing the quality of the built environment and national/global competitiveness of the Turkish construction industry. The lab is currently working on the integrated model SIMURG, which is the subject of the master project being conducted by Kanoglu, A., from the department of Architecture of ALKU/Management Sciences in Architectural Design and Construction expertise area; Yazıcıoğlu D.A., from the department of Architecture of ALKU/Interior Architecture expertise area; and Özcevik, Ö., from the Department of Urban and Regional Planning of ITU, who are the co-chairs of the Lab.

The final output of the master project SIMURG, a relational database software, will be an open-ended model with numerous modules in all dimensions and levels of the 3D Cartesian system of sustainable assessment in the future.

**5. Synthesis of the Conceptual Model**

The basic components of the conceptual model of SIMURG is defined as follows (Figure 1):

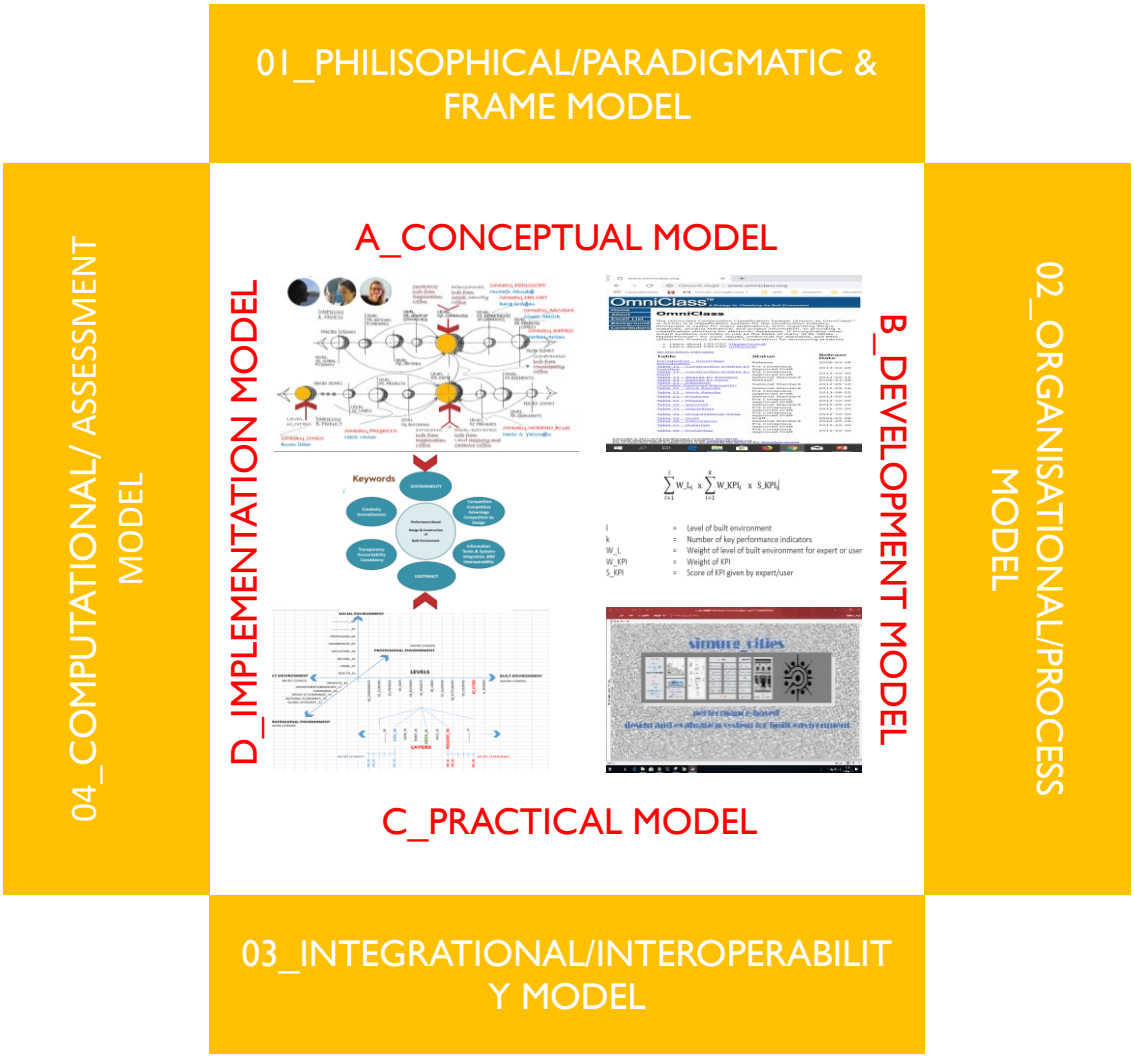


**Figure 1.** The components of the conceptual model as the objectives of the research of SIMURG.

- Philosophical/Paradigmatic Model: Proposal of a philosophical approach that accepts and supports "*sustainable planning, design, and building*" approaches instead of the initiatives, which is driven by individual interests and passions of entrepreneurs, such as making profit without considering common interests of society, is the first objective within this context.
- Framework Model: Proposal of a framework model that covers all dimensions required for the assessment of sustainability and allows multi-dimensional/multi-layer/multi-level interactions for computational and international parts of the model is the second objective within this context.
- Organizational/Process-Related Model: Proposal of the process of performance-based assessment and definition of supporting issues such as organizational entities, their functions and relationships, rights, and responsibilities, is another objective within this context to be able to implement the model.
- Integrational/Interoperability Model: Proposal of a "*multi-dimensional, multi-level and multi-layer*" structure requires the interactions among interrelated entities at different dimensions to be defined clearly and concisely. Solution of integration and interoperability problems of the model at conceptual and practical dimensions is another objective and challenge of the study within this context.
- Computational/Assessment Model: Definition of conceptual layers/sets of key performance indicators (KPIs), determination of design and production performance parameters/ performance criteria, development of a performance-based assessment system and its computational statements/equations for the performance-based assessment of the environmental dimensions of sustainability in the 3D Cartesian system is another objective within this context.
- Computer/Software Model: Identification of the processes, modules, and components for automation software and reporting system, which is based on the conceptual model to be developed is another and final objective of the study within this context.

**6. Hypotheses of the Conceptual Model**

Citizens are largely positioned as data points, consumers, users, players, testers, or people to be corralled, nudged, disciplined, and controlled (Cardullo and Kitchin, 2018). Occasionally they act as participants that provide feedback and suggestions, but rarely occupy roles of decision-makers, co-creators, or leaders (Kitchin, 2018). Instead of a chaotic order, which always cooperates with individual or organized entrepreneurs' ambition/greed, interest and initiatives motivated by only making higher profits and mostly supported by political power, who shares the benefits especially in third world countries, a philosophical approach, which is supported by a holistic paradigm of design/building/assessment approaches of sustainability at all hierarchical levels of the built environments. This philosophy must adopt the approach that global resources are our common heritage and all contracts and actions must protect future generations' rights. Moreover, it also must adopt innovative approaches supporting sustainability, which focuses on extending the competition in the construction industry to the entire building production process instead of limiting it with bid-price strategies in the tender process.

Thus, it will be possible to transform the role of the architect into a design professional, who does not act in line with the desires of the entrepreneur but, who protects the long-term benefits of the society in the context of "*competition by design*". The philosophical/paradigmatic model of the above-stated approach necessitates a new holistic approach at related dimensions of solution and sub-models such as integration/interoperability-related, organization/process-related, computation/assessment- related, computer/software-related models, which internalize the concepts of sustainability, innovation, competitiveness, integration/interoperability, accountability, transparency and legitimacy in the core part of the study as illustrated (Figure 2).

- A conceptual and practical model to achieve this goal must integrate all these concepts/keywords and re-thinking construction in this scope is inevitable. After developing a conceptual model, a relational database model including different modules for different levels, functions, and entities during the production process of the entities in the built environment is the main goal of this project.
- Our experience on the subject helps us to suggest the hypotheses listed below that drive us to design our framework model in the master project in solving the problem.
- Production is the total of product and process concepts and performances of these dimensions are influenced by human-related/societal/social facts on the third dimension of the 3D Cartesian system; an integrated approach is required in the assessment of sustainability.
- The entities in physical/built environment and professional/economic environment can be defined according to their hierarchical position at the "*levels*" of expansion of universal entities; they are in a relationship with each other in a hierarchical order.

- The levels of built environment entities at the product dimension might start at the "*subatomic*" level and end with the "*universe*" level in theory; yet, in our study, we start with the "*building components*" level and finish with "*cities*" level due to practical reasons.
- As for the entities at the process dimension, they start with the "*projects*" level and end with the "*national economy*" level, including "*departments of companies, companies, functional groups of companies and sectors*" levels in between.
- Social attributes and facts related to individuals and society such as creativity-related, health-related, crime-related, etc. facts in the social dimension must be integrated in addition to product and process-related dimensions stated above since the performances of built and economic environments are affected by these facts and it can't be assessed without considering the consequences of them.
- Assessment of the entities of the built environment must be based on both objective and scientific rules/principles/criteria and must be performed by both citizens, who are ordinary people, and specialty groups, who are experts of related levels and areas.




**Figure 2.** The keywords driving the study.

- The value systems of end-users, even if they are based on their subjective perceptions, inadequate experiences, and incomplete/inconsistent knowledge, must be considered in addition to an assessment of experts as well.

- The assessment model must provide the opportunities of using various sets of concepts and their key performance indicators such as slow, smart, safe, green, historical, resilient, etc. These concepts will be defined in the model as "*layers*" that are classified as basic patterns including concept-specific KPI sets associated with their impact factors referred to as "*weights*".
- Occupants and their social attributes of built environment entities at each level of built environment dimension in the 3D Cartesian system may increase or decrease the performance-based scores of these entities with their social, cultural, educational, health-related, crime-related, etc. activities and attributes, and they must be taken into consideration in calculation and assessment in the performance of the entities at different levels in the built environment.
- The model must address the assessment requirements of individuals and corporate level entities such as entrepreneurs, municipalities, ministry of construction, governments, and global assemblies such as UN, WHO, ILO, etc. in their assessment and decision-making processes for various levels in the built environment.
- The model must propose this three-dimensional (product/process/social) and multi-level/multi-layer approach by KPI sets in the calculation of performances of built environment entities by taking into consideration the mutual effects on each other.
- Interoperability, standardization, unification, and integration concepts must be considered and information classification systems such as OmniClass, MasterFormat, etc., are inevitable in the design of the model to be proposed.
- The computational model must support the assessments both in detail of level of entities in all dimensions of the 3D Cartesian system separately and total performance of the selected entity by considering the effects of the entities at other dimensions.

**7. The Philosophical/Paradigmatic Model**

Sustainability is not a concept that can be used by the triangle of the corrupted political system, entrepreneurs, and financial institutions, who tend to abuse it since the built environment is one of the most profitable investment areas in most places of the world; however, the main concept among those that can be achieved by the integrated use of all key concepts given in Figure 2, for the well-being of society. It can be achieved only by matching the basic requirements of life, for not only human beings but also all living creatures in nature, with their expectations and attributes appropriately and balanced to some extent. Today, in our society we can't achieve matching up requirements/ expectations/identities of individuals with the attributes of built/professional/social environments; i.e. children are misled by their parents to the professions that are supposed to provide high income during their professional lives, individuals invest their financial resources to houses that are only supposed to be highly profitable investments, municipalities support the investments of built environment entities that do not match with the identities/souls of the cities, etc., because of an ill-defined value system imposed to the individuals of the society, especially during the last four decades in Turkey.

It is seen that resident structures have the difficulties of evolving since they keep resisting all innovative initiatives all the time; yet, the existence and sustainability of life are at stake, where these evolutions could not be achieved. Some of us may think that the common sense and consciousness of the society can find the way outs sooner or later before unrecoverable damages arise; however, public authorities seem to be not affected by the efforts of individuals or weak non-governmental organizations to take timely steps. Today, after all, futile endeavors, which had limited effects on a solution by now since they do not have a holistic approach and an integrated strategy supported by a strong philosophy it is seen that we still have a very long way to go. Because of this, we have lost our past and now we are losing the future of our children, unfortunately. Duncan (2005) reports that neither national building codes nor those of today's new-build clients are adequately protecting the interests of the society and building users of the future; thus, the emergence of concepts/labels/layers such as smart/green/safe/slow, etc., are just being seen as a "market force" pressure on building owners.

**8. The Frame Model**

Proposing a framework model to define the components of the conceptual model and integrate all dimensions of the assessment process of sustainability with a holistic approach must be the first step of the study. There is a limited number of framework models for the assessment of sustainability in the literature; i.e., Harrison and Donnely (2011), Nam and Pardo (2011). Yigitcanlar et al. (2018) report that not many of them adequately addressed a balanced and sustainable approach. One of the well-known framework models is the EU model, which proposes economy, people, governance, mobility, environment, and living issues as dimensions.

Unlike the others, the SIMURG proposes a multi-dimensional, multi-level, and multi-layer framework model to be able to determine the relationships among the dimensions and entities on various levels of the dimensions of the 3D Cartesian system (Figure 3).

It is necessary to develop a comprehensive and holistic framework model to be able to increase the accuracy of the assessment process of the performance of the entities not only on the built environment dimension but also on the other two dimensions of the 3D Cartesian system in the framework model of the SIMURG. Achievement of this goal enforce the researchers to deal with a trade-off problem between the level of complexity and versatility of the model proposed and this endeavored study is supposed to result in a model that can measure/assess/understand/explain the performance of environmental dimensions regarding sustainability concept, more accurately and successfully compared with the other models reported in the literature and professional practice. In other words, the comprehensive/complicated character of the models does not guarantee the success of the solution and the "less is more" statement that was one of the popular mottos of the architectural practice in the 60s must be considered in the design of the framework model to be proposed as well. This study aims to propose a holistic model that means using "the system approach" to define the relationships of the related entities and to design *a*. multi-dimensional, *b*. multi-level, *c*. multi-layer/label architecture to express these relationships among the dimensions of the Cartesian system of sustainability and the entities on various levels of these dimensions. This approach imposes us to analyze the basic components of the system in four main folders: *a*. environmental dimensions of the sustainability, *b*. entities on each level of these dimensions, *c*. layers/labels/concepts of assessment of sustainability, *d*. methods/tools of assessment of sustainability. After clarifying our perception of the above-stated problem by these classifications, the conceptual model can be interpreted more accurately.

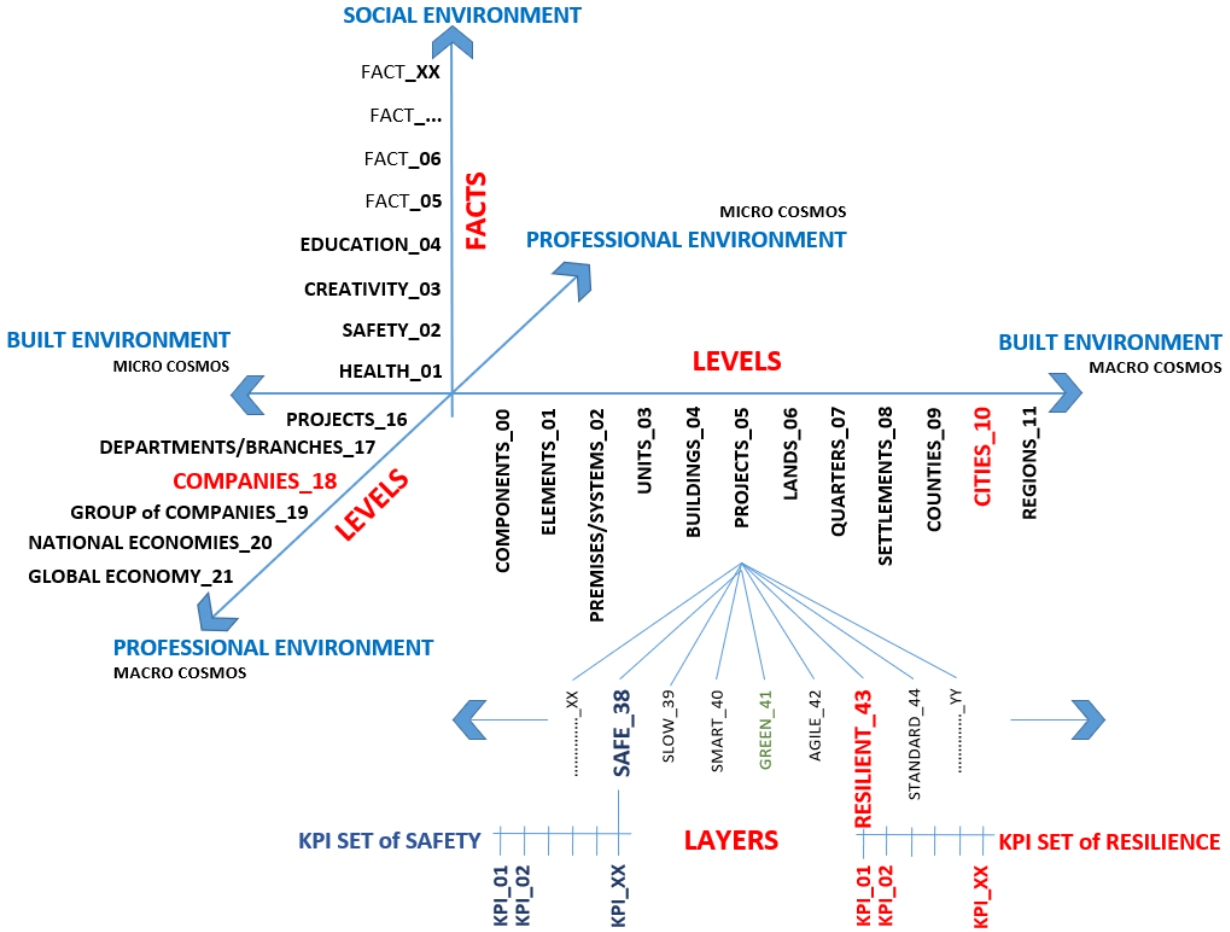


**Figure 3.** Generic example of the multi-dimensional, multi-level, multi-layer, and performance-based assessment model of sustainability proposed by the study.

**9. Environmental Dimensions of the Sustainability**

Studies within the context of sustainability concept, are still being conducted in three different but interrelated environmental dimensions in this study; built environment, professional environment, and social environment. For

this reason, it is reasonable to classify these environmental "dimensions" of the sustainability concept as explained below.

- Product-Related/Physical/Built Environment: It comprises of consecutive and hierarchical levels of built environment starting from the "premises" level; and the entities at "elements" and "components" levels that form the premises are also included in this succession similarly the other levels that can be extended up to the cities, countries and even to the globe. All the entities at each level of the built environment can be the subject of assessment for several shareholders.
- Process-Related/Professional/Economic Environment: Unlike the other studies in the literature, the term "economic environment" in our framework model is not related to product-related/physical/built environment entities but the organizational entities (companies) that take place in the production process of all designed/engineered/ manufactured-produced-constructed items in all segments (sectors) of the national economy as well as the companies in the construction industry, which undertakes basic roles of the production process of the built environment stated above. All the corporate level entities that are involved in the production process of the built environment such as local authorities, manufacturers, suppliers, designers, contractors, etc., has a direct effect on the total performance of the built environment due to the experience of their personnel, level of specialty, competitiveness, innovativeness, etc., in short, the organizational and economic performance of the company. It is inevitable to assess the performances of these entities to be able to assess the entities at all levels of the built environment. Just like the hierarchical structure of built environment levels, the entities in professional dimension are in a relationship with each other in a hierarchical structure; and each level's performance can be calculated as the weighted average of the performances of subordinate entities in addition to the assessment value of level-specific KPIs as it is in the built environment dimension.
- Human-Related/Societal/Social Environment: It is necessary to consider the effects of social facts such as quality of education, safety level, density and quality of cultural activities, etc., of human beings in the society, who utilize the entities of the built environment at all levels, on the performance of the built environment. Unlike the other dimensions, the facts to be assessed in this dimension do not have hierarchical levels and relationships.

**10. The Entities/Facts on Dimensions of 3D Cartesian System of Sustainability and the Levels**

The hierarchical levels of product-related dimension can be defined as 00_components of composite building elements, 01_composite elements of premises, 02_premises of building units, 03_units of buildings, which are defined by ownership records on cadastral systems, 04_buildings, 05_projects (group of buildings/gated communities), 06_lands, 07_quarters, 08_settlements, 09_counties and 10_cities levels as it is seen in Figure 3. The left side of the built environment dimension could have been extended down to subatomic levels, while the right side is possible to be extended up to the universe level theoretically. Yet, for practical reasons the levels start with the "00_components of composite building elements" level and end with "10_cities" level.

As for the hierarchical levels of process-related dimension, the entities and their levels can be defined as 00_projects, 01_departments of firms, 02_firms, 03_functional groups of firms (manufacturers/suppliers/designers/contractors, etc.), 04_industrial segments (sectors) of the national economy, 05_industrial segments of the global economy, and 06_global economy levels. Each level needs its own level-specific & layer-specific KPIs to be developed and associated impact factors/weights to be determined.

The facts on the social dimension can be defined as 00_health, 01_crime, 02_income, 03_education, 04_culture, etc. During the assessment process of sustainability, all these facts can be included by assigning them certain weights or desired facts can be eliminated by assigning the weights of these facts as zero.

**11. Layers/Labels/Concepts/Sets of the KPIs**

All the entities, which take place on the 3D Cartesian system of environmental components of sustainability can be assessed by using a performance-based assessment approach using various sets of Key Performance Indicators (KPIs). These sets are expressed by some well-known terms such as smart, slow, safe, green, resilient, etc., and are referred to as "*layers/labels/concepts*" in this study. In this context, an assessment can be made for a given set of cities by using, for example, "*smart city*" KPI set or "*safe city*" KPI set, and resulting performance values of these both entities at "*cities level*" will be different at the end of a comparative assessment process regarding the KPI set used. Just like the entities on Product-Related/Physical/Built Environment dimension; i.e., cities in this example, it is possible to assess the entities at, for example, "*departments*", "*companies*" or "*sectors*" levels on Process-Related/Professional/Economic Environment and so on. This way, all the companies at "*contractors*", "*designers*", "*manufacturers*" or "*suppliers*" categories can be assessed, ranked, compared internally; just like all the industrial

segments (sectors) in national economies or all the national economies in the global economy can be assessed the same way.

**12. Methods for the Assessment of Built Environment and Performance-Based Approach**

It is necessary to use a combined unit of measurement in the assessment of various attributes of entities in the built environment. Cost, quality, or performance can be stated among the options. Although Life Cycle Assessment (LCA), Life Cycle Inventory Analysis (LCI), and Life Cycle Cost (LCC) based models are proposed in the literature, it is stated that they lack in the assessment of the facts of sustainability on the social environment dimension (Ahmad and Thaheem, 2015). As for the computation process, various studies propose to use various methods such as Multi-Attribute Utility Analysis (Lam and Yang, 2020; Walnum et al. 2019), Performance Benchmarking (Shmelev and Shmeleva, 2019; Ahvenniemi et al. 2017; Sáez et al. 2020), Technique for Order Preference by Similarity to Ideal Solution/TOPSIS (Gok and Yigit, 2017; Zhang et al. 2018), Multi-Criteria Decision Making (Manupati, 2018), Machine Learning (Ahmad and Chen, 2018).

On the other hand, performance-based assessment is a comprehensive approach and can be used as an effective conceptual tool to deal with the assessment problem of built environment entities. The conventional methods and tools of controlling the content of the built environment almost by the beginning of the 21st century were specifying requirements in prescriptive terms and it was based on central control of how a built environment would be created regarding the basic dimensions of production; i.e. products and processes. Since the traditional descriptive approach does not allow a responsive control system some countries decided to use performance-based specifications and regulations. Duncan (2005) reports that a third voice is now clear, from the “sustainability” corner.

A performance-based approach is inevitable to support and utilize the benefits of innovation; the most common universal motivators of a performance-based approach appear to revolve around a desire for more flexibility, more innovation, and cheaper construction (Lovegrove, 2005). The author further emphasizes that there is a developing awareness that the performance approach is not just about the development of technical codes; rather it is a holistic system, a legislative, regulatory package that is complemented by expertise, accountability, and responsible allocation of risk.

**13. Discussion**

Sustainability is the key concept of integrating various aspects of life; that’s why numerous studies are being conducted by research teams from various disciplines. It is not unusual for these disciplines to define the problem within the boundaries of their domains. Dividing the problem into its smaller components is also one of the basic rules of scientific research and that’s why most of the studies related to sustainability concept have their limitations. However, the outputs of these fragmented studies do not provide us with a comprehensive perception of the big picture and convenient tools for policymakers to be able to increase the transparency and accountability of their decision-making processes. The SIMURG, as the master project of dozens of prospective sub-projects related to the entities in all dimensions of the 3D Cartesian system of sustainability, made the cooperation and participation of multi-disciplinary teams possible in the conceptualization phase. Thus, it proposes a multi-dimensional, multi-level and multi-layer framework model that covers the whole space of solution for the problem. In addition to civil engineers with construction management and informatics expertise; academicians from an architectural domain with construction management and informatics, architectural philosophy, architectural history, and preservation expertise, academicians from interior architecture domain with the design expertise of building premises level entities, academicians from urban and regional planning domain with sustainability expertise, all research team contributed to the design of conceptual and practical models of the SIMURG.

**14. Conclusions**

The paradigmatic model of the SIMURG proposes a human-centric governance approach and accepts sustainable development goals (SDGs) defined by the UN. The framework model proposes a 3D Cartesian system as the dimensions of sustainability. The organizational model is based on a distributed system of roles and functions and proposes rethinking these roles and relationships by considering the functions of information providers and accredited labs and institutions in the certification process of the entities by specialty areas in the design of built environment entities. The integration and Interoperability model proposes integration and interoperability of information sources of public services. OmniClass information classification system and BIM 6D tools are proposed to organize the information needed in the built environment dimension. The calculation model is based on a solar system simulation algorithm that is inspired by gravity equation and performance-based assessment. And finally, the computer model is based on relational database architecture that allows integration of required information sources to be plugged in the frame model.

The master project and its components are currently being conducted in the research lab SIMURG_ALKU & ITU, in both institutions; Alanya Alaaddin Keykubat University (ALKU) and Istanbul Technical University (ITU). This article is the first paper of a trilogy and tries to explain the framework of the proposed solution by defining the essentials of the philosophical/paradigmatic model and framework model parts of the conceptual model developed in the study. Two more papers will be published to explain the complementary components in detail; the first one for the organization/integration-interoperability/computation models in the conceptual dimension, and the second one for the computer model in the practical dimension.

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**Conflict of Interests**
The authors declare no conflict of interest.

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# Promoting Sport Practice in Urban Public Space

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## Abstract
Participating in physical activities and sports in contemporary urban public spaces has increased and proven benefits for health and social well-being. The aim of this study was to overview and identify those aspects to promote sports practice in public spaces for everyone. This study finds that those aspects play an important role in increasing participation in sport for all in public spaces including integration of spatial sports facilities, organization, adaptation, and attractiveness. This study concludes by identifying existing evidence to increase participation in sport and practice and future policy that can help to ensure that demand for all sporting facilities in urban environments and redesign urban public spaces through inclusive design be able to adapt and organize different types of sports for all.
**Keywords:** Sport; Physical activity; Public space; Promoting participation in sport; Sport for all.

### 1. Introduction

Promoting physical activity and sport is an important part of increasing public health and achieving dimensions of urban sustainability (Eime et al., 2015, WHO, 2011, & Christiansen et al., 2014, Amen,2022). particularly in developed countries, such activities become a priority in the planning and governments to achieve a healthy city for all by providing easily accessible facilities where sports can be practised (Shen et al., 2020, & Lee et al., 2016). In recent decades urban public spaces become a stage to organize and practice sports activities (Smith, 2016). However, public spaces and sports facilities in many countries are still needed to reconsider their planning and design by focusing on the spatial, organization, adaptation, and attractiveness of outdoor spaces in urban environments in order to increase the participation of all people in sporting events and to enhance city images.

Nowadays, sport is integrated with the modern lifestyle of our urban society. Participation in sports that take place in public spaces is increasing but organizing sports in clubs is decreasing (Van der Roest, 2015, & Borgers et al., 2016). The spatial quality of many sports facilities is often bad and ugly: no proper spatial planning, monofunctional, unattractive and anonymous architecture, badly embedded in the neighbourhood, hidden behind closed green areas, and little or no relationship to public space; sport (parks) are often isolated from its urban surroundings (Valle et al., 2013). Therefore, it brings a priority for urban planners to design urban public spaces that should be flexible, multi-uses and attractive in order to be a stage for different types of sports and influence how the sport is spatially integrated to increase sport participants (Valle et al., 2013). The major effects of promoting participation in sports and physical activity for all groups in society are increasing measured accessibility, safety, availability of sports facilities and to be properly distributed in different urban areas (WHO, 2011, Mota et al., 2005, Kaczynski et al., 2007, Ujma-Wąsowicz, et al., 2008, Hallmann et al., 2012, O'Reilly et al., 2015, Wicker et al., 2009, Haerens et al., 2009, Yfantidou et al., 2011, Asefi et al., 2020, & Christiansen et al., 2014). Thus, planners should optimize the attractiveness of the public space for sports for different groups of participants (Deelen et al., 2016). Designing public spaces and sport facilities need to adapt and access all groups of people to participate in sport (Al-Taesh et al., 2021 & Ujma-Wąsowicz, 2011).

Urban public space regeneration through leisure especially, with sports events, sports infrastructure and sports programmes has emerged in the post-modern city (Tallon, 2013 & Larissa, 2016). Many cities currently need to revitalize their public spaces of high physical and social degradation by placing sport and its power of social inclusion. Multifunctionality and inclusiveness are the main drivers of planning and design of an element at the core of urban regeneration strategies in terms of the quality of spaces with the possibility of hosting different sports activities or more inviting, convivial, and dynamic (Cognigni et al., 2020 & Smith et al., 2021), it becomes a place easier for organizing different sports and physical activities.

The important organizing and programming of multi-sports and physical activities are necessary to target all different groups in public spaces as well as participants from diverse backgrounds voluntarily take part and learn not only how to negotiate game rules but also complex interethnic and diasporic social relationships (DeLand et al., 2014, Teosk, 2015, & Wise et al., 2018). In addition, collaboration with informal groups and multiple agencies in organizing sports can promote participation people in sports (Jeanes et al., 2019, & Smith et al., 2020). However, the design of public open spaces frequently does not pay attention to management and maintenance issues (Santoso et al., 2015). Regarding those issues, the government can cooperate with private parties for the management and maintenance

of sport facilities and infrastructures positively influence the development of the sport to be advanced (Valle et al., 2013 & DHARMAWAN et al., 2018).

Designers and managers of urban spaces promote the desirability and attractiveness of these as places to spend time (Clare et al., 2018). As well as public space can influence the levels of the community's participation in doing sports for different groups of participants through its aesthetics such as convenient accessibility, design and pleasantness, safety, cleanliness and tidiness, facilities, service charges and functional solutions (Ettema, 2016, Deelen et al., 2016, Kostrzewska, 2017, Barnett, et al., 2017, Chacón-Borrego et al., 2018, Deelen et al., 2019, & Proklamalatu et al., 2021). Studies have found that the areas with more green space, blue space, and sports facilities in their residential neighbourhood as well as liveable environments were more stimulating and invite people to exercise or participate in sports (van Lenthe et al., 2005, Giles-Corti et al., 2005, Mohammed, 2016, Hussein, 2018, Ismael et al., 2019 & Deelen et al., 2019).

Previous studies have revealed evidence for the importance of urban public space as a stage for sport and physical activities. There has no study been conducted to investigate all aspects of creating an attractive urban environment for all in sport. The purpose of this study is to overview the literature on promoting participation in sporting events and physical activities in urban public spaces and identify those aspects including spatial, organization, adaptation, and attractiveness that increase the organizing and practice sport in public spaces as well as introducing new urban agenda can support planners to redesign public space based on it. Also, this can lead the local authorities and non-local organizers or informal participants to organize inclusive sporting events in public spaces.

## 2. The Aspects of Promoting Participation Sport in Urban Public Spaces

Based on overview literature regarding promoting participation in sport in public spaces, this study finds that there are four main aspects that influenced the public space as a staging for increasing and organizing various kinds of sports and physical activities for all, including 1) Spatial integration of sport facilities in city, 2) adaptation of public spaces, 3) organizing and programming sport, and 4) attractive public space environments.

*The first aspect is the spatial integration of sport facilities in urban environments***.** In the past, sport was disconnected from urban planning, which is a missed opportunity to create space for sport and physical activities. Currently, sport is integrated with the modern lifestyle of our urban society. In the last decades, there is a constant growth in sport participation in many European countries. This influenced urban planning, through the construction of various sport facilities and open sports parks in many cities because participation in sport becomes more and more individual. As the market share of memberships of organized sports clubs is decreasing, participation in flexible forms of sports, often taking place in public space is increasing (Van der Roest, 2015 & Borgers et al., 2016). The importance of urban space for sport is increasing and places in public spaces became a stage for major sporting events. That influences how the sport is spatially integrated, with new sport facility typologies and new kinds of public spaces (Kural, 1999 & Valle et al., 2013).

The provision of a varied, safe and accessible sports infrastructure for all groups in society is a key policy focus in many Western countries in order to promote participation in sports and physical activity (WHO, 2011, Christiansen et al., 2014, & Ujma-Wąsowicz et al., 2021). Generally, it is well-established that the availability of facilities in neighbourhoods is one of the most viable strategies to increase levels of sport and physical activity participation (Mota et al., 2005 & Kaczynski et al., 2007). Active sports participants pay more attention to the availability and accessibility of facilities in their neighbourhood than their non-active counterparts (Mota et al., 2005). The availability of facilities combined with flexibility is particularly compatible with new participation styles in sport (i.e. sport light). Hence, the role of such facilities should not be overestimated and calls for critical reflection on the Sport for All policies (Tuyckom et al., 2010; Hajialiakbari et al., 2022; Rafoss et al., 2010; Skille, 2011).

The issue to what extent official and informal sports facilities stimulate participation in sports has been addressed from different angles. Most prominently, one strand of research has addressed the effects of objectively measured accessibility and availability of sports facilities on sports participation and sports frequency (Hallmann et al., 2012 & O'Reilly et al., 2015). Thus, sports facilities should be properly distributed in different urban areas to facilitate their accessibility (Asefi et al., 2020). And, urban public space is a potentially attractive sports facility for many, including both participants and nonparticipants. In addition, due to its flexibility in accessibility regarding time and costs, the public space is also popular among sports participants that combine multiple types of sports. Planners should therefore optimise the adaptation and attractiveness of the public space for sports for different groups of participants (Deelen et al., 2016).

*The second aspect is the adaptation of public space***.** Urban regeneration through leisure and sport has emerged as a critical feature of the post-modern city of consumption, with sports events, sports infrastructure and sports programmes becoming increasingly important in facilitating this (Tallon, 2013 & Larissa, 2016). As well as the process of appropriation of unbuilt or structured spaces in the city by sports activities practised in their spontaneous forms

has been extended, by involving urban areas and areas in a widespread and pervasive manner. Public spaces, which are today open and flexible places, together with a leisure culture (Cognigni et al., 2020).

The availability of open space for sports has become the most important component of a society with a sports culture. Facilities for public or open spaces are required for the formation of a community in order to develop a sports culture. It is hoped that the availability of open space for the community should be designed as well as possible so that the culture of exercising is re-energized, and people can be free to do it whenever they want without any obstacles in doing sports or refreshing in public open spaces (Santoso et al., 2015). In order to avoid dropping out of sports in the longer term, it is important to intervene in infrastructural improvements or modifications of the public space in case inhabitants face accessibility or sports facility constraints (Deelen et al., 2016).

Many urban designers now focus on programming and activity as much as the design of physical space. This means reconsidering the role of the designer as someone who provides the platform on which social activities occur (Southworth, 2014). The new emphasis on designing programmable spaces originates from the pioneering work of Jacobs, Gehl, Whyte and Kent who saw the need to make urban spaces lively and populated (Ivers, 2018). It is reasonable to suggest that urban public spaces should be designed and managed to build sociability, tolerance of others, civic engagement and common purpose. Staging events in parks, streets and squares can help with this mission, by making public spaces more inviting, convivial and dynamic (Smith, et al., 2021). In order to reach vital cities, cities need to be equipped with new innovative tools to be used in urban design and planning (to redesign public spaces linked to sport activities, urban sports, games, and physical exercises) to adequately provide for recreation and sport services and exploit potential social, health and economic benefits (VITAL CITIES BP13 Integrated Action Plan, 2018).

Physical activity is practised outdoors and becomes a way of experiencing the city and its spaces. This trend leads to the creation of structures that integrate with the context, redevelop degraded areas, promote new ways of usage, enhancing existing spaces. One of the most significant European examples, which stems from the need to revitalise an area of high physical and social degradation by placing sport and its power of social inclusion as a subject of regeneration, is the Nelson Mandela Park in Amsterdam, which highlights the role of sport in enhancing the potential (not only physical) of people, and as a mechanism of social cohesion, capable of shaping the public space as a community hub that focuses on the relationship between people and communities (VITAL CITIES BP13 Integrated Action Plan, 2018 & Cognigni et al., 2020). In the conception of sports infrastructure: multifunctionality and inclusiveness are the main drivers of planning and design of an element at the core of urban regeneration strategies in terms of the quality of spaces and people's health. In this vein, the spaces for the practice of sport, both competitive and amateur, are increasingly characterized as an open urban place, both in architectural form and management, multipurpose and multifunctional with the possibility of hosting sports activities of different types and levels (Cognigni et al., 2020).

*The third aspect is organizing and programming sports in public spaces***.** In Sociópolis Valencia the public space is programmed that different sports are possible, such as basketball, skateboarding, circuit training, football and running. This combination of organized and non-organized sports of individual and group activities allows for the exchange between the different groups. In addition, the municipal approach in Valencia shows that a wide range of sports leads to higher sports participation by all residents of the city (Valle et al., 2013). Besides, meeting the users' needs and an interesting design of public spaces is not sufficient to physically activate the urban population. Examples from Great Britain show the significance of social programmes and actions for activating the residents. The English governmental organization Sport England has implemented the "Use Our School" programme, which is considered as a tool to open school sports fields and sports facilities to the local communities. Including them in the public system of sports facilities is much cheaper than building the new ones. They can become a part of the public space and a place for community members to integrate (Kostrzewska, 2017).

In addition, the rising popularity of street-based sport events like cycling and motorsport races meant that citizens were able to engage with a wide range of events staged in public spaces (Smith, 2016). Also, Open Streets as car-free days are community-based programs that promote the use of public space for sports, physical activity, recreation, and socialization by closing streets temporarily to motorized vehicles allowing access to pedestrians (Santoso et al., 2015 & Torres et al., 2016). Similarly, the meanings associated with city parks are attractive to organizers of music festivals, who want to recreate the image and feel of rural sites. City squares also attract event organizers for their symbolic qualities, especially when centrally located and near landmarks (Smith et al., 2020). However, the study has also highlighted potential problems with designing events, particularly the idea that providing events infrastructure effectively determines that space will be used for events. There is a danger that events will become too dominant, overwhelming more mundane uses. This will affect the accessibility of the space for everyday users, dilute its symbolic meanings, and ultimately make the space less attractive to event organizers (Smith, et al., 2021).

Using public spaces as event venues is a complex and contested practice and designers, event organisers, place managers and citizens should engage with it openly and critically. More collaboration with local people about event programming is important, and ideally, more events should be co-produced by local community groups (Jeanes et al., 2019, & Smith et al., 2020). The researcher notes, that event organizers are often regarded as 'invaders', leading to adversarial relations and contested events. To help address these problems, there needs to be more participatory programming and more emphasis on inclusive events. Work is also required to reduce the exclusionary impacts of events. This might include ensuring some free to access events are staged in the facilities installed or allowing community groups to programme some of these events (Wangro, 2018 & Smith et al., 2020). Public open space is critical for the environment, and spatial and architectural design frequently emphasizes urban planning as part of improving the quality of public open space (Ling et al., 2019). One example is the change in function of city parks; the design of public open spaces frequently does not refer to the design, so that the aspirations or desires of the user community; and the design of public open spaces frequently does not pay attention to management and maintenance issues (Santoso et al., 2015). While the management of sports facilities held by private parties can always be kept that can help the government in managing sports open space areas. Also, sport facilities and infrastructures will be better and well maintained. If the management of sport facilities and infrastructures is better, it will positively influence the development of sport to be better and more advanced (DHARMAWAN et al., 2018).

Further, existing research into informal social team sport posits that this form of recreation is better at facilitating democratic civic participation than organized sports (Vermeulen, 2011, Wheaton, 2015, & Jeanes et al., 2019). Participants from diverse backgrounds voluntarily take part and learn not only how to negotiate game rules but also complex interethnic and diasporic social relationships (DeLand et al., 2014 & Wise et al., 2018). Urban spaces designed and managed to achieve more socially equitable outcomes thus creating atmospheres that can ''prime bodies' to be receptive to 'newness'' (Wise, 2016). Beyond bringing people with shared backgrounds together, they may also generate pleasurable feelings towards engaging with and negotiating differences (Wise, 2016).

*The fourth aspect is the attractive public space environment***.** People need public spaces to carry out physical activities and sports. The availability of sport public spaces accessible can encourage people to be fond of conducting the physical exercise. Designers and managers of urban spaces promote the desirability and attractiveness of these as places to spend time (Clare et al., 2018). Promotion of public spaces for sports activities in each neighbourhood there should be at least one suitable and accessible place where people can do sport and recreational activities easily and safely (Chacón-Borrego et al., 2018). Public space is a potentially attractive sports facility for many, including both participants and nonparticipants. In addition, due to its flexibility in accessibility regarding time and costs, the public space is also popular among sports participants that combine multiple types of sports. Planners should therefore optimize the attractiveness of the public space for sports for different groups of participants (Deelen et al., 2016). Even a properly designed space, therefore, is not everything. Sport is present in the cities thanks to active people, not sports facilities. Places of importance for the residents are being created by acting, not only by preparing design plans. It has to be remembered that through its aesthetic and functional solutions (such as convenient accessibility, design and pleasantness, safety, cleanliness and tidiness, facilities, and service charges), design can and should play a great role in motivating and encouraging people to undertake physical activities in public spaces (Kostrzewska, 2017 & Proklamalatu et al., 2021).

Events have been identified by urban designers and urban planners as tools to make public spaces more convivial, interesting, and safe. In addition, events affect host spaces physically and symbolically, but events are themselves affected by the physical qualities and symbolic meanings of host places (Smith et al., 2017). Animating public spaces via events can also diversify the uses and users of public spaces (Smith, 2017). Policymakers increasingly recognize that the built environment can function as an important condition for active living environments. Municipalities aspire to design cities that encourage people to be more physically active (New York City, 2010, Sallis et al., 2016, & Gadais et al., 2017). In addition, perceptions of the physical environment, including perceived safety and attractiveness, are related to sports participation (Kamphuis et al., 2008 & Beenackers et al., 2011). For example, running has become one of the most popular and practised sports and it is a well-known phenomenon in the urban streetscape, public parks and natural areas. Both scholars and policymakers increasingly have become aware that an attractively designed public space may stimulate sports participation including running. Studies have found that perceived environmental characteristics, particularly green and lively running routes and a comfortable running surface, enhanced runners' evaluation of the attractiveness and restorative capacity of the running environment (Ettema, 2016 & Deelen et al, 2019).

In addition, the areas with more green space, blue space or sports facilities in their residential neighbourhood were more likely to participate in sports. Neighbourhood blue space in particular was associated equally strongly with sports participation at public spaces, sports clubs, and other sports facilities (Deelen et al., 2017). Those natural environmental characteristics (i.e., green and blue space) are related to sports participation is in line with previous research that showed that attractive and liveable environments stimulate and invite people to exercise or participate

in sports (Giles-Corti et al., 2005, Mohammed, 2016, & Hussein, 2018). These four aspects are very important and work together to promote participation in physical activities and sports in urban public spaces as well as applying to a new public space in order to create an attractive environment for all and can invite various sporting events.

**3. New Agenda to Promote Sport for All in Urban Public Space**

Previous studies have revealed evidence for the importance of urban public space as a stage for sport and physical activities. Further study needs to look at all the following aspects more deeply as a package that contribute to creating an attractive urban environment to increase participation in sport for all in urban environments that can address the barriers and needs to organize and practise sports and recreation in urban spaces.

*Spatial integration of sport facilities in urban environments***:** new design and policies required for the integration of physical aspects of sports facilities by customization sports as an urban meeting place, to decrease or obviate inequity in access to outdoor sports facilities and increase sports inclusivity that should be acknowledged the concept of sport for all that be able to address the barriers and needs in sports and recreation spaces.

*Adaptation of public spaces***:** further studies on sports open spaces should be conducted to examine the people's changes, adaptation, and flexibility toward open sports spaces because some public spaces cannot be maximally utilized for the reason that the design is not adjusted to possible changes. As well as various forms of programs and attractions should be developed to revitalize "sport for all" through inclusive design to encourage all to participate in various sport activities. Public space may need to be adapted through inclusive interventions to accommodate different activities.

*Organizing and programming sport*: increasing the organizing and programming of multi-sports and physical activities to target all different groups in public spaces and allows participants from diverse backgrounds voluntarily take part in how negotiating game rules. In addition, collaboration with informal groups and multiple agencies in organizing sports can promote participation people in sports. It requires a deep examination of how and under what circumstances various dimensions of safe space might be applied to cultivate those situations as well as contribute to stakeholders' perceptions of rising opportunity to provide a safe space for tourism and marketing purposes through organizing sports and events. And indicates a growing need for flexibility in the spatiotemporal organization of sports activities and the increased importance of the public space for sports participation.

*Attractive public space environments*: Increasing attention to making public spaces more attractive and suitable for sports participation by redesigning public spaces with a focus on enhancing the diversity, usability, and functionality of contact with natural areas including green open spaces, and blue spaces which is a key to attractive destinations for a range of recreational users and increasing participation in organized sports. Policymakers should investigate the motivations that different groups of (potential) public space participants have for sports participation and for the use of specific locations. In addition, an event organizer to create a strategy to increase the number of visitors to the local regular event through event image.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Theater, Space and Place Making in North-East Bangladesh

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**Abstract**
Although Theater activities inject a significant effect on outdoor public affairs, local urban planners do not sufficiently consider such impact while designing a new civic theater in Habiganj, a growing sub urban district of Bangladesh. Incoherent theater buildings in such urban areas fail to engage people with theater at large, in consequence, the act of theater remains incomplete. The research was conducted through a semi structured interview, social demographic data analysis, case studies, technical aspects and literature survey providing the anthropomorphic image of a theater as an embodied space, elementary spaces of theater and affordable & inclusive theatrical form as major findings. A regional model is driven from the research for local theater (different types of performing spaces) practice that can guide future municipal theater planning for theater to sustain among society & people.
**Keywords:** Public spaces, Theater, Elementary spaces, Anthropomorphic image, Architectural intervention Regional model.

## 1. Introduction

The term "theatre" encompasses both dramatic performance (performance) and the physical structure (architecture) that houses that production. As an art form, theatre contains the theatrical artifice of transient events that employ ephemeral materials such as gesture, light, and sound alongside disposable elements such as costume, prop, and setting; as a built form, theatre provides a stable environment designed to endure beyond the transitory events it houses. [1] For years, theatrical space evolved around a fundamentally distinct principle: a theatre was a site of human conversation. The audience did not sit, gaze, and listen passively; it took part in the performance—the experience was shared—with actors and members of the audience interacting. [2] Syed Jamil Ahmed (2022) stated that in this region, which is primarily deltaic, theatre and performance spaces referred to contextual and core performances presented in democratic and extremely flexible settings such as open, semi-open (Nat mandir), or robust arenas. Additionally, he stated that our ancient theatre ancestors were primarily farmers and other wage earners, which has changed throughout time. With the impact of Europe, the embodiment of theatre and performance became exclusive and belonged to a certain class of people in society, limiting the outcome and scope of theatre in this region. The theatrical space of experience, as well as theatre's place-making, have been transformed by economic and industrial modernization, and have largely lost their fundamental social and political purposes, which are primarily to serve the underprivileged sections of a society in a third world country. [3] According to several widely accepted practises in academic and professional circles, the fundamental aim of place-making appears to be the regeneration of crucial urban areas through the redesign of public space with the active participation of local populations. Recent research indicates that place-making has the potential to be an innovative and potentially independent field, competing with more established disciplines such as urban planning, urban design, and architecture. [4] This paper focuses on outlining the anthropomorphic image of theatre in this region by revising and re-visioning the scale, form and image of local theater masses and examining them in their current and previous forms, which may help in enhancing the decision-making process for future cultural development planning by providing context of the local lifestyle and pattern of cultural attributes, as well as exerting a positive influence on the physical settings of the local area.

## 2. Industrial Development and Morphology of Theatrical and Cultural Landscape

By and large, cultural landscape studies have stressed the relationship between natural settings and human-made interventions. However, cultural landscape methods for studying places and people's shaping of them have tended to emphasise the physical rather than the political dimensions of places, focusing on rural, pre-industrial landscapes, vernacular house types, and patterns of cultivation, while dealing with different ecology but avoiding political discord [5]. Syed Jamil Ahmed (2021) mentioned that a region's theatre and cultural activities evolve in response to its geographical, economic, and social orientations and constraints. Theatrical and artistic activities developed in this region around its level terrain, floodplains, impoverished population, and folklore. As a result, indigenous people produced, appreciated, and promoted old theatre in more democratic settings with few spatial boundaries. The fact that community boundaries are mostly symbolic does not mean that they indicate diverse meanings for different

people. Additionally, it implies that some individuals may see boundaries that are completely imperceptible to others. [6] According to structural elements, the ancient theatre and cultural environment is composed of a few natural and materialistic components, such as: a stage, monoliths, and roof, connected passages for artists, circular or rectangular areas for the audience, and organic spaces for the performers. The key tendencies in Bangladeshi theatre nowadays can be broadly classified as i) rural-based indigenous theatre and ii) urban-based non-professional socially and artistically involved play. [3] Bangladesh's indigenous theatre is rooted in the legacy of Indian subcontinental theatre practise and dates back at least thirteen centuries. On the other hand, urban theatre predates the 18th-century British occupation of the subcontinent. [3] The indigenous theater and cultural practices of Bangladesh are people orientated and the structure, space and their place making were also deeply humanitarian. But with time the planning of cultural spaces has become homogenous and exclusive at the pressure of industrialization and globalization which has caused the greater part of the crowd averse towards theater and cultural practices. The present planning of theater and theatrical buildings also disregard the indigeneity of the regions that fails to promote or in cases house the local cultural performances. The transformation phases of the theater and cultural performances transforming into modern theater practice in this region are depicted below.

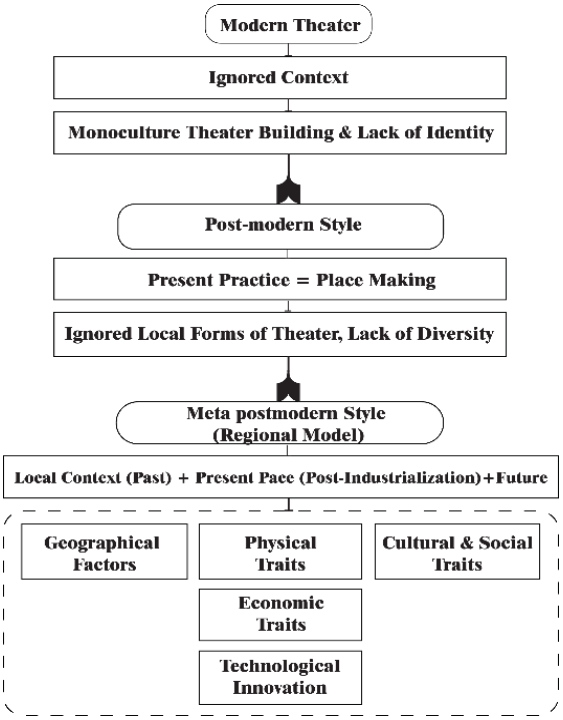


**Figure 1.** Structure of the Study (Developed by Author).

**3. Material and Methods**

The study on the cases of theatre spaces and placemaking creates a guideline for developing a methodological framework by including the site environment and the study's goals. The study essentially has three major goals: (1) to exhibit and promote the natural and cultural settings of local theatre; (2) to outline the picture of the anthropomorphic image of theatre in this region; and (3) to provide a future management guideline for Cultural planning.

To attain these objectives, a conceptual methodological framework has been developed for this project. First, theoretical analysis is used to justify the town's contextual theatrical significance, and then an action plan is developed based on an on-site survey and questionnaire survey, in which visitor experience objectives are identified through value identification mapping and value analysis of the study area. The following step was to recognise the identified assets, which resulted in a structured outline of anthropomorphic theatrical resources that can effectively convey the region's story. By the end of the study, we may have established an existing sense of connection or link of the most prominent elements of the local theatre, which can be reinforced through municipal development planning.

The comprehensive research was carried out in the following stages:

1) The figure comprising the study area's figure ground map and its connectivity with the cultural zone was obtained from the relevant institutions.

2) The traditional procession and dance-music-based theatrical performances that comprise the cultural landscape, values, historical structures (Temples, Nat mandirs, Banyan tree plazas, etc.), demographic structure, and cultural texture of the study region were obtained through a review of pertinent publications and official documents.
3) The methodology for this study for measuring urban dwellers' cultural values and preferences and merging them with the planning specialist's competence, so more accurately portraying all points of view, is determined by the audience's perspective. The authors regarded the local community or habitats that live or work in the area, as well as tourists and visitors that frequently visit the area, as their audiences. The questionnaire survey was administered to 100 members of the community and guests, as well as seven members of the theatre profession. A data collection form was created to assess existing heritage resources through the identification of cultural values. Oral data were gathered by inquiring about the current theatre scenario, practising facilities, physical and structural characteristics, infrastructure and spatial conditions, cultural activities and industrial development, population and population movement in the area, educational, sociocultural, and economic conditions of the area's residents, their customs and traditions, performances from the past to the present, and folkloric characteristics. Thus, the cultural landscape's contributions to the area's inhabitants were determined. Additionally, the interventions, notably the human ones, that altered the setting of theatre practises and their influence were questioned.[7]
4) To highlight the values of the area's indigenous culture, oral data obtained via information forms was analysed. A variety of factors were considered while evaluating the cultural background. This information was collected from a survey of the literature. Apart from that, several other aspects were considered, including the region's historical value, as well as the area's current historical-cultural components and spaces, as well as religious sites. Due to the presence of these characteristics in the study region, a qualitative evaluation was conducted. Qualitative study was conducted due to the region's continual dissemination of cultural values. Six cultural values were identified during the area's inquiry. There are four types of values: aesthetic, cultural, scientific and social values.
5) In light of the data gathered during the final stage, some guidelines were developed to demonstrate how the study area's cultural values operate effectively in the context of theatrical performances.



**Figure 2.** Monocultural Structures End up creating a Shabby Town and Lack of Sense of Place for People.

As a result, decreased social engagement and communication, comfort, and identity led to an increase in social conflict, criminality, and other infractions in urban areas where people were losing their sense of place.

**4. Postmodern Trends of Theater**

The post-modern style of architecture and urban forms is currently being used by municipalities and architects to try to revive a city's identity (Harvey, 1989). As a result, architects have made an effort to integrate elements from the past with those from the contemporary. Cities utilize local culture and traditional characteristics to build a feeling of place in the built environment. To improve the quality of life in a more conventional setting, post-modernists advocated using urban planning and construction methods. Some significant signs like the coming crisis of identity, the expected repercussions like an ageing population, and some of the most fundamental human needs are overlooked by the style of design, which lacks long-term vision. The postmodern style, on the other hand, led to a decline in design originality and creativity. According to Jamil Ahmed (2020), the style is inadequate in our environment because it relies on empirical and European knowledge of space and place creation. The lack of long-term vision causes urban incoherence, the loss of time-old traditions and anthropomorphic methods, mass communication, and social segregation in the cities. However, despite their efforts to incorporate cultural and social events from both the past and the present, designers were unable to achieve their goals due to a lack of contingency

analysis. The study will bring a creative approach to a new style of design by emphasizing the importance of creating sustainable theatres in the research area while maintaining a critical balance between the past, present, and future.

**5. Current Homogenous Approach of Theater Planning**

Environmental, social, and economic forces all work in concert to ensure a long-term future for the environment (Newman, 2002, Amen,2021). In contrast, the World Commission on Environment and Development (1987) defined sustainability as the ability of the current population to meet their own needs while also meeting the fundamental needs of future generations. As a result of this comprehensive examination, sustainable planning may be defined as raising quality of life for future and current generations without compromising the sense of place for present people. It's hard to find rehearsal and experimental space, let alone traditional or anthropomorphic theatre in the modern, uniform theatre planning in Bangladeshi cities, which includes large town halls with a variety of services on the ground floor, proscenium theatres, and seminar rooms.

**5.1 Theater Formation and Morphology of Anthropomorphic Theater In North-East Bangladesh**

According to Shree Brojendra Nath Bandopadhyay (1943), the earliest Bengali theatre was a foreign import. It had nothing to do with the country's enthusiasm or taste. As a result, this could not be permanent. There is a forty-year gap between the establishment of authentic Bengali theatre by Bengalis and European theatre. These forty years have marked a pivotal point in Bengali history. Until then, Bengalis were content with Jatra, Panchali, Kavigan, and Half Akhrai, among other forms of entertainment, and no new European form of entertainment became relevant.
Syed Jamil Ahmed characterises ancient North-East Bangladesh in his writings as a theatre space in which royals serve as producers, local theatre enthusiasts serve as directors, and farmers serve as actors-viewers-stage staff. As a result, the architectural environment in this spirits' basin is a spatial composition constructed to suit a shared narrative.

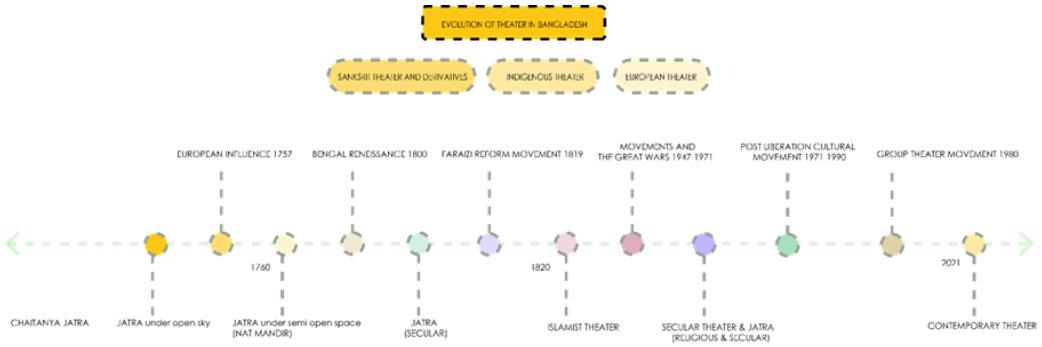


**Figure 3.** Historical Framework for Theatre.

Having established the historical framework for theatre in this region, this study will now seek to explore the indigenous theatre of the study area. 'Indigenous' refers to something that is 'naturally born or created in a land or region'. [8] The term 'theatre' refers to any action performed in three dimensions by an individual or a group for another individual or group.
On the basis of this understanding, the following figure depicts the transformation of morphological theatrical space in North East Bangladesh:

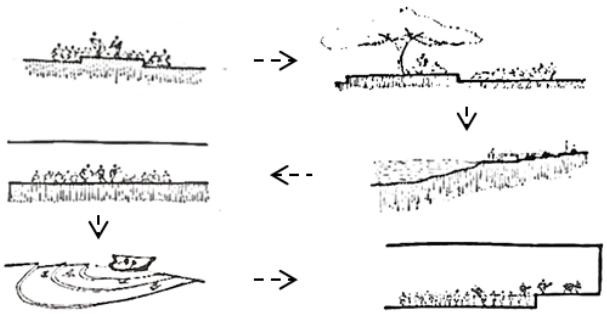

**Figure 4.** Transformation of Morphological Theatrical Space in North East Bangladesh.

This graphic depicts the progression of a theatre space as understood in the western world from its primordial stage of an open space that serves as an inspiration for theatrical productions to its pinnacle in the shape of a techno-expressive architectural design. This diagram illustrates how there is a current trend to bring theatre works out of their techno-physical shells and into a new investigation of spaces that can inspire and provide meaning to theatrical works in ways that were previously unimaginable.

It can be seen from the diagram that the theatre space in North-East Bangladesh has never experienced the articulation of its spaces in the same way that theatre space in the west has. What has changed in this region is the relationship between actors and audience members, or, to put it another way, the modification of the audience's relationship to the theatre performance. According to the sources we have, the first real Bengali plays were adapted from the Shri Chaitainya Jatra, which took the form of a parade. From open-air theatrical performances, our region's theatre has embraced a variety of venues influenced by diverse movements and invasions by other administrations. As a result, we studied and embraced indoor theatre approaches. The reason for our theatre style, which is based on minimum and vernacular settings, may be understood in terms of geopolitical and economic contexts.

**5.2 Anthropomorphic Image of Theater and Audience Engagement**

The anthropomorphic image of theatre is one that is shaped by a community's indignity. The settings, structure, and infrastructure that draw an indigenous audience to a theatre are generally referred to as the anthropomorphic image of theatre in this study.

In Greece (as the birthplace of European theatre) and Rome, the proscenium stage and the hill-carved amphitheatre serve as an anthropomorphic representation of their theatrical practises. On the other hand, the Nat mandir and the Banyan Tree shadow on the Indian Subcontinent serve as anthropomorphic settings for theatre practise.

**6. Results**

**6.1 Identification of Cultural Values in the Study Area: A Case Study of Habiganj, Sylhet**

The study selected the Habiganj and its surrounding area (Figure 5) as a sample of “North -Eastern Bangladesh” which is located at Habiganj, popularly known as the Industrial Area of Sylhet.

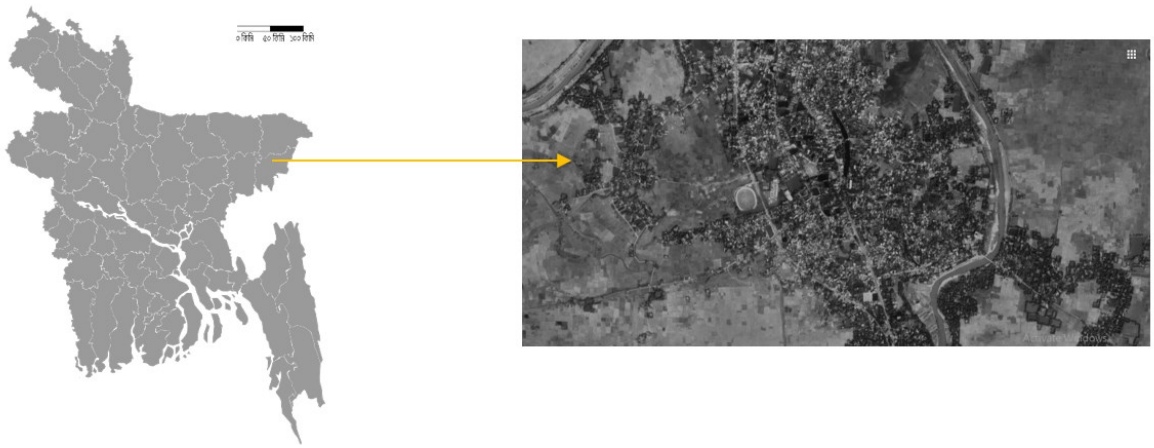

**Figure 5.** Map Showing Study Area (Habiganj).

**Habiganj** (Bengali: হবিগঞ্জ, Romanized: *Hobigonj*), formerly known as **Habibganj** (Bengali: হবিবগঞ্জ, romanized: *Hobibgonj*), is a district in north-eastern Bangladesh, located in the Sylhet Division. It was established as a district in 1984 as a successor to its *subdivision* status since 1867. Habiganj is a developing district in the country, with a population of around 20,00,000. The city has a significant history with education and culture.

Habiganj is well-known for its folk literature and culture, and there are numerous groups dedicated to fostering cultural and social activities. Clubs, libraries, theatrical groups, women's societies, and literary societies are only a few examples. Additionally, the region contains almost 1,300 mosques, 176 temples, and two churches.

Habiganj is a district in the Sylhet region of Bangladesh that has developed into a thriving hub for all activities relating to trade, manufacturing, economy, and electricity distribution. Additionally, this area has created a unique array of ethnic groups that are inextricably linked to ethnic lifestyles. Historically, they were largely uneducated labourers from impoverished communities.

Using their shared norms, beliefs, and practices, this energetic group of people has transformed themselves into a new style of cultural practice and developed a homogeneous and radical pattern, from which they have derived their current sense of self as a community.

The initial phase in this research is to identify the intangible cultural resources that exist within the Habiganj cultural environment. The following map depicts the cultural resources that have been discovered, which was created by compiling data from Google Earth and integrating it with a physical survey that included interviewing 150 people from the local population and visitors, as well as 7 persons from the theatrical industry.



**Figure 6.** Map Showing the Existing Performance Spaces in Habiganj. (Developed by Author)

### 6.1 Value Analysis

According to the findings of the audience perception survey, the identified and noteworthy heritage cultural performances are sorted into categories as shown in the following table. In the first instance, the value elements were classified into seven groups. They embody the rasa (essence of an art form): the pathetic, the devotional, the heroic, the comic, the furious, the erotic, and the peaceable. Based on the information in Table 1, all Heritage Cultural Performances can be split into two distinct categories. They are the values of the traditional acts that are either secular and religious in nature.

**Table 1.** Table Showing the Aesthetic & Anthropomorphic Values of local performances in the study area.

| performances (related to) | pathetic (karunya) | devotional (bhakti/madhur) | heroic (vira) | comic (hasya) | furious (roudra) | erotic (sringara) | peaceful (santa) | time of the year | Secular | religious |
|---|---|---|---|---|---|---|---|---|---|---|
| siva & parvati dance | | ✓ | ✓ | | | | | chaitra sangkranti | ✓ | ✓ |
| dhamail | | | | ✓ | | | | programs | ✓ | |
| marsia jari | | ✓ | | | | | | muharram | | ✓ |
| bhatiwali gaan | | ✓ | | | | | ✓ | festival | ✓ | |
| jatra | ✓ | | | ✓ | | ✓ | | festival | ✓ | |
| kirtan | ✓ | | ✓ | | | | | festival | | ✓ |
| karbala legend | ✓ | | | | ✓ | | | muharram | | ✓ |
| kumari puja | | ✓ | | | | ✓ | | durga puja(sharat) | ✓ | ✓ |
| bhatu gaan | | | | ✓ | | ✓ | | festival | ✓ | |
| rasnritya | | ✓ | | | | ✓ | ✓ | ras purnima | ✓ | ✓ |

The result of the audience perception study demonstrates that all tangible heritage pieces have substantial aesthetic and geographical significance because of their scenic beauty, as well as making major contributions to anthropological and vernacular architecture research areas.

The audience was quite interested in hearing their thoughts on the Valuable and Rare Cultural Values of Theater, and they were interested in sharing their thoughts. Their perspective is that the most significant Tangible Cultural components are found in the town's central public area, which is where the majority of the people congregate. The "Nat Mandir" has the greatest number of values of any of them and may be considered one of the most important "Cultural Icons" of theatre, as the theatre scholars who were interviewed reiterated as well. When it comes to Cultural Centre, the living style, the sense of worship, and its rituals have all been acknowledged as having higher cultural worth than physical cultural heritage. The rural and contextual theater of this region is mainly Giti Natya (Songs and Dance).

**Table 2.** Table Showing the Character and Spaces of local performances in the study area.

| Performances (related to) | Character of the Play | Community Space of performances | Building Structures of Performances |
|---|---|---|---|
| *Shiv Parvati Dance* | *Procession, Dance & music* | *Courtyard, Street* | |
| *Dhamail* | *Songs and dance* | *Community program* | |
| *Marsia Jari* | *Songs and Waz* | *Community Field* | |
| *Bhatiwali Gaan* | *Songs* | *On boats and by rivers* | |
| *Jatra* | *Folk Theater* | *Open Air* | |
| *Kirtan* | *Recitation, Narration* | *Household programs* | *Nat Mandirs* |
| *Karbala Legend* | *Procession, Re-enactment of Karbala Battle* | *Streets* | |
| *Kumari Puja* | *Ceremonious worship* | | *Mandirs* |
| *Bhatu Gaan* | *Songs and dance* | *Community program* | |
| | | | |
| *Ras Nritya* | *Indigenous dance* | *Monipuri Para* | |

## 7. Discussion

### 7.1 Evaluating the Existing Elements of Local Theater Spaces in the Neighboring Areas of the Study

Tea local contextual theatre is being introduced as part of a living cultural legacy, and its significant values are being identified in this study, which is a preliminary method. Conserving the current harmony between forms and practices has the potential to protect the social and built eco-system as well as the spatial coherence of the area. Because of the existing network of cultural landscape resources in the research region, it is feasible that it will serve as a vehicle for the advancement of economic development if it is promoted by supporting cultural tourism and presenting cultural heritage (Amen & Nia, 2020). Ancient history, geographical location, and cultural customs all have an impact on it. Sustainable cultural planning encourages appreciation of the local forms of theatre and other activities such as visiting famous actors and nostalgic Spaces, demonstrations of theatre production, participating in local ceremonies and cultural events and sustain the cultural context in the midst of recurring hegemony.

In this study, the spatial structure of Theater spaces has been studied; cultural resources are identified and then classed according to the value typology and user perception. Theater orientation can be understood as a multifaceted depiction of local narratives and scriptures.

### 7.2 Regional Model

In order to get started on this research project, a comprehensive grasp of the primary concepts of nature-human interaction and a conceptualization of the theatre culture in and around the regions were produced. Following the presentation of the situation of the research region at the time of writing, a preliminary evaluation was carried out in order to identify the initial issues. In addition, engaging in conversation with others who live nearby is helpful in determining the true nature of the problem at the place. At the same time, a large number of pertinent papers, journals, and articles were analyzed and examined in order to determine the issue. The zoning was established in order to produce a public-oriented complex while preventing significant constructions from becoming off-centric and heroic. Therefore, as a result of our efforts, we have developed a set of guidelines that should be adhered to when planning a theatre building or complex in the study area. These guidelines include the incorporation of outdoor and semi-outdoor space, Banyan tree plazas, intermediate space incorporation, horizontal expansion if feasible, configurable halls, free and fair entrances, and all of these features should be sculpted around an unheroic scale.

## 8. Conclusion

Cultural cohesiveness and spatial structure of theatre is a self-sustained and organically produced variation that was formed and impacted by the inhabitants living in it. Theater (Giti Nritya), it- self has potentials to be regarded as valuable cultural resource. However, these important types of theatre are being overlooked as a result of a lack of ingestion. Sustainable Conservation management of Cultural planning\s can bring people together to be conscious about their collective identity and legacy, and create a shared local vision within a global context. Involvement of the local community helps help bring back the process, as they are the most effective keepers of the cultural legacy [10]. This paper is a primary initiative that explored for the heritage forms and values in the existing theatrical cultural landscape in Habiganj in North East Bangladesh, which can help to realize the importance of protecting this valuable

heritage and also can serve to guide detailed culture management planning and designs. Therefore, the successes of this study could also contribute to strengthen the conservation systems of dwindling local traditions.

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**Conflict of Interests**
The authors declare no conflict of interest.

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# Vegetation and Its Impact According to User's Perception: Case of North Land Use Plan of Guelma City

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**Abstract**
The vegetation takes a primordial place in the reflection on our urbanity for the balance of the ecosystem. Guelma, attractive Mediterranean city, by the picturesque character of its site, incites to discover it from the inside to better understand its urban landscape. In this same regard our study focuses on the north land use plan of the city. Today, the city is characterized by accelerated urbanization, which leads to the consumption of natural resources. One of the consequences of these phenomena is the deterioration of green substrates, by fragmentation of natural environments and agricultural areas. The objective is to show the role of vegetation in the satisfaction of the users of north land use plan of Guelma city, this can only be done through a survey of the various users of this city. Finally, recommendations dedicated to the proposal of the implementation of ecological planning to the management.
**Keywords:** Vegetation; users; perception; Guelma city; northland use plan.

## 1. Introduction

The word vegetal element is found in various fields and each time takes on a different meaning depending on the discipline. In the humanities in general, and urban planning in particular, plant elements meet the definition of natural space, with regard to the new vision of the city as an ecosystem in its own right (D.U.V.I.G.N.A.U.D.P, 1974). In the imagination of urban planners, there is no doubt that vegetation brings more comfort and happiness to the inhabitants. It is clear: it creates an atmosphere, brings society together, filters views, welcomes wildlife, individuals like to feel the physical presence of leaves, the coolness brought by shade...

However, these are the feelings of space specialists, which does not prevent us from looking at other feelings experienced by city dwellers (Olivier BALAŸ, & J.-L.B, 2013). For them, the perception of plants is inseparable from the aesthetic perception of their habitat. Therefore, the planting of vegetation, which is necessary in a city that will be wetter and more walkable than today, cannot be considered only from its visual impact or its climatic role. It must also be thought from the ambiences offered for the uses, for example from the public space and from housing to live, work, circulate, and recreate well (Olivier Balaÿ, 2012; Adedeji et al., 2018; Nia et al., 2017).

Neighborhood as a location of the built environment refers to a small part of a city or suburb that provides housing and related services to a smaller percentage of the resident population. In other words, the community can be studied in terms of the density of the resident population, which can range from 2,500 to 25,000 residents, with sizes up to 30 acres (Agboola, O. P et al, 2018, Aziz Amen & Nia, 2018).

The accelerated growth of urbanization over the past decades is leading to a deterioration of the balance between vegetation and impervious surfaces in cities due to the demand for social rent. The biggest challenge is the adequate supply of green spaces and their even distribution among the inhabitants. According to the "*Land Use Policy Framework", the amount of green space per inhabitant in urban areas (10 m²)* (Tok, E et al,2020).

In addition, a multitude of studies have been initiated to address neighborhood-related issues, namely: a greater sense of resident involvement, increased social exchange at the neighborhood, improved safety, reduced environmental pollution, and reduced neighborhood health risks (Francis et al., 2012; French et al., 2014; Middleton, 2010; Bonilla 2013; Peter et al., 2010; Song &Knaap, 2003; Broadbent, 1990, Amen,2021).

Unlike traditional planning methods, based solely on socio-economic concerns, which underestimate the biophysical environment: soil, fauna, flora, landscape, etc., ecological planning calls on knowledge of the norms of the material environment so as not to lose the great natural balances (F.A.L.Q.U.E.M,1972).

The diagnosis of the ecological quality of neighborhoods is generally based on a diagnosis of the daily functions of users, which are the basis of architectural and urban values: These are the values of well-being, awareness, landscape, and satisfaction.

## 2. Material and Methods

Our research work integrates these three elements:

1. Residential neighborhood : l'environnement où se passe le phénomène physique, bâti d'interaction (bâtiments, infrastructures, mobilier...) et naturel (parcs, végétation, plans d'eau,...).

2. The actors: A user who regularly perceives and experiences a set of physiological phenomena in this environment.
3. The scenario: it consists in defining in advance the qualities of the vegetation element, in order to think about a new concept that integrates to the maximum the respect and the preservation of the vegetation, where the survey by questionnaire is presented as a tool of choice to achieve this integration. Two tools for the action of this survey are: the questionnaire and the users.

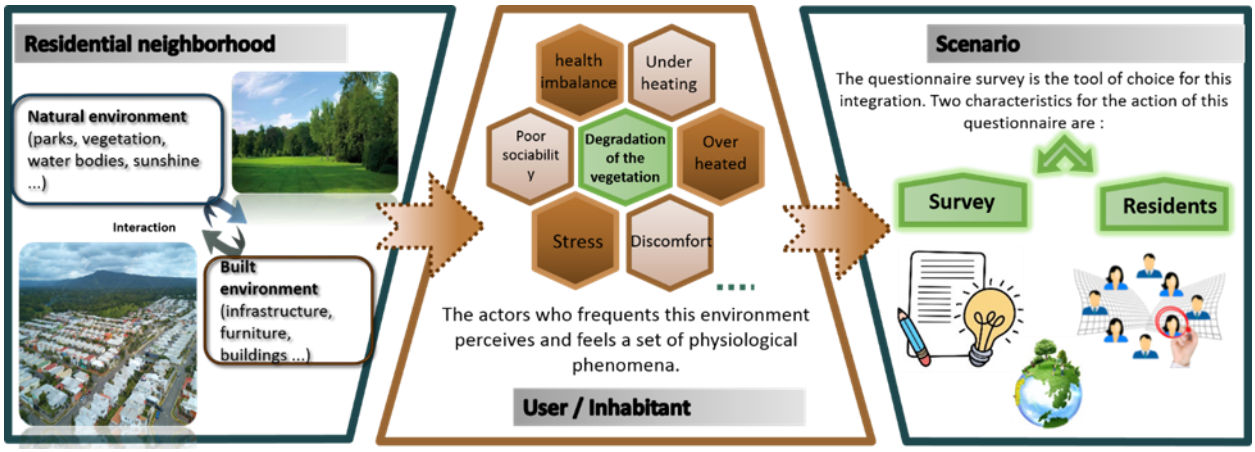


**Figure 1.** Structure of the Study (Developed by Author).

### 2.1 Case Study

The objective of this study is to show the socio-psychological effects of the green areas in residential neighborhoods through the perception of users. Where the northland use plan "POS NORTH" of Guelma city has been chosen for this application.

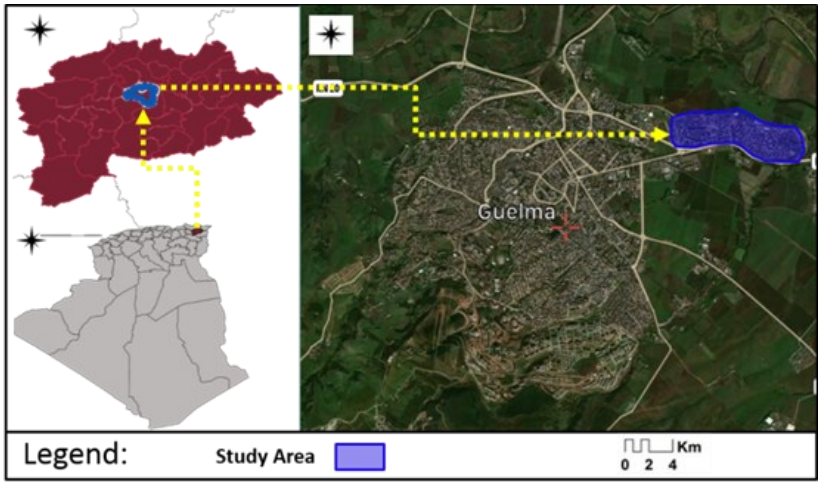


**Figure 2.** geographical location map (Developed by Author)

- **Geographic location of the city:**

The state of Guelma is located in the Northeast of Algeria.

- **Geographical location of the neighbourhood:**

Our study area, which is the northland use plan "POS NORTH", is located north of the city of Guelma.

### 2.2 Method

Green spaces are always considered as an index of environmental quality in urban areas. To this end, the analysis of the role of vegetation in the neighborhood consists of a set of evaluation criteria and sustainable indicators.

In this respect I have the four functions of the city: live in, move, work, recreate as criteria, and the values As indicators which are the reactions of the users which are:

- Value of the quantity and types of vegetation
- Recreational value
- Landscape value
- User participation value

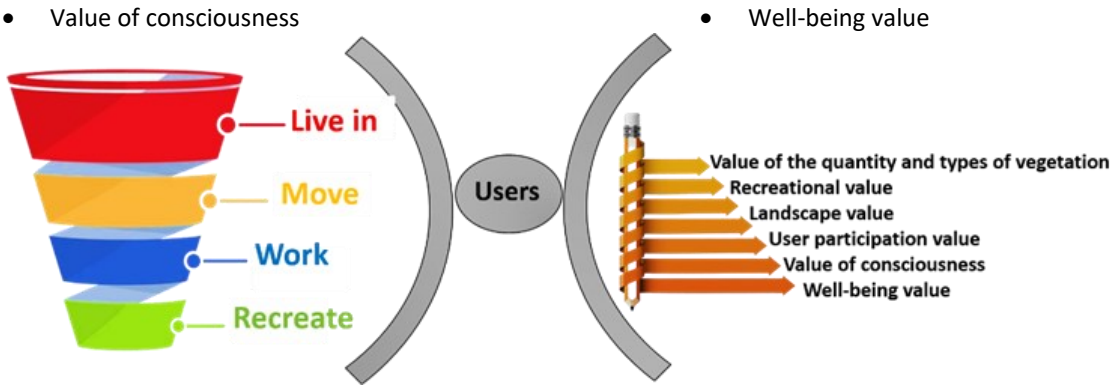


**Figure 3.** criteria and indicators diagram (Developed by Author)

### 2.2.1 Data collection

A survey was developed to determine the psychosocial impact of urban green spaces and the satisfaction of residents. North Pos area population in 2019 was 6,500, according to APC. Therefore, 363 surveys were conducted with a sample size of 5% and a confidence level of 95%. , and met face-to-face and on the line, in French or Arabic. The number of surveys conducted in the neighborhood is determined by the demographic measure (Tok, E, 2020).
The questionnaire includes a number of question types grouped under three categories, including recognition of residents, measurement of environmental value, and participation in the management of community initiatives. The evaluation criteria are derived from the Public Space grid (Zaid, 2015), whose detailed criteria are well-being, awareness, landscape, and satisfaction values.

**Table 1.** The indicators used to estimate environmental values.

| **Distribution Modern Design** | |
|---|---|
| *indicators* | *Questions* |
| Well-being value | Is there any vegetation in your neighborhood?<br>In your opinion, what is the percentage of vegetation compared to the built-up area in your neighborhood? |
| Value of consciousness | Have you done any private initiatives in your neighborhood?<br>Do you consider vegetation in the city: unavailable, optional, not important? |
| Satisfaction value | How would you rate your neighborhood?<br>How satisfied are you with your neighborhood? |
| Landscape value | Do you like the complete removal of this vegetation to build your neighborhood?<br>What are the issues with vegetation in the neighborhood? |

## 3. Results and Discussion

### 3.1 Well-Being Value

The question asked about the value of user wellbeing, the percentage of greenery to the built environment in the neighborhood, and problems with degradation of the green cover. 239 people responded negatively to the question of whether they had a lack of greenery (see, Figure 8). Based on the survey data, the users (239 people "66%") who affirmed the lack and degradation of vegetation in their neighborhoods were used as the main group to determine user profiles, satisfaction, and psychosocial impact of green cover. This initially reflects the lack of harmony in the relationship of the inhabitant with their environment in this neighborhood. Thus, the social demand for green planning increases.

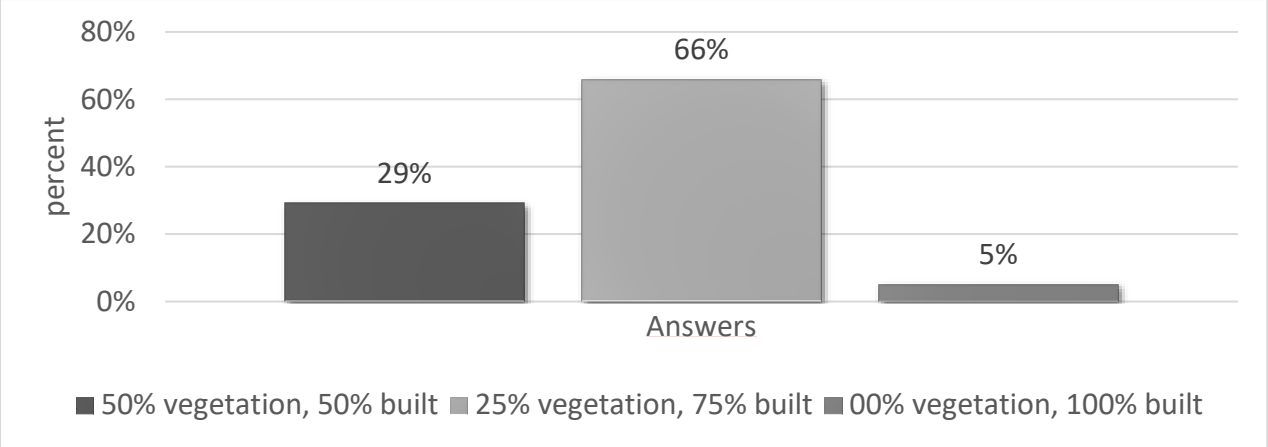


**Figure 4:** Analysis of the value of the well-being of the vegetation in the neighborhood north land use plan in Guelma city.

Indeed, it consists in appealing to the two criteria, namely the political criterion and the criterion relating to the relation of the man with his environment, by intervening at the same time on the subject that is the citizen of the city and on the object that is the urban green space.
Increase environmental awareness: Only awareness and increased knowledge can influence behavior. Education, including school-based education, public awareness, information and training, is essential to promoting the presence of nature in cities and increasing awareness levels. These actions are essential to change attitudes so that individuals have the ability to assess and act on the environmental issues around them.

**3.2 Value of consciousness**

This is illustrated by two diagrams (Fig.02). These two questions answer the general points, they verify that the residents are aware of the importance of urban vegetation and its different proximity services. 80.20% and 69.80% of the residents of the surveyed communities think that, therefore, the residents consider the green space as an essential component in the neighborhood. But the residents declare the management responsible to only one actor, the State. For this, it is necessary to establish a process of awareness of values.

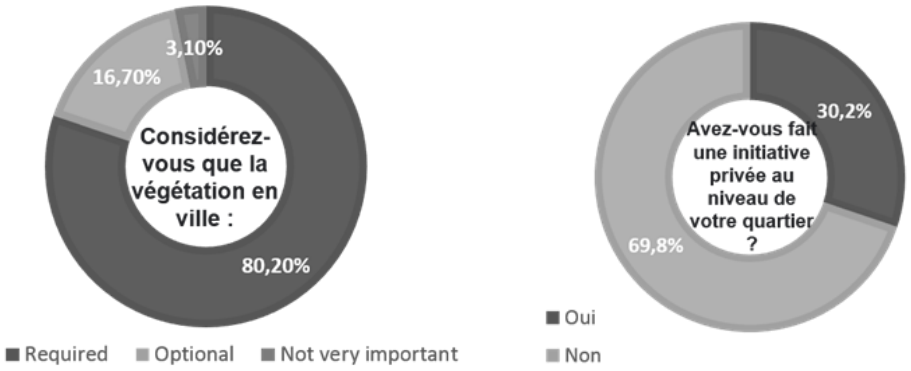


**Figure 5:** Analysis of the value of vegetation consciousness in the land use plan of the northern district of the city of Guelma.

A number of questions remain regarding the local management strategy of these elements in the City of Guelma, which leads us to make the following recommendations:

- Organize the agencies specialized in the management of green spaces by identifying the roles of each agency and mobilizing them ;
- Continuous training of staff through the ongoing development of materials, machines and management methods ;
- Facilitate public networks to share experiences,
- Strengthen the work of environmental protection associations to raise public awareness and encourage the creation of new associations related to green spaces to broaden the scope of all those working to protect these spaces; - Create a public environmental agency modeled on the city's ecological agency to

guide the development of green spaces in Paris, coordinate the dynamism of the entire system of urban actors and accompany the environmental changes in the territory; - Citizen participation and involvement in the various development efforts to ensure their satisfaction;

**3.3 Satisfaction value**

The results of the satisfaction value in the diagrams "figures 3" show that the respondents were generally dissatisfied with the condition of the green space in the whole sample. To this end, it can be seen that society has an increasing demand for natural places. These shortcomings are the result of poor planning and design of green spaces and a lack of resources to maintain these green spaces. A very inefficient governance model, as the different actors do not really play their roles separately, and they are poorly coordinated. The Association for the Protection of the Environment of the Province of Guelma has not been able to carry out its advocacy mission because of its low profile.

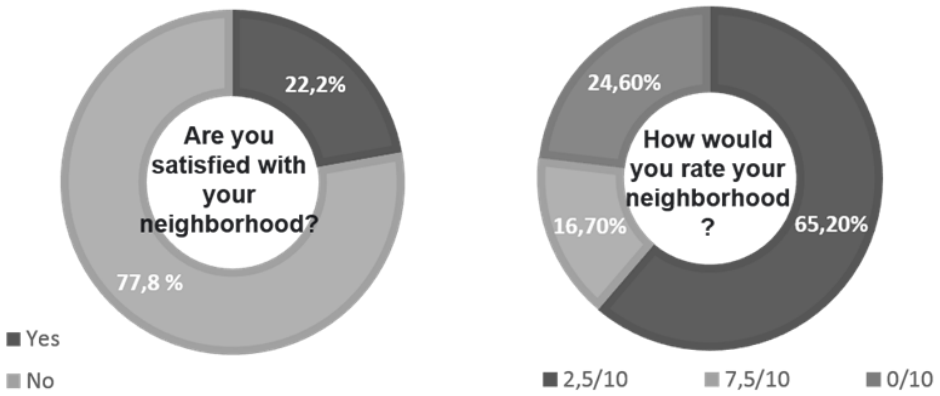


**Figure 6:** Analysis of the satisfaction value of vegetation in the land use plan of the northern district of the city of Guelma.

**3.4 Landscape value**

Similarly, the results of the landscape value of the scheme show that residents have a perception of visualization of aspects with aesthetic value of natural elements, especially vegetation, which represents the most important landscape elements that they imagine. Today, by infusing the three pillars of the latter, it appears crucial to reconcile the various landscape issues with sustainable development; the environmental, social, economic transcend the landscape issues. Towards a new utopia "*sustainable urban landscape*" for urban development. Introducing a global approach to sustainable urban landscapes in construction and urban development operations is a first element of response to create the ideal landscape of sustainable districts.

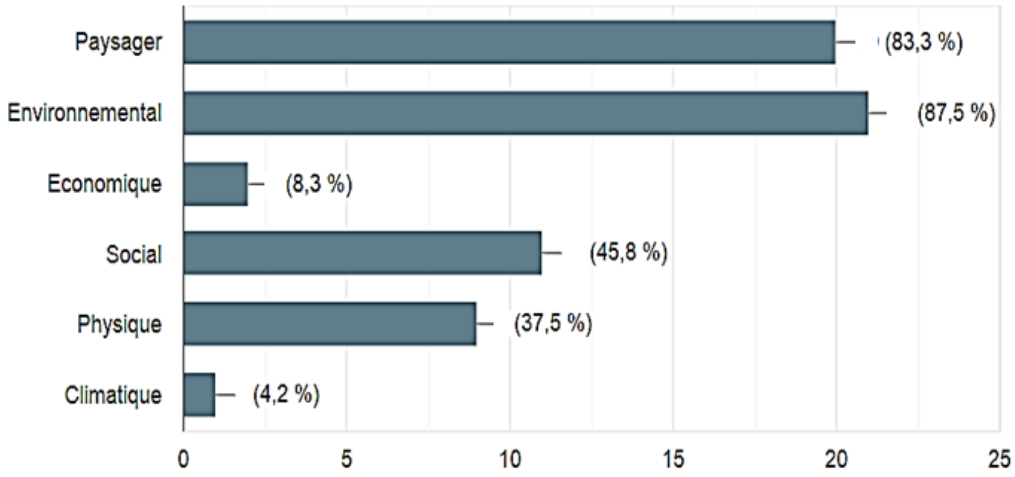


**Figure 7:** Analysis of the landscape value of vegetation in the land use plan of the northern district of the city of Guelma.

**4. Conclusion**

Urban vegetation is becoming increasingly important in scientific and social theory and discourse, and is seen by planners as a concrete example of the concept of sustainable development being considered; this is particularly relevant to making cities greener, more lively and more pleasant. Finally, it makes suggestions for the implementation of ecological planning and management. Driven by the desire to better integrate with urban nature to improve the living environment of these citizens, green spaces have emerged. They also play multiple roles at different levels of the city: ecological, aesthetic, psychological and social, and their absence is a phenomenon that must be analyzed.

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# Subjective Assessment of Thermal Outdoor Comfort in Downtown Guelma During Summer Heatwave

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**Abstract**
The assessment of the outdoor thermal comfort should consider the interrelationships between the thermal conditions outdoors, the psychological responses of users and physiological phenomena. The aim of our study is to subjectively assess thermal outdoor comfort in downtown Guelma during summer heatwave. The scientific methodology is based on the acquisition of quantitative and qualitative data, to do so we have conducted a survey questionnaire in parallel with a field microclimatic measurement during the heat wave period. As a result, we assessed the thermal sensation of the three parameters, air temperature, relative humidity and air speed for six sessions from 09:00 to 21:00. As well as, the thermal acceptability, the thermal comfort levels and the thermal preferences for each session. The findings indicate that the subjective assessment of the outdoor thermal comfort makes it possible to conclude on the effect caused by the urban thermal environment in space and time.
***Keywords:*** Outdoor thermal comfort; Subjective assessment; summer heatwave; survey questionnaire; downtown Guelma.

## 1. Introduction

A comfortable outdoor space provides a pleasant climate comfort experience for people and effectively improves the quality of urban life. However, people experience different thermal sensations when performing different outdoor activities; in streets, squares, playgrounds and urban parks. According to ASHREA 55, thermal comfort is "that state of mind that expresses satisfaction with the thermal environment". On this basis, the thermal comfort is synonymous with the availability of pleasant thermal conditions in outdoor spaces. However, outdoor thermal comfort is fully considered as a guarantor of the use of outdoor spaces (Elnabawi & Hamza, 2019; Hammadi., 2017). The assessment of the outdoor thermal comfort should consider interrelationships between the thermal conditions of the environment, the psychological responses of users and physiological phenomena (Sayad & Alkama, 2021a). The human thermal sensation can be evaluated objectively or subjectively, the subjective evaluation consists in exploring the thermal sensation of the local populations by means of questionnaires or interviews.(Andris Auliciems and Steven Szokolay, 1995; Sayad & Alkama, 2021b, Amen,2021).

The Subjective assessment of outdoor thermal comfort is based on the acquisition of data relating to the physiological phenomena carried out by the users, hence, it is necessary to explore the thermal sensation of the local population. This data is generally collected by means of questionnaires or interviews, describing the satisfaction of the latter vis-à-vis the external thermal conditions. For example, the research of (Neto, 2016) who considered that the feeling of thermal comfort is influenced by environmental and personal factors while thermal comfort must be measured by the number of people complaining of thermal discomfort. The author proposed a procedure to assess thermal comfort, including the creation of a ratio scale and a set of statistical procedures to process the data collected from this scale. This method was used to assess the influence of fans on the feeling of thermal comfort of the occupants of a small office, it proved to be useful and then it was applied to outdoor environments. As a result, the method has shown great ease in including humans in the control loop of comfort systems. Also, a research by (Cheung & Jim, 2019) who implemented an outdoor thermal comfort survey questionnaire to determine the range of acceptable transient temperatures. Which is only valid when the answer of more than 80% of the respondents is acceptable. The study therefore proposed a new evaluation of outdoor thermal acceptability: thermal acceptability in 1 hour. Respondents were asked to indicate whether the urban thermal environment is acceptable at the time of the interview and to stay at the interview site for one hour. This predictive assessment was tested against the transitional assessment in Hong Kong by a survey questionnaire for a whole year, with 830 respondents. Results at 80% over 1-hour summer from 22.6° to 25.4°C air temperature.

## 2. Material and Methods

As the aim of our study is to subjectively assess thermal outdoor comfort in downtown Guelma during summer heatwave, we simultaneously conducted a survey questionnaire with a field microclimate measurement of three microclimate parameters to acquire both, quantitative and qualitative data.

### 2.1. Assessment Methodology

The investigation was carried out following an urban pathway composed of 41 different points which requires two hours to cover it (120 minutes), whose collection of data specific to this pathway involves a complicated process which consists in measuring three microclimatic parameters of a given place and at the same time to question its users, in a period of time which does not exceed three minutes at most. The figure below explains the data collection process for an investigation session.

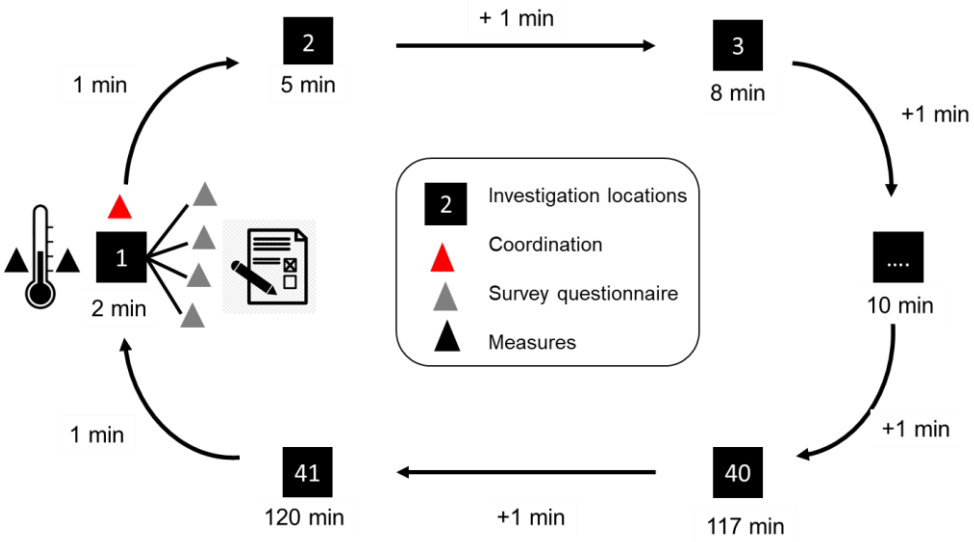


**Figure 1.** Data collection process (in-situ measurements and questionnaire) for an investigation session.

### 2.2. On-Site Measurement

The field measurement was carried out following the urban pathway located in downtown Guelma made up of 41 points using a calibrated multifunction hand-held device (Testo 480 – AG 501 1ST, 0563 4800) (Sayad, Alkama, Rebhi, Kidar, et al., 2021). As a result, we obtained a daily record made up of six sessions from 9:00 a.m. to 9:00 p.m. of the three parameters:

- **Air temperature:** the air temperature is a main element of the atmosphere, it refers to the sensation of hot and cold outdoors. In our research it is used as a subjective independent indicator to measure thermal sensation during summer overheating, but also an objective indicator of climatic comfort used to quantify heat stress.
- **Relative humidity:** relative humidity represents the amount of water present in the atmosphere, it is a good indicator to demonstrate the effects of air humidification (Sayad, Alkama, Rebhi, Menni, et al., 2021). Its measurement then allowed us to study the effects of natural elements; water and vegetation in outdoor spaces, it is also an important element for quantifying the degree of outdoor thermal comfort.
- **Wind speed:** air speed represents the flow or movement of air particles, it is conditioned by the urban configuration and it is an important parameter for evaluating outdoor climatic comfort.

### 2.3. Survey Questionnaire

The survey questionnaire was conducted simultaneously with the field measurement, following the same measurement points for. The questionnaire is organized into two sections and set out in tables to encourage respondents to provide accurate, unbiased and complete information.

The first section; "Thermal sensation assessment", the assessment is based on three synthetic criteria, degree of thermal comfort, thermal acceptability and thermal preferences. Each of these addresses detailed criteria through a closed question with an assessment level (choice of answer) and an open question aims to develop the citizen's opinion in terms of thermal preference.

The second section "Assessment of the microclimatic parameters influencing thermal sensation" asks direct questions about the microclimatic parameters responsible for all thermal sensations, including the sensation of stress. For the three measured parameters, temperature, humidity and wind speed, the question “How do you rate such a parameter in this place? “was asked with a scale of five answers.

The management and accessibility to the collected data were greatly facilitated using the IBM SPSS Statistics 23 software "Statistical package for the social sciences". The process began with coding and a twice-hourly manual

entry of the questionnaires, then a step of cleaning up the data was carried out, of which 581 is the total number of valid questionnaires, then the preparation of the tabulation, namely frequency, cross-reference or descriptive and finally the export of the data usable in tables or graphs.

## 3. Results and Discussion

### 3.1. General Weather of The Study Period

According to the weather forecast of Guelma city (Ventusky - Weather Forecast Maps, n.d.), the highest value of temperature was 41°C, the minimum relative humidity was ± 20%, with an average wind speed of 3.5 m / s. In-situ measurements in downtown Guelma showed more meteorological detail, giving an accurate description of the weather during the study period. The highest temperature reached 42.9°C at 3:00 p.m. at point 41 with low relative humidity 17.4% and low wind speed 0.3 m/s. The lowest temperature of 30.5°C was recorded at 09:00 at point P1, with a maximum relative humidity value of 56% and a low wind speed of 0.5 m /s. It can be concluded that the study period experienced a major heat wave. The microclimatic parameters measured are represented in Table 1.

**Table 1.** General weather during the investigation period

| Air Temperature (C°) | | | Relative Humidity (%) | | | Wind speed (m/s) | | |
|---|---|---|---|---|---|---|---|---|
| Mean | Max | Min | Mean | Max | Min | Mean | Max | Min |
| 36.9 | 42.9 | 30.5 | 30.5 | 56.0 | 16.5 | 0.6 | 1.5 | 0.3 |

### 3.2. Satisfaction with the Thermal Environment

Five sensual options were used to determine the thermal comfort sensation in summer, of which the "Neutral" option is used to express an average sensation state which means that the environment is neither comfortable nor uncomfortable.

The results indicate that the urban thermal environment is mostly voted as "a little comfortable" and "neutral" for the morning session, from 9:00 a.m. to 11:00 a.m., as well as the evening session, from 7:00 p.m. to 9:00 p.m.: 00. Moreover, the five options were used in the flowing session from 11:00 to 13:00. The feeling of discomfort is most dominant during the afternoon hours, with the feeling of “neutral” around 7:00 p.m., which often announces the start of the daily shift after long hours of thermal stress (Figure 2).

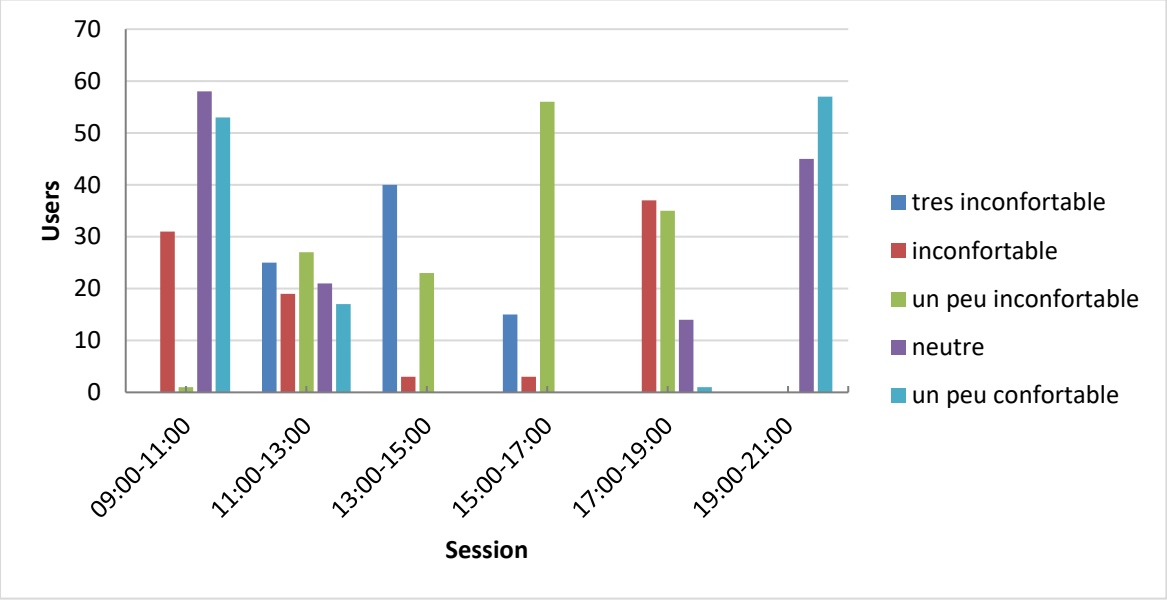


**Figure 2.** Thermal comfort sensation.

The assessment of the urban thermal environment was carried out through three options, with the aim of exploring the thermal acceptability throughout the hot summer days following six sessions from 09:00 to 21:00. (Figure 3).

For the first session, the urban thermal environment is largely voted as "acceptable and neutral" with a minority who see it as "unacceptable". Contrary to the following session, where the urban thermal environment is voted mainly as "unacceptable". The two sessions from 1:00 p.m. to 5:00 p.m. are judged almost totally as "unacceptable". The sessions after experienced the shift towards appreciation, hence the acceptable option is the dominant one during the last session from 7:00 p.m. to 9:00 p.m.

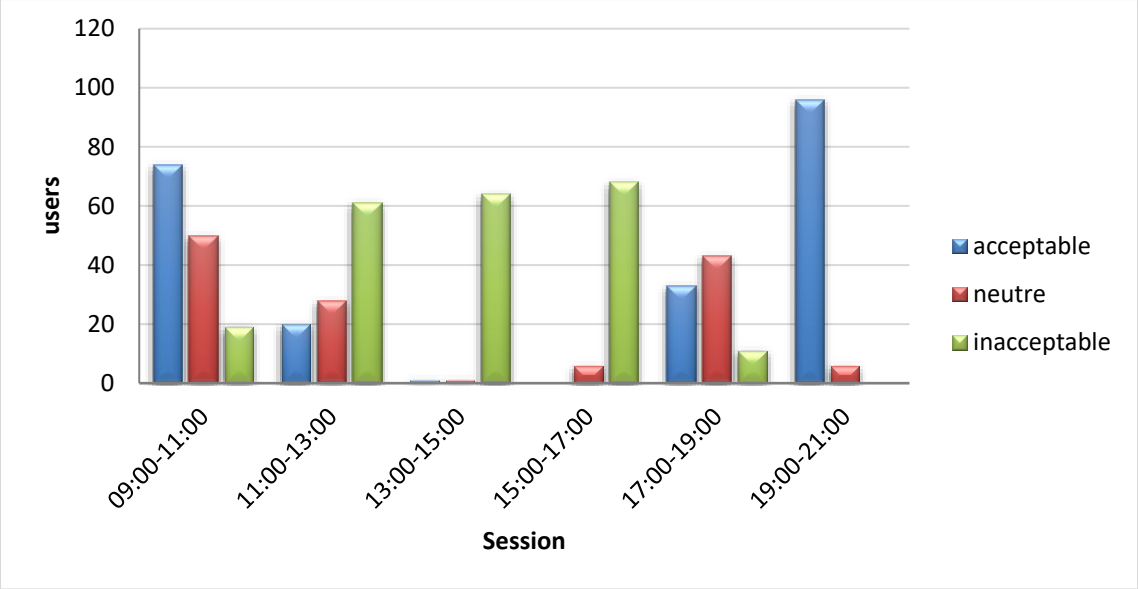


**Figure 3.** Thermal acceptability.

Users' thermal preferences were explored by asking the question "For better conditions, you suggest!" with three response options; more freshness, no change or more heat.
Only two options were used as shown in the histogram (Figure IV.17). The "no change" response was widely used by users during the morning session, from 9:00 a.m. to 11:00 a.m., as well as the evening session from 7:00 p.m. to 9:00 p.m. While, the majority prefers more freshness during the sessions, from 11:00 to 17:00. For the session, from 5:00 p.m. to 7:00 p.m., the thermal preferences are almost evenly split between the two options.

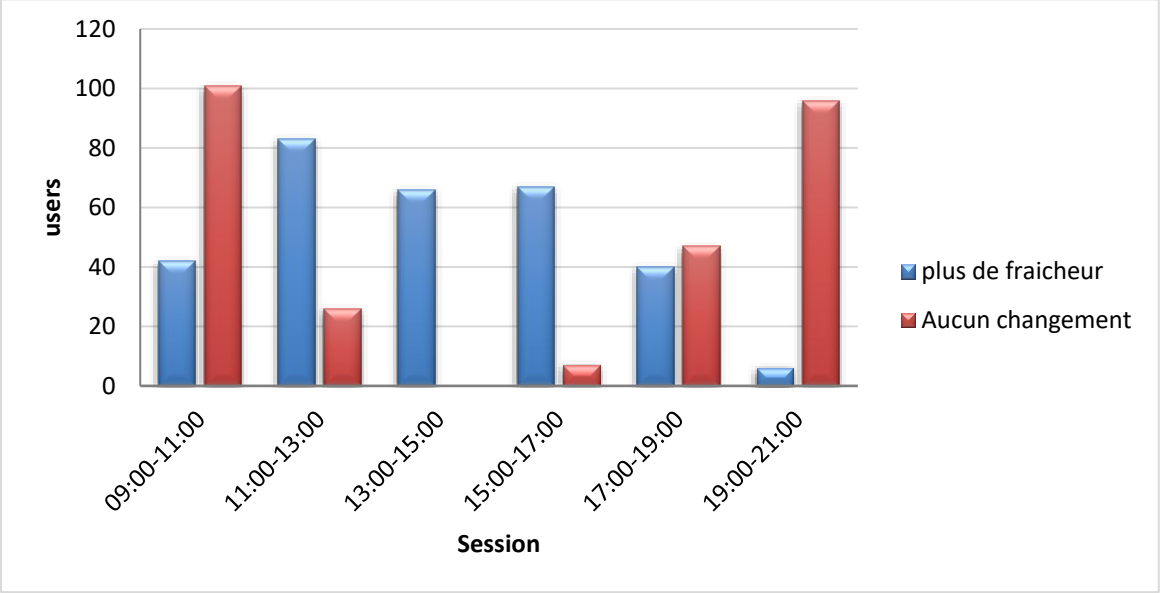


**Figure 4.** Thermal preferences.

### 3.3. Thermal Sensation of Microclimatic Conditions

The sensation of microclimatic conditions involves the use of five sensual options to judge or appreciate the following parameters: the air temperature, the relative humidity and the wind speed. As the case with the thermal comfort sensation, the "Neutral" option is used to express an average sensation state of each parameter along the six sessions from 09:00 to 21:00.
The histogram below presents the results of the sensation of air temperatures per session (Figure 5). For the first session, three sensual options were used; "neutral", "a little fresh" and "a little warm" with a dominance of the first. The second session from 11:00 a.m. to 1:00 p.m. involves the five sensual options, including the two options; "a little hot" and "hot" dominate equally. The urban thermal environment is voted by the majority of users as "very hot" and

"hot" during the period from 1:00 p.m. to 5:00 p.m. The following session from 5:00 p.m. to 7:00 p.m. is voted as "a little hot" by the majority of users. For the last session, the appreciation of the urban thermal environment is made according to the two sensual options; "neutral" and "a little cool", expressing a state of feeling that often tends towards thermal satisfaction.

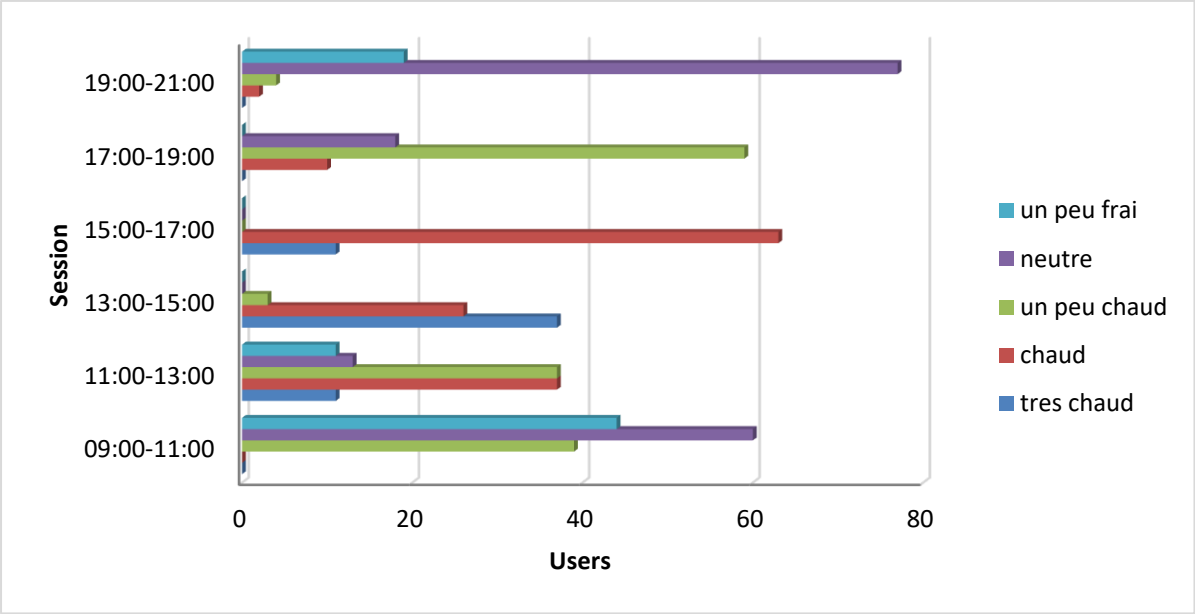


**Figure 5.** Thermal sensation of the air temperature.

Following the example of air temperatures, the sensation of relative humidity was explored according to a response scale composed of five sensual options. The results are presented in the histogram on the next page (Figure 6).
The first session is characterized by two dominant sensations; "neutral" and "a little wet". Overall, the urban thermal environment experienced a dry feeling during the three sessions from 11:00 a.m. to 5:00 p.m. Hence the "a little dry" option was widely used during the three sessions, while the "dry" option was greatly raised in the session from 1:00 p.m. to 3:00 p.m. The wet feeling is the dominant during the last two sessions, especially that from 7:00 p.m. to 9:00 p.m., where more than 90% of the votes were for the "a little wet" feeling.

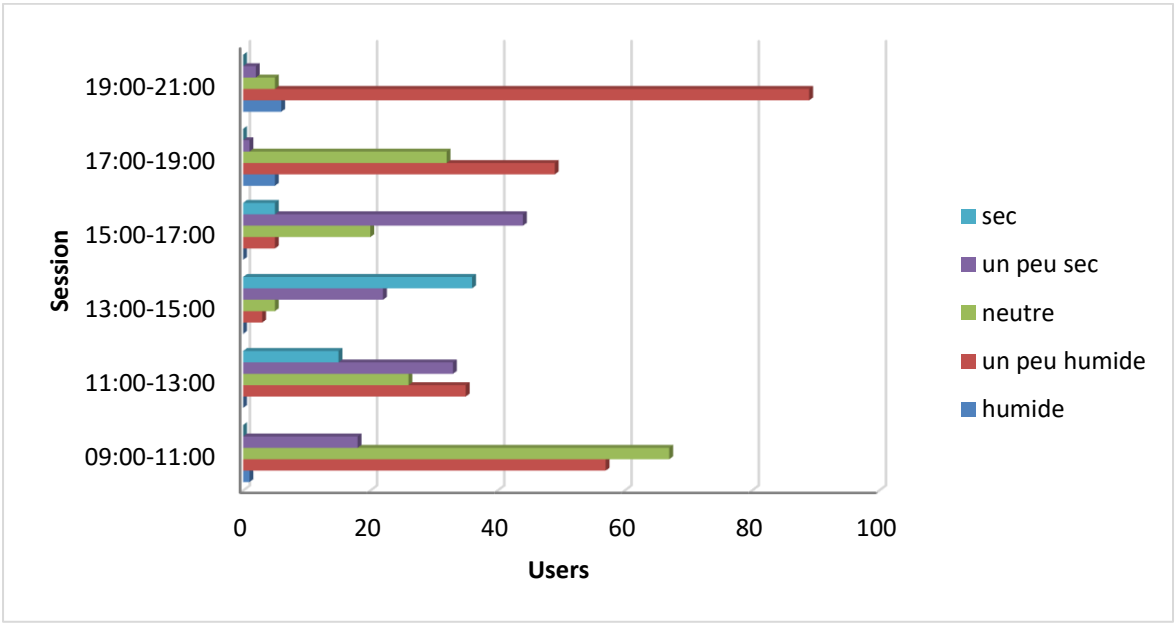


**Figure 6.** Thermal sensation of the relative humidity.

Overall, the thermal sensation of the wind speed was voted as “a little soft” and “neutral” for the first session, the flowing session from 11:00 a.m. to 5:00 p.m. were voted mostly as “stagnant”. The session from 5:00 p.m. to 7: 00 p.m. was voted as “a little stagnant” and “neutral”, while the last session was greatly voted as “a little stagnant”.

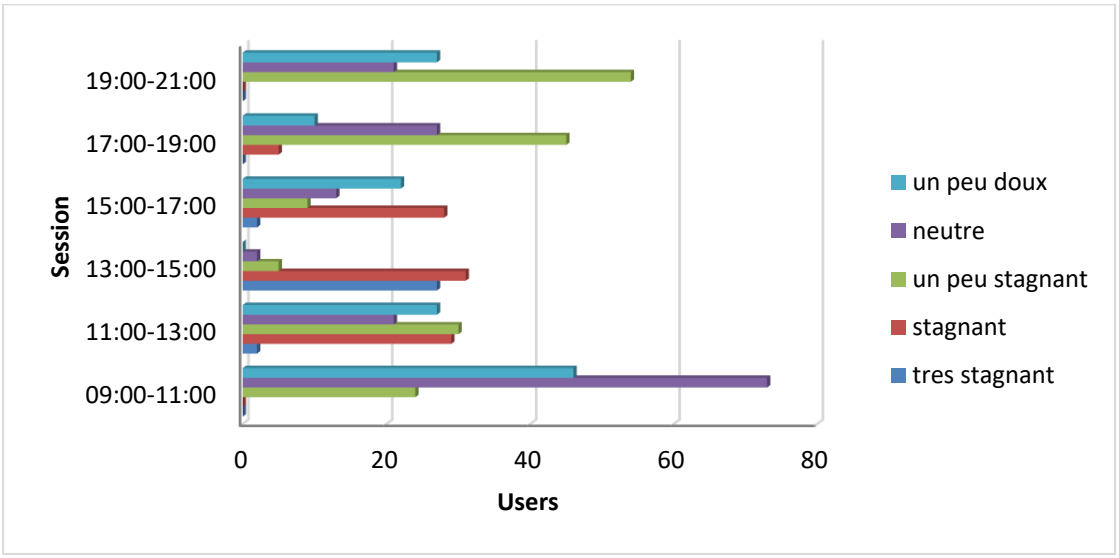


**Figure 7.** Thermal sensation of the wind speed.

**4. Conclusions**

In our study we have assessed the thermal comfort levels in downtown Guelma during the summer heatwave, based on qualitative and quantitative collected data, the main conclusions are as follows:

- The microclimatic variations that exist between successive places make it possible to relate the composition of the urban thermal environment and the level of comfort expected in that place.
- The thermal sensation per session of the microclimatic parameters provides information on the bi-hourly level of climatic comfort to be provided.
- The use of sensual response options makes it possible to conclude on the effect caused by the urban thermal environment in space and time.

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# Towards Bikeability through Place Attachment Approach in Yogyakarta

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**Abstract**
Cycling is energy-efficient transportation, free of carbon emissions, and is an active transportation embodiment of a healthy lifestyle. This study aims to understand the process of place attachment in cycling spaces. The objective of this research is to guide the design of attractive new bicycle point destinations and paths, increase the interest in cycling among city residents, and contribute to reducing carbon emissions in urban spaces. The research was conducted using a qualitative method with a place attachment theory approach and descriptive narrative analysis. Primary data collection was carried out by observing cyclists, cyclists' destinations, and interviews with cyclists & other actors. In addition, we do active participation as cyclists to get hands-on experience. This study reveals aspects of interaction, activity, memory, and experience as elements that play a role in place attachment at destination points and cycling routes in Yogyakarta.
**Keywords:** Bikeability; Place Attachment; Cycling Space; Tourism; Built Environment.

## 1. Introduction

The transportation sector is the most significant contributor to energy consumption in urban areas. An increase in the need for transportation impacts the expenditure on carbon emissions (Prato et al., 2018), and an increase in pollution in cities (Dill, 2009) will affect climate change. The use of bicycles can minimize the threat of environmental damage due to transportation. In addition, cycling has various positive impacts from an ecological perspective, including low economic operating costs and long distances compared to walking time. It is part of a sustainable development strategy. Cycling is also a concrete step to creating an environmentally friendly city by changing healthy lifestyles and being increasingly concerned about protecting the environment (Artiningsih, 2011). One of the efforts to increase interest in cycling for the community is to improve the quality of travel and urban space experiences. This effort can also be referred to as increasing bike-ability or providing a space that can accommodate cycling activities. The ability to use space for cyclists or bike-ability (Lowry et al., 2012; Winters et al., 2013; Lopez et al., 2015; Nielsen et al., 2013) is always associated with security aspects (Neufert et al., 2002; Sanz, 2006; CROW, 2017; Gunn, 2018), convenience, route continuity, coherence, and attractiveness (Gunn, 2018; CROW, 2017). However, no one has discussed the emotional and affective aspects created between cyclists and road spaces and destination points. So, the concept of place attachment has a high urgency to be explored to create a space that attracts cycling interest.

Understanding the terminology of place attachment has a different meaning in each discipline. This difference is because place attachment is considered a determinant of an individual's decision to do something in his environment based on complex and dynamic experiences (Seamon, 2013). Anthropology defines place attachment as a symbolic relationship between humans due to emotional attachment to a place (Altman & Low, 1992). Hashemnezhad et al. (2013) identified four aspects that affect cognition and perception. Those aspects are satisfaction, interactions & activities, memory & experiences, and time factors. These statements align with the science of architecture and behaviour, which states that the concept of place attachment plays an essential role in increasing the attractiveness of public spaces, green spaces, and other environments (Rastbod & Aflatounian, 2018). Based on this, the study of the concept of place attachment contributes to creating a sustainable environment from various aspects. According to Hashemnezhad et al. (2013), the place attachment research has been discussed by Yi (2019), but the topic and subject are still very general. For this reason, we will particularly disassemble the relationship between interactions, activities, memory, and experiences in a place attachment to the concept of bike-ability. In this way, the development of the quality of road space and destination points becomes a critical focus to influence the interest of local communities and tourists in cycling. The availability of facilities for socializing and integrating it with the potential of a place will provide an attractive character for cyclists. Improving the quality of the cycling space will increase the use of bicycles for recreation (Yu & Tian, 2013) and be the first step to forming cycling habits as daily transportation (Stefanus & Carina, 2021).

## 2. Objective

This research does not discuss the reduction of carbon emissions directly but tries to dismantle the process of attachment to specific destinations in the cycling route. The study focused on the cycling destination as a gathering point and a point of interaction between individuals. This research aims to design a cycling destination point that is safe, attractive, and possible to increase social interaction between residents. In addition, it also produces urban design guidelines that can develop the quality and experience of cycling spaces because attractive areas are then able to increase interest in cycling, create a healthy lifestyle, and minimize the increase in carbon emissions in urban spaces.

## 3. Methodology

To conduct this qualitative study, we used a place attachment approach (Tuan, 1974; Relph, 1976; Tuan, 1977; Steele, 1981; Altman & Low, 1992; Carl et al., 1992 in Sattarzadeh, 2018; Giuliani & Feldman, 1993 in Vaske & Kobrin, 2001; Williams & Patterson, 1999 in Vaske & Kobrin, 2001; Seamon, 2013; Hashemnezhad et al., 2013; Rastbod & Aflatounian, 2018). Primary data collection was carried out by observing cyclists, cyclists' destinations, and interviews with cyclists & other actors. In addition, we do active participation as cyclists to get hands-on experience. The analysis was carried out with a descriptive narrative. Secondary data is collected through literature studies through news, social media, books, and journals. The study location chosen was a tourist bicycle path named Monalisa (Yogyakarta, 2021), which the Yogyakarta City Government had established to develop a sports tourism program.

## 4. Literature Review

### 4.1 Perception

Tuan (1974) stated that place has more meaning than physical components, but rather a space with a social system formed (Williams & Patterson, 1999). Tuan (1977) also states that place and sensory experience emphasize repetition and routine activities carried out in an area. Space users have specific experiences and memories through their ordinary senses of smell, touch, sight, hearing, and taste through these habits. Based on this familiarity, these places become known by the public. Carl et al. (1992) stated that an ideal public space must support humans to achieve basic needs such as comfort, passive and active engagement, and discovery. Place attachment is also defined as the link between the physical characteristics of the environment with cognitive and perceptual factors (Steele, 1981; Hashemnezhad et al., 2013).

### 4.2 Place Attachment

Hashemnezhad et al. (2013) state that physical and social features have the same role in forming a place attachment. Four aspects affect cognition and perception: satisfaction, interactions & activities, memory & experiences, and time factors (Hashemnezhad et al., 2013). Happiness discusses the relationship between humans to places depending on the level of individual perception. This satisfaction occurs due to aspects of quality and security (physical, social, emotional) formed from the perception of conscious, unconscious, objective, subjective, personal, or social (Hashemnezhad et al., 2013). Social interaction makes man the leading actor in public space, then discussion between people-people and people with surroundings (Seamon, 2013). Cushing & Miller (2020) identify the main drivers that cause attachment to their community, namely the existence of social offerings and openness. Social offering means a place for people to gather and cultural and social participation. In it, there is the presence of community members who are interrelated with each other. Openness is the openness of a community manifested by the diversity of people in it, namely families, the elderly, minorities, and various work backgrounds. Fereeidooni & Soheili (2018) reinforced this community openness allows interaction between humans and causes a close relationship between place and society (Fereeidooni & Soheili, 2018). Place attachment is also formed from community participation, social network engagement, and cultural interactions (Hashemnezhad et al., 2013). In addition, cultural attraction in the form of festivals, celebrations, and exciting activities in a place can also contribute to attracting people's attention (Hashemnezhad et al., 2013). These repetitive activities can increase experiences and memory so that humans feel familiar with the place (Tuan, 1977). If we have a memory of space, an exciting experience is formed (Hidalgo & Hernandez, 2001). These points become the basis for deepening the place attachment process in the context through field observations.

### 4.3 Bikeability and Place Attachment

According to Altman & Low (1992), there is a correlation between human behaviour and the human environment, forming a behavioural model of elements. The applications and models are (1) point of origin and destination of walking or bicycle trips (Moudon et al., 2002), (2) Characteristics of the selected route on the trip (Moudon et al., 2002; Federal Highway Administration, 1999), (3) Characteristics of the surrounding area on the trip (Moudon et al.,

2002; Gunn, 2018), (4) environmental factors (Federal Highway Administration, 1999), and (5) intrapersonal and interpersonal factors (Federal Highway Administration, 1999; Gunn, 2018). According to Moudon et al. (2002), determining the point of origin and destination for transport can differ but can be the same for recreational or sports activities. Based on these models, human behaviour in cycling can be identified as follows: distance travelled between origin and destination, bicycle space design, and the intensity of motorized vehicles, bicycles, or people in the space. In addition, the quality of space is also a consideration for the impact on aspects of safety, comfort, experience, and cyclist's perception. The intensity of land use, route choices, and the availability of alternative means of transportation also affect the desire to cycle. Based on this, bike-ability is always associated with safety, comfort, route continuity, coherence, and attractiveness. However, no one has discussed the emotional and affective aspects created between cyclists and road spaces and destination points. So, the concept of place attachment (activity, interaction, experience, and memory) has a high urgency to be explored to create a space that attracts cycling interest.

### 4.4 Study Area Yogyakarta

Based on its history, Yogyakarta is a city that lives and develops bicycles. The Yogyakarta city government made efforts in addition to launching a tourist bicycle path that connects destination points in Yogyakarta. This study explores the potential for space development for cyclists in urban spaces, especially at essential and exciting points for users. The location chosen is Yogyakarta City, a city with a solid historical and cultural background related to bicycles. This city is also a tourist city that is developing a sports tourism program by creating a tourist bicycle path named Monalisa (Yogyakarta, 2021). The first step is to conduct a literature study by collecting data from news, social media, and journals. This step aims to find out the cycling phenomenon and its potential in Yogyakarta, understand the applicable government policies, and identify locations that are favourite spots for cyclists. This information becomes the primary material in the field survey to match it back with current field conditions. This survey activity is observed and documented through photos and videos.

Our first survey looked at the activities of cyclists and how cyclists use their space. This survey was conducted using the drifting method, travelling without a definite destination and only stopping at points that we think are interesting to explore (Andreotti & Costa, 1996 in Fuad & Yatmo, 2017). This method helps review the process of place attachment on the Monalisa tourist bike path, especially the Old City Romance Route or *Romansa Kota Lawas* Route.

## 5. Result and Discussion

Field observations were made along the *Romansa Kota Lawas* route, as shown in figure 1. Based on this, we can see how a destination or potential point creates a place attachment made field observations. Place attachment discussed in the description is what activities are carried out, how actions and interactions can occur, who are the actors at that point, and how the experience of space can be a memorable memory in a place.




**Figure 1.** Destination on *Romansa Kota Lawas* Route (Source: author)

### 5.1 Warung Soto Pak Dalbe

The first route is Jalan *Jenderal Sudirman*, around the garden city area. Based on Figure 2(a), this stall can be easily accessed from the protocol road and is on the edge of a pedestrian path of about six meters. The main activity that becomes the main attraction on this road is the activity at Pak Dalbe's food stall, which is quite popular among cyclists and *soto* connoisseurs. This *soto* stall is attractive because, in addition to the typical Javanese *soto* culinary that is served, the physical condition of the building also attracts attention. Figure 2(a) shows the proportion of warungs to public spaces, and as shown in figure 2(d), this simple building is sandwiched between two extensive facilities such as a fast-food restaurant and a church. In figure 2(b), the limited space in the stalls causes the expansion of activities to the pedestrian way or open city public spaces. Based on the observations of many customers who use benches and planter boxes as in figure 2(c) who are on the pedestrian way while chatting and enjoying the beautiful atmosphere in the middle of the city. It is not uncommon for customers to open their mats and sit *"lesehan"* in the area shown in figure 2(c). In addition, the availability of minimal parking space is also a significant problem for motorized vehicles. In this case, cyclists can get around the problem by placing their bicycles on the church fence or leaning on a pew. Although there are limitations in several ways, this *"soto"* stall remains an option because the spacious and shady surrounding space provides an exciting experience for its users. The flexibility of space offers opportunities for various and unlimited social activities. The shade provided by the large trees in the garden city area also increases comfort in activities in the space around *Jalan Jenderal Sudirman*. Based on this, Pak Dalbe's *Soto* stall becomes an activity generator for the pedestrian area of *Jalan Jenderal Sudirman*, both for cyclists and other vehicle users to stop and increase the crowd in the city space.




**Figure 2.** (a) the proportion of stalls to public spaces; (b) expansion of stalls to public spaces (c) benches and *"lesehan"* space; (d) bicycle parking

### 5.2 Garden City, Kotabaru

The shady trees and plants in the park along the roads dominate the visual character of this area. Architecturally, the characteristics of the building during the Dutch Colonial era are the expression of the building. Figure 3(c) shows the facilities in the form of benches in the park or pedestrian area used to sit and rest or become a gathering point for cyclists. The use of this space can occur because of the beautiful atmosphere of the trees that make it comfortable. There are signs to support the safety of cyclists, such as special bicycle crossing lanes, special bicycle lanes on both sides of the road, and bicycle parking, as seen in figures 3(b) and (c). The shade and uniformity of the nuances of the building with various uses become the distinctive character of the Kotabaru area. The attachment of

the Kotabaru area is influenced by the presence of green elements from trees and gardens and the diversity of building functions with a distinctive colonial atmosphere.

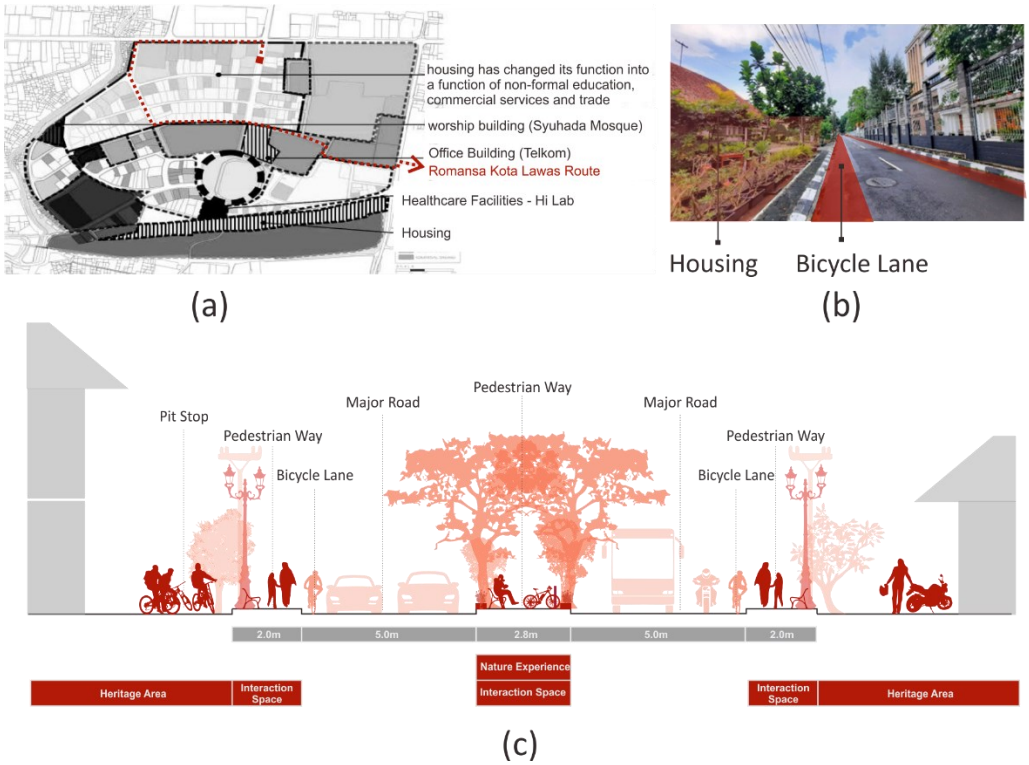


**Figure 3.** (a) area zoning; (b) residential areas
(c) Suroto Street pedestrian path

### 5.3 Street Vendors in *Balai Yasa* Area

Another exciting destination is the street vendors around the *Balai Yasa* emplacement area. The excitement is due to the green, shady, and relaxed environment, directly influenced by the large trees still firmly standing along the road segment, as shown in figures 4(a) and (b). The Dutch heritage houses right across from *Balai Yasa* also add accents to the area. The road that runs along *Balai Yasa* is not the main road, so it has a minimum density of motorized vehicles. So that the comfortable, quiet, and spacious space, as shown in figures 4(b), (c), and (d), is used by street vendors to trade from morning to evening. Based on figure 4(b), traders are dominated by ice traders, ranging from *es dawet, es campur, es doger,* and some sell snacks such as *rujak, batagor,* dumplings, as well as heavy culinary delights such as *soto* and meatballs. Because the area is very comfortable, visitors to this area usually prefer to enjoy the food on the spot while looking at shady views and historic buildings. The need for space makes the traders provide temporary seats with a large enough capacity, as shown in figures 4(b) and (c). The seats in figure 4(b) make activities in open spaces longer and allow various activities such as chatting with friends, interacting with traders, and interaction with visitors. The diverse culinary offerings, the comfortable place, and the quiet road space from motorized vehicles make this area very attractive to cyclists. Although there is no rigid parking facility, there is a relatively flexible and spacious parking area that the eyes of the bicycle owner can still reach. The bicycle is sometimes propped up against the trees, and the owner enjoys culinary delights not far from the bike, as shown in figure 4(b). This behavior is related to a sense of security which is an essential factor and causes cyclists to return to the facility. The spacious space with a natural appeal makes a special attachment to its users. The interaction between humans and humans and humans with the surrounding trees is an experience. Based on this, the *Balai Yasa* area is a culinary area characterized by historical buildings and shades of green accompanied by supporting facilities that support its activities.

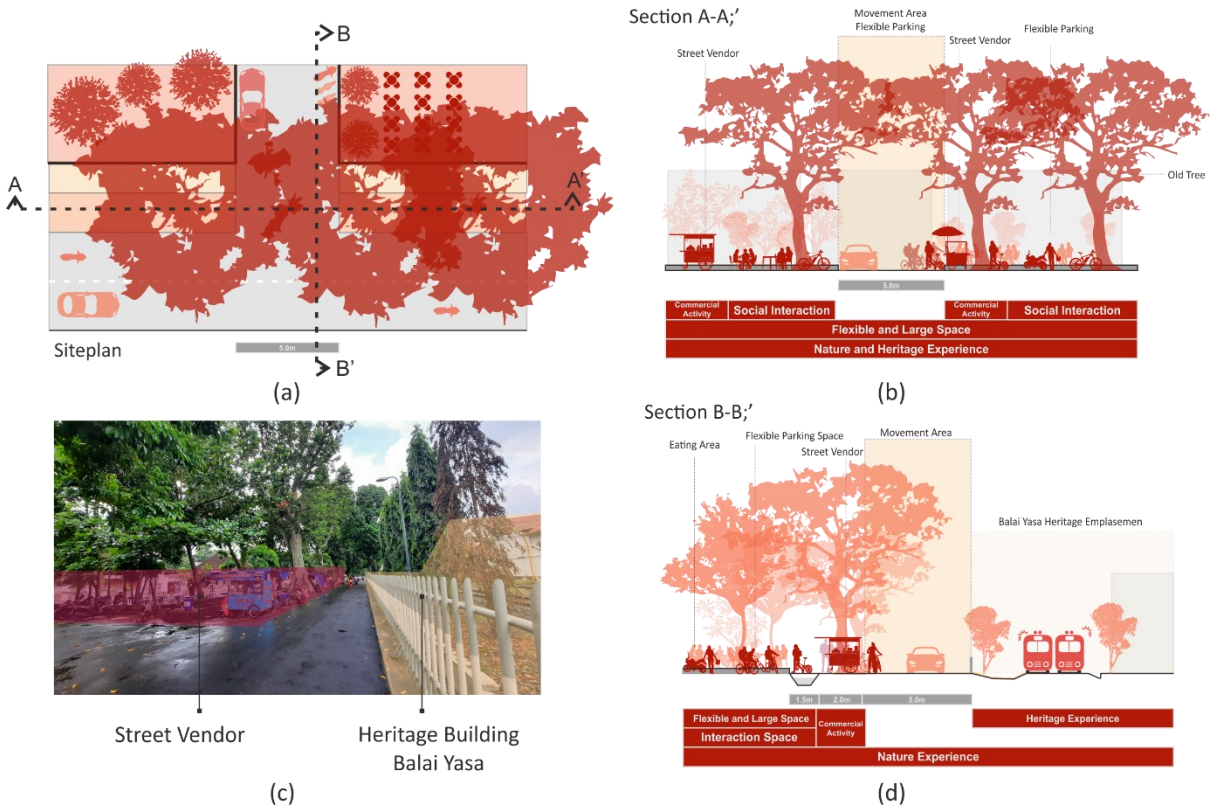


**Figure 4.** (a) the shade of the street space; (b) street vendors; (c) use of space for eating and interacting (d) relationship between street vendors and the Balai Yasa emplacement

### 5.4 Village Area

The next destination is *Gadjah Wong Muja Muju* Village, located on the bank of the *Gadjah Wong* river. Based on observations and data from social media, cyclists often gather in this park to socialize or enjoy the village by the river, which is quite beautiful. The attraction in the form of environmental harmony and the activities of the people of Kampung Gadjah Wong are unique for cyclists. A gazebo and bench by the river, as in figure 5(a), allow for activity and interaction.

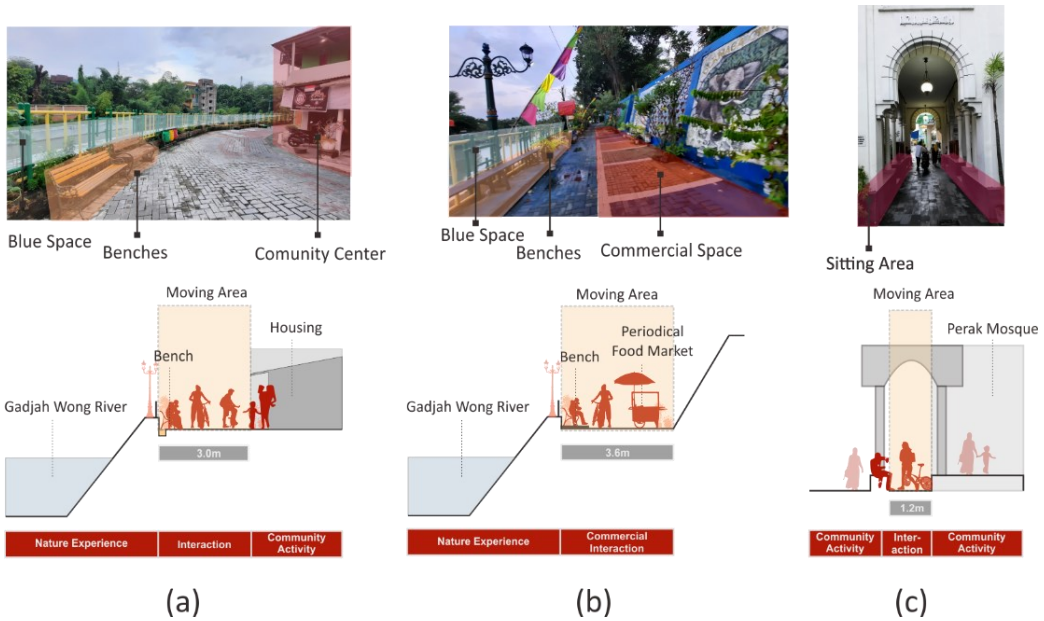


**Figure 5.** (a) *Muja Muju* Village; (b) *Bendhung Lepen* Kotagedhe; (c) Perak Mosque Kotagedhe

The last destination is Kotagedhe. Kotagedhe is a heritage area with interesting architectural relics such as the Kotagedhe Silver Mosque, the Kotagedhe Grand Mosque, the Tomb of the Kings, and residential buildings with a distinctive Javanese feel. The area, which is dominated by residential areas, makes cyclists who pass through are served with local community activities. Activities such as shopping at the market, traditional culinary traders lined up, people talking on the mosque terrace, and other daily activities such as figures 5(b) and (c). The relatively narrow road space makes cyclists must pass by people who are passing through or stay. Figures 5(a), (b), and (c) show the interaction between tourists and residents due to activities carried out in an alley in the village.

**5.5 Results**

In this case, activities and interactions are divided into "where" the process occurs and "what" drives action in space. There are generally mixed-use, commercial, housing, and major road areas as destination areas based on-field findings. There are also regional generators in culinary, social, and cultural attractions. On the other hand, some experiences and memories are formed from the character of space, including nature and heritage areas. Furthermore, 4 points and destination areas are connected to each point, creating a place attachment as shown in table 1.

**Table 1.** Process Analysis of Place Attachment

| Destination | Place Attachment | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Activity and Interaction | | | | | | | Experience and Memory | |
| | Mixed-Use Area | Commercial Area | Housing Area | Major Road | Culinary | Social | Cultural | Nature | Heritage |
| ***Warung Soto Pak Dalbe*** | | | | √ | √ | √ | √ | √ | √ |
| **Garden City Kotabaru** | √ | √ | √ | √ | √ | √ | | √ | √ |
| **Street Vendors in Balai Yasa Area** | | | | | √ | √ | | √ | √ |
| **Village Area (Kampung)** | | | √ | | √ | √ | √ | √ | √ |
| | 1 | 2 | 2 | 2 | 4 | 4 | 2 | 4 | 4 |

Then the culinary and social activity factors and nature and heritage characters have an essential role in forming place attachments. Figure 6 indicates a further and detailed relationship between the element of place attachment and the physical aspect based on the development of observations in the Monalisa route.




**Figure 6.** Place Attachment Diagram

## 6. Conclusion and Recommendation

This study indicates that activities, interactions, experiences, and memories are the basis for exploring the occurrence of the place attachment process in a place. Space exploration based on spatial experience shows that there are triggers for activities and interactions in a space dominated by culinary and social community activities and the occurrence of experiences and memories of areas dominated by natural and heritage characters. Thus, the findings of this study are that aspects of culinary, social community, nature, and heritage trigger attachment to a place in cycling destinations in the city of Yogyakarta. Therefore, we need to explore the physical elements that support each character in the region.

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## Conflict of Interests

The authors declare no conflict of interest.

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# Identifying Urban Public Spaces Through Substance and Surface Approaches

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**Abstract**
The provision of well-designed sidewalks in urban environments with mixed-use functions can increase pedestrian activity. This research aims to examine the role of substances and surfaces in the city's public space. The objective of this research is to create a city design guide for livable and interactive urban public spaces. The research was conducted using qualitative methods, the approach of Gibson (1979) about substance and surface, and the walking experience from Rapoport (1977); Jacobs (1993) was used in this study. Data collection was done by walking, direct observation, interviews, and visual documentation with photos, videos, and sketches. Analysis using descriptive narrative. This study reveals aspects of interaction, behavior, connection, and space use patterns in the city's public spaces as aspects that play a role in substance and surface. The presence of a substance on the vertical surface (facade) and horizontal surface (pedestrian way) can intervention with visitors to the store and make the pedestrian way function as a workspace. However, substances can also be a distraction in the human circulation space.
**Keywords:** Public Area; Substance; Surface; Walking Experience; Urban Design.

## 1. Introduction

The city is a space that is the center of human activity and the environment, so many say that the city is the most effective and efficient space to carry out productive activities regularly and can establish communication with humans and the space they occupy (Farida, Yudana, & Rini, 2017). The communication carried out can express the close relationship between humans and space because humans need space to live. The space needed by humans must be suitable to be inhabited when used (Tuan, 1977). Currently, urban design is believed to impact people's health and welfare positively. Research findings show that the provision of well-designed sidewalks in urban environments with mixed-use functions can increase pedestrian activity (Jackson, 2003). It can integrate marginalized sectors, such as the weak economy, into urban life and increase the sense of place in the community (Jackson, 2003).

In this research, pedestrian paths are identified as critical public spaces for urban spaces because they can show vitality in urban areas. Jacobs (1991) reveals that urban vitality is generated through the interaction between human activities and urban space. Then Lynch (1984) stated that urban vitality is the ability of urban systems to maintain internal survival, growth, and development. So that the elements of urban space, space patterns, and surfaces can determine the human experience when walking in public spaces. (Lan, et al., 2019; Yue, et al., 2020; Sulis, et al., 2018; IDRUS, et al., 2010; Sung & Lee, 2015; Pan, Yang, Quan, & Liao, 2021; Jiang, Han, Liu, & YE, 2022). The element of urban space is referred to as substance which refers to the part of the environment that is in a solid state, has a hierarchy, and is structured. So, the substance in an urban environment can affect human behavior when experiencing the visual perception of an object and judged based on its surface. While the surface is the outermost layer of the object seen by humans, the surface has a composition such as a layout, color, and texture. The surface is essential for human perception and incredibly visual perception because humans can physically react to what they see (Gibson, 1979; Nonaka, 2019; Chatterjee, 2011).

To understand the substance and surface of public spaces, we will reveal them through the experience of walking on pedestrian paths in urban spaces. Walking in practice benefits the environment and public health (Erkılıç, Özmen, & Kararmaz, 2022) and can provide a spatial experience of everyday life in urban spaces (Pallasmaa, 1996; Tuan, 1977). Walking is associated with reduced dependence on vehicle use (Zhu et al, 2014; Lee et al, 2014). In addition, the urban built environment provides an experience for pedestrians (Degen & Ros, 2012)

## 2. Objective

This research does not discuss urban vitality from a macro perspective, but the study focuses on examining the role of substances and surfaces in urban public spaces. This research aims to formulate urban design guidelines for public spaces in urban areas, especially pedestrian paths in commercial spaces. Thus providing a spatial experience of everyday life in urban spaces.

## 3. Methodology

Qualitative methods we used to conduct this research. To conduct qualitative research, we used an approach of substance and surface (Gibson,1979; Chatterjee, 2011; Nonaka, 2019) and walking experience (Rapoport, 1977; Tuan, 1977; Jacobs, 1991; Pallasmaa, 1996; Lund, 2005; Dunn, 2008; Barter, 2011; Suwarlan, 2020; Erkılıç, Özmen, & Kararmaz, 2022). For primary data collection, we walked and documented with photos and videos. As well as conducting interviews directly with area visitors and traders in the city space. Secondary data collection by conducting literature studies such as journals, books, and news. The method of analysis used the descriptive narrative method. The research location is in the Suryakencana area, a strategic area of the city (KSK) designated as a cultural tourism destination, commercial center, and culinary center that still maintains the identity of "Chinatown" in the city of Bogor.

## 4. Literature Review

### 4.1 Urban Vitality

Urban vitality has a vital role in developing an urban area and is often used as an evaluation material for the quality of urban development (Landry, 2000). Jacobs (1961) states that urban vitality manifests the diversity produced by the interaction between human activities and urban space. However, Lynch (1984) defines *urban vitality* as the ability of the urban system to maintain viability, both internally developing and evolving from suitable urban forms. Maas (1984) explained that urban vitality is seen in three aspects, namely

- human activities as space users using roads and public spaces continuously,
- human activities and opportunities in urban spaces, and
- the environment in which these activities are carried out.

This is reinforced by Montgomery (1998), which states that urban vitality can be seen based on the time of human activity in urban space and the facilities provided, thus creating a functional city space. Human activities can reflect how humans can participate in urban life. Jacobs (1961) states that to achieve urban vitality in a city, the city must have a relatively dense population concentration to affect intensive land use and high-density buildings. The recommended land use to support urban vitality is mixed land use to convert a single function into a versatile spatial function and provide more significant opportunities to support human activities (Koe, 2013).

### 4.2 Substance and Surface

Gibson (1979) explained that affordances are closely related to the medium, Substance, surface, and surface layout as the basis for the categories identified in human perception. Medium is things that can be seen or sometimes cannot be seen, such as air, gas, and water. However, we can see things more clearly with the medium because it provides movement from each part to the other, so the medium is the main category of perception and thus can also be considered an identifiable subject. A substance is denser than a medium: it can be liquid or stiff like iron/wood. The two substances have different properties or qualities; a person cannot stand on water because water has no density. However, wood/iron has a density, so other solid objects do not easily penetrate it, and we can stand on its surface because of its density. Gibson (1979) reiterates that a surface bounds a medium, and affordance can be intertwined with a surface layout. According to Nonaka (2019), Substance refers to the part of the environment in a dense, hierarchical, and structured state. So Substance in an urban environment can affect human behavior when experiencing the visual perception of an object and judged based on its surface. While the surface is the outermost layer of the object seen by humans, the surface has a composition such as a layout, color, and texture. The surface is essential for human perception, primarily visual perception, because humans can physically react to what they see. Substance and surface are a concern for users of urban space in their daily lives because Place is part of the habitat where city space users stand based on their point of view.

### 4.3 Walking Experience

Pallasmaa (1996) explained that bodily experience is needed, such as walking experience, which aims to discover spatial experiences in everyday life in urban spaces. Experience can be generated through sensory experience when we are in certain places (especially in urban spaces) through the senses of smell, touch, sight, hearing, and taste (Tuan, 1977; Dunn, 2008). Sensory senses are generally based on a comprehensive and realized understanding of our environment (Pallasmaa, 1996). Methodologically, by walking in urban spaces, we can understand how all the senses can be integrated with how the body moves (Lund, 2005; Barter, 2011). Walking in practice can bring environmental and health benefits to urban communities and provide the foundation for sustainable and balanced mobility within cities (Erkılıç, Özmen, & Kararmaz, 2022). Walking activities are generally divided into two activities, namely dynamic activities such as walking and running activities, while static activities such as standing, sitting, and leaning activities (Rapoport, 1977). When viewed from the standard speed of a person walking, it is possible to observe the surrounding environment and observe an object in detail and create a walking experience (Rapoport,

1977). The pedestrian path, which is the primary path for pedestrians, is expected to meet livable principles, namely having easy mobility for walking and having aesthetic value to public spaces (Suwarlan, 2020), as well as good pedestrian paths that can invite people to come, interact in the space, and create a space experience while performing each pace (Cambra & Moura, 2020).

### 4.4 Study Areas in The Suryakencana Area

The Suryakencana area is the Chinatown area, located straight from the main entrance to the Bogor Botanical Gardens by crossing Otto Iskandardinata Street and Ir H Juanda Street. At first, the area was a small village for the Chinese and served as the economic center of Bogor in the 1800s, and continues until now (bogor, 2021). Its strategic location makes Chinatown the most urban environment because it has a very high density. In order to make efficient use of space, the majority of the existing building forms are Shophouses with a linear pattern of streets following the main road corridor. The shophouse seems to be a 'landmark' for the Chinatown area itself, where the lower floor is used as a commercial/trade area, and the upper floor is used as a residential area (Bogor, 2021). In this Suryakencana area, these shops sell daily necessities, such as electronic stores, clothing and textile shops, household appliances stores, supermarkets, pharmacies, Etc. As well as various street vendors selling in front of these shops, both permanently and temporarily. In this study, the author has a research objective to determine the behavior of street vendors with shop owners so that it can affect the pattern of space use in the city's public spaces and impact regional visitors. The first step is to study literature such as journals, books, and news. The aim is to obtain information and identify the area, and its activities, such as visitors and street vendors. This information is used as a reference at the initial survey stage and checked with field conditions. Field studies were carried out by observing; we walked and documented with photos and videos. As well as conducting direct interviews with area visitors and traders in the city space. To check all the data collected, we do drifting, a journey without a definite destination, so we will stop when there is an object that speaks and is interesting for us to explore (Sadler S. , 1998).

### 5. Result and Discussion

Field observations were carried out along SuryaKencana road in Bogor City with a length of 1 km, starting from the border of the botanical garden to the border of the Siliwangi road, as shown in figure 1. Suryakencana road is dubbed as a tourist destination with very diverse activities in its daily life, ranging from food trading, Street vendors, trading of basic needs, and other activities carried out individually or in groups. Based on this, we can see how urban space is used based on substance and surface mechanisms. Substance and surface that will discuss in this paper are how behavior and relationships can affect the pattern of space use, the function of the space, who the actors are, and how it affects pedestrian circulation.




**Figure 1.** Mapping of Travel Routes on Suryakencana road, (source: author).

Based on observations in the field, there are several types of space use used by shop traders and how street vendors sell, such as there are several open shops that expand their merchandise to the pedestrian way and form a linear pattern, then there are street vendors who sell in front of open shops. or closed, attached to the front of the shop,

even though the activities in the store have different functions. Street vendors are selling in front of shops that are no longer active. Thus, these phenomena are interesting to analyze and study further to determine the impact.

**5.1 An open store that expands its wares to the pedestrian way and forms a linear pattern**

Based on figure 2 (a), (b) this food vendor places his merchandise cart in front of the shop, and the dining area is placed inside the shop. The shop is a food court that sells various kinds of fried foods, especially *combro*, yummy chicken noodles, yellow Soto, fried bean sprouts, dim sum and *nasi tim*, and *cakue*, each of which has its cart. The food court has a high density both on weekdays and on holidays starting at 11.00 WIB to 13.00 WIB in the afternoon and 16.00 WIB to 18.00 WIB in the afternoon. Although it has a high density in a place that is not too wide, the circulation and mobility patterns in the place can be entirely organized so that visitors who want to eat and finish eating do not overlap. This is due to the food vendors who put their carts in front of the shop and use part of the pedestrian area so that visitors who come to order food are done on the outside and inside the shop specifically for the dining area. Figure 2 (c) shows the response of regional visitors to the merchandise carts placed in front of the shop. Shop traders consider that placing their carts in front of the store can provide great potential because their merchandise carts can be used as markers so that many visitors to the area are interested in their merchandise. In addition, placing the cart in front can provide good air circulation because every trader sells using a stove that can cause smoke, so the smoke from each trader's cooking does not interfere with culinary activities inside.

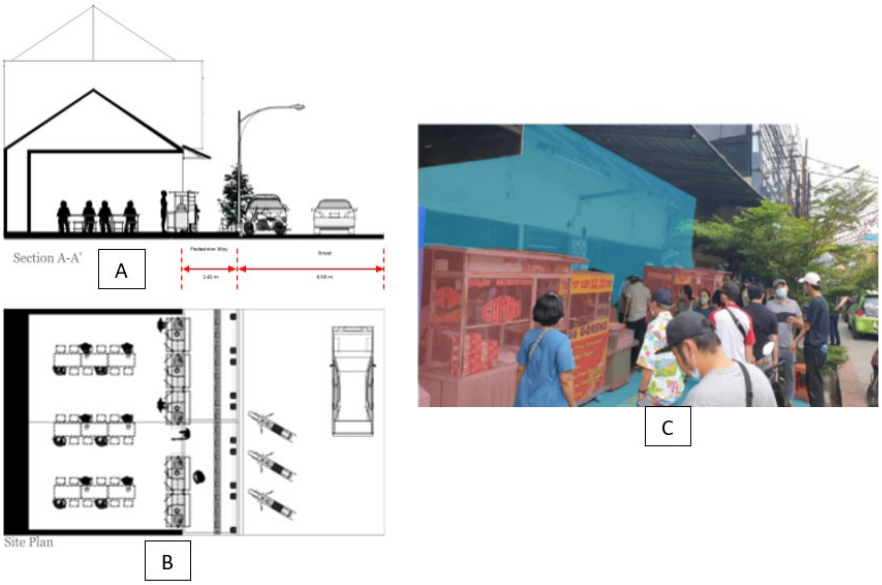



**Figure 2.** (a) The overall cut of the trading space; (b) Circulation and Mobility; (c) Merchandise cart in front of the shop

Food court food vendors and other food vendors, such as satay traders, placed a cooking/burning area in front of the shop and used part of the pedestrian path, and the dining area is placed inside the shop (figure 3). The cooking/burning area in figure 3 can intervene in area visitors buying their merchandise and make it easier for area visitors to order food. The placement of the cooking/burning area in front of the shop allows for other activities, such as interacting with traders and paying close attention to visitors.



**Figure 3.** Expansion Satay Merchant

Apart from food vendors, other traders, such as bicycle sellers, are expanding their merchandise to pedestrian paths (figure 4). The bicycle shop sells various types of bicycles, both in new and used conditions, which are sold at relatively low prices, and the shop offers bicycle repair and maintenance services. So, do not be surprised if the shop has become one of the favorite bicycle shops in Bogor, especially for bikers. Based on figure 4, the space use pattern of the bicycle shop utilizes part of the pedestrian path. On the inside, the shop is focused as a display area for new and used bicycles, and on the outside, the shop is focused as a service area. The location of the area is because the store area is not too wide, so to accommodate all these needs, the shop owner has extended his shop to the pedestrian path. Other than that, another reason for the store to extend the store is to facilitate the circulation of visitors, both visitors who want to see bicycle displays and those who want to do assembly and repair.



**Figure 4.** Expansion Bike Merchant

Based on this, it can be concluded that food court traders, satay traders, and bicycle sellers are substances that use space in front of the horizontal surface (pedestrian way) because the substance in the shop penetrates outside the surface. Substance using a horizontal surface intervenes with visitors so that visitors are interested in their wares. Traders cause the intervention behavior; shop traders tend to make some public spaces a selling area. (figure 5)

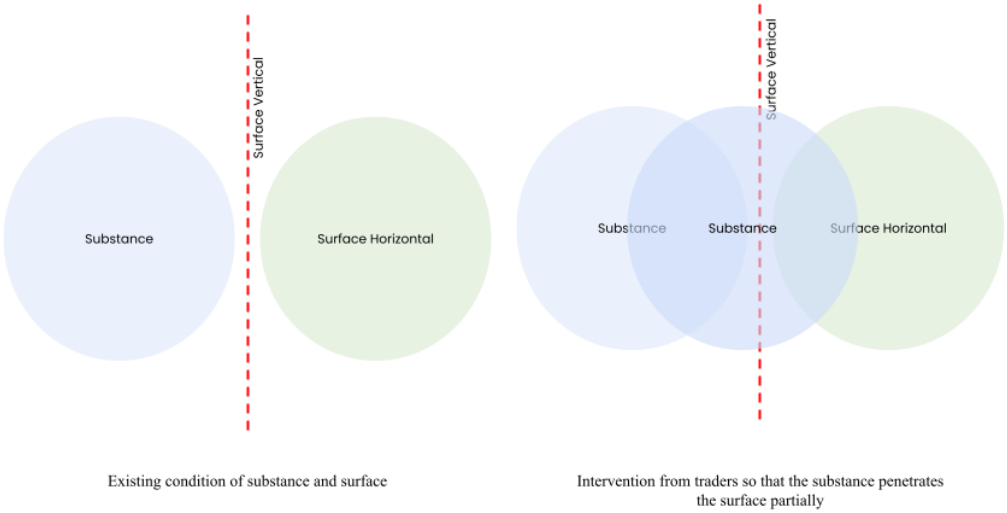



**Figure 5.** Existing Condition Diagram and Substance and Surface Intervention

### 5.2 Street Vendors Sell in Front of Shops That Are Open or Closed, Even Though the Activities Inside The Store Have Different Functions

Figures 6 (a) and (b) show two different activities that sell simultaneously; inside the shop is a clothing shop with closed sales and on the outside is a street vendor selling meatballs. Both traders are open every day simultaneously from 10.00 WIB to 18.00 WIB. The street vendors choose to sell regularly in front of the clothes shop because the shop's location is quite strategic, so it has easy access to visit. If observed, the space use pattern of the meatball vendor uses part of the outside area of the clothes shop; the dining area is placed right in front of the barrier (opening), which is still part of the shop, while the street vendors' carts are placed in a part of the pedestrian path. Figure 6 (c) shows the response of shop owners to street vendors who sell in front of closed shops, the condition of these street vendors can provide benefits for clothing shop traders because with the presence of street vendors selling in front of the shop, these street vendors can be used as an intervention to attract interest—area visitors who

want to eat on the spot. So, after a visitor finishes eating, the visitor usually enters a clothing store to look around and buy it. Figure 6 (d) shows that the dirty plate and glass washing area is placed on the outside so that many pedestrians complain because they are quite disturbed, especially when the shop is full of shoppers; as a result, pedestrians cannot walk on the pedestrian path. In practice, pedestrian paths are expected to have easy and safe mobility to create an experience and interaction.

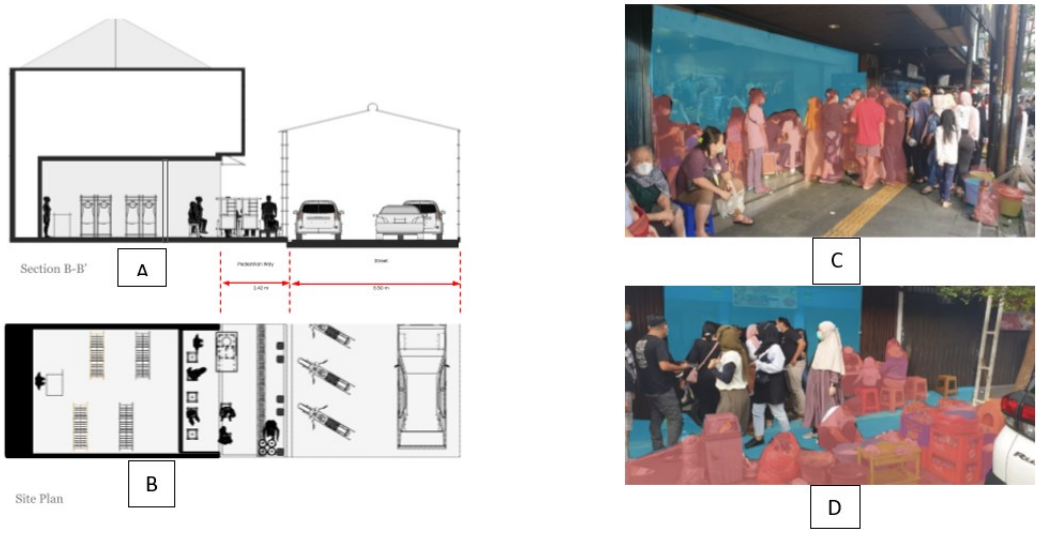



**Figure 6.** (a) The overall cut of the trading space; (b) Circulation and Mobility; (c) Merchandise cart in front of the shop; (d) The washing area is located on the pedestrian path

Based on this, it can be concluded that the presence of street vendors indicates that there is intervention from outside to inside, so that street vendors create a new function space, namely the public area as a selling area. Furthermore, the street vendors are part of the substance of the clothes shop. However, it becomes a distraction for pedestrian circulation. We know that pedestrian paths in urban areas are critical to facilitating pedestrians, so pedestrian comfort and safety are the focus that must be considered (Figure 7).

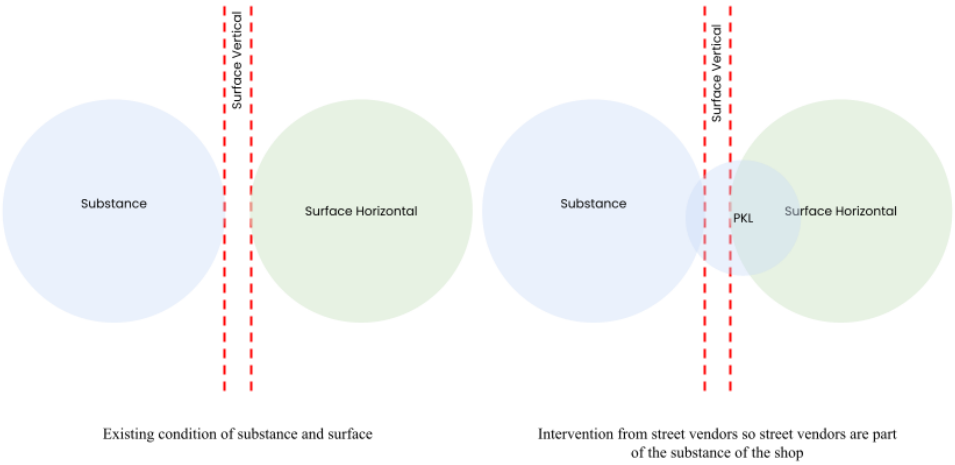
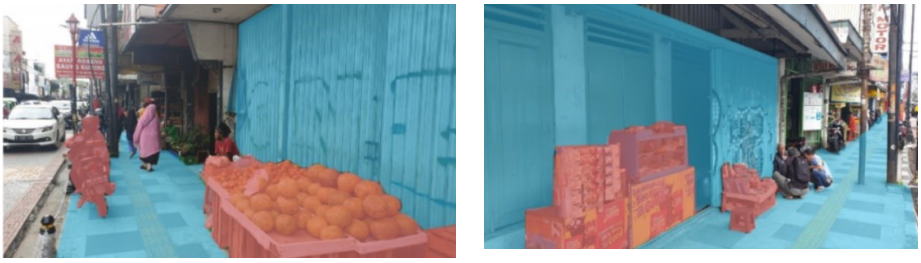



**Figure 7.** Existing Condition Diagram and Substance and Surface Intervention

### 5.3 Street Vendors Selling in Front of Inactive Shops

Figures 8 (a) and (b) show the activities of street vendors who sell temporarily. The PKL considers that the closed shop with a dead surface is a significant and profitable potential because the PKL can sell using the entire surface of the closed shop. In general, the target buyers from these PKl are day laborers and drivers of public transportation, so these PKl only sell drinks and snacks. However, these temporary street vendors often experience problems when selling because government officials often reprimand these street vendors because they are considered to be selling illegally and disrupting the activities of pedestrians. Based on the observations and analysis results, these temporary

street vendors need to be addressed and given proper space to sell. These temporary street vendors can be used as an intervention that can revive pedestrian paths.

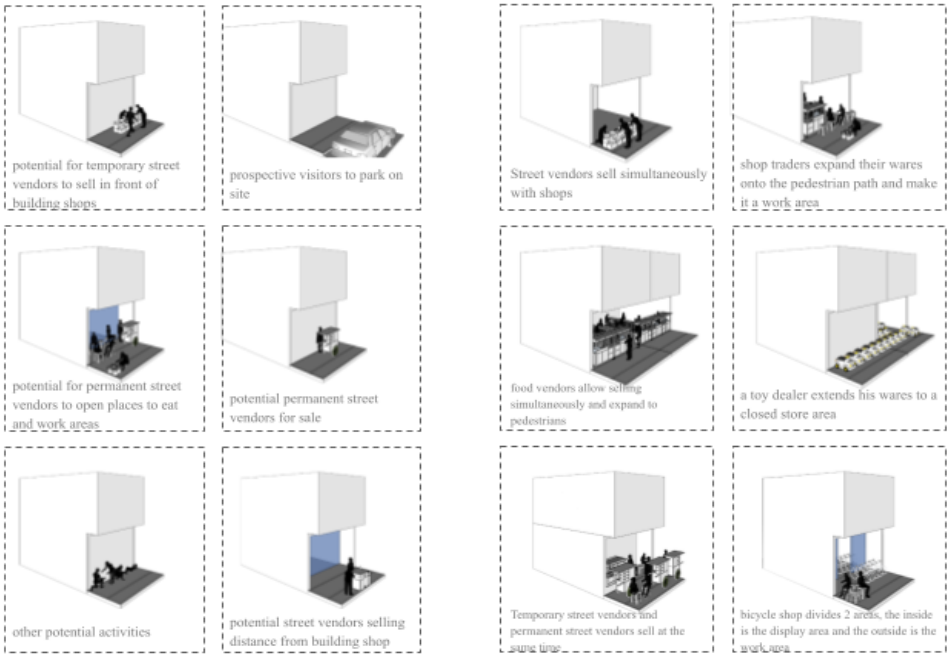


A B

**Figure 8.** (a) Temporary fruit seller; (b) Coffee and fried food seller

**5.4 Behavior, connection, and pattern of substance use of space on the surface**

Figures 9 (a) and (b) show the behavior, connection, and pattern of space used by street vendors and shop owners in city public spaces. It can affect the activities of city space users, especially pedestrians on the pedestrian way. Figure 9 (a) shows the behavior of street vendors and the activities of urban space users towards closed shops, so street vendors are the substance, and closed shop faces are vertical surfaces (facades) which are accommodated by horizontal surfaces (pedestrian way and pedestal). Figure 9 (a) shows that these street vendors have three behaviors towards shop owners. Street vendors intervene to shop owners because street vendors can attract visitors to the shop. Hence, street vendors and shop owners have a mutually supportive relationship with the pattern Street vendors in front of the shop. Second: street vendors have closed shops and have a pattern of street vendors in front of the shop. In general, street vendors who have occupancy behavior are usually street vendors who sell temporarily. Furthermore, the existence of street vendors on the pedestrian way can cause a distraction for city space users because the patterns created by street vendors can interfere with pedestrian circulation. There are work areas that are placed and use almost all pedestrian paths. Then, figure 9 (b) shows the behavior of street vendors and the activities of urban space users toward open shops. In figure 9 (b), it can be seen that street vendors and shop owners sell simultaneously, so the relationship between street vendors and shop owners has a mutually supportive relationship; therefore, street vendors are part of the substance of shop traders. However, there are shop traders who expand their wares so that they have a substance pattern that is partly inside the shop and partly outside the store. The existence of an expanding substance tends to make the public space an intervention area and make the public area and area for selling.




A B

**Figure 9.** (a) The behavior of the substance when the surface is closed; (b) The behavior of the substance when the surface is exposed

**5.5 Results**

In this case, three elements are interconnected and become the focus of the substance and surface approach: behavior, relationships, and space use patterns. Behavior describes the relationship between street vendors and owners, whether or not to intervene or for occupancy and distraction. Then, the relationship explains whether street vendors and shop owners support, harm, and interfere with each other. Also, the pattern of use of space by street vendors and shop owners, whether in front of the store, separate in front, and partially inside and outside, is the focus of table 1.

**Table 1**. Process Analysis of Substance and Surface Mechanisms

| No. | Space Function | | Behavior | Connection | Space usage pattern |
|---|---|---|---|---|---|
| | Inside | Outside | | | |
| 1 | Clothes shop | Food Merchant | Food vendors intervene in visitors | mutual benefit | in front of the shop and merge |
| 2 | Shop Closed | Temporary street vendors | Temporary street vendors occupy a closed shop | loss | upfront partly inside and outside. narrow the pedestrian path |
| 3 | Shop Closed | Other Activity | Permanent street vendors occupy closed shops | Bother | in front of the shop and merge |
| 4 | Cafe | Permanent street vendors | Permanent street vendors intervene visitors | mutual benefit | in front of the shop and merge |
| 5 | Toy Store | - | Expansion, so that distracts the pedestrian path | Disturbing pedestrian activity | upfront partly inside and outside. narrow the pedestrian path |
| 6 | Food Traders | - | Expansion, so that distracts the pedestrian path | Disturbing pedestrian activity | upfront partly inside and outside. narrow the pedestrian path |
| 7 | Bike shop | - | Expansion, so that distracts the pedestrian path | Disturbing pedestrian activity | upfront partly inside and outside. narrow the pedestrian path |
| 8 | Eyeglass Shop | Food Traders | Food vendors intervene in visitors | mutual benefit | in front of the shop and merge |

In this case, the three elements are associated with the function of space in the Suryakencana area; the results obtained are:

1. The function of the space that is different between inside and outside can provide intervention for the space inside so that it is mutually beneficial
2. The function of the indoor space that is no longer used and the function of the outside space occupied by street vendors or other activities can harm shop owners
3. The function of the same space between the inside and outside can distract pedestrians, thus narrowing the pedestrian path

**6. Conclusion and Recommendation**

This study indicates that interactions, behavior, connection, and space use patterns are the basis for knowing the role of substance and surface in urban public spaces. So, based on observations of the four aspects, results show that the open surface gives the substance inside the opportunity to expand to the outside. Moreover, it shows that a closed surface provides an opportunity to transform the surface into part of the substance if there is an intervention. Substance uses a surface if the substance functions as an attracting element or sign for consumers. Substance uses a vertical surface (facade) and a horizontal surface (pedestrian), while substance uses a surface as a workspace. The substance is on the face of an open vertical surface; the substance also plays a role in attracting visitors to the store. The presence of a substance on the horizontal surface (pedestrian way) makes the pedestrian way also functions as work or commercial space and a driving force for the life of urban space. However, the presence of a substance on a horizontal surface (pedestrian way) can cause a distraction for pedestrian circulation.

Understanding the phenomenon, intervention, symbiosis, and disturbance by substance on the surface in urban space, in this case, the pedestrian way (especially road Suryakencana) will facilitate the realignment of the role of substance on the road by making urban design guidelines for livable and interactive urban public spaces. This conclusion only looks at the substance of street vendors, kiosks, shop surfaces and their facades, and the pedestrian way. I have not seen the relationship between substances such as parked vehicles, and elements of urban space, such as signage, with horizontal and vertical surfaces. So further research is needed.

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**Conflict of Interests**
The authors declare no conflict of interest.

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# Assessing The Role of Natural Soundscapes in Urban Areas and Role of Landscape in Bringing Back the Lost Voices of Nature

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**Abstract**
Nature made every living being on earth to communicate and get lost in its voices. Imagining a nature without its voices is impossible as everything in this world communicates and is interconnected. Landscape acts as a connecting link for the sounds of nature and organisms. “Cities” the hubs for the noises in this world are muting the nature’s hum. By muting un-wanted noises one can re-hear the nature’s sounds. The inter-dependency of everything in this nature, either a living or a non-living thing is making these sounds possible. The ecological settings for any ecosystem are organised which enable to communicate to the other. When the system is disturbed, it faces an immense affect and create communication gap between the living and the non-living things. The study focusses on the sources of nature’s sounds, noise causes that deplete natures' voices and the proposals of possibilities to overcome the loss of Natural-Soundscapes.
**Keywords:** Nature’s Muted voices, Landscape and Soundscape, Noise pollution, Nature's voices, Sounds from the woods.

## 1. Introduction

**Aim:** To study the nature of natural sounds and the way they are missing in the urban context. Arriving at possibilities to bring back the lost sounds of nature into cities.

**Objectives:**

- To study about sound and its role in nature.
- To find the causes for the muting or missing of the natural sounds in cities.
- To also know how the dominating noises of urban life made the natural voices mute.
- To study few Soundscapes projects in the world that will be set as a good example and to revive the lost voices of nature in cities.
- To co-relate how landscape can help to bring back those lost sounds and make cities more Soundscape friendly by creating natural spaces.

**Scope and Limitations:**

**Scope**: I in my research paper will be talking about the relation of nature and its sounds, issues thinning these sounds. By taking the example of Delhi's situation I will arrive at strategies to bring back those lost sounds of nature.

**Limitation:** I limit my study to the natural soundscapes that are there in the world by considering landscape as an anchoring point.

## 2. Methodology

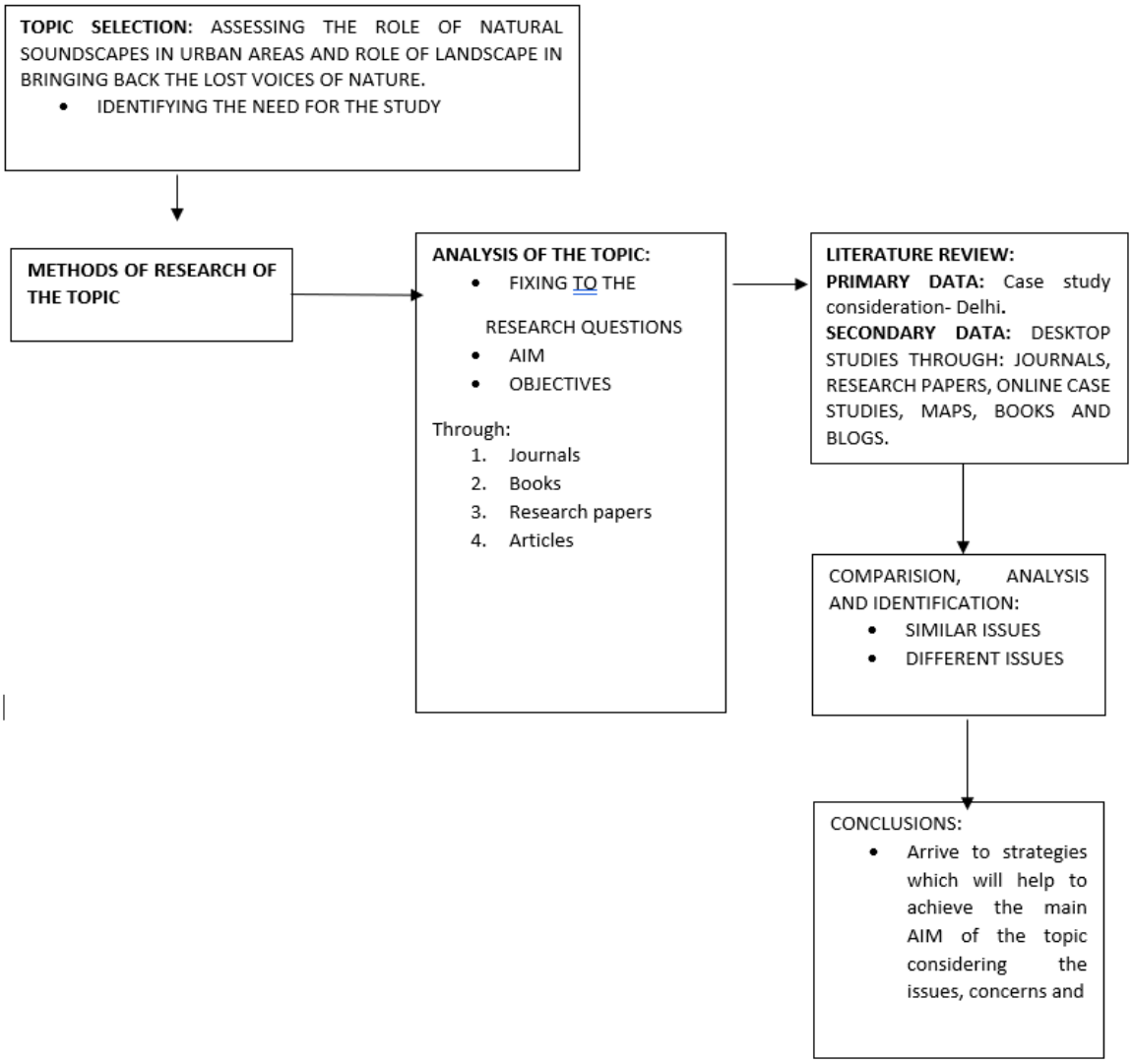



**Figure 1**. Structure or Methodology of the Study

## 3 Definitions

### 3.1 Soundscape

Sound, which is one of the five senses of humans, acts like an anchoring joint to connect many things in this world. Soundscape as a broad study is defined as a component of acoustical environment which can be heard and perceived by various living beings. Soundscapes has its varied history which is depending upon the discipline it has been used, (ie) it is ranging from its use in urban design to wildlife ecology. Though acoustical environment is a much wide and a broader study whereas the term soundscapes is just a part of it. In any given area one can identify a wide combination of various acoustical resources which are again divided in to Natural and Human made sounds as directed by the environment. This is called acoustical environment. Looking into its history the term soundscapes was framed by R.Murray Schafer , who was a Canadian composer and an active environmentalist and is considered as a Father or Soundscape. According to him Soundscape is a final resultant sound of the combination of various sounds that comes from an immersive environment. Sound is a study of Acoustic ecology. According to Schafer Soundscape is basically composed of three main elements:

- Natural acoustic sounds
- Human created sounds
- Machinery sounds.

Bernie Krause, musician, and bio acoustician, in his terms reframed the elements of Soundscape as three:

**Geo-phony**: The name itself defines it's as the sounds that are emerged from the Soundscape sources that generate non-biological natural sources wind in the trees, water in a running stream and waves of an ocean etc.
**Bio-phony**: As the name denotes from its prefix "Bio" which means life. The sounds that are generated from the non-human and non- domestic biological Soundscape sources of sound.
**Anthrophony**: These are the sounds created by the humans.
If we consider the Soundscapes and the environment there are two distinct verities of Soundscapes created by the environment. They are

- Hi-fi
- Lo-fi

Hi-fi system of sounds are basically the sounds which possess a positive signal-to-noise ratio. Which means in this system of sounds the settings that are there will let one possible to hear the discrete and specific sounds without any distance created by the background noises. For examples, if we consider the rural areas, the rural landscapes will generate more hi-fi frequencies than the city because of the natural settings of a landscape will create an opportunity to hear the sounds from far and near. Whereas in Lo-fi soundscapes the sound signals are very close and compact, in which one can listen to immediate sound encounters. In many cases even ordinary sounds must be highly amplified in-order to be heard. However, all sounds are unique in nature, and they are generated in one time in one place and can't be repeated or replicated. (https://en.wikipedia.org/wiki/Soundscape)

**3.2 Soundscape Ecology**

Soundscape ecology is basically defined as a study, in which the sound in a landscape and its effect on organisms are studied. These sounds that are generated may be from the sources of biophony, geophony and anthrophony. The variations in soundscapes will have its effects on various organisms in obtaining information's from the environmental sounds which range widely. Around the world many of the active soundscape's ecologists are investigating in various ways in framing structure of soundscapes and explain how the sounds are generated from their respective sources. Along with these studies they are understanding how this will affect various organisms. (https://en.wikipedia.org/wiki/Soundscape_ecology)



**Figure 2.** The sounds generated from the natural landscape elements like running water will account for a natural Soundscape (Source: https://www.patriotdirect.org)

The sounds that are created by any organisms are generated with an intension of creating an acoustical niche among that species of organisms. This enables those organisms to communicate in that acoustical niche. Any disturbances created in the frequencies of these acoustical niche affects the organisms and their functions too. On another hand these affects signal the thinning of the species number or acts a sign of their extinction. Of all the soundscapes Anthrophony, which means sounds created by humans, dominates other soundscapes in cities particularly which creates noise and leads to noise pollution. As this led to the muting of biophony and geophony voices of nature there came a need to concentrate on conservation of natural soundscapes which is recognized as a conservation goal by many active environmentalists. Acoustical ecology emerged as a separate science in which most of the environmentalists had involved in restoring and conserving the ecology which is directly helping in conserving the acoustical niche created by these organisms.

### 3.3 Noise pollution

The annoying or the disturbing sounds created by any sound source, which is unpleasant is called Noise. Noise pollution is the excessive and disturbing noise that is created which on other hand disturbs the ecological systems and is harm to humans and other animal life. The source of most of the noises is mainly human created through the machines he uses and the vehicles he drives. The sources of the noise pollution is mainly from factories through their machines and vehicles like motor cycles, airplanes, trains and other transportation systems. Industrial revolution which led to the birth of machines and increase in number of factories is one of the main reasons of creation of noise pollution in urban areas. The crowd that migrates to cities from villages in search of employment gave rise to urbanization and thus to transportation which resulted in more urban noises and noise pollution. Moreover, a poor urban planning also plays its major role in creating such unhealthy and unpleasant environments to live to its dwellers in residential areas when the industrials areas and major highways are close to their residential areas (Amen,2022). The indoor noises that are created in-between few walls spreading to a very small area don't show its major negative impact on the environment.

## 4. Landscape and Soundscape

### 4.1 Nature's Sounds

Nature has its own unique way of connecting various species in various manners. Sounds are one of many such ways that the nature made its various kinds of species to identify, connect and communicate among themselves. Geologically and biologically nature has a wide variety of sounds which are created by many natural elements like wind, water, animals, birds etc. As we had already discussed that Biophony consists of sounds created by various biological and non-human elements like organisms and Geophony consists of the sounds which are made by non-living elements of nature like sounds of splashing and flowing water in a stream, sound of wind, crunching of leaves on a mulch and trees. Sound being one of the five senses acts as an anchoring point for a human to enjoy these nature's sounds and connect to the natural world. A walk or by sitting in a park, noticeably or un-noticeably makes one to hear to many sounds like a buss of a bee, sounds of wind, the blowing wind that moves the leaves, sounds of various birds. All the sounds made by various elements of nature are connected to other elements in the nature itself. For example, if we consider a bee buzzing it need flowers which store nectar for it. If in case a flowering plant isn't there, the sound of buzzing of a bee wouldn't have been there. The acoustical niche that are created by various animals and birds helps them to communicate in migrating, defending, reproducing etc., should never be disturbed. Cities which stood as a hub for noise pollution has its effect on the lower organisms.



**Figure 3.** The humming of the birds (Source:http://manythoughtsoncewritten.blogspot.in/)

In a study it's shown that grasshoppers are getting extinct in few cities where noise pollution is there, as their mating calls are being disrupted by the heavy vehicular and machinery sounds. This which in turn will directly show the reduction in reproduction of these organisms and reduce the number. This is not the story of only one species but most of the species that is directly affecting their habitat. The natural setting of any area will let the water get collected at a low point called watershed and thus it will lead to a stream. The sound of running water is very soothing. If one takes a walk in the woods where there is a stream, can hear splashing water in a stream. The habitat that it created supports vegetation that will give shade and act as a place of shelter to the birds to nest. Topographical conditions including the slopes, the soil conditions and the climate of that place will manage habitat. If anyone gets disturbs that shows the downfall of the other. The bird that is humming, the bee that buzzes, the water that splash while flowing, the leave that crunch when the wind passes on and the wind that blows all these are the sounds that nature had set for us to enjoy and rejoice. Rachel Carson named this a "Nature's Music". Yes, the music that the nature is singing for us. It's a communication that will lead one to a different world. In another way to tell the nature

speak with us through these sounds. These deeply nourishing natural sounds are the signs that acts like a kind or window or an aural portal into the complexity and the diversity of living and non-living things that are there around us. The Geophones and the bio phonies together contribute to the natures sounds. These sounds will represent the biodiversity and the complexity that the nature has. The change in seasons and the climatic conditions again has an impact on the migration of these bird and animal species. The ecological conditions thus, will how sustain a habitat, the organisms in it, their sounds, and the natural soundscapes.

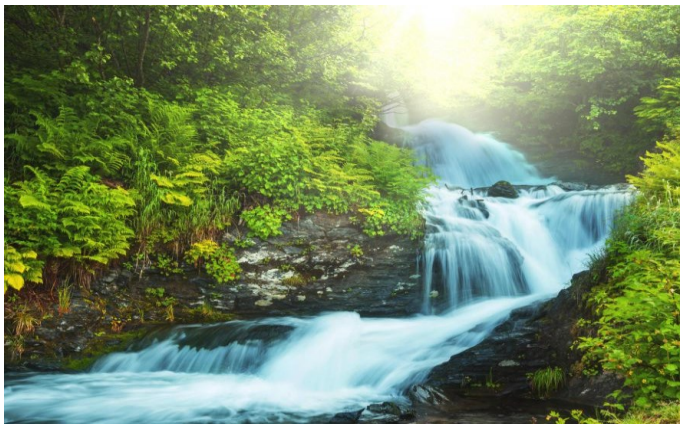


**Figure 4.** The running water in a stream or a water fall is another source of nature's sound, *(*Source: http://activerain.com/)



**Figure 5:** The wind that moves the tree branches and the leaves is another source of Natures sounds that give the rhythm of the wind blowing (Source: http://www.gettyimages.fi/)

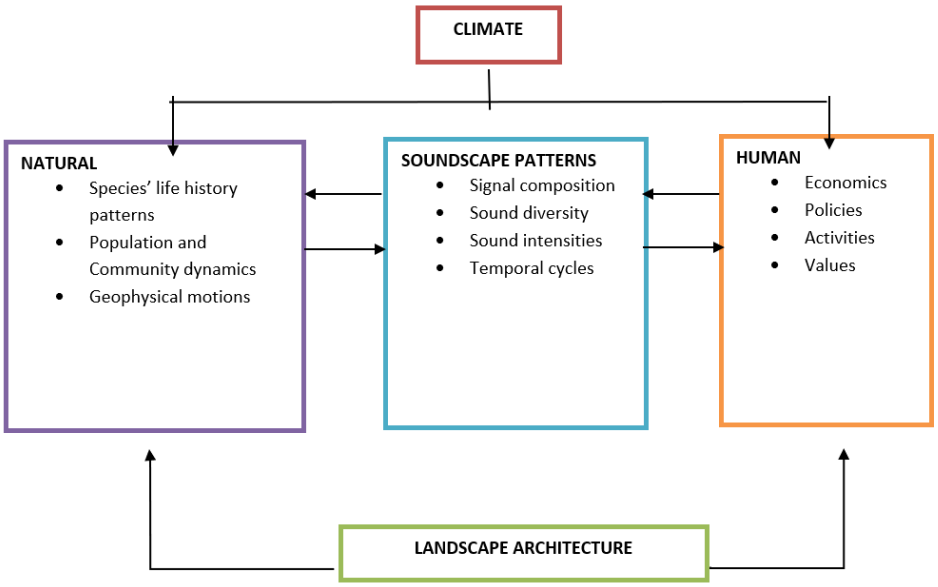



**Figure 6.** Conceptual framework for Soundscape ecology (Source: Site Soundscapes, Landscape architecture in the light of sound, Per Hedfors, Department of Landscape Planning Ultuna,Uppsala)

**4.2 Sound as a part of Landscape Architecture**

Landscape architecture is mainly related to the natural elements like water, vegetation, wind etc. In fact, it evolved using the elements of nature. Soundscape mainly natural soundscapes are sounds which is evolved from the natural landscapes i.e., the elements and organisms there in that landscape. In a rural area which had the natural landscape setting the rhythms of nature are heard which will connect one to nature. But in an urban context where natural settings are not always a part of it. Landscape architects generally use few landscape elements in showcasing and capturing the sounds of nature. For examples, by creating a fountain or any other water feature, one can feel the sounds of water that is splashing and creates an ambiance in that space. Though fountain, waterfall or any water feature is something artificially provisioned and created the element water, that used is basically from nature.



**Figure 7.** An artificially created waterfall that is designed along a road in Kansas City metropolitan area.

The cities which are on the banks of any river, as a part of their development programs and in the part of urban planning and design various river front parks and waterfront developments are done. This is one aspect of ecological development to free out some space that separate the quite areas and the busy urban noisy area. The sounds of water, wind, the birds etc., will act as the source to generate natural soundscapes in cities. In a way such projects will act like an anchoring point to make one get connected with the nature. Various community parks, lake side parks, riverfront barriers, ammusement parks on the shores of the sea etc are the concepts of waterfront developments which will connect to one main big natural element water and later to wind in such vast open areas.



**Figure 8**. A river front park on the banks of Arkansas River (Source: http://www.sayweee.com/article/view/8nvo1)

## 5. Urban Sounds

### 5.1 Urban Environment

Cities which are a hub for many happenings around the world, are like core points to attract various crowds of populations. Cities which are an anchoring point that allows its populations and migrants to settle and move to them as they have a wide verity of opportunities, education, employment, entertainment, transport, amenities etc. The cities are always happening with its active populations, traffic, markets, parks, plazas, skyscrapers, rail, road and air transport networks, office, educational, administrative buildings, residential colonies, slums, etc., But in the process of expanding the city size we are eating up the natural areas and, in a way, disturbing the nature.

### 5.2 Noise Pollution and Sources

The heavy traffic sounds along the roads, machinery sounds in the factories and industries are the main sources of heavy noise pollution created in cities and other urban environments. Noise disturbs the soothing and silent environments finally resulting in giving less peace to the humans and living organisms living in it. Baring large number of active populations, road traffic, construction activities and by expanding the cities are in a way expanding the noise environments also. The increase in production of vehicles and machinery, in a way disturb the peaceful environments with their increase in noise levels. The sources of noise are basically listed as Traffic, industry, household, public address systems, defence equipment, agricultural machines, and other miscellaneous sources. All these noise sources have a lot of impact on the systems of living beings and in humans. (https://en.wikipedia.org/wiki/Noise_pollution)

#### 5.2.1 Disturbances on Humans

Noise is being a disturbing source for the city's residents. As we had already discussed that heavy noise pollution has its impact on the Human health which led to many physical, physiological as well as psychological effects. Most of all the effect of noise pollution leads nowhere and erases the peace in the environments which is the most needed thing to a human. **T**he main physical disorders that noise pollution let is its direct impact on hearing. Heavy sounds in factories were the workers must stand in front of the machines and work entire day will finally affect his hearing system. Negative physiological impacts that are shown on humans is that heavy noises will affect the cardiovascular system of humans leading to heart attacks, cardio attacks, impairment of night vision etc. Psychologically also noise pollution effects humans snatching the peaceful environment. Various psychological manifestations of noise pollutions are depression, Insomnia, straining of senses annoyance, emotional disturbances etc.



**Figure 9.** A picture depicting the way how various urban sounds disturb human beings (Source: https://en.wikipedia.org)

The effects of noise pollution on humans basically divide into Auditory and Non-auditory effects.

**5.2.2 Disturbance on Fauna**

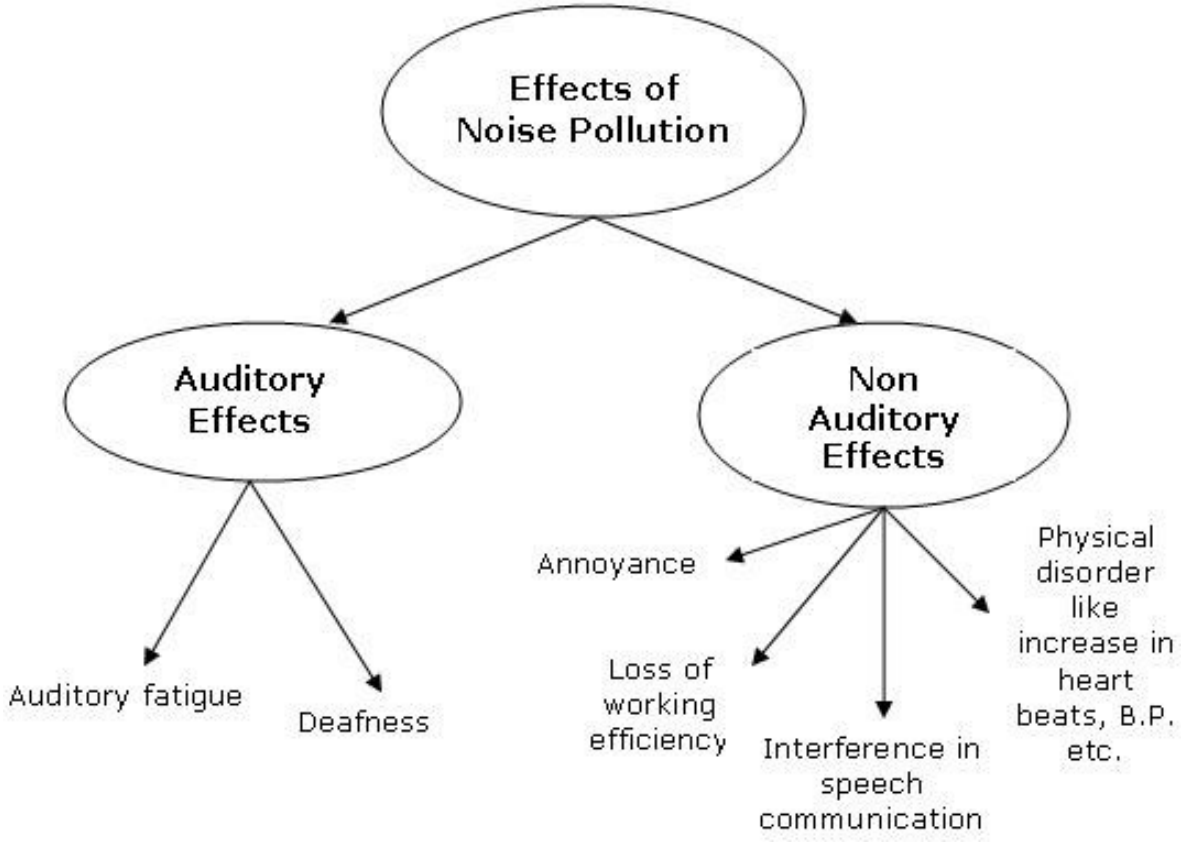



**Figure 11.** Effects of noise pollution on humans (Source: http://www.indiaonline.in/)

The Lower set of living organisms present in nature have a very sensitive noise baring capacity. As we know that the nature bares a delicate balance in the wildlife and their predator and prey detection and avoidance, communication of living organisms for reproduction, safety, navigations etc. These are the settings that the nature has set to itself to sustain its organisms and to maintain various ecological conditions. This thin line of delicate balance must be maintained by them. Lower living organisms like birds, insects, small animals etc. are the main types of wildlife that the noise pollution impact, by disturbing the habitat of noisy areas, which in case of endangered species may take a path to extinction. In some cases, when there is a lot of noise that might even make the species communicate much louder than the usual sound level, they communicate on by masking the other organisms and finally leading the whole ecosystem to speak and communicate more loudly. Mostly these are like signals of warning to its fellow living beings when any danger is surrounding them. This is another way of noise pollution that is created by the nature itself. This is called Lambard vocal response. For example, the Wales generally communicate to 75dbls, but when the sub-marine detectors are on their voice increase and that creates a Lambard vocal response at about 85dbls which is very high. This is one example which showcases the disturbances that is created by human activities in the actions of other living beings. In certain cases, the voices of small living beings like birds are muted by the noises that are generated by heavy vehicles and machines.

**6. In the Context of Delhi**

**6.1 Delhi's natural conditions**

Delhi ridge or the Ridge is present in the National capital territory of Delhi in India. The ridge is a northern extension of the ancient Aravalli Range, some 1500 million years old (compared to just 50 million for the Himalaya). The Delhi Ridge is said to be the green lungs for the city and protects Delhi from the hot winds of the deserts of Rajasthan to the west. It is also responsible for earning Delhi the tag of the world's second most bird-rich capital city, after Kenya's Nairobi.

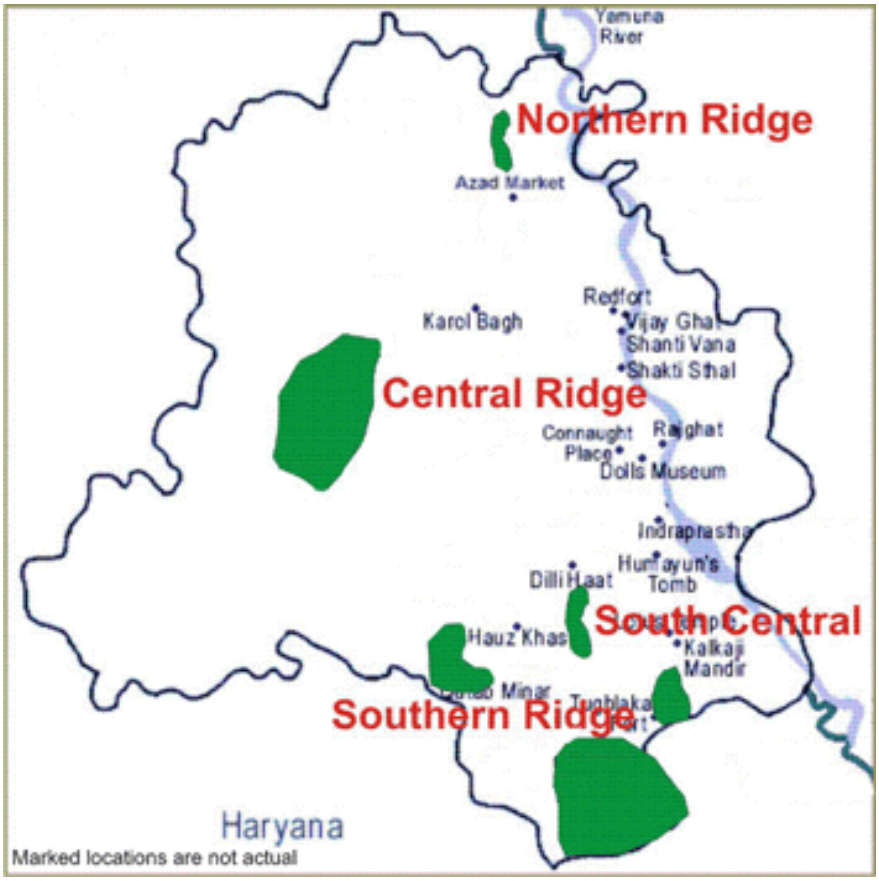



**Figure 12** Map showing the locations of four parts of Delhi ridge that is present today. (Source : http://toxicslink.org/delhiridge/map)

The Ridge today, for administrative reasons, is divided into 4 separate zones,[7] namely:
1. The Old Delhi or **Northern Ridge** denotes the hilly area near Delhi University and is by far the smallest segment of the Ridge. Nearly 170 hectares were declared a Reserved Forest in 1915. Less than 87 hectares remain today, which is slated to develop as Biodiversity Park by the Delhi Development Authority.
2. The New Delhi or **Central Ridge** was made into a Reserved Forest in 1914 and stretches from just south of Sadar Bazaar to Dhaula Kuan. It extends over 864 hectares, but some bits have **been** nibbled away.
3. The Mehrauli or **South-Central Ridge** is centred on "Sanjay Vana", near JNU and Vasant Kunj, and encompasses 633 hectares. Large chunks have been encroached and built upon.
4. The Tughlaqabad or **Southern Ridge** sprawls across 6200 hectares and includes the Asola Bhatti Wildlife Sanctuary. This is the least urban of the 4 segments of the Ridge, but a lot of it is village-owned or privately owned farmland. (https://en.wikipedia.org/wiki/Delhi_Ridge)

**6.2 Human interventions and Disturbances**

As a Nation's capital Delhi is baring about one fourth of the national population, i.e around 25 million population crowd. In the process of extending the city to accommodate its migrants in it, Delhi's ridge was occupied and disturbed for various constructions and developments. As the ridge has a great treasure off Delhi red quartzite and other stones it was mined vigorously without assuming the depletion of the vast forest area that support a wide variety of ecosystems in it. This created a heavy loss in the vegetation, fauna and natural slopes that showcase the ridge conditions. In 1982 a study done by the School of Planning and Architecture, New Delhi, it was stated that about 40%of the ridge has been destroyed. The main activities are stated are large and uncontrolled encroachments and use of ridge for non-forest purposes which lead to the shrinking of ridge. This created a lot of depletion in the ridge's original frame and thus to the ecological situations it had. The land under Aravali Biodiversity Park was once a site for mining. Land, which once was covered with a dense forest, soon turned into pits and hillocks.



**Figure 13.** A part of mined site in Aravali biodiversity park, Gurgaon.

It was around in 2002 that the mining activities were given a check in awakening the Ridge's depleting scenario. In the process of recovering the ridge from the aftereffects of mining, and other non-forest uses the various voluntary organizations, citizens' groups, NGOs had arrived forward with many programs in rising awareness of the need of recovering and protecting a huge chunk of natural forested area, which welcomed and is still welcoming many species back to their home. Another aspect that disturbed the natural conditions of the Delhi's ridge is the introduction of few of the exotic species that totally changed the vegetation type of the ridge. In the process to making the ridge green a tree a tree species called *Prsophis juliflora* was planted which is an exotic species from France. This was planted by French people around 1880, it became so invasive that it didn't allow another species to grow under it. Despite it being a tree that is adaptive to any soil and moist conditions, ecologically it's not at all a friendly tree, as no bird nets sunder it and no animals feed on its leaves.

Yamuna River which is the major water source for Delhi is being mixed with almost 19 drains that carry sewerage from the city. This is the most miserable way contaminating the river. This in way is affecting the river ecosystem and causing to the loss of many river bases species. The flood plains are Yamuna River are misused for constructions and a space for natural habitat and hazard management have been concreted with buildings and roads leaving no scope for the 50 and 100-year flood plains to bare the flood. This is again disturbing the Urban habitat.

**6.3 Muted sounds of Delhi**



**Figure 14.** Constructions that are made on the flood plains of Yamuna River (Source: https://sandrp.wordpress.com/2013/11/29/river-yamuna-through-the-prism-of-political-manifestos)

In the process of development that is happening in Delhi is leaving o space for the birds and animals that thrive upon. Slowly the city is losing the nature's species that sing, hum, communicate in their own way. Acoustic communication is one of the most crucial aspects of bird behaviour having a bearing on the very survival of a species in each habitat. Birds are one of the most vocal classes of animal kingdom and depend on acoustic signals to attract mates, defend

territories, synchronize behaviours, and warn of dangers. However, their habitats can be noisy because of biotic and abiotic sounds, which interfere with signal detection and limit the range of communication. Although a wide variety of habitats have been investigated for their impact on animal signal design, until recently these did not include the urban habitat.

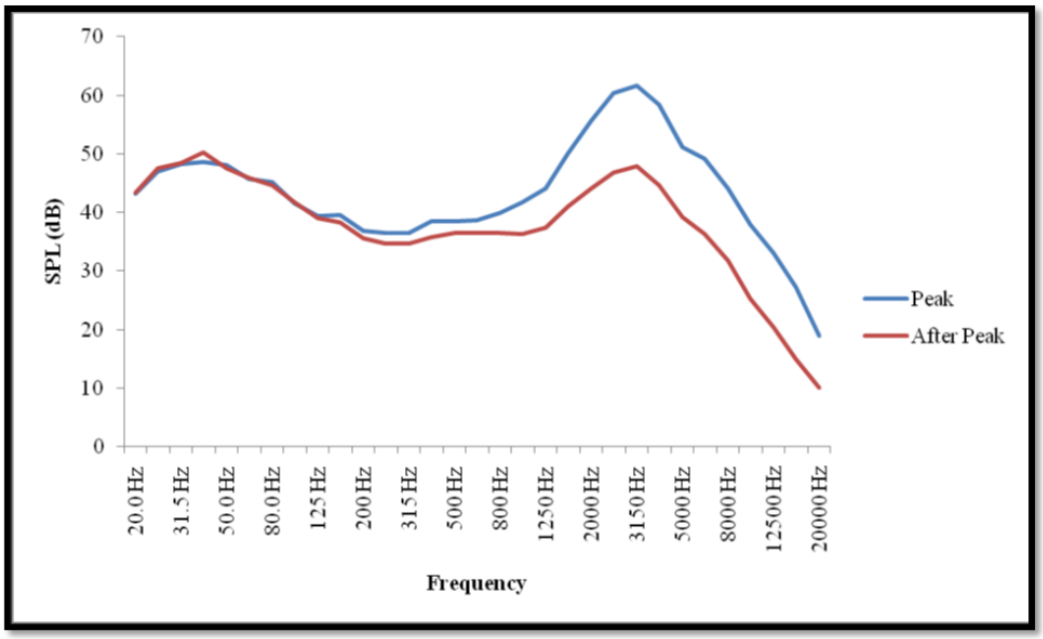



**Figure 15.** Power spectrum of Peak and after peak dB levels of dawn chorus at the ISTM (JNU Old campus) site. (Source: http://rspb.royalsocietypublishing.org/content/280/1773/20132290)

**7. Case Studies (Selection Criteria):**

To welcome the pleasant sounds into a city context it is very important to know the situations and activities that are happening in these urban spaces. To voice up the sounds of the nature, one should reduce the intensity of noise pollutions that is aching the urban environments. As a part of it one should know the method of Sound mapping which will help us to have a check on the activities leading to noise. There are projects around the world which are done as a ecology specific but not Soundscape oriented

The case studies for the Soundscape are selected based on three basic considerations:

- Noise mapping
- Natural sounds into urban contexts
- Artificially created soundscapes
- Natural sounds
- Musical sounds

**7.1 Noise Mapping**

Noise pollution which is a very serious problem these days in cities is killing the pleasant environments and muting the natural sounds. The sounds of vehicles, machinery, activities taking place at the events, market spaces, loading, unloading, conversations, gatherings etc. are the main sources of noise that is created in the cities. These sounds intensities should be measured according to the range of low, medium, and high levels of decibels and are categorized based on the activities which are becoming the main points of source to generate the noises. The method to be choose for these exercises is called Sound mapping. Mapping of sound in the areas, can help one to understand the activities to be eliminated, elements to be incorporated to enhance the natural sounds and the maintenance that can be done to sustain such areas.

For this purpose, as a part of noise mapping an exercise is done by the students of Department of architecture of C.E.P.T, Ahmadabad.

**7.1.1 Case study 1**

**Location**

This is mainly a sound mapping exercise done considering a very busy market area in Ahmadabad called Sindhi market which is near the Kalupur gate.

**Activities**

It is a very heavy activity baring area encouraging activities like shopping, hawking, loading, and unloading, having conjunction of traffic and vehicle movement, conversation, pouring etc. It is an ideal example for a typical market space which is a source to major noise generation area in cities. Such markets in Indian context are also the main source for attracting the crowd for shopping, business, hangout purposes etc. Noise which is the main disturbing problem in this main activity attracting market should be mapped out and categorized to take any steps to reduce it.

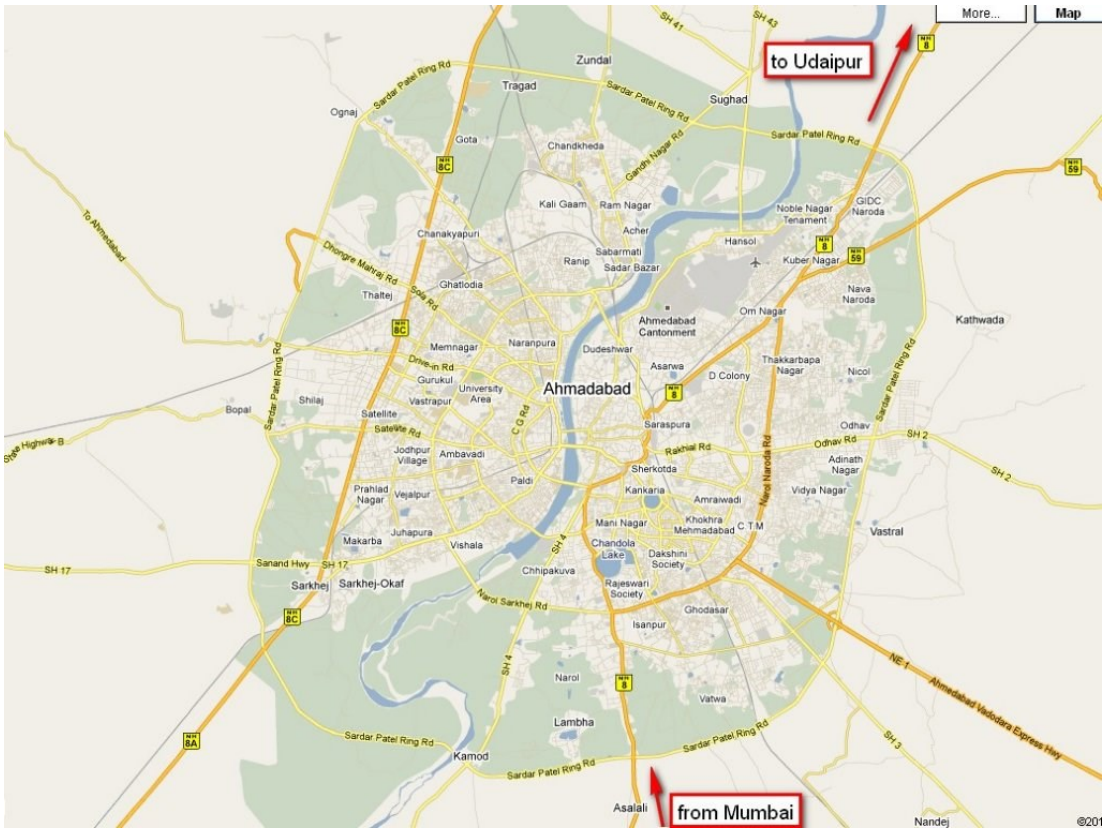



**Figure 16.** Map of Ahmadabad (Source: https://www.iter-india.org/map_ahmedabad.htm)




**Figure 17.** Location of Sindhi Market (Source: https://www.google.co.in/maps/place/Ahmedabad)




**Figure 18.** Activities happening in and around Sindhi market (Source : https://www.google.co.in*)*




**Figure 19**. Texture Map of Sindhi Market (Source: M.L.A, CEPT )

A Map of Sindhi market is taken and the activities that are happening in the market space are keenly observed that generate sounds. The activities are noted and the noise that is emitting out of these activities is recorded and is categorized as Low, Medium, and High. The measurements of sounds in a decibel form is finally formatted using a software called “Revan" This is done using a grid and is mapped accordingly. Various activities are mapped accordingly in a separated procedure, and a layering of the activities and the sounds emitting out of them are done.

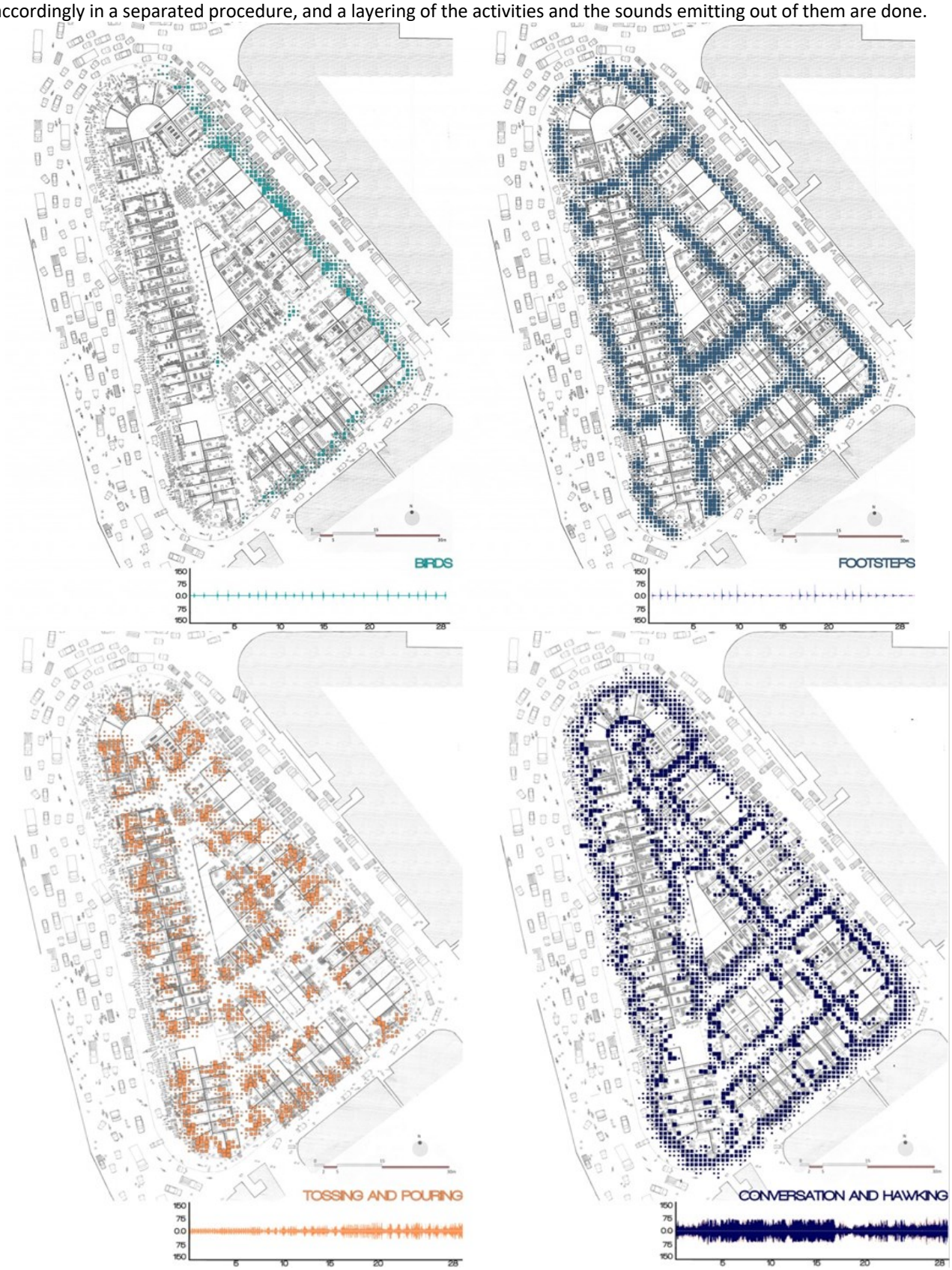



**Figure 20.** Sound mapping of Sounds emitted by Birds and by Footsteps (Source: M.L.A, CEPT)

The sounds that are emitted by the above activities are market and are layered to understand the intensity of sound is affecting the spaces and what are the major sources that are pricking the ears of the visitors, shopkeepers, customers, and other end users of Sindhi market.

**Analysis:**

The major noise that is affecting the area is the noise from the vehicles, which is due to the presence of the major road that is surrounding the market space. The next level of sounds that are affecting the space are the sounds emitting from the activities of conversation and hawking, tossing, and poring and then the noise created by footsteps of the people there in the market. These activities are muting the level of sounds created by birds that are there in the market. So, understanding this the activities that can be minimize should be clearly identified.

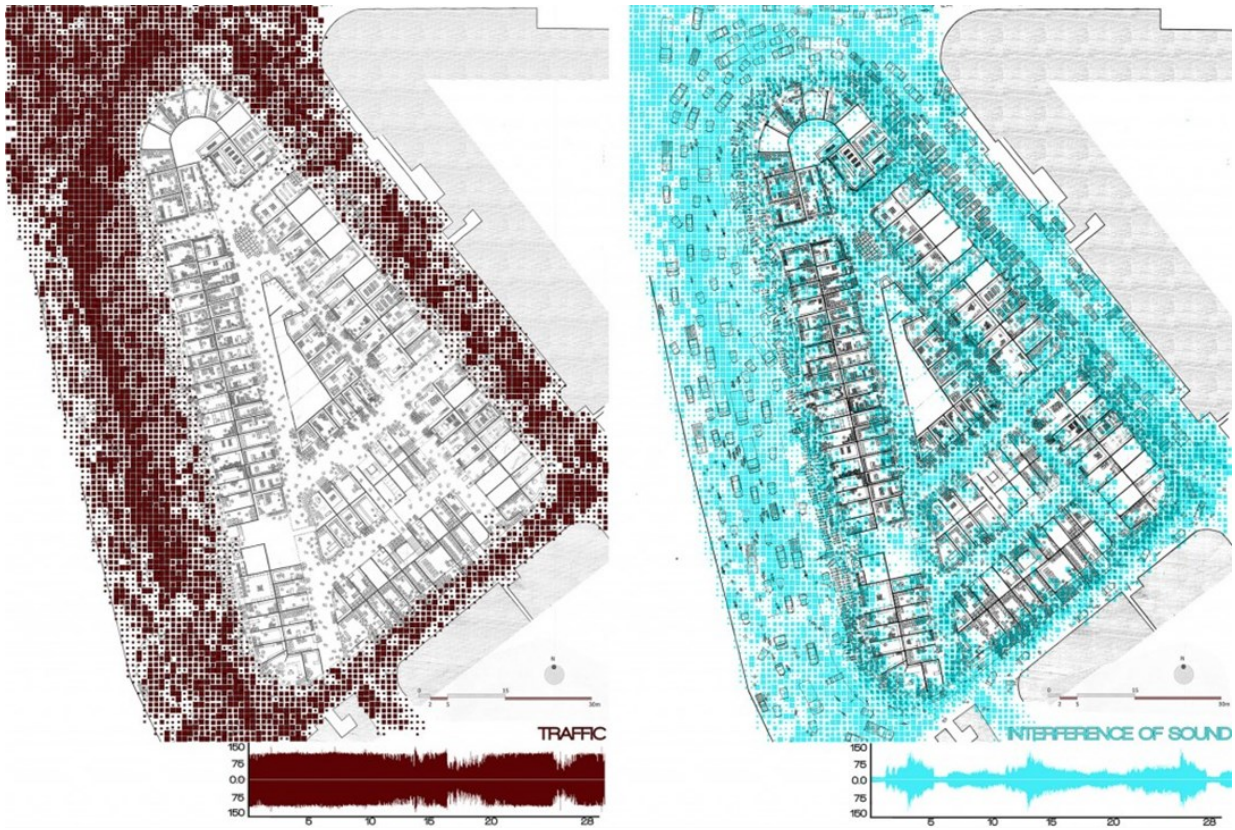



**Figure 21.** Sound mapping of sounds emitted by Traffic and the inference of sound that is there in the market (Source: M.L.A, CEPT)

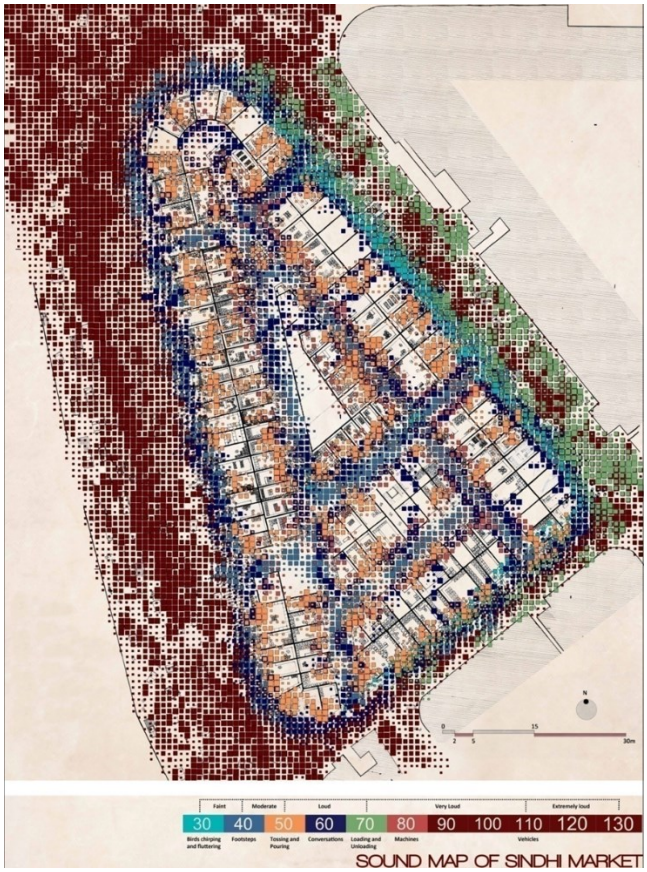



**Figure 22**. Sound mapping of layering of sounds by the activities (Source: M.L.A, CEPT)

**7.2 Bringing Natural Sounds into Urban Contexts:**

Attempting to get the natural sounds of water, birds and other fauna, winds, crushing of leaves etc is actually an ecological way of using landscape to create such an atmosphere to welcome those sounds into the urban areas. An ecological project from the city of Seoul.

**7.2.1 Case study 2**

**Location**

Seoul is the capital city and largest metropolis of South Korea. It is situation on the banks of river Han, where the city bisected into northern and southern parts by the river.




**Figure 23.** The river park development in the city Seoul (Source: https://www.google.co.in/maps)

**Project**

In the centre of the city Seoul there used once be an express highway which is more. The express highway was demolished, and it is replaced with a five mile, 800-yard-wide and 1,000-acre lateral park which became place for refreshment. Demolishing an existing highway way and then converting that as a lateral river park was the main idea of the Mayor of the city Seoul in the year 2002. It is developed as a main vision to bring back the lost heritage of the river and creating an ecological link considering other benefits like attracting economic growth, tourists, and investors in midst of a busy urban area. 22 new bridges were constructed across this river to allow the connectivity and help for the linkages of the either side of this lateral park. The water in the river is restored, albeit from the ground water. Initially like any other restoration projects, this project also faced a lot of problems from the drivers and end users of the highways. The sound of splashing water is achieved by creating small level differences instead of a slopping land. Now fish, bird and insects have made their way back into the urban river, and the area surrounding the park is about 3.6 deg C cooler than other parts of the city.



**Figure 24.** The Seoul's River Park (Source: http://inhabitat.com/seoul-recovers-a-lost-stream-transforms-it-into-an-urban-park/)



**Figure 25.** Activities happening at the edges of the river park at various points of time (Source: http://inhabitat.com/seoul-recovers-a-lost-stream-transforms-it-into-an-urban-park/ )

As a part of this project the vehicular traffic that once passed by this way is diverted towards the other route which ensured the threat of disturbing the flora and fauna of this river park. This project is not directly worked with an aim to create a pleasant Soundscape in the city. But indirectly it welcomed the sounds of nature into its busy bussing city environment which attracted more people.

### 7.3 Case study 3

**Location:**

Another similar case study that is satisfying the ecological aspect of getting the natural sounds in to the city is in Oslo, the capital and the most popular city of Norway, which is sitting on the banks of river Akerselva. It starts at Maridalsvannet in Oslomarka, and follows the urban areas Nordre Aker, Sagene, Grünerløkka, Oslo centre and Grønland, whereby it finally ends at Paulsenkaien and Oset in Bjørvika.

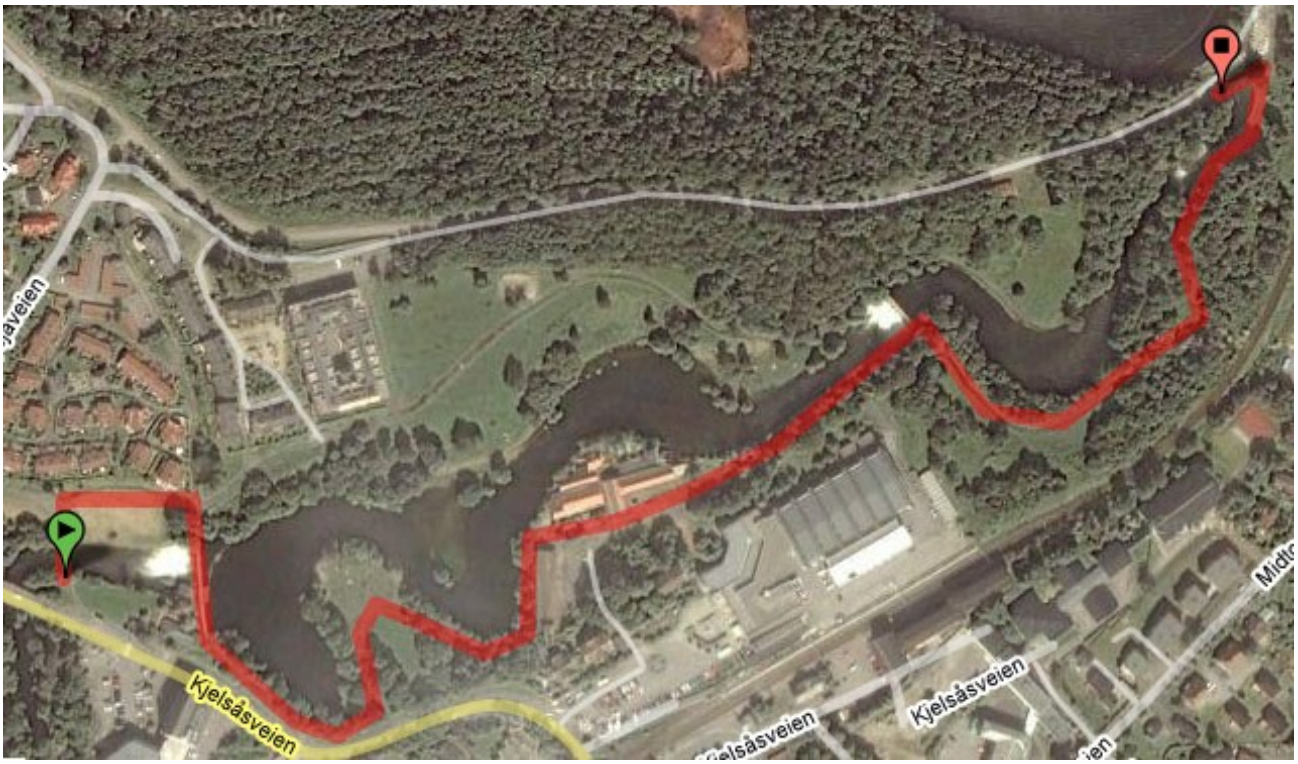



**Figure 26.** The River Akerselva flowing through the city Oslo.(Source : www.lifeinnorway.net)

**Project**

To create a positive city development at a same time attracting many tourists, investors and pubic, being the main motto of the Government of Norway for its cities. During the eighties, old, worn-down, and vacant buildings, deterioration, and poor environmental quality characterized the river basin area along the main river Akerselva. As a need to construct a healthily and an attractive city environment Akerselva Environmental Park was established. The main intention being is to improve the develop green spaces, parks, improve water quality and enhance cultural a tourism heritage of the city Oslo. The old building is now accommodated with new offices which had brought a part of the urban life towards the river edges by using the left-over built space. The existing setting of the topography that is guiding the river naturally makes the splashing sounds of river waters that is flowing through the city. The residences which are right beside the river get the most luxurious sounds of running water at their back yards. Since the interfering of vehicular traffic along the river is minor these sounds don't disturb the natural sounds of water, birds, winds, leaves etc. The walks that are there along and across the river Alkerselva are the spot for hanging out. The sounds of running water will make the space happening. (http://www.lifeinnorway.net/2011/12/a-winter-walk-along-akerselva)

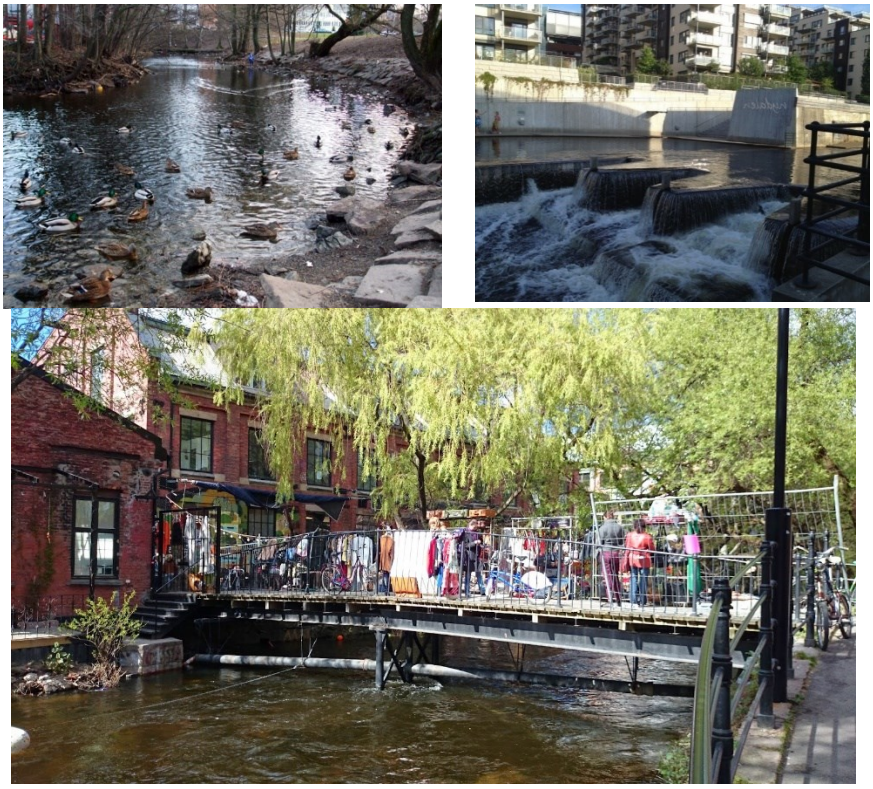


**Figure 27.** Images showing the river side activities across the bridge that become a part of crowd attraction in these areas (Source: www.lifeinnorway.net)



**Figure 1** Accommodating public buildings along the river (Source: www.lifeinnorway.net)

**7.4 Case study 4**

**Location:**

The Aravallis are among the oldest mountain ranges having evolved about 1500 million years ago and extend from Gujarat through Rajasthan to Haryana–Delhi. The spurs of the Aravallis are popularly known as the Delhi Ridge in Delhi which is divided into the Northern, Central, South Central and Southern Ridge. The Aravalli Biodiversity Park is located on the South-Central Ridge and spreads over an area of 692 acres. The area is bounded clockwise by JNU (Nelson Mandela Marg), the Mehrauli - Mahipalpur road, NH-8 and the Palam road and the southern boundary of Vasant Vihar.

**Context:**

The landscape is undulating with gentle slopes and dotted with numerous morrum and clay mined pits of different sizes, depths and shapes. The site selected on the biodiversity park is an edge of the site which has a combination of various conditions. It has a heavy vehicular traffic on its southern end, a residential neighbourhood on its western end, and in the site, itself is free from vehicular traffic and is totally and ecological ridge condition that is happening in the site. the site is mined over years due to the presence of Delhi red quartzite. This activity of mining had eaten up the natural topographical conditions of the site and this had left the site with sliced depressions, and the vegetation of the site is highly disturbed that once whatever the dense vegetation it used to have also was disturbed. The invasive species *Prosophis juliflora* that sprawled over the ridge had overtaken the growth of other native species

of the ridge. This major destruction done by mining and invasion of other species had disturbed the ecology also. The fauna which is dependent on the vegetation have taken its route of distinction of few species.

**Revival programs:**

Various programs of reviving this part of the ridge are going on, by various NGOs and government. Ecological walks and participations are being encouraged by these bodies to create awareness in the people about the importance of the ridge and the nativity it once had. Planting of the ridge's native species to give back nature its own condition is being done, which will give a welcome call for the fauna which had left the ridge and heading its routs to extinction. The part of the ridge had a wide variety of birds, like Raptors, Peafowls, Non-passerine land birds, Perching waders, Doves, and animals like reptiles and mammals with a great diversity.

**Analysis:**

A part of the Aravali range is taken for the study which is accessible and have a mixed use. The combination of ridge, the heavy traffic road with metro above it, and a housing community. The sounds of various birds and mammals in the park and the housing community account for natural sounds. The sounds created by humans in the park who come jogging, trekking, planting, and exercising at various times of the day. the sounds of the vehicles and the metro that is dominating at one end of the park are with high intensity. As a part of observing the sounds of the site selected, various sounds and their levels are recorded. The sounds of vehicles that re there on the road and the sounds of metro, sounds of birds and other fauns in the park, sounds of people who are using the park and their levels are recorded. The levels are again categorized as High, Low and Medium. The mapping of these sound levels is framed in the form of individual maps as. The layering of these sounds' levels is done to understand the dominant sounds of this area. The most dominant sounds outside the park are the vehicular sounds on the main road that is edging the site. When one moves into the park one can feel the difference of the environment that is changed from outside of the road to its inside. As one moves inside, can feel the environment to be very calm, which makes on to admire the sounds of the birds, this can have happened only when the environment in the park is away from the heavy vehicular sounds. A balance in the ecosystem is another way of conserving and preserving the natural sounds. The sound intensity of the birds in the Aravali biodiversity park is found to be more when one goes to the interiors part of the park than at the entrance or at the places where the park is edged by the housing community and the heavy vehicles road and the metro line. The presence of various species of birds in the site are the main sources of the natural sounds in the park. The ecosystem is the main baring support that is maintaining these sounds. In a way this is a balance of ecosystem.




**Figure 2.** Sound levels of birds in the park.




**Figure 3.** Sound levels of people that are using the park

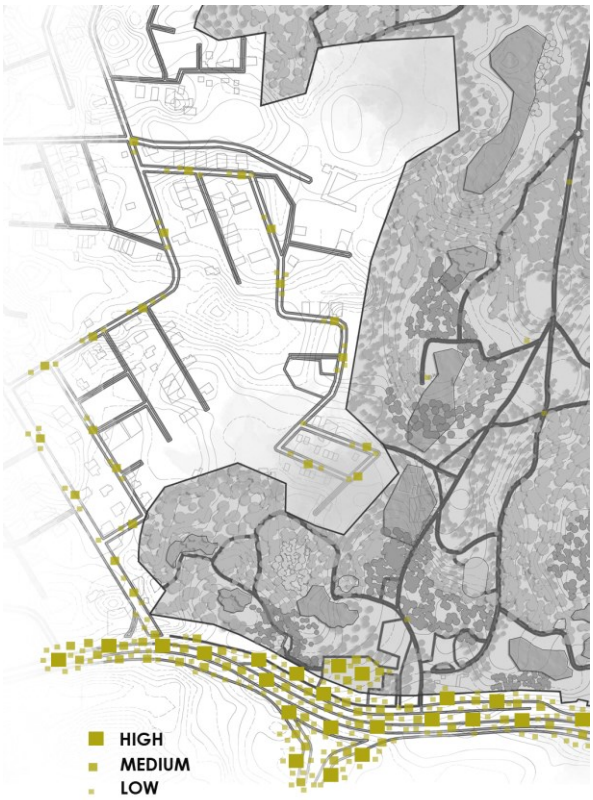



**Figure 4.** Sounds of various vehicles and metro that are coming from the main road and the community that is edging towards the west of the park.



**Figure 5.** Layering of various sounds that are there in and around the site.

**7.5 Artificially Created Soundscapes**

In environments were bringing or creating the sounds can't be achieved by ecological ways, there are ways to achieve by creating artificial landscape elements that can either tune up the musical sounds or natural sounds. Creating the water features in spaces where ecologically creating such spaces is a hard task to achieve, is one way that is an effective way to create the natural sounds of water. As a part of a personal observation two case examples are done.

**7.5.1 Case study 5**

**Location:**

Ambiance mall which is in Vasanth kunj, South-west Delhi, sets as a very good example for the projects that achieved getting the sounds of water by using landscape design.

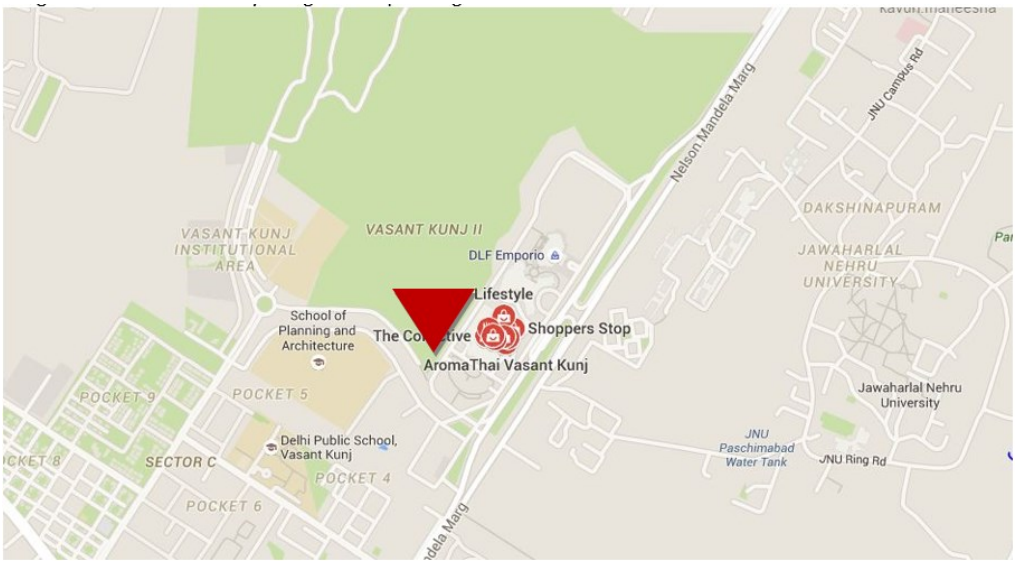



**Figure 6.**Location of Ambiance mall in Vasanth kunj (Source: https://www.google.com)

**Project:**

The water feature that is there right in front at the entrance of the Ambience mall is acting like a transition space between the road and the mall. This acting like a transition space will and mainly with its water fountains and the sound that is being created by it will act like a space which will arrest the noisy traffic sound. This will also become like a transition zone for the visitor to leave the tiredness of traffic and vehicular sounds and enter the shopping complex with a rejoice of hearing water.

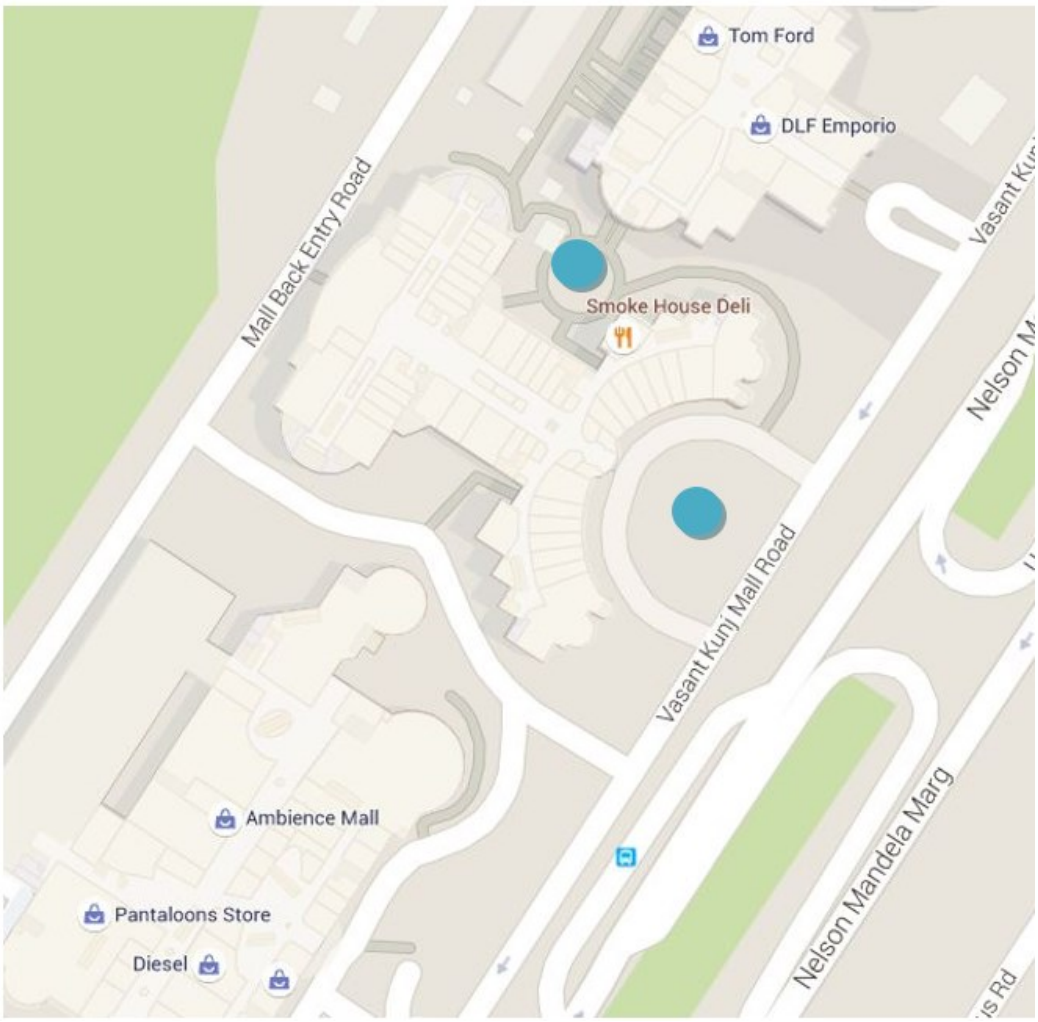



**Figure 7.** Presence of various water features in the mall complex

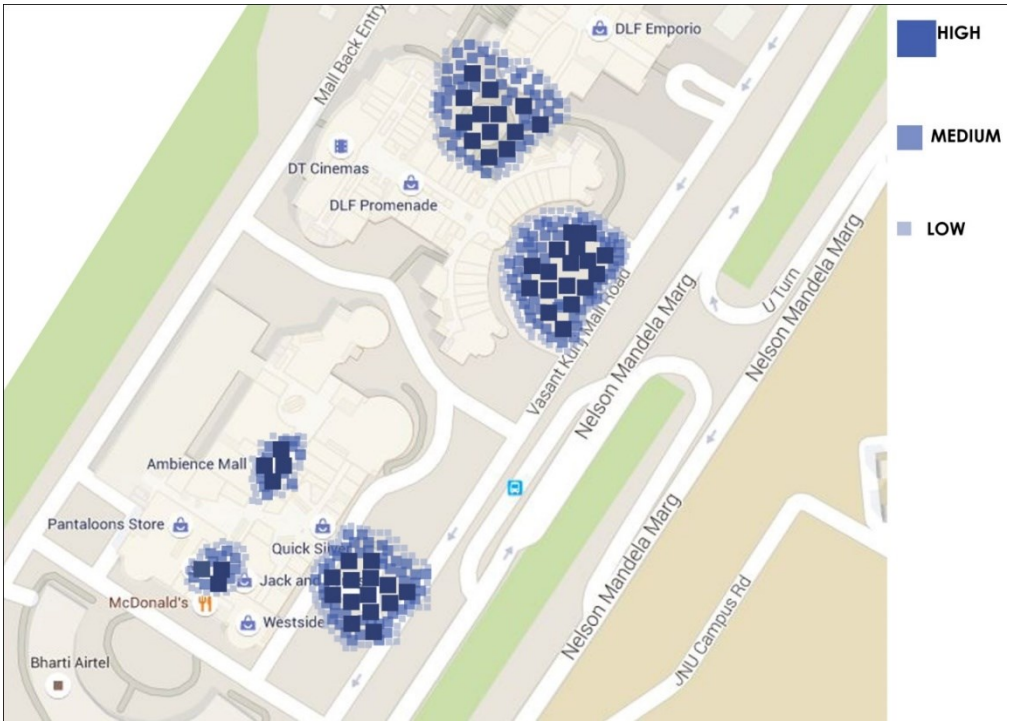



**Figure 8.** Density of water sounds that come from the water features.

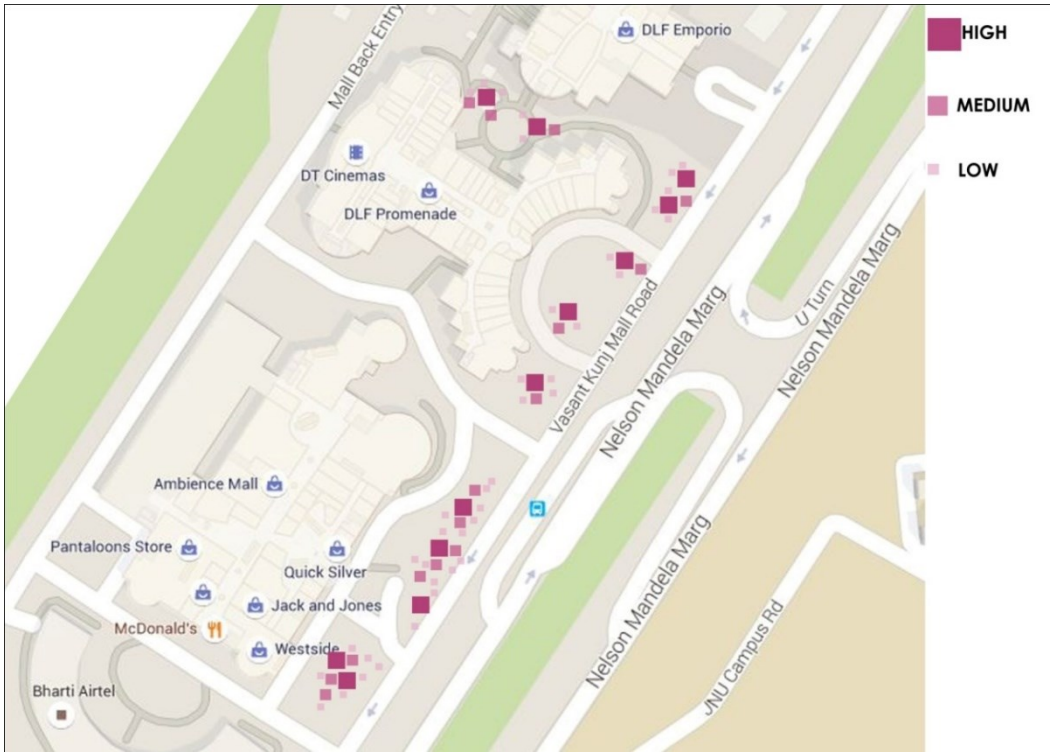



**Figure 9.** Density of bird sounds found around the mall

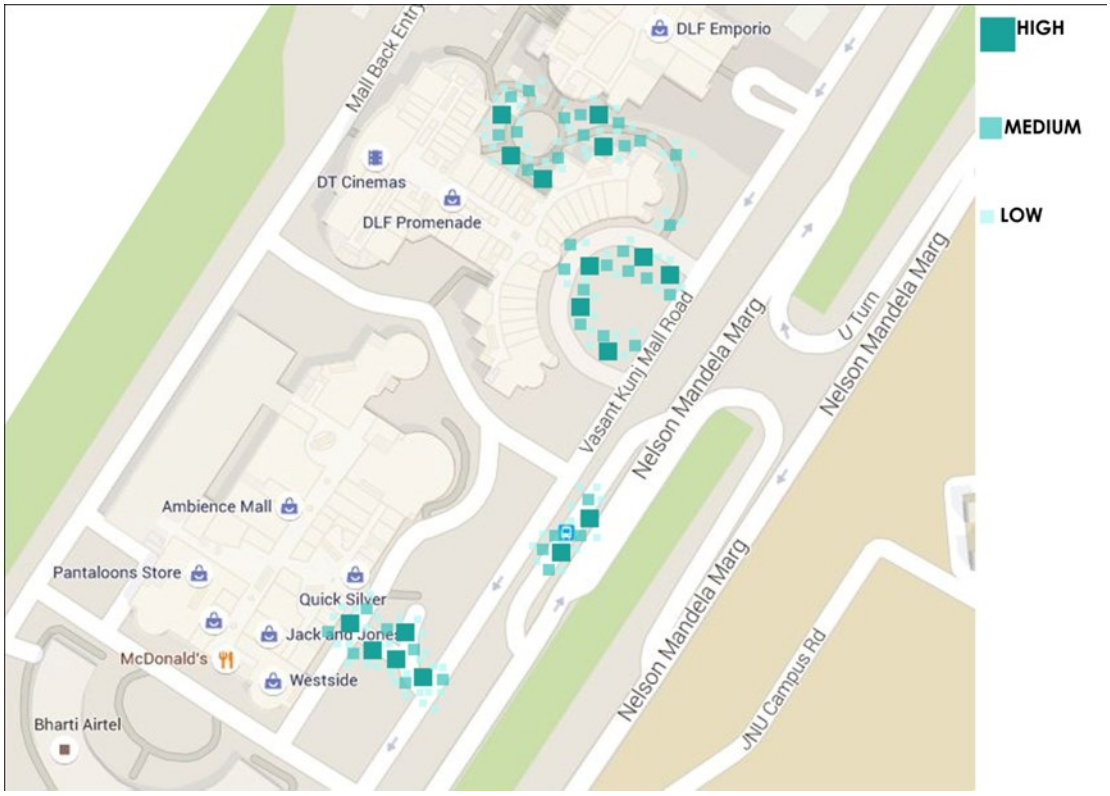



**Figure 10.**Density of sound distribution by people in main core points

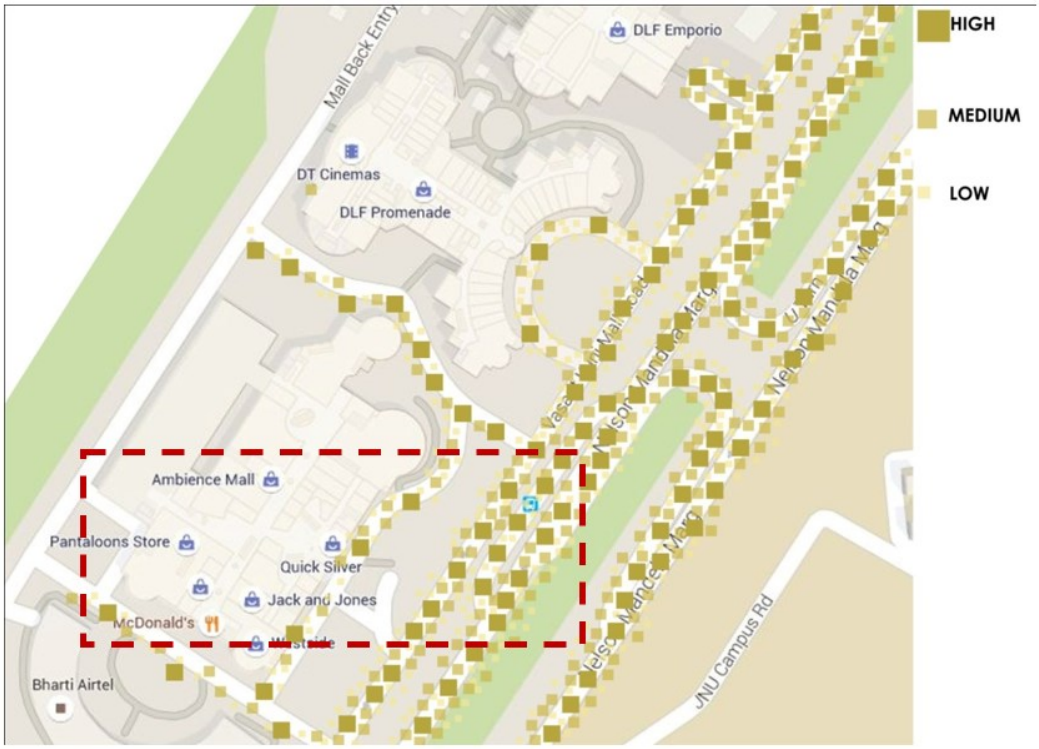



**Figure 11.** The vehicular sound density distribution along the roads and drive ways

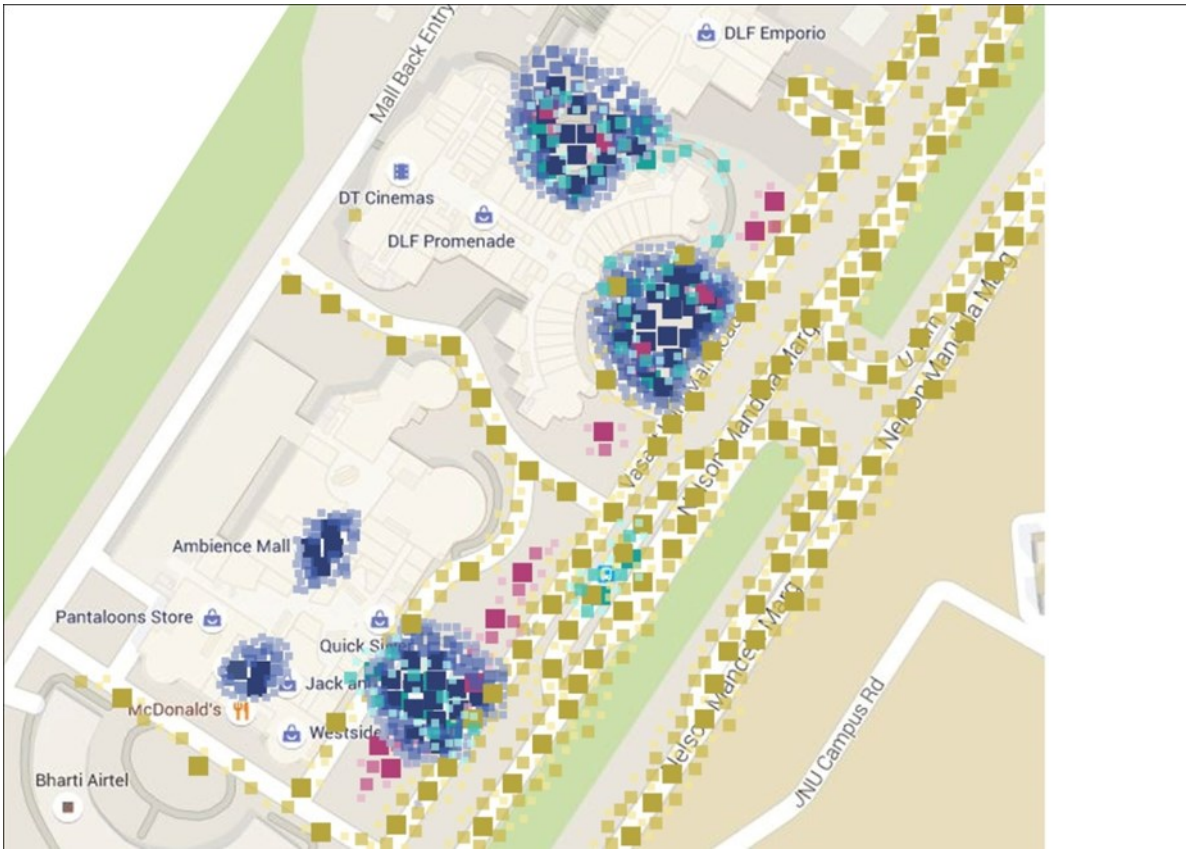



**Figure 12.** Layering of various sounds that are distributed to understand the dominated sound distribution in and around the mall.




**Figure 41.** The presence of a water feature in front of the mall that is acting like a transition zone between the road vehicular sounds and the sounds from mall. (Source: http://delhi-ncr.mallsmarket.com/malls/ambience-mall-vasant-kunj)



**Figure 42.** Function of water feature in the night time (Source: http://delhi-ncr.mallsmarket.com/malls/ambience-mall-vasant-kunj)



**Figure 43.** The water features

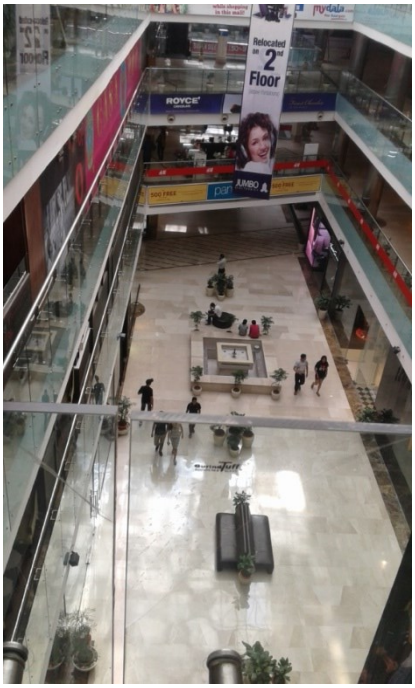



**Figure 13.** The image of the water feature that is seen from the 3rd floor of the mall.



**Figure 45.** The water fountain that are present inside the mall



**Figure 46.** The water fountain in front of the DLF mall that serves the same function as the other water feature.

**7.6 Musical Sounds**

In places where achieving the sounds of nature is difficult few alternatives can be done by using the elements of nature and incorporating the structural and architectural implementations and ideas to create tunes of music and stand as an iconic examples of case study.

**7.6.1 Case study 6**

**Location:**

Singing ringing tree in Burnley in England, which resembles a tree but is actually a wind powered sound sculpture set in the landscape of Pennine hill. It was a part of regeneration project created by the East Lancashire Environmental Arts Network (ELEAN) in 2006.

**Project:**

Designed by architects Mike Tonkin and Anna Liu of Tonkin Liu, the Singing Ringing Tree is a 3-metre-tall construction comprising pipes of galvanized steel which harness the energy of the wind to produce a slightly discordant and penetrating choral sound covering a range of several octaves. Some of the pipes are primarily structural and aesthetic elements, while others have been cut across their width enabling the sound. The harmonic and singing qualities of the tree were produced by tuning the pipes according to their length by adding holes to the underside of each. In 2007, the sculpture won (along with 13 other candidates) the National Award of the Royal Institute of British Architects (RIBA) for architectural excellence.

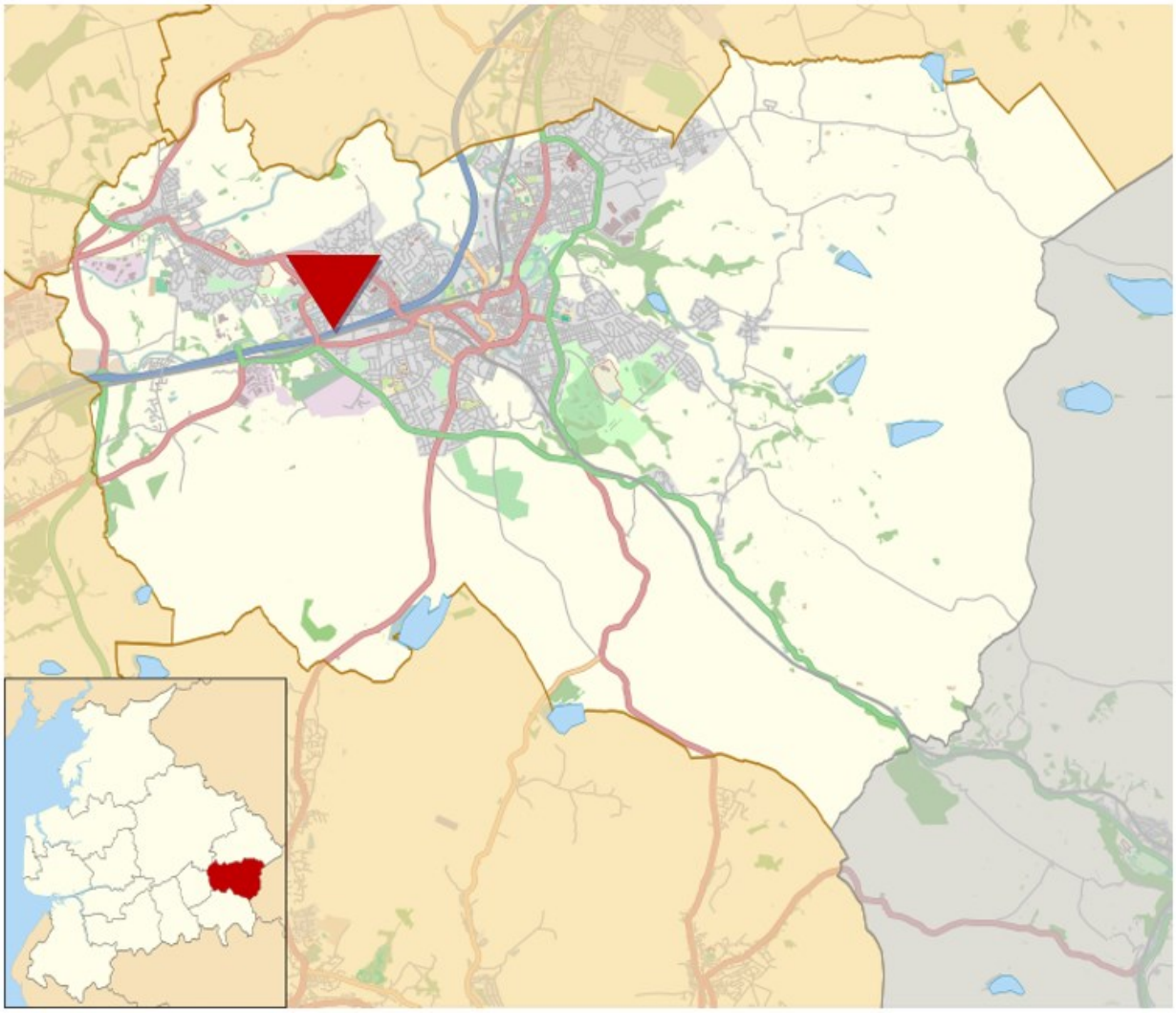


**Figure 47.** Location of Burley (Source: https://en.wikipedia.org/wiki/Queen_Street_Mill)



**Figure 48.** The Singing ringing tree (Source: http://www.midpenninearts.org.uk/panopticons-singing-ringing-tree)

The tree is constructed of stacked pipes of varying lengths, orientated to lean into the directions of the prevailing wind. As the wind passes through the different lengths of pipe, it plays different chords. Each time you sit under the tree, looking out through the wind, you will hear a different song.



**Figure 14.** 3d model of structural form of the Singing ringing tree (Source: http://www.midpenninearts.org.uk/panopticons-singing-ringing-tree)

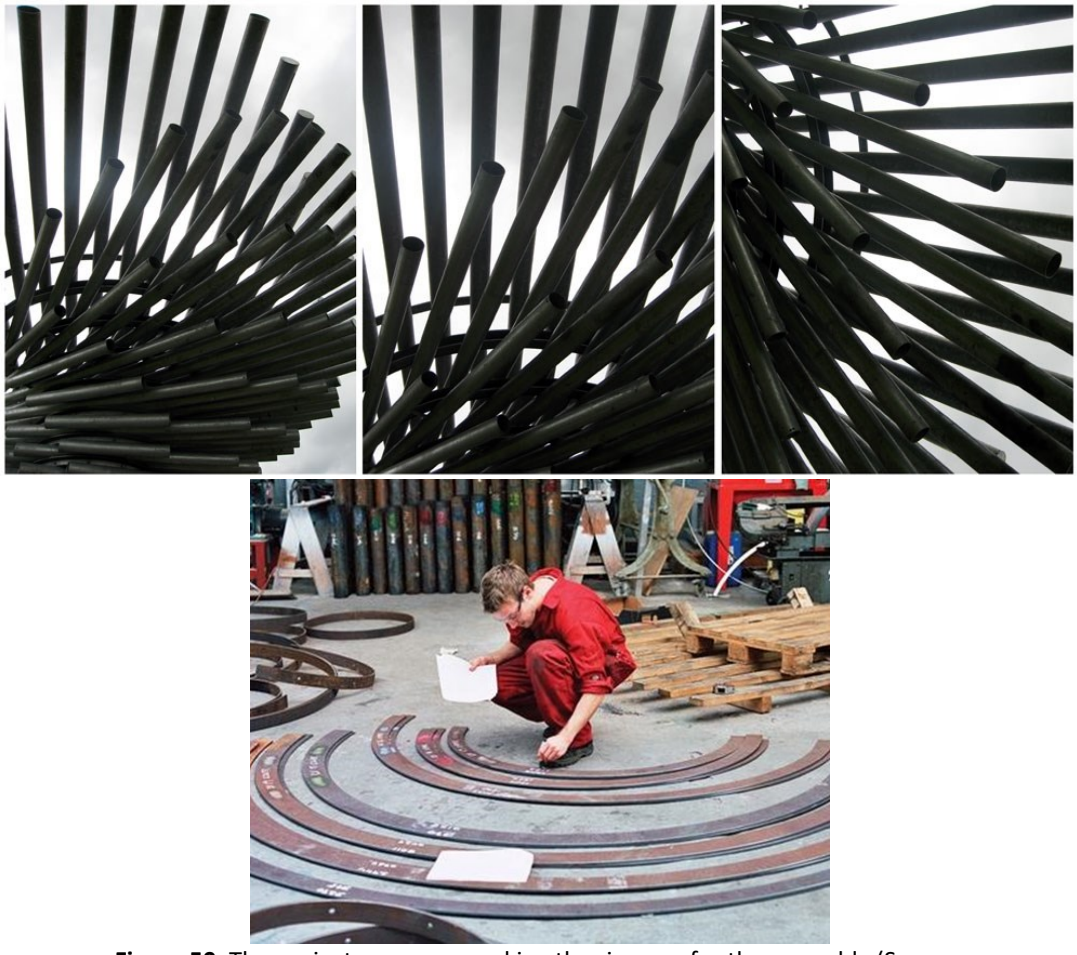


**Figure 50**. The project manager marking the rings up for the assembly (Source: http://www.midpenninearts.org.uk/panopticons-singing-ringing-tree)

**7.7 Case study 7**

**Sea Organ - musical instrument played by the sea**

**Location:** The sea organ is in the Zadar, a city on Croatia's Dalmatian coast, is known for te Roman and Venetian ruins.




**Figure 51.** Location of Sea organ in the town of ZADAR (Source: http://monplan.info/plan-de-zadar-2/)

**Project:**

The musical Sea Organ (morske orgulje) is located on the shores of Zadar, Croatia, and is the world's first musical pipe organs that is played by the sea. Simple and elegant steps, carved in white stone, were built on the quayside. Underneath, there are 35 musically tuned tubes with whistle openings on the sidewalk. The movement of the sea pushes air through, and – depending on the size and velocity of the wave – musical chords are played. The waves create random harmonic sounds. This masterpiece of acoustics and architecture was created by expert Dalmatian stone carvers and architect Nikola Basic in 2005, who recently received the European Prize for Urban Public Space for this project. Many tourists come to listen to this unique aero phone and enjoy unforgettable sunsets with a view of nearby islands. Famed director Alfred Hitchcock said that the most beautiful sunset in the world can be seen from precisely this spot on the Zadar quay Given that the uppermost horizontal edge of the corridor contains all along towards the seaside dense flanking apertures, this is the only passage for sound to emanate. It was estimated that by action of the waveguide a maximum of 10 pipes (2 chords) can be heard on a spot. With the operating frequency band chosen only the highest-pitched pipe sounds will radiate towards the sea. Most of the sound spectral contents will be heard not only at the scalinade but at margins of the nearby park and houses. We estimate that the SPL at the nearest house (55 m) will not surpass some 35 dBA in 90% of total time. If sound annoyance would be registered during the first period of operation the measures shall be taken to reduce the SPL. Three solutions to such a problem are envisaged: 1) by reducing the hydraulic pressure in the entry tubes, 2) by choking up a certain percentage of apertures, 3) by adequate damping the interior of the enclosure. The right measure or a combination thereof will be

decided upon after a suitable period of monitoring. (http://everwideningcircles.com/2015/11/14/sea-organ-croatia-public-space/)



**Figure 52.** Organ with its holes at its edges and the water splashing at the holes (Source: http://croatia.hr/en-GB/Destinations/Town/Zadar/Dalmatia-%E2%80%93-Zadar-Sea-Organ-and-Greeting)

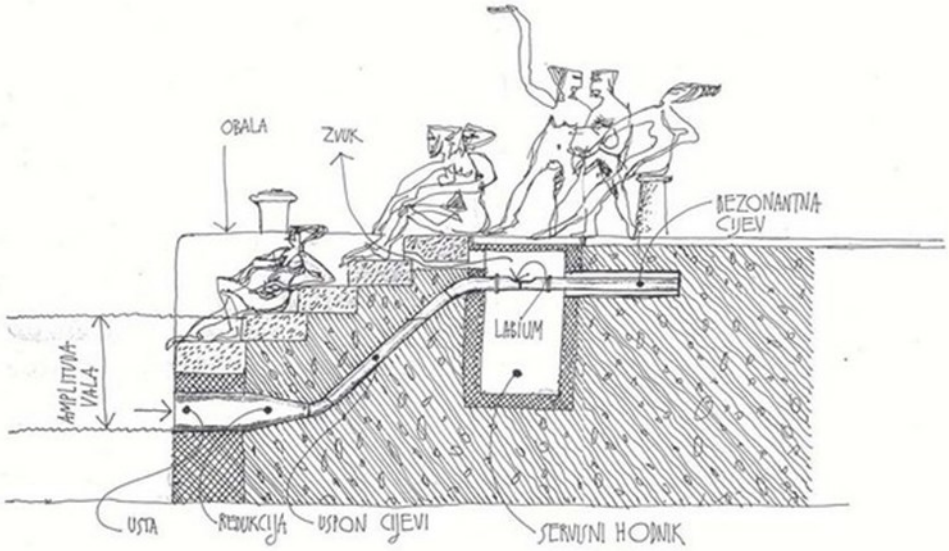



**Figure 53.** Architect's schematic sketch of the working of the sea argon and the activities that can happen at that space

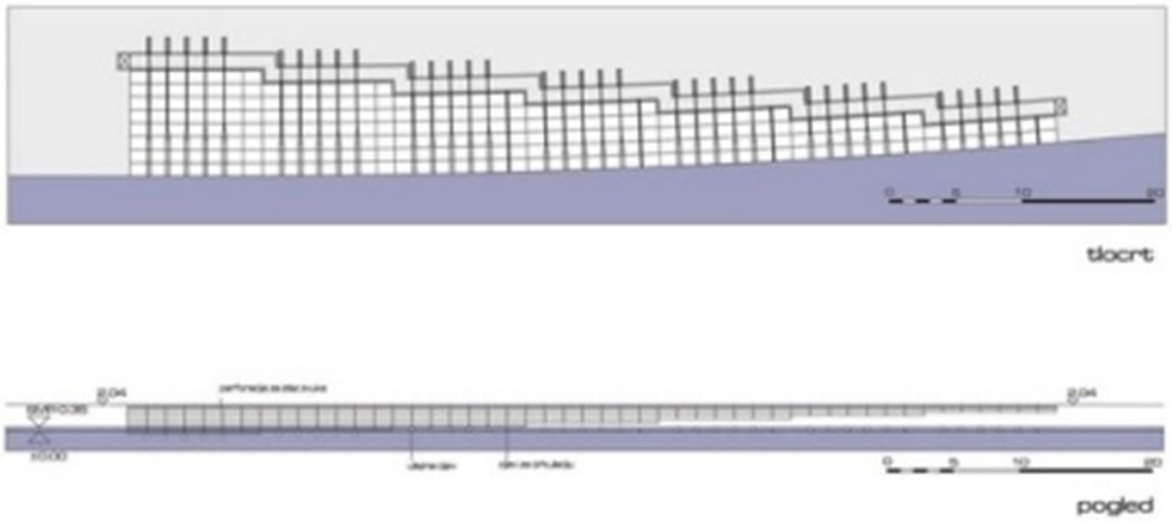
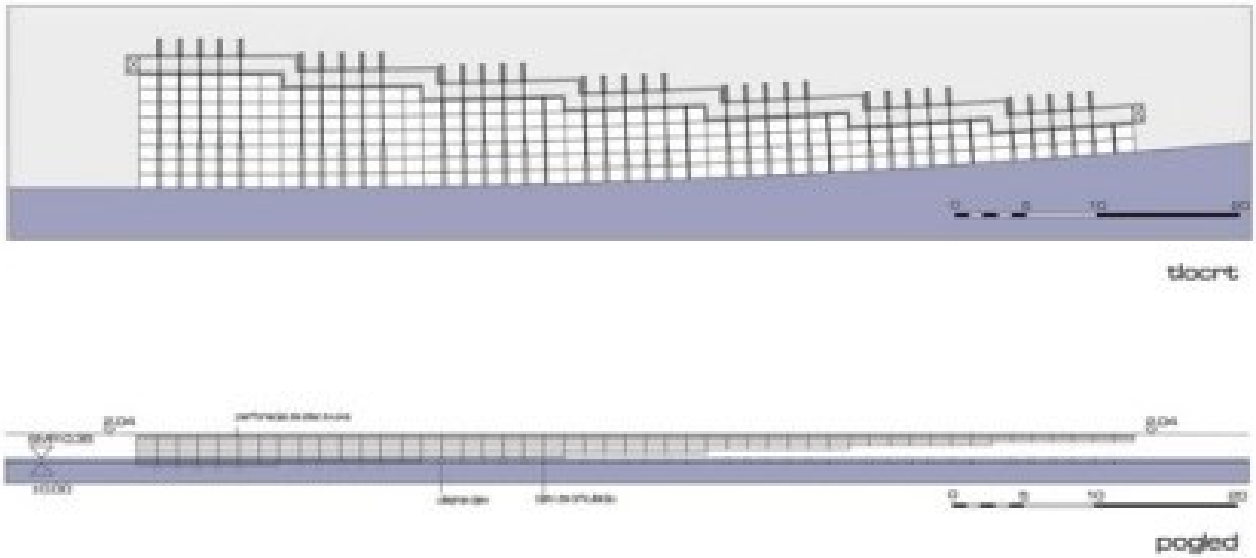



**Figure 54.** Plan of the Sea argon (Source: http://www.croatia.org/crown/articles/9359/1/nikola-baiae-author-of-the-zadar-sea-organ.html)

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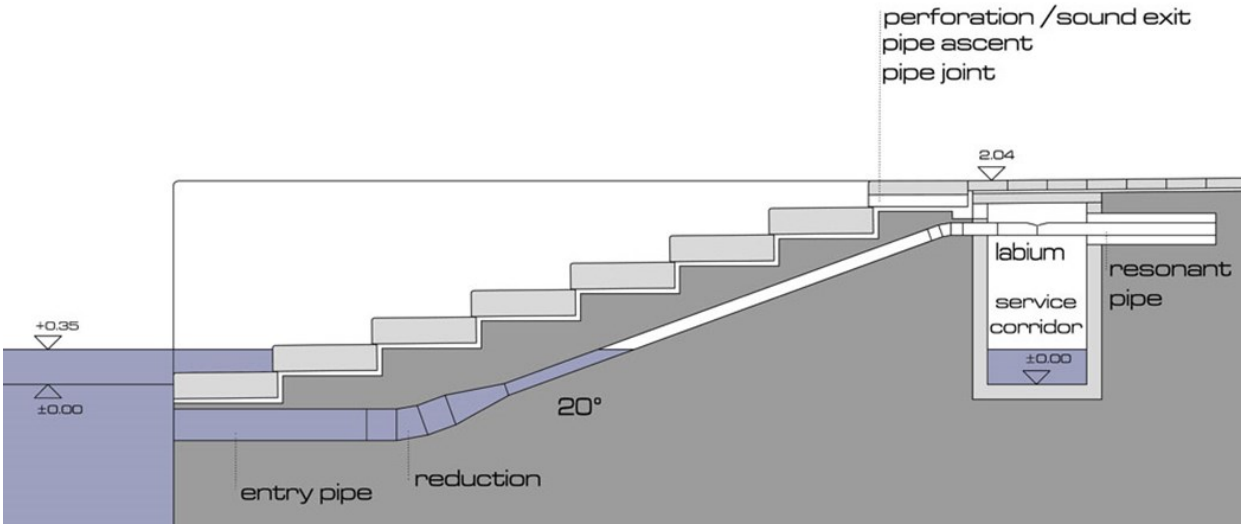


**Figure 55.** Basic section showing the passage of water through the holes and move the sound joint. (Source: http://www.croatia.org/crown/articles/9359/1/nikola-baiae-author-of-the-zadar-sea-organ.html)

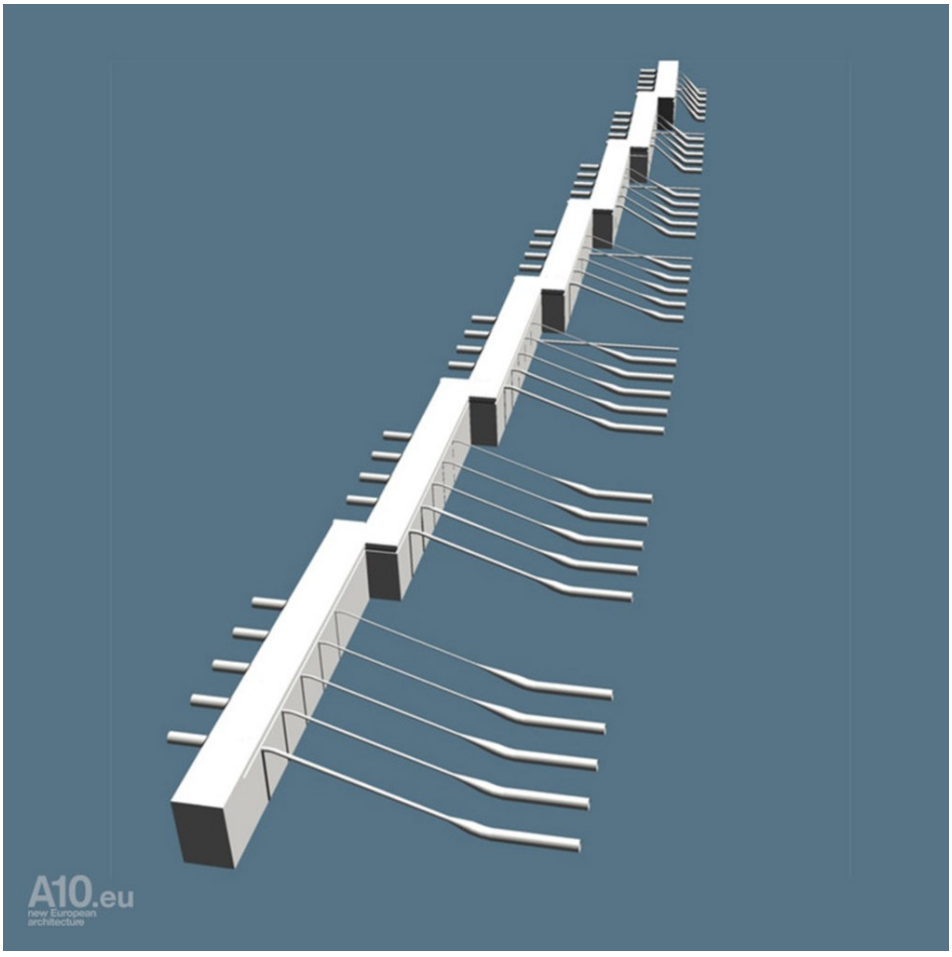


**Figure 56.** Sound joint incorporated inside the sea argon (Source: http://www.croatia.org/crown/articles/9359/1/nikola-baiae-author-of-the-zadar-sea-organ.html)



**Figure 57.** Activities that are happening along the length of the Sea argon (Source : http://www.croatia.org/crown/articles/9359/1/nikola-baiae-author-of-the-zadar-sea-organ.html)

**8. Conclusion and Policies**

- Sound should be identified as a measure of sensing the ecological sensitivity and the happening of the systems.
- Ecologically sensitive zones should be conserved and preserved the local fauna to come, habitat and survive in that area.
- As a part of the eco-friendly development of these natural landscapes, species of selection should be native specific than exotic.
- Various urban developments which are a part of city's expansion should be kept in check so that the aftereffects on the ecological conditions can be reduced.
- Natural water bodies are to be developed wisely and ecology friendly, with encouraging sensible activities and helping one to experience the beauty of sounds of water, yet without dominating or disturbing these areas with the sounds of vehicles and other machinery.
- Activities creating loud noises near to the ecologically sensitive areas should be controlled or kept in check to not to disturb the communications of the fauna that is residing in those areas.
- Welcoming nature into the urban context is equal to welcoming the sounds of nature into the cities.
- Encouraging the plantation programs and policies will bring the sounds of birds, winds and leaves into the urban areas and resulting in a great experience of sounds of nature.
- Techniques and policy checks which can reduce the noise levels in busy city environments which cater to the noises of vehicles, factories, loud music etc, will surely let the muted voices of the nature to raise.
- Incorporating landscape design ideas in urban areas like giving a water feature, a chabutra, various trees, etc can be done to create a point of interest in these busy areas.
- Architectural or artistic installations that can use natural elements like wind, water etc and create musical sounds can be another way of creating soundscapes in the cities.

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# Investigation of Urban Flood Management Principles within the Scope of Buffalo Bayou Watershed Rehabilitation Project

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**Abstract**
In this study, the 20-year watershed rehabilitation master plan, which was prepared after the severe Allison storm in 2001 in the Buffalo Bayou watershed in the city of Houston, is examined in detail. For this purpose, a literature review is conducted on the concepts of watershed and watershed management. Then, the existing situation of the study area is presented, and the flood control strategies and rehabilitation practices proposed within the scope of the master plan are investigated. The environmental and social outcomes of the rehabilitation project are evaluated in the conclusion. In Turkey, floods and overflows are one of the most important disasters that cause material and moral damages. Central and local governments need to develop sustainable approaches for the protection of watersheds and the preparation of management plans. In this context, the Buffalo Bayou watershed rehabilitation project can be considered as a resource in taking supportive steps for sustainable watershed management in Turkey. This project and similar good practices will contribute to solve the social, economic and environmental problems in watersheds of Turkey.
**Keywords:** Watershed rehabilitation; Flood management; Local government; Buffalo Bayou.

# Buffalo Bayou Havzası Islah Projesi Kapsamında Kentsel Alanlarda Taşkın Yönetimi İlkelerinin İncelenmesi

**Özet**
Bu çalışmada, Texas Eyaleti sınırları içerisindeki Houston Şehri'nde yer Buffalo Bayou Havzası'nda 2001 yılında meydana gelen şiddetli Allison Fırtınası'nın ardından hazırlanan 20 yıllık sel taşkın yönetim master planı incelenmiştir. Bu amaç doğrultusunda öncelikle havza kavramı ve kentsel alanlarda havza ıslahına yönelik bir literatür çalışması yapılmıştır. Ardından, çalışma alanının mevcut durumu ortaya konmuş, master plan kapsamında önerilen stratejiler ve ıslah uygulamaları araştırılmıştır. Sonuç bölümünde ise, master planının yayınlanması sonrasında, havza ve çevresinde gerçekleştirilen yenileme çalışmalarının günümüzdeki çevresel ve sosyal sonuçları değerlendirilmiştir. Ülkemizde, meydana gelen sel ve taşkınlar, maddi ve manevi zararlara neden olan en önemli afetlerden biridir. Merkezi ve yerel yönetimlerin havzaların korunması ve yönetim planlarının hazırlanmasına ilişkin sürdürülebilir yaklaşımlar geliştirmesi gerekmektedir. Bu bağlamda, Buffalo Bayou Havzası rehabilitasyon projesinin, Türkiye'de sürdürülebilir havza yönetimi için destekleyici adımları atmada bir kaynak olacağı düşünülmektedir. Bu çalışma ve benzer iyi uygulamalar, havzalarımızdaki sosyal, ekonomik ve çevresel sorunların çözümüne yönelik katkı sağlayacaktır.
**Anahtar kelimeler:** Su havzası ıslahı; Taşkın yönetimi; Yerel yönetim; Buffalo Bayou.

## 1. Giriş

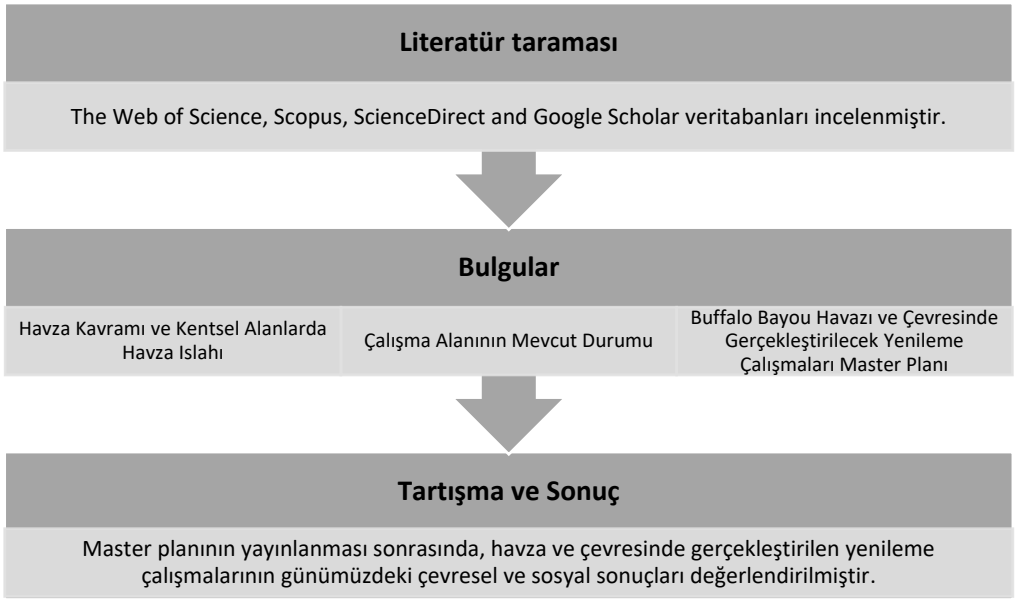
Yaklaşık son 50 yılda, çevre ve doğal kaynaklar, nüfus artışı ve beraberinde getirdiği insan ihtiyaçlarının artmasına bağlı olarak yoğun bir baskıya maruz kalmıştır (UNDESA, 2019). Birleşmiş Milletler'in Sürdürülebilir Kalkınma Hedefleri Raporuna (2020) göre, iklim değişikliği 39 milyondan fazla insanı etkileyerek ölümlere, geçim kaynaklarının aksamasına ve ekonomik kayıplara neden olmuştur. Küresel olarak bugüne kadar Dünya'daki kara alanının beşte biri (2 milyar hektardan fazla) bozulmuştur. Bu yüzyılın sonunda, tüm deniz yaşamının yarısını etkileyen okyanus asitleşmesinde %100-150'lik bir artış öngörülmektedir. 2015'ten 2020'ye kadar, yıllık ormansızlaşma oranının 10 milyon hektar olduğu tahmin edilmektedir. Türlerin yok olma riski, son 30 yılda yaklaşık %10 oranında artmıştır. Orman alanları endişe verici bir hızla azalmaya devam etmekte ve birçok bitki ve hayvan türlerinin nesli tükenme tehdidi altındadır. Bununla beraber, artan arazi kullanım değişiklikleri ve habitat parçalanması, COVID-19 dahil olmak üzere, halk sağlığını ve dünya ekonomisini tehdit edecek yeni bulaşıcı hastalıkların ortaya çıkışında başlıca etkenlerden biri olarak görülmektedir.

Dünyadaki tüm su kaynaklarının yaklaşık %97,5'i okyanus ve denizlerde tuzlu su olarak bulunmakta, tatlı su kaynakları toplam su hacminin yaklaşık %2,5'ini oluşturmaktadır. Tatlı suyun sadece %1'inden daha azı göllerde, nehirlerde ve diğer yüzey su kütlelerinde bulunmaktadır (Birleşmiş Milletler Su İstatistikleri, 2021). Tatlı su olarak aktif şekilde dolaşan suyun bu ufak kısmı, Dünya'daki yaşamda inanılmaz derecede önemli ve dinamik bir rol oynamakta, insan hayatını ve diğer tüm kara ve tatlı su türlerinin yaşamlarını sürdürmesine olanak sağlamaktadır (McCarton ve ark., 2020). Sağlıklı su havzaları, yaşamları su, jeoloji, toprak, bitki örtüsü ve vahşi yaşam arasındaki karmaşık etkileşimlere bağlı olan insanlar da dahil olmak üzere zengin bir tür çeşitliliğini desteklemektedir (Mwangi ve ark., 2016). Arazi ve su kaynaklarının yanlış ve bilinçsiz

kullanımı, dünyanın bazı bölgelerinde geri dönüşü olmayan hasarlar meydana getirmiş ve bu alanların büyük ölçüde bozulmasına neden olmuştur. İklim değişikliği, ormansızlaşma ve biyolojik çeşitlilik kaybı gibi küresel çevre sorunlarının boyutu artıkça arazi örtüsü ve ekosistem bozulmaları daha belirgin hale gelmiştir. İnsan, flora, fauna ve doğal kaynaklar arasındaki karmaşık etkileşimi anlamak, arazi kullanımı ve ekosistem sağlığında değişikliklere yol açan doğal ve insan kaynaklı süreçleri araştırmak gittikçe daha önemli bir araştırma konusu haline gelmektedir (Baird ve Plummer, 2021).

## 2. Materyal ve Metot

Türkiye'de hızla artan nüfus ve mevcut kaynakların kirlenmesiyle birlikte kişi başına düşen kullanılabilir su miktarı giderek azalmaktadır. Yaşanan su sıkıntılarının engellenmesi ve su kaynaklarının yönetiminin iyileştirilmesi için kapsamlı bir havza yönetimine ihtiyaç duyulmaktadır. Bu çalışma, Türkiye'deki idari otoritelerin su kaynaklarının etkin yönetimi farkındalığını artırmayı ve yerel yönetimleri insan-doğa ilişkisini göz önünde bulunduran bütüncül havza yönetimi uygulamalarına teşvik etmeye katkıda bulunmayı amaçlamaktadır. Bu bağlamda, Texas Eyaleti sınırları içerisindeki Houston Şehri'nde yer Buffalo Bayou Havzası'nda 2001 yılında meydana gelen şiddetli Allison Fırtına'sının ardından hazırlanan 20 yıllık sel taşkın yönetim master planı detaylı olarak incelenmiştir. Havzada çeşitli rekreasyonel aktivitelerin sağlanması, taşkın yönetimi ve erozyon kontrolü uygulamalarını içeren master planı, havza çevresinde yaşayan insanlar ve yaban hayatı arasında sağlıklı bir denge kurma ilkesine dayanmaktadır. Bu amaç doğrultusunda öncelikle havza kavramı ve kentsel alanlarda havza ıslahına yönelik bir literatür çalışması yapılmıştır (Şekil 1). Ardından, çalışma alanının mevcut durumu ortaya konmuş, master plan kapsamında önerilen stratejiler ve ıslah uygulamaları araştırılmıştır. Sonuç bölümünde ise, master planının yayınlanması sonrasında, havza ve çevresinde gerçekleştirilen yenileme çalışmalarının günümüzdeki çevresel ve sosyal sonuçları değerlendirilmiştir. Bu çalışmanın özgünlüğü; Buffalo Bayou Havzası'nda başarıyla gerçekleştirilen sel taşkın yönetim master planının, ülkemizdeki havzaların sürdürülebilirliğini destekleyecek havza yönetim planlarının geliştirilmesinde örnek teşkil etmesidir.




**Şekil 1.** Araştırma metodolojisinin şematik gösterimi

## 3. Bulgular

### 3.1 Havza Kavramı ve Kentsel Alanlarda Havza Islahı

Havza, yağış ve kaynak suları aynı mecraya veya göle akan, su kesimi (su ayrım çizgisi) denilen sırtlarla çevrili olan su çekim alanıdır. Sırtlardan geçen su bölüm hattının sınırladığı ve yağışlarla üzerinde toplanan yüzey sularının bir drenaj ağı sistemi ile ortak noktaya ulaştığı içbükey topografik arazi parçasıdır (Uzunsoy ve Görcelioğlu, 1985). Havzalar hidrolojik döngüyü yöneten ve besleyen kaynaklardır. Hidrolojik döngü, havzadaki yüzeysel su kaynaklarının nasıl depolandığını ve havza içerisinde nasıl hareket ettiğini açıklamaktadır. Bu döngünün devamlılığı yağış miktarı, buharlaşma, terleme, toprak suyu, yeraltı suyu ve akarsu akışına bağlıdır (Edwards ve ark., 2015). Su havzası dört ana bileşenden oluşmaktadır. *Üst bölge*, akarsu koridoru ve etrafındaki peyzaj arasında bir sınır oluşturur. Üst bölge bitki örtüsü ve toprak yüzeyini stabilize eder, yüzey erozyonunu azaltır ve çevredeki araziden yüzey suyu akışıyla taşınan çözünmüş ve askıda kalmış maddeleri filtreler ve tutar. *Akarsu kanalı*, yılın belli bir kısmında akan suya sahiptir. Akarsular yüksek arazilerden sulak alanlara, çayırlardan taşkın yataklarına kadar tüm havzaları entegre eder. Başka bir deyişle, akarsular bir su havzasının dolaşım sistemini temsil eden dinamik ekosistemlerdir. *Taşkın yatağı*, periyodik olarak su baskınına uğrar. Şiddetli yağışlardan sonra taşkın yatağı

fazla suyu tutarak nehir sistemine yavaşça salınmasına veya yeraltı suyu akiferlerine sızmasına yardımcı olur. Taşkın yatakları bol miktarda *sucul habitat alanları* içermektedir. Sucul habitat alanları sel kontrolü, yaban yaşam alanı sağlama, su ve toprak koruma gibi çeşitli fiziksel ve biyolojik işlevleri yerine getirmektedir (USEPA, 1998).

Sulak alanlar, havza ekolojisinde su kalitesinin korunması ve su kaynakları yönetimi açısından önemli rol oynamaktadır. Sulak alanlar, sürekli veya periyodik sığ su baskınlarına maruz kalan veya en üst düzeydeki alt tabakanın doyduğu bölgelerde oluşur. Bir akarsu koridoru içerisinde yer alan sulak alanlar, akıntı kanalında, nehir bölgesinde veya taşkın düzlüğünde oluşabilir. Sulak alanlar oldukça verimli ekosistemlerdir. Karasal ve sucul ekosistemlerde yaşayan canlılar için beslenme, yuva yapma ve üreme alanı sağlar. Özellikle hem düşük akış hızlarından hem de bol gıda kaynaklarından faydalanan yavru balıklar için önemli bir habitattır. Akarsu kıyıları boyunca devam eden sucul habitat alanları ve bu alanları oluşturan bitki örtüsü, kök yapısı ile suyun akış hızını kıyı şeridi boyunca yavaşlatarak, akıntı kıyılarını stabilize eder. Akarsuların gölgelenmesine ve su sıcaklığının serin tutulmasına yardımcı olur. Fırtınalar sırasında sulak alanlar yağmur suyunu yavaşlatarak ve geçici olarak tutarak taşkın riskini azaltır. Sulak alanlar havza suyunun kalitesini çeşitli yollarla iyileştirebilir. Öncelikle suyun akışını yavaşlatarak çökeltinin ayrılmasını sağlar. Ağır metaller ve organik bileşikler gibi toksik kirletici maddeler çökelti partiküllerine yapışır. Böylelikle çökeltinin artırılmasıyla, sulak alanlar suyun toksik kirleticilerden temizlenmesine de yardımcı olur (Naiman, 1992; Mitsch ve Gosselink, 2000; Kusler, 2003).

Kentsel sistemler içinde kalan su havzaları, hızlı ve çarpık gelişen kentlerin baskısı altındadır. Artan arazi kullanım değişiklikleri ve beraberinde getirdiği çevresel sorunlar, akarsu sisteminin fiziksel ve işlevsel özelliklerini önemli biçimde değiştirerek çevresinde yer alan havzanın hidrolojisinde köklü değişikliklere yol açmaktadır. Bir havzadaki kentleşme baskısı, hidrolojik rejimi önemli şekilde değiştirebilir ve bu durum artan miktarda yüzey akışı ve taşkın akışlarına, daha kısa zaman dilimine sıkışmış yoğun yağmur suyu akışlarına ve daha az yeraltı suyunun yeniden şarjına yol açar. Havzada gerilim yaratan temel faktörler aşağıdaki şekilde sıralanmaktadır;

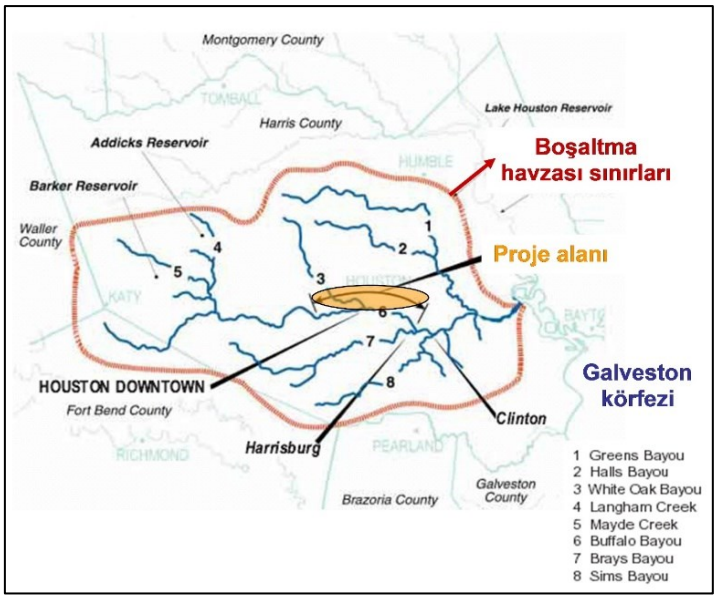
- *Hidrolojik rejimin bozulması:* Havzada kentleşmenin en önemli etkileri, evler, yollar ve otopark alanları gibi geçirimsiz yüzeylerdeki artıştan kaynaklanmaktadır. Geçirimli toprağın geçirimsiz yüzeylere dönüştürülmesi, suyun infiltrasyon miktarını azaltır ve akış miktarını artırır. Yağmur suyu akışları, pürüzsüz sert kaplama üzerinde doğal bitki örtüsünde olduğundan daha hızlı hareket eder. Sonuç olarak, yağmur suyu akışları kentsel alanlardaki akarsularda yoğunlaşır. Artan yüzeysel akış miktarı ve azalan akış süreci sonucunda kentsel alanlarda sel taşkınları meydana gelmektedir (Sarma ve ark., 2016).
- *Erozyon ve sedimantasyon:* Kentsel alanlarda yüzeysel akış miktarının artması erozyon ve sedimantasyona sebep olmaktadır. Sedimantasyon, suyu taşıyan akarsuyun ve suyu tutan rezervuarın kapasitesini azaltır. Kapasitedeki bu azalma, taşkın riskini yükseltir ve suyun temin edildiği su kaynaklarında su kalitesi ve miktarın azalmasına neden olur (Pamukçu ve ark., 2020).
- *Akarsu yataklarında meydana gelen değişiklikler:* Kentsel alanlardaki akarsular, özel arazi kullanımlarına yer açmak ve bitişikte yer alan mülkü taşkın veya nehir yatağı erozyonundan korumak için geniş ölçüde değişikliğe uğramaktadır. Akarsu yataklarının kentsel alanlarda sık sık yeri değişmekte ve akış kesiti daralmaktadır. Yatakların bazı bölümleri yer altında kalmakta veya beton kanallar içine alınarak doğal yapısı bozulmaktadır (Sarma ve ark., 2016).
- *Su kirliliği:* Kentsel alanlarda meydana gelen yüzeysel su akışı, pek çok kirletici madde içermektedir; yollarda ve otopark alanlarında biriken yağ, gres yağı ve ağır metaller; çöpler; ticari ve konut alanı peyzajı için kullanılan gübre ve pestisitler; boya gibi yanlış şekilde atılan toksik maddeler vs. Bu kirletici maddelerden oluşan akıntılar, pek çok havzada su kalitesini düşürerek hem suda yaşayan balıklar ve diğer sucul organizmalar ve havza çevresinde yaşayan yaban hayatını hem de havza suyundan faydalanan insan sağlığını tehdit etmektedir (Gregersen ve ark., 2007).

Havzalar, yerleşim, sanayi, tarım, orman ve rekreasyonel alanlar gibi farklı arazi kullanımlarını içeren bütünleşik sistemlerdir (UN, 1997). Bu nedenle sürdürülebilir kalkınma politikaları oluşturulurken, kaynakların etkin bir şekilde yönetiminde değerlendirilmesi gereken önemli bir doğal eşiktir. Havza yönetimi, arazi ve su kaynaklarının kullanımını kapsamlı bir şekilde yöneterek, bir havzadaki su ve diğer doğal kaynakların kalitesini korumak ve iyileştirmek için arazi kullanım ve su yönetimi uygulamalarının sürecini tanımlamak için kullanılan bir terimdir (Brooks ve ark., 2013). Havza yönetimi, bir havzanın sürdürülebilir kaynak kullanımıyla ilgili özelliklerinin incelenerek, havzanın işlevini iyileştirmek ve sürdürmek için planlanması, geliştirilmesi ve yönetilmesidir. Havza içerisindeki ekolojik, ekonomik ve kültürel/sosyal koşullar arasında sağlıklı bir denge kurmayı amaçlayan kapsamlı bir kaynak yönetim planlama sürecidir (Wang ve ark., 2016). Havza yönetimi kapsamında uygulanan ıslah çalışmaları havzada, toprak, su, bitki örtüsü arasında doğal dengeyi sağlamaya yönelik teknik, kültürel ve idari tedbirlerin alınması ile havzada yaşayan halkın sosyal, kültürel ve ekonomik kalkınmalarının sağlanması için yapılan çalışmaların tamamı olarak tanımlanmaktadır (ÇEMGM, 2016). Havza ıslahı çalışmaları erozyon riskini azaltmak, taşkın sularına karşı koruyucu tesisler meydana getirmek ve içme suyu ve kanalizasyon problemlerini çözmek gibi amaçlarla yapılır. Havza ıslahına yönelik uygulamalar şu şekilde özetlenebilir (FISRWG, 2001):

- *Akarsu kanalının stabilize edilmesi:* Bir akarsu kanalının stabilize edilmesi için kullanılabilecek pek çok yöntem mevcuttur;
    - *Kanal açma:* Akarsuların beton kanallara yerleştirilmesi, en yaygın kanal sabitleme yaklaşımlarından biridir. Bu yaklaşım kanal yatağı erozyonunu önlemede etkilidir, fakat beton kanallar suda yaşayan canlı türleri için uygun habitat sağlamaz ve su kenarı bitkilerinin büyümesini engeller.
    - *Tesviye kontrol yapıları:* Kanal yatağındaki akış hızını azaltmak ve eğimi stabilize etmek için kullanılır. Ancak, balıklar ve yaban hayatı için bir bariyer haline gelmeyecek şekilde tasarlanmalıdır.
    - *Şev stabilizasyonu:* En yaygın yaklaşım, şeve kayalar veya çakıl taşları dizilmesidir. Kayaların arasındaki boşluklara, ilave stabilize sağlayacak bitkiler dikilir. Şev stabilizasyonuna yönelik yeni biyoteknik yöntemler giderek yaygınlaşmaktadır.
- *Sulak alan bitki örtüsü:* Akarsu sistemlerinin önemli bir bileşeni olarak çeşitli fonksiyonları bulunmaktadır. Öncelikle, kök yapısı kıyıya ilave güç sağlayarak stabilize olmasına yardımcı olur. Su kenarı ağaçları, akarsu kanalının gölgelenmesine ve su sıcaklıklarının düşürülmesine yardımcı olur. Su kenarı bitkileri, buharlaşma hızını artırır ve aşağı doğru akıntıyı azaltır. Bitki örtüsü, kuşlar ve diğer yaban hayatı için habitat sağlayarak biyolojik çeşitliliği artırır.
- *Sulak Alanlar:* Taşkın sularının depolanması ve böylelikle yüksek düzeyde akışların azaltmasına yardımcı olur. Sulak alanlar akış hızlarını azaltarak yeraltı suyunun yeniden dolmasını ve kıyı koylarına tatlı su akışının azaltılmasını sağlar. Sudaki tortu, besin ve kirleticileri gideren bir filtreleme sistemi görevi görerek su kalitesini iyileştirirler.
- *Yağmur hendekleri ve su tutma havzaları:* Yağmur hendekleri, su tutma havzaları ve diğer su toplamaya yönelik olarak tasarlanmış yapılar, yüksek düzeydeki akış hızlarının azaltılması için yaygın olarak kullanılan yöntemlerdir. Yapımlarına bağlı olarak, bu yapılar sel yatağı oluşumlarının önlenmesine, sürüklenen toprakların tutulmasına ve yağmur suyunun toplanarak süzülmesine yardımcı olur.
- *Geniş akarsu koridorunun korunması:* Kentsel akarsuları ve aşağı havza kıyı kaynaklarını korumanın en etkili yöntemlerinden biri, aktif kanalı, taşkın yatağını ve geçiş arazi tamponunu içine alabilecek geniş bir akıntı koridoru elde etmektir. Böylelikle geniş bir akıntı koridoru ile, havza çevresindeki toplulukların taşkın kontrolü ihtiyaçları karşılanırken doğal akıntı fonksiyonları sürdürülebilir.

**3.2 Çalışma Alanının Mevcut Durumu**

Yaklaşık 120 km. uzunluktaki Buffalo Bayou Havzası Amerika'nın güneydoğusunda bulunan Teksas Eyaleti sınırları içerisindeki Houston Şehri'nde yer almaktadır (Şekil 2). Batıda Waller Bölgesi'nden başlayarak, doğu-batı istikametinde bir akıntıyla ilerlemekte ve San Jacinto Nehri ile birleşerek Galveston Körfezi'ne dökülmektedir. Beş adet kuzeyden (Greens Bayou, Halls Bayou, White Oak Bayou, Langham Creek, Mayde Creek) ve iki adet güneyden (Brays Bayou, Sims Bayou) birleşen toplam yedi büyük kolu bulunmaktadır. Buffalo Bayou Havza yatağı, geniş ve düz bir yapıya sahip bir ova üzerinde uzanmaktadır. Arazi yüzeyi Galveston Körfezi'nden kuzeybatı yönüne yükselen hafif bir eğime sahiptir (Turner Collie & Braden Inc., 2002).




**Şekil 2.** Buffalo Bayou Havzasının Genel Konumu (Turner Collie & Braden Inc., 2002)

Houston'da sert hava koşullarından dolayı sık sık tropikal fırtınalar ve kasırgalar meydana gelmektedir. Bu fırtına ve kasırgalar Atlantik Okyanusu veya Meksika Körfezi'nde oluşarak Houston'a ulaşmakta ve beraberinde şiddetli yağmur ve rüzgâr getirmektedir. 2001 yılının haziran ayında meydana gelen Allison Tropikal Fırtınası ile sel taşkını oluşmuş ve bölge sular altında kalmıştır. Teksas kıyı körfezi ovası subtropikal iklim kuşağında yer almaktadır. Bölgenin iklimini kontrol eden en büyük faktör Meksika Körfezi'dir. Yüksek sıcaklıklar ve nemin etkili olduğu bölgede Meksika Körfezi'nden esen rüzgarlar yazın sıcak boğucu havayı serinletmektedir. Hâkim rüzgarlar yazın güney/güneydoğu yönünde esmektedir. Kışın ise yüksek basınç etkisi altında kalarak kuzeyden esen rüzgarlarla sıcaklık ve nem gün içerisinde yükselip azalan bir değişkenlik göstermekte ve sis bulutları oluşmaktadır. Nadiren de olsa bölgeden mal ve can kaybına neden olabilecek büyüklükte yıkıcı kasırgalar ve fırtınalar geçmektedir. Örneğin: 2008 Ike Kasırgası, 2015 Memorial Day Sel Taşkını, 2016 Tax Day Sel Taşkını ve 2017 Harvey Kasırgası. Buffalo Bayou Havzası, Erken Pleistosen dönemi jeolojik formasyonlarından biri olan Beaumont formasyonu üzerinde bulunmaktadır. Beaumont formasyonu yüzeye yakın olmasından dolayı kil, alüvyon ve ince kum tanecikleri içeren bir yapıya sahip katmanlardan oluşmaktadır. Buffalo Bayou Havzası'nın Beaumont formasyonunu kesmesi sonucunda ince kumlu yapıdaki bu katmanlar açığa çıkarak bölgeyi erozyona karşı hassas hale getirmektedir (Van Siclen, 1985; Abbott, 2001). Ayrıca fırtınalar sonucu hızı artan akıntılarla topraktaki kil parçacıklarının yıkanması sonucu havzanın suyunun berraklığı azalmakta ve çamurlu bir görünüm almaktadır.

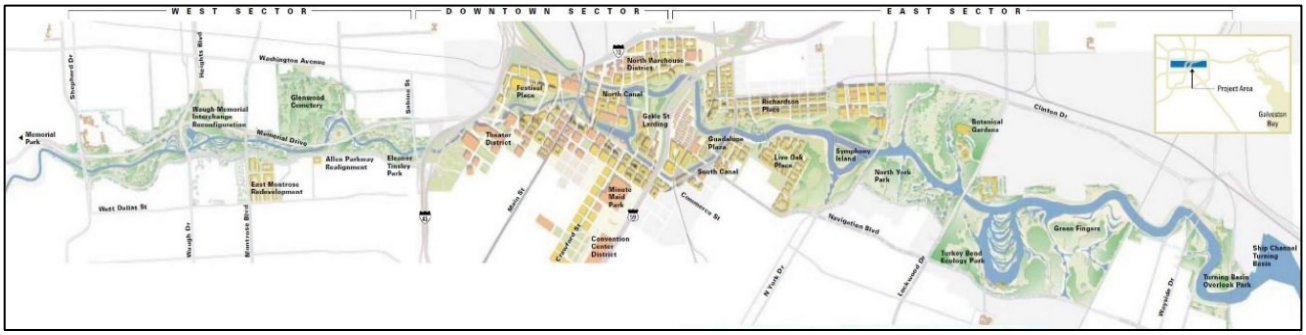
Buffalo Bayou Havzası'nın geçmişine baktığımızda; 1820'li yıllarda bölgenin tarımsal amaçlı kullanıldığı görülmektedir. 1830'larda ise bölgedeki öncelikli alan kullanımı büyükbaş hayvanların otlatılması olmuştur. 1900'lerin başında ise yerleşim alanları ve endüstriyel alanlar kurularak kentleşme süreci başlamıştır. Ayrıca 1910 ile 1920 yılları arasındaki dönemde bölgede kum ocakları bulunmaktaydı. Giderek ticari bir öneme sahip olmaya başlayan Houston Şehri'nin bu durumu ulaşımı etkilemiştir. Gemilerin daha iç kısımlara kadar girebilmesi için havza bölgesi genişletilerek, su yüzeyi derinleştirilmiştir. Daha sonraki yıllarda tren yolları, köprüler ve otoyollarla havzanın iki yakası arasında ulaşım ağı kurularak bölge gelişmeye başlamış ve günümüzdeki halini almıştır (Turner Collie & Braden Inc., 2002). Günümüzde havza boyunca en baskın kullanım alanı olarak (özellikle doğu kısmında) endüstriyel alanlar yer almaktadır. Havzanın ortasında şehir merkezi olarak kullanılan alanda yoğun olarak ticari yapılar bulunmakta ve batı kısmında ise karışık bir alan kullanımı görülmektedir. Arazi kullanım çalışmaları sırasında proje alanının yakın çevresinde zararlı atık maddeler üreten çok sayıda fabrika alanları tespit edilmiştir. Özellikle havzanın kuzeyinde yaklaşık 2,5 km. uzaklıkta kimyasal atık deposu yer almaktadır. Bu alanının içerdiği arsenik, krom, kobalt, kurşun, bakır ve nikel gibi ağır metallerden oluşan tehlikeli maddelerin sızarak havzanın suyuna karışma tehlikesi bulunmaktadır. Kısacası, Buffalo Bayou Havzası hem şehir içindeki fabrika, hastane, okul, ev, iş yeri gibi çeşitli kaynaklardan ulaşan zararlı atıklarla hem de havzaya dökülen derelerden fırtına, rüzgâr ve yağışlarla oluşan akıntılar sonucu ulaşan çöp ve kirletici maddelerle kirlenerek çevreyi ve insan sağlığını tehdit etmektedir.

Buffalo Bayou Havzası çevresindeki yapılaşma ve endüstriyel alanlara rağmen bitki örtüsü bakımından çeşitlilik göstermektedir. Havza yatağının eğimine, akıntının şiddetine ve toprak durumuna göre çeşitlilik gösteren bazı bitki türleri şu şekildedir; *Ulmus americana* (American elm), *Salix nigra* (Black willow), *Betula nigra* (River birch), *Platanus occidentalis* (American sycamore), *Acer negundo* (Boxelder maple), *Fraxinus pennsylvania* (Green Ash), *Quercus virginiana* (Southern live oak), *Quercus phellos* (Willow oak), *Catalpa bignonioides* (Southern catalpa), *Populus deltoides* (Eastern cottonwood), *Gleditsia triacanthos* (Honey locust), *Pinus taeda* (Loblolly pine), *Baccharis halimuifolia* (Eastern baccharis), *Andropogen glomeratus* (Bushy bluestem), *Phragmites australis* (Common reed), *Equisetum hyemale* (Scouring rush), *Bidens aristosa* (Tickseed sunflower), *Ambrosia trifida* (Giant ragweed), *Polygonum hydropiperoides* (Swamp smartweed), *Cynodon dactylon* (Scutch grass), *Paspalum dilatatum* (Dallis grass), *Paspalum distichum* (Knotgrass), *Ampelopsis arborea* (Pepper vine) and *Parthenocissus quinquefolia* (Virginia creeper) (Turner Collie & Braden Inc., 2002). Büyük bir taşkın yatağı olarak çevresinde küçük gölcükler, bataklık ve sulak alanlar yer almaktadır. Sık dokulu ağaçlık alanların bazı kısımlarında güneş ışığı yetersizliği, akıntıların neden olduğu toprak yıkanması ve besleyici organik maddelerce yetersiz kalan toprak yapısından dolayı yer örtücülerden yoksun alanlar bulunmaktadır.

**3.3 Buffalo Bayou Havazı ve Çevresinde Gerçekleştirilecek Yenileme Çalışmaları Master Planı**

Buffalo Bayou Havzası, taşkın sularını taşıyarak uzaklaştırıcı büyük bir kanal olarak hem Houston Şehri için hem de tüm güneydoğu Teksas Körfezi kıyı bölgeleri için kamusal güvenliği sağlamak adına önemli bir doğal kaynaktır. Fakat günümüzde kentleşme sürecinde yapılan birtakım olumsuz müdahaleler sonucu bu görevini yerine getirememekte ve birtakım problemlere neden olmaktadır. Havzanın çevresel kalitesini etkileyen birçok olumsuz faktör bulunmaktadır. Günümüzde havzanın %80'e yakın bir kısmı kentleşmiş durumdadır. Kentleşme ile asfalt, beton vb. su geçirmez yüzeylerin artması sonucu, fırtına ve yağış suları doğal koşullardan daha hızlı bir şekilde havzaya ulaşarak su seviyesini artırmakta ve havza suyunun düzensiz ve hızlı bir şekilde akmasına neden olmaktadır. Çevresindeki derelerden akan suların havzaya karışması, havza yatağı çevresindeki yoğun yapıların suyun akış alanını daraltması, havza üzerinden geçen köprülerin destek kısımlarının suyun akışını zorlaştırarak yavaşlatması gibi olumsuz faktörler havzada sel taşkınlarına neden olmaktadır. Havza çevresinde yer alan endüstriyel alanların meydana getirdiği kirlilik sonucu havza suyunun kalitesi

azalmakta ve bu durum havzadaki doğal balık türlerini ve çevredeki bataklıklarda yaşayan hayvan türlerinin neslini tehdit etmektedir. Endüstriyel alanların ve yapılaşmanın fiziksel ve görsel açıdan engel oluşturduğu havza çevresi yeşil alanlar bakımından yetersiz olmakla birlikte bu kısıtlı açık alanlardaki yaya yolları ve kentsel donatı elemanları da konfor bakımından yetersiz durumdadır. Tüm bu olumsuz özelliklere sahip havzada 2001 yılında meydana gelen Allison Fırtınası sonucu oluşan sel taşkını ile bölge büyük bir tahribata uğramıştır. Bu olay sonrasında 2002 yılında havza ve çevresinde yenileme çalışmalarına başlanmıştır. Araştırmalar sonucu oluşturulan çevresel raporlar ışığında bölgenin rehabilitasyonu için geniş kapsamlı 20 yıllık bir master plan oluşturulmuştur (Şekil 3).




**Şekil 3.** Proje Alanı Master Planı (Thompson Design Group Inc./EcoPlan, 2002)

Çalışma ile ilgili genel plan stratejileri şu şekildedir;

- *Havzanın ekolojik olarak işlevsel bir sisteme dönüştürülmek üzere rehabilite edilmesi:* Havzanın su tutma ve drenaj kapasitesinin artırılması, yaban hayatı habitatının sürdürülmesi, yağmur suyunun temizlenmesi ve su kalitesini sürdürme kapasitesi dahil olmak üzere doğal fonksiyonlarına yeniden kavuşturulması.
- *Havzanın taşkın suyu taşıma kapasitesinin artırılması:* Havzanın taşkın suyu taşıma kapasitesini destekleyici kanallar ve setlerin düzenlenmesi, şehir merkezindeki havza suyunun hareketini engelleyici yapıların kaldırılması gibi önlemlerle su taşıma kapasitesinin artırılması, bölgesel taşkın etkilerine çözüm bulunması.
- *Havza çevresinde düşük etkili kentleşme uygulaması:* Koruma bilinçli planlama ve mühendislikle, havzanın ekolojik yapısının korunarak çevresindeki kentsel yapılaşmanın yeniden planlanarak iyileştirilmesi.
- *Havza bölgesinin görünürlüğünün artırılması:* Havza kıyılarının yeniden şekillendirilmesi ile doğal habitatın ve rekreasyonel kullanım kapasitesinin artırılması, kullanıcıların ulaşım olanaklarının kolaylaştırılması, havza kıyısında oluşturulacak gezinti yolları ile bölgenin görsel kalitesinin artırılması.
- *Havza boyunca ulaşım olanaklarının artırılması, kolay erişilebilirliğin sağlanması:* Planlama ve tasarım standartları ile havza setlerine ve su kıyısına halkın erişiminin sağlanması.
- *Bölgenin karma kullanımının yeniden geliştirilmesinin teşvik edilmesi:* Havza çevresindeki kullanım çeşitliliğinin artırılması, gerçekleştirilecek birçok su kıyısı etkinlikleri ve festivallerle hem halkın katılımının artırılması hem de turizm açısından bölgede bir çekim noktası oluşturulması.

Plan stratejileri kapsamında ele alınan havza ıslah çalışmaları incelendiğinde genel olarak aşağıdaki sonuçlara ulaşılmaktadır;

- *"Yeşil Parmaklar" yaratılmasıyla havzanın ekoloji ve hidrolojisinin geliştirilmesi:* Uygulanan küçük yeşil parmaklar yaklaşık 7-20 metre genişliğinde; büyük yeşil parmaklar ise 75-300 metre genişliğindedir. Bu sistem ile pasif teknikler (sulak alanlar vb.) uygulanarak yağmur sularının havzaya dökülmeden önce tutulması, süzülmesi ve temizlenmesi sağlanmaktadır. Yeşil parmakların her birinde akan yağmur suyunu kanallamak üzere bir dere, kirletici maddeleri süzmek ve ince kumu yakalamak için bir durultma göleti, ve suyun havalandırıldığı basamaklı bir set yer almaktadır. Göletin ve derenin kenarları sulak arazi bitkilerinden oluşan bir bataklık halinde bulunmaktadır. Yavaşlayan akış ayrıca suyu arındırmakta ve yaban hayatına fayda sağlamaktadır. Havzanın çevresinde ve yeşil parmaklar boyunca oluşturulan yeni sulak alanlar, kirletici maddelerin sudan süzülmesine yardımcı olmaktadır.
- *Set kenarlarının geliştirilmesiyle taşkın etkilerinin azaltılması:* Havzada uygulanan değişiklikler erozyonu büyük ölçüde azaltsa da bazı bölgelerin yüksek hızda taşkın akımlarından korunması gerekmektedir. Menderesin dış kenarları gibi yerlerde ve sulak alanlar gibi hassas bölgelerde erozyon kontrolü için, bitkilerin ve doğal tekniklerin kullanıldığı, aşınabilir setleri sabitlemeye yönelik biyomühendislik teknikleri uygulanmıştır.
- *Yeni doğal yaşama alanları yaratılarak yaban hayatı habitatının genişletilmesi ve artırılması:* Havzanın mevcut kıyı alanları, yaban hayatı habitatı bakımından yetersiz durumdaydı. Bu alanların yeniden düzenlenerek yeni sulak alanların, göletlerin oluşturulması ve su kenarı bitkilendirmesi ile havzanın biyolojik çeşitliliğinin büyük ölçüde artırılması hedeflenmiştir.

- *Düşük etkili kentleşme teknikleri yoluyla boşaltma havzası üzerindeki olumsuz etkilerin azaltılması:* Uygulanan teknikler şu şekilde özetlenebilir: (1) Binaların, asfaltın ve peyzajın tasarlanma ve inşa edilme yollarının değiştirilerek yağmur sularının sahada tutulması; (2) Bitkilendirilmiş çatı örtüleri ile yağmur suyunun emilmesi ve taban düzeyinde drenaj yapılarına akışının yavaşlatılması; (3) Yeraltı saklama sarnıçları ile yağmur sularının depolanarak alandan yavaş yavaş tahliye edilmesi ve böylelikle kentsel yüzey akışının hacim ve hızının azaltılması; (4) Bitkilerle oluşturulan hendeklerin, yağmur sularının akışını yavaşlatması ve kirletici maddeleri süzmesi; (5) Gözenekli kaplama elemanları ile yağmur sularının bir bölümünün yeraltı bekletme havzalarına girmesinin sağlanması, ve; (6) Yollardan, park alanlarından, meydanlardan ve binaların altındaki yaya alanlarından gelen yağmur sularının yeraltı havzalarına boşalmasından önce arıtılabileceği biyofiltre kanallarının oluşturulması.
- *Havza kıyısı boyunca yer alan kamusal alanlarda sürekliliğin sağlanması:* Sel sularının akışına karşı direnci azaltmak için havzanın köprü geçişleri sağlamlaştırılmış, gereken yerlerde geçişler kaldırılarak köprüler yeniden inşa edilmiştir. Teraslandırılmış kanal kıyıları ile alana erişim ve kullanımın artırılması amaçlanmıştır. Yer yer oluşturulan istinat duvarları, rampalar ve merdivenler yardımıyla, havza kıyısı boyunca uzanan kamusal alanlar ve kıyı kesiminin dik, eğimli ve doğal bitki örtüsü ile kaplı alanları arasında süreklilik sağlanmıştır. Kentsel alanlarda terasların bir avantajı, taşkın meydana geldiğinde insan kullanımı için alternatif alanlar sağlamalarıdır. Daha alçak teraslar taşkın altında kalırken, üst teraslar kullanılabilmektedir. Ayrıca önerilen iskele ve kıyı kenarı yürüme alanları, kıyı kesimi boyunca kesintisiz erişimi sağlamaktadır. Dış mekân oturma yerleri, özel etkinlikler, kafe ve restoranlar için çeşitli yüksekliklerde daha büyük teraslar ve meydanlar oluşturulmuştur.
- *Havza boyunca birbirleriyle bağlantılı içerisinde gezinti yolları, dinlenme ve oyun alanları içeren geniş bir park sisteminin oluşturulması:* 250 dönümlük mevcut park alanı artırılarak 850 dönümlük yeni park alanı ilave edilmiştir. Ayrıca henüz yapım aşamasında olan Memorial Parkı Turning Havza'sına bağlayan 2500 dönümlük bir yeşil alan sistemi düzenlemesi önerilmiştir.
- *Havza kıyısı boyunca çeşitli rekreasyonel aktivite alanlarının oluşturulması:* Havza kıyısı boyunca su kenarı aktivitelerinin gerçekleştirileceği iskeleler sistemi uygulanmıştır. Sistem ana ve ikincil iskelelerin yanı sıra kanolara ve küçük kayıklara yönelik küçük erişim noktalarını içermektedir. Erişim noktalarına ek olarak, havza kıyısı boyunca yer alan patikalar, yürüme yolları ve ahşap kaldırımlar ile iskeleler yayalar ve tekne sahipleri için erişilebilir hale getirilmiştir. Yeni tekne tesisleri tekneleri konuk ederek, teknecilere ve ziyaretçilere yiyecek-içecek, ambar ve duş hizmeti sağlamaktadır. Önerilen tekne tesisleri, havza sularında yapılan kürek çekme gibi yarışma organizasyonları için gelen sporcuları da konuk edebilmektedir. Havza boyunca kilit noktalara pavyonlar yerleştirilmiştir. Küçük pavyonlar, park ziyaretçilerine barınma ve bilgilendirme imkanları sağlamakta, daha büyük pavyonlar ise kafe, restoran vb. yiyecek ve içecek mekanlarını içermektedir. Büyük ve açık yeşil alanların yanı sıra, havza boyunca güneşten mümkün olduğunca korunma sağlamak için yoğun şekilde gölge veren ağaçlar dikilmiştir.
- *Havza erişim ve ulaşım planı* kapsamında, havzanın her iki kıyısı boyunca yürüyüş ve bisiklet yollarının birbiriyle bağlandığı bir sistem oluşturulmuş, Geleceğe yönelik METRO Mobility 2025 planlama çalışmaları kapsamında, Buffalo Bayou bölgesine erişimi ve daha etkin trafik akışını sağlamak için Main Street Hafif Raylı Sistemi önerilmiştir.

**4.Tartışma ve Sonuç**

Houston Şehri'nin yapılaşma sonucu artan geçirimsiz yüzey oranı, kasırga ve sel felaketlerine karşı şehri savunmasız bırakmıştır. Bununla birlikte, sanayi ve liman faaliyetleri, havzanın su kalitesini olumsuz yönde etkilemiştir. 2001 yılında Allison Tropikal Fırtınası'nın bölgeyi sular altında bırakmasının ardından, 2002 yılından itibaren, Buffalo Bayou Havzası'ndaki suyun sürdürülebilir yönetimi ve afete dayanıklılık amacıyla, master plan doğrultusunda havza boyunca birbiriyle bağlantılı yeşil alanlar sistemi geliştirilmiştir. Plan kapsamında havzanın büyük ölçüde doğal hali korunarak, doğa temelli taşkın yönetim stratejileri uygulanmıştır. Havza üç ana bölgeye ayrılmıştır. Kent merkezinde, bisiklet ve yaya gezinti yolları, festival ve sergi alanları, yaya köprüleri, tekne inişleri ve çeşitli su kenarı faaliyetler için kayıkhaneler ve yeme-içme alanları önerilerek "konforlu ve canlı bir kent kıyısı" tasarlanmıştır. Batı bölgesinde, mevcut yeşil alanların restore edilerek yeni park alanları ile desteklenmesi ve havza kanalının genişletilerek su kenarı rekreasyonel aktivitelerinin artırılması hedeflenmiştir. Ayrıca, havzadaki su miktarını ve kalitesini iyileştirmek için mevcut kıyılar yeniden düzenlenerek, yeşil parmaklar, sulak alanlar, göletler ve su kenarı bitkileri ile ekolojik restorasyon amaçlanmıştır. Doğu bölgesinde yer alan âtıl sanayi alanlarının, sulak alanlardan oluşan bir ekoloji parkına dönüştürülmesi önerilmiştir. Terk edilmiş kanalizasyon arıtma tesisinin kubbe şekilli cam konstrüksiyon yapılar içerisinde sera alanları içeren bir botanik bahçesine dönüştürülmesi planlanmıştır.

Havzanın rehabilitasyonu ve canlandırılması amacıyla kurulan Buffalo Bayou Ortaklığı, proje alanında devam eden temizlik ve bakım çalışmaları ve yeni projeler için kamu özel sektör iş birliği ile sürekli bir fon sağlamaktadır. 2002'de proje çalışmaları başladıktan sonra bölgeyi, 2008 yılında Ike Kasırgası, 2015'te Memorial Day Sel Taşkını, 2016'da Tax Day Sel

Taşkını ve 2017'de Harvey Kasırgası vurmuştur. Harvey Kasırgası'nın ardından, 2019 yılında Buffalo Bayou Ortaklığı tarafından havzanın doğusunda yer alan endüstriyel, ticari ve konut alanlarının içerisinde bulunduğu bölge için yeni bir master plan hazırlanmıştır. Doğal alanların ve vahşi yaşamın korunması ile birlikte bölgedeki kültürel ve rekreasyonel faaliyetlerin iyileştirilmesini amaçlayan planda, 263 dönüm yeni park alanı, 70 km. uzunluğunda yürüyüş ve bisiklet yolları, 7 adet yeni yaya köprüsü önerilmektedir. Planda yer alan sel taşkın yönetimi ilgili stratejiler şu şekilde özetlenebilir: (1) havza boyunca yer alan yapıların su baskını, enkaz ve döküntülerin yaratacağı darbelere dayanıklı şekilde yeniden tasarlanması; (2) sel suları altında kalan açık alanların sulak alan olarak restore edilmesi; (3) dik yamaçların yeniden kademeli olarak yükseltilerek havzanın taşıma kapasitesinin iyileştirilmesi; (4) korkuluklar, duvarlar, yürüyüş yolları, rampalar ve merdivenlerin potansiyel erozyon ve su kaynaklı döküntüler nedeniyle bozulmaya karşı dayanıklı hale getirilmesi, ve; (5) aydınlatma sistemlerinin suya dayanıklı armatürler monte edilerek sel sırasında elektriği kesen su sensörleri ile tasarlanması (Buffalo Bayou Partnership, 2021). Projenin bir diğer başarısı, tasarım sürecinin her aşamasında, halkın katılımı sağlanarak ihtiyaçları ve istekleri göz önünde bulundurulmuştur. Yerel işletmeler içinde yeni alanlar tasarlanarak istihdamın artırılması hedeflenmiştir.

Özetle, su havzaları, geniş bir fauna ve flora yelpazesi için yaşam alanı sağlamada önemli role sahip ekosistemlerden biridir. Ayrıca, toplumsal refah düzeyinin ve yaşam kalitesinin artırılmasına katkı sağlayan birçok hizmet bu ekosistemler tarafından sağlanmaktadır. Fakat günümüzde, su havzaları yoğun kentleşme ve yanlış arazi kullanımları nedeniyle geri dönüşü olmayan kayıplara uğramaktadır. Havza yönetimi tüm dünyada önemli bir konu haline gelmiştir. Dünya çapında gerçekleştirilen başarılı rehabilitasyon projelerinin incelenmesi, birçok ülke için etkin ve sürdürülebilir havza yönetimi planlarının hazırlanmasında örnek teşkil etmesi açısından önemlidir. Ülkemizde, meydana gelen sel ve taşkınlar, maddi ve manevi zararlara neden olan en önemli afetlerden biridir. Merkezi ve yerel yönetimlerin havzaların korunması ve yönetim planlarının hazırlanmasına ilişkin sürdürülebilir yaklaşımlar geliştirmesi gerekmektedir. Bu bağlamda, Buffalo Bayou Havzası rehabilitasyon projesinin, Türkiye'de sürdürülebilir havza yönetimi için destekleyici adımları atmada bir kaynak olacağı düşünülmektedir. Bu çalışma ve benzer iyi uygulamalar, havzalarımızdaki sosyal, ekonomik ve çevresel sorunların çözümüne yönelik katkı sağlayacaktır.

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# Increasing Flood Disasters with Climate Change and Urban Adaptation Strategies; Suggestions for Bursa City

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**Abstract**
Cities have begun to experience the effects of climate change, which is a global problem, more and more. Many cities around the world are developing mitigation and adaptation strategies for urban resilience and have 2030-2050 targets. Cities in Turkey also suffer from flood disasters. In recent years, flood disasters have occurred in Istanbul, Izmir, Ankara, Samsun and Giresun, due to extreme precipitation. This study, in the first stage, investigates adaptation plans for a resilient city that includes increasing green areas and permeable surfaces, using green roofs, rehabilitation of stream beds, and using cisterns against the risk of flooding. This study focuses on Bursa, which is one of the cities that have many stream beds and prone to extreme precipitation. Accordingly, suggestions for the flood risk adaptation will be given based on the literature particularly for the Yildirim district, which is vulnerable due to the built environment and low-profile socioeconomic status it has.
**Keywords:** Climate Change; Flood Risk; Floods in Turkey; Urban Resilience; Urban Adaptation.

# İklim Değişikliği Etkisiyle Artan Sel Felaketleri ve Kentsel Uyum Stratejileri; Bursa Kenti İçin Öneriler

**Özet**
Kentler küresel bir sorun olan iklim değişikliğinin etkilerini son yıllarda daha fazla yaşamaya başlamıştır. Dünyada birçok şehir dirençli kent olmak için azaltma ve uyum stratejileri geliştirmektedir ve kentlerin bu stratejilere yönelik 2030-2050 hedefleri bulunmaktadır. İklim değişikliğinin etkisi ile dünyada olduğu gibi Türkiye'deki şehirlerde de sel felaketleri yaşanmaktadır. Son yıllarda aşırı yağışlar nedeniyle İstanbul, İzmir, Ankara, Samsun ve Giresun'da sel felaketleri meydana gelmiştir. Bu çalışma, ilk aşamada yeşil alanların ve geçirgen yüzeylerin artırılması, yeşil çatıların kullanılması, dere yataklarının rehabilitasyonu ve su baskını riskine karşı sarnıçların kullanılması gibi dirençli bir kent için literatürde yer alan uyum planlamalarını araştırmaktadır. Çalışma, çok sayıda dere yatağına sahip olan ve aşırı yağışların yaşandığı illerden biri olan Bursa kentine odaklanmaktadır. Bu çerçevede, özellikle planlanmamış yapılı çevre ve düşük sosyoekonomik düzey nedeniyle sel riskine karşı kırılgan olan Yıldırım ilçesi için, literatüre dayalı olarak, sel riski adaptasyonuna yönelik önerilerde bulunulacaktır.
**Anahtar Kelimeler:** İklim değişikliği; Sel Riski; Türkiye'de Seller; Kentsel Dirençlilik; Kentsel Uyum.

## 1. Giriş

İklim değişikliğinin bir sonucu olarak, kentsel alanlar hem can hem de mal kaybı açısından yıkıcı etkilere neden olabilecek sel baskınlarına karşı giderek daha savunmasız hale gelmektedir. Bu nedenle, kentsel sel süreçlerinin doğru bir şekilde değerlendirilmesi ve tehdit altındaki alanlarda afet öncesi iyileştirme stratejilerinin geliştirilmesi esastır. Şu anda, iklim değişikliği ve artan kentleşme ile ilgili olarak, sel, şehirlerin karşılaştığı en zorlu sorunlardan biridir (Yin vd. 2015). Sellerin doğal nedenleri son zamanlarda iklim değişikliğinin sonucudur (Jamshed et al. 2020), diğer nedenler ise kentleşme ile artmaktadır (Waghwala ve Agnihotri 2019).

Kentler, özellikle geç kentleşme süreci yaşayan ülkelerde, yoğun nüfusludur ve geçirimsiz alan çoktur. Ayrıca kentler genellikle yetersiz altyapı ile hızlı bir büyüme yaşamaktadır ve bu da daha fazla kentsel sel ve çevresel bozulmaya yol açmaktadır. Bu eğilimin önümüzdeki yıllarda da devam etmesi beklenmektedir (Lo vd. 2015). Bu nedenle, kentsel sel tehlikesini önleme ve azaltma stratejileri, kentsel planlama ve yönetimin kritik konuları olarak giderek daha fazla tanınmaya başlanmıştır.

Kentsel sel vakalarının artması, can ve mal kayıplarını en aza indirebilecek güvenilir taşkın azaltma stratejilerine olan ihtiyacı göstermektedir. Buna yönelik farklı ülkelerde farklı isimlerle sürdürülebilir yağmur suyu yönetimi önerileri ve uygulamaları mevcuttur. Uygulamalar genel olarak aynı temele oturmaktadır. Hepsi hidrolojik döngü ile bunların kentsel havza üzerindeki etkileri arasındaki dengeyi kurmanın önemini vurgulamaktadır. Çevre düzenlemesi ve ekonomik kazanımların yanında asıl amaç olarak yüzey akışı kontrolünü sağlamak önem taşımaktadır.

İklim değişikliği, dünyamız için en büyük zorluklardan birini oluşturmaktadır. Bununla birlikte, dünyanın tüm bölgelerinin daha fazla kentleşmesi öngörülmektedir. Sonuç olarak, sürdürülebilir kalkınma sorunları şehirlerde giderek yoğunlaşacaktır. Bunun sonucunda karşılaşılacak sorunlardan bir tanesi de dünyanın birçok bölgesinde kentsel sel riskinin artmasıdır. İklim değişikliğine uyum, taşkın azaltmanın yanı sıra birden fazla fayda sağlayan yeşil-mavi altyapıların

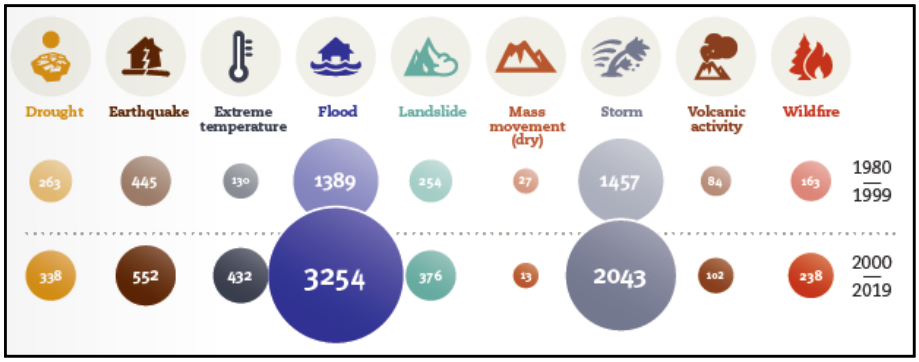
uygulanmasıyla birlikte kentsel koşulların iyileştirilmesi şekinde sağlanabilmektedir. Ancak kentsel drenaj sistemleri karmaşık yapılar olduğu için bu kolay bir iş değildir.
Bu çalışmada iklim değişikliğinin kentlerde artırdığı sel riski üzeride durulmuş, dünyada ve Türkiye'de yaşanan sel felaketlerine değinilmiştir. Sonrasında dünyada uygulanan uyum çalışmalarından bahsedilmiştir. Son olarak ise Bursa'da planlanmamış ve yoğun yapılaşmaya sahip Yıldırım ilçesinde sel riski azalım ve uyum önerileri verilmiştir.

**2. İklim Değişikliği ve Kentler**

Kentlerde iklim değişikliği etkisi giderek daha çok hissedilmektedir. Özellikle Sanayi devriminden sonra şehirlerde karbon salımının artmasıyla iklim değişikliği etkileri görülmeye başlanmıştır. (Aksay vd., 2005) İklim değişikliğinin kentlerdeki etkileri sıcaklık değişimi, kuraklık, kentsel ısı adası, fırtınalar, su seviyesinde yükselmeler ve aşırı yağışlar sonucu oluşan seller şeklinde sıralanabilir.
2050 yılına kadar kentleşmenin 6 milyar kent sakini ile sonuçlanacağı tahmin edilmektedir. (Met Office, UK) İnsanların %54'ünün şehirlerde yaşadığı ve 2050 yılına kadar bu oranın %66'ya çıkacağını tahmin edilmektedir. (UN 2015a). Şehirler, sera gazı kaynaklı olarak iklim değişikliğine ve kentsel ısı adası gibi kentsel etkilere maruz kalmaktadır. (Met Office, UK) Hızlı kentleşme, iklim değişikliği, su altyapılarının yetersizliği ve kötü katı atık yönetimi, şehirlerin direncini azaltmaktadır. Sel, su kıtlığı, su kirliliği, olumsuz sağlık etkileri ve rehabilitasyon sorunlarına neden olmaktadır. Tüm bu etkiler şehirlerde zorluklar doğurmaktadır.
Kentler iklim değişikliğinden fiziksel, sosyal, coğrafik ve ekonomik olarak etkilenmektedir. Kentlerin gelişmişlik durumlarına göre ise kırılganlık düzeyleri değişmektedir. Kentlerin dirençli hale getirilebilmesi için iklim değişikliği etkileri azaltılmalı ve uyum çalışmaları yapılmalıdır. İklim değişikliğine uyum , UNFCC tarafından 'yaşanan veya beklenen iklimsel uyaranlara veya etkilerine yanıt olarak, zararı azaltan veya faydalı fırsatlardan yararlanan doğal veya beşeri sistemlerde ayarlama' olarak tanımlanmaktadır.
Afet riskinin azaltılması , UNISDR tarafından 'Tehlikelere maruz kalmanın azaltılması, insanların ve mülkün kırılganlığının azaltılması, arazinin ve çevrenin akıllıca yönetimi dahil olmak üzere, afetlerin nedensel faktörlerini analiz etmeye ve yönetmeye yönelik sistematik çabalar yoluyla afet risklerini azaltma kavramı ve uygulaması' şeklinde tanımlanmaktadır. Aynı zamanda çevre ve olumsuz olaylara karşı geliştirilmiş hazırlıktır.
İklim değişikliğini azaltma ve uyum politikaları kapsamında ekosisteme dayanan uyum stratejileri sıklıkla kullanılmaktadır. Ekosistem yönetimi, iklimle ilgili afetlere karşı fiziksel savunma sağlamaktadır. Sağlıklı ekosistemler, toplumları afetlerden korumaktadır ve etkilerle mücadele etme yeteneklerini geliştirmektedir. Sel riskine karşı uygulanan ekosistem temelli stratejilerin bazı örnekleri arasında, kıyı savunması için ağaçlandırılmanın kullanılması ve taşkın koruması için taşkın ovası yönetimi sayılabilir (Colls A vd., 2009). Örneğin Filipinler'de kıyı şeritlerini fırtına dalgalanmalarından ve deniz seviyesinin yükselmesinden korumak için kıyıların yeniden ağaçlandırılması , deniz seviyesinin yükselmesi arazi edinim programları gibi halihazırda iyi uygulamalar mevcuttur. Doğaya dayalı çözümler insanları ani taşkın, sel ve kar erimesi sonucu oluşabilecek heyelan gibi birçok felaketten korumaktadır.
İklim değişikliğine uyum ve afet riskinin azaltılması kentlerin direncini artırmaktadır. İklim değişikliği ve afetlerin kentler üzerindeki olumsuz etkilerini azaltmak için uyum ve afet yönetimi önlemlerine ihtiyaç vardır. İyi tasarlanmış uyum önlemleri, kentlerin direncini artırabilir ve ayrıca iklimle ilgili afet riskini azaltabilir. Adaptasyon, iklim değişikliği etkilerinin belirlenmesinden ve projelendirilmesinden başlayarak, bu etkilere tam olarak yanıt vermeye kadar uzanan bir süreçtir. Gelecekteki iklimle ilgili afetlere hazırlıklı olma ve bunlardan korunma açısından afet riskinin azaltılmasına yardımcı olur. Öte yandan, afet riskinin azaltılması genel uyum sürecine katkıda bulunur ve iyi yapılırsa, uzun vadeli iklim değişikliği etkilerinin ele alınması için temel oluşturarak uyum sürecini iyileştirebilir (O'Brien K, 2008).

**3. Dünyada ve Türkiye'de Sel Felaketleri**

Hızlanmış ve çarpık kentleşme kentlerde geçirimsiz yüzeylerin artışına neden olmuş ve hidrolojik anlamda dengeleri bozmuştur. (Kourtis ve Tsihrintzis, 2021) İklim değişikliği ve artan kentsel ısı adası etkisi nedeniyle sık görülen aşırı yağış olayları, son yıllarda hassas ve karmaşık kentsel hidrolojik sistemler için ciddi bir tehdit oluşturmaktadır. (Wang vd., 2020; Zhou, 2020). Yağış dengelerinin bozulması kentsel sel gibi etkilere yol açmaktadır ve tüm bu etkiler giderek daha endişe verici hale gelmeye başlamıştır. (Arnbjerg-Nielsen, 2012)
Çin'deki şehirlerin yaklaşık üçte biri, her yıl selden etkilenmekte ve ciddi ekonomik ve maddi kayıplara neden olmaktadır (Li ve diğerleri, 2015; Liu ve diğerleri, 2021). Bu sorunu çözmek için son birkaç yılda sünger şehir kavramı önerilmiştir. Sünger şehir inşaatı, şehrin hidrolojik döngüsünü iyileştirmeyi ve yağmur suyu depolama ve arıtma kapasitesini iyileştirmeyi amaçlayan düşük etkili geliştirme (LID) önlemlerini temel almaktadır (Macro ve diğerleri, 2019; Tang ve diğerleri, 2020; Baek ve diğerleri, 2015). Çin'de olduğu gibi dünyada birçok kentte sel felaketleri yaşanmaktadır. Kentli hayati ve maddi açıdan birçok risk altında yaşamaktadır. Kentlerin coğrafi konumları, topografik özellikleri, kentsel yerleşimleri farklı olduğundan kentsel anlamda bu risklere karşı sunacakları stratejiler ve tasarımlar farklılık göstermektedir.




**Şekil 1.** Afet türleri ve sayıları: 1980-1999 vs. 2000-2019, (UNDRR, 2020)

Şekilde görüldüğü gibi afetler 1980-1999 arasında ölçülene kıyasla 2000-2019 yılları arasında büyük bir artış göstermiştir. Dünyada en çok artan afetler ise fırtına ve sellerdir.



**Şekil 2.** Dünyada sel felaketleri (ABD,Bangladeş) (https://www.bbc.com/news/science-environment-58396975-https://slate.com/technology/2016/10/blaming-natural-disasters-on-climate-change-will-backfire.html)

Aşırı sel, 2020 yılı içinde Tennessee ve California'daki kırsal alanlardan Michigan banliyölerine ve Brooklyn, New York sokaklarına kadar ülkenin neredeyse her bölgede etkili olmuştur. Seller ABD'de her zaman en yaygın ve en maliyetli hava felaketi olmuştur ve iklim değişikliği hızlandıkça daha da kötüleşmiştir. Ulusal Okyanus ve Atmosfer İdaresi (NOAA) verilerine göre, 2021 yılında sel ve kasırgalardan kaynaklanan toplam hasar 100 milyar doları aşmıştır. (https://grist.org/extreme-weather/flood-risk-growth-development/)
Yaşanan sel felaketlerinde iklim değişikliğinin ekisi büyüktür. Fakat yalnızca iklim değişikliği yüzünden kentlerin olumsuz etkilendiğini söylemek doğru olmaz. Kentlerdeki artan nüfus, yerleşimlerin nasıl yapılacağına dair bir planlamanın yapılmaması, plansız kentleşmenin ortaya çıkması gibi etkenler selden etkilenme oranını artıran nedenlerdir.

**Tablo 1.** Dünyada sel felaketleri

| | |
|---|---|
|  **Almanya, Erftstadt** (https://www.dw.com/tr/foto%C4%9Fraflarla-almanyadaki-sel-felaketi/a-58314889) |  **Çin, Hubey** (https://www.trthaber.com/haber/dunya/cinde-sel-felaketi-milyonlarca-kisiyi-etkiledi-502856.html) |
| | |



**Almanya , Rheinland-Pfalz**
(https://tr.euronews.com/2021/07/16/bat-avrupa-da-yasanan-sel-felaketleri-iklim-krizinin-bir-sonucu-mu)



**İtalya, Como**
(https://www.ntv.com.tr/galeri/dunya/almanya-ve-belcikanin-ardindan-italyada-sel-felaketi,6A7TD40Dd0atg2YdTny39Q/RL2ZrHpJYUmLLUVBENmGuQ)

Çin'de şiddetli yağışların yol açtığı seller hayatı olumsuz etkilemiştir ve 2020 Temmuz ayında yaşanan seller nedeniyle 31 can kaybı yaşanmıştır. 2 milyondan fazla kişi tahliye edilmiştir ve yaklaşık 151 bin ev zarar görmüştür. (2020)
İtalya'da ise ülkenin kuzeyinde yer alan Lombardiya bölgesinde 2021 yılında sel felaketi yaşanmıştır. Aşırı yağışlar nedeniyle Como Gölü ve çevresindeki kasabalarda toprak kaymaları ve su baskınları yaşanmıştır. Gölün batı kıyısında yer alan ve selden en çok etkilenen kasaba olan Brienno'da, heyelan felaketi de olumsuz sonuçlar doğurmuştur. 50 sakin evlerinde mahsur kalmış ve bazı bölgelerde sel tehlikesiyle karşı karşıya olan bir apartman tahliye edilmiştir.



**Şekil 3.** Kastamonu'nun Bozkurt ilçesinde sel ve toprak kaymalarında onlarca kişinin hayatını kaybetmesinin ardından yıkılan binalar ,13 Ağustos 2021, Cuma. (Fotoğraf: İsmail Coşkun/ İHA)

Türkiye'de, Batı Karadeniz'de (Bartın, Kastamonu ve Sinop) Ağustos 2021'de yaşanan sel felaketinde 74 can kaybı yaşanmıştır ve 45 kayıp bulunmaktadır. Aşırı yağışlar sonucu yaşanan sel felaketinde alınan hasarın büyük olmasının sebebi dere kenarında yerleşimin bulunması ve yaşanabilecek felaketlere karşı önlem alınmamasıdır.





**Şekil 4**. (https://www.aa.com.tr/tr/turkiye/izmirde-saganak-sel-ve-su-baskinlarina-neden-oldu-/2130674, Fotoğraf: Mehmet Emin Mengüarslan/AA)

2022 Şubat ayında İzmir'de aşırı yağışlar sonucu yaşanan sel felaketinde evleri ve işyerlerini su basmış ve trafikte ciddi anlamda aksamalar yaşanmıştır. Dere kenarındaki yol kapanmıştır.

**Tablo 2**. Türkiye'de Sel Felaketleri



Bursa Temmuz 2020
(https://www.bursa.com/bursada-selin-zarari-aciklandi-n435259/)



Bursa Haziran 2020
(https://artigercek.com/haberler/bursa-daki-selde-olu-sayisi-yukseldi-sele-kapilip-kaybolanlar-araniyor)



Ankara 2021
(https://www.hurriyet.com.tr/gundem/son-dakika-ankarada-yogun-saganak-sonrasi-sel-araclar-suruklendi-caddeler-su-altinda-kaldi-41828586)



Giresun 2020
(https://www.dw.com/tr/giresunda-sel-felaketi/a-54664018)

Türkiye gibi tropikal iklimin dışında kalan ülkelerde de şiddetli gök gürültülü sağanak yağışlar nedeniyle şehirlerdeki sel sayısı ve şiddeti de artmaktadır. Hızla artan çarpık yerleşim alanlarında deprem, sel vb. tehlikeler daha büyük felaketlere dönüşebilmektedir.

**4. Sel Felaketleri ve Kentsel Uyum**

İklim değişikliği nedeniyle yaşanan aşırı yağışlar sel riskini artırmaktadır. Fakat tek etken iklim değişikliği değildir. Şehirlerimizde risk faktörünün düşünülmeden kentleşmenin hızlanması yaşanan sel felaketlerinden etkilenme miktarını ve kırılganlığı artırmaktadır. Dünya nüfusunun önümüzdeki 15 yıl içinde bir milyardan fazla artarak 2030'da 8,5 milyara ulaşacağı ve 2050'de 9,7 milyara ve 2100'de 11,2 milyara ulaşacağı tahmin edilmektedir (UN 2015). Bu durum kentlerimizi daha kırılgan bir konuma doğru sürüklemektedir. Kentlerde riski azaltmak, kırılganlığı, can ve mal kaybını önleyebilmek için azaltım ve uyum çalışmaları yapılmalıdır. Kentler risk oranını artırabildiği gibi düşürme potansiyelini de barındırmaktadır. İklim değişikliğinden kaynaklı sel riskini önleyecek olan uyum çalışmaları dünyada birçok kentte uygulanmaktadır. Bu bölümde dünyada uygulanan uyum çalışmalarından bahsedilmektedir.

**4.1 Sünger Şehir**

Çin'de sıkça kentsel seller, aşırı yağışlar ve tayfunlar yaşamaktadır. Buna karşı Çin uyum stratejisi olrak sünger şehir programını ciddi riskler taşıyan 30 pilot şehirde uygulamaya koymuştur. Bunu yaparken mavi-yeşi-gri altyapı sistemlerinin bütünleşik olarak uygulamakta ve doğaya dayalı çözümler sunmaktadır. Şiddetli yağışla oluşan yüzey suyu akışını ve taşkınları azaltmak hedeflenmektedir. Bunu yaparken de sürdürülebilir direnaj sistemi ile birlikte borulu direnaj sitemleri, barajar ve taşkın duvarları kullanmaktadır (Yunfei Qui, 2020).

Sünger şehir, yağmur suyu akışını emerek ve depolayarak sellere karşı esnek bir uyum sağlayan şehirler olarak tanımlanmaktadır (Shao vd, 2016). Depolanan su gerektiğinde kullanılabilmektedir.

### 4.1.1 Shenzhen

Shenzhen bir kıyı şehri olmasından kaynaklı olarak yüksek sel riski altındadır ve ciddi boyutlarda seller yaşamaktadır. Sel, ani yağışlardan kaynaklanmakta ve kentsel altyapının tahrip olmasına ve kentsel ekolojik güvenliği tehdit etmesine neden olmaktadır. Kentsel su basması, kısa sürede yağış yoğunluğunun büyük olması, sızma kapasitesinin kentsel yüzey alanının geçirimsiz olması ve nem tutma kapasitesinin zayıf olması nedeniyle kentsel alandakileri etkilemektedir. Ayrıca kentleşme ile birlikte geçirimsiz yüzeylerdeki akış artmakta ve sellerin olumsuz etkileri de artmaktadır. (Yin, 2014).
Şehirler genellikle gri altyapı sistemlerini kullanmaktadır. Yağmur suyu akışı sırasında suyun emilmemesi ve başka yere aktarılması su baskınlarına neden olmaktadır. Bu durumlarla başa çıkmak için yeşil çatılar, geçirgen kaldırımlar ve yüzeyler kullanılabilir. Böylelelikle depolama ve emmenin atması sağlanabilir. Ayrıca yapay göletler, hendekler artırılarak yeşil önlemler uygulanabilir. Sünger şehir kavramı ile su yönetimi ve mekansal planlama birleştirilebilir.



**Şekil 5.** Kentsel köy Ganxia, (https://www.ekoyapidergisi.org/yasanabilir-sehirler-icin-green-cloud)

Ganxia'da yapılaşma yoğunluğu bulunmaktadır. Bu nedenle yeşil alan ve doğanın eksikliği hissedilmektedir. Sellere karşı uyum çalışması olarak Ganxia köyünde geçirimsiz araziler azaltılarak çatılar bitkilerle doldurulmuştur. Ayrıca yağmur suyu depolaması da sağlanmaktadır.

### 4.2 Yeşil Çatı

Kentler, kıyı kentleri ve körfez ülkeleri sellerle karşı karşıyadır. *(*Husnain Haider vd, 2019). Buna uyum sağlamak için drenaj altyapısı geliştirilmeli, yeşil, sürdürülebilir çözümler üretilmelidir. Örneğin yeşil çatı, su tutma havzaları, iyileştirilmiş drenaj sistemleri bu çözümlerden bazılarıdır. Sel riskinin azaltılması amacıyla farklı arazi kullanım alanlarından geçen yağmur suyu, drenaj altyapısı yardımıyla küçük ölçekli kontrol barajlarında veya tutma havuzlarında toplanabilir. Yağmur suyu hasadı ile de su tutulabilir ve sel riski önlenebilir. Geniş yeşil çatılar yardımıyla yağmur suyu hasadı yapılabilir. Bitkilerin suyu emmesi ve ardından yavaşça drenaj sistemine bırakması aşırı yağışlardaki riski azaltmaktadır.

### 4.2.1 Chicago Belediye Binası



**Şekil 6**. Chicago Belediye Binası'ndaki yeşil çatı (Julie Cidell, 2017)

2001 yılında, Belediye Başkanı Daley'nin Kentsel Isı Adası Girişimi'nin bir parçası olarak Chicago Belediye Binası'nın üzerine 20.300 metrekarelik yeşil bir çatı kurulmuştur. Çatıda 20.000 bitki, çalı, çimen, asma ve ağaç bulunmaktadır. Bitişikteki

normal bir çatıyla karşılaştırıldığında, Belediye Binası'nın yeşil çatısı yaklaşık 56°C daha düşüktür - artı faydaları arasında iyileştirilmiş hava kalitesi, 1 inçlik bir fırtına için %75 oranında azaltılmış yağmur suyu akışı ve enerji tasarrufu bulunmaktadır.

**4.2.2 Vancouver, Kanada**



**Şekil 7.** Vancouver Olimpiyat köyü (http://mimdap.org/2010/02/olimpiyatlar-ve-kent/32275/)

Olimpiyat köyü ilk olarak 2010 yılında Olimpiyat sporcuları için inşa edilmiş bir yerleşim tesisi olarak ortaya çıkmıştır. Olimpiyat oyunlarından sonra, topluluk için karma olarak kullanılan bir konut olarak kullanılmaktadır. Ayrıca, bu mahallenin tasarımı, çevresel ve sosyo-ekonomik sorunları ele alan ve Vancouver'ın ilk hedefleriyle uyumlu olan güneş panelleri, yeşil çatılar ve yenilikçi enerji verimli araçlar gibi kapsamlı yeşil özelliklere dayanmaktadır.

Dairelerin güneş sistemleri içeren yeşil çatıları bulunmaktadır. Yağışları toplamak için kullanılan ve çoğunlukla tuvalet sifonu veya bahçe sulama olarak kullanılan yağmur suyu toplama sistemi kullanılmıştır. Aynı şekilde, binaların yeşil çatısı, sakinlerin bir araya gelip sosyalleşebilecekleri bir ortak bahçe ve gıda üretim yerine dönüştürülmüştür. Buna ek olarak, Sel riskini yönetmenin bir yolu olarak, Kompleks çevresindeki sulak alanlar suyu emmenin ve erozyonu yavaşlatmanın doğal bir yolu olarak kullanılmaktadır.

**4.3 Mavi çatı uygulamaları**



**Şekil 8**. Mavi Çatı Uygulaması (https://sustainabletechnologies.ca/home/urban-runoff-green-infrastructure/low-impact-development/blue-roofs/)

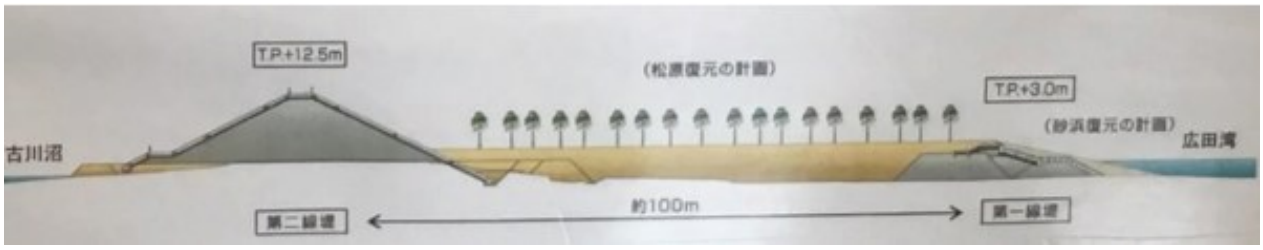
Mavi çatı uygulamaları, artan bu ihtiyaçlara yönelik yeşil altyapı çözümlerinden biridir. Yeşil çatıya benzemektedir. Fakat mavi çatı yeşil çatıdan farklı olarak yağmur suyu akışını yavaşlatmaktadır, bitkiler yerine su akışını düzenleyen ve kontrol eden bir sistemle bunu sağlamaktadır. Mavi çatı teknolojilerine örnek olarak iniş vanaları, oluk depolama sistemleri ve

sarnıçlar verilebilir. Mavi Çatı uygulamalarındaki amaç, yerel yağmur suyu altyapısı üzerindeki aşırı yüklenmeleri azaltmak ve yerel taşkınları, olası taşkın hasarlarını önlemektir.

Mavi çatı terimi, nispeten yakın zamanda, yağmur suyu azaltma tekniklerini yeşil çatılarla ilişkili olanlardan ayırmanın bir yoludur. Aslında, mavi çatı, yağmur suyunu yakalayan ve belirli bir süre tutan ya da dış mekan sulama veya iç mekan içme suyu kullanımını dengelemek gibi başka amaçlar için yeniden kullanan bir sistemdir (Hammond, 2017).

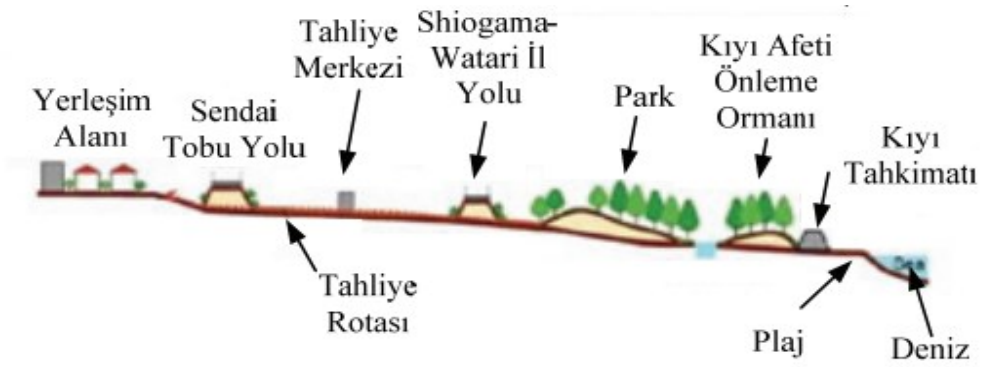
**4.4 Yeşil Alanların Kullanımı**

Doğaya dayalı çözümler iklime karşı dirençlilik sağlamaktadır. IUCN (Uluslararası Doğa Koruma Birliği) Doğaya dayalı çözümler tanımı şu şekildedir; hem insan refahı hem de biyolojk çeşitlilik yararları sağlamak için verimli ve uyarlanabilir bir şekilde toplumsal zorlukları ele alacak şekilde korumayı sürdürülebilir bir şekilde yönetmek ve restore etmek için uygulanan eylemlerdir. Bu çözümlerden biri de yeşil alanların kullanımıdır.




**Şekil 9**. Japonya Tsunmami için kıyı ormanları ve kıyı önlemleri (Güler vd, 2018)

Japonya Kıyı ormanlarının bina hasarlarını ve su baskını yüksekliğini azaltarak tsunaminin azaltılmasında etkili olduğunu ortaya koymuştur. Bu nedenle kıyı bölgelerine bitki örtüsü ve ağaç dikilmiştir. Buna ek olarak, gelecekteki tsunami ve felaketlerin (tayfunlar, depremler, yoğun kar yağışı) erken tespitini sağlamak için, felaket meydana gelmeden önce vatandaşlarla erken haberleşmeyi sağlayan yeni simülasyon teknolojileri oluşturulmuştur.




**Şekil 10.** Japonya Tsunmami için kıyı bölgesi önlemi (Güler vd, 2018)

**4.5 Drenaj sistemi**

Hidrolojik döngünün temel birimi drenaj sistemidir ve kentsel yağmur suyu yönetiminde önemli bir rol oynamaktadır ( Fathullahi ve Coupe, 2021). İklim değişikliği, kentsel hidrolojik döngü ve Gri Drenaj Tesisleri kentsel sel kontrolü kapasitesini etkileyen ana faktörlerdir (Zhang vd, 2020) Bu nedenle, drenaj sistemi kapasitesini ve işlevini en üst düzeye çıkarırken, yatırım maliyetlerini ve taşkın riski olasılığını en aza indirmek için kentlerde optimizasyon çalışmaları yapılmalıdır (Muleta ve Boulos, 2007 ;Shao ve diğerleri, 2017 ).

Kentsel yağmur suyu yönetiminde, organik bir kombinasyon olarak yeşil altyapı ve gri drenaj Tesisleri ayrı ayrı incelenmemelidir. Bu ki sistem karşılıklı uyarlanmalı tasarımları, arazi kullanımının sınırlamaları, iklim değişikliğinin öngörülemezliği ve gelecekte hidrolojik değişkenlik nedeniyle özellikle kritiktir. Ancak, GI ve GDF'nin entegre optimizasyon tasarımındaki sınırlamalar devam etmektedir.

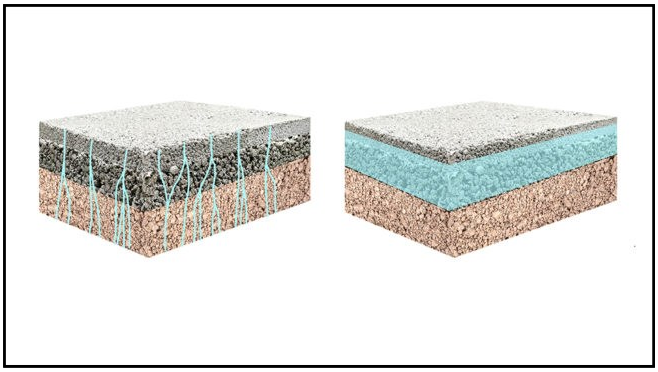
Çok fazla drenaj tesisi yüksek inşaat maliyetlerine ve kaynakların boşa gitmesine neden olurken, çok az drenaj tesisi sel riski ve maddi hasar olasılığını artıracaktır ( Maharjan ve diğerleri, 2008 ).



**Şekil 11.** Portland Yeşil Cadde (https://www.portlandoregon.gov/bes/45386)

Yeşil sokaklar veya sokaklar, yağmur varilleri ve ağaç dikmenin, geleneksel yöntemlere göre daha etkili olduğu bilinmektedir. Portland, zorlu altyapı maliyetlerinde 250 milyon dolar tasarruf sağlamak için yeşil altyapıya 8 milyon dolar yatırım yapmıştır.Tek bir yeşil altyapı kanalizasyon rehabilitasyon projesi, daha temiz hava ve yeraltı suyu şarj faydaları ve yeşil uygulamalarla ilişkili diğer faydaları sağlamaktadır. Portland'ın Green Street projeleri yılda yaklaşık 43 milyon galon su tutmaktadır ve Portland'ın yıllık akışının %40'ını yönetme potansiyeline sahiptir.

**4.6 Geçirimli Zemin**

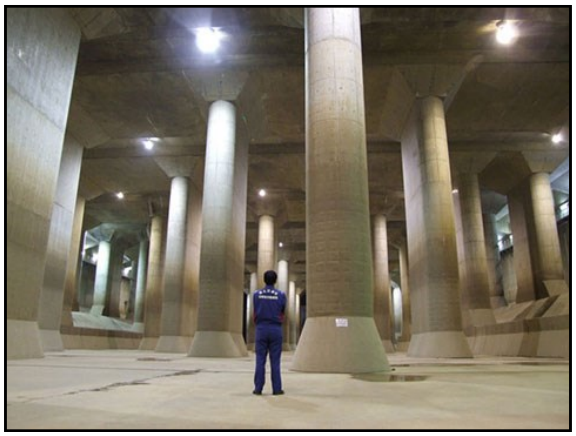


**Şekil 12.** Geçirimli zemin şematik gösterimi (https://www.tredjenatur.dk/en/2020/03/permeable-concrete/)

Geçirgen kaplamaların kullanılmasıyla yağmursuyunun yüzey akışının azaldığı, filtrelendiği ve temizlendiği ve yeraltı sularının beslendiği bilinmektedir (Hein, 2014). Gözenekli kaldırımlar Kuzey Amerika'da yağmursuyunun yönetiminde etkili olması ve en iyi uygulama yöntemlerinden olduğundan dolayı popüler hale gelmiştir. Ayrıca otopark alanlarında tercih edilerek yüzey alanı geniş yerlerde yağmur suyu geçirgenliği sağlanablir.

**4.7 Sarnıç Uygulaması**

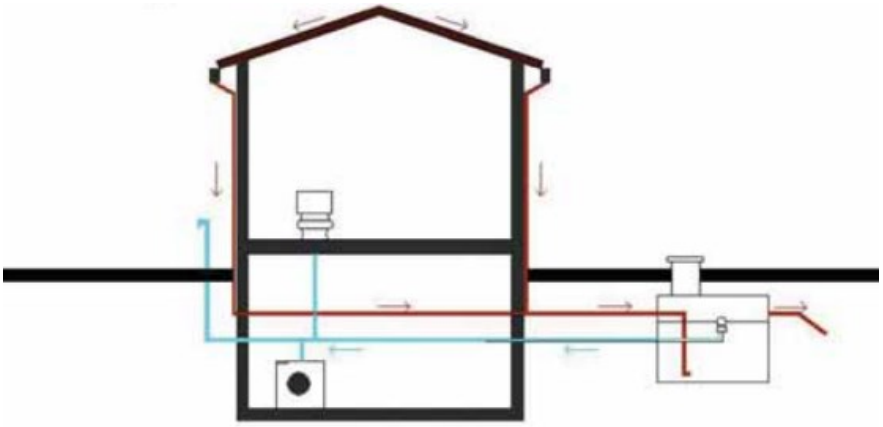
**4.7.1 Kentsel Ölçekte Sarnıç**



**Şekil 13**. Tokyo kentsel sarnıç (https://web-japan.org/trends/11_tech-life/tec130312.html)

Tokyo sel ile mücadele için büyük bir sarnıç sistemi kurmuştur.Tokyo birçok nehrin bulunduğu ova bölgesinde bulunmaktadır. Bu yüzden sellerle mücadele etmek durumunda kalmaktadır. Bununla birlikte hızlı sanayileşme ve kentleşme ile birlikte kırılganlığı artmıştır. Mücadele için yerin 22 m altında 6,3 km uzunluğunda bir sarnıç sistemi oluşturmuşlardır.

**4.7.2 Bina Ölçeğinde Sarnıç Uygulaması**



**Şekil 14.** Binada sarnıç sistemi (Şahin, N.İ., 2010).

Bina ölçeğinde sarnıç uygulaması kentsel sarnıçlara göre daha küçük ölçekli depolama ve kullanım sağlamaktadır. Konut içerisinde basit bir yağmur suyu toplama sisteminde, çatıdan toplanan yağmur suyu, büyük parçaları tutan filtreden geçirildikten sonra yağmur suyu deposuna gelmektedir. Yağmur suyu deposundan ise çamaşır makinası ya da tuvalet rezervuarı gibi konut içerisinde ihtiyaç duyulan alanlara
pompalanmaktadır. Bu sarnıç uyglaması mahalle ölçeğinde kullanılarak depolama sağlanabilir. Böylelikle yüzey akışları önlenebilir ve sel riski azaltılabilir.

**5. Bursa ve Kentsel Sel Riski**

Marmara bölgesinin güneyinde bulunan Bursa'da yerleşim Bursa ovasında ve Uludağ yamaçlarında yoğunlaşmıştır. Yerleşim sel riski açısından değerlendirilecek olursa; Uludağ'ın yamaçlarında dere yataklarının olması, eğimin fazla olması, altyapının yetersiz olması gibi sebeplerle ekstrem yağışlarda seller yaşanmaktadır. Bursa ili, göç sonucunda endüstriyel gelişme ve nüfus artışına paralel olarak arazi kullanımı açısından dramatik bir değişim yaşamıştır. İlin toplam yüzölçümü 10882 km2 olup, yüzde 45'i ormanlarla kaplıdır. Ancak bölgenin arazi örtüsündeki ve karasal özelliğindeki değişim kentin sele karşı hassasiyetini artırmaktadır. Öte yandan, değişen iklim, büyük yağış olaylarını daha sık ve yıkıcı hale getirebilir. Özellikle şehrin doğusunda, yamaçlarda planlanmamış yapılaşma mevcuttur. Gecekondu tipi konutlara sıklıkla rastlanmaktadır. Bu alanlar sel riskine karşı daha kırılgandır. İklim değişikliği etkileriyle risk giderek artmaktadır.
Bursa Marmara bölgesinin güneyinde yer alır ve Türkiye'nin nüfus olarak 4. büyük şehridir. Bursa'nın doğu-batı ekseninde uzanan sıradağları şehre önemli bir coğrafi özellik getirmektedir. Bu dağ sırası arasında en önemlisi ise Uludağ'dır. 2.543 m'lik yüksekliğiyle Marmara Bölgesi'nin en yüksek dağı Uludağdır. Uludağ'ın güney eteklerinden doğan birçok dere bulunmakta ve bu dereler yerleşim yerlerinden geçerek Bursa Ovasına doğru akmaktadır.



**Şekil 15**. Bursa Yıldırım ilçesi Güllük, Ortabağlar ve Selçukbey mahalleleri- Yoğun Yapılaşma (Google Earth)

Bursa'da yerleşim ise Uludağ eteklerinde ve Bursa ovasında yoğunlaşmıştır. Kentin batısında, planlı gelişen, doğusunda ise plansız ve kaçak yapılaşmalarla gelişen alanların yer aldığı görülmektedir. Kentin doğusunda yerleşim yerlerinden geçen derelerin bulunması ve plansız yerleşimin mevcut olması sel riskini artıran başlıca faktörlerdir. Kentin doğu kesiminde özellikle Kestel ve Yıldırım ilçelerinde dere yataklarından uzaklaşılmadan gerek ova kesiminde gerekse yüksek eğimli bölgelerde yoğun ve plansız yerleşimler bulunmaktadır.

Alanda iklim değişikliği etkisiyle ani ve şiddetli yağışlar sonucunda kentsel seller meydana gelmektedir. Küresel ısınma ve iklim değişikliğine bağlı olarak 2015 yılı haziran ayında aniden bastıran sağanak yağışla Uludağ eteklerden boşalan suyun sele dönüşmesiyle Fidyekızık Mahallesi büyük zarar görmüştür. Bu anlamda Bursa'nın iklim değişikliğine dair 2017 yılında hazırlanmış Bursa Büyükşehir Belediyesi Sürdürülebilir Enerji ve İklim Değişikliği Uyum Planı bulunmaktadır. Bu planda Bursa'da kent merkezinden ve yerleşim yerlerinden geçen derelerin aşırı yağışlar ile taşkınlara neden olmasından ve plansız mahallelerin tehdit altında olduğundan bahsedilmektedir. Ayrıca "Sel ve taşkın riskinin ortadan kaldırılması için altyapı durumu iyileştirilerek geliştirilmeli, doğaya uyumlu kentsel dönüşüm projeleri hızlandırılmalı, nehir ve dere ıslah projeleri iklim uyum stratejilerine göre yapılmalıdır" ifadeleri kullanılmaktadır. Bursa su alanlarıyla ilgili olarak "iklim olayları neticesinde oluşabilecek sel ve taşkın risklerine karşı riskli bölgelerde tedbir alma", "yağmur suyunu çeşitli ihtiyaçlar için kullanarak su tasarrufu sağlamak", "Bursa halkının sel / taşkın gibi olaylar, kuraklık ve tasarruf konularında bilinçlendirilmesi" gibi eylemlere kitapçıkta yer verilmektedir.

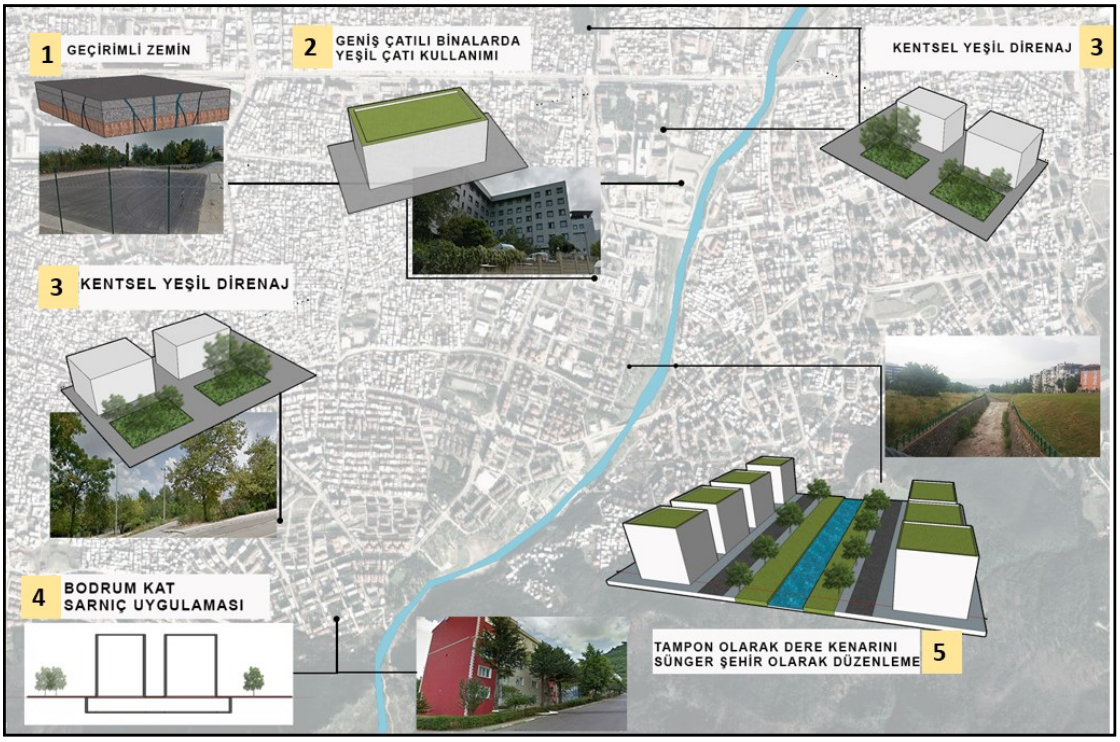
**6. Bursa İçin Kentsel Uyum Önerileri**

Bursa kentinin yerleşimi doğu batı ekseninde uzanmaktadır. Kentin batısında planlı bir yapılaşma mevcutken doğusunda yapılaşma plansız olarak gelişmiştir. Ayrıca kentin gerek Uludağ'a doğru olan kısımlarında gerekse ova kısmında dere yatakları mevcuttur. Doğu kısmında plansız yapılaşmanın da etkisiyle zaman zaman yaşanan seller ciddi sonuçlar doğurmaktadır. Doğuda coğrafi özelliklerin eğimli olmasıyla birlikte plansız yapılaşmanın olması bu bölgelerde sel riskine karşı kırılganlığı artırmaktadır. Bu bölümde Bursa kentinin sel riskine yönelik sorunlarına değinilmiş ve sel riski yüksek bir bölge için uyum önerileri verilmiştir.

**Tablo 3.** Bursa Kenti Sel Riski Çerçevesinde Sorunlar ve Çözüm Önerileri

| **Bursa Kentindeki Sorunlar** | **Çözüm Önerileri** |
|---|---|
| **Planlı çalışmalar bulunmamaktadır. (Kent, mahalle, sokak ve bina ölçeklerinde)** | Kent, mahalle, sokak, bina ölçeklerinde sel rsikini azaltacak yönetim planları oluşturulmalı ve uygulanmalıdır. |
| **Yönetim ve planlama eksikliği** | Bursa Büyükşehir Belediyesi tarafından 2017 yılında hazırlanmış Sürdürülebilir Enerji ve İklim Değişikliği Uyum Planı bulunmaktadır fakat bu plan detaylı çözüm önerileri sunmamaktadır. Yönetim planları ve tasarım ilkeleri oluşturulmalı ve uygulanmalıdır. |
| **Tasarımsal eksiklikler** | Dünyada ve Türkiye'de uygulanan örnekler incelenerek Bursa kenti için çeşitli kentsel alanlar için uygun öneriler düşünülmeli, tasarlanmalı ve uygulanmalıdır. |

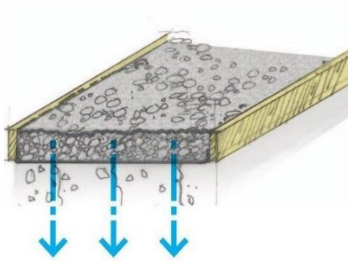
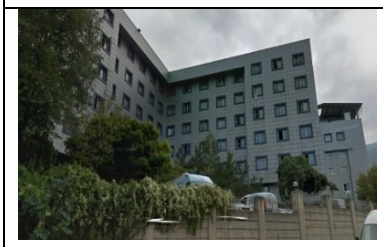
Türkiye'de olduğu gibi Bursa kenti için de iklim değişikliğinin etkisiyle artan sel riskine yönelik planlamalar yeterli değildir ve tasarımsal eksiklikler mevcuttur. Ayrıca bu eksikliklerin giderilmesi için kent, mahalle, sokak ve bina ölçeklerinde planlamalar ve tasarımsal çalışmalar yapılmalıdır. (Tablo 3)

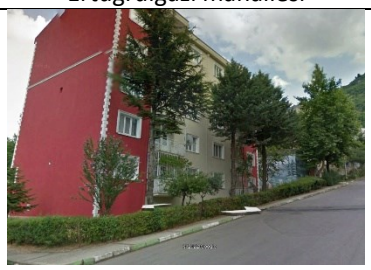
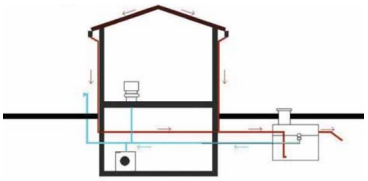
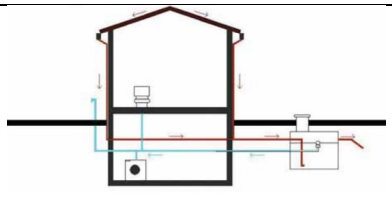



**Şekil 16.** Kentsel uyum önerileri

Bursa'da şehrin doğusunda bulunan eğimli bir bölge olan Yıldırım ilçesinde farklı yerleşim yapılarına ve fiziksel özelliklere sahip mahallelerde, sel riskini azaltacak ve uyum sağlayacak öneriler verilmiştir. Öneriler Şekil 16'teki numaralandırmalara göre Tablo 4'te açıklanmaktadır.

**Tablo 4**. Riskli Kentsel Alanlar ve Öneriler

| Riskli bölge | Öneri | Açıklama |
|---|---|---|
|  Mimar Sinan Mahallesi |  **Geçirimli Zemin** | Kamu kurumları ve geniş yollar ve otoparklar olmak üzere sert geçirimsiz yüzeylerin çok olduğu Mimar Sinan Mahallesi'nde geçirimli zemin tercih edilerek sel riski azaltılabilir. 33.900 m2'lik bir alana sahip olan Belediye araç otoparkında geçirimli zemin uygulanarak sel riski azaltılabilir. **(Şekil 16, 1 numaralı öneri)** |
|  Mimar Sinan Mahallesi, Bursa Yüksek İhtisas Eğitim ve Araştırma Hastanesi |  **Yeşil çatı uygulaması** | Geniş çatı alanına sahip Kamu kurumlarının ve Hastane binalarının olduğu Mimar Sinan Mahallesi için için ani yağışlarda yüzey akışının azaltılabilmesi için çatı alanları kullanılabilir. **(Şekil 16, 2 numaralı öneri)** |

| | | |
|---|---|---|
|  Ertuğrulgazi mahallesi |  **Yeşil direnaj** | Bahçeli konut yapılarına sahip Ertuğrulgazi mahallesinde konutların bahçesindeki yeşil alanlar yeşil direnaj olarak değerlendirilebilir. Bu sayede yüzey akışı azaltılarak sel felaketleri önlenebilir. **(Şekil 16, 3 numaralı öneri)** |
|  Kaplıkaya Mahallesi |  **Sarnıç uygulaması** | Eğimli ve site tipi yapılarının olduğu bir bölge olan Kaplıkaya mahallesi için ani yağışlarda yüzey akışının azaltılabilmesi için bina ölçeğinde çözümler üretilerek, bina bodrum katlarında, sarnıç uygulamasıyla yağmur suyunun depolanması sağlanabilir. **(Şekil 16, 4 numaralı öneri)** |
|  Kaplıkaya-Hacivat Deresi |  **Sünger Şehir** | Ani Yağışlarda risk barındıran dere yatağı paralelindeki yeşil alanlarda sünger şehir uygulamasındaki geçirimlilik sağlanarak yağmursuyunun yüzey akışı yavaşlatılıp azaltılabilir. Böylece sel riski azaltılabilir. **(Şekil 16, 5 numaralı öneri)** |
|  Arabayatağı Mahalesi |  **Yeşil direnaj** | Ovada yer alan Arabayatağı bölgesinde komşu mahallelerdeki eğimden ve mahallenin eğimin bittiği noktada olmasından dalayı yağmur suyunun birikme riski bulunmaktadır. Yeşil direnaj kullanılarak su birikme riski önlenebilir. |
|  Selçukbey Mahallesi (yoğun yapılaşma) |  **Sarnıç uygulaması** | Eğimli ve yoğun konut yapılarının olduğu bir bölge olan Selçukbey mahallesi için ani yağışlarda yüzey akışının azaltılabilmesi için bina ölçeğinde çözümler üretilerek sarnıç uygulamasıyla yağmur suyunun depolanması sağlanabilir. |

**7. Sonuç**

Sel dünyadaki etkisi ve sonuçları ağır olan en önemli afetlerden biridir. Sellerin nedenleri yoğun yağış, taşkın ve gelgit gibi doğal faktörler ve kanalların tıkanması veya drenaj kanallarının ağırlaşması, yanlış arazi kullanımı, ormansızlaşma vb. gibi insan faktörlerinden kaynaklanmaktadır.

Sanayi devrimi sonrasında yaşanan doğa hızlıca tahrip edilmeye başlanmış, kentlerde hızlı bir kentleşme sürecine girilmiş ve geçirimsiz yüzeyler artmıştır. Nüfus artışı, daha fazla kentleşme, daha geçirimsiz alan ve daha az sızma ve daha fazla taşkın ve su akışı ile sonuçlanmaktadır. Şehirlerde yeşil dokunun ve doğanın tahrip ederek geçirimsiz yüzeylerin artması ve bina yoğunluğunun plansız bir şekilde artması sel riskini artırmaktadır. Geçirimsiz yüzeylerdeki kontrolsüz artış, yağmur suyunun yüzey akış hızını artırmakta ve doğal drenaj formunu olumsuz yönde etkilemektedir. Toprak tarafından emilemeyen su, yüzey akışına geçerek riski arttırmaktadır.

Sonuç olarak şehirlerde acilen gerekli önlemler alınmalıdır. İklim değişikliği nedeniyle hiçbir bölge için sel riski olmadığı söylenemez. Özellikle şehirlerin kırılgan bölgelerinde afetlerden etkilenme oranı artmaktadır. Şehirler risklerle karşı karşıyadır, ancak riskleri azaltmak için birçok kapasiteye de sahiptir. Bu kapasite her bölge, kent, mahalle için değerlendirilmeli ve çok geç olmadan gerekli tedbirler alınmalıdır.

Kentlerde gittikçe artan sel riskine karşı azaltım ve uyum stratejilerinin önemi de artmaktadır. Bu çalışmada dünyadaki uyum ve azaltım çalışmalarından bazılarına değinilmiştir. Bursa kenti Yıldırım ilçesinde için farklı fiziksel özelliklere sahip mahallelerde, dünyada uygulanmış örneklerden yola çıkılarak, öneriler verilmiştir.

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# Karmaşık Uyumlanabilir Kentsel Sistemlere Doğru: Bir Literatür Analizi

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**Özet**
Son 30 yılda kentsel sistemler toplumların beklenti ve değişimlere ayak uydurabilmek için popüler bilimsel yaklaşımlarla yeniden ele alınmaktadır. Doğal ve sosyal sistemlerin kendini örgütleyen dinamiklerini anlayabilmek için kullanılan karmaşık uyumlanabilir sistem kuramı da bu araçlardan biridir. Bu çalışmada, kent planlama alanındaki bilimsel literatür, karmaşık uyumlanabilir kentsel sistem yaklaşımı bağlamında incelenmiştir. Web of Science ve SCOPUS'ta yapılan gelişmiş arama, eleme ve seçim sonucuna göre bulunan 49 bilimsel çalışmanın içeriği gözden geçirilmiştir. Sık tekrarlanan kelime analizi; iklim, su kaynakları ve kıyı alanları temalı çalışmaların uyumlanabilir sistem yaklaşımını gündemine aldığını ortaya koymaktadır. Öncü çalışmalar, uyumlanabilir sistem yaklaşımını çevresel ve ekolojik kentsel sorunların çözümüne katkıda bulunan bir araç olarak gördüğünden, yaklaşımın bu bağlamlarla ilişkilendirildiği anlaşılmaktadır. Mekânsal gelişim, turizm ve altyapı gibi araştırma alanları ise halen gelişim göstermektedir. Bilimsel çalışmalar, yaklaşımın kentsel sorunların karmaşıklığını anlayarak mekânsal planlara etki etme potansiyeli taşıyan, esnek bir araç olabileceğini ve farklı ölçek ve bağlamlar için kullanılabileceğini göstermektedir.
**Anahtar kelimeler:** Karmaşık Uyumlanabilir Sistemler; Kent Planlama; Kentsel Dinamikler.

## 1. Giriş

Yirminci yüzyılın ikinci yarısında temel dinamik kuralların karmaşık davranışlara yol açabileceği kabulü, bilim dünyasında birden fazla disiplini etkileyen bir devrim olarak karşılanmıştır. Karmaşıklık olarak adlandırılan bu olgunun Poincare'in kuramına dayanması, soyut matematiğin diğer birçok disiplinle etkileşimini teşvik etmiştir (Aubin ve Dalmedico, 2002). Disiplinlerarasılık, doğa bilimlerinin öncülük ettiği ve ardından sosyal bilimlere de adapte edilen yeni bilimsel açılımları beraberinde getirmiştir. Bu paradigma değişikliği, kısa zamanda kent problemlerinin ele alınış biçimine de yansımış, şehircilik disiplini karmaşıklık ve ilişkili kuramları benimsemeye başlamıştır.

Kentsel mekânın artan karmaşıklık düzeyi, çözülmesi zor problemlere (*wicked problems*) duyarlı planlama söylem ve eylem arayışını teşvik ederek yeni bir vizyona yol açmıştır. Artık nüfus, istihdam, ulaşım, ekolojik çevre, arazi kullanım ve gayrimenkul gibi birbiriyle ilişkili ve doğrusallığı meçhul birçok bileşeni bünyesinde barındıran kentsel sistemleri ve bu sistemlerin çözümlenmesi güç unsurlarını keşfetmeye olan ihtiyaç gündemdedir. Belirsiz ve karmaşık kentsel problemlerin doğasına dair daha derin bir anlayış arayışına ise karmaşıklık kuramı yanıt vermektedir.

Karmaşık düşünce sistematiği, belirsizliğin temsiline dayanmaktadır. Geleneksel planlama yaklaşımları, belirsizlikleri planlama müdahaleleri için zorlayıcı görür ve belirsizlikleri mümkün olduğunca azaltmaya/önlemeye ve istikrarı sağlamaya odaklanır. Bununla birlikte içinde bulunduğumuz çağ, iklim değişikliği, salgınlar ve çevre kirliliği gibi çevresel, ekolojik ya da toplumsal kaynaklı keskin belirsizliklerle doludur. Deneyimlediğimiz kentsel çevre bize her gün aynı görüntüyü sunmamaktadır; birbirini etkileyen unsurlardan oluşmuş olan bu yapıda daimî bir dinamizm vardır. Sistemin bir bileşeni değiştiğinde, bağlı olduğu diğer bileşenler var olmaya devam etmek için uyum sağlama eğilimine girmektedir. Bu bağlamda, planlama kuramlarının dinamik ilişkileri keşfedebileceği, kentsel sistemlerin ise öngörülemeyen koşullarda dahi varlığını sürdürebilecek seçenekleri araştırabileceği yeni açılımlara ihtiyaç vardır (Eken, 2019).

Bu araştırmanın kilit kavramı olan karmaşık uyumlamalı sistem (*complex adaptive systems, CAS*) kuramı, belirsizliğin dinamiklerini anlamayı ve değişken koşullara uyum sağlama refleksi geliştirmeyi amaçlayan tamamlayıcı bir araç sunmaktadır. Planlama için yeni bu araştırma alanı, stratejik mekânsal planlama gündemini temel almakta, buna ilave olarak karmaşıklık, doğrusal olmama, kendi kendine örgütlenme, karşılıklı bağımlılık gibi mekanizmalardan beslenmektedir (Rauws, 2017). Uyumlanabilir bir sistem, ani geri besleme döngülerine kendini ayarlayabilme kapasitesine sahiptir. Prensibini bir yandan toplumun sosyoekonomik amaçlarını tatmin ederken, diğer yandan belirsizliklere göğüs germe yeteneğine dayandırmak olasıdır (Rauws, 2017).

Çalışmada, esnek mekânsal kararlar ile değişen koşullara uyumlanabilir bir planlama çerçevesinin uygulandığı alanlar, yaklaşımın mekânsal planlama ekseninde gelişme eğilimi ve gelecek araştırma gündemi literatür üzerinden çözümlenmeye çalışılmıştır. Yaklaşımın hangi şehircilik problemlerinin çözümü için araç görevi gördüğünü anlamanın yanı sıra, planlama politika ve stratejilerine katkısı da ele alınmaktadır. Literatür tarama ve çözümlemesinin aşağıdaki araştırma sorularına yanıt vermesi amaçlamaktadır:

- Uyumlanabilir kentsel sistemlere yönelik araştırmalarda analiz edilen konular nelerdir?

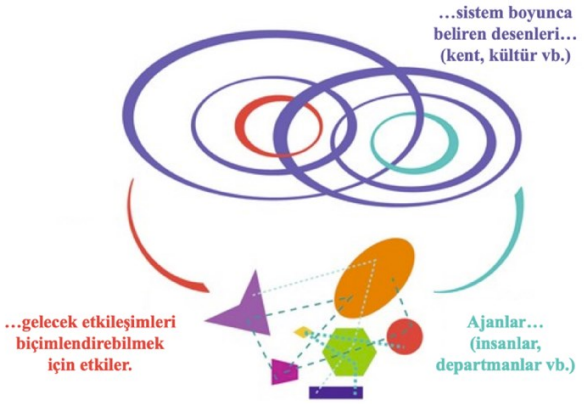
- Bu çalışmalardan elde edilen bulgular nelerdir?
- Uyumlanabilir kentsel sistem yaklaşımı, kent planlamada yeni ve etkili bir araç olabilir mi?

Araştırma beş bölümden oluşmaktadır. Karmaşık uyumlanabilir sistem kuramının tanıtıldığı ikinci bölümün ardından, literatür çözümlemesinin yöntem ve aşamalarının anlatıldığı üçüncü bölüm gelmektedir. Dördüncü bölümde seçilen bilimsel çalışmaları tanımlayıcı bilgilere ve literatür çözümlemesinin bulgularına yer verilmekte, beşinci bölümde ise karmaşık uyumlanabilir sistem yaklaşımının şehircilik sorunlarını çözmek için bir araç olup olamayacağı tartışması ile araştırma sonuçlandırılmaktadır.

**2. Karmaşık Uyumlanabilir Sistem Kuramı**

Doğal ve sosyal sistemlerin kendini örgütleyen dinamiklerinin anlaşılmasına katkıda bulunmak amacıyla ortaya atılan karmaşık uyumlanabilir sistem kuramı, esasen karmaşıklık kuramı kapsamına "yeni koşullara adaptasyon" perspektifi katan yeni bir paradigmadır (Notarnicola vd., 2017). Terim, 1990'larda Nobel Ödüllü pek çok teorisyenin üyesi ve kurucu ortakları arasında olduğu New Mexico'daki Santa Fe Enstitüsü'ndeki araştırmacılarca türetilmiştir; ancak gerek Enstitü'de kuramla ilgili çalışan grupların kendi içinde dahi farklı olguları CAS olarak adlandırdığı gerekse gelişimi devam eden bir anlayış olduğu için net bir tanımını yapmak zordur (Gell-Mann, 1994). Bununla beraber genel bir tanımla, kendi yerel etkileşim kurallarına ve bilgisine göre hareket eden çok sayıda bağımsız ajandan oluşan sistemler karmaşık uyumlanabilir sistem olarak adlandırılmaktadır (Burnes, 2005).

Burada ajanların kendi yerel etkileşimlerine bağlı olarak harekete geçmeleri vurgusu önemlidir; sadece yerel habitata karşı sorumlu olan sistem bu habitatı keşfetmekte ve onunla etkileşime geçmektedir. Öte yandan parçalarının etkileşimi üzerinden betimlenen uyumlanabilir sistemleri anlamak için etkileşimlerin kendine özgü doğasını anlamak elzemdir; çünkü ajanlar sistem boyunca beliren desenleri gelecek etkileşimler üzerinde söz sahibi olabilmek için etkilemektedir (Şekil 1) (HSDI, 2016). Sistem bileşenlerinin kullanım biçimlerindeki alternatifler çeşitlilik ve yeniliği de beraberinde getirmektedir; bu durumu Nel (2009) İngiliz alfabesindeki yirmi altı harf kullanılarak milyonlarca kitap yazılmasına benzetmektedir.




**Şekil 1.** Karmaşık Uyumlanabilir Sistemlerin Şematik Gösterimi (HSDI, 2016)

Etkileşimde bulunma kadar aniden belirme (emergence) de CAS'lerin temel bir ayırt edici özelliğidir. "Aniden belirme, birkaç basit kural tarafından yönetilen ve etkileşim-geri bildirim üzerinden deneme yanılma yoluyla çalışan basit unsurların, orijinal unsurlardan oldukça farklı olarak kalıcı ve sistematik modeller üretebilmesi düşüncesine dayanmaktadır" (Innes ve Booher, 1999). Temel bir örnekle, insan çok sayıda hücrenin, kentler ise barındırdığı sayıda insanın beliren bir özelliğidir. Belirme, bileşenlerin kendini örgütlemesinden kaynaklanmaktadır. Tıpkı karmaşık sistemlerde olduğu gibi CAS'lerde de sistem bütünü bileşenlerin toplamı değildir veya parçalara bölünerek anlaşılamamaktadır. Beliren karakterler bileşenlerin karakterlerinden tamamen farklı özellikler sergilemektedir ve ayrı ayrı incelenen bileşenlerin davranışlarından tahmin edilmeleri mümkün değildir (Auyang, 1998). Bu nedenle CAS'lerde dikkate alınması gereken bileşenler değil, bileşenler arasındaki etkileşimlerdir.

CAS düşüncesi temelde uyum sağlamaktan ileri gelmektedir. Uyumlanabilir bir kendini örgütleme, kriz etkenini uzaklaştırmak yerine sönümleme gayretine girmektedir (Eken, 2019). Haliyle en iyi işleyen ajanlar kendini örgütleyerek yeni formlar almakta, buna karşın bunu yapamayanlar ortadan kalkmaktadır. Böylece sistemin yeterliliğini/yeteneğini artıracak bir adaptasyon çevrimi tamamlanmış olmaktadır. CAS, çeşitli modifikasyonlar kanalıyla, karmaşık ve dinamik bir toplumda gerçekleşen değişimlere karşı varlığını sürdürebilmek için gerek duyulan yeteneklerin ortaya çıkarılmasını sağlamaktadır ki, bu öğrenme ve öğrendiğini uyarlama anlamına gelir.

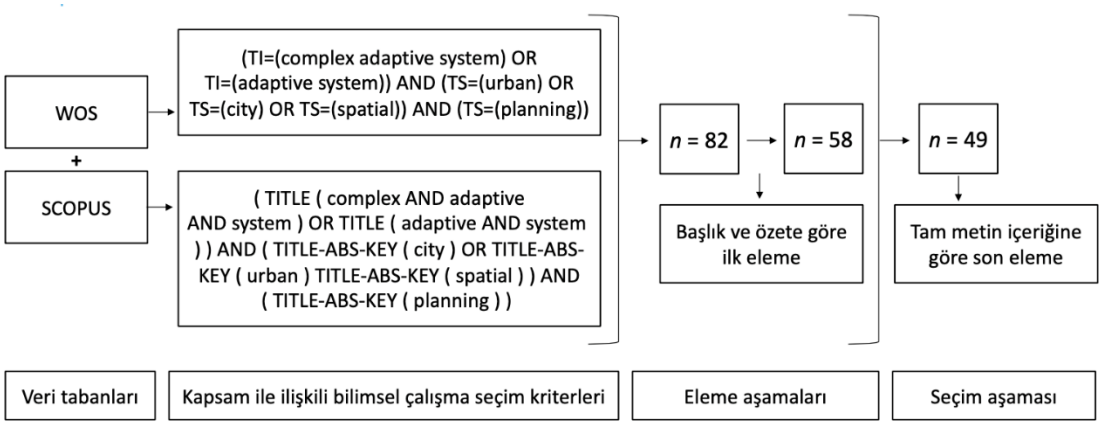
**3. Literatür Analizinin Yöntemi**

Bu araştırmada, doğrusal olmayan sorunlara esnek yaklaşım önerisi sunan karmaşık uyumlanabilir sistem kuramının kentsel ve mekânsal planlama disiplininde ele alınış biçimini incelemek üzere bir literatür analizi yapılmıştır. Sürekli öğrenen, öğrendiklerini geribildirimle sisteme dahil eden yapısı nedeniyle karmaşık uyumlamalı yaklaşımı, esneklik (*flexibility*) kavramıyla karakterize edilmektedir. Araştırma konusu ile ilintili literatür, Web of Science (WOS) ve Scopus veri tabanlarında taranmıştır. Web of Science ve Scopus, pek çok farklı disiplinden çalışmaya erişim sağlayan iki büyük veri tabanıdır. Her iki veri tabanında da gelişmiş sorgu yapılabilmekte, başlık, konu, özet, çalışmanın dili, türü ya da yılı gibi filtreler uygulanarak ilintili bilimsel çalışmalar tespit edilebilmektedir.

Bilimsel çalışma sorgusu, çalışmanın başlığında "karmaşık uyumlanabilir sistem" ya da "uyumlanabilir sistem" ifadelerinin geçmesi ve çalışmanın konusunda "kentsel", "şehir" ya da "mekânsal" terimleri ve "planlama" teriminin bir arada bulunması kriterlerine göre yapılmıştır (Şekil 2). Yalnızca İngilizce dilindeki çalışmalar dikkate alınmış, çalışmaların yıllarına ilişkin bir filtreleme ise yapılmamıştır. İlk sorgu neticesinde bu kriterlere uygun seksen iki çalışmaya erişilmiştir.

İkinci aşamada seksen iki çalışmanın başlık ve özetleri dikkate alınarak, araştırma kapsamı dışında kalan çalışmalar elemeye tabi tutulmuştur (*screening*). Bunun sonucunda yirmi dört çalışma ayrılarak, kalan elli sekiz çalışma dikkate alınmıştır. Tam metin incelemelerinden sonra ikinci derinlemesine eleme yapılmış, araştırma sorusuna yanıt vermeyen dokuz çalışma daha ayrılarak, kalan kırk dokuz çalışmanın literatür çözümlemesinde kullanılması kararlaştırılmıştır (Şekil 2). Seçilen bilimsel çalışmalardan on altısı konuyu kavramsal olarak ele alırken, otuz üçü ampirik temellidir. Söz konusu bilimsel çalışmaların detayları Ek 1'de sunulmuştur.

Karmaşık uyumlanabilir yaklaşımın öne çıktığı temaları ve zaman içinde değişen bağlamını ortaya koymak için içerik çözümlemesi yapmak büyük önem taşır. Bu bağlamda, araştırma kapsamında örneklemi oluşturan kırk dokuz bilimsel çalışma MAXQDA 2022'den faydalanılarak içerik analizine tabi tutulmuştur. MAXQDA, veriyi sınıflandırmayı kolaylaştıran bir nitel araştırma programıdır. Araştırmada MAXQDA 2022'nin kullanılması, sık tekrarlanan terimlerin ve kelime kombinasyonlarının belirlenmesini mümkün kılmış, bilimsel çalışmaları gruplandırmaya ve kavramsal tahlil yapmaya olanak tanımıştır. İçerik çözümlemesine bilimsel çalışmaların kaynakça kısmı dahil edilmemiştir.




**Şekil 2.** Literatür Taramasının Uygulanma Aşamaları

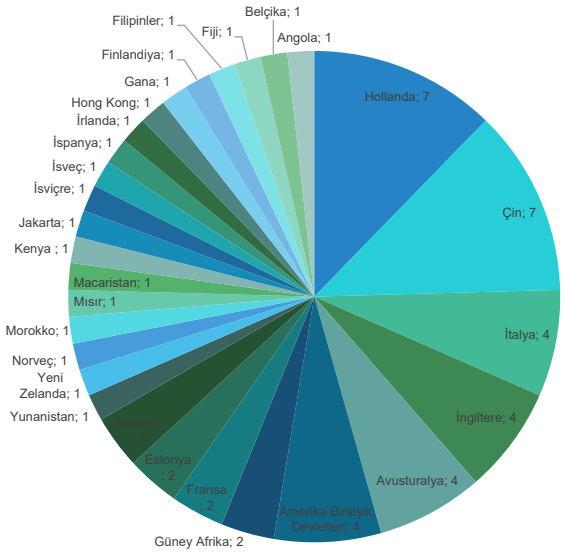
**4. Literatür Analizinin Bulguları**

Bu araştırmada, dünyada planlama gündemine yaklaşık son on beş yılda girmiş CAS yaklaşımının kent planlamayı ilgilendiren karmaşık ve öngörülemeyen problemler için bir çıkış yolu olabileceği varsayılarak, plancılar, yerel ve merkezi yönetimler gibi aktörlerin daha etkin politika kararları almalarına fırsat sağlayabilecekleri bir araç keşfedilmesi amaçlanmaktadır. Bu çerçevede bu bölüm, bilimsel çalışmaları betimleyici bilgileri ve MAXQDA 2022 programı ile yapılan içerik çözümlemesinin bulgularını içermektedir.

Araştırma sonuçları, CAS yaklaşımının Hollanda ve Çin planlama pratiklerinde yer edindiğini göstermektedir. Bu iki ülkeyi İtalya, İngiltere, Avusturalya ve Amerika Birleşik Devletleri izlemektedir (Şekil 3). Çalışmaların %45'inin Avrupa ülkelerinde gerçekleştirilmiş olması, Avrupa ülkelerinin esneklik ve kendini örgütleme mekanizmalarına açık bir planlama arayışında olduğunu göstermektedir. Öte yandan örneklem dahilinde Türkiye'de uygulanmış herhangi bir çalışmaya rastlanmamıştır.

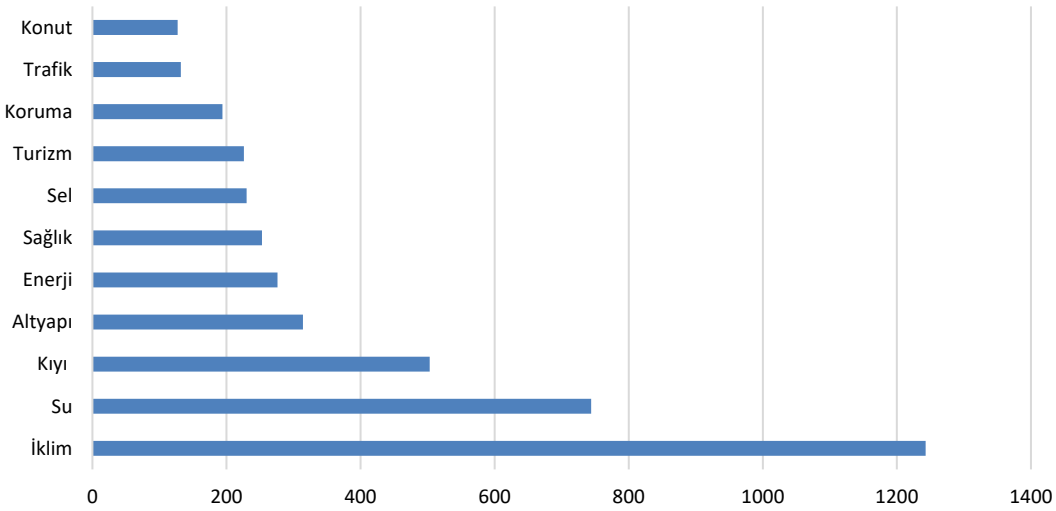
Bulgulara göre CAS yaklaşımı kentsel ve mekânsal planlamada ilk olarak 1971 yılında, uyumlanabilir sistemin kapsayıcı bir yöntem sunmasına vurgu yapan kuramsal bir çalışmada ele alınmıştır. Yirmi birinci yüzyılla birlikte koruma-kullanma dengesi ve iklim değişikliği gibi ekosistem için ciddi risk teşkil eden sorunlara yaklaşmanın popüler bir yöntemi haline gelmiştir. 2010 yılı ve sonrasında CAS yaklaşımının kıyı alanları planlamasına temas etmesiyle, kıyı alanlarının yönetişim etkinliğinin sağlanması, izlenmesi, değerlendirilmesi ve bu alanların yönetiminden sorumlu

aktörlerin yetki ve rollerinin net çizgilerle belirlenmesi konuları daha sık tartışılır hale gelmiştir. Zaman içinde yaklaşımın mekânsal gelişim, turizm ve altyapı gibi mekânsal planlama ile görece daha ilintili bağlamlara konu edildiği saptanmıştır. Son beş yıla bakıldığında, en sık olarak mekânsal gelişim ve değişim dinamiklerini analiz etme, kıyı alanlarının planlanması-yönetimi ve yeni planlama politikaları üretme arayışında karmaşık uyumlanabilir sistem yaklaşımına başvurulduğu anlaşılmaktadır. Öncü çalışmalarda aktörlerin planlama sürecine katılımı ve geri bildirimi tartışılırken, bugünlerde geri bildirim döngüleri için veri toplama ve yenilikçi teknolojilerle daha geniş kesimleri sürece dahil etme kritik önemde görülmektedir.



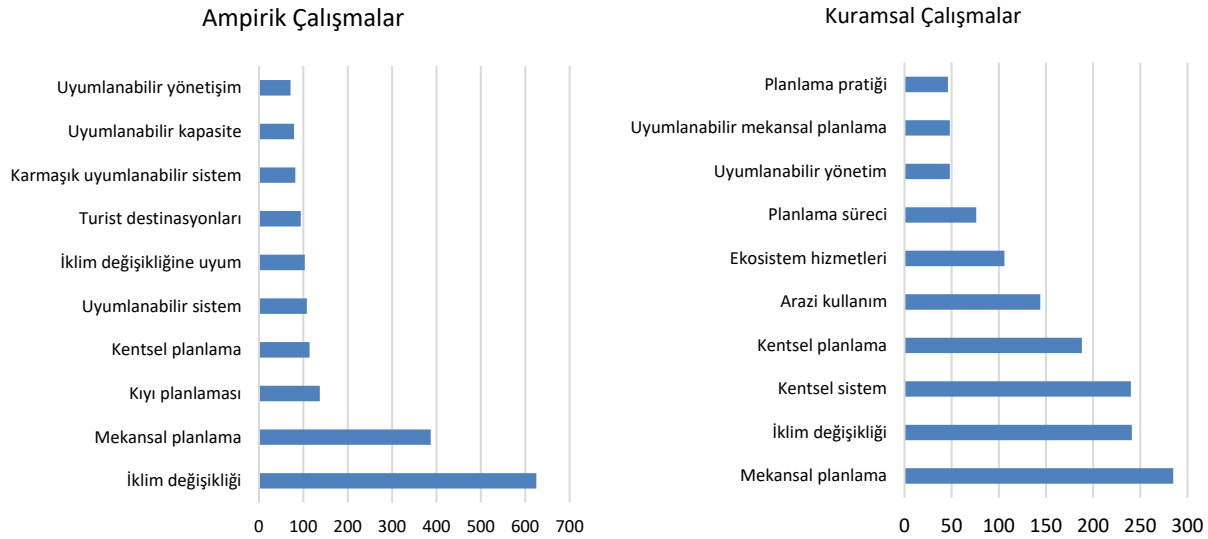

**Şekil 3.** Seçilen Bilimsel Çalışmaların Gerçekleştirildiği Ülkelerin Dağılımı

Örneklemi oluşturan bilimsel çalışmalarda sıkça tekrarlanan terimler, çalışmaları temalarına, ölçeklerine ve kapsamlarına göre sınıflandırmayı mümkün kılmıştır. Sık tekrarlanan kelimelerin tespitiyle, yaklaşımın yaygın olarak iklim temalı çalışmalarda kullanıldığı anlaşılmaktadır ($f$ = 1.243). Su kelimesinin 744 kez, kıyı kelimesinin 503 kez tekrarlandığı, bunları altyapı enerji, sağlık, sel, turizm, koruma, trafik ve konut kelimesinin izlediği tespit edilmiştir (Şekil 4). Bu bulgu, seçilen bilimsel çalışmaların büyük oranda çevresel bağlam taşıdığını ortaya koymakta olup, bunu ekonomik, sosyal ve ekolojik bağlamlar izlemektedir. Uygun olarak, "çevresel" teriminin en sık tekrarlanan bağlam olduğu saptanmıştır ($f$ = 761). Çalışmalarda kentsel kelimesinin kullanım sıklığından yola çıkarak ($f$ = 1.812) değerlendirmelerin diğer mekânsal ölçeklere kıyasla büyük oranda kent ölçeğinde yapıldığını söylemek mümkündür. Bunu "bölgesel" ($f$ = 377) ve "ulusal" ($f$ = 327) ölçekler izlemektedir.




**Şekil 4.** Seçilen Bilimsel Çalışmalarda Sık Tekrarlanan Kelime Analizine Göre Oluşturulmuş Temalar.

Araştırmada kelime kombinasyonlarının sıklığı analiz edilerek olgular arasındaki etkileşim tespit edilmeye çalışılmıştır. "İklim değişikliği" ve "mekânsal planlama" kavramlarının hem kuramsal hem de ampirik çalışmalarda en sık tekrarlanan kelime kombinasyonları olduğu saptanmıştır (Şekil 5). Uyumlanabilir yönetim, yönetişim, uyumlanabilir kapasite kavramlarının kullanım sıklığı da dikkat çekici düzeydedir. Yaklaşımın farklı bağlam ve yere özgü olarak yorumlanma şekli de farklılaşsa da genel itibariyle mekânsal stratejik planlamayla benzer şekilde mekânı şekillendirmede karar merkezli bir araç işlevi gördüğü anlaşılmaktadır.




**Şekil 5.** Sık Tekrarlanan Kelime Kombinasyonlarının Ampirik ve Kuramsal Temelli Çalışmalara Göre Analizi.

**5. Karmaşık Uyumlanabilir Kentsel Sistemlerde Araştırma Gündemi**

Son zamanlarda, şehircilik araştırmalarında karmaşıklık bilimlerine dayanan dinamik bir planlama anlayışına önemli oranda yönelim vardır. İklim değişikliği ve su kaynakları yönetimi gibi çevresel sorunlar (Roggema, 2009; Schuetze ve Chelleri, 2011; Hetz ve Brunz, 2014; Xie ve Zheng, 2017), kıyı alanları planlaması gibi biyo-ekonomik temelli sorunlar (Douvere ve Ehler, 2010; Mills vd., 2014; Greenhill vd., 2020) ya da altyapı (Schuetze ve Chelleri, 2011; Saxe ve MacAskill, 2019; Hishammuddin ve Wang, 2021) ve enerji (Korhonen ve Snäkin, 2015) gibi ekosistem hizmetlerine ilişkin sorunlar söz konusu olduğunda, sürekli değişen koşullara uyumlanabilir bir planlama anlayışının eylemsel ve düşünsel olarak benimsendiği görülmektedir. Bu bölümde karmaşık uyumlanabilir kentsel sistemlerin araştırma gündemi, bilimsel çalışmaların terim sıklığı analizi ve içerikleri esas alınarak belirlenen çevresel bağlam ve planlama sistemi alt başlıklarında değerlendirilmiştir.

**5.1 Çevresel Bağlam**

Çevresel bağlamda iklim değişikliği kuşkusuz karmaşık uyumlanabilir sistem yaklaşımından en çok beslenen temadır. İklim değişikliğinin beklenmedik birtakım zorluklarla kentsel mekânın akışında değişikliğe neden olması, toplumun önlenmesi mümkün olmayan bazı etkilere hazırlanmasına yönelik arayışları beraberinde getirmiştir. İklim değişikliğine uyum konusunun belirsizlik ve karmaşıklıkla karakterize edilmesi ise politika üretiminde karmaşık uyumlanabilir sistem yaklaşımının dayanak alınmasında etken olmuştur (Roggema, 2009; Van Buuren vd., 2013). Uyumlanabilirlik, iklim değişikliğinin potansiyel hasarlarını en aza indirmek ve etkilerin sonuçlarıyla başa çıkabilmek için aktörler arasında esnek ve kapsayıcı bir iş birliği geliştirmeye odaklanmaktadır (Van Bureen vd. 2013). İklime uyumlanmış bir kentsel sistemde mekânsal fonksiyonlar tahsis edilirken alınan kararların iklim değişikliğinden kaynaklanan gereksinimlerle örtüşmesi önem taşımaktadır.

Paydaş katılımının neden olduğu etkileşimli yeniden örgütlenme özelliği, karmaşık uyumlanabilir yaklaşımı doğal kaynak yönetimine ilişkin politika üretimi için elverişli hale getirmektedir (Maynard vd., 2011). Bununla birlikte, ekonomik ve ekolojik faydalar arasındaki çatışmayı içeren kapsamı nedeniyle bir yönetişim meselesi olarak görülen kıyı alanları planlanması da CAS yaklaşımının gündeminde yer edinmiştir (De Vrees, 2021). Karmaşık sistemdeki uyumlanabilir değişime değinen panarşi (*panarchy*) çerçevesi ise ekonomik ve çevresel değerler arasındaki karmaşık dengeyi çözümlemeye katkı sunan güncel bir araçtır (Higgins ve Duane, 2008).

### 5.2 Planlama Sistemi

Planlama sistemi günümüzde değişen kentsel dinamikleri ve belirsizlikleri hesaba katmalıdır. Geleneksel planlama sistemlerinin yeniden düşünülmesini gerekli kılan bu gerçeklik, doğrusal bir uyum anlayışına ve doğrusal planlama araçlarına karşı çıkmaktadır (Birkmann vd., 2014). Kentlerin sosyal açıdan eşit ve ekonomik açıdan rekabet edebilir olabilmesi, dış şokların etkisiyle gerçekleşen biçimsel ve işlevsel değişimler karşısında kendini örgütleyen yapıya kavuşmasıyla ilişkilidir (Nickayin vd., 2022). Kentsel sistemin değişken koşullara ve şoklara başarılı bir şekilde yanıt vermesinde ise esnek mekânsal kurgu önemli rol oynamaktadır (Kruse ve Pütz, 2014). Karmaşık uyumlamalı kentsel sistem yaklaşımının planlama gündemine yaptığı katkı, karmaşıklık ve doğrusal olmama mekanizmalarından beslenmesi ve süreç içinde öğrenme ile esnek bir planlama ve yönetişim anlayışını dikkate almasıdır.

Uyumlanabilir yaklaşımda esas olan farklı katmanlardan aktörlerin sürece sürekli katılımı ve sağlanan geribildirimle sürekli iyileştirmenin devam etmesidir (Greenhill vd., 2019). Bu sayede planın farklı kullanıcıların ihtiyaçlarıyla uyumu da sağlanabilmektedir (Walsh vd., 2013). Planlama sürecine geniş katılımın yanı sıra, aktörler ve hükümetin yetki ve rollerinin netliği de önem taşımaktadır. Katılım sürecine dijital teknolojilerin entegre edilmesi ise daha geniş paydaş kitlesine ulaşabilmek için etkili bir araçtır (Türken ve Eyüboğlu, 2021).

Uyumlanabilir planlama sistemi, planlamanın bilgi ve iletişim teknolojileri ile desteklenmesini gerektirir. Belirli bağlamlar içinde bilgi toplayan uyumlanabilir sistem, kararların yeni verilerle iyileştirilmesine ve mekânsal yönetim düzenlemelerinin sürekli değişen sistemlere uyacak şekilde ince ayarlanmasına izin vermektedir. Bu bağlamda izleme ve değerlendirme aşaması hem karmaşık uyumlanabilir mekânsal planlama boyunca düzeltici bir işlev olarak hizmet etmekte hem de gelecekteki planlama faaliyetlerini daha etkin ve verimli bir şekilde yapılandırmak için bir kılavuz görevi görmektedir. Uyumlanabilirliğin daha iyi uygulanabilmesi, sonuçların sürekli izlenmesi ve değerlendirilmesine yönelik metodolojinin geliştirilmesi ile yakından ilişkilidir (Kruse ve Pütz, 2014).

## 6. Sonuç

Kentler, sayısı günbegün değişen belirsizliklere maruz kalan sistemlerdir. İklim değişikliği, salgınlar, afetler, savaş, zorunlu göçler gibi sisteme aniden etki etmesi muhtemel koşullara hazır olmak ya da değişen bağlamlara uyum sağlama kapasitesi geliştirmek, günümüz karmaşık kentsel sistemlerinin temel yetkinlikleri arasında yer almalıdır. Öngörülemeyen bir ortamda politika ve strateji üretecek yetiye sahip olmak ise kentlere karmaşık uyumlanabilir sistemler olarak yaklaşmayı gerektirir. Dolayısıyla son on beş yılda kentin ani şoklara fazla duyarlı çevresel ve sosyoekonomik yapısının, biçim ve işlev bağlamında dinamik mekânsal yapısının ve zaman zaman etkisiz kalabilen planlama sisteminin karmaşık kentsel sistem perspektifi üzerinden temsili gündemdedir. Bununla birlikte, yaklaşımın yeni bir yöntem dayatma girişimi olarak görülmemesi önem taşır; esas amaçlanan günümüz kentsel sorunlarının karmaşıklığı ile başa çıkabilen esnek politika gelişimine yönelik bir paradigma değişimini benimsetmektir.

Karmaşık uyumlanabilir yaklaşım, belirsizliğin etmen tabanlı modelleme, yapay sinir ağı, hücresel otomasyon, sistem dinamiği gibi pek çok doğrusal olmayan problem çözme teknikleri ile modellenebilmesine olanak tanımaktadır. Kent denilen bu sistemde kurala dayalı etkileşimler ve bu etkileşimlerin de bir örüntüsü vardır. Sistemdeki bileşenleri öğrenmek ve modellemek örüntüyü netleştirmektedir. Böylece kentsel sistemin belirsizlik karşısında uyumlanabilir bir tepki göstermesini sağlayacak stratejiler geliştirmek mümkün hale gelmektedir. Bildiklerimizi değerlendirmek, nereye gideceğimizi keşfetmek için önemli bir adım olarak görülür. Bunu sağlamak içinse sistemin ve bileşenlerinin etkileşimlerinin anlaşılması hedeflenmelidir. Karmaşık kentsel sistemin geleceği hakkında öngörü sahibi olabilmek ve sistemi uyumlanabilir hale getirebilmek için geriye dönük zaman-uzamsal göstergelerin açılımlarından yardım alınmalıdır. Zira yeni bilgiler eklendikçe sistemin uyumlanabilir olma kapasitesi artmaktadır. Benzer olarak literatür çözümlemesi, son beş yılda yapılan çalışmaların kolektif veri toplamanın önemine ve karmaşıklığın modellenmesini sağlayan metotlara odaklandığını açığa çıkarmaktadır.

Ekler

**Ek 1.** Araştırma Kapsamında Seçilen Bilimsel Çalışmaların Detayları.

| Yazar | Yıl | Ülke | Araştırma Yöntemi | Tema | Ele Alınan Konu |
|---|---|---|---|---|---|
| Ahern vd. | 2014 | Amerika Birleşik Devletleri | Kuramsal | Ekosistem hizmetleri | Yaparak öğrenme pratiği<br>İzleme ve müteakip düzeltici önlemlerin uyumlamalı planlama çerçevesinin hayati bir parçası olması |
| Allan ve Plant | 2022 | Avusturalya | Kuramsal | Planlama sistemi | Planlama sürecinde geri bildirim döngüleri oluşturabilmek için veri toplama prototiplerinin oluşturulması<br>Planlama sisteminde daha etkili danışma, şeffaflık ve hesap verebilirlik |

| | | | | | |
|---|---|---|---|---|---|
| Aps vd. | 2018 | Estonya | Ampirik | Kıyı alanları planlaması | Uyumlanabilir stratejik kıyı alanları planı için deniz üzerindeki çevresel ve insan kaynaklı baskıların değerlendirilmesi |
| Baoxing | 2018 | Çin | Kuramsal | Afet yönetimi | Uyumlanabilir yaklaşımın kentlerin ekolojik, sosyal ve ekonomik dirençliliğini ve canlılığını geliştirmedeki rolü |
| Basile vd. | 2016 | İtalya | Ampirik | Planlama sistemi | Karmaşık uyumlanabilir sistem perspektifinin yer yönetimi ve pazarlaması için yol gösterici olarak kullanımı |
| Birkmann vd. | 2012 | Almanya | Kuramsal | İklim değişikliği | Uyumlanabilir mekansal yönetişimin işlevsel ölçek uyumsuzluklarının gidermedeki rolü<br>Planlamada bilgiye erişimin iyileştirilmesi |
| Birkmann vd. | 2014 | Almanya | Ampirik | Planlama sistemi | Planlama sisteminin uyumlanabilir yönetişim çerçevesinde yeniden düşünülmesi |
| Caldera vd. | 2021 | İtalya | Kuramsal | Planlama sistemi | Etkileşimli teknolojilerin yerel yönetimlere uyarlanmasıyla uyumlanabilir planlama süreci oluşturabilme<br>Yenilikçi teknolojilerle daha geniş toplumsal tabakaları planlama sürecine dahil edebilme |
| Cettner vd. | 2012 | İsveç | Ampirik | Ekosistem hizmetleri | Geleneksel drenaj sistemlerini sürdürülebilir drenaj sistemlerine uyumlama |
| Cooper vd. | 1971 | Amerika Birleşik Devletleri | Kuramsal | Planlama sistemi | Planlamada vatandaş katılımının önemi |
| Crowe vd. | 2016 | İrlanda | Ampirik | Ekosistem hizmetleri | Sosyal-ekolojik dirençlilik düşüncesinin kent planlamaya etkileri |
| Dai vd. | 2018 | Hollanda | Ampirik | Ekosistem hizmetleri | Yağmur suyu toplamada kamu ve özel mülkiyetin sorumluluklarının belirgin olması gerekliliği<br>Öğrenme ve uyum sağlama kapasitesini geliştiren yöntem önerisi |
| Daudin vd. | 2022 | Fransa | Ampirik | Ekosistem hizmetleri | Atık su arıtma sistemlerinde uyumlamalı yönetim önerisi |
| De Vrees | 2021 | Hollanda | Ampirik | Kıyı alanları planlaması | Geçmişe yönelik bilgi ve deneyimlerin kıyı alanları mekânsal planlarına entegre edilmesi<br>Paydaş katılımının önemi |
| Douvere ve Ehler | 2010 | Fransa | Kuramsal | Kıyı alanları planlaması | Mekansal ve zamansal yönetim etkinliğinin izlenmesi ve değerlendirilmesi |
| Greenhill vd. | 2020 | İngiltere | Ampirik | Kıyı alanları planlaması | Kıyı alanları planlamasında yetki ve rollerin belirsizliğinin ve yönetişim eksikliklerinin giderilmesi<br>Finansal kapasitenin kısıtlı oluşunun uyumlanabilir yaklaşımdaki harekete geçme kabiliyetini sınırlaması |
| Gupta vd. | 2015 | Hollanda | Ampirik | İklim değişikliği | Kurumların toplumu karmaşık ve belirsiz iklim değişikliği etkilerine uyum sağlamaya teşvik etme kapasitesi |
| Hetz ve Brunz | 2014 | Güney Afrika | Ampirik | Ekosistem hizmetleri | Sel vb. iklim değişikliği etkilerine yönelik uyumlanabilir planlama seçeneklerinin potansiyeli |
| Higgins ve Duane | 2007 | Amerika Birleşik Devletleri | Ampirik | Planlama sistemi | Değişen fiziksel ve sosyal koşullara uyumlanabilen, interaktif plan önerisi<br>Dinamik planlama<br>Stratejik planlamanın panarşi çerçevesine oturtulması |
| Hishammuddin ve Wang | 2021 | Çin | Ampirik | Ekosistem hizmetleri | Esnek ve uyumlanabilir kentsel yeraltı mekanları |
| Keeton ve Nijhuis | 2019 | Kenya, Morokko, Mısır, Gana ve Angola | Ampirik | Planlama sistemi | Sürdürülebilir ve kapsayıcı kentsel gelişim için uyumlanabilir kent planlama yaklaşımı önerisi |

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|---|---|---|---|---|---|
| Korhonen ve Snäkin | 2015 | Finlandiya | Ampirik | Ekosistem hizmetleri | Eko-verimlilik çalışmalarında karmaşık uyumlanabilir sistem yaklaşımı |
| Kruse ve Pütz | 2014 | İsviçre | Ampirik | İklim değişikliği | İklim değişikliğine uyumlu bir mekansal planlamanın için hem planlama yetkililerin iklime ilişkin bilgiye erişmesi hem de uyum konusunun mekansal planlama mevzuatında kabul görmesi gerekliliği |
| Lerouge vd. | 2017 | Belçika | Kuramsal | Ekosistem hizmetleri | Uyumlanabilir arazi kullanım sisteminin benimsenmesiyle sosyoekonomik veya biyofiziksel iç ve dış şoklara rağmen insan yararına hizmet sunma kapasitesinin korunabileceği/artırılabileceği |
| Manesh ve Tadi | 2011 | İtalya | Ampirik | Kent morfolojisi | Kent morfolojisinin enerji performansı üzerindeki etkisinin karmaşık uyumlanabilir sistem yaklaşımıyla analizi |
| Marsal-Llacuna ve Fabregat-Gesa | 2016 | İspanya | Kuramsal | Planlama sistemi | Kent planlamanın bilgi ve iletişim teknolojileri ile desteklenmesi ihtiyacı |
| Maynard vd. | 2011 | Avusturalya | Ampirik | Ekosistem hizmetleri | Planlama ve doğal kaynak yönetimi için uyumlanabilir katılımcı yaklaşım çerçevesi |
| Mills vd. | 2014 | Fiji, Filipinler, Avusturalya, Güney Afrika ve Amerika Birleşik Devletleri | Ampirik | Kıyı alanları planlaması | Uyumlanabilir yaklaşımın uygulanması önündeki kurumsal ve politik engeller |
| Nadin vd. | 2020 | Hollanda | Kuramsal | Planlama sistemi | Planlamada şeffaflık ve yönetişim ihtiyacı |
| Nel vd. | 2018 | Yeni Zelanda | Ampirik | Mekansal planlama | Kentsel değişimin karmaşıklığını karmaşık uyumlanabilir sistem yaklaşımı ile anlama gayreti |
| Nickayin vd. | 2022 | Yunanistan | Ampirik | Mekansal planlama | Metropoliten sistemlerin dış şoklar karşısında daha hızlı toparlanabilmesi için planlamada sosyoekonomik göstergelerin zaman-uzamsal analizinden faydalanma gerekliliği |
| Olsen vd. | 2011 | Norveç | Kuramsal | Kıyı alanları planlaması | Başarılı kıyı alanları planlaması için ekosistemin de dahil edildiği yönetişim stratejileri<br>Planlamada yetki ve rollerin netliği |
| Orru vd. | 2018 | Estonya | Ampirik | İklim değişikliği | Sağlık sisteminin iklim değişikliğine yönelik hedeflerle uyumlu hale getirilmesi |
| Perez vd. | 2017 | Avusturalya | Kuramsal | Planlama sistemi | Karmaşık kentsel dinamiklerin anlaşılması için kent planlamanın bilimsel araştırma ile daha fazla işbirliği içinde olması gerekliliği<br>Birey temelli yaklaşımlara yönelim<br>Mekansal ve zamansal çok-ölçeklilik<br>Aşağıdan yukarıya modellemenin gerekliliği |
| Poerbandono vd. | 2014 | Jakarta | Ampirik | İklim değişikliği | İklim ve arazi örtüsünde görülen değişikliğin sonuçları üzerinden uyumlanabilir havza yönetimine girdi sağlayacak bir yöntem önerisi |
| Roggema | 2009 | Hollanda | Ampirik | İklim değişikliği | Karmaşık uyumlanabilir sistem perspektifinin bölgesel mekansal sistemler için yol gösterici olarak kullanımı |
| Salvati vd. | 2015 | İtalya | Ampirik | Arazi yönetimi | Biyofiziksel ve sosyoekonomik göstergeler üzerinden karmaşık uyumlamalı toprak-peyzaj sisteminin bileşenleri arasındaki ilişkiyi değerlendirme |
| Saxe ve MacAskill | 2019 | İngiltere | Ampirik | Ekosistem hizmetleri | Dinamik kentler için uyumlanabilir altyapı sistemleri geliştirilmesi |
| Schuetze ve Chelleri | 2011 | Hollanda | Ampirik | Ekosistem hizmetleri | Hollanda'da iklim değişikliği kaynaklı olarak değişen su seviyeleri nedeniyle kentsel gelişimde iklime uyumlu tasarımlara ağırlık verme ihtiyacının oluşması |

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|---|---|---|---|---|---|
| Sengupta vd. | 2016 | İngiltere | Kuramsal | Planlama sistemi | Yukarıdan aşağıya yaklaşım eleştirisi<br>Planlamada kendini örgütlemenin önemi |
| Shi vd. | 2021 | Çin | Kuramsal | Planlama sistemi | Kendini örgütleyen bir kentsel gelişim modeli oluşturma<br>Baskıları absorbe eden ancak temel işlevlerini, yapılarını, sistemlerini ve özelliklerini koruyabilen, dirençli kentsel sistem önerisi |
| Szkordilisz vd. | 2016 | Macaristan | Ampirik | İklim değişikliği | Şehir plancılarına yardımcı olabilecek, iklime uyumlu planlama sistemi kurgusu |
| Van Buuren vd. | 2013 | Hollanda | Kuramsal | İklim değişikliği | İklim değişikliğine uyumda aktörlerin ve hükümetin rollerinin tartışılması |
| Walsh vd. | 2013 | İngiltere | Ampirik | İklim değişikliği | Yerel yönetimin karmaşık sorunlarla baş etme kapasitesinin kısıtlı oluşu nedeniyle kent ölçeğinde model geliştirme sürecine bilim insanları ve paydaşların entegrasyonu |
| Xiang vd. | 2018 | Çin | Ampirik | Afet yönetimi | Afetten sonra kentsel toplumun iyileştirilmesinde ve yaşam alanlarının yeniden inşasında uyumlanabilir değerlendirme sisteminin rolü |
| Xie ve Zheng | 2017 | Çin | Ampirik | İklim değişikliği | Yerleşimlerin iklim değişikliğine uyarlanabilirliğinin karşılaştırılması |
| Yang C. vd. | 2019 | Hong Kong | Kuramsal | Mekansal planlama | Kentsel tasarım sürecinde kendini örgütleyen tasarım yöntemi önerisi |
| Yang Z. vd. | 2019 | Çin | Ampirik | Turizm | Turistik destinasyonlarının karmaşık bileşenlerinin incelenmesi |
| Zhao vd. | 2019 | Çin | Ampirik | Mekansal planlama | Arazi kullanım tahsisinde paydaş görüşlerine açık ve esnek bir mekansal planlama mekanizmasından faydalanmaya ilişkin öneri |

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# Examination of the Urban Evolution Process of Dorylaion and Sultan Öyüğü (Sultanönü) Settlements in Eskişehir

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**Abstract**
Eskişehir, where settlements have been made since the first periods of history, is one of the important cities of Anatolia. Started from the early bronze age, the development evolution of the ancient Dorylaion settlement, which is the predecessor of the Eskişehir, has many breaking points in the historical process. The most important of these break points is the re-building of the city in a different settlement by the Muslim-Turkish states after the capture of the city by the Seljuks. The city, which was founded as Sultan Öyüğü (Sultan's Hill), has entered a new development process since the 12th century and the present city of Eskişehir has developed around this settlement. In this study, it has been tried to reveal what kind of urban development process the city of Eskişehir has experienced since the oldest known settlement area. In this process, the effects of the ruling states on the development of the settlement were examined in a chronological process and the reasons for the preference of the first settlements of the cities, the states and their policies affecting the development of the cities, geographical guides, economic factors and the elements that reveal the urban development were evaluated comparatively. The aim of this study is to examine the development of the city of Eskişehir through two different settlements and to examine the evolution of the city with a comparative method.
**Keywords:** Eskişehir; Dorylaion (Dorylaeum); Sultan Öyüğü (Sultanönü); Urban Development; Urban Evolution.

# Eskişehir Dorylaion Ve Sultan Öyüğü (Sultanönü) Yerleşimlerinin Kentsel Evrim Sürecinin İncelenmesi

**Özet**
Eskişehir, tarihin ilk dönemlerinden itibaren yerleşimin olduğu, Anadolu'nun önemli kentlerinden biridir. Erken tunç çağından itibaren yerleşimin başladığı kentin öncülü olan antik Dorylaion yerleşiminin gelişimi, tarihi süreçte birçok kırılma noktasına sahiptir. Bu kırılmalardan en önemlisi kentin Selçuklular tarafından ele geçirilmesi sonrası Müslüman Türk devletleri tarafından farklı bir yerleşim yerinde tekrar kurulmasıdır. Sultan Öyüğü olarak kurulan kent, 12. yüzyıldan itibaren yeni bir gelişim sürecine girmiş ve günümüz Eskişehir kenti bu yerleşim etrafında gelişmiştir. Çalışmada Eskişehir kentinin bilinen en eski yerleşim alanından itibaren nasıl bir kentsel gelişim süreci yaşadığı ortaya konulmaya çalışılmıştır. Bu süreçte hüküm süren devletlerin yerleşimin gelişimine olan etkilerinin neler olduğu kronolojik bir süreç içinde incelenmiş ve kentlerin ilk yerleşim yerlerinin tercih nedenleri, kentlerin gelişimini etkileyen devletler ve politikaları, coğrafi yönlendiriciler, ekonomik etkenler ve kent gelişimini ortaya koyan öğeler karşılaştırmalı olarak değerlendirilmiştir. Çalışmanın amacı Eskişehir kentinin gelişim sürecinin farklı iki yerleşim üzerinden Cumhuriyet dönemine kadar incelenerek, kent evriminin karşılaştırmalı bir yöntemle irdelenmesidir.
**Anahtar Kelimeler:** Eskişehir; Dorylaion (Dorylaeum); Sultan Öyüğü (Sultanönü); Kent Gelişimi; Kent Evrimi.

## 1. Giriş

Eskişehir sahip olduğu coğrafi konumu, verimli toprakları, iklim ve topografik özellikleri, sıcak su kaynakları ve ulaşım olanakları özellikleri ile MÖ 3000'li yıllardan itibaren çok katmanlı bir yerleşim özelliği gösteren önemli bir Anadolu kentidir. Kentteki ilk yerleşim erken tunç çağında, günümüzde Şarhöyük olarak bilinen arkeolojik sit alanında başlamıştır. Bu bölgede önce Asur ticaret kolonilerine ait izler bulunmuş, devamında Hitit ve Frig uygarlıklarına ev sahipliği yapan Dorylaion (Dorylaeum) kenti gelişmiştir (Darga ve Sivas, 2000). Helenistik dönemde tarihi belgelerde etkin bir izi olmayan kent, önce Roma ardından Bizans imparatorluklarına ev sahipliği yaptığı dönemde bir sayfiye kenti olarak gelişimini sürdürmüştür. Türklerin Anadolu'yu gelişiyle birlikte, kent Selçuklu-Bizans savaşına tanıklık etmiş ve fiziksel olarak da bu savaştan fazlasıyla etkilenerek metruk bir hale gelmiştir. Bu dönemde Anadolu'ya yerleşmeye başlayan Selçuklular tarafından günümüzde Odunpazarı olarak bilinen alanda yeni bir yerleşim kurulmuştur. Selçuklular döneminde, kentin gelişim süreci değişerek aynı bölgede fakat yeni bir alanda Sultan Öyüğü yerleşimi inşa edilmiştir (Ertin, 1994). Günümüzde Eskişehir kenti, ikinci yerleşim yeri olan Sultan Öyüğü'nün gelişimiyle oluşmuştur. Dorylaion antik kenti ise zamanla önemini yitirmiştir. Bu kentsel gelişim süreci Eskişehir

kentinin aynı bölgede bulunan iki alanda iki defa kurulduğu kendine has bir gelişim evrimine sahip olduğunu göstermektedir. Kentin ilk yerleşim yeri Dorylaion olmasına karşın, günümüzdeki Eskişehir kent sınırları Sultan Öyüğü merkezli bir gelişimi göstermektedir. Cumhuriyet sonrası dönemde küçük bir kasaba görünümündeki kent, batılılaşma ve sanayileşme hareketleri ile birlikte gelişimini sürdürmüştür. Cumhuriyet döneminde kurulan Şeker fabrikası, Tülomsaş (Türkiye Lokomotif ve Motor Sanayi A.Ş.), Tayyare Bakım Atölyesi gibi yapıların ardından kent bir sanayi kenti kimliği kazanmış ve 1950'lerden itibaren çok sayıda sanayi yatırımı alarak ekonomik ve fiziksel olarak günümüzdeki halini almıştır (Taneri Yılmaz, 2009).

Kentlerin kuruluşu ve gelişimini ele alan kentsel evrim süreci, kentin bulunduğu konum, siyasi, sosyokültürel, ekonomik ortam, dış etkenler (savaşlar, doğal afetler vb.) gibi farklı ölçütlere bağlı olarak tarihsel bir süreç içinde kentlerin değişiminin incelenmesini sağlamaktadır. Eskişehir kentinde ise bu süreç kronolojik olarak devamlılık içinde olan ancak farklı iki konumda kurulan iki kent olarak ortaya çıkmaktadır. Eskişehir kenti örneğindeki bu durum, aynı kentin gelişim süreçlerinin iki farklı zaman dilimi ve farklı etkenler üzerinden değerlendirilmesini gerektirmektedir. Çalışmada Eskişehir kentinin bilinen en eski yerleşim alanından itibaren nasıl bir kentsel gelişim süreci yaşadığı ortaya konulmaya çalışılmıştır. Bu süreçte hüküm süren devletlerin, yerleşimin gelişimine olan etkilerinin neler olduğu ve kentinin gelişiminin hangi dönemlerde bir değişim/dönüşüm yaşadığı değerlendirilmiştir.

## 2. Materyal ve Metot

Çalışmada, öncelikle Eskişehir kentinin coğrafi konumu ve özellikleri tanıtılmış, ardından kentin gelişim süreci kronolojik olarak incelenmiştir. Süreç, kentteki bilinen ilk yerleşimden, Selçukluların yeni bir şehir kurmasına kadar geçen süreyi kapsayan Dorylaion dönemi (MÖ 3000 – 12. yy.) ve Sultan Öyüğü'nün kuruluşu ile Cumhuriyet dönemine kadar geçen süreyi kapsayan Sultan Öyüğü dönemi (12. yy. – 20. yy.) olarak iki bölümde ele alınmıştır. Bulgular bölümünde kentin bu iki dönemde yaşanan gelişim sürecine etki eden; devletler ve politikaları, coğrafi ve topografik yönlendiriciler, ekonomik etkenler, kent gelişimini ortaya koyan öğeler ve kentlerin ilk yerleşim yerlerinin tercih nedenleri başlıklar halinde karşılaştırmalı bir yöntemle değerlendirilmiştir. Sonuç ve tartışma bölümünde ise kentini bu iki yerleşim sürecinin karşılaştırması sonucu elde edilen bulgular yorumlanmıştır.

## 3. Eskişehir Kenti ve Kentin Gelişim Süreci

### 3.1 Eskişehir Kenti

Türkiye'nin önemli kentlerinden olan Eskişehir, İç Anadolu Bölgesinin kuzeybatısında bulunmaktadır. Sert bir karasal iklimin hakim olduğu kentin topografik yapısını, Sakarya ve Porsuk nehri havzalarındaki düzlükler ile bunları çevreleyen dağlar oluşturur. Havza düzlüklerini, kuzeyden Bozdağ-Sündiken Sıradağları, batı ve güneyden ise İç Batı Anadolu eşiğinin doğu kenarında yer alan Türkmen Dağı, Yazılıkaya Yaylası ve Emirdağ kuşatır (Eskişehir Coğrafya Yapısı, 2022).

### 3.2 Eskişehir Kentinin Gelişim Süreci

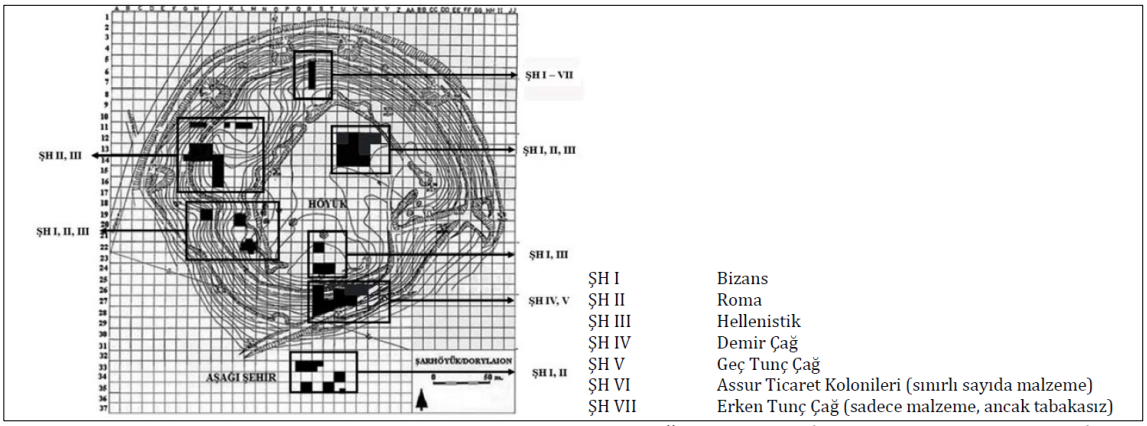
Eskişehir iki kere kurulmuş bir kenttir. Bu kuruluşun ilki erken tunç çağında başlayıp sonrasında Dorylaion olarak bilinen, günümüzde yok olmuş antik kent, ikincisi ise Selçukluların kurarak Osmanlı hakimiyetinde gelişimine devam ederek modern Türkiye devletindeki Eskişehir kentinin temellerini oluşturan Sultan Öyüğü'dür. Şekil 1'de Dorylaion ve Sultan Öyüğü yerleşimlerinin mevcut Eskişehir kentindeki konumları görülmektedir.




**Şekil 1.** Güncel Eskişehir kent sınırları içindeki Dorylaion ve Sultan Öyüğü yerleşim yerleri.

### 3.2.1 Dorylaion Dönemi (MÖ 3000 – MS 12. yy)

Dorylaion günümüzde Eskişehir kentinin kuzey bölgesinde konumlanmıştır (Şekil 1). Yerleşim yeri porsuk havzasındaki düz ovalarla çevrilidir, herhangi bir engebeli arazi görülmez. Dorylaion antik kentindeki katmanlar 1989 yılında Prof. Dr. Muhibbe Darga'nın başlattığı ve sonrasında Prof. Dr. Taciser Sivas başkanlığında devam eden kazı çalışmalarıyla ortaya çıkarılmıştır (Darga ve Sivas, 2000). Şimdiye kadar höyükte başlıca 4 alanda kazı çalışmaları gerçekleştirilmiştir. Höyüğün zirvesinde Bizans ve Helenistik dönem; batı bölümünde Helenistik, Roma, Orta ve Geç Frig tabakaları; zirvenin güneybatı ve güneyinde Bizans, Roma ve Helenistik tabakalar, güney yamaçta ise Hitit tabakaları ortaya çıkartılmış (Baştürk ve Baştürk, 2017) (Şekil 2), ayrıca Roma ve Bizans dönemlerinde de yerleşmenin olduğu alanın güneyinde bulunan Aşağı Şehir'de küçük kazılar yapılmış ve höyüğün yaklaşık 900 metre batısında yer alan Nekropol açmasında Geç Helenistik, Roma ve Bizans dönemlerine ait mezarlar ortaya çıkartılmıştır (Şarhöyük Kazısı, 2022).




**Şekil 2.** Şarhöyük kazı alanında katmanlaşmalar ve ait olduğu dönemler (Baştürk ve Baştürk, 2017).

MÖ 3000 ile MS 12. yy. arasında farklı dönemlere ait katmanların tespit edildiği kazı çalışmasında, bölgeye ait bilinen ilk yerleşim katmanının Erken Tunç Çağına ait olduğu tespit edilmiştir (Darga ve Sivas, 2000). Erken tunç çağında henüz bölgeye hakim siyasi bir uygarlıktan söz edilemez. Malzeme tespiti yapılmış ancak bir tabaka görülmemiştir. Orta tunç çağına (MÖ 20. yy.) ait Asur ticaret kolonilerine ait malzeme tespiti yapılmış ancak tabaka görülmemiştir. Yerleşim anlamında ilk tabakalanmalar geç tunç çağında (MÖ 15. yy.) Hitit kalıntıları ile başlamaktadır (Baştürk, 2018).

Kentin Dorylaion ismi ile tarihi belgelerde ilk yer alışı Frigyalılar döneminde başlar. Ancak kazı çalışmalarının sonucuna göre kentin asıl kuruluşunun Frigyalılar öncesi Hitit dönemine uzandığı söylenebilir (Sönmez, 1983). Frigyalıların önemli bir tarım devleti olması ve nehir havzasında yer alması itibari ile tarımın kentin ana ekonomik kaynağı olduğu görülebilir. Ayrıca dönemin en önemli ticaret yolu olan ve Batı Anadolu'dan Pers topraklarına uzanan Kral Yoluna yakınlığı itibariyle (Şekil 5), ticaretin de kentin gelir kaynaklarından olduğu sonucu çıkarılabilir.




**Şekil 3.** Pers İmparatorluğu döneminde Kral Yolu ve Dorylaion kenti (Wikipedia, 2022).

Kentteki bir sonraki katmanlaşma Helenistik dönemine aittir. Frigyalıların yıkılması sonrası Lidyalılar, Persler ve İskender imparatorluğu tarafından ele geçirilen kent, İskender sonrası Helenistik dönem etkisinde gelişmeye ve

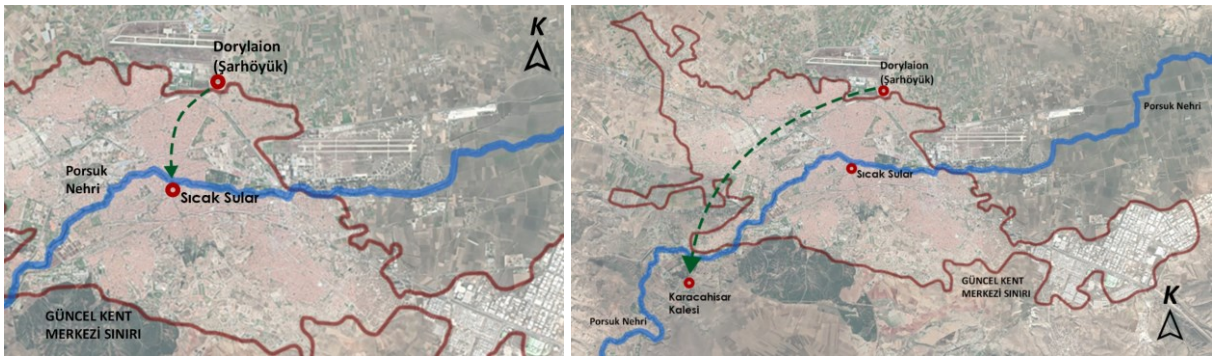
önemini korumaya devam etmiştir. Ancak antik kaynaklarda kentin isminin çok fazla geçmediği görülmektedir. Bunun başlıca nedeninin kentin gelişmişlik açısından çevresindeki daha önemli kentler olan Kollossai, Ikonion, Peltai ve Kelainai'nin gölgesinde kalması olduğu düşünülmektedir (İznik, 2003) (Şekil 3).



**Şekil 4.** Porsuk nehri yakınlarındaki sıcak sular bölgesinde bulunan Roma dönemine ait kalıntılar (Hakyemez, 2016)

Kentin asıl önemini Roma döneminden itibaren kazandığı düşünülmektedir. 1. yüzyılda Romanın Batı ve Orta Anadolu'yu da kapsayan geniş sınırlara ulaşması ve iç karışıklıkların büyük ölçüde azalması sonucu Pax Romana (Roma Barışı) olarak adlandırılan sükunet dönemi başlamış, bu barış kapsamında Augustus Anadolu'daki Dorylaion gibi Grek kentlerini destekleyerek gelişmesini sağlamıştır. Pax Romana sonrası, daha önce tarihi yazıtlarda ismi pek geçmeyen ve küçük yerleşim yeri olan kent, ekonomik, siyasi ve fiziksel olarak büyümeye ve zenginleşmeye başlamıştır (İznik, 2003). Nitekim yapılan kazı çalışmalarında kent alanında ve kentin batısında yer alan nekropol bölgesinde çok sayıda Roma dönemi katmanının yer aldığı görülmektedir (Baştürk ve Baştürk, 2017) (bkz. Şekil 2). Buna ek olarak günümüzde de çarşı ve hamamların yer aldığı sıcak sular bölgesinde bulunan ve Şekil 4'te görülen Roma dönemine ait kalıntılar, kuzeyde yer alan Dorylaion bölgesindeki yerleşmenin bu bölgeye doğru genişlediğinin göstergesidir. Özellikle bölgedeki sıcak su kaynaklarının varlığının, bu yönelimin temel nedeni olduğu söylenebilir (Şekil 5).

Roma İmparatorluğunun parçalanmasıyla Doğu kolunu oluşturan Bizans İmparatorluğu döneminde, kentin Hristiyanlaşması gerçekleşmiştir. Kent bulunduğu topraklar itibari ile bir tarım ve ticaret kenti olmayı sürdürmüştür. Ayrıca havasının güzelliği ve termal kaynaklara sahip olması itibari ile kent Bizans için bir sayfiye yeri niteliği kazanmıştır (Ertin, 1994). Dönem dönem Arap istilalarına uğrasa da bölge Selçukluların egemenliğine kadar Bizans hakimiyetinde kalmaya devam etmiştir (Hakyemez, 2016).




**Şekil 5.** (Solda) Roma döneminde Dorylaion yerleşimi ve kentin sıcak sular bölgesine doğru genişleme yönü.

(Sağda) - Selçuklulara mağlup olan Bizans İmparatorluğu, Dorylaion'u terk ederek Karacahisar Kalesine yerleşmiştir. Anadolu'ya göç eden Selçuklular, Bizans topraklarına yaptıkları akınla Anadolu'yu ele geçirmeye başlamıştır. Bu akınlar ve savaşlar kentin büyük ölçüde tahrip olmasına neden olmuştur. 11. yüzyılın ikinci yarısında yoğunlaşan Selçuklu ataklarına karşın Bizans İmparatoru Manuel Komnenos Dorylaion'u terk ederek kentin 10 km güneybatısında bulunan ve günümüzde Karacahisar Kalesi olarak bilinen alana yerleşmiştir (Şekil 5). Selçuklulara yenilerek Anadolu'nun hakimiyetini Türklere bırakan Bizanslılar, yapılan anlaşmalar gereği Karacahisar ve Dorylaion'daki kaleleri yıkarak bölgeden çekilmiştir. Albek'e göre (1991) ise kaleler hemen yıkılmamış, Hristiyan halkın bölgeyi terk etmesi sonrası zamanla harabeye dönüşmüştür. Kent 12. yy sonlarına kadar Bizans ve Selçuklu

arasında el değiştirmiş ve bu süreçte antik kent yerleşim yeri olan Dorylaion tamamen harabe haline gelmiştir (Hakyemez, 2016).

**3.2.2 Sultan Öyüğü - Sultanönü Dönemi (12. yy. – 20. yy.)**

Selçukluların kenti işgali sonrası yeni bir yerleşim olarak kurdukları Sultan Öyüğü, günümüzde Odunpazarı olarak bilinen ve Porsuk nehrinin güneyindeki tepelik bölgenin kuzey yamaçlarında kurulmuştur. Bizans İmparatorluğunu mağlup ederek bölgeye hakim olan Selçuklular, harabe halindeki Dorylaion ve Karacahisar yerine, Porsuk ve sıcak su kaynaklarına yakın, günümüzdeki kent merkezinin güneyinde yer alan tepelerin yamacına yerleşmiştir. Yeni yerleşim alanı Sultan Öyüğü olarak adlandırılmış ve günümüzdeki Eskişehir kent merkezinin oluşumunu etkileyerek, kentin yayılımının başladığı alan olmuştur. I. Alaeddin Keykubat tarafından yaptırılan ve günümüzde de ayakta olan Alaeddin Camii (1220), Selçukluların yerleşim yeri ve kentin yeni başlangıç bölgesinin bugünkü Odunpazarı bölgesi olduğunun göstergesidir (Şekil 6) (Ertin, 1994).



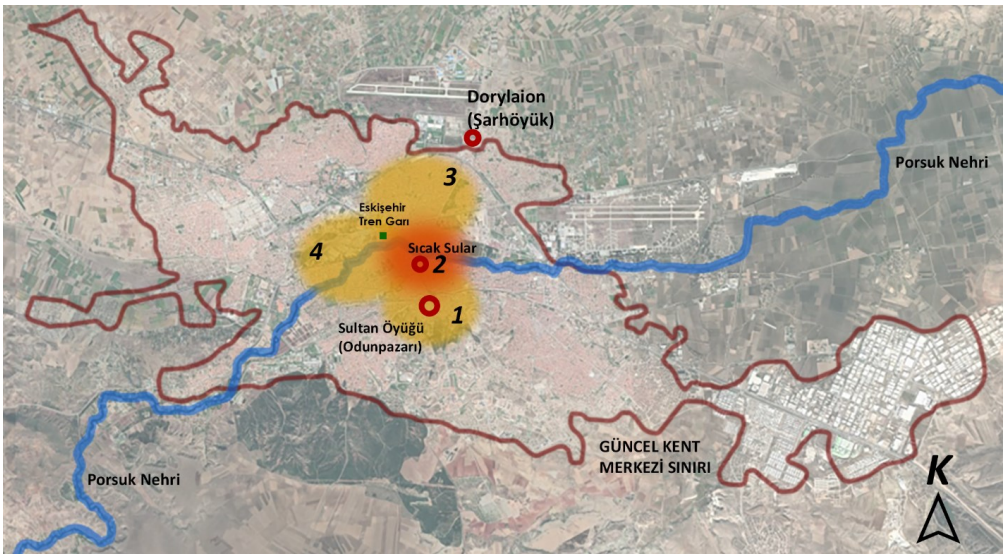

**Şekil 6.** Dorylaion'un yıkılmasının ardından kurulan Sultan Öyüğü'nün konumu ve çevresiyle ilişkisi.

Boz'a (2020) göre Selçukluların zayıfladığı dönemlerde bölgenin kontrolü, kentin 50 km kuzeybatısında bulunan Söğüt'te yerleşmiş olan Ertuğrul Bey'e verilmiştir. 1299 yılında bağımsızlığını ilan ederek bölgenin tek hakimi olan Osmanlı Beyliği döneminde, kurucu Osman Bey'den itibaren yeni kentin imar faaliyetleri yoğunlaşmıştır. Kentteki birçok kilisenin mescide çevrilmesiyle kültürel bir dönüşümün başladığı görülmektedir. Sıcak suların bulunduğu alanda pazar inşa ettiren Osman Bey, bu pazarın Rumlar ve bölgedeki Müslüman halk tarafından kullanılmasını sağlamıştır. Bu dönemden itibaren kentin iki bölgeden oluştuğu netlik kazanmıştır. Bu iki bölge kentin güneyinde yer alan ve sırtı yamaca dayalı konut bölgesi ve Porsuk nehri ile sıcak su kaynaklarının etrafında büyüyen pazar bölgesidir (Tanyeli, 1987, Nalçakan, 1993).

Osmanlı döneminden Cumhuriyet ilanına kadar kent önce bir duraklama devrine girmiştir. Osmanlı Devleti'nin toprakları genişledikçe bir iç şehir olarak konumlanan Sultanönü'nde (Osmanlı döneminde Sultan Öyüğü yerine bu isim kullanılmaya başlanmıştır) gelişme hareketleri zamanla yavaşlamıştır. Selçuklu dönemi ve Osmanlı kuruluş döneminde (12-14. Yy.) bir uç şehir olan kent, askeri ve stratejik olarak önemli bir şehirken, Anadolu'nun kesin bir şekilde Osmanlı hakimiyetine girmesiyle eski önemi kaybetmiştir. Bu durum kentin duraklama döneminin (16.-19. Yy.) başlangıcı olarak görülebilir (Ertin, 1994).

Duraklama dönemi ardından göçler ve demiryollarının gelişiyle fiziki ve ekonomik olarak büyümeye devam etmiştir. Kente ilk büyük göç, Rumeli'deki tarım topraklarının kaybı ardından 18. yy. da Anadolu tarımının tekrar önem kazanması ardından gerçekleşmiştir. Porsuk havzası ile bereketli tarım topraklarına sahip olan kente, Yörük ve Türkmen göçebelerin yerleştirilerek kentin büyümesi ve tarımsal faaliyetlere göre ticaretin gelişmesi sağlanmıştır (Ertin, 1994). Yine 18. yy. da yöreye özgü lületaşı rezervlerinin keşfi ile kentin ticaret hayatının canlanmasını sağlamıştır. Avrupa'da ilgi gören bu taşın kaliteli rezervlerine sahip kentte, tüccar sınıfı yerleşmiş ve taş temizleme atölyeleriyle birlikte ticaret hayatı da gelişmiştir (Ertin, 1994). İkinci büyük göç ise Osmanlı-Rus savaşıyla kaybedilen topraklardan getirilen Kırım Tatarlarının 1860 yılından itibaren Eskişehir'e yerleştirilmeye başlamasıyla gerçekleşmiştir. Göçmen mahallelerinin ve evlerinin kurulmasında, Padişah fermanıyla belirlenen kriterlere uyulması sağlanmış ve Porsuk nehrinin kuzeyinde belirlenen alanlara göçmen mahalleleri kurulmuştur (Şahin, 2011). Bu durum, şehrin gelişiminin kuzeye doğru kaymasını sağlamıştır. 1894 yılında Eskişehir İstasyonu açılan Bağdat-Berlin

demiryolu bağlantısının sağlanmasıyla kentin ekonomik, toplumsal ve fiziki yapının gelişimi hızlanmıştır. Demiryoluyla ulaşım kolaylığının artması, yurtiçi ve yurtdışı pazarıyla ticari ilişkinin artmasını sağlayarak ekonomik gelişim sağlamıştır. Bu gelişim, kente azınlık grupların göçünü tetikleyerek nüfusun da artmasına neden olmuştur. Ayrıca demiryolu ve istasyonun çekim merkezi olması bu bölgede konut ve otel inşasını tetikleyerek fiziksel değişimi de beraberinde getirmiştir (Ertin, 1994). Şekil 7'de Osmanlı döneminde fiziksel ve ekonomik olarak büyüyen kentin genişleme bölgeleri ve mevcut kent merkezi sınırları gösterilmiştir.




**Şekil 7.** Osmanlı döneminde fiziki ve ekonomik olarak büyüyen kentin genişleme bölgeleri (1- kentin kurulma alanı ve konut bölgesi, 2- kentin pazar bölgesi, 3- göçmen yerleşimleri ardından kurulan göçmen mahalleleri, 4- demiryolunun hizmete açılması ardından gar-konut-otel bölgesi.)

**4. Bulgular**

Eskişehir kentinde Dorylaion ve Sultan Öyüğü yerleşimlerinin gelişimleri, kendi dönemlerine ve yönetenlerine özgü bir sürece sahiptir. Bu süreç kentin fiziksel gelişimine katkıda bulunmuştur. Her ne kadar Dorylaion yerleşimi zamanla önemini yitirse de Sultan Öyüğü yerleşiminin kuruluş ve gelişiminde antik kentin izlerinden yararlandığı söylenebilir. Tablo 1'de Dorylaion ve Sultan Öyüğü yerleşimlerinin bazı özellikler ve fiziksel gelişimine etki eden etkenler sunulmuştur. Tabloda görülen kentin gelişiminde rol oynayan etkenler başlıklar halinde karşılaştırmalı olarak değerlendirilmiştir (Tablo 1).

**Tablo 1.** Dorylaion ve Sultan Öyüğü yerleşimlerinin fiziksel gelişimini etkileyen başlıca etkenler.

| **Kent adları** | Dorylaion, Dorylaeum, Şarhöyük | Sultan Öyüğü, Sultanyüki, Sultanönü, Eskişehir |
|---|---|---|
| **Yerleşim tarihleri** | MÖ 3000-12.yy. | 12.yy.-20.yy. |
| **İlk yerleşim yerinin coğrafi özelliği** | -Ova<br>-Nehir havzasında, taşma sınırından uzak | -Yamaç<br>-Nehir havzasında, taşma sınırından uzak |
| **Kentin gelişimini etkileyen devletler** | -Asur ticaret kolonisi (MÖ 20. yy)<br>-Hititler (MÖ 15. -12. yy.)<br>-Frigler (MÖ 12.-7. yy.)<br>-Lidyalılar (MÖ 7.-6. yy)<br>-Pers İmparatorluğu (MÖ 6.-4. yy.)<br>-Helen devletleri (MÖ 4.-2.yy)<br>-Roma İmparatorluğu (MÖ 2.yy.-MS 4.yy)<br>-Bizans İmparatorluğu (4. – 12. yy.) | -Selçuklular (12-13. yy.)<br>-Osmanlılar (13-20. yy) |
| **Kentin gelişimini etkileyen devlet politikaları** | -Pax Romana (Roma Barışı) | -Kentin stratejik konumuna Selçuklu ve Osmanlıların verdiği önem:<br>• Selçuklularda Bizans savaşları nedeniyle bir uç şehir olan yerleşimin önem kazanması. |

| | | |
|---|---|---|
| | | • Osmanlılarda iç şehir haline gelen kentin önemini kaybetmesi.<br>-Osmanlı göç politikası |
| **Coğrafi ve topografik yönlendiriciler** | -Porsuk nehri<br>-Nehir havzası<br>-Sıcak su kaynakları | -Porsuk nehri<br>-Nehir havzası<br>-Sıcak su kaynakları |
| **Ekonomik etkenler** | -Verimli tarım toprakları<br>-Kral yolu<br>-Pax Romana | -Rumeli tarım topraklarının kaybı<br>-Lüle taşı ticareti<br>-Demir yolu |
| **Kent gelişimini ortaya koyan eserler** | -Şarhöyük kazı alanı<br>-Sıcak sular bölgesinde yer alan Roma kalıntıları | -Selçuklu ve Osmanlı dönemi yapıları<br>-Göçmen mahalleleri<br>-Demiryolu İstasyonu |

***Yerleşim yerinin tercih sebepleri:***

Bilinen ilk yerleşimin erken tunç çağında başladığı Dorylaion'da yerleşim yerinin tercihindeki ana sebebin tarıma elverişli topraklar olduğu söylenebilir. Yerleşim yeri düz bir ovada, su kaynağına yakın ancak taşma sınırından da güvenli bir uzaklığa sahiptir. Henüz organize devletlerin oluşmadığı bir dönemde köy ölçeğinde başlayan bu yerleşim, Porsuk nehri havzasının verimli topraklarını ana geçim kaynağı olarak benimsemiştir. Nitekim ilerleyen süreçlerde ilk kentleşme çalışmalarının da bir tarım devleti olan Frigler döneminde başlaması da kentin tarım açısından elverişli konumunun göstergesidir.

Sultan Öyüğü yerleşim yerinin tercihinde ise öncelikli sebebin güvenlik kaygısı ve mevcut kentin fiziksel şartları olduğu söylenebilir. Yerleşim Porsuk nehrinin diğer yakasında (Dorylaion Porsuk nehrinin kuzeyinde, Sultan Öyüğü ise güneyinde) yer almaktadır. Kentin güneyindeki yüksek tepelerin kuzey yamacında kurulan yerleşim, güneyinden erişilmesinin zor olduğu daha güvenli bir konumda gelişmeye başlamıştır. Güvenlik kaygısındaki ana sebebin aktif olarak devam eden Selçuklu-Bizans savaşları olduğu söylenebilir. Selçuklu-Bizans savaşlarında büyük ölçüde yıkılan mevcut kentin yerleşilemez olarak değerlendirilmesi de kentin yeni bir yerleşim alanında kurulmasını sağlayan bir diğer başlıca sebep olduğu düşünülmektedir. Yerleşimin kentin güneyinde yer alan tepelerin Porsuk havzasına bakan yamaçlarında kurulmuş olması Sultan Öyüğü yerleşiminin, Porsuk nehri ve termal yer altı sularının bulunduğu bölgeye yönelerek öncülü olan Dorylaion'un adımlarını takip ettiğinin göstergesi olarak kabul edilebilir.

***Kent gelişim süreçlerine etki eden devletler:***

Eskişehir kentinin kendine özgü bir biçimde, iki farklı alanda kurularak ilerleyen kentsel gelişim evrimi, gelişim sürecinin devam ettiği döneme, kentin hakimi olan devletlerin ekonomik ve politik kararlarına bağlı olarak farklılıklara sahiptir. Dönemlere göre yapılan inceleme ve değerlendirmelerde, Dorylaion kentinin çok sayıda devlete ev sahipliği yaptığı, kentin fiziksel gelişiminin ise zamana yayılarak yavaş bir biçimde gerçekleştiği görülebilmektedir. Pax Romana harici kentte gelişim evrimini olumlu ya da olumsuz etkileyen önemli bir kırılma noktası olduğu söylenemez. Bu durumun sebeplerinin; kentin ilk kurulduğu dönemde büyük siyasi uygarlıklarının olmaması ve Roma dönemi sonrası kentte güçlü siyasi devletlerin hüküm sürmesi itibari ile sükunet ve durağanlığın etkin olması olarak ifade edilebilir. Kentin son dönemlerinde ise savaşlar belirleyici etken olmuş, Selçuklu-Bizans savaşı kentin fiziksel varlığının sonlanmasına neden olmuştur.

Sultan Öyüğü kentinde ise gelişim evresi Dorylaion'un aksine daha değişken bir sürece sahiptir. Kentin kurucu Selçuklular, kentin konumu ve gelişim yönünü belirleyerek ardılı olan Osmanlılar için bir gelişim yol haritası çizmişlerdir. Osmanlı Devleti'nin yükselme-duraklama devirlerinde Roma ve Bizans dönemindekine benzer bir biçimde kentin gelişiminin yavaşladığı görülebilir. Ancak Osmanlı Devleti gerileme devrindeki siyasi çalkantılar kentin gelişim sürecine de doğrudan etki etmiştir. Osmanlının kaybettiği topraklar, Anadolu kentlerinin tekrar gelişmesinin önünü açan göç ve tarım politikalarını tetikleyerek, Sultan Öyüğü'nün de durağan gelişim sürecini hızlandırmıştır.

***Kent gelişimini etkileyen politikalar:***

Bir antik dönem kenti olan Dorylaion'un gelişimini etkileyen en önemli devlet politikasının Roma döneminde gerçekleşen Pax Romana (Roma Barışı) olduğu söylenebilir. Kentin borçlarının silinmesi, barış kapsamında Grek kentlerinin siyasi öneminin artması, kentin fiziksel ve ekonomik olarak gelişerek büyümesini hızlandırmıştır. Bu refah döneminde kent Porsuk nehri ve termal sular bölgesine doğru gelişmiş ve bir sayfiye kenti özelliği kazanmaya başlamıştır.

Sultan Öyüğü yerleşiminde ise devlet politikaları kentin gelişimine olumlu ve olumsuz biçimde etki etmiştir. Osmanlı Devleti sınır şehirleri ve İstanbul kentinin gelişimine önem verirken, iç kentler ise daha az önemsenmiştir. Bu durum Osmanlı sınırlarını genişlettikçe bir iç kente dönüşen Sultan Öyüğü'nün gelişimini olumsuz yönde etkilemiş, kent gelişimi duran ve fakirleşen bir yerleşim haline gelmiştir. İlerleyen süreçlerde ise Osmanlı göç politikaları kentin tekrar büyümesi ve gelişmesini hızlandırmıştır. Kaybedilen topraklarda yaşayan halkları zorunlu olarak belirlenen kentlere

yerleştirmeye yönelik iskan politikasının gereği olarak, ağırlıklı olarak Kırım Tatarlarından oluşan göçmenler Sultan Öyüğü'ne yerleştirilmiştir. Bu sayede kentin nüfusu artmış ve yeni yerleşim alanlarıyla beraber fiziksel olarak da büyümüştür.

***Coğrafi ve topografik yönlendiriciler:***

Porsuk nehrinin iki farklı yakasında kurulan iki farklı şehir olan Dorylaion ve Sultan Öyüğü için coğrafi ve topografik yönlendiriciler ortaktır. Her iki kent de kurulduğu noktadan Porsuk nehri ve Porsuk nehri etrafındaki sıcak sular bölgesine doğru yönlenerek büyümüştür.

***Kent gelişimini etkileyen ekonomik etkiler:***

Dorylaion kentinin ana geçim kaynağı her dönem tarım olmuştur. Kentin gelişimini sürdürmesi için Porsuk nehrinin etrafındaki verimli ovalar ilk kurulduğu dönemden itibaren önemli bir kaynak olmuştur. Antik dönemde bir diğer olumlu ekonomik faktör, kentin kral yoluna yakınlığı ile ticaret ağına da dahil olabilmesidir. Buna rağmen kent Roma dönemine kadar çevresindeki önemli kentlerin gölgesinde kalmıştır. Bu durumu değiştiren bir başka etken ise Pax Romana ile kentin borçlarının silinmesi ile ekonomik anlamda gelişmesidir.

Sultan Öyüğü'nün gelişiminde olumlu ve olumsuz ekonomik etkenlerden bahsedilebilir. Osmanlı hakimiyetinde tarımsal üretimin Rumeli topraklarına kaymasıyla fakirleşmeye ve gelişimi durmaya başlamıştır. Ancak bu duraklama dönemi ardından kentin ekonomisini tekrar canlandıran üç önemli gelişmeden bahsedilebilir. Rumeli'nin kaybedilmesiyle 18. yüzyılda Anadolu tarımının tekrar önem kazanmasıdır. Porsuk havzası ile bereketli tarım topraklarına sahip olan kente, Yörük ve Türkmen göçebelerin yerleştirilerek kentin büyümesi ve tarımsal faaliyetlere göre ticaretin gelişmesi sağlanmıştır. Yine 18. yy. sonlarında bölgede keşfedilen lüle taşının, önemli bir ticari öğe olarak bölgenin zenginleşmesine katkı sağladığı söylenebilir. Son olarak 19. yy. sonunda Bağdat-Berlin demiryolu rotasının üzerindeki kentte istasyonun açılmasıyla ticaret hayatı hızlanmış, göçler artmış ve ekonomik zenginleşmenin yanında kent fiziksel olarak da büyümüştür.

***Kent gelişimini ortaya koyan eserler:***

Dorylaion kenti, 12. yüzyıldan itibaren savaşlar ve terkedilmenin getirdiği bir yıkım ile yok olmuştur. Kentin gelişimini ortaya koyan en iyi bulgular günümüzde Şarhöyük kazı alanı olarak bilinen kentin ilk kurulduğu alandaki arkeolojik sit alanı ve kentin daha sonraki gelişme bölgesini gösteren sıcak sular bölgesindeki Roma kalıntılarıdır (bkz. Şekil 4).

Günümüzdeki Eskişehir kentinin temellerini oluşturması itibari ile gelişim izleri daha net okunabilen yapı ve yapı alanları Sultan Öyüğü yerleşiminden günümüze ulaşmıştır. Bu izlerin en önemlileri kentin ilk kurulma yerini gösteren Alaeddin Camii, Osmanlı döneminde kentin en önemli yapısı olan Kurşunlu Külliyesi, kente gelen Tatar göçmenlerin yerleştirildiği göçmen mahalleleri ve tren garı yapısıdır.

**5. Tartışma ve Sonuç**

Eskişehir kentinin ikili gelişim süreci birbirinden farklı dönemlerde ve farklı dinamikler üzerinden ilerlemiştir. Kentin gelişimindeki farklılık ve benzerlikler, bir önceki bölümde Tablo 1'de sunulan farklı dinamikler üzerinden incelendiğinde aşağıdaki yorumlar yapılmıştır:

- Bir yerleşimin kuruluş yeri incelenirken, kuruluş dönemindeki ortama ait dinamikler öncelikli olarak ele alınması gereklidir. Eskişehir örneğinde iki yerleşim yerinin tercihindeki temel farklılık, yerleşimlerin kuruldukları dönemden kaynaklanmaktadır. Dorylaion kentinin ilk izleri Erken Tunç Çağı dönemde, henüz sistemli bir siyasi yapılanma olmayan bir döneme ait olup, dönem şartları gereği kuruluş yerinin tercihinde iklim, topoğrafya, toprak verimi, su kaynaklarına yakınlık gibi öğeler önemsenmiştir. Sultan Öyüğü ise birden fazla büyük uygarlığın, kentin konumu için verdikleri yıkıcı bir savaşın ardından kurulmuştur. Bu nedenle Dorylaion tarımın en önemli unsur olduğu bir dönemde Porsuk havzasındaki düz bir alanda kurulurken, Sultan Öyüğü savaşlar ardından güvenlik unsuru dikkate alınarak sırtını tepelere yaslayan yamaçlarda kurulmuştur.
- Bir kentin gelişimindeki en önemli etkenlerden biri, kentin siyasi hakimlerinin devlet politikaları ve kenti etkileyen kararlarıdır. Nitekim hem Dorylaion hem de Sultan Öyüğü yerleşimlerinin fiziksel gelişimi ve kentlerin ekonomik yapılarını en çok etkileyen unsurlar devlet politikaları olmuştur. Roma dönemindeki Pax Romana ve Osmanlı göç politikası, yerleşimlerin fiziksel yapısını en çok etkileyen unsurlar olmuştur.
- Farklı dönemlerde, farklı devletlerin hakimiyetinde olsa da kentlerin fiziksel gelişiminde coğrafi ve topografik yönlendiricilerin etkisi çok büyüktür. Eskişehir örneğinde de her iki yerleşim yerinin, bölgedeki ana su kaynağı olan Porsuk nehri havzasına doğru genişlemesi bu durumun göstergesidir.
- Kentlerin fiziksel olarak genişlemesi, ekonomik güçlerine doğrudan bağlıdır. Her iki kent yerleşiminin de fiziksel olarak büyüdükleri dönemler incelendiğinde, ekonomik açıdan iyiye giden bir görünüm izlenirken, yerleşimlerin ekonomik olarak zayıf oldukları dönemde fiziksel büyümelerinin de durduğu görülmektedir.
- Kentlerin anıtsal veya önemli yapıları, kentlerin gelişim sürecini özetler nitelikte bilgiler sunar. Dorylaion yerleşiminin terk edilmesi ve en son gelişen bölgelerinin (sıcak sular bölgesi) üzerine yeni bir yerleşimin inşa

edilmesi nedeniyle, Dorylaion'un gelişim sürecini yapı izleri üzerinden okumak oldukça zordur. Ancak Sultan Öyüğü, Sultanönü ve devamında Eskişehir, kentin gelişim sürecini gösteren Alaeddin Camii, Kurşunlu Külliyesi, demiryolu binası, göçmen mahalleleri gibi önemli yapı ve yapı bölgelerine sahiptir.

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# Comparative Analysis of Housing Production Processes in the Context of Actor-Network Theory (ANT) in Urban Renewal Areas

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**Abstract**
Policies and strategies devoid of participatory planning principles applied in the urban transformation process; accelerated the formation of unplanned, unhealthy, and identity-less urban environments; It has caused the physical, socio-cultural, and psychological needs of people not to be adequately met. Since transformation applications are a complex process involving various actor groups; It is thought that it can be solved with the inclusion of actors in the stages of the transformation process holistically and with innovative approaches based on cooperation. The main purpose of the study is to create a strategic framework by taking the housing production systems developed on a local and global scale, including all the actors that should be in the urban transformation areas, with the perspective of the Actor-Network Theory, by making comparative analyzes of the case studies in which the causal relationships are analyzed. ANT, which is one of the approaches to solving the social relations system, has been evaluated as a research methodology that can reveal the whole network of relations between the actors, objects, and things involved in the housing production process, and the examination of ANT-based housing production models is planned within the scope of the study. It is aimed to question the applicability in our country by researching housing production models in urban transformation areas and raising them to the global level based on the theoretical framework.
**Keywords:** Actor-Network Theory (ANT), Actors, Stakeholders, Housing Production, Urban Transformation.

# Kentsel Dönüşüm Alanlarında Aktör Ağ Teorisi (ANT) Bağlamında Konut Üretim Süreçlerinin Karşılaştırmalı Analizi

**Özet**
Kentsel dönüşüm sürecinde uygulanan katılımcı planlama ilkelerinden yoksun politika ve stratejiler; plansız, sağlıksız ve kimliksiz kentsel çevrelerin oluşmasını hızlandırmış; insanların fiziksel, sosyo-kültürel ve psikolojik gereksinimlerinin yeterince karşılanamamasına neden olmuştur. Dönüşüm uygulamaları, çeşitli aktör gruplarını içeren karmaşık bir süreç olduğundan; aktörlerin dönüşüm sürecinin aşamalarına bütüncül olarak dâhil edilmesi ve işbirliğine dayalı yenilikçi yaklaşımlar ile çözülebileceği düşünülmektedir. Çalışmanın temel amacı, kentsel dönüşüm alanlarında olması gereken tüm aktörlerin dâhil olduğu yerel ve küresel ölçekte geliştirilen konut üretim sistemlerinin Aktör Ağ Teorisi perspektifi ile alınarak, nedensel ilişkilerin analiz edildiği vaka çalışmalarının karşılaştırmalı analizlerinin yapılarak yorumlayıcı/kuramsal ve analitik bir çerçeve oluşturmaktadır. Toplumsal ilişkiler sistemini çözmeye yönelik yaklaşımlardan biri olan ANT, konut üretim sürecine dâhil olan aktörler, nesneler ve şeyler arasındaki tüm ilişkiler ağını açığa çıkarabilecek araştırma metodolojisi olarak değerlendirilmiş ve ANT temelli konut üretim modellerinin incelenmesi çalışma kapsamında planlanmıştır. Kentsel dönüşüm alanlarında konut üretim modelleri araştırılarak ülkemizde uygulanabilirliğinin sorgulanması ve kuramsal çerçeveye dayandırılarak küresel seviyeye çıkartılması hedeflenmiştir.
**Anahtar Kelimeler:** Aktör Ağ Teorisi (ANT), Aktörler, Paydaşlar, Konut Üretimi, Kentsel Dönüşüm.

## 1. Giriş

21 yy. sürecinde kentleşme hızının giderek artması ve bu süreçte dünyada yaşanmakta olan ekonomik, sosyal, teknolojik, kültürel ve politik değişimlerin sonucunda başlayan çok yönlü küreselleşme süreci, hızlı bir kentsel değişim ve dönüşümü de beraberinde getirmektedir (Khondker, 2000). Özellikle sanayisizleşmenin ve tüketime dayalı bir kentsel gelişmenin yaşandığı kentlerde, "*yeni kent politikası*" nın en önemli unsuru olarak "*kentsel dönüşüm*" olgusunun gündeme geldiği görülmektedir. Değişime uğramış bir bölgenin ekonomik, fiziksel, sosyal ve çevresel koşulları bağlamında ortaya çıkan kentsel sorunlarına çözüm önerileri sunma amacı taşıyan, kapsayıcı bir eylem ve vizyon olarak tanımlanan kentsel dönüşüm (Thomas, S. 2003), Türkiye'de hızla gelişen kentleşmenin beraberinde getirdiği problemler sebebiyle önemi her geçen gün artan bir süreçtir. Türkiye'de özellikle İstanbul'da 1999 Marmara depremi sonrasından itibaren, kentsel dönüşüm yoğun olarak kullanılan bir kavram haline gelmiştir. 2012 yılı sonrasında ortaya çıkan yasal mevzuat çerçevesinde kentsel dönüşüm, dar kapsamı ile ele alınarak, "yıkıp yerine yeniden yapmak süreci"ni ifade eder biçimde kullanılmaya başlanmıştır (Türkün, 2014).

Kentsel dönüşüm sürecinde uygulanan katılımcı planlama ilkelerinden yoksun politika ve stratejiler; plansız, sağlıksız ve kimliksiz kentsel çevrelerin oluşmasını hızlandırmış; insanların fiziksel, sosyo-kültürel ve psikolojik gereksinimlerinin

yeterince karşılanamamasına neden olmuştur. Dönüşüm uygulamaları, çeşitli aktör gruplarını (paydaşları) içeren karmaşık bir süreç olduğundan; karşılaşılan sorunların ancak yerleşik müdahaleler, aktörlerin dönüşüm sürecinin aşamalarına bütüncül olarak dâhil edilmesi ve iş birliğine dayalı yenilikçi yaklaşımlar ile çözülebileceği düşünülmektedir. Bu bağlamda, kentsel dönüşüm projelerinde kentsel ilişkiler ağlarını anlamayı sağlayacak ağ analizlerinin görselleştirilmesi, katılımcı ve iş birliğine dayalı yenilikçi stratejilerin nasıl uygulanabileceğinin ve bunların etkileri ve etkileşimlerinin nasıl olacağının irdelenmesi, sağlıklı ve planlı bir kentsel dönüşüm süreci gerçekleştirebilmek için gereklidir.

Yapılı çevrede, yerleşim alanlarını daha sürdürülebilir ve eşitlikçi bir kentsel gelecek için yeniden şekillendirmek, üretmek sadece mekânsal bir tasarım zorluğu değil, aynı zamanda paydaşlar arasında ilişkisel bir sorundur. Kentsel dönüşüm alanlarında, değişim ve dönüşüm süreçleri ile yapılı çevrede karar verme analizinde aktörler arası ilişki ağlarını anlamak gereklidir. Kentsel ilişkiler ağının deşifre edilebilmesi için, ağ ortamının çoklu, çoğul ve heterojen okumasının önünü açabilecek yenilikçi, çözümleyici sosyal yaklaşımlar ve yöntemler, çalışmanın literatür taraması bölümünde incelenmiştir. Bu doğrultuda; ilişkisel sistemleri ve bu sistemlerin bir yerde ya da bir yapıda nasıl etkileşime girdiklerini izlemeye ve çözümler önermeye yönelik yorumlayıcı/kuramsal ve analitik bir çerçevenin hedeflendiği bu çalışmada, ağ analizi yaklaşımına bağlı kalarak Latour tarafından geliştirilen Aktör Ağ Teorisi yönteminden yararlanılmıştır. Bu çalışmada, ağ analizi merceği ile kentsel dönüşüm alanlarında konut üretim süreçlerindeki ilişkiler belirlenerek, her bir projenin kendi bağlamında paydaşlar arasındaki bağlantıların ortaya çıkarılması düşünülmektedir. Aktör Ağ Teorisi (Actor Network Theory) hem insan hem de insan olmayan varlıklar arasındaki ilişkilere ve yeni varlıkların / oluşumların yaratılmasına öncülük eden bu ilişkilerin nasıl olduğunu açıklamaya odaklanan disiplinlerarası bir araştırma yöntemi olarak ortaya çıkan bir yaklaşımdır. “Yaptığımız bilim ve teknolojiye neden ve nasıl sahip olduğumuzu açıklamak” için geliştirilen Aktör Ağ Teorisi (ANT), inşa ettiğimiz konutlara neden ve nasıl sahip olduğumuzu ortaya çıkarmak için bir yol sunmaktadır.Toplumsal ilişkiler sistemini çözmeye yönelik yaklaşımlardan biri olan Aktör Ağ Teorisi, konut üretim sürecine dâhil olan aktörler, nesneler ve şeyler arasındaki tüm ilişkiler ağını açığa çıkarabilecek etkin bir araştırma metodolojisi olarak değerlendirilmiş ve ANT temelli konut üretim modellerinin incelenmesi bu çalışma kapsamında planlanmıştır.

Çalışmada, dünya genelinde yapılmış bilimsel çalışmalar üzerinden Aktör Ağ Teorisi (ANT) kapsamında konut üretim süreçlerinde rol oynayan kilit aktörler ve ilişkileri incelenip karşılaştırmalı analizinin yapılması için, gerçekleştirilmiş ve elde edilen veriler kategorize edilmiştir. Yapılan çalışmaların son yıllarda yoğunlaşması ve konunun güncelliğinin artması nedeniyle; konut araştırmaları literatürünün SCI-SSCI indeksli dergilerinde, 2000-2021 yılları arasında konu ile ilgili yayınlanmış bilimsel makaleler ve yayınlar taranmıştır.

Bu çalışma kapsamında, Aktör ağ teorisi konut üretim ilişkisel sistemleri, planlama ve yapım süreçlerinde aktörlerin rolleri ve örnek uygulamalar irdelenerek yapı-aktör ilişkisi çerçevesinde değerlendirilmiş, kentsel dönüşüm alanlarında konut üretim modelleri araştırılarak ülkemizde uygulanabilirliğinin sorgulanması ve kuramsal çerçeveye dayandırılarak küresel seviyeye çıkartılması hedeflenmiştir. Projelerdeki paydaşların ANT yöntemi ile değerlendirilmesi ve konut üretiminde belirleyici etkileri makalelerde yer alan literatür vaka çalışmalarından elde edilen verilerle ortaya konarak karşılaştırmalı analizi yapılmıştır.

***Bu çalışmanın temel amacı,*** kent araştırmalarında konut üretim süreçlerinde yer alan tüm aktörlerin dâhil olduğu yerel ve küresel ölçekte geliştirilen konut üretim sistemlerinin ***Aktör Ağ Teorisi perspektifi ile alınarak***, nedensel ilişkilerin analiz edildiği vaka çalışmalarının karşılaştırmalı analizlerinin yapılarak analitik bir çerçeve oluşturmaktadır. Bu çerçeve; kentleşme eğilimleri, aktörlerin konut üretimi sürecindeki rolü, ilişkilerin yapısı, yasa ve yönetmelikler, kilit aktörler ve aktanlar gibi değişkenleri kapsamaktadır. Çalışmada, ANT yönteminin ilişkiler arası ağ etkileri, ilişki yapıları ile incelenen vakalar üzerinden ülkemizde uygulanabilirliği ele alınmıştır.

***Araştırmanın iki temel amacından ilki***, Dünyada Aktör Ağ Teorisi yöntemi ile ilgili yapılmış konut ve kent çalışmaları üzerinden yapılacak meta analizi ile konu hakkında Türkiye için teorik bir çerçeve oluşturarak bu boşluğu doldurmaya çalışmaktır.

***Araştırmanın ikinci amacı ise***, Kentsel dönüşüm için ‘yenilikçi yaklaşımlar ve Aktör Ağ teorisi’ konusunda bulguların değerlendirilmesi ve yöntemin ülkemizde planlama, tasarım ve uygulama süreçlerinde kullanılabilirliğinin irdelenmesidir. Ayrıca bu araştırmanın, konut üretim süreçlerindeki farklılığı açıklamak için nedensel ilişkileri ortaya koyarak konut sorununa sürdürülebilir çözüm önermeye yönelik bir modeli önerisi geliştirilmesi yönünde yeni çalışmalara katkı sağlayacağı düşünülmektedir. Bu çalışma ile kentsel dönüşüm alanlarında konut üretimine yönelik yenilikçi yaklaşımlar geliştirmek ve ANT yöntemi kullanımı konusunda bir farkındalık yaratmak ve ***gelecek çalışmalar için de bir başlangıç noktası*** oluşturmak hedeflenmektedir.

**2. Materyal Ve Metot**

Son yıllarda konut araştırmacıları, sosyal konut sağlamanın değişenkenleri ve bileşenlerini incelemek için ağ yaklaşımlarını kullandılar. Özellikle ağ analizi ve yönetişimi yaklaşımı, konut çalışmalarında ve kentsel yenilemede 'yeni bir yönetişim biçimi olarak' geçerlilik kazanmıştır (Mullins ve Rhodes, 2007). Ağ analizi ve yönetişimi çerçevesi, kentsel yenileme süreçlerini incelemek, açıklamak ve bilgilendirmek için kullanılmaktadır. Ağ yönetişimi, temel, stratejik ve kurumsal belirsizliği içeren karmaşık toplumsal sorunlar olarak kötü sorunları ifade etmektedir (Koppenjan ve Klijn, 2004).

Belirsizliğin yönetimi, çok yönlülük (aktörlerin çeşitli değer sistemlerine sahip olması), kapalılık (her aktör veya konunun ağa girememesi), karşılıklı bağımlılık (hedefler aktörler arasında işbirliğini gerekliliği) ve dinamikler (ağ aktörleri ve güçlerin değişimi) ile karakterize edilen ağlarda gerçekleşir (De Bruijn vd, 2002). Teori, işbirliği ve fikir birliği yoluyla ağları belirli hedeflere yönlendirmek için güçlü bir pratik görüşüne sahiptir. Aktör-ağ teorisinin (ANT) kökenleri, bilimsel bilgi üretimi ve 1980'lerde Bruno Latour, Michel Callon ve John Law tarafından geliştirilen teknolojik yeniliklere dayanmaktadır (Latour ve Woolgar, 1986; Law and Lodge, 1984; Callon, 1980). Sonuç olarak, modernist doğa ve toplum ayrımını eleştirir ve bir dolaşım sosyolojisi önerirler.

**2.1 Aktör Ağ Teorisi (ANT)**

ANT, insan ve insan olmayan aktörler arasındaki ilişkiler aracılığıyla toplumsalı yeniden bir araya getirme çalışmalarıyla ilgilenmektedir. Toplumsal olanı özel bir alan, belirli bir alem ya da tikel bir tür şey olarak değil, yalnızca hayli kendine özgü bir yeniden ortaklık kurma ve yeniden bir araya toplama hareketi olarak tanımlayan Bruno Latour, toplumsalın başlangıçtaki anlamına dönerek ve tekrar bağlantıları izleyebilmesini sağlayarak toplumsal nosyonunu yeniden tanımlamayı amaçlıyor. Aktör-Ağ Teorisi (ANT) çerçevesinde Latour (2005), sosyal bilimlere bir asırdan fazla hakim olan *"toplum sosyolojisi"* paradigmasının aksine, *"ortaklıklar sosyolojisi"* dediği şeyi tasvir etmektedir.

Bu çalışma kapsamında, ANT bir evrensel iddialar teorisi değil, öncelikle doğal olanı toplumsaldan ayırmama fikrine dayanan analitik bir çerçeve sağlayan bir metodolojidir. Bu yaklaşım, ilişkisellik, simetri ve birliktelik ilkelerinden kaynaklanmaktadır (Farìas ve Bender, 2010). Çalışmanın kuramsal çerçevesini, yapı-aktör ilişkisi çerçevesinde Latour'un ağ analizi kavramsallaştırmasına temel oluşturacak şekilde değerlendirilerek, kentsel dönüşüm uygulama biçimlerini farklı kentsel aktörlerin oluşturduğu ilişkiler üzerinden okuyan *"Aktör Ağ Teorisi"* oluşturmaktadır. Bu yaklaşımın temel ilkesi olarak kabul edilen genelleştirilmiş simetriye göre, aktör/actor veya aktant/actant olarak kavramsallaştırılabilen, insan ve insan olmayan tüm varlıklar, oluşumlar eşit derecede eylemde bulunma kapasitesine sahiptir. Ağ analizi, kentsel dönüşüm dinamiklerini anlamak, ağların karmaşık ve değişken yapısını çözümlemek için analitik bir çerçeve sunmaktadır. Koşulları fark yaratacak şekilde değiştirebilen herhangi bir şey ***"aktör"***, henüz biçimlendiremeyen ise ***"aktant"*** olarak tanımlanır (Latour, 2005). Aktant, aktörden daha soyut bir şekilde kavramsallaştırılır. Eş anlamlı olarak kullanıldığı metinler de bulunmaktadır.

İlişkisel sistemleri ve bu sistemlerin bir yerde ya da bir yapıda nasıl etkileşime girdiklerini izlemeye ve çözümler önermeye yönelik yorumlayıcı/ kuramsal ve analitik bir çerçevenin hedeflendiği bu çalışmada, ağ analizi yaklaşımına bağlı kalarak Latour tarafından geliştirilen ***Aktör Ağ Teorisi*** yönteminden (ANT) yararlanılmıştır. ANT, nesneleri de sosyal yapının birer parçası olarak kabul eden bir sosyal teori ve araştırma yöntemidir.

**2.2 Aktör Ağ Teorisi (ANT) Kavramları ve Araştırma Soruları**

"Ağ" (network), "aktör/ aktant" (actor/actant), "aracılar" (mediators), "arabulucular" (intermediaries), "çeviriler" (translations) "kara kutu" (black box) gibi kavramlar, bu yeni yaklaşımın kendine özgü terminolojisini oluşturmaktadır.

- Kentsel dönüşüm projelerinde karmaşık ağları anlamayı sağlayacak etkin sosyal yenilikler neler olabilir? Katılımcı ve iş birliğine dayalı stratejiler nasıl uygulanır? Etkileri ve etkileşimleri nasıldır?
- Kentsel dönüşüm projelerinde hangi aktörler yer almaktadır? Konut üretiminde yer alan tüm aktörler ve bileşenleri nasıl tanımlanmaktadır? İşbirliği nasıl sağlanır ?
- Aktörleri bir araya getiren koşullar / ortamlar nelerdir? Ve üzerinde fikir birliğine vardıkları ilke ve olgu nelerdir?
- Aktör ağa katılım nasıl gerçekleşmektedir? Aktörlerin ağa katılım sürecinde, paydaşlar arası ilişki düzeylerini tanımlamaya yönelik ağ da etkili olan faktörler nelerdir?
- Kentsel dönüşüm alanlarında hangi aktörler / aktantlar ağda yer almaktadır?
- Aktör ağı uygulamalarının konut yerleşimlerine etkileri nasıldır? gibi yöntemsel sorulara cevaplar aranmıştır.

## 2.3 Araştırma Metodolojisi

Kemeny (2001), farklı konut sistemlerinin ve tipolojilerinin neden ortaya çıktığını açıklamak için konut ve bağlam arasındaki ilişkinin kuramlaştırılması gerektiğini öne sürmektedir. Benzer şekilde Elsinga (2014), karşılaştırmalı konut araştırmasının "... ulusal farklılıkları vurgulamak için güvenilir bir kanıt temeli" sağladığını öne sürerek sonuçların niteliksel karşılaştırmasını savunmaktadır. Bu doğrultuda, bilimsel çalışmalar üzerinden Aktör Ağ Teorisi (ANT) bağlamında yerel ve küresel ölçekte konut üretim süreçlerinde rol oynayan kilit aktörler ve etkileşimi / ortaklıkları ile kamu-özel sektör stratejik planlama ve uygulamaları incelenip karşılaştırmalı analizi yapılmıştır.

Bu çalışmalar kapsamlı bir literatür taraması olan meta analizi sonucunda belirlenerek kategorize edilmiştir. Araştırma tasarımında kullanılan yöntem olan ***Betts ve Lansley'in*** meta analizinin değerlendirme çerçevesi dört bölümden oluşmaktadır. Birinci ve ikinci bölümlerde araştırmanın örneklemini oluşturan makalelere ilişkin içerik boyutu başlığı

altında, tanımlayıcı bilgiler ve bağlam kategorileri, üçüncü ve dördüncü bölümlerde makalelerde konu edilen araştırmaların biçim boyutu başlığı altında, şekil / girdi-çıktı ve amaç sonuç ilişkisi kategorileri yer almaktadır (Tablo 1).
***Meta analizi yönteminde*** öncelikli olarak yapılması gereken, meta analizine yönelik araştırma sorularını ve meta analizinin çerçevesini oluşturmaktır. Ardından, meta analizine dahil edilme ve hariç tutulma kriterlerinin belirlenmesi gerekmektedir (Timulak, 2009). Bu işlemler meta analizinin güvenilirlik ve geçerlilik koşullarını sağlaması için büyük önem taşımaktadır. Analiz sonucunda elde edilen bulgular anlamlı grafikler ve tablolarla görselleştirilerek değerlendirilmiştir. Bu kavramsal çerçevede oluşturulan genel ilkeler, işbirliğine dayalı kentsel yenileme / dönüşüm alanlarında kuramsal ve analitik bir çerçeve geliştirmek üzere sentezlenmiştir.
Çalışma kapsamında, kentsel dönüşüm alanlarında konut üretimine yönelik yapılacak meta analizinde cevap aranacak sorular şu şekilde belirlenmiştir:

- ***Literatürden seçilen çalışmalarda vurgulanan ortak noktalar***
- Projeye özgü dinamikler,
- Grupların ve ortaklıkların ANT bağlamında değerlendirilmesi,
- İşbirliğine dayalı konut üretim modellerine etkileri,
- İncelenen konut araştırmalarından hangisi sosyal bilimlerdeki kuramlar üzerine inşa edilmiştir?
- Araştırma konusu sosyal bilimlerden hangi alanlar ile ilişki kurmaktadır? Nelerden beslenmektedir ?
- ***İncelenen vaka çalışmalarında,***
- Aktörler / aktantlar / dinamiklere odaklanarak,
- Projelerin uygulanışı aktörler / aktantlar üzerinden nasıl açıklandığı incelenmiştir.

Aynı konu üzerindeki farklı araştırma bulgularını sistematik bir biçimde değerlendirip konuyla ilgili anlamlı ve bütüncül sonuçlar ortaya koymaya olanak tanıyan meta analizi yöntemi (Timulak, 2009), bu çalışmada toplanması gereken verilerin hızlı bir biçimde toplanmasını ve nitelikli veriye ulaşılmasını sağlayacaktır. Meta analizinin literatür araştırmasından farkı, aynı konudaki araştırmaların bütünleştirilmesinden sonra tekrar analiz edilmesidir (Sönmez ve Alacapınar, 2019).

- ***Meta Analizi sürecinde yer alan adımlar şu şekildedir:***

1. Tema – Başlıklar
2. Kategoriler
3. Anlamlı ilişkiler
4. Tablo – Grafikler

**Tablo 1.** Meta analizi sınıflandırma çerçevesi ( Betts, M., Lansley, 1993)

| BOYUT | KATEGORİLER | FAKTÖRLER |
|---|---|---|
| ***İÇERİK*** | **TANIMLAYICI BİLGİLER** | Yayın Yılı<br>Yayının Başlığı<br>Veri Tabanı- Ülke<br>Yazar Bilgisi<br>Anahtar Kelimeler |
| | **BAĞLAM** | Araştırma Konusu<br>Amaç – Odak noktası<br>Araştırma Sorunsalı<br>İncelenen Kentler – Case study<br>İlişkili konuları Sosyal bilim dalı |
| ***BİÇİM*** | **ŞEKİL / GİRDİ- ÇIKTI** | Veri Toplama Tekniği<br>Araştırmanın Yöntemi<br>Araştırma Tasarımı<br>Katkılar / Model |
| | **AMAÇ – SONUÇ İLİŞKİSİ** | Araştırmanın Bulguları<br>Gelecek Çalışma Önerileri<br>Engeller / Zorluklar |

Meta analiz yöntemi, literatürde ilk defa Glass tarafından uygulanmıştır. Glass, meta analizini '***analizlerin analizi'*** olarak tanımlamıştır. *Glass'a* göre meta analizi, ''sayıca çok olan bireysel çalışmalardan anlamlı bir sonuç çıkarabilmek için yapılan istatistiki analizlerdir''. *Çarkungöz ve Ediz'e* göre meta analizi; 'ilişkili fakat bağımsız çalışma sonuçlarının niceliksel gözden geçirilmesi ve sentezi' olarak tanımlanabilmektedir.
Meta analiz yönteminde sonuçların niceliksel olarak analiz edilmesi, bu yöntemi klasik literatür tarama yöntemlerinden ayırmaktadır. Çalışma kapsamında öncelikli olarak konu ile ilgili meta analizi yapılabilmesi için çok sayıda kaynak incelenmiştir. Meta analizinin araştırma örneklemini oluşturmak amacıyla "***kentsel dönüşüm***", ***"urban transformation", "actor network theory", "aktör ağ teorisi", "network mapping", "housing theory", "housing policy", "konut üretimi"*** anahtar kelimeleri kullanılarak elektronik veri tabanlarında tarama yapılacaktır. Taramanın, Türkiye'de kentsel dönüşüm çalışmalarının dönüm noktası sayılabilecek 2000 ile 2021 yılları arasını kapsaması ve konuyla doğrudan ilintili olması bakımından seçilen anahtar kelimelerin "başlık, anahtar kelimeler"de bulunması ile sınırlandırılacaktır.

Yapılan çalışmaların son yıllarda yoğunlaşması ve konunun güncelliğinin artması nedeniyle; konut araştırmaları literatürünün "Taylor&Francis, Science Direct, Sage, Springler link, DergiPark, Ulakbim, ProQuest, Ulusal Tez merkezi" veri tabanları üzerinden SCI-SSCI indeksli dergilerinde, konu ile ilgili yayınlanmış 54 adet bilimsel makaleler, tezler, bildiriler ve yayınlar incelenmiş ve meta analizi çerçevesindeki kategoriler üzerinden birtakım bulgular elde edilmiştir.

**3. Bulgular**

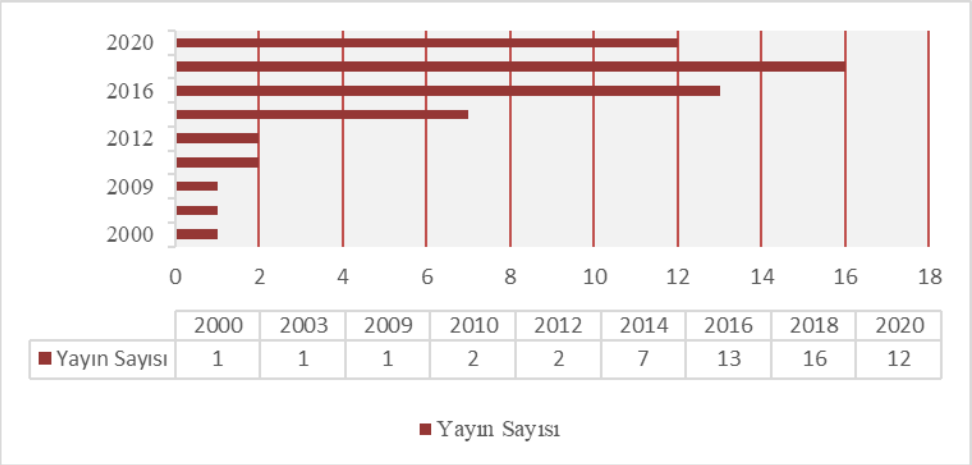
Son yıllarda yapılan kente dair çalışmalarda, ağa bağlı kentsel sistemlerin karmaşıklığı ve dinamikleri, Latour'un Aktör-ağ teorisinin (ANT) prizmasıyla kapsamlı bir şekilde yeniden yorumlanarak, tüm insan, sosyal ve teknik unsurlar bir sistem içinde simetrik olarak işlenmiştir. Tüm bu varlıklar, aralarındaki ilişkilerde fenomen anlayışının (sosyal olanlar dahil) yattığı dinamik, sürekli ağ oluşturmaya katkıda bulunmuştur.

Bu çalışma kapsamında, Aktör ağ teorisi (ANT) konut üretim ilişkisel sistemleri, planlama ve yapım süreçlerinde aktörlerin rolleri ve örnek uygulamalar irdelenerek yapı-aktör ilişkisi çerçevesinde değerlendirilmiş, kentsel dönüşüm alanlarında konut üretim modelleri araştırılarak ülkemizde uygulanabilirliğinin sorgulanması ve kuramsal çerçeveye dayandırılarak küresel seviyeye çıkartılması hedeflenmiştir.

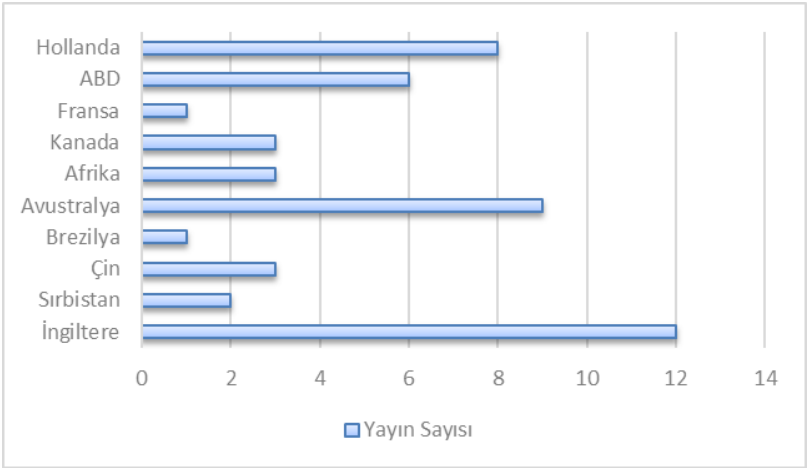
***ANT temelli konut üretimine*** yönelik çalışmaların ele alınmasındaki amaç, bu alanda bütünsel bir yaklaşım elde edilmesi, güncel eğilimlerin belirlenmesi ve bu alandaki bilgi boşluğunun doldurulmasıdır. Ulusal ve uluslararası literatür incelendiğinde, uluslararası literatürde özellikle konut üretimi sürecine ilişkin aktörler/ paydaşlar arası ilişkilerin incelenmesine yönelik çok sayıda çalışma bulunmakta iken ulusal literatürün aynı zenginlikte olmadığı görülmektedir.

*Meta Analizi süreci sonunda elde edilen istatistiki analizler şu şekilde sıralanabilir :*

ANT temelli konut üretimi konusunda yapılan makale sayısı yıllara göre ele alındığında, çalışmaların 2010-2020 yılları arasında yoğunlaştığı görülmektedir. Başlangıçta az sayıda çalışma yapılırken, 2012-2020 yılları arasında konuyla ilgili çalışma sayısının arttığı gözlenmektedir (Şekil 1).

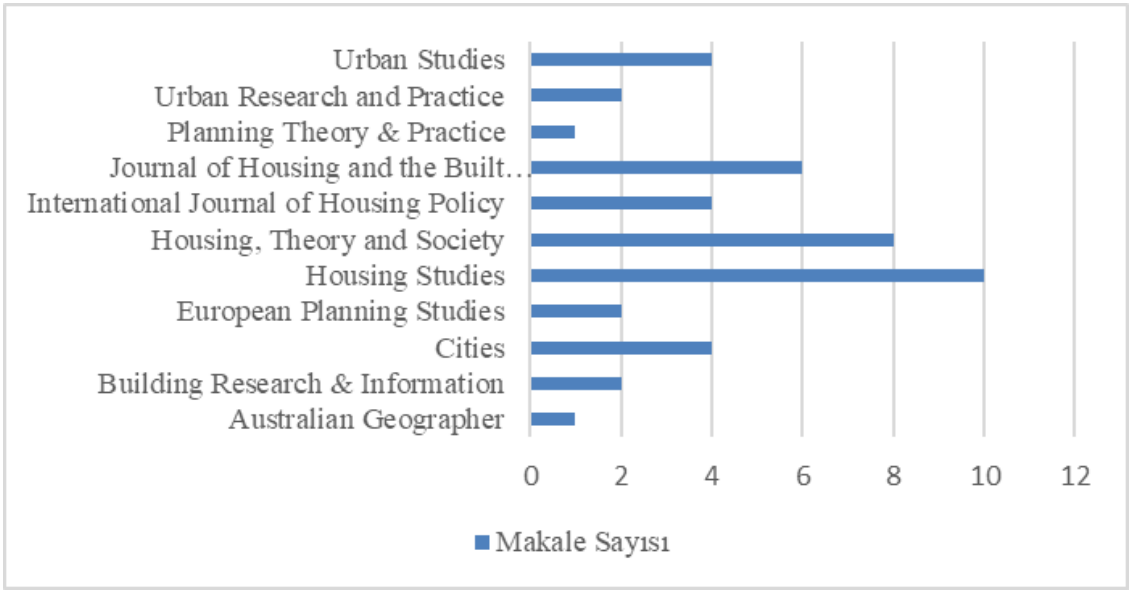



**Şekil 1.** Aktör Ağ Teorisi (ANT) konulu araştırmaların yıllara göre dağılımı

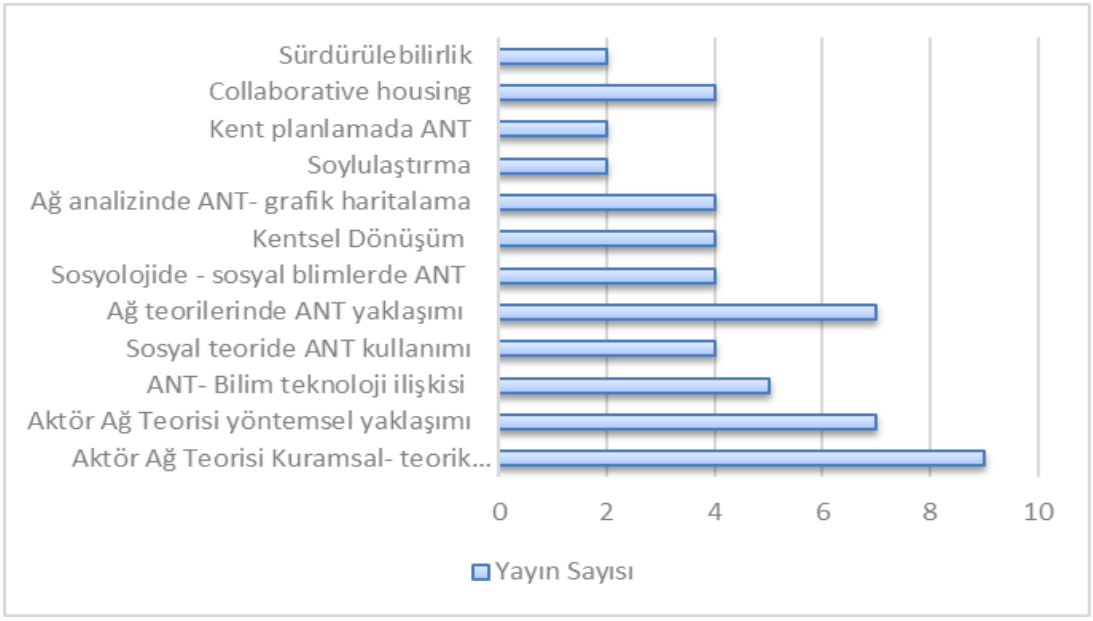



**Şekil 2.** Aktör Ağ Teorisi (ANT) araştırmalarında incelenen ülkeler

İncelenen makalelerde, ANT temelli yaklaşımların hangi ülkelerdeki uygulamalar üzerinden ele alındığına bakıldığında en fazla sayıda çalışmanın İngitere ile ilgili olduğu görülmektedir (Şekil 2). İngiltere'yi Avustralya ve Hollanda takip etmektedir. Makalelerin yer aldığı yayınlar ele alındığında büyük bir kısmının "Housing Studies"de yayımlandığı görülmektedir (Şekil 3). Bunu "Urban Studies", "Journal of Housing and Built Environment" ve "Housing, Theory and Society" yayınları izlemektedir.

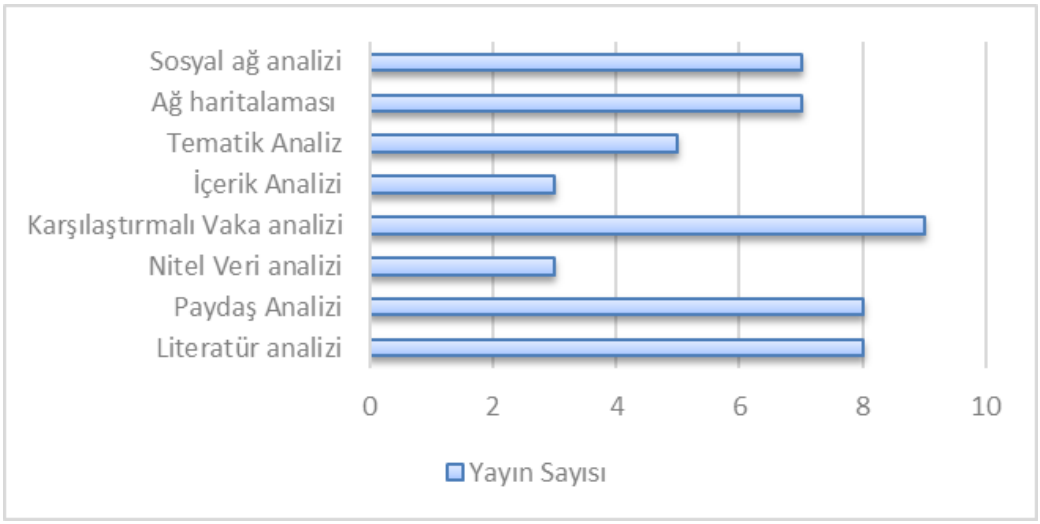



**Şekil 3.** Aktör Ağ Teorisi (ANT) araştırmalarının yayınlara göre sıralaması

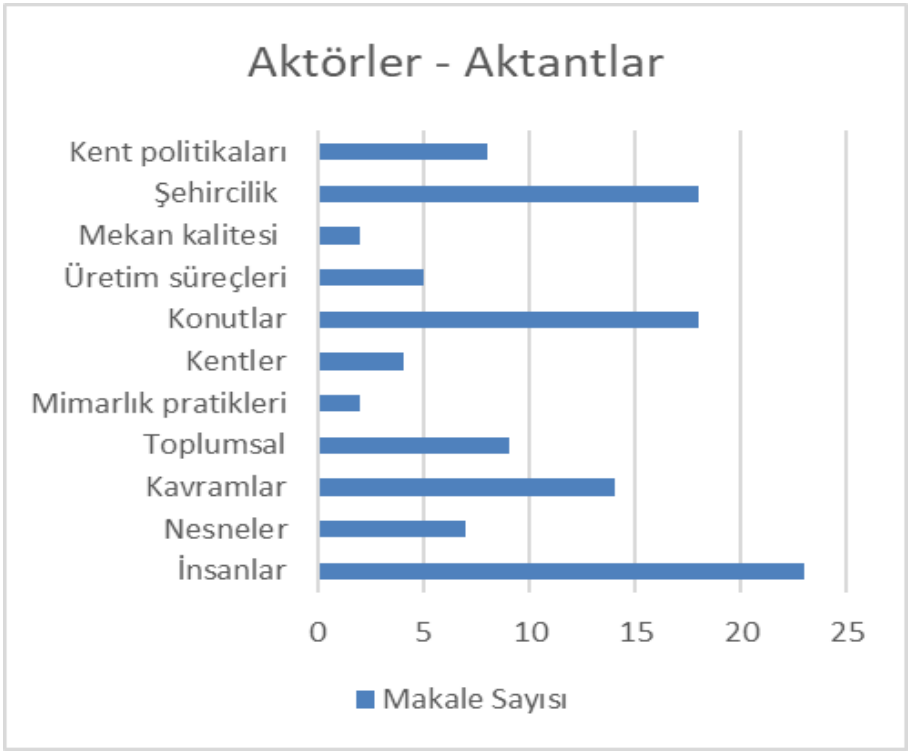



**Şekil 4.** Aktör Ağ Teorisi (ANT) araştırmalarında ele alınan konular

İncelenen makalelerde araştırmalar çok çeşitli konulara ilişkilendirilmiştir. Konu çeşitliliğine bakıldığında, "aktör ağ teorisi" kavramı ağırlıklı olmak üzere "sosyal teori, toplumsallık", yenilikçi konutlar "ağ haritalaması" ve "sosyal yenilik" kavramlarının üzerinde durulduğu görülmektedir (Şekil 4). Analiz edilen makalelerde çeşitli araştırma yöntemleri kullanılmıştır. "vaka analizi" ve "sosyal ağ analizi" en çok kullanılan yöntem olmakla birlikte "anket", "gözlem" ve "literatür analizi" yöntemlerine de sıklıkla başvurulmuştur (Şekil 5).




**Şekil 5.** Aktör Ağ Teorisi (ANT) araştırmalarında kullanılan veri analiz yöntemleri




**Şekil 6.** Aktör Ağ Teorisi (ANT) araştırmalarında incelenen aktör /aktant türleri

"***Konut üretiminde ANT yaklaşımı***" ile ilgili incelenen küresel ölçekte yapılmış bilimsel makaleler (2000-2020 yılları arası) tabloda gösterilmiştir. İncelenen makalelerde, ANT yaklaşımının hangi ülkelerdeki uygulamalar üzerinden ele alındığı incelenerek araştırma konusu, yöntemi , veri analizleri ve rol alan aktörler / aktantlar açısından karşılaştırmalı olarak yorumlanması görülmektedir. Küresel ölçekte taranan bilimsel makalelerden çalışmaya dahil edilenler Tablo 2'de ayrıntılı bir şekilde belirtilmektedir.

İncelenen makalelerde, literatürden elde edilen vaka çalışmalarının karşılaştırmalı analizleri karar , tasarım ve uygulama süreci başlıkları altında yapılarak tablolar halinde sunulmuştur (Tablo 3).

**Tablo 2.** "Konut üretiminde ANT yaklaşımı" ile ilgili incelenen makaleler (2000-2020 yılları arası)

| Yazarlar | Tarih | Yayın | Konu | Yöntem | Ülkeler | ANT Yaklaşımı Uygulamaları |
|---|---|---|---|---|---|---|
| Kurokawa, Schweber ve Hughes | 2017 | BRI | Müşteri katılımı ve yapı tasarımı: Aktör-Ağ Teorisinden bir bakış | ANT<br>Görüşme | İngiltere | -Yapım projelerinde müşteri katılımı<br>- Aktörlerin tanımlanması<br>- ANT problemleştirme, ikna ve dayanıklılık kavramları |
| Bezemer ve Martin | 2019 | PP | Sosyal konut tasarımı, planlama ve uygulamaları | ANT<br>Veri toplama | Kenya | -Konut tipolojileri, Nairobi – Kariakor- Kaloleni saha çalışmaları |
| Cvetinovic, Budic ve Bolay | 2017 | Geo forum | ANT metodolojisi ile kentsel gelişim dinamik kodlarının çözümü | ANT<br>Literatür analizi<br>Görüşme | Sırbistan | - Kentsel gelişim projeleri<br>-Savamala – Belgrad saha çalışması<br>-ANT sürecinde toplanan dataların analizi<br>-Ağ sürecine dahil olanların tanımlanması |
| Chen C., Gao ve Chen J. | 2019 | JRS | Kırsal Çin'in yeniden yapılandırılmasında kayıtlı yerel aktörlerin davranış mantığı: | ANT<br>Literatür analizi<br>Görüşme | Çin | - Jiangsu'nun kuzeyindeki bir Haoqiao Köyü örneği,<br>-Kırsal alanların yeniden yapılandırılmasında aktörlerin tanımlanması ve etkileri |
| Bradley | 2019 | HS | Mahalle ölçeğinde katılımcı halk modelinde demokrasinin kullanımı | ANT<br>Anket<br>Görüşme | İngiltere | -Konut geliştirme politikası<br>-Planlama ve uygulama süreçlerinde ANT yaklaşımı |
| Palmer | 2014 | RSD3 | Konut projesi sistemlerinde sosyal ağ analizi araçları ile ağ haritalaması | ANT<br>SNA<br>Anket<br>Görüşme | Avustralya | -ANT ağ haritalaması<br>-SNA analizi araçları |
| Moor | 2019 | C&T | İşbirlikçi Bir Toplulukta Ortak Zemini Keşfetmek | ANT Ağ haritalaması | URBACT – 10 Avrupa Şehri | -Boosting Network projesi<br>-Dijital araçlar |
| Romero | 2017 | UD | Kentsel yenileme uygulamalarında iş birliğine dayalı yaklaşımlara doğru | ANT , Ağ teorileri | Brezilya | -İşbirliğine dayalı planlama<br>-Rio de Jenerio vaka çalışması |

**Tablo 3.** "Konut üretiminde ANT yaklaşımı" ile küresel ölçekte seçilen projelerin karşılaştırmalı analizi

| ÇALIŞMA ALANLARI | KARAR SÜRECİ | TASARIM SÜRECİ | UYGULAMA SÜRECİ AKTÖRLERİ |
|---|---|---|---|
| **LV 1-ÇİN** | Kırsal alanlarda yerel halkın katılımı modeli – Projenin uygulanabilirliğinin sorgulanması | Kırsal alanlarda yeniden yapılandırma ile arazi toplulaştırma yapılarak aktör ağ sistemi kurulumu | KAMU SEKTÖRÜ<br>Yerel halk–Merkezi yönetim |
| **LV 2-AVUSTRALYA** | Sosyal ağ analizi (SNA) araçları ile konut projelerinde ağ haritalama sistemi | Çok üniteli sosyal konutların üretimi ve tasarım projeleri | AKTÖR AĞ HARİTASI<br>Kilit Aktörler |
| **LV 3- İNGİLTERE** | Mahalle ölçeğinde katılımcı halk modeli<br>Yapı ölçeğinde müşteri katılımı örneği | Konut geliştirme projelerinde planlama sürecinde katılım stratejisi Müşteri tercihlerine göre yapı tasarımı projeleri | HAK SAHİPLERİ<br>Yerel halk–Merkezi yönetim |
| **LV 4- KENYA** | Kırsal alanlarda tarihsel süreçlerde aktörlerin belirlenmesi | Sosyal konut tasarımı, planlama ve uygulama projeleri | KAMU SEKTÖRÜ<br>Kanunlar- Merkezi yönetim |
| **LV 5- SIRBİSTAN** | Savaş sonrası sosyalist şehirlerde yeniden kalkınma-yapılanma programları | Sosyalizm sonrası bir mahallede kentsel kodların çözümlenmesi | KAMU SEKTÖRÜ<br>Merkezi yönetim - devlet kontrolü |
| **LV 6- 10 AVRUPA ŞEHRİ** | İşbirlikçi bir toplulukta ortak zemini keşfetmek için dijital araçların kullanılması – Boosting Network Projesi | İç içe geçmiş faktörlerin Ağ Haritalaması yöntemi ile görselleştirilmesi | HAK SAHİPLERİ<br>Yerel halk–STK lar |

**4. Sonuç**

Harvey (2006), kent çalışmalarına dair yayınlarında; kentin dolayısıyla mekânın tanımlanmasında, insan davranışlarının cereyan ettiği yerin özelliklerinin topluma yansıdığını, bununla birlikte mekânın dolayısıyla şehrin tamamlanmış / sonlanmış bir unsur olmadığını, aktörlere göre şekillendiğini ve aktörleri şekillendirdiğini vurgulamıştır. Gerçekçi (realist) araştırmacının amacı, konut olgusundaki farklılığı ve değişimi açıklamak için konut sistemlerinin gerekli ve koşullu nedensel ilişkilerini keşfetmektir.

Konut araştırmalarında ağ perspektifleri son on yılda geçerlilik kazanırken, kentsel yenileme alanlarında konut üretiminin aktör ağlarına bakan araştırmalar sınırlıdır. Aktör-ağ teorisinin (Latour, 2005) kentsel çalışmalar (Farías ve Bender, 2010) ve planlama teorisi (De Roo vd, 2012) ile ilgili alanlarda tanıtılması dikkate değerdir. Bu araştırma, ülkemizde kentsel dönüşüm alanlarında konut üretiminine katılımına aktör-ağ teorisi (ANT) perspektifinden bakmayı hedeflemektedir (Latour, 2005). Çalışma kapsamında , kentsel yenileme çalışmalarında aktör-ağ teorisinde yer alan kavramlar tanıtılarak test edilmektedir.

Bu literatür, (sosyal) ağları düzenlemede maddi ve insan dışı aktörlerin gücünü göstermektedir (Latour, 1996). ANT perspektifi, yapılı - yani maddi - ortamın yenilenmesinin nasıl organize edildiğine dair bir çalışmaya fayda sağlayabilir. Dolayısıyla konut çalışmaları, konut yenileme süreçlerinde ilişkiler ve bunların yönetimi hakkında faydalı açıklamalar sunarken (Mullins ve Bortel, 2010; Haffner ve Elsinga, 2009; Bortel ve Elsinga, 2007), yalnızca insan aktörlerin rolünü dikkate almaktadır. Ancak karmaşık ağlar, tartıştığımız gibi, hem insanlardan hem de insan olmayanlardan oluşur. Buna göre, konut yenileme çalışmasında ANT kavramlarını tanıtmak ve kentsel yenilenmesine ilişkin bir vaka incelemesinde bunları ampirik olarak test etmek önem taşımaktadır. ANT'nin konut yenileme sürecinin heterojen yollarla yapılışını anlamak için analitik potansiyelini keşfetmesi amaçlanmaktadır.

Latour'un '***planlama kavrayışı'*** bağlamında teori ve uygulama arasındaki bağlantılara yönelik Aktör Ağ Teorisi'nin kavramsal çerçevesinde incelenen kentsel dönüşüm projelerinde önemli bulgular elde edilmiştir. Bu doğrultuda, kentsel dönüşüm alanlarında mekânın yeniden üretiminde rol alan çeşitli aktörleri Ağ Analizi bağlamında tanımlamak ve aktörleri kavramsallaştırmak çalışmanın metodolojik arka planını oluşturmaktadır. Literatürdeki *küresel ve yerel ölçekte yapılan çalışmalarda*, toplumun farklı kesimlerinde yer alan aktörlerin artan katılımının anahtar rol oynadığı değişen yapılı bir çevre konusu önem kazanmaktadır. Dönüşüm alanlarında; yeni iş birliklerinin nerede mümkün ve yararlı olacağını belirlemelerine ve oluşabilecek tüm ihtiyaçlara cevap verebilecek veri görselleştirmesi oluşturulmasına yönelik ***önemli bir altlık*** oluşturacağı düşünülmektedir. Yerel halkın etkin katılımı ile kentsel dönüşüm süreçlerinde olması gereken tüm paydaşlar / aktörler arasındaki ilişkileri güçlendiren iş birliğine dayalı yaklaşımlar ile yerel yönetimler ve kent sakinleri arasında köprüler kurularak paydaşlar arasında etkileşim sağlanması büyük önem taşımaktadır.

Çalışmanın tamamlanmasıyla amaçlanan alt hedeflere orta ve uzun vadede ulaşılması öngörülmektedir. Bu bağlamda, kentsel dönüşüm projelerinde kentsel ilişkiler ağlarını anlamayı sağlayacak ağ analizlerinin görselleştirilmesi, katılımcı ve iş birliğine dayalı yenilikçi stratejilerin nasıl uygulanabileceğinin ve bunların etkileri ve etkileşimlerinin nasıl olacağının irdelenmesi, sağlıklı ve planlı bir kentsel dönüşüm süreci gerçekleştirebilmek için gerekli olduğu ve kentsel dönüşüm alanlarında konut üretiminde ***stratejik bir model*** olarak kullanılmasına katkıda bulunulacağı düşünülmektedir.

Ülkemizde ise son yıllarda yerel yönetimlerde katılımcı ve iş birliğine dayalı planlamaya yönelik çalışmaların uygulanması gerekliliği önem kazanmış ve buna yönelik stratejik eylem planları ile kalkınma planlarında konunun gerekliliğine ilişkin stratejiler geliştirilmiştir.

Konut üretiminde ANT yaklaşımı ile ilgili yayınlar incelenirken ***konut üretiminde aktörlerarası ilişkilerin önemi*** ile ilgili farkındalık düzeyi artmış, konunun ne kadar önemli ve geniş olduğu anlaşılmıştır. Bu çalışmada, konu ile ilgili güncel durumun ele alınması amaçlanmış, hangi konularla ilişkili olarak ele alındığı, değerlendirme ölçütlerinin nasıl olduğu, hangi noktalarda eksikler olduğu, gelecekteki çalışmaların ne yönde ilerleyebileceği ortaya konarak, dünya genelinde yapılmış olan çalışmaların tanıtılması ve yapılan meta analizi çalışmasının bu alanda yol gösterici olması amaçlanmıştır.

*Çalışma sonucunda;*

Aktörler arası ilişki ve katılımı teşvik edecek ***organizasyon alternatifleri*** üretilmesi,

Kentsel dönüşüm dinamikleri bağlamında, ***sürdürülebilir kentsel gelişim kriterleri*** gözetilmesi,

Merkezi ve yerel yönetimler, özel sektör, sivil toplum kuruluşları ve ***yerel halk sakinlerinin ortaklıklarının*** kurulması,

***Çok boyutlu bakış açısıyla*** konut alanlarının planlanması ve tasarlanması plancılar, mimarlar ve diğer tasarımcıların

***katılımıyla*** gerçekleştirilmesi önerilmiştir.

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# The Importance of Environmental Characteristics in Choosing a Walking Route in Cities

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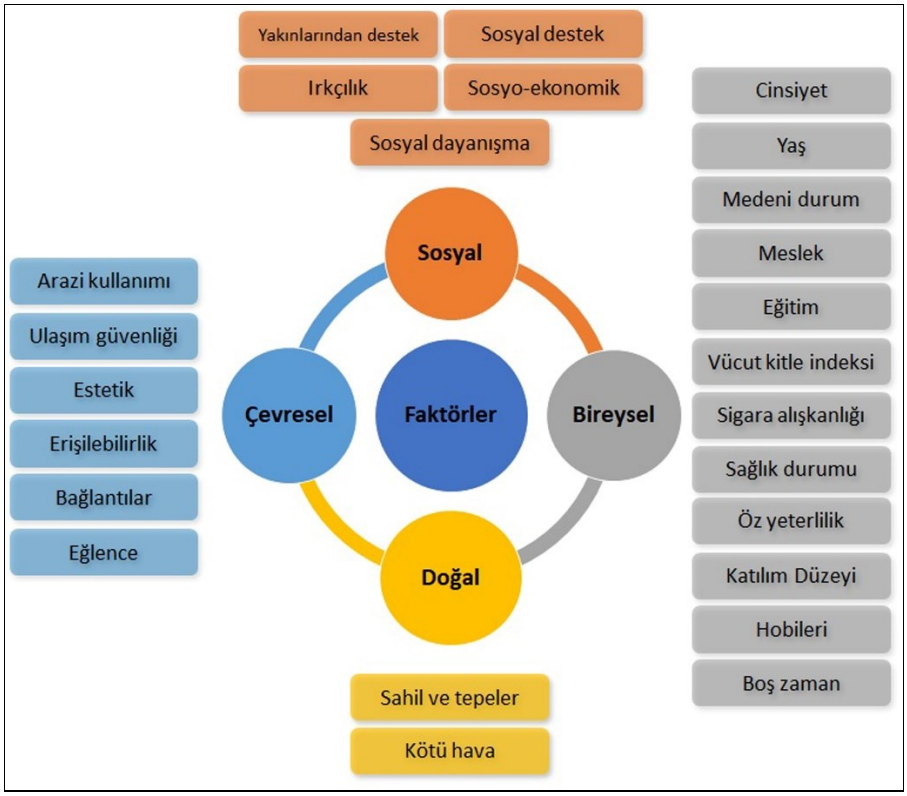
**Abstract**
The characteristics of the streets, which are defined as open urban public spaces, affect the desire and preferences of individuals to walk on the street. In this study, it was aimed to determine the characteristics of the routes preferred by individuals for walking. In the study, sample studies evaluating the importance of environmental characteristics in choosing a walking route were examined, and a survey was designed in line with the results obtained. The survey was conducted with a total of 400 adult participants residing in the Gölbaşı district of Ankara. Environmental characteristics were defined as the independent variable and the tendency to walk as the dependent variable. As a result of the cause-effect analysis, it has been determined that variables such as safety (human, animal, and vehicle), landscape density, pavements, cleanliness and care, calmness and silence, flat terrain and comfort, visual diversity, and lighting have positive and significant relationships with individuals' willingness to walk, respectively. As a result, the environmental characteristics of the routes, especially the perceived safety, the aesthetic pleasure such as landscape density, cleanliness and visual diversity, as well as the qualities such as flat terrain and pedestrian pavements that provide walking comfort, encourage individuals to walk.
**Keywords:** Walkability, Environmental characteristics, Safety, Route preference, Gölbaşı

# Kentlerde Yürüyüş Amaçlı Rota Seçiminde Çevresel Özelliklerin Önemi

**Özet**
Açık kentsel-kamusal mekân olarak tanımlanan sokakların özellikleri, bireylerin sokakta yürüme istekleri ve tercihlerini etkilemektedir. Bu çalışmada, bireylerin yürüyüş amaçlı tercih ettikleri rotaların özelliklerini belirlemek amaçlanmıştır. Çalışmada, yürüyüş amaçlı rota seçiminde çevresel niteliklerin önemini değerlendiren örnek araştırmalar incelenmiş, elde edilen sonuçlar doğrultusunda anket formu tasarlanmıştır. Anket çalışması, Ankara ili Gölbaşı ilçesinde ikamet eden toplam 400 yetişkin katılımcı ile gerçekleşmiştir. Çevresel özellikler bağımsız değişken ve yürüyüş yapma eğilimi ise bağımlı değişken olarak tanımlanmıştır. Neden-sonuç analizi neticesinde, sırasıyla güvenlik (insan, hayvan ve araç), peyzaj yoğunluğu, yaya kaldırımları, temizlik ve bakım, sakinlik ve sessizlik, düz arazi ve konfor, görsel çeşitlilik ve aydınlatma gibi değişkenlerin bireylerin yürüyüş yapma istekleri ile pozitif ve anlamlı ilişkileri olduğu tespit edilmiştir. Sonuç olarak, rotaların çevresel nitelikleri, özellikle algılanan güvenlik, peyzaj yoğunluğu, temizlik ve görsel çeşitlilik gibi estetik hoşluk ve aynı zamanda, yürüyüş konforunu sağlayan düz arazi ve yaya kaldırımları gibi nitelikler bireyleri yürüyüş yapmaya teşvik etmektedir.
**Anahtar Kelimeler:** Yürünebilirlik, Çevresel Özellikler, Güvenlik, Rota seçimi, Gölbaşı.

## 1. Giriş

Kentsel tasarım projeleri, insanların yaşam kalitesi ve memnuniyet düzeylerini yükseltme gibi amaçları içermektedir. Sokak, kentsel mekânın önemli bir parçası olarak, insanların gündelik hayatlarında sıklıkla kullandıkları bir kentsel-kamusal alandır ve bu bağlamda, yayaların hangi sokağı ve rotayı yürümek için tercih ettiklerini belirlemek, başarılı bir kentsel tasarım projesinin ortaya çıkmasına neden olmaktadır. Bu bağlamda, bir rotanın yürüyüş için ne düzeyde uygun olduğunu belirten parametre, kentsel tasarım çalışmalarında, yürünebilirlik ilkesi olarak tanımlanmaktadır. Sürdürülebilir kentsel tasarımın önemli bir bileşeni olan yürünebilirlik ilkesi, finansal, sosyal ve çevresel olmak üzere birçok faydanın sağlanmasına neden olmaktadır. Bu anlamda, bireyleri yürümeye teşvik etmek için, yürünebilir yollar ve rotaların niteliklerini ortaya çıkarmak, kentsel tasarım projeleri için önem kazanmaktadır. Yürüyüş, kentsel alanlarda önemli bir ulaşım yöntemidir ve toplu taşıma yolculuğunun gerekli bir parçası olarak bilinmektedir. Kentlerdeki güzergâh ve sokakların ne ölçüde güzel ve ilginç olduğu, dolayısıyla yürümeye davet etme potansiyelleri, o rotaların yürünebilirlik özelliği ve düzeyini yansıtmaktadır. Bu özellik çevresel nitelikler, işlevler, insanlar ve bunlar arasındaki bağlardan etkilenmektedir (Knapskog vd., 2019; Newman ve Kenworthy, 2015; Yin, 2017). Bir rotanın ne kadar yürünebilir olduğu anlayışı, öznel değerlendirme sonucunda, bireylerin algılarına göre değişmektedir (Ewing & Handy, 2009). Şekil 1'de, bireylerin yürüyüş gibi fiziksel aktivite davranışları üzerinde etkili olan faktörler açıklanmaktadır.




**Şekil 1.** Fiziksel aktiviteyi etkileyen faktörler (Wang vd., 2016)

Yürüyüş rotalarının çevresel özellikleri ve nesnel nitelikleri, bireysel algılardan bağımsız olarak, evrensel bir olgudur. Southworth'a (2005) göre, yürünebilirlik, günümüzde, çeşitli nedenlerden dolayı giderek daha fazla değer ve önem kazanmaktadır. Yaya ulaşımı sadece araç trafiğini azaltmak ve çevresel etkileri düşürmek amaçlı değil, aynı zamanda, sosyal ve rekreasyonal değere sahip bir aktivite olarak ta görülmektedir. Son yıllarda yapılan birçok araştırmaya göre, yürümenin zihinsel ve fiziksel sağlığı desteklediği ispatlanmıştır. Yaya rotalarının kalitesi, insanları araba kullanmak yerine yürümeye teşvik etmelidir. Başarılı bir yaya ağının tasarımı için altı kriter belirleyicidir: (1) bağlanabilirlik, (2) diğer ulaşım olanakları ile bağlantı, (3) arazi kullanım biçimleri, (4) güvenlik, (5) yolun görsel kalitesi ve (6) yolun durumu ve bakımı (Southworth, 2005). Cervero ve Kockelman'a (1997) göre, yürünebilirliği en çok etkileyen üç değişken tasarım, yoğunluk ve çeşitlilik olarak tanımlanmakta ve bunlar arasında, 'tasarım' faktörü en önemli etkiye sahip bulunmaktadır (Cervero ve Kockelman, 1997). Forsyth'e (2015) göre ise, sokak tasarımı, kaldırımlar, güvenli geçişler, uygun otomobil hızları, suç ve kazalardan korunma, ağaçlar ve peyzaj yoğunluğu gibi çevresel nitelikler, bireylerin yürüyüş yapma eğilimleri üzerinde olumlu etkilere sahip bulunmaktadır. Ayrıca, ulaşım ve rekreasyon amaçlı yürünebilir ortamların özellikleri bazen örtüşmekte, ancak çoğu zaman örtüşmediğini görülmektedir (Forsyth, 2015). Tablo 1'de, çevresel özelliklerin bireylerin yürüyüş eğilimleri üzerindeki etkisini araştıran örnek çalışmalara yer verilmiştir.

**Tablo 1.** Benzer çalışmalar

| Araştırmacı | Açıklama |
|---|---|
| (King vd., 2000) | Bu çalışmada, kentsel mekanlarda fiziksel aktivite ve yürüyüş yapmanın önündeki çevresel engeller, 40 yaş ve üstü 2912 kadından oluşan bir örneklem üzerinde araştırılmıştır. Çalışmanın sonucuna göre, keyifli ve estetik bir manzaranın olmaması %85,3 oranla katılımcıların kentsel mekânda yürüyüş yapma isteğini olumsuz yönde etkilediği tespit edilmiştir. |
| (Zacharias, 2001) | Literatür araştırmasından oluşan bu çalışmanın sonuçlarına göre, yerleşim düzeninin geometrik özellikleri, topoğrafya ve seviye değişiklikleri gibi faktörler, insanların karar noktalarındaki rota tercihlerini etkilemektedir. Sokağın görüş açısı ile yayaya sunulan gizem duygusu ve keşfetme motivasyonu, bireyin bilmediği rotaları tercih etmesine neden olmaktadır. |
| (Ball vd., 2001) | Bu çalışmada, çevresel estetik ve yürüyüş yapma isteği arasındaki ilişki, cinsiyet ve ayrıca, bireylerin fiziksel ve zihinsel sağlığına bağlı olarak araştırılmıştır. 3392 Avustralyalı yetişkinle yapılan araştırmada, estetik açıdan çevrelerini hoş bir ortam olarak değerlendirmeyen bireyler, diğerlerine göre, daha düşük oranla yürüyüş yapma eğiliminde olmuşlar. Sonuç olarak, algılanan çevresel estetik ve yürüyüş yapma isteği arasında pozitif bir ilişki olduğu tespit edilmiştir. |

| | |
|---|---|
| (Dalton, 2003) | Bu çalışmada, 30 katılımcının kavşaklarda rota seçimlerine ilişkin tercihleri incelenmiştir. Çalışmanın sonuçlarına göre, katılımcılar yolculukları boyunca doğrusallığı korumaya çalıştıklarından, kavşaktan açısız ve düz ilerleyen rotaları tercih etmişlerdir. Bireylerin tercih nedeni, süreklilik ve görünürlük algısı olarak yorumlanmıştır. |
| (Hodgson vd., 2004) | İnsanları yürüyüşe teşvik etme amaçlı yapılan bu çalışmada, yürüme önündeki engellere yönelik tutum ve algıları araştıran benzer çalışmalar incelenmiştir. Çalışmanın bir bölümünde yayaların rota seçimini etkileyen faktörler detaylı bir şekilde incelenmiş ve sonuç olarak, sokak estetiğinin rota seçiminde etkili olduğu tespit edilmiştir. |
| (McCormack vd., 2004) | Bu çalışmada, çevresel özellikler ve fiziksel aktivite davranışları arasındaki ilişkiyi inceleyen benzer araştırmalar gözden geçirilmiştir. Fiziksel aktiviteyi etkileyen çevresel nitelikler dört kategoride incelenmiştir: işlevsellik, güvenlik, estetik ve destinasyonlar. Sonuç olarak hem algılanan hem de nesnel olarak ölçülen çevresel faktörler ile fiziksel aktivite davranışı arasında pozitif bir ilişki olduğu tespit edilmiştir. |
| (Giles-Corti vd., 2005) | Bu çalışmada, kamusal açık mekanlar ve fiziksel aktivite arasındaki ilişki, bu mekanlara erişilebilirlik, mekanların çekiciliği ve boyutlarına göre üç model üzerinden incelenmiştir. Sonuç olarak, mekanların çekiciliği ve büyük olması yürüyüş sıklığı ve isteğiyle pozitif ilişki kurmuştur. |
| (Hoehner vd., 2005) | Bu çalışmada, "düşük-yürünebilirlik (low-walkability)" ve "yüksek-yürünebilirlik (high-walkability)" özelliğine sahip iki farklı kent seçilmiştir. Bireylerin sosyo-ekonomik durumlarına göre, yürüme alışkanlıkları incelenmiştir. 1068 yetişkin katılımcı ile yapılan anket çalışması sonucunda, algılanan çevresel özellikler ve fiziksel aktivite davranışları değerlendirilmiştir. Sonuç olarak, bireylerin yaşadıkları mahallenin çekici özellikleri, bireylerin yürüme isteklerini arttırdığı görülmüştür. |
| (Agrawal vd., 2008) | Bu çalışma, California ve Oregon'daki beş tren istasyonuna yürüyen insanların rota tercihlerini 328 katılımcı ile yapılan bir anket çalışması ile incelemiştir. Elde edilen sonuçlara göre, rota seçiminde kısa mesafe ve güvenlik gibi çevresel faktörlerin yanı sıra, rotanın estetik unsurları de etkili olmuştur. Sonuç olarak, sokaktaki bina ve peyzaj elemanlarının çekiciliği, %79 katılımcının rota tercihinde olumlu etkiye sahip olduğu tespit edilmiştir. |
| (Inoue vd., 2010) | Çalışmada, Japonların algıladıkları mahalle ortamı ile çok amaçlı yürüme eğilimleri arasındaki ilişki incelenmiştir. 1461 yetişkin katılımcı ile, mahalle ortamı ve yürüyüş alışkanlığı üzerine tasarlanan anket çalışması yapılmıştır. Sonuç olarak, katılımcıların yürüme istekleri ve mahallenin estetik ve trafik güvenliği doğrudan ilişkili olmuştur. |
| (Jia ve Fu, 2014) | Bu çalışmada, mahalle sakinleriyle 1800 anket çalışması yapılmış ve sonuç olarak, yürüyüş yollarının estetiği ve görsel kalitesi, katılımcıların yürüme eğilimleri ile önemli ölçüde pozitif korelasyon kurmuştur. |
| (Sugiyama vd., 2014) | Bu çalışmada, 12 farklı ülkeden 13745 yetişkin katılımcıdan toplanan veriler incelenmiş ve algılanan çevresel özellikler ile yetişkinlerin spor amaçlı yürüme eğilimleri arasındaki ilişki değerlendirilmiştir. Algılanan konut yoğunluğu, arazi kullanımı ve işlevsel çeşitlilik, sokak bağlantıları, estetik, suça karşı güvenlik ve parklara yakınlık gibi özellikler spor amaçlı yürüyüş ile doğrusal ilişki kurmuştur. |
| (Ferrer vd., 2015) | Bu çalışmada, Valencia'da (İspanya) yaşayan, 18 ile 65 yaş aralığında olan üç odak grup belirlenmiş ve yaşadıkları mahallenin çevresel faktörleri ile haftada en az bir kez alışveriş dışı yürüyüş yapma eğilimleri incelenmiştir. Sonuç olarak, geniş kaldırımlar, peyzaj yoğunluğu ve düşük trafik hacminin, katılımcıların yürüyüş eğilimlerini olumlu yönde etkilediği görülmüştür. |

Tablo 1'de açıklanan birçok araştırmanın sonucuna göre, yürüyüş yollarında algılanan görsel kalite ve estetik, güvenlik, kaldırım yolları, topoğrafya, arazi kullanımı, erişilebilirlik, peyzaj, trafik yoğunluğu, sokak donatıları, bakım ve binaların kalitesi gibi birçok çevresel faktör bireylerin yürüme davranışları üzerinde etkili olmuştur. Çevrenin algılanan kalitesi, bireylerin çevresel tercihlerini etkileyen ve davranışlarını şekillendiren bir unsur olarak, kentsel tasarım çalışmalarında önem arz etmektedir (Nasar, 2008). Bu çalışma, öznel değerlendirme sonucunda, yürüyüş yollarının çevresel özelliklerini belirlemeyi hedeflemektedir. Bu amaçla, literatür araştırması sonucunda, anket formu tasarlanmıştır. Anket çalışması, Ankara ili Gölbaşı ilçesinde ikamet eden toplam 400 yetişkin katılımcı ile gerçekleşmiştir. Elde edilen veriler ışığında, katılımcıların yürüyüş yapma eğilimleri üzerinde etkisi olan çevresel özellikler, önem sırasına göre açıklanmıştır.

## 2. Materyal ve Yöntem

Bu çalışmada, bireylerin spor amaçlı yürüyüş yapma isteklerini etkileyen çevresel özelliklerin belirlenmesi amaçlanmıştır. Çalışmada, literatür taraması sonucunda, benzer araştırmalar incelenmiş ve elde edilen sonuçlar doğrultusunda, anket formu tasarlanmıştır. Anket formunda, bireylerin spor amaçlı yürüyüş yapma eğilimlerinde etkili olan çevresel özellikler sorgulanmıştır. Çevresel özellikler bağımsız değişkenler ve yürüyüş yapma eğilimi ise bağımlı değişken olarak tanımlanmıştır. Elde edilen veriler SPSS programında analiz edilmiş ve neden-sonuç ilişkisi incelenmiştir.

### 2.1. Alan Çalışması

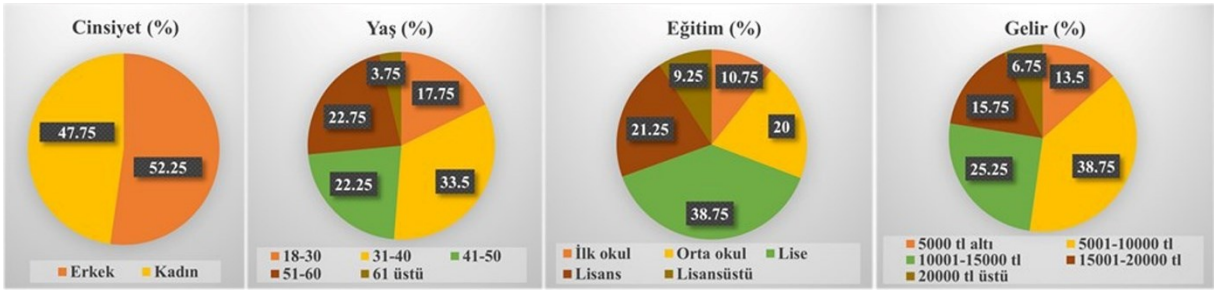
Anket çalışması, Ankara'nın Gölbaşı ilçesine bağlı, Kızılcaşar mahallesinde yaşayan toplam 400 katılımcı ile gerçekleşmiştir. Alan incelemesi sonucunda, bu semtin mahalle ölçeğinde tasarlanmış olmasına rağmen, yaya

yürüyüş yollarının yetersiz olduğu, yürünebilirlik ilkesi açısından kullanıcılara hitap etmediği ve konforlu bir yürüyüş ortamı sağlamadığı tespit edilmiştir. Gözlemlenen bu problem neticesinde, bu mahallede yaşayan sakinler ile öznel bir araştırma çerçevesi tasarlanmıştır. Araştırma kapsamına alınan semtin, hava fotoğrafı ve yürüyüş rotalarına ait bazı resimleri Şekil 2'de verilmektedir.




**Şekil 2.** Hava fotoğrafı ve resimler

Anket çalışması 18 yaş üstü erkek ve kadın katılımcılardan oluşan toplam 400 kişi ile yüz yüze gerçekleşmiştir. Katılımcıların demografik özellikleri Şekil 3'de verilmektedir.




**Şekil 3.** Demografik özellikler

Anket çalışmasına katılanların %47,75'i yetişkin kadın ve %52,25'i yetişkin erkeklerden oluşmakta, yaş ortalaması ise 35,70 olarak hesaplanmaktadır. Katılımcıların eğitim seviyeleri en yüksek %38,75 oranla lise ve en düşük %9,25 oranla lisansüstü olarak tespit edilmiştir. Gelir düzeyleri ise, %13,5 oranla 5000 TL ve altı, %38,75 oranla 5001-10000 TL aralığında, %25,25 oranla 10001-15000 TL aralığında, %15,75 oranla 15001-20000 TL aralığında ve %6,75 oranla 20000 TL üstü olarak belirlenmiştir.

**3. Bulgular**

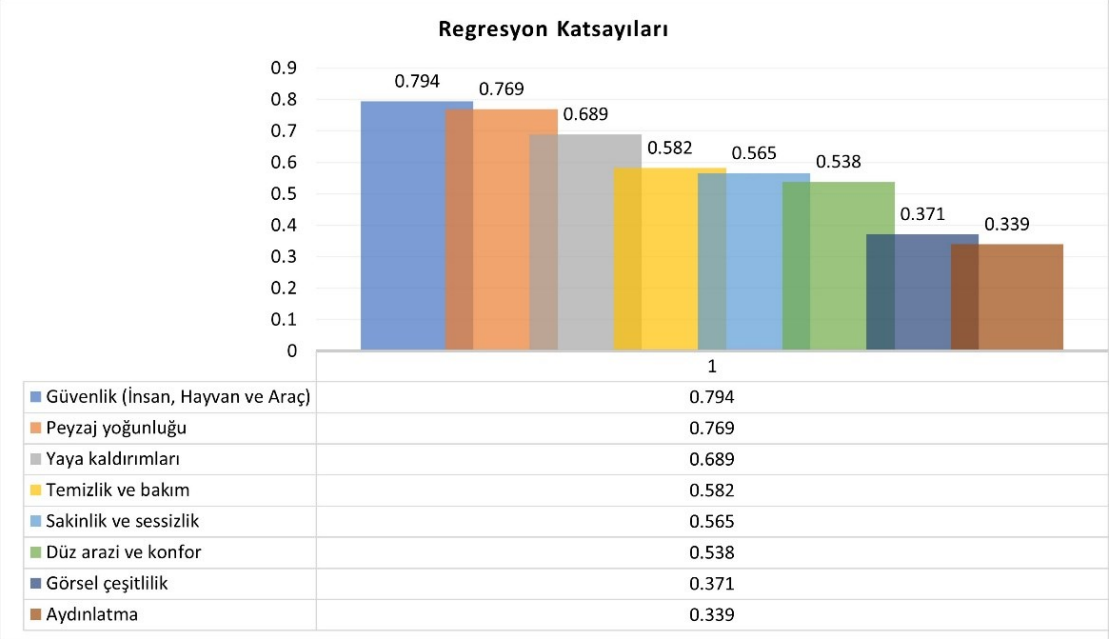
Çalışmanın bu aşamasında, anket sorularından elde edilen veriler değerlendirilmiş ve analiz edilmiştir. Anket çalışmasındaki sorular, bağımlı ve bağımsız değişken kapsamında, Tablo 2'deki gibi tanımlanmıştır.

**Tablo 2.** Bağımlı ve bağımsız değişkenler

| **Anket Soruları** | |
|---|---|
| Bağımlı değişken | Mahallenizde ortalama ayda kaç kere spor amaçlı yürüyüş yapıyorsunuz? |
| Bağımsız değişken | Mahallenizde spor amaçlı yürüyüş için tercih ettiğiniz rotaların çevresel özelliklerini puanlayınız. |

| | |
|---|---|
| | (1: En kötü, 7: En iyi).<br>1. Peyzaj yoğunluğu<br>2. Peyzaj çeşitliliği<br>3. Görsel çeşitlilik<br>4. İşlevsel çeşitlilik<br>5. Aydınlatma<br>6. Sakinlik ve sessizlik<br>7. Güvenlik (İnsan, Hayvan ve Araç)<br>8. Yaya kaldırımları<br>9. Düz arazi ve konfor<br>10. Açık yeşil alanların yeterliliği<br>11. Açık yeşil alanların erişilebilirliği<br>12. Yürüyüş yollarının uzunluğu<br>13. Yürüyüş yollarının genişliği<br>14. Temizlik ve bakım<br>15. Sokak mobilyaları<br>16. Bina cephelerinin estetiği<br>17. Sosyalleşme olanakları |

Anket çalışmasından elde edilen verilerin güvenirlik analizi yapıldıktan sonra, verilerin normal dağılımları ve varyansların homojenliği incelenmiştir. Daha sonra, çoklu-regresyon analizi yapılmış ve tahmin edilen modelin $R^2$ değeri 0,73 olarak hesaplanmıştır. Bu değer, modelin anlamlı ve yorumlanabilir olduğu göstermektedir. Bağımlı değişken üzerinde istatistiki olarak anlamlı bir etkiye sahip olan bağımsız değişkenlerin katsayıları P<0,05 anlamlılık düzeyinde yorumlanmıştır. Şekil 4, P<0,05 düzeyinde anlamlı bulunan regresyon katsayılarını göstermektedir.




**Şekil 4.** Katsayılar

Şekil 4'te görüldüğü üzere, "Güvenlik", "Peyzaj yoğunluğu" ve "Yaya kaldırım yolları" nın yeterliliği sırasıyla ilk üç önemli değişken olarak, bireylerin yürüyüş yapma eğilimlerini olumlu yönde etkilediği tespit edilmiştir. Diğer değişkenler ise, sırasıyla "Temizlik ve bakım", "Sakinlik ve sessizlik", "Düz arazi ve konfor", "Görsel çeşitlilik" ve "Aydınlatma" olarak yürüyüş eğilimi üzerinde olumlu etkiye sahip olmuştur.

**4. Tartışma**

Kentsel alanlarda ve sokaklarda, yeşillik, ağaç ve peyzajın geliştirilmesi, insan, hayvan ve araç trafiğinden korunan güvenli ortamların sağlanması, uygun yol ve kaldırımların yapılması, geometrik ve topoğrafik düzenlemeler ile konforlu yürüyüş yollarının sunulması, bakımlı ve estetik olarak yüksek görsel kaliteye sahip rotaların tasarlanması bireyleri yürümeye teşvik eden çevresel özellikler olarak tanımlanabilmektedir. Yürüyüş etkinliklerini arttırmak

amaçlı, yürümeye teşvik eden ortamlar ve rotaların özelliklerinin belirlenmesi, sürdürülebilir kentsel tasarım çalışmaları için önemli konular arasında yer almaktadır. Ancak, bireylerin yürüyüş gibi fiziksel aktivite davranışları birçok faktörden etkilenmektedir (Şekil 1'e bakınız). Bu çalışmada, sadece çevresel özelliklerin nitelikleri sistematik bir yöntem ile tanımlı bir alan üzerinden ortaya konulmuştur. Ancak, bireysel özelliklerin yürüme eğilimleri üzerindeki rolü göz ardı edilmeyecek kadar önemlidir. Bu bağlamda, bireylerin cinsiyet, yaş, eğitim ve gelir düzeyleri gibi niteliklerin fiziksel aktiviteler üzerindeki etkisini araştırmak, yürünebilirlik ile ilgili yapılan çalışmaların tutarlığını ve önemini arttıracağı düşünülmektedir.

**5. Sonuç**

Son yıllarda, kentsel tasarım araştırmalarında, yürünebilirlik kavramının açıklanması ve yürünebilir rotaların özelliklerinin belirlenmesi, önemli kentsel çalışmalar arasında yer almaktadır. Yürünebilirlik olgusunda, her ne kadar bireysel özellikler önemli olsa da büyük ölçüde çevresel özelliklerin etkisi yürünebilir ortamların niteliğinin tanımlanmasında belirleyici rol oynamaktadır. Bu çevresel özellikler, çeşitli araştırmacılar tarafından farklı biçimlerde tanımlanmıştır. Bu araştırmalar, obezite krizinden trafik sıkışıklığına, çevresel adaletsizlikten sosyal izolasyona kadar sayısız soruna çözüm bulmayı amaç edinmişler. Sonuç olarak, yürünebilir ortamlar yaratmak ve yürünebilirliği geliştirmek, birçok kentsel ve sosyal sorunun çözülmesine yardımcı olacağı düşünülmektedir. Forsyth'e (2015) göre, güvenlik, yürünebilir rotaların diğer özellikleriyle yakından ilgili bulunmakta ve güvenliğin eksikliği yürümenin önündeki en önemli engellerden birisidir. Trafik güvenliği kadar insanlardan korunma isteği de yürüyüş yollarının güvenliği kapsamında geçerlidir (Forsyth, 2015). Ancak, yürünebilir bir rota, güvenli olmaktan daha fazlasını gerektirir. Ağaçlar ve yeşil tamponlar, geniş ve bakımlı kaldırımlar, yaya odaklı altyapı ve yaya ölçekli tasarımlar, aydınlatma ve yön bulma tabelaları gibi olanaklar yürünebilir rotaların özellikleri arasında tanımlanabilmektedir(Al-Hagla, 2009). Dolayısıyla, fiziksel çevrenin özellikleri, çok sayıda insanın fiziksel davranışlarını etkileme potansiyeline sahiptir ve yürümeye teşvik edici ortamlar yaratmak, fiziksel aktiviteyi artırmaya yardımcı olmaktadır. Bu çalışmada, bireylerin yürüyüş eğilimleri ve spor amaçlı yürüyüş için tercih ettikleri rotaların özelliklerinin belirlenmesi amaçlanmıştır. Çalışmada, literatür araştırması sonucunda, yürünebilir yolların özellikleri tanımlanmış ve bu kapsamda, anket formu hazırlanmıştır. Anket çalışması, Ankara-Gölbaşı ilçesine bağlı Kızılcaşar mahallesinde yaşayan yetişkin mahalle sakinleri ile gerçekleşmiştir. Yürüyüş için tercih edilen rotaların çevresel özellikleri bağımsız deşişken ve yürüyüş eğilimleri bağımlı değişken olarak tanımlanmış ve çoklu regresyon analizi yapılmıştır. Analiz sonucuna göre, sırayla, "güvenlik", "peyzaj yoğunluğu", "yaya kaldırım yolları" nın yeterliliği, "temizlik ve bakım", "sakinlik ve sessizlik", "düz arazi ve konfor", "görsel çeşitlilik" ve "aydınlatma" gibi çevresel özelliklerin yürüyüş eğilimi üzerinde olumlu etkisi olduğu tespit edilmiştir. Sonuç olarak, mahalle ölçeğinde bireyleri yürüyüş yapmaya teşvik etmek için, yolların insan, hayvan ve araç gibi olası tehlikelerden güvende olması, sakinlik, düz topoğrafya ve kaldırımlar gibi yürüyüş konforunun sunulması ve ayrıca, peyzaj, bakım ve görsel çeşitlilik gibi estetik hoşluğun sağlanması bireyleri yürümeye teşvik eden önemli çevresel özellikler arasında yer almaktadır.

**Çıkar Çatışması**

Yazar herhangi bir çıkar çatışması beyan etmemektedir.

**Kaynakça**

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# BOOK OF ABSTRACTS
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## **SESSION C**: Heritage and Cultural Landscapes

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# The role of Structure and Structural Analysis in Adaptive Reuse of Zahir-ol-Islam Historical House in Tehran, Iran

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**Abstract**
Adaptive reuse of historic buildings is a way of conservation provided for the rehabilitation of historic cities. It helps to revive the heritage value and the integrity of buildings' compatibility with the contemporary needs of the community. Through this process, historic buildings will renew their physical characteristics to adopt new functionality. Therefore, the necessity of analysis and evaluation of building" statements shows the essential practices that need to be taken to confirm new uses for the buildings. This study aims to investigate the structure of the Zahir-of-Islam historic house to initiate the adaptive reuse project through an analytical study of structure and fabric. Using qualitative research methodology, this study concludes that the structure of the historic house of Zahir-ol-Islam can be reused with multifunctional, cultural new services to be rehabilitated.
**Keywords:** Zahir-ol-Islam Historic House; Adaptive reuse; Structure of heritage buildings; Structural analysis.

## 1 Introduction

Iranian cities' historical and cultural fabrics and centres are fraught with valued buildings that confront erosion and decline because of ignorance. Rehabilitation of historical buildings that have lost their original functions and remain as a solid fabric with new uses will help create a bond between past inheritances and reduce ancient experiences (Fakhaari Tehrani et al., 1993). Considering the immense changes in communities, the construction and design methods should be upgraded alternately to meet the modern requirements of society. Therefore, heritage buildings are necessary to be rehabilitated in the new era since they are a symptom of the past. Hence, they must be conserved instead of demolished to be the manifestation of a nation's ancestors and cultural lives. Also, conserving historic buildings and granting new uses according to their location, dimension, and possibilities cause a better understanding for future generations (Misirlisoy & Gunce, 2016, Al-Dujaili & Amen, 2018, Aziz Amen & Kuzovic, 2018). Nowadays, the conservation of historic buildings and structures has been altered from mere preservation to conservation and has been retained as a comprehensive urban regeneration and sustainability strategy. In this case, most cultural heritage professionals believe that adaptive reuse made a solid strategy to control the change in urban environments. In these circumstances, adaptive reuse of a heritage building is a challenging process since the heritage values, physical characteristics, and potentials of the heritage building should be well analyzed holistically (Günce & Mısırlısoy, 2014). Having an entirely free hand in the election and deciding on a new function of the historic structure is one of the main challenges in adaptive reuse projects without a deep and holistic review of and building's structural condition. Thereby, the determination of the new function would be based on scientific and analysis methods, which consider the best strategy for adaptive reuse projects. Nonetheless, after a while, the historic building would become impracticable in case of social and economic issues, or the new use will destroy the authenticity of the heritage.

## 2 Material and Methods

Structural analysis of architectural buildings, specifically the historic buildings with a heritage significance, needs to be carried out in qualitative and quantitative methods during research. While an expert in structural engineering might be a more suitable option to measure the quantity of pressure and forces a structure load, conservator professionals can better understand the loads transferred to the earth. This paper studies the adaptive reuse process of the Zahir-ol-Islam historical house in two phases. In the first part, the study is devoted to investigating the role of structure through analytical studies of heritage buildings to reuse them with contemporary functionality. For this purpose, studies emphasize structural challenges faced in adaptive reuse projects and consider complained theoretical framework adapted from Clark's (2008) research. During this phase, necessary challenges in assessing structural analysis have been acknowledged. Later, the result of the investigation in the former part was used in the case study, Zahir-ol-Islam historic house. Here, after a holistic recognition of the building through a field survey,

other assessments such as reconsideration of the structure and fabric of the building, analysis of the static loads, and tangible damages to the building have been considered to proceed with the adaptive reuse project.

**3 Adaptive Reuse of Historic Buildings**

Sensitive people about heritage buildings prefer to restore historic structures and retrieve their original glory and condition in the past. However, the costs of renovation practices mostly lead to vain, and Buildings' planning and design processes may seem redundant for various reasons, such as changing economic and industrial practices, demographic shifts, and increasing cost of upkeep or maintenance (Orbaslı, 2008; Aziz Amen, 2022). Despite this reason, there is a need for new preservation, renovation, and adaptation strategies for the cultural heritage with its broad physical, diverse, and intangible components. In order to preserve cultural heritage, the Council of Europe has proposed that new uses be provided for protected buildings so that they can be adapted to meet modern-day needs in terms of living. Hence, an adaptation of old buildings for new uses and an integration of protection requirements with the requirement of economic, social, and cultural activities of modern times are essential. The replaced concept for this plan is an adaptive reuse of heritage buildings (Girginkaya Akdağ & Sayar, 2020:38). Adaptive reuse is a process in which appropriate historic buildings condition for new considered function. It also helps heritage buildings to retain and conserve their historical integrity while responding to modern necessities for contemporary inhabitants. In this situation, if the building stock's life is more prolonged than sustains its function, adaptive reuse with a new function is inevitable. However, the proposed new use must be appropriate in preserving the historic fabric's cultural significance. Thereby, when heritage buildings are adapted for different functions, the new use and the interventions should maintain the originality and architectural character of the building to not give wrong or missing information for the further generations (Misirlisoy &Gunce. 2016).

Orbasli (2009) defines adaptive reuse as an activity which, with change in structure and physical fabric of heritage building and adapting new contemporary use for it, cause to retain building's heritage values. The adoption can consist of; originating new services or functions or a set of changes that occurred in a building or a structure or historic ensembles to safeguard and preserve it. To be more precise, suitable adoption is an activity sympathetic to a historic building and its context with a new use that reinforces the structure with recent changes and adds a layer to valuable layers of the building (Orbasli, 2009; Ghasemi & Ozay, 2018). In this regard, adaptive reuse may help communities, governments, and developers in the quest to reduce the environmental, social, and economic costs of continued urban development and expansion (Ball, 1999; Wilkinson and Redd, 2008; Bullen and Love; 2009). Also, adaptive reuse can transform heritage buildings into accessible and valuable places as well as provide the added benefit of regenerating an area in a sustainable manner. This practice of conservation involves converting a building to undertake a use change required by new or existing owners (Latham, 200; Minkinson et al.; 2009). Although, the new use adaptation requires refurbishment and/or complete renovation of existing buildings or structures. Next, changes to facilities can involve major internal space organization and service upgrades or replacements. Alternatively, adaptive reuse may require minor restoration works where nothing changes except the building's function. When adaptive reuse is applied to heritage buildings, it retains the structure and conserves the original builders' effort, skill, and dedication (Love and Bullen, 2009). Adaptive reuse also conserves the architectural, social, cultural, and historical values (Latham, 2000). All in all, the practical outcomes of adaptive reuse and the conceptual importance of conservation support the reuse of heritage buildings as a sustainable strategy. Cooper (2001) suggests that the effects of adaptive reuse include improvements in material and resource efficiency (environmental sustainability), cost reductions (economic sustainability), and retention (social sustainability) (Bullen & Love, 2011).

During an adaptive reuse project, the condition of the historical pattern must first be assessed, and a conservation plan must be coordinated with a management plan (Yıldırım, 2012). Adaptive reuse is a complex process that requires participants to clearly understand how to determine the most appropriate future for the building in a particular location and time (Kincaid, 2002). It can also transform heritage buildings into accessible and useable places and provide the added benefit of regenerating an area in a sustainable manner (Bullen & Love, 2011). Therefore, rather than replacing buildings, reuse is generally the most resource-effective strategy to provide accommodation, especially if a conservation strategy is incorporated into the design (Ball, 1999; Douglas, 2002). The most successful adaptive reuse projects respect the heritage significance of the building and preserve it since this project adds new valued layers in the current condition and transfers new values to future generations (Hein &others, 2008). In order to implement a reuse project for historic buildings, Fuentes (2010) proposed a method with six successive steps. This method is universal and can apply to different types of buildings, from historic industrial buildings to social, residential, etc. (Figure 1). In this diagram, an assessment of the structural condition and physical maintenance of a historic building is placed as the first step in "Preliminary Studies" to initiate an adaptive reuse project (Hussein, 2017: 26).

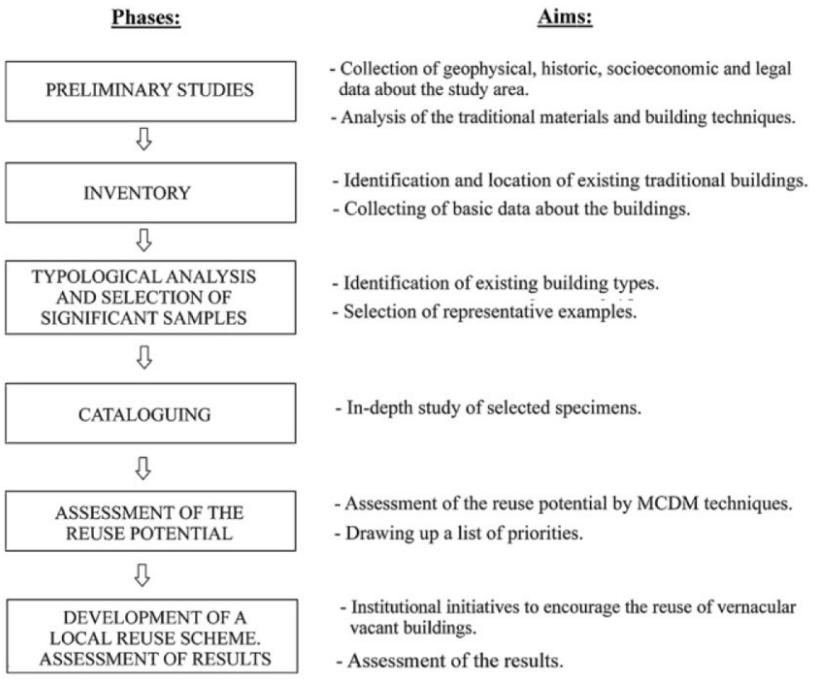


**Figure 1.** Process of documenting Adaptive reuse process for historic buildings, Source: Hussain, 2017.

**3.1 Adaptive Reuse of Building Challenges and Opportunities**

Understanding the cultural significance of a place is one of the worldwide admitted principles of heritage conservation. According to the Burra Charter (1996), to understand the cultural value of a heritage place, that place should have an adaptive use with its structure and physics. Hence, adopted functions should respond to the modern community's needs as well as maintain its cultural significance with the help of minor changes in valued structures, details, and historical place settings (ICOMOS, 1996). The result is only available with historical and structural analysis of the building. Therefore, adaptive reuse does not mean conformity with strict conservation regulations; instead, it involves extensive solutions after revealing accurate analysis, evaluation, and consistent heritage interpretation in planning challenges of the design process.

Using a historic structure or a heritage building fabric helps reduce the building's rubbish; material and man work as much as possible. Also, it helps to maintain and conserve the structural integrity and structure of the building, leading to the survival of its historical values and meanings. Thus, it helps create environmental, economic, and social sustainability in rehabilitating historic buildings and cities. While the general essence of adaptive reuse projects since they need to be confirmed with the existing structure and the necessity of conserving them, most often, these actions are more costly than destroying and rebuilding processes (Old Buildings, New uses, 2005).

One of the most critical determinations of reuse success is the structural integrity of the building. Any adaptive reuse or change in the use of a building requires a proactive look at the structure. In this case, how a building or conservator responds to the following questions straightforward the needed treatments in adaptive reuse projects:

- Will the structure experience new loads?
- Are structural modifications necessary?
- Will there be new openings and penetrations?
- What is the impact of mechanical systems, and will they force any structural changes?

Many historic buildings are designed to respond to the construction standards. Structural analysis of building materials should be completed; hence the indicators and measures confirm the minimum safety obligations in changing the function of buildings. During the adaptive reuse process, the internal space of the building is most often built from the beginning and replaced with new materials and suitable design with new function necessities. New openings on the floor, additional load bearings, and general changes in the building are prevalent. Usually, supportive, innovative solutions are necessary for continuous changes even during the project (Clarck, 2008).

According to the restoration codes and regulations, construction building standard methods are likewise utilizing temporary structures and contemporary attachments to the historic building such as handicap accesses, mechanical system installations for heat, lighting devices, etc. Besides structural challenges like evaluating foundation strength, prospering and diminishing historic building's foundation, and transformation in skeleton includes structure repairer, conservation or reconstruction of enveloping systems. These challenges are the main issues contractors confront within the adaptive reuse process (Adaptive reuse of historic structures, 2014).

As an example, in adaptive reuse projects, in envelop system of a building (including roof, windows, doors, upper and lower load-bearing walls), there are just some particular elements that can be replaced entirely, stabilized, conserved, or restored. In many cases, they cannot be seen in a project or participate unless they have significant damages or ruin. The deterioration of fallen elements or their injuries can cause many costs during construction. Yet, heritage buildings have unsafe conditions (Clarck, 2008). Design experts should do a holistic assessment and analysis of building fabric to determine an exact recipe for adopting covering components of the building. Fundamental principles in evaluating the structure encompass a useful building lifetime and ingrained value than anticipated for any construction element, preserving historical systems and components, and authenticated requirements. These principles of time duration considered by the owner for conservation of building are instances that influence structure condition (ibid). In addition to the building envelope, one main aim of a successful adaptive reuse project is to maintain structural and historical integrity. Every adaptive reuse project or alteration in building function requires an active view of a structure. Therefore, the foundation should be studied and considered for evaluating the possibilities and strength of bearing new loads. Temporary structures should also help sustain the building and surrounding buildings during reconstruction. Renewing plumbing, plumber system, ventilation system, and HVAC, lightening and communication systems require complex and delicate operations in historic buildings" existing crust and skeleton (Adaptive reuse of historic structures, 2014).

**4 Case Study: The Zahir-ol-Islam Historic House**

The historical house of Zahir-ol-Islam is located on the corner of Shahid Ghaedi Street (former Hedayat St.), at an intersection that adopted the house's name crossroad in Tehran city. This house is a palace built during the Qajar period, and its architecture combines Iranian and Foreigner styles with adorable plasterwork. In the early maps of Tehran, the house was located near the first-built connecting network of roads within the borders of the historic city of Tehran. During the Naser Shah Qajar period, this building was located beside the northeast defensive- the wall of Tehran in the middle of city gardens. Nowadays, this house is within the historic fabric of Tehran, which connects current Jomhouri Street and Baharestan Square. So, this house has an excellent location in the city.



**Figure 2.** Location of Zahir-ol-Islam traditional house in 1956 aerial photography; Source: Cartography institution of Iran



**Figure 3.** Location of Zahir-ol-Islam traditional house in 2016 aerial photography; Source: Google Earth

There are two separate narratives about the owner. First, it is believed that this house belonged to the '"Seyed Zein-ol-Abedi" Friday pray header known as "Zahir-ol-Isla", Naser-Eldin-Shah's son in law. The other narrative relates its ownership to the army commander, Vali Khan Tonekabon". Thereby, this place has historical, political, social, and authenticity value since it is a house related to one of the constitutionalist leaders. As an example of the Qajar period, residential houses show palaces' transmission and composition with European architecture and its location. Nowadays, this building has been listed as "Zahir-ol-Islam House" in the National Iran list of heritages in Aug,13,2013, with the number 31096 (Domehri, 1391).

Studies show that this building has no inscriptions or plates, determining the construction time. Still, regarding the composition of traditional and European architecture with the existing gable roof in this house, this building belongs to the late years of the Naser-Eldin-Shahs government period. This house has a demonstrative design, and all the places gather around the central salon of the building. Thus, this building had a big yard and a nice basin that had originated from one of Tehran's Qanats. Nowadays, just a part of the yard exists, and the bay has been demolished. In this building with a brick and plaster façade, all rooms look like a fabulous garden long ago. For its decorations, its façade has been ornamented with ample light and shade and colour differences in brick redness and plaster whiteness.



**Figure 4.** Current situation of Zahir-ol-Islam historic house; Source: Authors

Eskandar Mokhtari, analyzing the architectural styles of eight traditional houses in Tehran, notes the evaluation of Iranian architecture in the Qajar Period in two separate sections the first section, he notes this evaluation related to historical experiments in traditional architecture and its domination of structure sustainability and various forms that promoted and gained perfection. In the latter one, he described it as a gradual bias toward the European lifestyle as well as gradual exclusion against national knowledge in architecture practices and constructions. Also, he addressed the Zahir-ol-Islam historic house as a sample of the latter group, which is related to after the Mashrootiat revolution time. Furthermore, he admitted that the house's architecture resulted from conformity with the European cultural lifestyle, as illustrated in conjunction with the Andaroni and Birooni parts of the building in an integrated place (Hariri &others, 1394).
After all, this house consists of a yard, kitchen and two baths, a cellar and a dining room on the basement floor as Andaroni (Interior Part of the house) and living rooms, bedrooms, and a central place on the ground floor as Birooni (Exterior part of traditional houses in traditional Iranian architecture). Profited decorations in this building include Muslim design paintings on plaster context, plaster works on interior walls and some parts of the roof, and the use of brick in alabaster and faced of the yard and basement plinths of the house.

**5 Analyse and assessment of Architectural structure of Zahir-ol-Islam House**

During surveys, it has been acknowledged that the Zahir-ol-Islam building has three different structural systems to bear the forces building is confronted. The statical and structural analyses show that this building consists of three structural systems with various but symmetrical stability and bearing capabilities. On each level of this house, there is a unique structure. Like other houses, in the Zahir-ol-Islam traditional house, the Foundations are isolated and consist of rough stones like limestone. The structural system on the basement floor is a composition of vaults and groin with sun-dried bricks. In this level, the downcoming force and load from upper classes and lateral troops have been supported by a quadripartite vault (Taq Chahar Bakshi in Persian) in the central extent room with the help of four columns in for corner and load-bearing walls in the middle of cues. Imported forces in crossing spaces in basement floor, e.g., corridors, granaries, and cellars since of geometrical shape of the room has been covered with barrel-vaults and then with the aid of two side load-bearing walls this load transferred to the foundation and then to earth (Fig 4, second phase of structural system of building).
On the ground floor, the roof covering this level is a wooden beam and pale restrained in each other. A part of the imposed forces and loads are supported by leaning on four wooden columns in four corners of the central place other has been beard by load-bearing walls with masonry, brick, and plaster materials in for a side of the main room led to four separate parts of the house and transmit them to underline structure system. Since it uses material, this structural system has less weight than the basement floor and thus has more freedom to organize the spaces on ground level. It causes us to experience various unique structures at this level. The ground floor openings have been locked with the aid of wooden lintels between bricks and, namely, transfer coming bears to lateral elements and materials of the house (Fig 4, Seventh phase of structural system of building).
The trusses have been settled on the first floor and under the gable roof to construct the envelope skeleton. This section shows a collection of wooden trusses and columns responsible for transferring the loads and imposition forces to lower levels of the building structure. This level's structural system has the minimum weight among other groups and settles in the maximum height (Fig 4, Eighth phase of structural design of building). Generally, the structural system in this house in the primary and older sections is in a hierarchical order that from top to bottom, the load bears rise. The structure has become heavier and more massive, thus strengthening the bear load-supporting systems (Fig 6). Also, this composition with various structural systems allows more optimal exceptional accumulation in the building.
We have faced and attached part of the building in the structural analysis. These attachments that relate to a few decades after the initial construction of a building are on the north and south sides. The extensions are structurally self-independent and do not import any additional load to the original structure of the building. These attachments are on the ground level and settled on the earth; they transfer their loads directly underground. The south side roof of the extensions is a barrel vault, and the iron beam fixed on the lateral load-bearing walls of the North building here attachments is also a stair complex that associates the north façade of the ground floor to the ground and shapes the main entrance of the building in the attachments period.

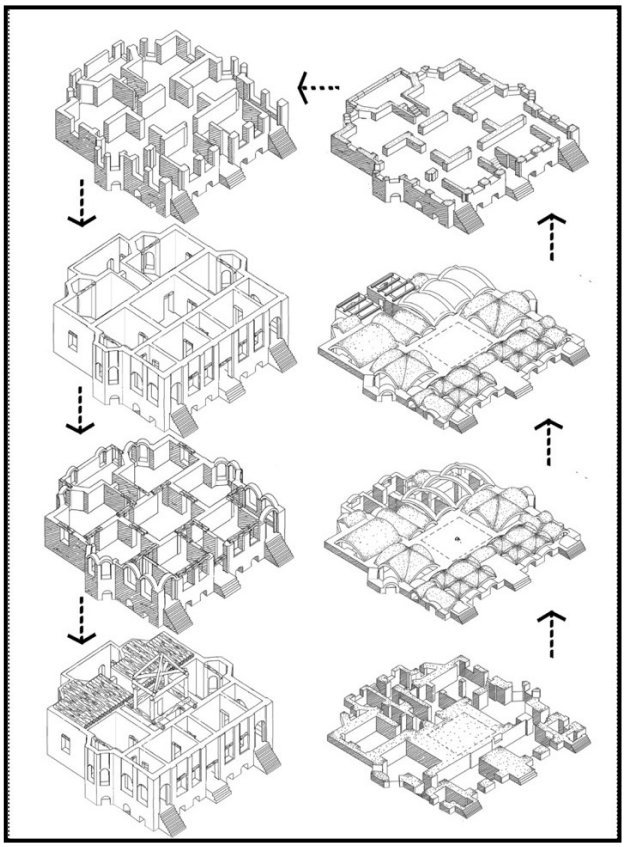

**Figure 5.** structural analysis procedure in Zahir-ol-Islam historic house from basement to roof; Source: Authors

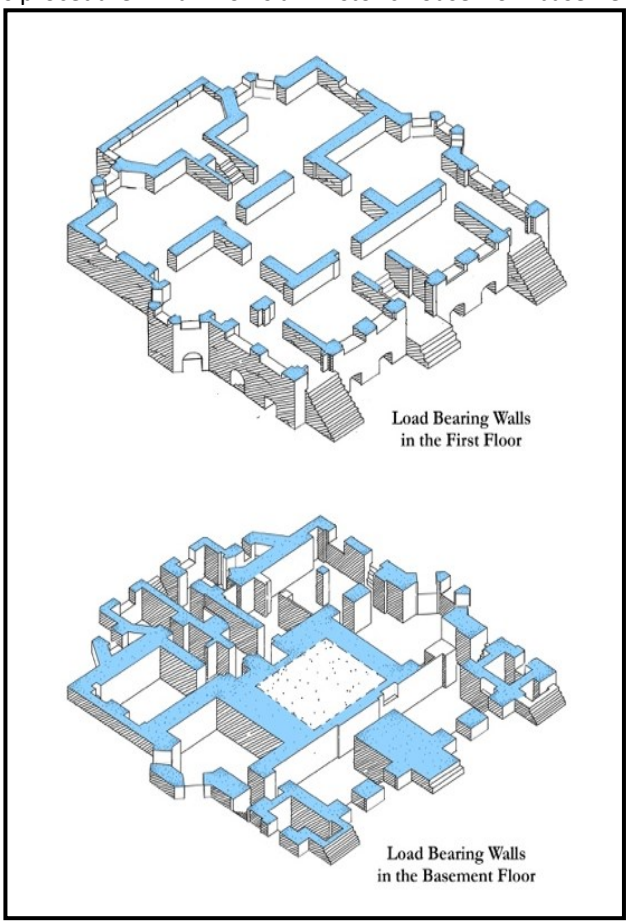


**Figure 6.** Load bearing and non-load-bearing walls in basement and ground levels; Source: Authors

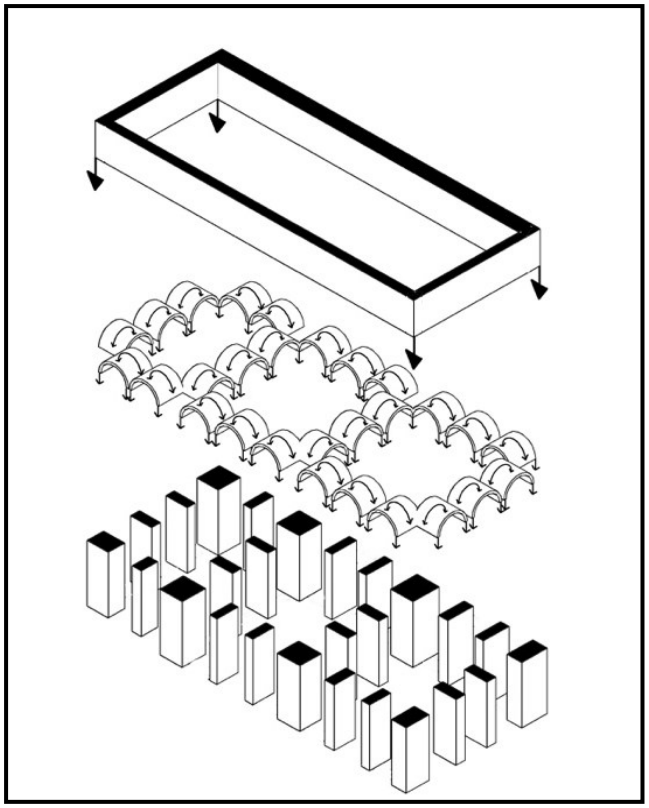

**Figure 7.** Hierarchical order in the transformation of forces in Zahir-ol-Islam house; Source: Authors

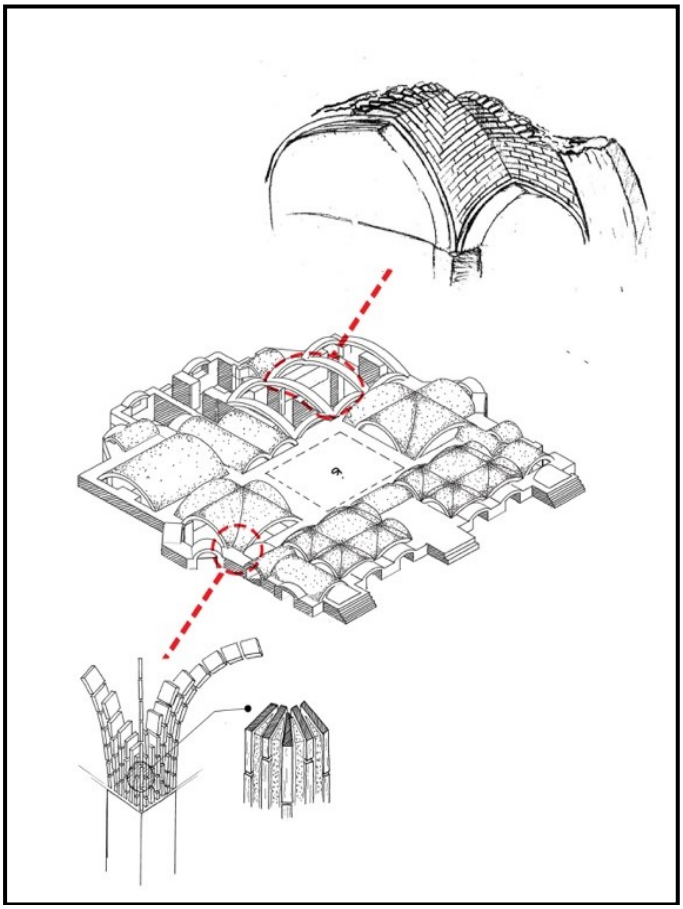

**Figure 8.** The junction of enveloping and load-bearing walls in basement level; Source: Authors

**5.1 Evaluation of Structural System of the Zahir-ol-Islam House**

Structural deficits in the Zahir-ol-Islam house constructed with brick, wood, stone, and other masonry materials are included:

- Incomplete load transferring path because of injured materials in roof and walls.
- Unsuitable shear strength of the building.
- Disability of building in maintaining the integrity during the trembling caused by an earthquake and various pollutions.
- Negation of secondary auxiliary system, e.g., systematic horizontal and vertical filature.
- Disorder in the plan after attachments; plan assessment before extensions shows that there are two symmetrical axes in the building, and their intersection is in central space.
- The absence of a suitable foundation to bear the whole loads, considering the construction of the Zahir-ol-Islam isolated foundation, shows that one of the significant damages is a result of unequal subsidence of the building.

In the historic buildings during the construction process, architects rely on their experimental acknowledgements in confronting earthquake distractive forces, as we can call it in a most traditional building. There is no tenacious system between foundation and diaphragms against lateral loads that could transfer earthquake loads from levels to earth. Also, in the case study building, the lateral load-bearing system could not sustain against additional load. Thus, we need to design a new lateral load-bearing system for the house. Regarding the shear strength evaluation of the building, the entire cross-section of walls on each level and along each linear and transversal extension is lower than standard dimensions.

Hence, the fabric of the Zahir-ol-Islam house, especially in the load-bearing and non-bearing walls, crushed mortals, and bricks, are off the wall. Therefore, the load-bearing strength of the elements diminished some tracks can be seen in the building, and therefore many load paths are incomplete.



**Figure 9.** Some of the damages on the roof of the ground floor in Zahir-ol-Islam house; Source: Authors

**6 Discussion on Pathologies on Adaptive Reuse of Zahir-ol-Islam House**

Diagnosing the tracks and damages is an important action in a restoration operation. The material spices, contiguity between building components and elements, suitable distribution of forces, foundation strength against loads, accordance between internal parties and material power, etc., are necessary factors and conditions in providing stability, life continuity, and building revival (Mohebali &Mohammadmoradi, 1393). Disturbing elements in heritage buildings can be classified into two orders internal and external factors. In Zahir-ol-Islam traditional house, based on field studies, these factors include:



**Figure 10.** An example of damages on basement level walls in the Zahir-ol-Islam historic house, Source: Authors

**Table 1.** Visible damages in the Physical Structure of the Zahir-ol-Islam historic house; Source: Domehri, 1391, p62

| Factor | Environmental Factors | | | | Statical Factors | | | | Continental Factors | | | Ecological Factors |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Structural Elements of Building | 1 Earthquake | 2 Metocamechanical | 3 Acoustic Impression | 4 winds and Trembling | 5 Statical and Foundational structure | 6 statical behavior of surrounding buildings | 7 Stable pressed Forces | 8 Additional Loads | 9 Wheater | 10 Humidity | 11 Temperature | 12 Environmental Pollution |
| Envelop-Roof | ◇ | ◇ | ● | ● | ◇ | ■ | ◇ | ◇ | ■ | ■ | ● | ● |
| Roof &Balcony | ◇ | ◇ | ● | ● | ● | ■ | ◇ | ◇ | ◇ | ◇ | ◇ | ■ |
| Walls &column | ● | ● | ■ | ● | ● | ■ | ◇ | ◇ | ◇ | ◇ | ◇ | ■ |
| North Wall | ■ | ■ | ■ | ■ | ■ | ■ | ● | ● | ● | ● | ● | ■ |
| Foundation | ● | ● | ● | ● | ● | ■ | ● | ● | ● | ● | ● | ● |
| Coating &Floor | ◇ | ● | ■ | ● | ● | ■ | ◇ | ◇ | ● | ◇ | ● | ■ |
| Stairs &Trench | ● | ● | ● | ■ | ● | ■ | ■ | ■ | ● | ● | ■ | ■ |
| Earthquake &Physical body | ● | ● | ● | ● | ● | ■ | ● | ◇ | ● | ● | ● | ● |

■ Limited and local damages ◇ Damage to structure & Foundation ● Continual Damages

**Table 2.** Some of the visible structural damage in the Zahir-ol-Islam historic house; Source: Authors

| Type of Damage | Picture of Damage | Location | Cause of Damage | Structural Damage | Architectural Damage |
|---|---|---|---|---|---|
| **Collapsed roof** |  | Three-door rooms and rooms in south | Humidity enters the building (caused by rain and snow) | Imbalance and loss of integrity in structure because of material erosion | Erosion in the insulation of the roof and incorrect implementation of dope |
| **Collapsed, cracked &blowing up on plaster and mortar** |  | All rooms in the house | Collapse on the roof and humid entrance | Imbalance and loss of integrity in structure because of material erosion | Diminishing and entrance of humid |
| **Water sign and saltpetre on the walls** |  | Basement level corridors | Entrance of rising and anticlimactic humid | Imbalance and loss of integrity in structure because of material erosion | Erosion in materials and mortar |
| **Cracks on façade walls and plaster** |  | Rooms and saloon on the ground floor | Earthquake and foundation subsidence | Imbalance in structure because of unequal subsidence and damages of the earthquake | Subsidence in-wall foundations and cracks over the walls |
| **leaning on the walls from a vertical position** |  | Side rooms on the ground floor | unequal subsidence of the foundation | unequal subsidence and damages of earthquake leaning on the walls from injunction point | Demolition of roof and walls |

**7 Conclusions**

The permanence of historic buildings' life in an urban context needs a partnership as mediocre in community life. As long as historic buildings remain without a function compatible with a community's modern needs, they will confront erosion and decadence. Therefore, adaptive reuse of historic sites and buildings is a strategy that maintains the historic fabric of the structures by involving them within the contemporary life of society. Thereby, adaptive reuse helps preserve historic assets' historical, physical, social, cultural, and economic integrity. Adaptive reuse is the best choice for the conservation of historic buildings and sites when it conserves the existing values and significance while finding the best solutions for upcoming challenges. Since conservation and continuation of physical integrity and

structure respond to the new bearing loads in the building when granting new uses. However, during the practice of reuse, buildings may need to install new services considering standards and current guidelines to sustain their social, economic, and environmental durability. During the adaptive reuse process, the structural system and the physics of the building areas are the most critical factors in accomplishing changes and interventions since, as well as the effect on the building. Ipso facto, structural analysis and assessment of the condition of a historic building to adopt a new function will clear the primary precautions that must be considered prior to any interventions. By taking these measures, the integrity, historical and structural values of a historic building would be alive while it is ready to answer the modern necessities.

In the case of Zahir-ol-Islam historic house, technical analysis of the building's structures depicts that despite minor cracks, damages, and material lost on the fabric of the building, the architectural structure of the building is capable by itself to accept new multifunction and more culturally oriented use to meet its significance and current needs of the neighbourhood.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Discourse on Lost Pages of History: Architectural Works of Vasudev Kanitkar in Western India

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**Abstract**
Ample western historiographical resources are available to understand Colonial Architecture in India. Architectural language evolved during Colonial period in India was a collaborative effort of British Royal and Local engineers from several parts. Eclectic architectural language of British India is a product of amalgamation of western models and eastern knowledge simultaneously. They worked in collaboration with Indian philanthropists, engineers, contractors and artisans. Much is available to read about royal engineers as a pride for British sovereign but contributions of local engineers who equally built colonial India lost in the pages of history.
This Paper tried to document and discuss works of local contractor Vasudev Kanitkar born in Baroda and worked at several places in Western India. With the help of archival resources and primary secondary surveys conducted this research paper compiles architectural contributions of Vasudev Kanitkar less known for his many landmark edifices he designed and built in western India.
**Keywords:** Eclectic Architecture; Colonial India; Local Contractors; Royal Engineers; and Public Architecture.

## 1. Introduction and Framework of Study: Role of Locals in Building Western Part of Colonial India

Western India was mostly under the presidency of Bombay during British rule in the nineteenth century. Royal engineers in collaborations with locals proposed and construct notable architectural works under Bombay presidency. Many local engineers and contractors were involved in decision-making at various levels during the actual implementation of public buildings on site. There were roadblocks in the execution process, including as opposition from locals and a lack of funds. Colonial sovereignty was built on democratic ideas to some extent. Documents such as old newspapers and municipal records may be sufficient proof that choices appear to be made democratically with the cooperation of local leaders and people. Correspondence between officers and commissioners about decisions made in the selection of appropriate sites for specific projects and its character in general can be found in municipal and PWD archives (Aziz Amen & Nia, 2017). Detailed estimates, material selections, and local community responses appear in the overall paperwork, although names of local contractors appear to be included in the files linked to public buildings completed very rarely. (Fig. 1 and Fig. 2) Framework shows how colonial rule was percolated and reached at grassroots levels. How the architectural vocabulary of colonial urban heritage and landscape could be interpreted in time and space. (Munasinghe, 2022)
Numerous articles published in Professional Papers on Indian Engineering by Indian local contractors such as Teekaram, who worked primarily in Lucknow, Babu Shumbhoo Dass, whose works can be seen in Bahwalpur, Pakistan, Rai Bahadur Kunhya Lal's and Sir Ganga Ram's legendary projects in Lahore, Pakistan, Muncherjee Beyzunjee at Hyderabad during the Nizam reign, are excellent resources indicating their contribution to the architectural vocabulary developed[1] [2] (Chopra, 2011, Lavand, 2017) Researchers such as Preeti Chopra states extraordinary works of Murzbaan in Mumbai in her writings. On the other hand local engineers such as Narso Ramchandra, Vasudev Kanitkar from Pune and some other towns in Deccan were never got recognized and documented extensively for their contributions in the development of architectural character. These are important unexplored figures in the context of Pune. Their names and associations transiently appear in the history of Pune. This chapter seeks to review account of who built Pune in colonial context on ground. Further discourse tries to detail out development of Vasudev Bapuji Kanitkar as an engineer and designer. Perhaps lack of resources and primary sources related to his own

[1] Preeti Chopra in her Book *A Joint Enterprise* on the page number 76 mentions name of Sir Ganga Ram as legendary figure who worked for PWD in Lahore now in Pakistan.
[2] Lavand Vaidehi, "Public Architecture And Role Of Local Contractors In Late Nineteenth Century, Case Of Pune." In *Urban Regeneration*. Nashik, 2017

opinions for his projects he executed may lead in missing links in the few of descriptions. This is due to the negligence in documenting biographies of local engineers and exploring their influences in their social contexts.

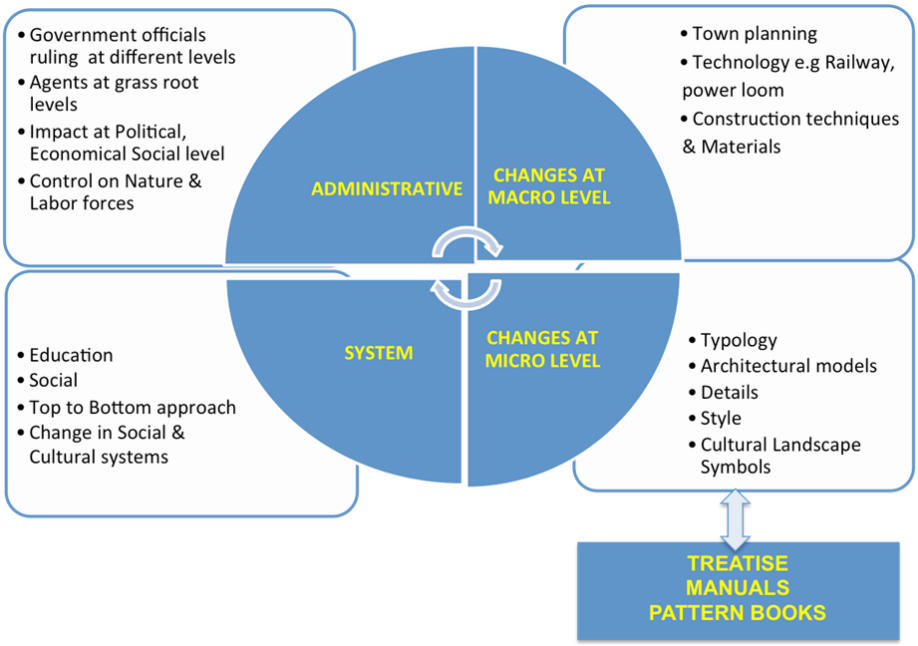


**Figure 1.** Structure of the Study (Developed by Author).

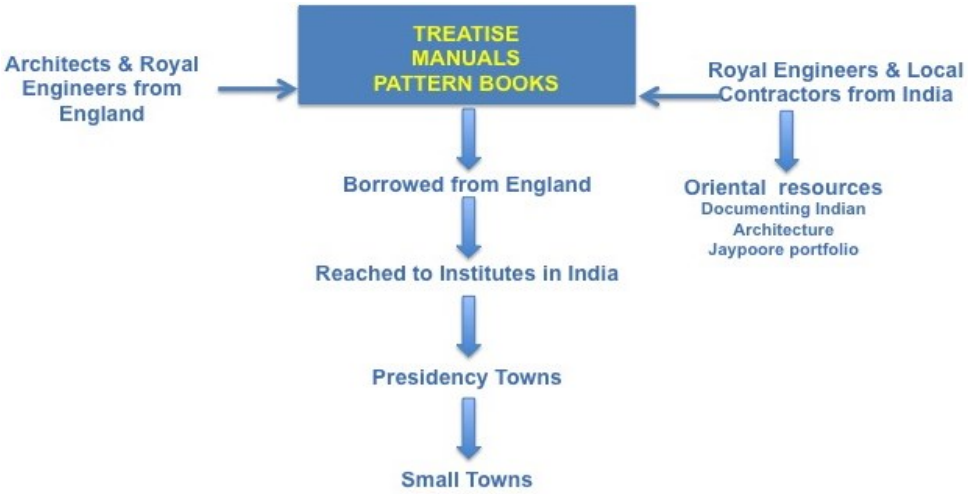


**Figure 2.** Image showing transmission of primary sources in small towns as reference to trigger construction activity, Top to Bottom approach. Source: Author

**2. Early life of Vasudev Kanitkar**

Research could uncover particulars of family and background of Vasudev Kanitkar (Fig. 3) perhaps his contribution as an engineer to some extent with the help of books *Kanitkar Kul Vrittant*[3] by Shankar Kanitkar published in the year 1948 and *341 Sadashiv Va* Amhi by Moreshwar Kanitkar published in 1992. (Kanitkar, 1948) As per the records mentioned in the book it had documented names and brief background of members of Kanitkar family in Maharashtra their decedents and family tree. The books refer to details about Vasudev Kanitkar and his involvement in the field of architectural landmarks in brief though he was not formally trained as an engineer or architect. Vasudev Kanitkar was born in Baroda Gujarat in the year 1829 or 1830.[4] His father was in the service of Patwardhan the then minister of the princely state of Baroda. It is indispensible to mention that he had never went through formal engineering training like Murzbaan who was trained as an engineer in Pune Engineering College. Vasudev

[3] *Kanitkar Kul Vrittant* the name of book suggests tidings of Kanitkar

[4] Two different years mentioned in both the books, so not very sure about exact day and year whether 1829 or 1830.

Kanitkar (Lethbridge, 1893, reprinted 2013) completed his education till old matriculation. He had good knowledge of engineering. He stayed in Karachi now located in Pakistan for larger period of time where he worked on several construction sites and must have gained experience in the field of Architecture and Engineering. Unfortunately, this part of his life couldn't be traced much, due to lack of resources.[5]




**Figure 3.** Image of Vasudev Kanitkar, Ref: Image at Reay Market

**3. Observations and Discussions: Architectural contributions of Vasudev Kanitkar**



**Figure 4**. Laxmi Vilas Palace at Baroda Designed by Charles Mant in 1878 and partly executed by Vasudev Kanitkar Ref: Image by Author

Further discourse tries to highlight notable projects by Vasudev kanitkar. His works at various levels with several people enriched his experience. Vasudev Kanitkar was honored as Rao Bahadur for his proficiency in the field of architecture. The title was given to him as personal distinction on 1st January 1877, on the occasion of the

[5] Kanitkar Shankar Ramchandra, *Kanitkar Kul Vrittant, /* Tidings of Kanitkar family *(Pune, 915/1 Shivajinagar Vitthal Hari Barve, Aaryabhushan Mudranalay, 1948),* 146; Kanitkar Moreshwar, 341 Sadashiv *va amhi/* 341 Sadashiv and us, (Pune, Moreshwar Kanitkar, 1992), 89 it's a autobiography re written on Vasudev Kanitkar's step brother's son Balukaka Kanitkar. 341 Sadashiv was residential address of Balukaka Kanitkar. In the description about Vasudev Kanitkar very respectfully he mentions his kind nature and connections with several reformists and activists in Maharashtra. He raised Balukaka Kanitkar after his father's death that was a great support to the family.

Proclamation of Her Most Gracious Majesty as Empress of India.[6] (Lethbridge, 1893) Few references are available to see with for Laxmi Vilas Palace (Fig. 4) designed by Royal engineer Charles Mant in 1878 and partly executed by Vasudev Kanitkar. This iconic palace located in Princely state of Baroda in western India known for its unique Indo-Saracenic style.

High court at Mumbai was another structure partly worked out by Vasudev Kanitkar built in between 1871-1878. John Augustus Fuller R.E. prepared design with Massive central tower, Turrets and Basalt rock resembling much to medieval castle. The prominent central tower is covered with steeply sloped roof with number of dormer windows. Main access is through porch on western façade adjacent to which two octagonal towers of spiral staircase and pinnacles are located. Christopher London criticizes the overall composition as "exaggerated massing in the muscular neo-gothic style".[7] (Christopher, 1994) Preeti Chopra in her discourse mentions that colonel Fuller proposed Vasudev Bapuji Kanitkar, Mukund Ramchandra and Muncherji Cowasji Murzban to be designated as assistant engineer in 1869. She also states the position of local engineers in colonial hierarchy the link between rulers and local workers, which is very much relevant to Vasudev Kanitkar.

Very unique structure designed and built by Vasudev Kanitkar was Reay market (1884-1886) (Fig. 5). It was the sixth market in the series of covered markets built in pre-independent India.[8] Despite a lot of opposition from local Communities the project was successfully raised at the heart of native town. Reay market later named as Phule Mandai was a unique design for a market in India. Spatial organization of market majorly resembles plan of a Jail. After studying various typologies and models followed in 19th century especially from *professional papers on Indian Engineering* and *Roorkee Treatise*, it could be observed that very simple plan of barrack and jail was preferred for designing this market. Its prominent central tower and rectangular flanges projecting out of eight sides indicates image of jail. Perhaps this was chosen with the concern of capturing ample light and cross ventilation in structure. Its probably expression of a bigger model of Lambert Market, Karachi detailed out with Neo-Gothic style. As Lambert market was located at the center of town at a junction of roads market accessible from all sides must have been the criteria in selection of that particular model. Unfortunately no much information is available on Lambert Market of Karachi so cant be discussed beyond certain point. Prevailing form and fine stonework mark its exceptional presence in the medieval town of Pune. Grippingly, the building is visible from long distance on the main axis of old town connecting to the fortress of *Peshwas.* Residence of Vasudev Kanitkar is located at a close distance exactly behind Vishrambag Wada.[9]

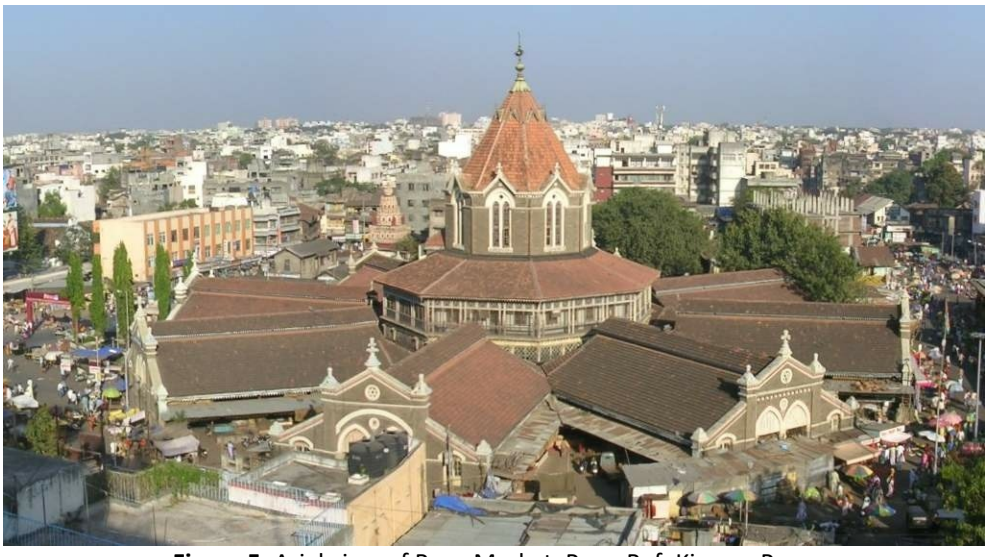

**Figure 5.** Arial view of Reay Market, Pune Ref: Kimaya Pune

[6] Lethbridge Sir Roper, *The Golden Book of India*, (London, Macillan and co.,1893, reprinted 2013), 566-7, https://archive.org/details/bookofindi00lethgoldenrich

[7] London Christopher W., *Bombay Gothic*…cit., 53.

[8] Before partition of 1947 Pakistan was part of India. Earlier examples of covered markets built were Lambert Market in Karachi (1864), Tollinton Market Lahore (1864) earlier built as community hall later converted in market by Rai Bahadur Gangaram well-known local government engineer, Crawford market (1867) Mumbai designed by architect Sir William Emerson, Hogg Stuart Market Calcutta (1872) and Bolton Market Karachi (1883). Commencement year of Empress Market Karachi was probably same as Reay market (1886) it was 1884. In later decade of the century Connaught or Shivaji Market (1885-1886) and Moore market Madras (1898-1900) were built.

[9] As Earlier residence of Kanitkar family was located behind Vishrambag Wada close to Pushkarni tank

On the same axis of the street a very important public library well known as *Nagar Vachan Mandir* (1884-1890) was built to promote literature in local language. Designed and built by Vasudev Kanitkar the library contains immense archival documents, books and various resourceful materials written in Marathi and English. In all the archival documents it was named as Pune Native General Library. As a part of inculcating modern education and governance amongst locals Sir George Clark the then governor of Bombay presidency proposed establishment of a library named as Pune Native General Library in the year 1848. Initially located in Budhwar Wada. The mansion was burnt down in 1879 that boosted a need for a separate space allocated to the library. Eminent personalities such as Justice Mahadeo Govind Ranade[10], Lokhitwadi Gopalrao Hari Deshmukh[11], Krishnashastri Chiploonkar and so many have contributed in the process of establishment and running of the library. The location was selected after long discussions and the space was borrowed from Belbagkar family[12] on 15th May 1882 at the cost of Rs 4000/-. Vitthalrao Vasudev Gujar proposed initial plan and estimate for the library. Later Vasudev Kanitkar reworked on design and execution of the project. Library building was started in the year of 1887 and in two years two-storied building was completed. Earlier cost of the project was assumed to be Rs 24476/- but at the end of it costed around Rs 25176/. Mumbai Government donated fund of Rs 12080/-, and Rs 12080/- collected from various philanthropists from Pune. Raja Holkar donated watch of Rs 500/- put on east façade at the entrance. Pune Municipality helped in getting service of maintenance of watch from Pendol Watch Company that was installed on front facade. Governor of Bombay Presidency Lord Reay invited for the opening of 2-storied library on 30th July 1889. Three clocks were installed on three different buildings at the same time, naming Sassoon Hospital, Reay Market and Nagar Wachan Mandir those were maintained by Pendol watch Company.[13] Symbolism of using clock as modern age and industrialization in front facades of public buildings was becoming trend in all parts of the country. This native library is considered as pioneering work in promoting local literature and had played important role as a hub during freedom movement. Various resources contributed to the overall building process of the Library. In true sense this was a public architecture in the old core of Pune city.

Institute of Anandashram[14] (Fig. 6) was the next important project completely designed and constructed by Vasudev Kanitkar in the year 1891. The edifice is located in the same premise close to Reay market and Shaniwarwada. Reformist and Philanthropist Mahadev Chimanaji Apte founded the institute at the heart of old town. It comprises administrative office, library, and hostel for Brahmin boys from economically weaker families from nearby towns. Along with that a large temple of *Sachchidananda* Shiva[15] is located at the center of complex. A property and trust record of institute shows Vasudev Kanitkar was one of the trustees of the center. Stone and iron building built is one of the fine works in the vicinity and credit was solely given to Vasudev Kanitkar.[16] He was involved in designing and execution of the project. Overall plan follows introvert planning. Which include typical Wada plan with central courtyard followed as a model for design. The Architectural details are Indo-western in at several levels. Construction materials such as Iron, lime concrete, colored glass, imported Minton tiles and local stone are wonderfully amalgamated in the composition. Exclusive woodwork in front façade and on temple reminds indigenous floral forms worked out by local craftsmen. Spiral staircase built in stone and finished with Marble tiles is exactly the same as one built in Reay market in wood. External façade of the whole institute resembles a Wada or royal mansion in Pune, whereas temple built in rectangular form with central nave and aisle on both sides. Minton tiles and glass windows remind old colonial structure in Bombay. Wooden arches at the joining point of columns and ceiling follows *Mahirap*/ Maratha Style cusped arch form typically used in Royal mansions of Maratha ministers. Entry point to ground floor

[10] Ranade: Mhadev Govind Ranade was social reformer, founding member of Indian National Congress, was judge in Bombay Highcourt

[11] Lokhitwadi: Gopal Hari Deshmukh part of Freedom movement, scholar, social reformer. Taken strong stand against child marriages, dowry, caste system

[12] Belbagkar Raosaheb Mahadev Ballal Phadnis was one of the Ministers of Peshwas was one of the owners of precious land in the old town.

[13] http://www.punenagarvachan.org/; Dixit M. S., *Pune Nagar Vachan Mandir Didshe Varshancha Itihas 1848-1998*, (Pune, Pune Nagar Vachan Mandir Prakashan, 1998), 23,24; Shrigondekar G. N., *Pune Nagar Vachan Mandir Shambhar Varshancha Itihas 1848-1948*, (Pune, Sadashiv Keshav Nerugaonkar, nagar vachan mandir, 1949), 40,41; Mumbai, Elphinston college, Maharashtra State archives, *PWD General*, 1868-89 *Vol. 563;* Mumbai, Elphinston college, Maharashtra state archive, *Bombay public works proceedings imperial and local 1886*,135; PWD General Vol. 563, 1868-89, Elphinston college, Maharashtra State archives Mumbai; Correspondence mentioned in appendix 12,13,14 supports the details of expenditure and comments on sanctioning process of the building.

[14] As per synopsis of activities briefly mentioned by institute, "Anandashram *Sanstha*" founded in the year 1888 by late Mahadev Chimanaji Apte was advocate of Bombay High court. Institute has great collection of manuscripts and books related to Sanskrit and Indology to support researchers in world.

[15] Shiva is one of the important deities worshipped in India. *Sachchidanda* means total bliss.

[16] Schedule "A" in will by Mahadev Chimnaji Apte, , Schedule "B" written in 1891, page no. 7, 11.

library adorned with segmental arch covered with ornamented overlooking gallery and three-arched door. On top of the sloping roof a small scale Shikhara[17] is placed as representation of temple. It is interesting to note though Vasudev Kanitkar worked on restoration works of Tulasi Baug and Kasaba Ganpati temples he has not followed same architectural language in this Shiva temple located at the center of the institute. As it was built entirely in stone, it has a very strong presence in the complex.




**Figure 6.** Roadside View of Aanadashram, Pune Ref: Author

Two landmark structures built during the last decade of the 19th century were residence of reformist Dr. Bahndarkar*[18]* was known as Sangamashram[19] (1892) and Fergusson College main building (1892-1895). Unfortunately, Sangamashram doesn't exist anymore but main building of Fergusson college still stands out in the whole campus. Both these buildings were built in local basalt rock are admired for there workmanship and character. Vasudev Kanitkar being good friend of Dr. Bhandarkar designed and built his own house in Pune at a confluence of two rivers. Perhaps Sangamashram described as one of the best amalgamation of western and oriental style in spatial arrangement by Kamalini Damale and Sulabha Panandikar in their books.[20] Various references and descriptions given by Sulabha Panandikar shows that the house was built for joint family so all arrangements and sizes of rooms such as halls, common rooms were of good enough size to accommodate all family members. Though layout wasn't explained much as per its glimpses in writings some inferences are discussed further. The model that was followed was rectangular and not a typical of Wada courtyard style. Perhaps resembling to old English house, Orientalized with the use of several elements changed the pattern of design. Kitchen and toilets were detached from main house. This was generally followed in old Indian houses. Two gable ends were adorned with rose windows at top usually used in western style structure. Central part of the structure was covered with flat roof used as terrace known as *Gacchi* in local language. Simple straight planning followed in all respect. Layout was made to catch maximum southwest wind. Study room mainly used by Dr. Bhandarkar was located on the west. In addition it had semicircular arches in front façade highlighting the entry.[21] (Kanitkar, 1948) Western comfort was seen in furniture design whereas in dinning area Indian traditional seating arrangement generally on ground was used as per number of family members. Surrounding area was developed as a garden with several trees and plants. The building had a small tank as well. This house was passed on to another owner and was finally demolished due to unknown reasons. This place had great significance in terms of associational and architectural value. Enterprise of education as an effort

[17] Shikhara is an ornamental pyramidal roof adorned with sculptures located on top of temples in India.

[18] Bhandarkar: Dr. Sir Ramkrishna Gopal Bhandarkar welknown in late 19th century for his research work on Indian history and his extensive contributions in freedom movement in terms of literature, lectures he conducted in several Indian communities.

[19] Name "Sangamasham" residence of Dr. Bhandarkar suggests its picturesque location of site near the confluence of two rivers in Pune. *Sangam* is confluence and *Ashram* is a secluded building generally used as religious retreat or instruction in Hinduism.

[20] Damale Kamalini, *Shrimati Ahilyabai Bhandarkar Smriti Grantha*, (Pune, Shrimati Ahilyabai Bhandarkar Smarak Granth Prakashan Samiti Wadia College, 1966); Panandikar Sulabha, Vyakti Titkya Prakruti, (Pune, A.V. Gruha Prakashan, 1958).

[21] Kanitkar Shankar Ramchandra, *Kanitkar Kul Vrittant,/* Tidings of Kanitkar family…cit. 146; Panandikar Sulabha, *Vyakti Titkya Prakruti/* One of the Marathi phrase referring each one his own, (Pune A.V. Griha Puublications, 1958), 199-208; http://www.fergusson.edu/upload/document/77939__History.pdf; Damale Kamalini, *Shrimati Ahilyabai Bhandarkar Smriti Grantha*, ( Pune, Shrimati Ahilyabai Bhandarkar Smarak Granth Prakashan Samiti Wadia College, 1966), 6 this book particularly written as a biography of Ahilyabai Bhandarkar. She was grad daughter of Dr. Bhandarkar; Karnataki Shreenivas, *Guruvarya doctor Sir Ramkrushna Gopal Bhandarkar yanche Charitra*, (Pune, S.N. Karnataki, 1972), 67.

of the Government and Indian people resulted in dawn of new education system that could be termed as formal Indo-western style perhaps reflected in architectural style.
Education policies initiated by British Government in India and focus was upon creating more workforces to support empowerment of colonial empire. But eventually it appeared that educational empowerment helped in increased number of reformists who fought in the freedom movement in various ways. Pune was the education hub during the 19th century. Wood's Educational Dispatch (1854)[22], the Educational Commission of 1882 and the Hunter Commission (1891) were suggestive of collective efforts of British Government and locals as enterprise of education. Several names of reformists such as Mahatma Phule, Maharshi Karve, B.G. Tilak, G.G. Agarkar and so on were associated in educational reforms focusing on philosophy of education for all despite of cast, class and gender of communities. One of the very important examples of those was Deccan Educational Society established by Vishnushastri Chiplunkar, Lokmanya Bal Gangadhar Tilak, Gopal Ganesh Agarkar, Mahadev Ballal Namjoshi, and Vaman Shivram Apte in 1880. In the year 1891 land of 37 acres was acquired at outskirts of old town on lease. Foundation stone was laid in the year 1892 was named after the then governor of Bombay James Fergusson (1880-1885). He donated Rs 1200/- for the construction of main building.[23] Fergusson College (**Fig. 7)** was one of earliest institute in Pune that was run in collaboration with Government and locals. Vasudev Kanitkar carried out design and execution of the main building.



**Figure 7**. View of Fergusson College, Pune Ref: Author

Similar to other contemporary institutional models in India simple form of "C" shape was adapted. Porch is projected little out highlighted as entrance gateway. Semicircular arches are used throughout the structure. Rose windows are used on ground and first floor highlighted with lime plasterwork. Segmental arches are used at entrance porch. Unfortunately, as like the other structures designed by Vasudev Kanitkar original handmade drawings are not available for further research. But one of the finest works in institutional typology that is fortunately preserved well by the management of institution in good condition. English tracery is used for window details and façade treatment. Decorative wrought Iron and wooden railing are used for upper floors adorning the elevation. Decorative elements such as windows arches and overall composition in elevation are very similar to the Reay market building.

**4. Conclusions**

Despite of not being architect or engineer Vasudev Kanitkar worked on landmark structures those represented urban public spaces in Bombay and Pune. While looking at the typology of projects built by Vasudev Kanitkar mainly he has

[22] Wood's Educational Dispatch (1854) speaks about right to education for all and discourse on inculcating western knowledge in "Natives". This was in order to create a class of civil servants for empire. Charles Wood was the President of the Board of Control of the East India Company.

[23] http://www.fergusson.edu/upload/document/77939__History.pdf; Sundaram M.S., "A Century of British Education in India 1857-1957", *Journal of the Royal Society of Arts*, Vol.107, No.5035, (June 1959), 491-507, Stable URL: http://www.jstor.org/stable/41368746. Author in his article mentions "There was a network of autonomous, self –supporting decentralized school system all over the land. The village priest and the village craftsmen played the role of teachers in addition to their religious and occupational pursuits." This explains the state of indigenous education system at the beginning of 19th century. Educational Commission of 1882 and the Hunter Commission (1891) gave emphasis on primary secondary education of masses in India. Wiliam Wilson Hunter was one of the members of the Indian Civil Service well known as statistician, later he was Vice President of Royal Asiatic Society.

contributed in public oriented projects working in association with the government and local philanthropists. Reay market in Pune being a first of its kind stands out in whole series of his works, which marked its presence predominantly in old town of Pune that later triggered further extension of town towards south. Its design and actual construction on ground was a great collaborative effort of R.E.[24] Walter Ducat and Vasudev Kanitkar. This structure has importance in the context of urban landscape of Pune, as it changed the skyline and brought covered market as an important typology for citizens in the context.

Looking at the graph of all architectural landmarks built by Vasudev Kanitkar it is clearly observed that he had practiced with western models modifying it in local context of important Indian towns under Bombay presidency. Bombay is considered as starting point of Neo-Gothic style as well as Indo-Saracenic style Architecture. Similar style, features and detailing were carry forwarded and modified by him while constructing in the case Pune that was then Monsoon capital under Bombay presidency. Perhaps in his designs in Pune to mention few as Reay market, Fergusson College, followed extensively Bombay Gothic models. Architectural elements, material and techniques, Anandashram widely shows his proficiency in rigorous workmanship. He might have borrowed elements such as prominent central tower with dormer windows, finials at top and use of polychromatic scheme from High court and Secretariat for the model of Reay Market built in Pune. Both of these examples mark their significance metaphorically as supremacy of sovereign. Being purely colonial structure built at the heart of the old town Reay Market followed similar language of prominence.[25]

Names of Walter Ducat and Vasudev Kanitkar mentioned in Bombay University Calendar[26] under the list of faculty of civil engineering in the year 1868 and 1874 simultaneously. Unfortunate demised of both Walter Ducat (1902) and Vasudev Kanitkar (1905) occurred during the same decade. Ascending graphs of the works of both are noteworthy in the Bombay Presidency those are important cultural heritage sites in the context. It is worth noticing that that Vasudev Kanitkar was well associated with Colonial ruling agents as well as local philanthropists and reformists that progressed in executing pioneering projects in a very conservative historic core of Pune. Precise knowledge of construction and extensive experience of local materials and craft helped him in quite successful execution of projects during late 19th century. Scant original resources and correspondence between the designer and Vasudev Kanitkar are missing links in understanding many of the architectural development accomplished by him. All these important landmarks still retain their character and tells the story of this very noteworthy self learnt, experienced, dedicating designer and engineer in the Indian context.

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**Conflict of Interests**

The authors declare no conflict of interest.

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[24] R.E. refers to royal engineers

[25] Kanitkar Shankar Ramchandra, *Kanitkar Kul Vrittant (Pune, 915/1 Shivajinagar Vitthal Hari Barve, Aaryabhushan Mudranalay, 1948),* 146; Mehrotra Rahul and Dwivedi Sharada, *The Bombay Highcourt The story of the building 1878-2003*, (Bombay, Eminence Designs Pvt. Ltd., 2004), 39.

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# The Vietnam Veterans Memorial – Presenting the Unpresentable

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**Abstract**
A study of the Vietnam Veterans Memorial in Washington, DC, designed by Maya Lin in the 1980s. The memorial operates on multiple levels simultaneously and this is what gives it its communicative power. The memorial will be examined from both an arts and architecture context. Several interlinked aspects will be explored which include place, social context, diagram, minimalism, phenomenology and time, and materiality. These elements combine to form a dialectical image in the mind of the viewer. Merleau-Ponty's concept of the preobjective and Jean-Luc Nancy's concept of infinite on the border of presentation are used in the analysis along with Gilles Deleuze's concept of the diagram. Walter Benjamin's concept of the dialectical image where multiple elements are combined to form a unique separate experience is also employed. The writer is both an artist and an architect.
**Keywords:** Monument, Architecture, Urban Design, Place, Phenomenology, Memory, Cultural Memory

## 1. Introduction

"We erect monuments so that we shall always remember, and build memorials so that we shall never forget."[1] (Arthur Danto writing on the Vietnam Veterans Memorial in *The Nation*).
The Vietnam Veterans Memorial (VVM) in Washington, D.C. was constructed in 1982 and was the result of an open design competition won by Maya Lin. The memorial lists the names of approximately 58,000 American military personnel who were either killed or missing in action in the Vietnam war from 1959 to 1975.[2] The design generated tremendous controversy[3], but once built became one of the most visited monuments in the United States with visitor numbers exceeding 5.5 million people per year in recent years.[4]



**Figure 1.** Vietnam Veterans Memorial, Washington, D.C., image courtesy of Maya Lin Studio



**Figure 2**. Vietnam Veterans Memorial, Washington, D.C., image courtesy of Maya Lin Studio



**Figure 3**. Vietnam Veterans Memorial, Washington, D.C., image courtesy of Maya Lin Studio

The VVM has sense as well as meaning. It produces a deep reaction in the viewer on a figural level that lays beyond rational language and thought. This connection is based on presentation, not representation, and is a presentation of something, that in the words of Jean-Luc Nancy is a "movement of the unlimited . . . that takes place on the border of the limit, and thus on the border of presentation . . . it is the infinity of a beginning.[5] The VVM, like other great works of art, has a special relationship to what is not there and it is not graspable through concept alone. The VVM is a presentation that accesses the imagination. In this essay, I will attempt to demonstrate that the multiple elements of the design amplify each other to create a dialectical image in the mind of the viewer and that this image is created from both pre-objective perceptions and socially constructed perceptions. The elements discussed are place, social context, diagram, minimalism, phenomenology and time, materiality, and absence and presence.

**2. Place**

The location of the VVM as a place is significant. The VVM is located within the Mall of Washington, D.C. and this carries significant cultural meaning. Charles Griswold observes that "the Mall is *the* place where the nation conserves its past . . . simultaneously recollecting it . . . honoring it, and practicing it (in the White House and Capitol)".[6] By virtue of the place, the VVM will be perceived within this context of Washington, D.C., and it has conferred upon it a measure of institutional significance. In addition to being a place of embedded meaning, the Mall, and specifically the area between the Lincoln Memorial and Washington Monument (which is adjacent to the VVM site) is also a principal area of civil protest. In large part because of the symbolic meaning of the Mall, it is a place where active protests and demonstrations are held. Figs. 5-7 show instances of protests which have included demonstrations on civil rights demonstrations, anti-Vietnam War, and women's rights, among others.



**Figure 5**. March on Washington 1963 for civil rights, US Government photo.



**Figure 6**. March on Washington 2020, photo by Isaiah Headen.



**Figure 7**. Vietnam War protest on the Mall, Washington, D.C., 1967, photo by TommyJapan1.

Beyond the site of the Mall itself, the city of Washington, D.C. also has a relevant cultural history. In 1968, following the assassination of civil rights leader Martin Luther King Jr., riots broke out in Washington, D.C., and other American urban areas.[7] These riots (Figs. 8 & 9) were indicative of underlying social tensions around the issue of race. Not surprising perhaps, many of these same tensions were also reflected within the US military fighting in Vietnam.[8] These social tensions were embedded in the collective memory of Washington, D.C., as in other large American urban areas. These tensions, when overlaid with the symbology noted above about the Mall, amplify each other and create a place that is highly emotive and symbolic.

The issue of place alone does not explain the resonance of the VVM, but it is clear that without the context of the Mall and Washington, D.C., the VVM would not be as meaningful or emotive.



**Figure 8**. Washington, D.C. Riots, 1968, photo Darrel Crain Collection / D.C. Public Library



**Figure 9**. Washington, D.C. Riots, 1968, photo by Washington Post

**3. Social Context**

The social context surrounding the Vietnam War in American society was very fractious. This has a significant influence on those individuals, particularly Americans, who were alive at the time. The Vietnam war was the first televised war,[9] and Americans were able to view the actions of the war on their television screens (figs. 10 & 11) in the nightly news, and images of the war were widely distributed in the print media (figs. 12 & 13). There were deep divisions within American society about the Vietnam war, as was demonstrated by many antiwar protests (fig. 7), particularly as American casualties mounted.[10]



**Figure 10**. Vietnam war on television, 1968. Photo by Warren K. Leffler.



**Figure 11**. Vietnam war, with a television crew in attendance, 1966, photo by Associated Press/Eddie Adams.



**Figure 12**. South Vietnamese chief of the national police, executes suspected Viet Cong officer on a Saigon Street, photo by Associated Press/Eddie Adams.



**Figure 13**. Vietnam war, 1972. Photo by Associated Press/Nick Ut.

Adding to the social context was the issue of the draft. The American military relied on conscription[11] to maintain their desired troop levels, as there was a shortfall in requirements relative to volunteers. In the 1960s the annual draft selection was televised (fig. 15), with a lottery-style draw of birthdates indicating the order of priority for conscription. This brought the process directly into the living rooms of America and is part of the Vietnam era collective memory.
Alongside the Vietnam war were issues of race and civil rights (fig. 14), and this was reflected in the Vietnam war. While there was nationwide conscription in place, there were exemptions and deferments, the net result being, in 1967, that black Americans, while representing approximately 11 per cent of the population were 23 per cent of all combat troops and nearly 25 per cent of all combat deaths.[12]




**Figure 14**. Vietnam war protest.

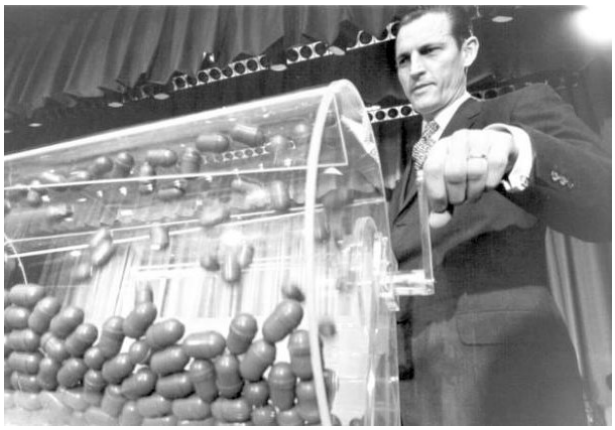

**Figure 15**. Televised Vietnam draft, 1969.

The above examples are not meant to be exhaustive or all-encompassing, but rather to demonstrate the impact that the Vietnam war had on the civilian population in America. These memories will structure part of the perception of the VVM, particularly for those whose memories were formed first-hand. The VVM provides a physical embodiment to which are attached the above memories and perceptions.



**Figure 16**. Vietnam Veterans Memorial, Detail, photo by J. David Ake/Associated Press



**Figure 17**. Vietnam Veterans Memorial.

The social context noted above will most prominently affect those that lived through the events. Additionally, the memorial is a where individuals, presumably with a direct connection to those that died, leave various physical artefacts (Fig. 16) and American servicemen who fought in Vietnam will have a direct connection to the individuals listed on the memorial (Fig. 17). The impact of these cultural memories will recede with each successive generation the further they are away from the actual events. In this sense, these cultural memories are different from the implications of place and the context of Washington D.C. which have a longer-lasting influence over successive generations. However, while the social context may only have a shorter-term relevance to the longer-term perception of the memorial, it is an important factor for those individuals who directly experienced it. By extension, this means that the perception of the VVM will change over time, although some themes, such as death will have greater stability over time, whereas the influence of the diagram of Washington, D.C. may lie somewhere between these elements.

**4. Diagram**

The VVM is located within the Mall in Washington, D.C. On the Mall, it sits slightly north of the centreline of the Mall which connects the Lincoln Memorial on the west and the Washington Monument on the east. Many authors have commented on the relationship of the VVM to both the Washington and Lincoln Memorials.[13] The connection of VVM to these other monuments is more powerful than what these authors have proposed.

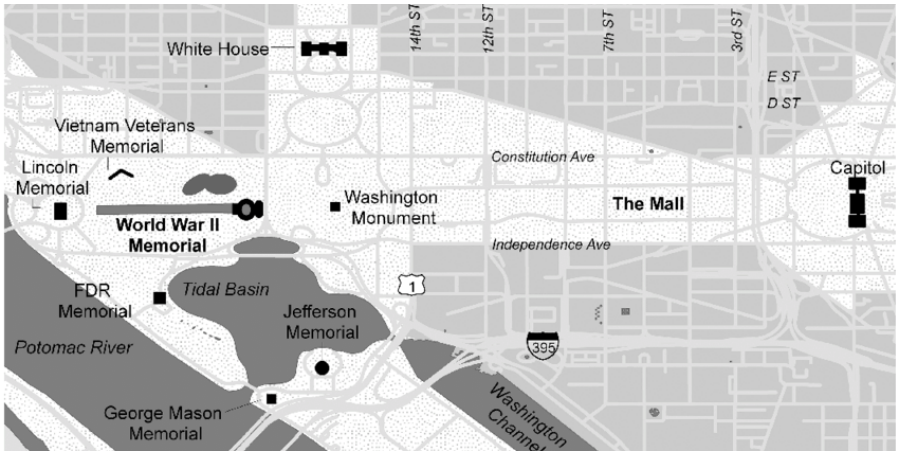


**Figure 18.** Present-day Washington D.C. monuments. Along the Mall, from left to right are the Lincoln Memorial, the Vietnam Veterans Memorial, the Washington Monument, and the Capitol building. Image by Spatial Analysis Lab.

The VVM sits within the context and has a unique connection to the physical structure of Washington DC. The plan of Washington DC was conceived as a series of nodes, with the street pattern focussing on these nodes. The L'Enfant plan of 1791 (Fig. 18) shows the initial concept which is still the spatial framework for the present day. This formal structuring of the street pattern underscores the cultural importance of these node points, and elements such as the Mall (shown in the 1791 map).

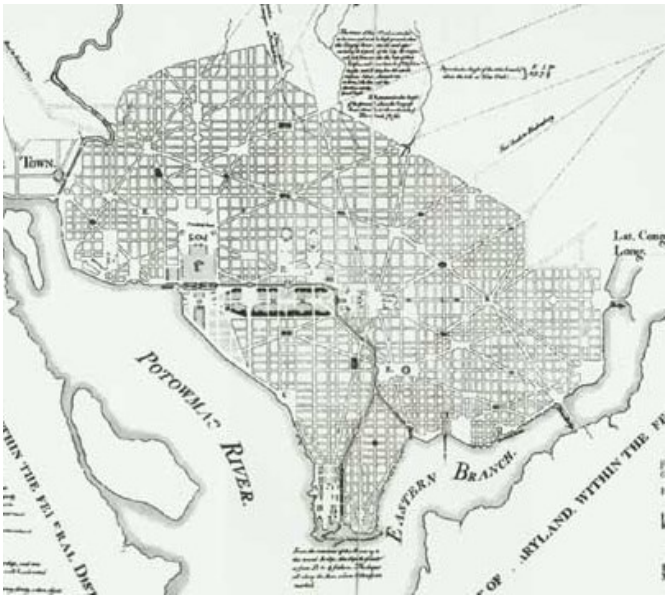


**Figure 18**. L'Enfant's 1791 plan of Washington, D.C.

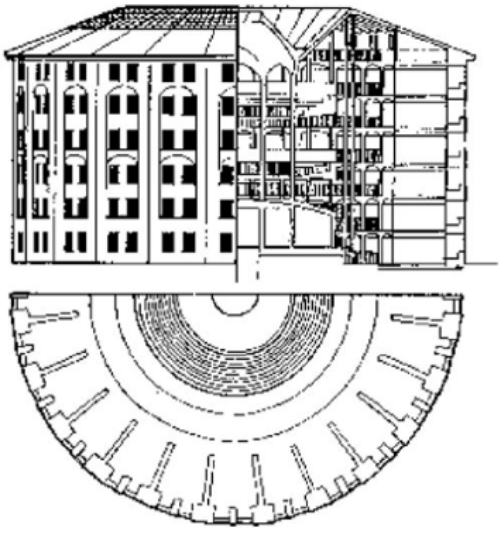

**Figure 19**. Jeremy Bentham, *Panopticon* (circa 1791)

The formal structure of the Washington D.C. street pattern is both an expression of power, and a power that influences individual behaviour. Jeremy Bentham's *Panopticon* (circa 1791) (Fig. 19) is an often-referenced example in this vein. The *Panopticon* was a model design for a prison where surveillance of all the inmates could be made by one guard, and additionally, the prisoners did not know when they were being watched. Michel Foucault in discussing the *Panopticon* postulates that the permanent visibility induced by the design produces an automatic functioning of power vis-à-vis the behaviour of the prisoners.[14] He further goes on to say that the Panopticon is a generalisable model of functioning and that it defines power relations in terms of everyday life.[15] In this vein, Giles Deleuze discusses the concept of the

'Diagram'. In his book on Foucault, he goes further than Foucault and says that the diagram "is no longer an auditory or visual archive but a map . . . that is coextensive with the whole social field."[16] These concepts directly bear on the meanings created by the VVM.

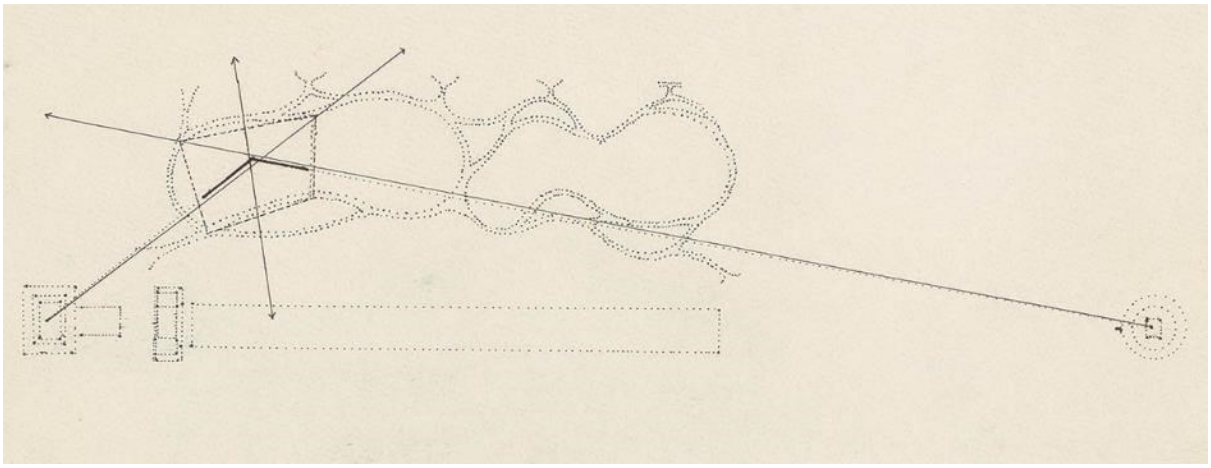

**Figure 20**. Maya Lin, 'Vietnam Veterans Memorial Competition Site Plan'. VVM to top, with Lincoln Memorial to the bottom left, tidal pool (showed dotted) in the centre, and Washington Monument to bottom right.



**Figure 21**. Vietnam Veterans Memorial, View towards the Lincoln Memorial from the VVM. Photo by Stephen S. Griswold.



**Figure 22**. Vietnam Veterans Memorial, View towards the Washington Monument from the VVM. Photo by Stephen S. Griswold.



**Figure 23**. Aerial view of the Mall. Photo by NPS. Lincoln Memorial in the foreground, Lincoln Memorial Reflecting Pool, the Washington Monument in the background, and the VVM to the left.

Consider the site plan of the VVM (Fig. 20). The arms of the 'vee' focus directly onto the Lincoln Memorial and the Washington Monument (see Figs. 21 and 22), and the centreline of the 'vee' indirectly links with the tidal pool. The connection to the Lincoln Memorial and the Washington Monument is particularly strong due to the design's geometry, and when in the VVM, the two monuments provide clear visual anchor points. Both the Lincoln Memorial and the Washington Monument are key memorials within both the physical and mental infrastructure of both Washington, D.C. and the entire United States.

Applying Foucault's and Deleuze's concepts to the VVM, the plan of Washington, D.C., is a diagram that both demonstrates the institutional power of the United States government, but also that this manifested institutional power influences the viewer. The VVM, by its seamless and subtle visual linking with the monuments themselves, and with the underlying spatial geometry of Washington, D.C. itself, firmly embeds itself into the physical and psychical infrastructure of Washington, D.C.

One interesting aspect of this is the subtlety of the VVM in making this connection to the diagram of Washington, D.C. A typical monument stands out and makes a declarative statement. The VVM by contrast uses a judo-like move and channels and transforms the energies and meanings of the institutional diagram. This connection and transformation aren't readily obvious when one views the VVM from a distance and only becomes apparent as one approaches the VVM. The solemnity of the individual names is placed in the direct context of the diagram of Washington, D.C. This context, and the direct linking to it, give added institutional importance to the memorial.

**5. Minimalism**

While the VVM adopts some of the tropes of minimalism, a reading of it purely in this vein would only give a partial account. The most striking feature of the VVM is the listing of the names, and the resonance this brings. This has parallels to the seriality of minimalism, but with added meaning.

It is interesting to compare the VVM with a monument such as the Tomb of the Unknown Soldier (Fig. 24). In this monument, the singular object is meant to represent all the war dead. The monument deliberately chooses the remains of a soldier that cannot be individually identified. The concept of the individual is removed. The one represents the many. By contrast, the VVM (Fig. 25) individually lists the names of the more than 58,000 American dead. The individual listing of names was a condition of the design competition.[17] While the memorial is read as a whole, it is constructed from each individual name. The many represent the one. The individuality of the names is reinforced by them being presented solely as names, without the addition of institutional rank.

In what was meant to be a critical appraisal of the VVM, the *National Review* stated that "the mode of listing the names makes them individual deaths, not deaths in a cause . . . they might as well have been traffic accidents."[18] This precisely, though inadvertently in the *National Review's* case, identifies what makes the VVM such a powerful memorial. The names are also listed without any denotation of rank or battalion which is common on other military memorials. The absence of this additional information removes the direct connection of the memorial to an institutional structure and instead emphasizes the names as those of individual human beings. Robert Pogue Harrison comments that it is the individual that shines through the generic multitude of names and that the "lyric ambition to monumentalize the Vietnam War in the memorial comes to grief in the lyric singularity of each and every name."[19]



**Figure 24**. Tomb of the Unknown Soldier, Arlington National Cemetery, photo by RPavich

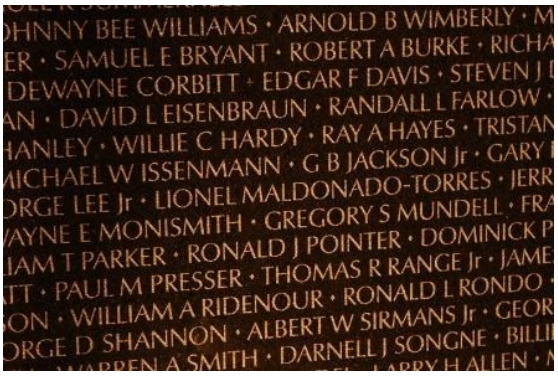


**Figure 25**. Vietnam Veterans Memorial, detail, US Government photo

The use of individual names in a series has parallels in minimalist art, as in the examples of Carl Andre and Sol LeWitt (figs. 26 and 27). In these works, as in the VVM, the individual components collectively create the entire work, and there is a resonance in the repetition of the components. The individual elements are subsumed to the perception of the artwork as a whole. The listed names in the VVM also combine to form a larger artwork, but what differs significantly

with the VVM is the indexical meaning attached to the component, i.e., the individual name. The viewer need not know the individuals whose names are listed, but there is a connection of the viewer to the fact that a single human is attached to each name. [20] The elements in the Andre and LeWitt examples are industrial components and carry meaning in this respect, but they do not carry a deeper and more complex meaning as is the case with the names at the VVM. There is a powerful and visceral connection between the viewer and the component names of the VVM. The VVM's designer, Maya Lin, has commented that she views the names as surrogates for the bodies and that she conceptualizes the dead as being in a space behind the wall.[21] While many visitors to the memorial won't make the connection that Lin states, it nonetheless underscores the degree of connection intended between the physical person and the engraved name.



**Figure 26**. Carl Andre, 'Sculpture as Place', 1958–2010, Installation view

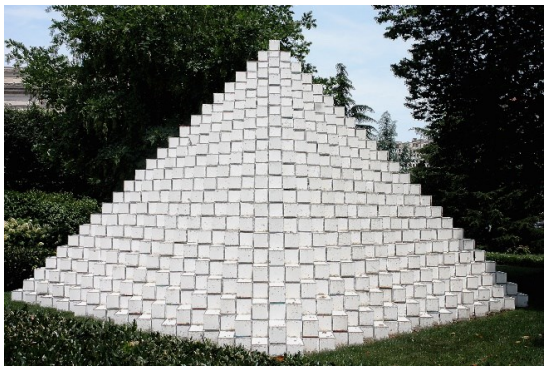

**Figure 27**. Sol LeWitt, 'Four-Sided Pyramid'

Connected to the idea of individual names is the vast number of names. From a distance, the individual names are not visible, but rather appear as some form of colour or texture on the wall of the VVM. It is only when one is closer that one can read the actual names. The VVM is nearly 150 metres long and is covered with the names for the entire surface. The immensity of the names becomes overwhelming and incomprehensible, creating a sublime experience in the mind of the viewer.[22] This is reinforced by the 'vee' shape of the VVM whose two endpoints taper into the ground meaning there is no finite endpoint of the memorial, rather a gentle continuation into the earth.

**6. Phenomenology and Time**

As a sculptural object in the landscape, the VVM engages the viewer in a phenomenological manner. In the art world, works by Robert Morris and Richard Serra also operate in this manner (see Figs. 28 & 29). These artworks use simple objects to create a 3-way relationship between the viewer, the environment and the object(s). Robert Morris, in describing his work described these simple objects as 'unitary forms' that he used to create a haptic rather than optical experience that engages the viewer's body with the self-reflective.[23] The haptic quality, i.e., perceiving the work through one's body via touch and memory of touch is a fundamental aspect of this work. Ignoring the individual names on the VVM for a moment, the VVM and the Morris and Serra works all employ objects that are plain and carry no overt material or social meaning in themselves. These objects are used as tools to create the relationship between the environment and the viewer, and they rely on the haptic perception of these relationships.

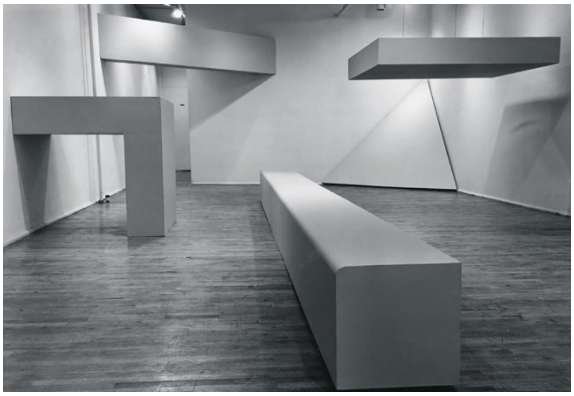

**Figure 28**. Robert Morris, Installation view 1964–65, Green Gallery, New York. Photo: Rudolf Burckhardt



**Figure 29**. Richard Serra, *Shift*, 1970

The kinaesthetic perception of the VVM introduces temporality as part of its composition. The VVM is a memorial that is perceived by walking through it and by touch and the memory of touch. This further integrates the viewer into the overall context of the VVM and reinforces and is reinforced by other connections the memorial creates. What the VVM does, which neither the Morris nor Serra works do, is to kinaesthetically connect with the deep social and cultural issues of its site. There is more at stake with the social and cultural issues of the VVM site, but these attributes would not be attached in the same way as other, less appropriate designs.

The phenomenological interpretation of the VVM is different from that of other more typical monuments. A good example is to compare the VVM with the Tomb of the Unkown Soldier (fig. 24). With the later monument, the viewer is kept at a distance and the viewer's perception is purely cerebral. While one can walk around the Tomb of the Unknown Soldier, the viewer is not bodily immersed in the installation in the way that occurs with the VVM.

Another way that the VVM is experienced is through the body in the manner in which the memorial is cut into the ground, see figs. 30 and 31. One approaches the memorial from one of the two ends and then descends along the wall to the centre of the 'vee' which is the deepest point. As one walks along the wall there is a concurrent awareness of the magnitude of the names. There is a physical sense of descending into the earth as if descending into something sacred or other-worldly, and then one ascends back up into the profane world at the other end of the memorial. Several of the elements that make the VVM a great work of art was determined by forces outside of the designer. The approach sequence of the VVM is one of these elements. The original competition design had the viewer approaching from roughly perpendicular to the memorial. Due to controlling the visitor flow, the design was amended so that entry was made at either end of the memorial, and that travel was parallel to the wall along a defined footpath. This emphasizes the connection of the memorial to both the Lincoln Memorial and the Washington Monument, but it also heightens the phenomenological experience of descending into and ascending from a sacred space.[24]

By being buried in the ground the VVM makes an archetypal connection to the earth, whereas a typical monument makes a connection to the sky. This connection to the earth brings with it the idea and memory of burial chambers and the resting place of the dead. One can understand Maya Lin's sentiment that she felt as if the bodies of the dead were buried on the other side of the wall. This experience would be completely different if the memorial were not buried in the ground, or if one didn't have the feeling of descending into the earth. This is a powerful experience, perceived through the body, that works in parallel with, and amplifies other aspects of the VVM.

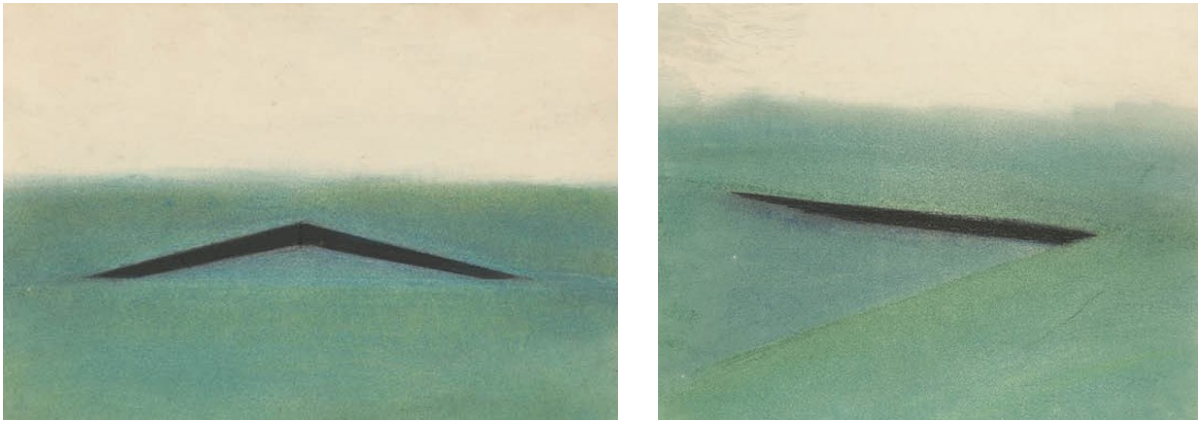

**Figure 30**. Maya Lin, Competition Drawings, 1981, shows the concept of cutting into the earth.

A typical artwork usually has restrictions on the viewer physically touching the object. The VVM, by contrast, is touched by many visitors and this is an important part of perceiving the work. Figs. 31 – 66 show typical examples of visitors touching the engraved names on the wall. Critically important is that the names are engraved, rather than printed, as this gives a tactile response when touched. The names, as previously discussed, create in the viewer a connection to an individual person, regardless of whether that person was known to the viewer. The touching of the name makes a direct physical connection between the viewer and the individual name/person. The haptic nature of interaction differentiates the VVM from a standard engraved tombstone – while a tombstone can be touched, its placement, and general convention, preclude this level of interaction. The kinaesthetic connection builds upon and reinforces other connections that the visitor makes with the memorial.



**Figure 31**. Vietnam Veterans Memorial, detail, photo by Peter Kaspari.



**Figure 32**. Vietnam Veterans Memorial, detail, photo by Wally Gobetz.



**Figure 33**. Vietnam Veterans Memorial, detail.

How the names are listed underscores the phenomenological and temporal perceptions of the work. The design competition guidelines specified that all the names be included, but did not stipulate how they should be presented. A typical manner of display would be in alphabetical order[25], but the VVM is different. Maya Lin proposed that the names be listed chronologically by the date when the individual died, starting in 1959 and finishing in 1975 (see figs. 35 and 36). There are several interesting and relevant aspects to this. Most importantly, the listing of names in this fashion physically locates the individual name/person in time. This has a double temporal quality in that the names of the dead have a physically expressed temporal relationship with each other and 'cultural time', and also that the viewer experiences the names of the dead physically when looking at or walking along the memorial. The act of walking along the memorial, traversing the chronological listing of the names of the dead creates yet another bodily-experienced connection to the memorial.[26] The VVM contains different temporalities and creates a density of time that is experienced through the body.

The other interesting aspect is the start and endpoints of the chronological listing. The listing starts and stops in the middle of the memorial at the crux of the 'vee', which is also the memorial's highest point (see fig. 34). Maya Lin has written that 'The time sequence, which has the dates of the first and last deaths meeting at the intersection of these walls is the essence of the design. It is a segment in time, meant to recognize all those who served during this war and give special recognition to those who will never return from it. [27] Arranging the names in this manner creates a closed loop in the time sequence. Had the names been arranged sequentially from one end to the other, the slice of time would have been indeterminate, especially given the tapering down to the ground of the memorial on each end. It is a very delicate balance because the closed-loop of time runs the risk of disconnecting other connections the memorial makes in the mind of the viewer. It does however maintain these connections and perhaps paradoxically present itself at the same time as a self-contained monument.

Charles Griswold makes the observation, as do others, that the fact that the names begin and end the way they do recalls the fact that the war did not have an official start, nor did it have an official end, and the returning veterans were largely ignored.[28] While this will have resonance for those Americans who were alive during the Vietnam War, it will, I believe, be an insignificant detail for future generations.

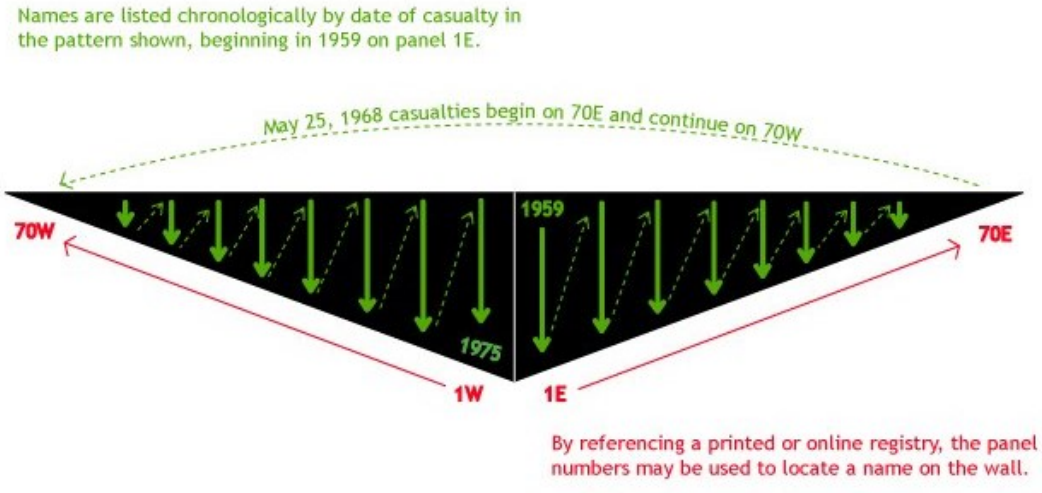


**Figure 34**. Vietnam Veterans Memorial, Naming layout diagram, image by National Park Service.




**Figure 35**. Vietnam Veterans Memorial, Ending name chronology, photo by Steven Zucker

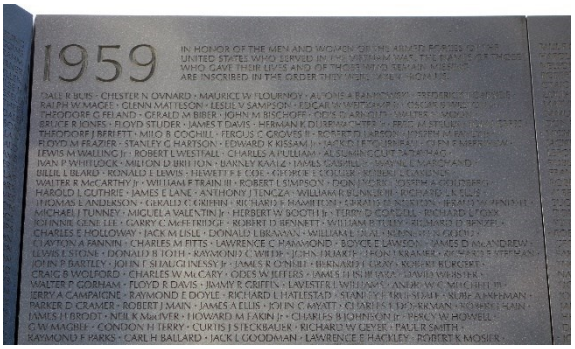


**Figure 36**. Vietnam Veterans Memorial, Beginning name chronology, photo by Steven Zucker

**7. Materiality**

The cladding of the memorial is polished black granite that is highly reflective (figs. 38 and 39). The use of black granite is not in keeping with the typical monuments of Washington, D.C., including the adjacent Washington Monument and Lincoln Memorial which are both white (fig. 23). This immediately sends a message that the work is not a monument in a conventional sense. A monument typically memorialises a cause or event that is larger than an individual. As noted previously, the VVM is a memorial to the individuals themselves that died in the war and is not a commemorative monument of the Vietnam War. Had the memorial been clad in white stone as per other Washington D.C. monuments, then part of its perception would have been that of a monument that would have worked against the combined interpretations of the memorial.



**Figure 37**. Vietnam Veterans Memorial, Detail.



**Figure 38**. Vietnam Veterans Memorial, Detail.



**Figure 39**. Vietnam Veterans Memorial, Detail.

The reflectivity is also a key characteristic of the materiality. Numerous authors have commented upon this[29], but for purposes of my argument, there are two principal aspects. First, the reflectivity lessens the perception that the VVM is a monument and thereby allows a more direct connection between the viewer and the memorial. When, for example, one looks at the Lincoln Memorial (fig. 40) there is a separation between it and the viewer that does not exist at the VVM. From certain angles (figs. 1, 2, and 41), the reflections give the memorial an ethereal quality that makes it more of a memorial rather than a monument.

The second aspect of the reflectivity is the more important one, and that is the reflectivity downplays the reading of the material as stone and emphasises the reading of the material as a continuous listing of names (fig. 7.03). This brings the names of the dead/the fallen individuals to the forefront of perception when perceiving the memorial.
Related to the reflectivity is how the viewer perceives the presence of the names. From a distance (fig. 7.01) the memorial appears more monolithic with the names appearing as some form of patination or texture (fig. 7.02). When one gets closer one realises that the patination is indeed a series of individual names, and as touched upon earlier, this contributes to a feeling of sublimity as the vastness of death becomes apparent.



**Figure 40**. Lincoln Memorial, Washington, D.C., photo by National Park Service.




**Figure 41**. Lincoln Memorial, Washington, D.C., Detail, photo by National Park Service

**8. Absence and Presence**

The VVM lists the names of approximately 58,000 Americans that died in the Vietnam war. What gets hardly any mention is the death and suffering of the Vietnamese people. It is estimated that 2 million civilians and more than 1 million Vietnamese military (from both North and South) died in the conflict.[30] Compared to the deaths of the American servicemen, this is a ratio of more than 50:1. If these names were also listed on the VVM, then the length of the memorial would equal that of 750 football pitches.[31]
While the above observation doesn't detract from the emotional resonance of the VVM, it does point to the power of social context, and the skewed nature in which attention is given and what is considered relevant or important.



**Figure 41**. Vietnamese women and children during a battle, 1966.



**Figure 42**. Vietnam war, Saigon.

**9. Conclusion**

The VVM is an emotionally powerful work, and it touches us at a figural level that is outside of rational language and thought. The work has elements of the sublime, and it is worth repeating the previously reference Jean-Luc Nancy quote in full:

> *In the sublime, it is not a matter of the presentation or nonpresentation of the infinite . . . Rather, it is a matter . . . of the movement of the unlimited, or more exactly, of the "the unlimitiation" that takes place on the border of the limit, and thus on the border of presentation. . .. The unlimited begins on the external border of the limit: and it does nothing but begin, never to finish . . . it is the infinity of a beginning.*[32]

When one is at the VVM it is a solemn experience that I argue borders on the sublime. There is something in the magnitude of the individual names representing individual human beings that hovers on the border of our limits of perception. In this hovering, it is a sensation of experience that does not rely on rational thought.
An important part of the perception of the VVM is through a bodily experience of movement, position, touch, and time. Maurice Merleau-Ponty postulated that:

> *Our bodily experience . . . is not a particular case of knowledge; it provides us with a way of access to the world and the object . . . which has to be recognised as original and perhaps as primary. My body has its world, or understands its world, without having to make use of my' symbolic' or 'objectifying' function.*[33]

For Merleau-Ponty, this type of perception is 'preobjective' and exists without social constructs to give the perceptions meaning. In the case of the VVM, the physical perception of time is perceived through one's body as one walks across the wall of the names/the dead. Similarly, the perceived immensity of 58,000 names and the realisation that these conform to individuals is something that overwhelms thought. The descent of the paths to the centre of the 'vee' of the memorial is also a sinking into the earth and its association with burial and death communicates with the viewer at a subliminal level.

But this isn't enough to make the VVM a great work of art. How does the VVM elicit such a deep response in us? Why does this work with the VVM, but not with other nearby monuments such as the Lincoln Memorial or the Washington Monument? The answer, I believe, is in the combination of elements that the VVM presents, and that these elements combine and reinforce each other to create a separate and unique sensation in the mind of the viewer. Walter Benjamin's concept of the dialectical image is a useful way of approaching this idea. Benjamin describes the dialectical images as:

> *It is not that what is past casts its light on what is present, or what is presents its light on the past; rather, image is that wherein what been comes together in a flash with the now to form a constellation . . . the relation of what-has-been to the now is dialectical: is not progression but image, suddenly emergent.*[34]

In the VVM, these various elements combine, and, using Benjamin's words, become 'suddenly emergent'. These elements on their own have varying degrees of resonance and had the VVM only exhibited one or two of these elements there would not have been the 'critical mass' required to create the dialectical image in the mind of the viewer. The conditions of the VVM are unique, and the elements that combine to form the dialectical image are authored by different groups and institutions and these coalesce in the VVM. It is the combination of all the elements previously discussed that combined to form a dialectical image that is more than the sum of the parts.

The dialectical image occurs in the viewer in a register that is outside of rational thought or language. However, some of the elements that combine to form the dialectical image are themselves very much perceived based on rational thought and language. For example, the social power structure embodied in the 'diagram' of Washington D.C. and the accentuated importance of the Mall is a rational construct. Similarly, the embedded social context of Washington D.C., e.g., the scenes of national protests, race riots, etc are perceived rationally. The dialectical image formed by the VVM then has elements from a pre-objective perception as well as elements that are analysed through language and thought. This recalls the architect Louis Kahn's quote on the design of great works of architecture that a "great building must begin with the immeasurable, must go through measurable means when it is being designed, and in the end, must be unmeasured".[35] In the case of the VVM, elements such as the phenomenological awareness of the dead would be an initial immeasurable element, and elements such as the power structure in the 'diagram' of Washington D.C., a measurable element. The dialectical combination of these then presents itself as immeasurable.

The VVM exhibits different temporalities and these influence the meanings perceived by the viewer. To what extent is the meaning permanent or transitory? I would argue that this question is answered by identifying the degree to which socially constructed elements versus pre-objective elements contribute to the dialectical image. Socially constructed elements will have a temporal aspect to their longevity, with pre-objective elements being universal to human beings. For example, the direct connection of 'feeling' the name of a loved relative whose name is on the VVM, and the association with the direct experience of that person is limited to those generations of people alive during the time of the Vietnam war. However, future generations will still experience the tactical sensation of feeling a name on the VVM wall and connecting it to a human being, albeit a human being that is not known to them. In a longer-term socially constructed perspective, the power structure of the 'diagram' of Washington, D.C. exists in the context of the United States as an ongoing civilization, compared to extinct civilisations such as the Maya, Indus, or Mesopotamia.

Further research will look at the combination of pre-objective and socially constructed elements to consider how precisely they combine to create a dialectical image.

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**Conflict of Interests**

The author declares no conflict of interest.

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# Behind the Skyscrapers: An Assessment of Dubai's Cultural and Creative Scene

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**Abstract**
Dubai has witnessed an upsurge of creative and cultural initiatives within the years of 2020 and 2021 with strong plans and strategies of becoming the hub of creative economy in the coming years. This research traces the arts, culture, and creativity within the city to produce a comprehensive timeline and an assessment of the repository of its physical manifestations in the city. Focusing on three main districts: Dubai Historical District, Al Serkal Avenue, and Dubai Design District, the narrative of arts and gentrification are explored in relationship to governance, urban development, and social life. The findings reflect on the path of culture and creativity in Dubai's urban fabric and explores the resilience of its network in relation to factors such as community engagement, financial risks, tourist activity, and global changes to assess best practices and envisage a plan of action for the new strategies put forth.
**Keywords:** Cultural Districts; Creative Districts; Grassroot Community; Gentrification; Observational Mapping.

## 1. Introduction

Stories and narratives of Dubai have always glorified it as the city that rose from the sand or the fishing town settlement, which turned into a fast growing urban metropolis in a miraculous amount of time. Dubai truly grew from what was a small town into a global metropolis under the visions of its leaders, however to narrow the narrative into such a focused statement disregards the storylines of many other components of Dubai's making as "there are many untold stories about the city that could offer unique and valuable lessons for planning practice and scholarship." (Al Awadi, A return to the old landscape)

Dubai's transformation started shifting rapidly at the end of the fifties and by 1961, Dubai had its first masterplan, which was drafted by John Harris at the time, a British architect residing in Dubai. This master plan introduced the ideas of modernist urban planning theories into the region clearly shown within the division of work, leisure, and industry over the city's expansion outwards. These same planning theories manifested over the course of sixty years to create the city as it is known today.

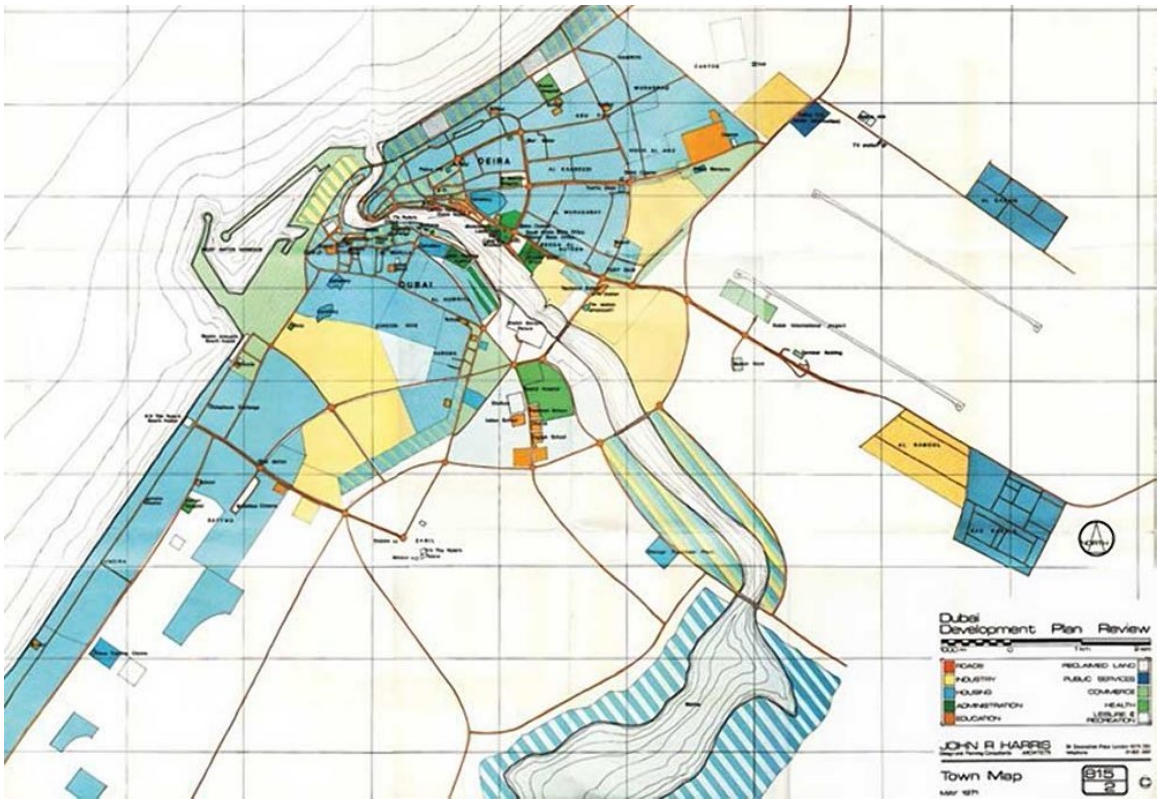



**Figure 1.** Dubai's second master plan by John Harris 1971 (Source: Dubai Municipality).

To this day, Dubai is a modernist's vision which manifested physically onto the urban fabric with large areas of land dedicated to different functions. This is why Dubai has often been described as a city made up of "urban fragments" (Archis Foundation, 2007) dictated by "traffic engineers and real estate developers" (Alawadi, 2018, p.13). Moreover, the fact that Dubai's lands are owned in a large part by developers or free zones over the government by about 51% (Alawadi et al., 2018) has led to another major phenomenon - the privatized public realms - such as shopping malls, gated housing developments, leisure destinations, theme parks, educational complexes (Archis Foundation,2007), and most importantly a number of creative and cultural districts.

This research shapes a comprehensive timeline mapping the cultural and creative movement within Dubai's urban fabric seeking to understand the nature of these creative and cultural districts by exploring the narratives of the untold stories of how Dubai's cultural and creative scene evolved into what it is today and by understanding the different creative and cultural typologies which exist in today's fabric.

**2. The Creative Cultural District (CCD) and Neighborhood Change**

Before diving into Dubai's historical trajectory of creativity and culture, it is important to define what encompasses culture and creativity and the differences and similarities within them. Creative-Cultural Districts as they exist today may be described as centrally located, and often historic, urban neighbourhoods that serve as nodes of creative–cultural production and consumption (e.g., Recording studios and music venues, art studios and galleries, live theatre, dining and retail, festivals and sporting events)." (Bereitschaft, 2014, p.3) However, Florida's (2019) definition of the creative class encompasses a much larger scope of fields that include technology sectors, academia, engineering, design and culture as the super-creative core, and the service workers in finance, health and legal fields as Creative Professionals; most of today's definitions encompass the super- creative core as the inhabitants of the Creative Cultural Districts (CCD). This leads to an important distinction on the type of creative and cultural districts; 1) cultural clusters that house concert halls, cinemas, theatres, libraries, museums, galleries and music venues 2) Entertainment zones (EZ) 'concentrated nightlife districts occupying the margins of downtowns in former commercial and industrial areas', tend to be less formal than entertainment districts, and cater to a decidedly younger crowd, 3) Historic Districts, 4) Business Improved District (BID)"usually initiated and governed by property or business owners, enabled by state laws, and authorized by local governments to provide public services in designated urban or suburban areas" (Bereitschaft,2014). The clustering or formation of such spaces is said to occur due to factors such as: economies of scale and scope, importance of proximity for the line of production to consumption, networking reasons, and the need for similar infrastructure (Bereitschaft, 2014; Ponzini, 2009; Scott, 2010, Aziz Amen, 2022, Amen & Nia, 2020). For the sake of this research, culture refers to spaces, incentives, and programs related to knowledge, art, music and cinema, while creativity encompasses a larger definition including entrepreneurship, academia, technology and engineering alongside all definitions included within culture.

Moreover, these CCD's have standard narratives in most literature that are always tied to them which are classicism (Scott,2010), gentrification and displacement (Grodach et al., 2016). Whether organically occurring or planned, the general observation is that creatives tend to cluster together and as they do, what tends to follow them next are unique spaces of consumption leading to the attraction of the upper middle class into the area. The slow gentrification of the area is fast forwarded as "Developers, property investors and governments spearhead new redevelopment projects marketed to affluent buyers" (Grodach et al., 2016, p.4) and "the expulsion of particular types of residents or even of users" happens (Ponzini, 2009; Nia et all., 2017). Other than gentrification, such spaces always create an important distinction when it comes to public spaces, where most of the spaces that constitute cultural and creative districts induce the phenomenon of privatized public realms due to their lack of integration within the existing context. Bereitschaft (2014) suggests that BID's specifically create this notion through the employment of security, maintenance and marketing strategies, however the general notion is these spaces' success depends largely on attracting a certain audience which is looking for an aura of security and hygiene standards (Bereitschaft, 2014).

However, newer literature suggests that the general narrative of gentrification and displacement of the arts is too generic and different types of cultural and creative organizations, developments, clusters, and districts can have a different effect on the urban fabric and population of an area or a city (Grodach et al., 2016, Aziz Amen & Nia, 2018). Another counter narrative is that most of the cities or even researchers that were "using" Jacob's theories to develop cities, or even mayors who took Florida's (2002) bohemian index planning methods seem to have carried out their own agendas under the false pretenses of diversifying and boosting the economy. The arts do not gentrify, "arts policy and urban policy alike have prominently shifted from supporting 'art for art's sake' and towards arts and cultural production as mainly drivers of economic development or place-based revitalization" (Grodach, 2016). Even Florida (2016) himself admits today that where creativity leads, segregation, inequality, and "winner takes all" urbanism follow and the only solution most scholars can suggest for this issue is that cities need to let go of top-down approaches in terms of creativity and cultural developments in the city (Florida, 2016; Grodach, 2016).

**3. Material and Methods**

In order to understand effects of creative and cultural developments in Dubai, a multilayered approach and socio-spatial analysis must be carried through. First, a comprehensive timeline of Dubai's cultural and creative path is to be established to understand the trajectory of the city's development. Then, understanding the different types of inclusion and exclusion that can be imposed through public policy and investment down to the architectural and geographical barriers of these sub-societies is carried through the collection of three data sets: (1) cultural and urban policy correlation in Dubai and how they materialize in the city through publications, research on policies, and urban development, (2) geographical and architectural features of the different creative and cultural developments through archival and field research, (3) social life of public spaces in the areas of these developments through observational mapping and interviews. Due to time and resource restraints, three neighborhoods were selected of different typologies to study the variety of the Dubai cultural landscape in relation to the hypothesis. Therefore, this research will focus on Dubai Historic District (Public), Al Serkal Avenue (Private), Dubai design District (Developer/Freezone).

**4. Tracing Dubai's Cultural and Creative Path**

Dubai's cultural and creative journey can be summarized in a manner of looking at the growth around the year of 2008; pre and post. Starting with the first structure of cultural significance – Al Ras library built in 1963, a structure of the late Modernism that had entered into Dubai's fabric in the 1960's, the library was one of the markers of urban transformation of the town into a city and more importantly a marker of the importance of culture and knowledge from the early stages of Dubai's formation. The period between the sixties and eighties establishes what is known today as Historic Dubai as a place of arts and culture with the formation of spaces such as the Dubai Museum 1971, the Majlis Gallery 1975 in Al Fahidi, and the restoration efforts carried on Sheikh Saeed Bin Maktoum House in Shindagha 1986. The next decade – the nineties - Dubai becomes a repository of different movements in culture, art, and creativity where different galleries settle into the new neighbourhoods of the city, and the foundation of cultural heritage and preservation gradually seeps into the urban narrative of Dubai. This decade defines the growth of the anchor points of culture in the city as movements are seen in the Historic Area with preservation efforts off Al Ahmadiya school and the opening of Juma Al Majid Center for Culture and Heritage and Sheikh Mohammed Centre for Cultural Understanding (SMCCU), the downtown area around Satwa and Jumeirah with Hassan Sharif's Atelier and Green Art Gallery respectively, and Al Quoz with the inauguration of Total Arts Gallery, 1x1 Gallery and finally the Courtyard in 1998. The openings in Al Quoz, Al Shindagha, Al Fahidi, and Jumeirah all formalize these spaces in the city as places for culture and creativity to prosper and furthermore, they invite other alike institutions to slowly agglomerate into these spaces as can be seen in the beginning of the 21st century. In 2003, the art scene sees another boom of galleries with the opening of Art Space Gallery by Maliha Al Tabari under the patronage of Princess Haya Bint Al Hussain in Fairmont Hotel Sheikh Zayed Road and XVA Gallery in the Al Fahidi District. The following years between 2005 and 2007, Al Quoz's galleries and art institutions count goes up with the establishment of the Third Line gallery and the Jam Jar in 2005, B21 in 2006 and the Dubai Community Theatre and Arts Centre/DUCTAC, and the existing Etemad gallery and Total Arts alongside Meem Gallery and the Flying House (Nouvel, 2020, p.5). Another important marker in Dubai's establishment of contemporary art is seen in 2006 with the first auction of International Modern & Contemporary Art in the Middle East held in Dubai (Nouvel, 2020, p.5) This sparks one of the most important events of Dubai's art path with the culmination of the Gulf Art Fair in 2007. On the other hand, this decade also introduces the first creative free zone into the fabric of the city, which opposes the organic growth that has been seen up to this point where three different free zones are established; Dubai Media City, Dubai internet City, and Dubai Knowledge Park.

The next year becomes the year that defines Dubai's establishment of a cultural and creative city with the formalization of government agencies and private foundations which open the city into a greater spectrum of narratives and stories of cultural history. The year 2008 becomes a radical year of change in Dubai's cultural narrative; this is highlighted in the various literature written on the subject matter with many timelines starting as early as 1998 and ending in 2008 or others only starting from the early 2000's then highlighting 2008 as a pivotal point with some only focusing on certain districts storyline (Allison et al., 2017; Nouvel, 2020; Harper's Bazaar Arabia, 2021; Vignal, 2018). There are many reasons why 2008 becomes the year of change for the Arts in Dubai but the most important one starts with the restructuring of the Dubai Cultural Council into Dubai Culture and Arts Authority in March 8 2008 as part of the Dubai Strategic Plan 2021[1]. The same year witnessed a large number of exhibitions,

[1] The Dubai culture and Arts Authority was established under the Law No. 6 of 2008 with 16 clear objectives in the fields of heritage, literary, arts and culture.
https://dlp.dubai.gov.ae/Legislation%20Reference/2008/Law%20No.%20(6)%20of%202008.pdf

districts, and art destinations forming all around the city. Starting with the further agglomeration of galleries in Al Quoz with the joining of Ayyam Gallery, and the beginning of the formation of Al Serkal Avenue right opposite the courtyard under the patronage of Abdel Monem Al Serkal and his family with many galleries moving into warehouses owned by the family and run at the time by a real estate agency. In downtown, DIFC Gate Avenue had officially become a home for a number of galleries which made it into a destination of galleries and restaurants. East into the desert, a small but magnificent modernist building became the home for Tashkeel, a space offering galleries, workshops and multidisciplinary studios by H.H. Lateefa Bint Maktoum with a branch established in Al Fahidi District later. In the same year, Dubai Culture and Arts Authority announced a large mixed-use project right in the heart of the city called the "Al Khor Cultural District" (Nouvel, 2020, p.6) which took many later years to materialize into reality. The year of the financial crisis actually turned into a positive outcome for the Art scene in Dubai; firstly, a large hit on the rental prices of many spaces making Dubai more affordable, the formalization of an arts community and the patronage of the government for a cohesive cultural program, and the emergence of new investors in the arts sector as the real estate market was down (Nouvel, 2020, p.8-9).

The coming years sees a flourishing of concepts, galleries, and artistic spaces around the city in Al Serkal Avenue, and DIFC especially. Furthermore, an establishment of local and international art fairs program, the formation of critique and more importantly a large governmental support for the arts and creativity sector. In 2014, the Dubai Technology and Media Free Zone Authority (DTMFZA) was renamed the Dubai Creative Clusters Authority (DCCA) with the addition of a purpose built master plan project under its jurisdiction – Dubai Design District – which had the first phase completed in 2015. This era sees a new trend in cultural development that is not seen in the usual trajectory of arts development in cities- the planned districts – where another added master plan known as the Dubai Culture Village is added to the Dubai plan in 2014 under the Dubai Properties Authority. A third development announced in 2015 is the Dubai Historical District project (what was announced as Al Khor Cultural District in 2008) is finally launched under three governmental entities Dubai Culture and Arts Authority (DCAA), Dubai Tourism and Commercial Marketing (DTCM), and Dubai Municipality[2] with a masterplan including around 20 museums, restaurants, and a boutique hotel. This establishes a benchmark for future developments of the city that started with the free zones of the early 2000's and differentiates Dubai's cultural plans and growth than most cities.

In April 2019, Dubai Culture and Arts Authority appointed a new ambitious strategic plan "to be a global cultural destination and a centre for talent and innovation". The strategy announced different initiatives, one being the introduction of a cultural visa to attract artists to coming into Dubai and ease the process[3], and another was the transformation of Al Quoz area into a creative district. The year 2020 shows the resilience of culture and how culture and creativity flourish even in the worst of times, this is reflected in how the creative economy has become one of the most powerful sectors in Dubai's financial investments. This is done through ministerial and local legislations and initiatives which aim to attract, fund, and invest in the talent and creativity of people from around the globe. The impression at this point in time, that the hard infrastructure (buildings, spaces, urban blocks) is already complete and it is time to complement it with soft infrastructure (programs, initiatives, legislations, etc.) to create a whole circle. This however, does not entail that the current infrastructure in place is on standby, as many of the aftermath effects of the established scene start showing within the fabric of the city through urban changes that are not induced directly by the artistic and cultural scene further explored in the next chapters.

## 5. Macro Scale: Neighborhood Changes

### 5.1 Al Quoz Creative Zone

By 2019, the attention that had surrounded Al Quoz has truly started to grow with the introduction of Al Serkal Avenue almost a decade ago in the area as many concepts and restaurants have joined the Al Quoz area replacing industrial spaces with retail, café, and gym spaces mostly alongside galleries as a main use. The organic movement of galleries to Al Quoz initiated the Al Serkal Avenue and in turn Al Serkal Avenue's, alongside the Courtyard's, increased footfall attracted the governmental efforts of culture and creativity by setting the Al Quoz area as one of the main projects of the new strategy initiated by Dubai Culture and Arts Authority in 2019[4]. Despite no clear decisions, in 2021, it was announced as the "Al Quoz Creative Zone"; the area is said to become a free zone. The project is mainly run under the supervision of Dubai Culture; however, a project team has been formed involving the Dubai municipality, Roads and Transport Authority, and Al Wasl Asset Management Group, Brand Dubai, and

[2] https://www.thenationalnews.com/uae/green-light-for-dubai-historical-district-project-1.17300

[3] https://www.mediaoffice.ae/en/news/2021/March/02-03/Dubai-Culture-to-grant

[4] https://dubaiculture.gov.ae/en/Media/Press-Releases/Pages/Mohammed-bin-Rashid-approves-the-new-vision-of-Dubai-Culture.aspx

Department of Tourism and Commerce Marketing[5]. The current announcements have revealed that there will be enhancements carried out in terms of transportation and soft mobility which would be an asset to the area, however a prototype of the new spaces show a predictable developer carbon copy format which emulates a much different future for the area.

**5.2 Dubai Historic District**

While the government's attention to the larger Al Fahidi area has allowed for the preservation of the historic fabric and heritage of the city, it has also sparked the interests of an opposing development interpretation; the area has now been a site of urban renewal projects and has attracted many developers to the areas. Due to the lack of legislation and control of the Dubai Municipality on many of the surrounding areas and the complex relationship of semi-private developers in the region, there has been an adverse effect creeping into the historic district with the Al Seef project completed in 2017 by Meraas right at the border of the Al Fahidi District[6]. The new project demolishes the efforts of the culture and municipal authorities in preservation and rehabilitation in both aspects. From the neighbouring side of Al Fahidi, Al Seef buildings have an embellished and misinformed interpretation of the old wind tower houses of Dubai made of new materials and aged in a theatrical manner to show distress that is not even seen in the originally preserved houses. Moreover, on the other side of the project, the contemporary buildings are carbon copies of Real Estate Developers', in particular Meraas' projects seen in other parts of the city. The "old" portion of the project blurs the lines between traditional houses and the artificially aged new ones which confuses visitors that might not be aware of Dubai's old architecture. The new buildings, likewise, completely disrespect the context of heritage creating a dystopian futuristic city effect with their industrial and international style as they encroach on historical territory, however completely disregard the architectural style of the space. Moreover, alongside the Shindagha shoreline, a new "Infinity" bridge has been completed with a futuristic steel design and on the other side of the shore, the Deira enrichment project is almost fully completed creating another discontinuation in the historic context with its grandeur modernity. Despite all the above, Al Fahidi Neighbourhood and Al Shindagha are still considered as potential spaces of generating creative economy as the Shindagha Museum is almost completed and set to open soon and Al Fahidi Neighbourhood has been announced recently to undergo a rehabilitation and revitalization project, however not much is revealed on the exact plans.

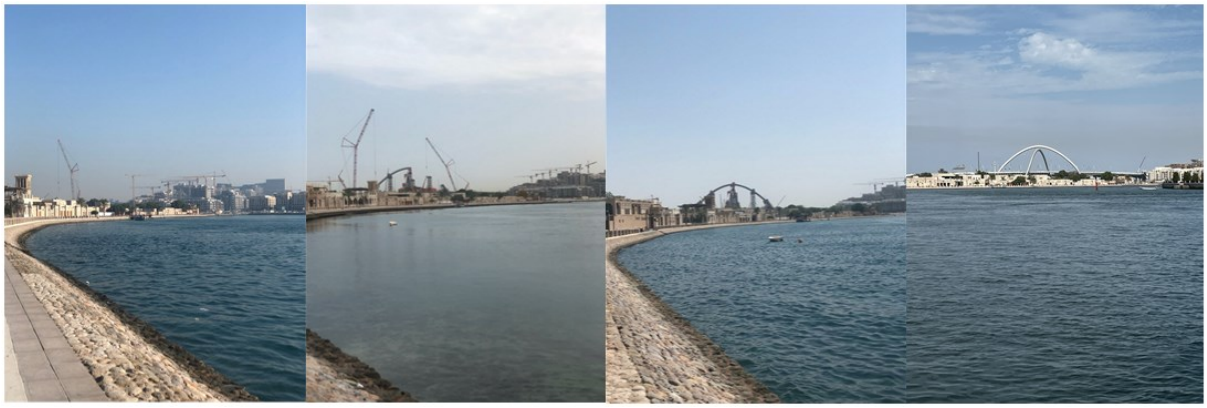


**Figure 2.** Progress of Deira Enrichment Project and Infinity Bridge from right March 2021- April 2021 -June 2021- Dec 2021(Source: Author)

[5] https://www.thenationalnews.com/arts-culture/art/al-quoz-creative-zone-dubai-s-newest-creative-hub-kicks-off-first-workshop-1.1208839

[6] https://gulfnews.com/going-out/society/al-seef-where-old-dubai-meets-the-new-1.2111592



**Figure 3.** Al Seef Project by Meraas - on the left: the modern part, on the right: the newly built historical replicas (Source: https://dubaiofw.com/al-seef-dubai/)

**5.3 Downtown Dubai**

The Downtown Area's development differs from the other neighborhoods slightly where in Downtown the grassroot initiatives were in a smaller capacity and the shift to planned districts came in earlier. The DIFC Gate Avenue was the first planned district in the area in the year 2008 which later attracted many galleries into its space. Today, DIFC gate avenue's galleries are in competition with the many fine dining restaurants surrounding them. Not long later, another project was announced as part of the revitalization of the downtown corridor which was the Dubai Design District. The Dubai Design district differs in terms of urban development in that it was created purposefully as a creative district. It was a masterplan that dedicated 1.9 square kilometers (21 million square feet) of Dubai's land under the supervision of TECOM group as a free zone. The project consists of three phases; phase one (consisting of 10% of the land) was completed in 2015, made of eleven buildings consisting of office and retail spaces for the creative community. The design process involved "leading global figures as well as local talent from across the spectrum of the creative industries"[7]. Phase 2 is currently on hold and Phase 3 is known today as "The block" which consists mainly of restaurants. The Downtown actually becomes a clear example of using the agenda of creativity and culture for the actual reason of revitalization and change.

**6. Micro Scale: Social Life**

This layer of information was collected to understand people's perception of these spaces and how different groups react and interact to these spaces in the city. A combination of methods were taken as a field survey for the different districts which included static observation, dynamic observation, interviews with users and visitors of the space, interviews with business owners, and interviews with artists that interact with these districts. The timelines show the differences in the three districts where in most of them you can see the decline of activity in the nighttime, a bit less in Serkal due to the new activities introduced such as sports and F&B, while in Shindagha the closing of the museums leads to the emergence of an illegal activity: betting kiosks. Moreover, the social life also emphasizes the importance of land use in the sense where D3 truly shows as an office space having the peak of its day within lunch breaks of employees. Dubai Historic District's neighborhoods reveal that tourists are the largest audience group that visit these spaces due to their interaction with the museum spaces and their interest in seeing the "other side of Dubai". The most surprising activity within these spaces falls in Shindagha Historic District where a large group of nearby residents use the public spaces as an exercise area in the morning and a picnic area in the afternoon. On the other hand, the largest similarity in these spaces is seen in event or festival days, where people of all ages, ethnicities and social status gather to enjoy the public activations surrounding the areas and enjoy what these communities have to offer.

[7] https://www.arabianbusiness.com/revealed-dubai-design-district-plans-in-detail-565307.html




**Figure 4.** Compiled timeline of three studied districts showing the typical daily social life in each space (Source: Author)

## 7. The Patterns

### 7.1 The Growth Patterns

Although throughout the decades there has been a constant rise of cultural and creative spaces within the city's fabric, Dubai's art scene has definitely seen a non-linear postmodernist approach (Nouvel,2020) as evident in figure 5, which creates a unique landscape of arts, creativity, and culture throughout the city. The city's mixture of planned and organic developments also has contributed to the complexity of its nature creating noteworthy enclaves within the urban fabric. Many of the initiatives were spearheaded by individuals passionate for creating something that speaks to them within the city at first, however the scene that exists today is due largely to the governmental and developer approach that is distinctive to Dubai.

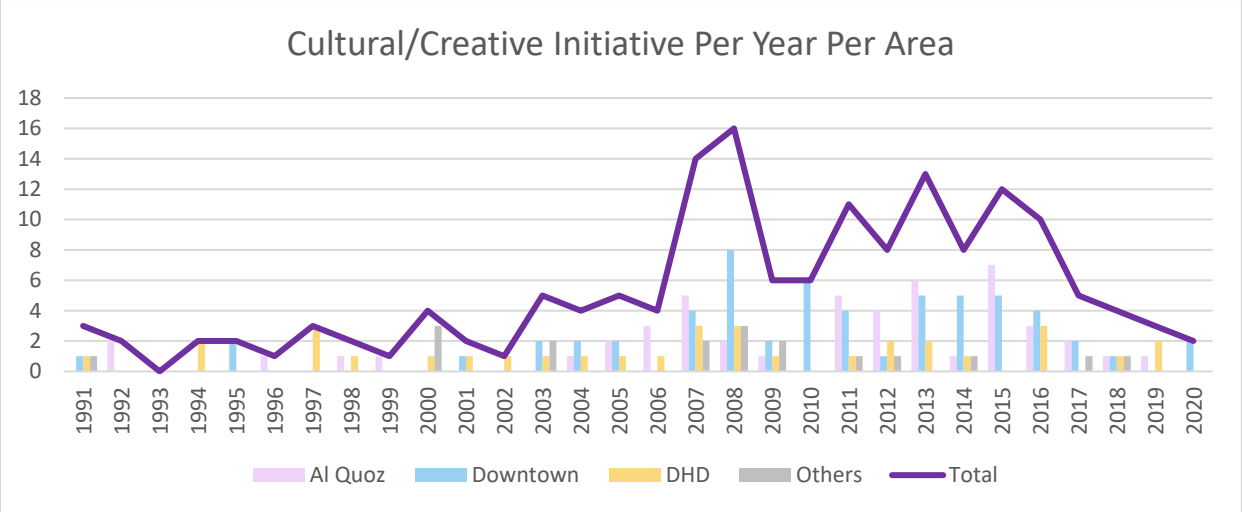



**Figure 5.** Cultural/ Creative Initiatives Per Year Per Area (Source: Author)

All the districts in Dubai that exist whether as planned or organic agglomerations fit the typical narrative that artists and creative tend to cluster for reasons such as the need for similar infrastructure or proximity to production spaces or the most common reason found in Dubai, rent, and then this leads to the creation of districts. Al Quoz was being utilized by different galleries, such as Total Arts (1992), The Third line (2005), and B21 Gallery (2006), as it offered the perfect space and blank canvas for many galleries, and then as more galleries came in due to rental prices between 2009 and 2011 (Carbon 12, Ayyam Gallery, Green Art Gallery, Gulf Photo Plus), the entrepreneurial decision was made to create a district dedicated to the arts and creativity. This in turn led to the government's decision of taking the opportunity of turning the larger Al Quoz area to a creative zone. The same goes with the downtown area where the "favorable winds" (Nouvel, 2020) and the growing appetite of the city for arts alongside galleries such as Tabari Art Space (2003) and Green Art Gallery (1995) predicted the creation of a dedicated district in DIFC, Downtown and later sparked the idea of creating another purposefully planned area, Dubai Design District in 2015. While in Dubai Historic District, the narrative follows the typical urban revitalization timeline seen in Jacobs (1961) and Florida's (2002) works and the wake of the importance of historic preservation within the GCC region (Boussaa, 2014) alongside the existence of spaces such as the Dubai Museum (1971). Majlis Gallery (1979), Sheikh Saeed Museum (1987), Heritage Village (1987) allowed for the realization of the importance of these spaces by the government turning them into a touristic destination and the concept of creating a historic downtown.

This approach led to a gated and clustered map of the creative and cultural spaces which can be largely pinned to the downtown areas of the polycentric Dubai emulating the Modernist planning principles enforced within Dubai's larger map. In other words, creative and cultural spaces were moving in a nonlinear and organic fashion through the city, however the formal responses within the urban fabric and the governing agencies overtook the informal growth language and dedicated centers for these spaces. The same formalized growth patterns are now being echoed within the new planned districts of Al Shindagha and Al Quoz Creative Zone creating "deliberate segregation and decontamination of numerous cultural institutions from the ordinary city" (Jacobs, 1961) with no regards to the failed global counterparts which fulfilled Jacob's vision that predicted cultural and civic centers and the centralization of cultural resources would be "tragic in their effects on their cities" (Jacobs, 1961). The effects are already being seen in spaces studied above where there is a disconnect of the districts from the city with either formal barriers such as gates or informal barriers of governance and rules which accompany the "decontamination" of these spaces, therefore adding more spaces of the same module will only amplify the effect within the city. Especially in terms of free zones, where the spaces seem to be not connecting either to the users such as galleries and entrepreneurs or the majority of residents due to the fact that they are not connected to the city's main planning entity.

Another major pattern is seen in the introduction of new projects and opportunistic investments due to the movement of these cultural and creative spaces into their respective areas. The patterns are seen in short-term displacements and microaggressions or long-term gentrification processes both reinforcing the theory that the arts, creativity, and culture are not direct perpetrators of gentrification necessarily. In reality, the case of Dubai reinforces the account of "treating the arts as amenities that catalyze land development and lure upscale consumption" (Grodach, 2016) as seen in the new developments of the Dubai Historic District or what possibly will become of Al Quoz Creative Zone plans.

"The cultural glamour surrounding such areas fades once capital is injected and more generic commercial land use dominates and displaces artistic originality and creativity" (Elsheshtawy, 2020, p.254) and this is exactly what Dubai's

current patterns and futuristic plans emulate. It is noteworthy to point that such approaches have deemed to be unsustainable in the long run, however just as Modernism was adopted in Dubai in the sixties when Jacobs and advocates were already condemning the consequences, it seems that the same approach of adopting western ideologies of bohemian enclaves and the "SoHo Effect" seems to be the current trend in planning creative cities. It is already evident in many cities such as London, Bilbao, New York, Shanghai, etc. that the module of formal and government-led initiatives is not sustainable. Scholars such as Grodach (2016) and Florida (2016), argue that the planning for arts should solely be for the arts for it to be successful and well-integrated into the city, and this was evident in the semi-organic development of Al Serkal Avenue, and its neighbor the courtyard within the Al Quoz Area as opposed to the aggressive development of the Dubai Design District area or the touristic wonderland of Dubai Historic District.

**7.2 The Social Patterns**

Zooming into the districts themselves, the subcultural enclaves evidently have created pockets within the urban fabric emulating new urbanism theories of the vitality of mixed uses. A certain similarity was seen in a few aspects of the different case study neighborhoods and generally to city and neighborhood design; diversity of operating times through diversity of land use and the effect of activation of space in the public realm.

First, most of the neighborhoods (with the exception of Al Serkal in 2020 and 2021) seemed to be quite deserted at nights and become dead spaces which is a testament to the validity of Jane Jacobs' theory that healthy and lively cities must have spaces which have diverse land use, used by a diverse population through day and night (Jacobs, 1961) however the current status used "to build 'creative cities', support the 'creative economy' and attract 'creative-class' workers are not helping cities to fulfill Jacobs' vision of what makes a city live." (Rosenstein, 2009, p.1). In Al Serkal Avenue and Dubai Design district, with the addition of gyms and food and beverage businesses, some signs of nightlife have been seen around the avenue. The emptiness in the day versus the small crowd in the night show how there is a crowd that is looking to spend their time there at night especially that during the day most people are at work and don't have the time to pass around. Moreover, in Al Shindagha and Al Fahidi this pattern is the opposite as the mornings and afternoons are more lively with the museums operating and the government entities working and the flock of usual tourists taking their tours. At night, the crowds are quiet, however an illegal activity of betting[8] takes place and this again is evident in Jacobs' (1961) theories where she states different examples of how nighttime activations allow for lower criminal activity. Additionally, the importance of activation of space is evident in all event days as the volumes of crowds of different nationalities flood into the districts, encouraging different and new experiences to the public and engaging the city with the creative developments. Al Serkal Avenue and Dubai Design District are witnessing a larger flow as they are accompanied with a full-rounded programming calendar within the year as opposed to Al Fahidi Neighborhood which only hosts Sikka for three days within the year and Shindagha days for another three days in Al Shindagha Historic District. Hence, it is imperative that these neighborhoods, just like the rest of the city must be diverse and alive during different times of the day and more importantly activated with comprehensive programming to ensure healthy, lively, and safe environments.

Surveying the current arts and creativity scene reveals the notion of what is yet to be established in terms of culture and creativity in Dubai's landscape. Seemingly, the current hard infrastructure still does not serve as the ideal space for creatives and cultural seekers- many business owners and artists seem to not connect to the current spaces proposed or have chosen to settle in the best option offered (see figure 7), others view these existing areas as high rent spaces (as evident in the figure 6 showing empty spaces within each district). However, government efforts are catering to certain artistic individuals for the upcoming plans of the Al Quoz area showing that there is a small change towards a community participatory planning approach. Nonetheless, little else is to be revealed in terms of the Al Quoz area or even the larger cultural plan meaning there is still a lack of transparency in terms of the future developments, therefore they cannot be fully analyzed or evaluated.

[8] Gambling is completely forbidden in UAW law. As per Article 414 of the UAE Penal Code, 'whoever gambles shall be punished by detention for a maximum period of two years or by a fine not exceeding Dh20,000.

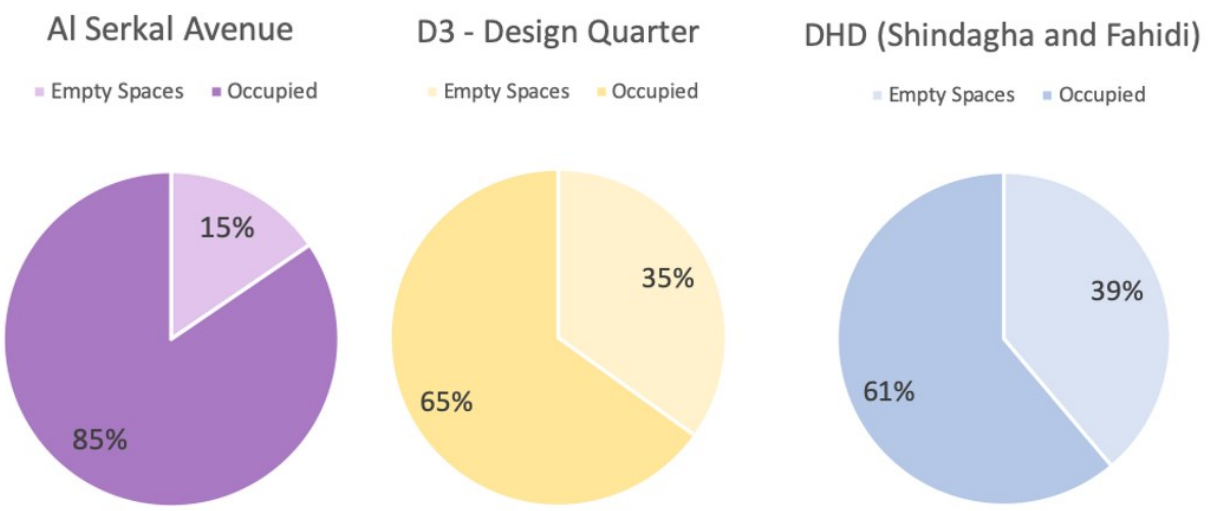
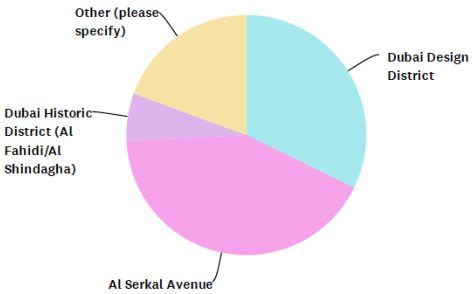



**Figure 6.** Empty vs Occupied Spaces per district (Ground floor occupancy only) - (Source: Author)

Q7 If you had to choose a place to set up your business/gallery/venture, which would it be?

Answered: 31 Skipped: 0




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Dubai Design District | 32.26% | 10 |
| Al Serkal Avenue | 41.94% | 13 |
| Dubai Historic District (Al Fahidi/Al Shindagha) | 6.45% | 2 |
| Other (please specify) | 19.35% | 6 |
| TOTAL | | 31 |

| # | OTHER (PLEASE SPECIFY) | DATE |
|---|---|---|
| 1 | Renovated one-storey villas in Jumeirah | 6/7/2021 3:15 PM |
| 2 | It depends on the nature. If it is an art gallery or a product design studio then I will need a bigger space. In this case I prefer utilise a warehouse at serkal Avenue. If it is only an office then D3 since it allows me and others to collaborate while being immersed in creative community. | 5/30/2021 7:52 PM |
| 3 | None. Affiliating with a district/avenue shouldn't be the norm. | 4/17/2021 2:53 PM |
| 4 | Those have now become high cost areas. Somewhere new | 4/12/2021 7:25 PM |
| 5 | literally far away from these places, subject targeted districts are all just aesthetically cool gimmicks with like 5% intention to support rest to just capitalize off "culture" | 4/12/2021 5:58 PM |
| 6 | It could be any of the above options, but I am aware that the rental prices are very high so it might not be achievable for me at this time. | 4/12/2021 3:43 PM |

**Figure 7.** Survey Responses regarding which district would be chosen as ideal space to set up a business showing Al Serkal Avenue as first choice (Source: Author)

The interviews with artists, creatives, gallery owners, and entrepreneurs revealed that the most sought-after improvements are actually within the soft infrastructure, moreover, it is important to note that spaces are only alive with the right programming and placemaking features (Jacobs, 1961; Gehl, 2010). Consequently, Dubai's efforts in creating a future of culture and creativity must first realize the reality that there is a large gap in the audience awareness, the urban planning, and economic procedures, and space development process currently omnipresent in the city. These underlying issues must be addressed to create a sustainable creative and cultural module before

moving ahead with further plans since the "build and they will come" will not be feasible in this scenario as evident with the Dubai Design District model.

**8. Conclusions**

Opposed to the formal growth of Dubai's Modernist vision, the arts scene witnessed a non-linear growth with an array of peaks and low years generating an urban pattern that is true to Dubai's informal spaces. The organic growth of the cultural and creative spaces in Dubai contrasted with the rigid modern grid, yet slowly and forcibly adopted into it. This created little mixed-use enclaves within the city which harnessed cultural and creative activities for the citizens and allowed for a thought-provoking narrative born within Dubai's common storyline. The year 2008 became a turning point in Dubai's cultural timeline due to significant governmental actions and entrepreneurial ventures which allowed for the creation of a starting point for the emergence of a cultural network of districts, events, and institutions. This allowed for a semi-formalization of the organic evolution of some of the pre-existing spaces and for the planned approach of creative and cultural districts to emerge as a module in the city. Al Serkal Avenue started as an organic clustering of galleries due to rent then shifted into a district, and Al Fahidi was planned as a restoration project, however, the tenants grew organically into the district; on the other hand, the introduction of planned districts became the norm from the year of 2008, starting with DIFC, then Dubai Design District and Shindagha Historic District, and today Al Quoz Creative Zone. This created clusters isolated from the "ordinary city" fabric through physical gates or boundaries and nonphysical barriers such as governance.

The current landscape of culture and creativity in Dubai requires central governance and a decentralized physical manifestation. All current modules have led to the gentrification patterns on a larger scale of development and smaller scales of removing the current creative and cultural spaces rather than supporting them. Therefore, an action plan needs to be taken which supports the plethora of cultural and creative spaces already existing in the city rather than replicating more carbon copies of existing districts. There is large support and advocation for creativity, culture, and art within Dubai's timeline which allowed for the creation of an initial network, however, the current direction shifted to focusing on the creative economy.

> "It is time to let go of the creative city planning agenda and concentrate more on how the arts might play a role in starving off some of the more inequitable outcomes of contemporary urban development."- Carl Grodach

Future developments must focus on community boosting and effective neighborhood planning with the incorporation of the public, transparent codes and permit processes, public programming and space activation around the year alongside cultural and creative educational groundwork, and integrating the cultural agenda with major decision making roles and entities of the city such as urban planning and infrastructure development to cultivate a mature soft infrastructure supporting the sustainability of the existing cultural and creative spaces and cementing a cultural network within the fabric of the city. There are steps taken in 2021 that exhibit the aforementioned recommendations, however, the focus on creative economy might lead to the same effects seen in global counterparts such as North America, where today, urbanists like Florida have already realized that such methods create a "new urban crisis".

The above was revealed through the studies and surveys carried through; however, it is also noteworthy to mention that there has to be further studies exploring larger samples of creatives to understand truly what the city's needs are, and further studies into each district mentioned in this research to allow for a comprehensive body of knowledge within the creative and culture sector as it is moving forward.

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**Conflict of Interests**

The author declares no conflict of interest.

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# Adaptive Reuse as a Tool for Sustainability: Tate Modern and Bilgi University Cases

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**Abstract**
Examples of "adaptive reuse" have started to be applied for giving new functions to the structures in historical environment are commonly used in the world and in Turkey. According to the current planning practise, the future applications should be done with consideration of different dimensions of sustainability. Aim of this study is to examine Tate Modern and Bilgi University Campus that used to have similar functions and were inhabited before restoration interventions in sustainability framework. Both cases were refunctioned with adaptive reuse concept. The structures transformed from energy buildings to serve as art museum and educational/cultural functions. Cases were compared in terms of sustainability principles. Social, economic and ecologic benefits of physical interventions were asked on structures which couldn't continue their original functions and refunctioned by adaptive reuse. Results support the positive impacts of adaptive reuse not only for the structures themselves but also for the environments they were located.
**Keywords:** Adaptive Reuse; Sustainability; Reuse in Historical Environment; Refunctioning; Sustainable Conservation.

## 1. Introduction

Necessity of conserving historical cities is accepted and inarguable with all its economic, cultural and ecological dimensions. According to the International Council of Monuments and Sites (ICOMOS) historical cities and areas are known with not only documentation features but also with their values belonging to urban culture (ICOMOS, 1987). The structure in architectural environment are reflections of the lifestyles of cultures they belong to. In this sense, it is essential to conserve them with the heritage value they carry. Transformation of cultural heritage to the next generations without any damage expresses the continuity of conservation in socio-cultural point of view. Keeping the structures that are valuable in some aspects alive by conserving them is more effective only when new functions are assigned to them. All these works are applied considering the concept and dimensions of sustainability nowadays.

Transferring the history without any interruption can be available by sustainable conservation. Giving new functions or conserving the structures by adapting their original functions have become an intervention method. In this sense; the major tool is "new addition". According to Hunt and Boyd, new needs should be done in a contemporary language in order not to cause any confusion and without decreasing the original value (Hunt and Boyd, 2017).

Plevoets and Cleempoel argue that "adaptive reuse" have been started to use more frequently in the sense of urban, architectural and conservation strategy and sustainability of the biggest reasons for this. Concept of sustainability refuses the big scale demolitions and seeks the solution to guarantee ecological and socio-cultural pattern for the sake of future in transformation (Plevoets and Cleempoel, 2019). Giebeler and Kahlfeldt evaluates the renewal concept as an adaptation of a structure in order to satisfy current standards caused by user's needs or technical organisations (Giebeler and Kahlfeldt, 2009; Akdağ & Sayar, 2020). It is acceptable that structures may be out of use or their functions may not be sufficient in time and besides they may be deteriorated. Roca et al. describe these factors as natural ones, climate changes, earthquakes, fires, human caused deteriorations (Roca, Lourenço and Gaetani, 2020). Conservation interventions have been developed against these deteriorations for the sustainability of these historical constructions. After interventions to ensure the physical integrity of the structures, some similar applications like reanimation, rehabilitation, revalorization, adaptive reuse are used to give new functions. Venice Charter (5. Article) emphasizes that monuments should be used for socially useful purposes and it is within these limits only that modifications demanded by a change of function should be envisaged and may be permitted (ICOMOS, 1964).

The changes that are emphasized within these limits are managed through these additions. Even though there are not any clear legal acceptance regarding design principles of these additions, common features of these are evaluated as they become widespread. In addition, conservation attitude of the country, authorized institutions, political conditions, legal arrangements and socio-cultural approaches would affect the approaches towards new designs (Büyükmıhçı and Kılıç, 2015). Rush; mentions the importance of three subjects; sustainability, architectural

feature of additional structure and integrity on the connection of old-new about the historical structures' additions (Rush, 1986).

Adaptive reuse is an application that is used frequently and is attracting attention in recent years among interventions used as a tool for sustainable conservation. In this study; an inspection over different cases were done in order to understand adaptive reuse as a concept. Design principles and criteria to be considered while adaptive reuse studies are being carried out were evaluated in applied case studies with the additions they have. It is among the sub goals to examine the concept of additions that are used in adaptation of transformed structures spatially and functionally.

## 2. Literature Review

### 2.1. Refunction and Adaptive Reuse as A Tool for Sustainability

The basis of enabling the sustainability in historical environments rely on evaluating the current resources. Adapting the existing structures by conservation methods and transferring them to the future provide a big resource management. Bullen describes restoration applications as returning the structure back to its original state and renovation as adapting the structure in order to reach current standards (Bullen, 2007). Refunctioning of the structures usually requires adaptation to current conditions. Adaptive reuse is an effective tool for the sustainable conservation in historical environment. It is often needed to introduce new additions to the structure since the works for adaptive reuse is usually related to the new function.

Adaptive reuse is a concept that came out because demolishing and rebuilding of current structures took more time, energy and cost (Velthuis and Spennemann, 2007).

Giving a new function and adaptation of historical structures as functional and spatial means an application that carries all aspects of social, cultural, economic and environmentally. According to Afify, adaptive reuse and refunctioning provide new job opportunities for the society by social cohesion and conservation of cultural identity, creating labour force during restoration applications, economic and social benefit by introducing a modern interpretation of living spaces of their ancestors to young generations (Afify, 2018). Adaptive reuse means enabling economic, cultural and historical continuity, having a labour based process instead of energy consumption and becoming an indicator of ecological approaches (Kuyrukçu and Kuyrukçu, 2015). Yung and Chan; describe adaptive reuse as a form of sustainable urban renewal and argue that renewing a structure instead of demolishing it, has social, environmental and economic benefits for the whole world (Yung and Chan, 2012).

Tanrısever, Saraç and Aydoğdu (2016) express sustainable processes of refunctioned structures visually as in Figure 1.

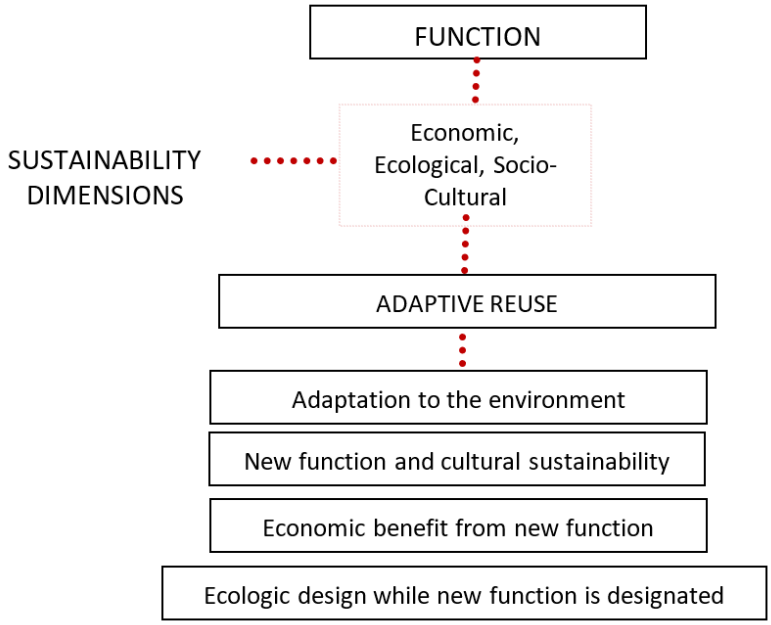



**Figure 1.** The process of refunctioning applications in terms of sustainability (Developed by the authors using Tanrısever, Saraç and Aydoğdu's work)

Adaptive reuse is defined as using existing structures with new functions in general description. It usually consists of designation of new functions to the isolated structures. The basis of the application refers to the transformation; this transformation is often not only for the function but it enables the transformation of material if possible.

Continuity of cultural phenomena, the existing infrastructure and protection of the place are aimed (Wong, 2017). Sustainable adaptive reuse applications are only possible by choosing a function that people would adopt and like to use in social sense. It is possible to maintain economic sustainability on the condition that the structure is assigned with a new function that would provide benefit without harming the authenticity. While creating new designs by adaptive reuse, priority is given to green spaces especially on the transformation of the inhabited industrial areas with large plots. Restoration applications often contribute socio-economic sustainability as they create a need for new workforce. Transformation of attraction points belonging old generations in urban areas allows sustainable socio-cultural conservation.

**2.2. Conservation and Dimensions of Sustainability in Historical Environment**

Concept of sustainability was first discussed comprehensively by former Prime Minister of Norway; Gro Harlem Brundtland in Brundtland Report published by United Nations in 1987. The main theme of the report which focused on environmental concerns and consisted of sustainable development strategies is "Our Common Future". Unesco (United Nations Educational, Scientific and Cultural Organisation) defines sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet own needs" (Unesco, 1996). Isolated structures in historical environments both cause the cultural heritage to be lost and create negative impact for the urban identity. For this reason, a planning cycle that can be called as sustainability or continuity was arisen. Reuse and recycling were added to the sustainable design processes which are planning, design, implementation and evaluation stages (Kuyrukçu and Kuyrukçu, 2015).

According to Rodwell, some sources define historical conservation is equal to sustainability. By prolonging a structure's life, saving of energy, money and material is obtained and the best benefit is achieved by conservation. Therefore, sustainability and conservation can be described as complementary (Rodwell, 2017; Rahbarianyazd, 2014). An emphasize of the economic advantage on conserving and transforming structures on historical environments instead of constructing a new one is done. Lower consumptions of sources and lower costs on transportation and installation encourage the refunctioning in terms of economic sustainability. Besides, a new function designated to an isolated structure would enable the structure's sustainability by vitality and new income potential.

The quality of the historical cities starts with environmental potential that urban infrastructure and structures represent and socio-cultural values together with roles of defining social cohesion and belongings of the society. An uninterrupted timeline represented by the past, present and future expresses this socio- cultural value (Afify, 2018). A multidimensional character is gained by contemporary additions that are done mostly for the new functions.

Due to the processes of transportation, installation, material and construction stages, the cost of constructing a new structure rather than transforming an existing one would be disadvantageous considering the economic and ecological dimensions. Historical structures that are conserved and transferred to the future, are socially important both for their society and world heritage.

Yung and Chan; argue a successful adaptive reuse maintains the continuity of vitality of a heritage site. During planning phase; the future operation costs, maintenance costs and potential market of the new function should be well estimated. Another important point is the potential of new workforce thanks to new function. The contribution on tourism development in long term are counted among economic advantages (Yung and Chan, 2012).

Dikmen believes protection of eco-system and sources are the roots of ecological sustainability. Long term use of resources and low cost of them are the roots of economic sustainability. Human health and conservation of cultural values are the roots of socio-cultural sustainability (Dikmen, 2017).

Even though historical constructions that were built in the past don't have active functions today, they carry cultural, historical and artistic values. They will remain their places as essential parts of urban memory thanks to restoration and reuse applications.

Dimensions of sustainability in historical environment were summarized on Table 1.

**Table 1.** The evaluation of restoration applications in historical environment in terms of major dimensions of sustainability

| DIMENSIONS OF SUSTAINABILITY IN HISTORICAL ENVIRONMENT | | |
|---|---|---|
| **Economic** | **Ecologic** | **Socio-cultural** |
| Saving of material and in transportation, energy consumption | Minimum waste and less carbon emission thanks to less resource consumption | Creating an attraction point for society with new function, providing social cohesion |
| Long term economic benefit with suitable new function | Less waste and new material usage thanks to recycled authentic material | An international level of tourism contribution and creating an iconic attraction point in the city |
| | Smart systems that helps producing solar or wind energy | Ensuring cultural continuity by reuse of existing structure |
| | Increasing green spaces in refunctioning | Ensuring social life continuity by given new function |
| | Providing public transportation if possible accessing to refunctioned structure (low carbon production) | |

**2.3. Concept of sustainable addition in adaptive reuse**

The concept of new additions in historical environment refers to the interventions like contemporary material or construction techniques during refunctioning and adaptive reuse of original structure. The relation between historical structure and addition was named after the terminology of biology. The original structure is defined as "host" and term of "symbiotic relationship" is used to define relationship that is set between new-old. Symbiotic additions are often used in historical environments as effective tools of sustainable conservation (Figure 2- pictures on the middle and right).

Symbiotic relationship is set when two sides are benefited from this relationship as mutual. If the balance is lost and one of the sides gets benefit while the other gets damage, parasite relationship is mentioned (Sijakovic and Peric, 2018). A parasite relationship is mentioned when interventions are too dominant, harming the authenticity or cultural value of the original structure (Figure 2- left picture).

Different thoughts from different researchers and experts are presented about how the additions should be in terms of design principles and conception. Şahin (2011) defines the concept of addition as it is added to a final setting after a time interval (t) and makes this setting as a part of a new whole. It can be described as an effort of making up the deficiencies of a structure that cannot answer the current needs. Additions sometimes exist as a part of a symbiotic relationship, sometimes are needed and accepted but sometimes parasite structures that are undesirable as Viollet le Duc's idea of stylistic unity.

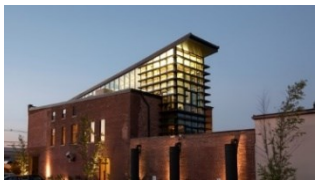
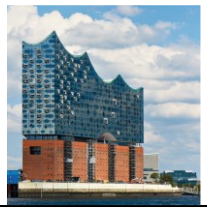


**Figure 2.** Parasite addition-Moscow (left), Amsterdam National Maritime Museum (middle) (Gürcan, 2013), Berlin Jewish Museum (right)- symbiotic courtyard roof (Sirel, 2015).

According to Brolin (1980), the relationship contrast between new and old is very effective if it is done properly. There is not a defined design criterion for the additions in historical environments. Some classifications according to the place of addition, spatial features or design approaches are done. However, there is no "additional building design" that has been definitely accepted as an international design standard. In Table 2, there are examples that

were transformed by using adaptive reuse with the help of contemporary additions. In the table, evaluation of case studies according to sustainable features is included.

**Table 2.** Evaluation of adaptive reuse applications in terms of sustainable features (Table was created by authors, visual documents were obtained from URL-1)

| | **Economic** | **Ecologic** | **Socio-cultural** |
|---|---|---|---|
| **Coal Drops Yard (HEATHERWICK STUDIO)**<br>Original Function: Train Station<br>New Function: Shopping Mall<br><br> | - A sustainable future for train station was achieved by shopping mall function (economic benefit)<br><br>- Transportation infrastructure was renewed and mall is accessible by rail system. Economic sustainability was achieved. | - Sustainable design materials were used to renew roof for comprehensive interventions<br><br>- The structure was renewed without demolition; the lower levels were turned into stores. Ecological sustainability was achieved by resource and material management. | - By giving new function where people get together, revival and socio-cultural sustainability was achieved<br><br>- By adaptive reuse, brick structure from 1800s was conserved and transferred to future |
| **The Green Building (FER STUDIO)**<br>Original Function: Warehouse<br>New Function: Office<br><br> | - Timber in the structure was taken out and used in the floors and other timber sections. Original brick materials were used in new designs. All original materials were transformed wherever possible. | - City water is not used in the building. Rain water is distilled after collected in barrels and green roof. Sustainability was achieved by smart design<br><br>- Green roof was design in the structure that was renewed by adaptive reuse. Energy production is provided by absorbed carbon dioxide, solar panels and ice storage systems. | - Original warehouse which was isolated was renewed and refunctioned as a commercial and office building. It has been renewed with adaptive reuse with new functions such as restaurants, office units and structure was transferred to the future with a sustainable approach. |
| **Elbphilharmonie (HERZOG& DE MEURON)**<br>Original Function: Warehouse<br>New Function: Cultural<br><br> | - The surrounding area of the structure became vivid and economically high profit one thanks to cafes, restaurants, hotels and parking lots after restoration. | - The conservation of the original structure that was used as a warehouse without demolishing is a pro for ecologically sustainability. Big scale demolition was avoided by transformation | - The original warehouse located in the port areas was transformed into a prestigious iconic structure attracting attention not only in Germany but also in all over the world<br><br>- Sustainability was achieved by establishing a place in city's image. An attraction point was created culturally with a sustainable design. |

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**3. Case Studies**

In the context of the study, two case studies from England and Turkey were chosen and inspected in terms of economic, ecologic and socio-cultural dimensions to explain the relation between adaptive reuse and sustainability clearer. The main materials of the study are Tate Modern Museum located in London and Bilgi University Campus from Istanbul. The visual documents of plans, sections and facades are included before and after the adaptive reuse interventions. Using these data from the parameters that were created with the help of the theoretical part, an analysis was done and findings were evaluated.

**3.1. Research Methodology**

Within the context of the study, adaptive reuse that forms the basis of the study, the place of reuse and refunction among conservation and intervention techniques have been revealed. The relation between adaptive reuse concept with sustainable conservation and planning has been mentioned. The importance of sustainability together with different dimensions and how it is shaped in conservation and historical environment were inspected with the help of literature.

Following the conceptual explanation of sustainable conservation and reuse applications, two cases selected from different countries were analysed in order to understand the subject. Interventions in both structures as a result of adaptive reuse concept were evaluated according to the three different dimensions of sustainability. Findings that were obtained from analysis were presented on tables and the result of the study was revealed. Suggestions regarding the subject for the future studies were made.

**3.2 Tate Modern Museum**

***Tate Modern Museum- before adaptive reuse***

Tate Modern Museum that is located in London, England is one of the iconic structures of the county. It was built by Architect Giles Gilbert as a power plant in two phases in 1947 and 1963 instead of the original structure destroyed following the II. World War. The structure was abandoned in 1981 as a result of pollution it was creating and other negative environmental effects. It remained abandoned until it started to operate after adaptive reuse intervention applied by designers Herzog& de Meuron in 1996 (Figure 3).

It is known that steam section adjacent to the turbine (35 meters high and 152 meters long) and iconic chimney were standing before the restoration processes. The structure remained isolated for a long time until the renovation processes. British Partnership started work regarding the reuse with an investment cost of £12 million. All later additions were demolished and the structure was turned into original steel and brick construction state.

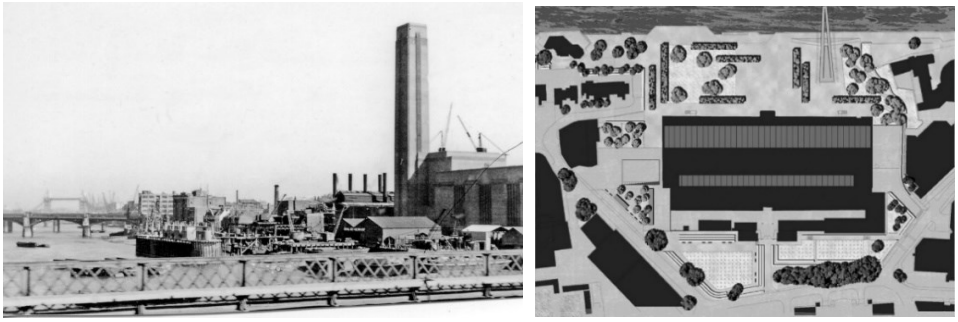


**Figure 3.** Tate Modern Museum's photo and site plan before adaptive reuse applications (URL-2, URL-3)

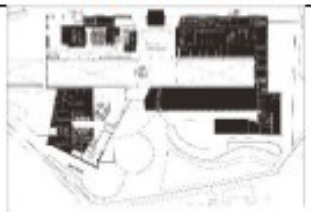
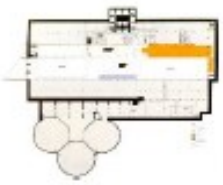
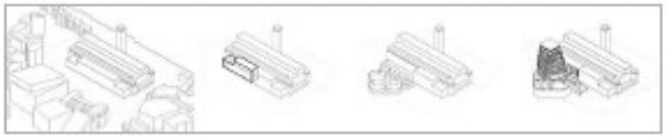
***Tate Modern adaptive reuse***

The turbine hall from the original structure was configured as a transition and meeting place in adaptation process. The structure has large volume and multi storied and this fact contributed as positive on the selection of its new function as a museum. Herzog& de Meuron created a design dominated by geometrical shapes in Art-Deco style in new version of the structure. Seven storied new addition has a total area of 34.500 square meters. Outer layer of the structure was untouched during restoration applications and original chimney was preserved (Çetin, 2021). Table 3 consists of pictures and drawings of the structure showing current state after restoration. New pyramid-shaped addition which is a concrete structure was designed with inspiration of brick façade of the original structure. In addition, glass skylight that has been designed separated from the original outer wall of the museum is among the most major interventions. This intervention lets interior units which are used as exhibition halls to get fully illuminated (Yiğitoğlu, 2020).

***Tate Modern's sustainable features***

During adaptive reuse process, design was done according to the sustainable planning targets. Natural ventilation was provided; it was focused on energy production with the help of solar panels. In the new design stage, priority was given to create green spaces and landscape, an ecological sustainable planning was aimed. New additions were designed in such a way to keep energy consumption the lowest and carbon footprint the minimum. Design was based on minimal destruction and usage of the original material of the structure as possible (URS, 2009). Considering the energy strategy, low consumption was aimed especially while the outer shell was designed. Tate Modern building has become an attraction point and an architectural icon with its additions done by two different periods and transformation by adaptive reuse. Different dimensions of sustainability were mentioned in Table 3.

**Table 3.** Sustainable features of Tate Modern after adaptive reuse (Compiled from in text information by the authors). Visual documents are from Architectural Viva Magazine (2012)

<table>
<tr><td colspan="4">Tate Modern and Its Surrounding<br></td></tr>
<tr><td>VISUAL DOCUMENTS OF THE STRUCTURE</td><td>Economic</td><td>Ecologic</td><td>Socio-cultural</td></tr>
<tr><td rowspan="5"><br><br> <br></td><td>- Resource management was achieved with new function without demolishing<br>-Structure became an attraction point with new function. Economic benefit was achieved by high interest</td><td>-Unnecessary disposal was avoided due to not demolishing the structure<br>-Green spaces increased in new design<br>-Solar energy was obtained with panels</td><td>-New open public function was given people would gather<br>-Structure's continuity was achieved by a vivid new function to become an attraction point in all the world</td></tr>
<tr><td>SITE PLAN</td><td colspan="2">FLOOR PLANS</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td>FLOOR PLANS</td><td colspan="2">SECTION</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td colspan="4">TATE MODERN ADDITIONAL BUILDING DIAGRAM<br>Axonometric perspectives showing the progressive additions of the museum<br></td></tr>
</table>

### 3.3. Bilgi University Campus

***Bilgi University Campus - before adaptive reuse***

The structure is one of the industrial heritage examples in Istanbul and originally was called as Silahtarağa Electricity Power Plant. It is located in Golden Horn. It was refunctioned by adaptive reuse intervention and started to be used as a part of Bilgi University Campus. The structure was built in Golden Horn during Ottoman Period when Westernization effects were dominant. Silahtarağa Electricity Power Plant was constructed in 1914. The structure that provided city's electricity until 1983 remained inhabited until 2004 when the restoration works started. Silahtarağa Electricity Power Plant was the first power plant on urban scale during Ottoman Period (Figure 4). It was constructed on the point where Alibeyköy and Kağıthane streams are connected and flow to Golden Horn and played an essential role as the only electricity provider until 1952 in all city.

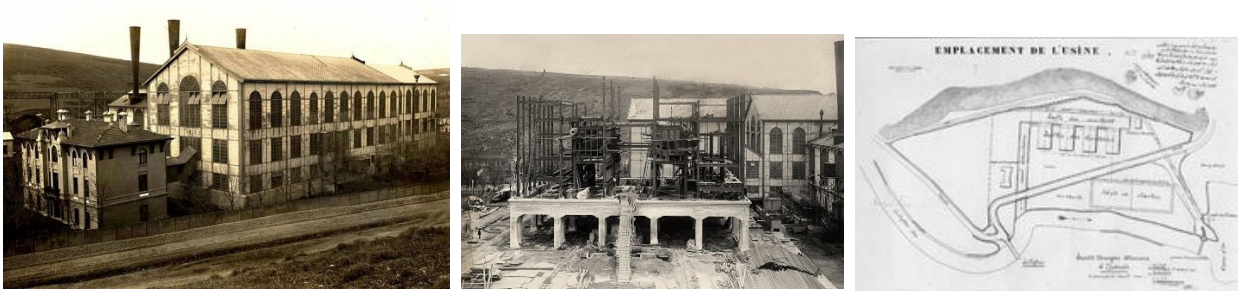



**Figure 4.** The Silahtarağa Electricity Power Plant' photo and site plan before adaptive reuse applications (URL-4, URL-5)

***Bilgi University Campus adaptive reuse***

Emre Arolat Architects, Nevzat SAyın Architecture and Han Tümertekin worked for the transformation project of the structure which is the only city scale power plant in Istanbul. The turbines which are the examples of early use of concrete and located in original setting of the structure were conserved with the places they embedded together with the engine rooms inside. The structure is important since it is the first industrial archaeological museum that was transformed in Turkey. Boiler rooms 1 and 2 were turned into Modern Art Museum without touching their integrity. Engine rooms 2 and 4 turned into Energy Museum with minimum intervention (Table 4). A new perforated shell was designed in order to minimize interventions on the original structure. This new shell covered with metal tulle is placed on reinforced concrete legs. Two of the six boiler rooms of the structure was adaptive reused and turned into libraries. Reinforced concrete walls and floors added to create the reading halls were supported with steel columns.

***Bilgi University Campus' sustainable features***

The structure was spread over an area of 120,000 square meters. Its adaptive reuse is an important gain for urban life with its central location and setting adjacent to Golden Horn. The fact that the structure is spread over a big area has enabled to recover such a large region at such a strategic point. A sustainable design was achieved socio-culturally since the structure was refunctioned as an active education and culture-art functions. Ecologically sustainable design was realized with a careful landscape arrangement in a large area by transformation. Refunctioning was applied with a minimum intervention and keeping the demolishing works as minimum on the original structure. Additional construction costs such as demolition and transportation were saved. Bilgi University Campus and Santralistanbul spaces have become brands in the city and stand out as good examples of sustainable design with their new functions (Table 4).

**Table 4.** Sustainable features of Bilgi University Campus after adaptive reuse (Compiled from in text information by the authors). Visual documents are from URL-7

## Bilgi University Campus and Its Surrounding

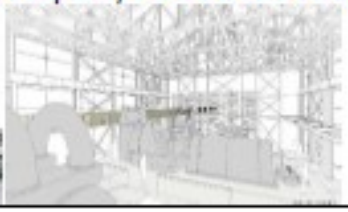


| VISUAL DOCUMENTS OF THE STRUCTURE | Economic | Ecologic | Socio-cultural |
|---|---|---|---|
|      | -Resource management economically was achieved by refunctioning<br>-It became an attraction point with new function. A vivid new function was obtained economically. | -Consumption kept minimum with minimum intervention on original setting of the structure<br>Scale of green areas increased in new design | -New open public function was given people gather<br>-Museum and art gallery (Santalistanbul) serve internationally not only for city |

| SITE PLAN | FLOOR PLANS |
|---|---|
|  |  |
| **FLOOR PLANS** | **SECTION** |
|  |  |

**BİLGİ UNİVERSITY CAMPUS ADDITIONAL BUILDING**

Cad drawings of details showing contemporary additions of museum

**4. Findings**

The data regarding adaptive reuse and dimensions of sustainability that was obtained in literature review of the study in conceptual framework was accepted as analysis parameters. Case studies were examined according to these parameters.

As a method of refunctioning in historical environment, "adaptive reuse" enables to extend the existence of the structures' and revitalise the inhabited heritage. For preventing waste due to unnecessary destruction and ensuring effective protection of ancient values; "adaptive reuse" is used frequently. Structures and areas that are refunctioned are adapted to social life and often become attraction points in the city. Cultural continuity is ensured by conserving and refunctioning heritage structures. Existing examples show that structures whose new functions are convenient for future use contribute to economic sustainability. It is observed that new additions are mostly needed in design processes of refunctioning. While using these design and materials, ecological sustainability targets are achieved thanks to solar panels, solar glasses and applications that can generate wind energy.

The comparative analysis of Tate Modern Museum and Bilgi University Campus is presented on Table 5. It has shown that both cases are sustainable in terms of economic dimension; thanks to their active use with their new functions and their restoration and evaluation without any demolition. In both cases, ecological sustainability was contributed by minimal additions and allocating large areas to green spaces on new functioning processes. Recycling of original materials in new design during adaptive reuse interventions in Tate Modern Museum are among design parameters supporting ecological sustainability. Both industrial structures have been well accepted by the society with their new functions and have continued their social and cultural continuity actively. They both have become well known and demanded areas within the city. Tate Modern Museum has become a well-known example not only for the city but also for visitors from all over the world making a positive contribution to the touristic promotion of the region. In this sense, interventions of adaptive reuse have made the museum an iconic attraction. Bilgi University Campus is a place that is used frequently in the city and international events are held in Santralistanbul. However, the connection of the structure with its surrounding areas and the worldwide reputation of the structure is not strong as in Tate Modern Museum.

**Table 5.** Comparison of Tate Modern Museum and Bilgi University Campus according to sustainability parameters (Created by authors)

| DIMENSIONS OF SUSTAINABLE CONSERVATION | CASE STUDIES | |
|---|---|---|
| | TATE MODERN MUSEUM | BILGI UNIVERSITY CAMPUS |
| **Economic** | | |
| Saving of material and in transportation, energy consumption | ✓ | ✓ |
| Long term economic benefit with suitable new function | ✓ | ✓ |
| **Ecologic** | | |
| Minimum waste and less carbon emission thanks to less resource consumption | ✓ | ✓ |
| Less waste and new material usage thanks to recycled authentic material | ✓ | - |
| Smart systems that helps producing solar or wind energy | ✓ | - |
| Increasing green spaces in refunctioning | ✓ | ✓ |
| Providing public transportation if possible accessing to refunctioned structure (low carbon production) | - | - |
| **Socio-cultural** | | |
| Creating an attraction point for society with new function, providing social cohesion | ✓ | ✓ |
| An international level of tourism contribution and creating an iconic attraction point in the city | ✓ | - |
| Ensuring cultural continuity by reuse of existing structure | ✓ | ✓ |
| Ensuring social life continuity by given new function | ✓ | ✓ |

**5.Conclusion**

In the study aiming to examine adaptive reuse in context of sustainability by giving new functions while conserving historical structures, two former industrial buildings one of which from England and the other from Turkey were comparatively examined. According to research findings, Tate Modern Museum and Bilgi University Campus which

were originally power plants are successful examples of adaptive reuse. In the process of adaptive reuse of both cases original building components saved as much possible and this is suitable for economic dimension of sustainability. New functions were chosen suitably that will allow their active use for long term and structures provide economic returns. This both ensures the continuity in conserving heritage values and secures sustainability while maintenance costs are being met.

Both cases are areas with large square meters. Thanks to transformation project, green spaces have increased with new landscape areas. Original materials extracted from Tate Modern Museum were used in new additions of other sections. Besides using of smart systems like solar panels during refunctioning stage is notable. In this sense, more emphasis was paid on the ecological dimension of sustainability principles during design phase comparing to Bilgi University Campus.

Both structures are attracting a large group of people since their functions are convenient and they consist areas with social purposes inside. The active use of the structures enabled their socio-cultural sustainability. Tate Modern Museum gained so much fame and popularity that it changed the physical characteristics of the area in which it was located. Thanks to this, its reputation grew internationally. The reason of this is the success of the adaptive reuse. The structure is a good example of a successful adaptive reuse practise in a developed country with a good promotion and management. Both structures were saved from deterioration thanks to refunctioning. Tate Modern Museum has had a positive impact on its surrounding areas and helped these areas to increase their values in terms of regional sustainable principles.

These two adaptive reuse examples show that the more interventions are parallel to sustainability principles, the more successful they are. Connecting with the public transportation facilities, increasing the square meters of green areas, defining a suitable new function that will let the structure be used actively in the future would contribute the success of the interventions to be made. A good management together with the proper new function surely help positively for international reputation. Successful examples show that transformation would be accelerated not only for the heritage structure itself but also for the area it was located in.

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# Cultural Entanglements in the Urban Fabric: A case of festivals in Old Dhaka and its impacts.

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**Abstract**
The historic city center of Dhaka, Bangladesh also known as 'Puran Dhaka', holds a lot of history and heritage of the region. This historic site has constantly been neglected and urban development has been done without integrating this part of the city into the plans. As a result, the traditional festivals that take place here annually create a greater impact on the urban fabric of the whole city. This paper will attempt to look at the importance of these traditions, how these festivals influence the urban life of the community and identity, and whether or not it has any significant effect on the economy. Through the use of both primary (interviews with the residents) and secondary sources and SWOT analysis, this paper will attempt to identify the issues faced during these festivals. This paper will also try to suggest some basic remedies based on general comparisons between case studies of similar festivals celebrated globally.
**Keywords:** Urban Fabric; Festivals; Cultural Celebration; Historic City Centre.; Urban Design.

## 1. Introduction

Dhaka, the capital of Bangladesh, was conceived at the banks of the river Buriganga like most other cities of the world. With a current population of 21 million as of 2020 (*Dhaka, Bangladesh Population (2022) - Population Stat*, 2022), Dhaka has a huge population density of about 23,234 people per square kilometer within a total area of 300 square kilometers (*Dhaka Population 2022 (Demographics, Maps, Graphs)*, 2022). Amongst this, 15% (approx. 3.5 million) live in the oldest part of the city where it was first conceived, known as Puran Dhaka (Old Dhaka). This part of the city still holds the rich history, heritage, and culture of the capital from the time of its conception. As a result, it holds many cultural and religious festivals that are famous all over the country. This historic site, however, had been neglected during the urban development and planning phases of the city's master plan and as a result, the festivals that take place in this area throughout the year have a greater impact on the urban fabric of the capital as a whole (Rossi & Rabie, 2021; Rahbarianyazd & Doratli, 2017).

This paper attempts to look at the cultural significance of these festivals both for the people of Bangladesh and as intangible cultural heritage, how these festivals are influencing the urban life of the community as well as whether or not these festivals have any significant economic impact. For the scope of this paper, five of the most important festivals are chosen as case studies. These five case studies are chosen because of their differentiating lengths of the events as well as because of their diverse religious and cultural context. Through the use of both primary sources, mainly one-to-one interviews with the residents of Old Dhaka, and secondary sources, in the form of a literature review, this paper identifies the issues faced during these festivals. Using SWOT analysis and studying similar festivals in other countries this paper also provides some basic suggestions to mitigate the said issues.

### Historic Overview

Puran Dhaka (Old Dhaka), has gone through merely a few changes throughout its 400-year-old life. The history of Old Dhaka can be traced back to the Pre-Mughal period when it is believed to have been "conceived". To understand the values of the heritage sites in this area, one must also look at the historic changes in the urban formation. According to Rahman and Hafiz and Rabbani, Old Dhaka had gone through five main historic phases of development that were categorized by the different changes in power or authority of the city. These phases are as follows:

- Pre-Mughal period,
- Mughal period (1606-1764),
- British period (1764-1947),
- Pakistan period (1947-1971)
- The Independence period (1971-present) (Rahman, 2009) (Hafiz & Rabbani, 2011)

These phases of development still have traces in the form of both tangible and intangible heritage in the area. The exceptional built heritage of Old Dhaka has significance not only to the locals but also in a national and regional context (F. F. Huq et al., 2017). The distinctive character of Old Dhaka can be seen in its topography, its location

amongst rivers and canals- which was and is still used as a transport system for many businesses along the riverside- as well as its built fabric. Most houses along the narrow labyrinths of Old Dhaka are workshops where craftsmen and women of different religious and ethnic groups work together, which goes to show the religious tolerance and the multicultural diversity of the area (Bangladesh.com, 2022). As a result of this, many diverse forms of religious and cultural festivals take place in the area where people from all walks of life celebrate together.

## 2. Material and Methods

### 2.1 Case Studies

For the scope of this paper, the five festivals that were chosen are as follows:

**Shakrain/ Poush Shakranti:** Shakrain is the oldest festival in Dhaka as well as the most popular one (F. F. Huq et al., 2017). It's the celebration of the last day of the Bengali month of Poush (which usually takes place around mid-January). This is an annual kite-flying event, where people from all walks of life in the area participate by flying kites from the roof of their homes. Kite flying competitions are also arranged and some stalls are set up by the locals who make and sell these kites. The preparation and arrangement of these festivals take about a month before the event. People from all over Dhaka as well as from outside of Dhaka come to take part in the event. Throughout the years this cultural event has evolved to include DJ parties on rooftops as well as light shows, fire spinning, and lantern lighting. While the skies during the day are filled with colorful kites, the night skies are filled with glowing lanterns and firecrackers. The festival usually lasts for a day.

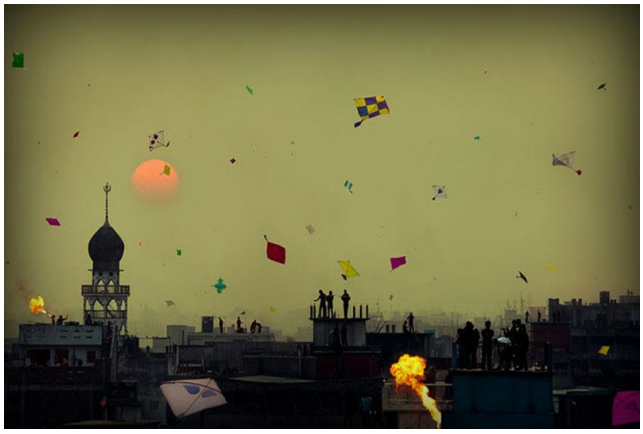

**Figure 1.** Image from a newspaper article: "Shakrain festival begins today." (Daily Bangladesh, 2018)

**Eid-Ul-Adha:** Eid-Ul-Adha is one of the largest Islamic festivals that are celebrated by Muslims all over the world. Even though this religious event is celebrated throughout Dhaka, it has a greater impact on the urban fabric of Old Dhaka- which will be discussed in detail later in this paper. At Eid-Ul-Adha, many Muslims make an effort to pray and listen to a sermon at a mosque. They also symbolically sacrifice an animal (e.g.: cow, goat, or camel etc.) in an act known as "Qurbani". The meat is required to be distributed equally amongst the poor members of the society and the relatives of each family. It is required that one buys the animal at least three days to a week in advance and takes care of the animal by themselves to create a bond so that one feels the pain of sacrificing something that they care about in the name of God. This part of the ritual is especially important to note in the urban context as most homes are not designed to include a place for these animals. The festivities of these events last for three days but the preparation begins about a week before the event with the organization of the animal markets and such.

**Durga Puja:** The five-day long Durga Puja is one of the biggest celebrations of the Hindu community of Old Dhaka where they celebrate the worship of Goddess Durga across the old city of Dhaka. The ritual is originally Ten days long but the residents of old Dhaka only celebrate the last five days. The worship begins as a post-monsoon harvest ritual and is celebrated by setting up elaborately and intricately designed "Mandaps" or stages where the statue of the Goddess is set up. These stages are arranged in certain open spaces around the neighborhood. People from all over Dhaka come to give offerings to the Goddess as well as to enjoy the festivities that take place in every other corner of the old city. People with varying religious beliefs also join in to see the beauty and celebrate with the local communities. At the end of five days, the statue of the Goddess Durga is immersed in the Buriganga River with a huge crowd accompanying the goddess on the journey.

**The Iftaar Baazar in Ramadan:** Ramadan is the ninth month in the Islamic calendar where Muslims are required to fast from dusk till dawn every day of the month. The time of breaking the fast at dawn is known as "Iftaar". During this time, at iftaar, a huge assortment of food is prepared to break the fast and no one does it better than the

people of Old Dhaka. This tradition had of great importance in Old Dhaka since the time of the Mughal era. The importance of food amongst the community of Old Dhaka is quite visible during this time as a huge after-market/bazaar is set up in the Chawk bazaar area of Old Dhaka during this time. During the whole month of Ramadan, this iftaar Bazar is well known for selling rare and unique delicacies during iftar and people from all over the city come here to buy food for their families. The market usually opens around 3 pm and remains open till dawn. During this time it is a custom of Old Dhaka to send food or iftaar items to special guests in adorning flat baskets with a high rim also known as 'dalas' (Akhter Sonia, 2016). The end of this month is marked by another big celebration known as "Eid-Ul-Fitr" where Muslims celebrate by wearing new clothes and visiting family and friends.



**Figure 2.** Iftar buyers throng Chawkbazar on the first day of Ramadan (Alam, 2013).

**Holi:** The Hindu festival of colors, marks the beginning of spring after a long winter, celebrating the triumph of good over evil. This festival is celebrated in March in Bangladesh, corresponding to the Hindu calendar month of Phalguna. In Old Dhaka, Holi has no religious boundaries as people from all over the country join in to splash a myriad of colors at each other. From kids to adults, everyone dresses in white and fills the street throwing colors at each other. Entire streets become vibrant with colors. Water guns are used to squirt color while balloons filled with colors are thrown from the rooftops. Later in the day, families gather to have festive meals at their houses while it is also customary to distribute sweets among neighbors and friends.

**2.2 Urban Formation**

Dhaka city went from being a rural settlement to a densely populated urban hub without much planning effort (Islam, 1996) (S. Huq & Alam, 2003) (Nilufar, 2010). Looking back at the history of urban development it is easy to see that even though the development of Dhaka city started in the Southern part, the present Old Town or Old Dhaka (pre- Mughal period), the extension of the city continued towards the west and the north (Mughal and British period). The development of the city continued towards the north during the Pakistan Period and continued rapidly and in an unplanned way towards all sides of the city (Ahmed et al., 2012). Nilufar, in her paper "Urban Morphology of Dhaka City: Spatial Dynamics of Growing City and the Urban Core" identified four distinct urban patterns in Dhaka. First is the urban fabric of Old Dhaka', which is unique from the rest of the modern-day Dhaka city for still using the Mughal layout with narrow lanes, very compact buildings, and mixed uses. Although there were certain zones of use, for example using riverside for businesses. The streets were mainly built for horse carriages and have not been changed from their historical context even though vehicles as big as trucks are often seen inside because of growing numbers of factories (Nilufar, 2010).

The second urban pattern described by Nilufar comprises the formally planned areas, some of which are right outside the outskirts of old Dhaka. These planned areas did not take into account the organic form of the old Dhaka city structure and hence no efforts were given to merging the two (Nilufar, 2010).

The Third category merges the two styles both organic and grid and makes a fusion of the old and the new and occupies most of the development (Nilufar, 2010).

Finally, the fourth category comprises Shanty towns and informal settlements which are organic and somewhat chaotic in formation, where about 30% of Dhaka dwellers live (Nilufar, 2010).

The master plan for Dhaka developed for the year 1995-2015, had no appropriate conservation plans for the heritage of this area. The existing Detailed Area Plan for Dhaka (DAP) is completely devoid of any heritage conservation aspect (F. F. Huq et al., 2017). Moreover, an excerpt from the DAP states "*A revitalization process will*

*be needed for renewing the haphazard, unplanned spatial structure of Old Dhaka. In the revitalization scheme, attractively developed blocks will be created as commercial, residential, and recreational, with wide avenues, significant open space, and civic amenities. This is the only solution to improve the blighted Old Dhaka and also prevent the future blight*" where surprisingly the historical city has been demarcated as "*blighted Old Dhaka*." (F. F. Huq et al., 2017).



**Figure 3.** (Left) Streets of Old Dhaka. Image series "Belonging" by Wasif (Wasif, 2013). (Right) Street at night in Dhaka. Taken at Dhanmondi 6 (right on the outskirts of old Dhaka) (Darda, 2014).

Figure 3 shows the difference in the width of a typical street in Old Dhaka compared to a street right outside of Old Dhaka.



**Figure 4.** (Left) The ruins of the Fort and the Palace of the Nawabs of Dacca, called Lal Bag 1874 (Khan, 2019). (Right) The Tomb of Pari Bibi, Lalbagh Fort, Dhaka, shows unplanned development. (Kamal, 2013)

This type of negligence in the urban planning process of the area has led not only to a lot of damage to the heritage buildings of Old Dhaka but also has a bad impact on the lives of the people who live there during the many festivals throughout the year. It also has a greater impact on the urban fabric as a whole as the city almost comes to a standstill during these events due to overcrowding and the fact that these narrow streets cannot hold the number of people that flood this part of the city during these celebrations.

**2.3 The Downside**

The very thought of 'Festival' is usually correlated with joy and celebration. However, it brings some basic problems along with them. The most common amongst those are the corresponding chaos and mess, the overcrowded area, massive sound pollution in the surrounding area, several road diversions, and finally a great deal of traffic congestion.

The festivals and celebrations highlighted in this paper, also have their fair share of problems. From the road and property mess created as an aftermath of 'HOLI' or 'Shakrain festival, the uncontrolled sacrifice of animals on the roadside in 'Eid-ul-Adha' celebration, to the long traffic congestion and road diversion due to the immersion in 'Durga puja' or month-long Ramadan food markets are just a few examples.

As much as the people of old Dhaka love their traditions and cultural celebrations, it didn't stop them from having certain complaints and pointing out sections where they expect to see some changes or improvement.

**3. Results**

**3.1 Facts from the Questionnaire**

A questionnaire was prepared to conduct a general survey among the people of old Dhaka and they were asked about the festivals, how much they enjoyed having them being celebrated on such a high scale nowadays and if they had some suggestions or insights about the whole arrangement. The target group was people of diverse religions and income groups who have been living in the surrounding areas for quite some time as it was

imperative that they could differentiate between how the festivals were and how it is changing over the years. The questionnaire includes both open and close-ended questions for an in-depth analysis of the issues that the local community might face during these celebrations. For this purpose, Twenty people between the ages of 50-and 60 years were interviewed over the phone. It was also expected from the locals to be honest in the spirit of mutual understanding.

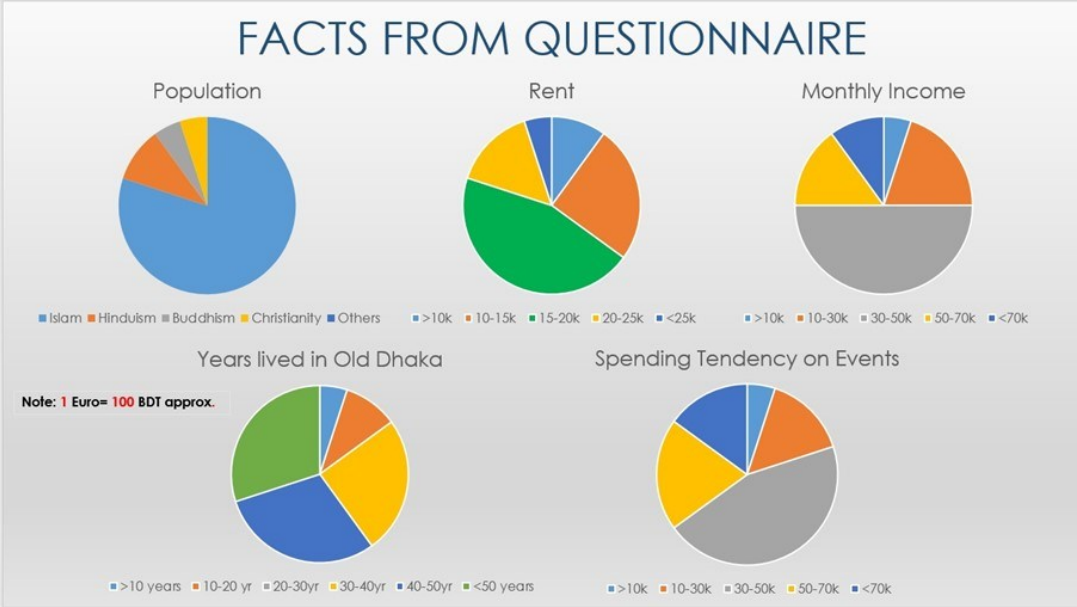


**Figure 5.** Facts were collected from the participants of the questionnaire survey. (Developed by Authors, 2020)

During the survey, a few questions were asked to the participating locals which helped develop a general idea of the participant's background which was handled with discretion due to privacy concerns and it is strictly for educational purposes.

From the first pie chart, it is clear that the majority of the participants were Islamic followers. It was expected as Bangladesh is a Muslim majority country. The second highest percentage was from the followers of Hinduism. Other religions such as Buddhism, Christianity, and others were found to be of the minority. The participants mentioned how many years they have lived in the area as well. As it was mentioned before, the target group consisted of people who have been living in the area for a longer time. Hence, the result shows that majority of the participants were living in the area for a minimum of 30 years or so. Another vital point that was asked was their rent payment. The participants were given a range and from the gathered result it was clear that most of them paid around 15-20 thousand BDT (equivalent to 150-200euro approx.). When asked about the monthly income of these people, almost 50 percent of the participants replied with a range of 30-50 thousand BDT (300-500 Euro approx.) where the second-highest range was divided almost equally into both sides (earned more or less). It needs to be mentioned that this income range was based on a fixed income for each month. Some of the participants did mention having external income sources such as business shares or entrepreneur opportunities. Since it was not regular, it was not calculated while making the charts.

The final chart represents the expenses which the same people tend to spend on events. The spending tendency can differ from person to person based on their religion or what kind of celebration they prefer more but it was astonishing to see that the locals spent a lot more on events than what they earn every month. The graph clearly shows that the ranges that have bigger amounts were selected more. This graph was essential to determine how enthusiastic these people are when it comes to the festivals and celebrations, it shows the significance of these festivals to the local people of the area.

**Questionnaire Key facts:**

• The number of visitors is growing almost every year at a considerable rate and with a more wide diversity of people. Due to rapid globalization and with the help of mass media, more and more people seem to know about these festivals and some even prefer visiting Dhaka during these times (especially Holi and Shakrain) to attend these events.

• The local people are happy with the big scale celebration and hopeful that this flood of people taking an interest will be beneficial in different ways. As Old Dhaka has a tradition of business and craftsmanship, the locals are hopeful that this would be economically constructive as well.

• It does create problems and difficulties in their daily lives especially when the events are not regulated and well organized but they enjoy the events and festivity in general.
• The recent growth of these celebrations is changing the original way to some extent so sometimes the locals do not feel the same they did before.
• The locals would prefer the 'less vehicle and happier crowd' scenario.
• The locals are happy with the governmental steps to some extent but the huge traffic situation should be handled better and the clean-up process should be faster.
• They would prefer more security measures to be in place so they are less concerned while welcoming the visitors.
• They (Islam followers) usually keep the animals of sacrifice in their home boundaries if possible or create boundaries and sometimes on roads creating congestion. A huge number of them prefer the sacrifice done on roads as it saves them the hassle of cleaning their area.
• Having said that the animals on road during Eid or '*mondops*' (stage) on every corner during Durga Puja or traffic due to event-related new markets disturb their daily life and movement.

**3.2 SWOT Analysis**

A SWOT analysis was done concerning these festivals to evaluate each section so that it was possible to figure out how these festivals have an active impact (whether good or bad) and to what extent. The results were as follows:

**Strength:**

• Cultural Celebration: These festivals grow a sense of celebration and joy amongst the locals and give them a proper chance to enjoy their culture with their loved ones.
• Promoting Cultural Identity: These very celebrations are the identity of the diverse culture of Bangladesh and its famous old Dhaka. By promoting the festivals, the Bangladeshi people promote their culture.
• Show of religious tolerance and diversity: Bangladesh is a country where ideally all the religious groups are free to enjoy and live in prosperity. The secular behaviour of Old Dhaka is a prime example of how it should be and the celebration throughout the year brings joy to its people regardless of what religion they follow.
• Year-long lively atmosphere: Since the local people of old Dhaka celebrate and participate in almost every festival both general or religion-based, it is safe to say that the area is in a festive and lively mood all year- long.
• Elevating the rich tangible heritage: Through these festivals, it is possible to make people aware of the rich tangible heritage that is present and might create awareness for its conservation.

**Weakness:**

• Overcrowded scenario: Festivals or events usually attract a huge number of tourists or people, which if not properly maintained can turn into an overcrowded situation that can become unpleasant for some.
• Sound pollution: A big gathering can be a source of sound pollution and can turn into a problem in terms of the environment.
• Chaotic atmosphere: A diverse crowd usually welcomes a diverse attitude. Sometimes it can be a source of chaos.
• Unwanted disturbance for some: These are situations where one person is not comfortable with a certain event or its preparatory situation which ultimately causes distress for some.
• Traffic congestion: A huge crowd can easily mean a huge surplus in the traffic situation in the surrounding area, which results in unwanted traffic congestion.

**Opportunity:**

• Entrepreneurship: These festivals can be a source of income or entrepreneurship for the locals as these events attract a lot of customers. This is already true in the case of Shakrain and Ramadan where locals set up stalls to sell kites and iftar.
• Making connections: Festivals can be a great place to make connections and make new friends. This creates an opportunity to have diverse surroundings.
• Tourism: A proper maintenance and well quality assurance, having safety measures can promote tourism.
• Promoting culture to the outside world: With other big celebrations around the world, the old Dhaka festivals can easily promote their culture to the outside world.
• Generating revenue for conservation purposes: Be it by introducing tickets or some other ideas, generating revenue that in turn can be used for conservation can be considered a brilliant idea.

**Threat:**

• Damage to Heritage buildings: If not careful, festival venues which sometimes surround heritage sites can cause damage to the heritage buildings.
• Losing authenticity: The traditional way of celebrating the festivals may face some difficulties in the modern days or the days to come, as new crowds tend to modify these traditions resulting in losing authenticity.

• Security concerns: Having a proper security measure is an absolute must when it comes to festivals or big events.
• Environmental issues: Environmental concerns and protection should be taken into consideration. Otherwise, it can have catastrophic outcomes.
• Gentrification: As events attract a lot of tourists, gentrification can be a major problem, as it happens to hamper the locals to some extent. It can also take away the natural atmosphere of the festival.

**4. Festivals Around the world and Comparison:**

The paper explored a few festivals which are celebrated around the world. The festivals selected were chosen based on their duration both for preparation and continuity. In addition, it focused on how the festivals were organized or what kind of steps/actions were taken by their respective government or organizers. These parameters helped with the comparison between the festival of the world with the festivals happening in old Dhaka. A short description of the festivals is given below:

**La Tomatina:** The world-famous biggest food fight, named 'La Tomatina' festival mainly takes place in a small town in Buñol, Spain. The festival itself is not that old as it started only back in 1945 but quickly made a name for itself. Every year around 40,000 tomato fighters make their way to this beautiful colorful event and try to make a good memory (Paulomi Dasgupta, 2017). Though the preparation of the event, as well as management, takes a long, the event itself lasts around 1hour. The organization of this festival is pretty efficient as the clean-up process takes place shortly as trucks containing water wash the visitors as well the roads of the town. Other mentionable steps taken by the government are basic roadblocks and diversions, Ticket entry which helps to create revenue, and high-security measures to prevent any unexpected situation.

**Oktoberfest:** Germany is well renowned for its festivities and beers. The prime example of this is the celebration of 'Oktoberfest'. This extraordinary celebration is well awaited not only for the locals but also for the people from all over the world. The most interesting fact about this is, that it starts in the middle of September and lasts two weeks. The location resides with the Bavarians in Munich and started way back in the year 1810. Each year it is expected that around 6 million people gather for this grand festival (Tiago, 2019). The beer festival usually faces a lot of cases of over-drinking, sickness, or vomiting to say the least. The festival organizers manage red cross tents for emergencies as well as well-built infrastructures specifically designed for these events. Roadblocks and diversion, local transport, expensive events to put some sort of filter, and extreme safety measures are some other features that are put into action in the event.

**Rio Carnival:** One of the biggest carnivals around the world, the 'Rio carnival' is considered one of the biggest cultural gatherings known to this world. As the name suggests, the celebration takes place in the heart of Brazil, the capital of Rio de Janeiro. It originated around 1840 and every year it takes place and brings joy to the people of Rio and tourists alike. The celebration expects by about 2 million people every year (Brazilian Experience, 2016). When it comes to the management of such an event, the organizers took a very interesting approach. Hotels are responsible to manage the transportation for the visitors. So, it is very much regulated. At the same time, the bigger parades are pre-determined, so it is well controlled and easier to maintain the crowd gathering. Among others, road diversion and blocking, ticket system, and security measures at high levels are well-rehearsed steps.

**Table 1:** Old Dhaka festivals of different duration for comparison.

| **Duration period** | Short Duration (1-2 days) | Medium Duration (1 week) | Long Duration (1 month) |
|---|---|---|---|
| **Events (examples)** | -Shakrain Festival.<br>-Bangla and English New Year Celebration.<br>-Holi. | -Durga Puja.<br>-Eid-Ul-Adha. | -Ramadan and Eid-Ul-Fitr. |
| **Description** | -Festival for all.<br>-Preparation takes longer but the Festival lasts 1-2 days.<br>-Huge Crowd Expectancy. | -Festival for all (Everyone is welcome and does celebrate).<br>-Eid-ul-Adha is a 3-day festival but it takes a week before to organize animal markets and preparations).<br>-Huge Crowd Expectancy.<br>-Immersion ceremony of the Durga puja brings together a big gathering. | -Festival for all.<br>-One of the biggest religious festivals that take place in Bangladesh.<br>-One month of Ramadan and Iftar market followed by the Eid festival.<br>-Huge Crowd Expectancy. |

**5. Discussion and Recommendations:**

The policymakers or government will take into consideration both geographical and cultural differences between different parts of the world before adopting certain recommendations or ideas. However, for the scope of this

paper, some basic remedies and recommendations are suggested based on the answers from the locals of the area as well as from the ideas generated from the case studies, SWOT analysis, and literature reviews.

• Proper security measures should be taken. Having security officials at certain points in the old city during festivals like Holi and Shakrain will make the participants feel safer and hence will have a more positive outcome while promoting these events.

• Ticketing system can be put into action depending on the event. This will not only filter out unwanted guests but will also add to generate revenues that can be put to use to help serve the community as a whole.

• Roadblocks and diversion can be a logical approach. This can help mitigate the traffic issues faced during the events.

• A certain parking facility can be put on the outskirts of the event place to clear the places on the streets that are packed with parked cars.

• Keeping the authenticity and essence of the culture should be preserved at the highest level.

• Heritage site protection is an absolute must and should be included in the detailed master plan of the city.

• Promoting Local businesses during these events will be beneficial.

• To keep the area clean, people should be employed which will last until the aftermath of the event mess is cleaned.

• In places near events, Medical help should be available.

• For a specific area or roads around the event location only 'Rickshaws' should be allowed and to a certain number.

• Lastly if the steps are taken properly and regularly, the festivals should be promoted to make tourism possible.

**6. Conclusions**

Cultural and religious festivals are a way of keeping in touch with one's heritage and identity) Aziz Amen & Nia, 2018). It is an asset for the community, a way to bond and celebrate together. Having such a place in a city where this takes place all year long is a wonderful way toward acceptance and tolerance as well as an ideal way to let the world know about one's culture. Old Dhaka is not only blessed with beautifully designed heritage sites but is also blessed with a rich cultural heritage that is visible in the way they celebrate each of these events.

As evident in this paper, the importance of the conservation of this historic city is something that had been neglected in the past. The development of a better conservation plan for this area will not only be beneficial to the local community but will also have a greater impact on the economy as it will bring more tourism and create more business opportunities for the locals.

These festivals are an important part of the community and present many opportunities that can be used for the betterment of the country as a whole. The protection of all cultural aspects of a society is not the job of only a particular community. Just like how these festivals bring together people from all walks of life to celebrate their identities, it is also important to come together to protect their identities and create an environment that makes these festivities easier to share with the world.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Evaluation of the Şerefiye Cistern in the Context of Reuse

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**Abstract**
The cisterns, which were built under the ground to meet the city's water needs, are cultural heritage historical structures that have lost their original functions today. Re-functioning historical buildings that lost their function in the process and contributing to urban life has been practiced in Turkey as well as in the world in recent years. The historical Şerefiye Cistern, a Byzantine water structure on the Historic Peninsula in Istanbul, was restored and re-functionalized in 2017 and opened to use as a cultural building. The aim of this study is to examine the Şerefiye Cistern in the context of reuse. The architecture of the Şerefiye Cistern, which could not maintain its original function, was compared before and after the restoration. After the restoration, a partial modern addition was made to the building. In the study, the socio-economic and cultural benefits of physical intervention in the cistern were questioned. After all; It has been seen that the reuse concept applied to the building both ensures its own sustainability and has positive effects on the historical environment in which it is located.
**Key words:** Cistern; Byzantine Cisterns; adaptive reuse; re-functioning; Historical peninsula.

## 1. Introduction

Water is one of the most important needs of people and civilizations have always been established near water. There has always been a thirst problem and people have acted with this awareness. In order to use the water easily, open or closed water tanks, namely cisterns, were built. Cisterns were initially used for irrigation of agricultural lands. In Istanbul, the emperors had cisterns built all over the city to protect the city and to meet its water needs. Emperor Theodosius solved the water problem between the years 379-396 and opened the water line to the Sultanahmet region. One of the cisterns that has survived from the Byzantine period is the Şerefiye Cistern, which is the subject of this study.

Re-functioning is the restoration of old and historical buildings to meet their new needs. Bringing extinct historical artifacts back to life is an important issue. In this regard, they can continue to contribute to urban life by re-functioning such structures in the world and in Turkey, and at the same time with new additions. From this point of view, the Şerefiye Cistern, which is discussed in the article, has been analyzed with criteria such as "space organization", "design approach" and "formal features" . While the Şerefiye Cistern, which is in the natural integrity of the Historic Peninsula, was idle, it was restored by the Istanbul Municipality in 2013, and was re-functionalized in 2017 and after this restoration, from an idle state to a functional state. The aim of this study; The aim is to reveal the old and new architectural texture of the cistern and compare it before and after the restoration. In line with the purpose of the study, the structural and historical characteristics of the Şerefiye Cistern, which is among the closed cisterns in the Historic Peninsula, were determined by literature research. In the study, first of all, the conceptual re-functioning of historical buildings with new additions is explained. Explained conceptually, this subject includes the work of reintroducing the idle state of the Şerefiye Cistern, which is important in terms of water reservation in the Historic Peninsula, to the city by giving it a function today. Before starting the research, articles, thesis data, various documents and internet resources were used. The obtained literature information was evaluated and interpreted.

## 2. Literature Review

### 2.1 Historical Development of Cisterns

As a result of scientific studies, it is known that waterways and springs feed the cisterns. One of the first cisterns of the world architectural heritage The cistern in Pavurallakonda Bheemili region in India was carved into the highest rock (Figure 1). During the archaeological excavations in Jerusalem, cisterns with small entrances and carved into natural stone were found. Spiral funnel-shaped structures are seen in the Nazca region of Pru (Figure 2). These cisterns found indicate that water storage has been important since ancient times (Güngör, 2017). It is possible to come across the cisterns of the Roman period, which have survived to the present day, in Anatolia. In the Byzantine Period, the cisterns were transferred underground with the support of columns. Over the years, they have improved in techniques and facilitated the transportation of water with the help of pressure water balances. Thus, the cisterns started to lose their importance, but there are cisterns that stand out with their architectural features. The cisterns, which lost their functions over time in the Ottoman Empire, were destroyed over time or their entrances were closed. Some of them were used as warehouses or for different functions.



**Figure 1.** The cistern in Pavurallakonda Bheemili area, India (URL 1)



**Figure 2**. The cistern in the Nazca area of Pru (URL 2)

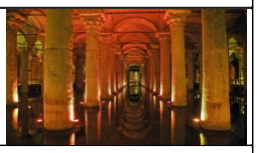
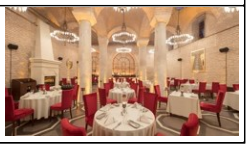
**2.2 Cisterns**

The word cistern, which comes from the Arabic origin "şahrinc", means "small pool". Cisterns were built for the purpose of storing rain water and in this direction, they are located underground, above ground or partially underground. The cisterns were generally underground and their walls were plastered with special mortars and were built as water tanks. The cisterns built to store rain water are either open or closed to meet the city's water needs (Güngör, 2017). In the past, cisterns were used all over the world and as time passed, they lost their function. The residents of Santorini abandoned the cisterns on their island in favor of desalination and well-drained water. Later, researchers worked towards improving water efficiency by restoring the cisterns (Enriquez et al., 2017). The cisterns were built in different ways, from very simple pots to large underground structures (Mays, Antoniou & Angelakis, 2013) (Table 1).

Open cisterns; It is called an open-air water pool. Open cisterns can be rectangular or square in plan. It is thought that the open cisterns that collect rain water are pools that allow the water to reach the city canals. Water is taken through a cylindrical wood or a cover pressed on a horizontal hole, and water can be taken from various levels with the help of these mechanisms. Six opposite piers are seen on the short sides of the cistern (Polat, 2004). Open cisterns are usually built at high points in the city, thereby reducing the pressure of the water on the walls and preventing them from collapsing. The walls of the cisterns were made of block stones, bricks and Khorasan mortar using Roman construction techniques. And in order to prevent leakage, a mixture of hammered brick and marble pieces with lime and flax oil was used by plastering the interior parts (Polat, 2004).

Closed cisterns are storage areas that allow water to accumulate underground (Yıldırım, 2021). Closed cisterns are generally built under important structures, so that water access is easier and they meet the water needs of the building. The larger the building, the larger the cistern built, and they become a solid foundation for the building. The cisterns are provided with marble columns from the inside. These columns are connected to each other by arches and cross vaults. The top of the cistern was covered with vaults made of stones and bricks. Stone stairs were built to descend into the cistern (Önlü, 2010).

**Table 1.** Open and closed cisterns and their new functions (created by the authors using URL 3)

| TYPE | Name | DATE OF BUILDING | NEW FUNCTION |
|---|---|---|---|
| OPEN CIRCLES | Aetios Cistern | Byzantium, 5th century. | Vefa Sports Club's stadium  |
| | Aspar Cistern | Byzantium, the period of Leon I. |  children's playgrounds and the annex building of Fatih municipality |
| | The cistern of Hebdemon's Elephant | Byzantium, 5th century. | Sports field and jogging track  |
| CLOSED CIRCLES | Theodosius (Şerefiye) cistern | Byzantine - Thedosius Period, 4th century. |  Museum |
| | Basilica cistern (Basilica cistern) | Byzantium, Period of Justinian I, 5th Century | Museum  |
| | Antique Hotel Cistern | Byzantium, 5th century. |  Restaurant |
| | Hagia Sophia Cistern | Byzantium, 5th century. | Restaurant  |

**2.3 Historical Peninsula Cisterns**

During the Byzantine period, from the 3rd century AD to the 14th century AD, different cisterns were built in Istanbul and water was stored. The cisterns were supported by underground columns and emerged as vaulted structures (Güngör, 2017). In the past, as it is today, it was important to prevent some diseases and fire accidents, so powerful empires built many cisterns and brought water to the cisterns by constructing aqueducts (Hakan, 2020). The Historic Peninsula in Istanbul is one of the regions where many cisterns were located during the Byzantine period (Figure 3). The most important reason for the Byzantine Period cisterns in Istanbul to survive is the use of the right system and the fact that they were built on the bedrock.

One of the reasons why open cisterns were given importance in the Byzantine period was that they could meet the water needs easily and easily. The number and size of Byzantine Cisterns are decreasing over time, and it shows that before the 7th century, there were large cisterns both in number and size (Ward, Crapper, Altuğ, Crow, 2017). The walls of the cisterns are approximately 4-6 m thick and their height varies between 10-15 m. Closed cisterns are preferred because these cisterns are also hygienically inconvenient. It is known that some cisterns belonging to the Byzantine Period were used outside of their functions. Sometimes they were places used as silk workshops or warehouses.

During the Byzantine period, hundreds of cisterns were built in Istanbul as the capital of the empire to meet the water needs. The fact that the water system is independent from each other ensures that only a certain amount of water is distributed. Some water cisterns used in the Byzantine period belong to the Roman period. Byzantine cisterns were repaired and used in the Ottoman period, as the repair technique is different, differences can be distinguished in wall repair. In the late Byzantine period, when the canals became unusable, the cellar walls of some buildings were plastered with waterproof mortar and used as cisterns. Some of the closed cisterns that have survived from the Byzantine period have been destroyed during road construction or construction.

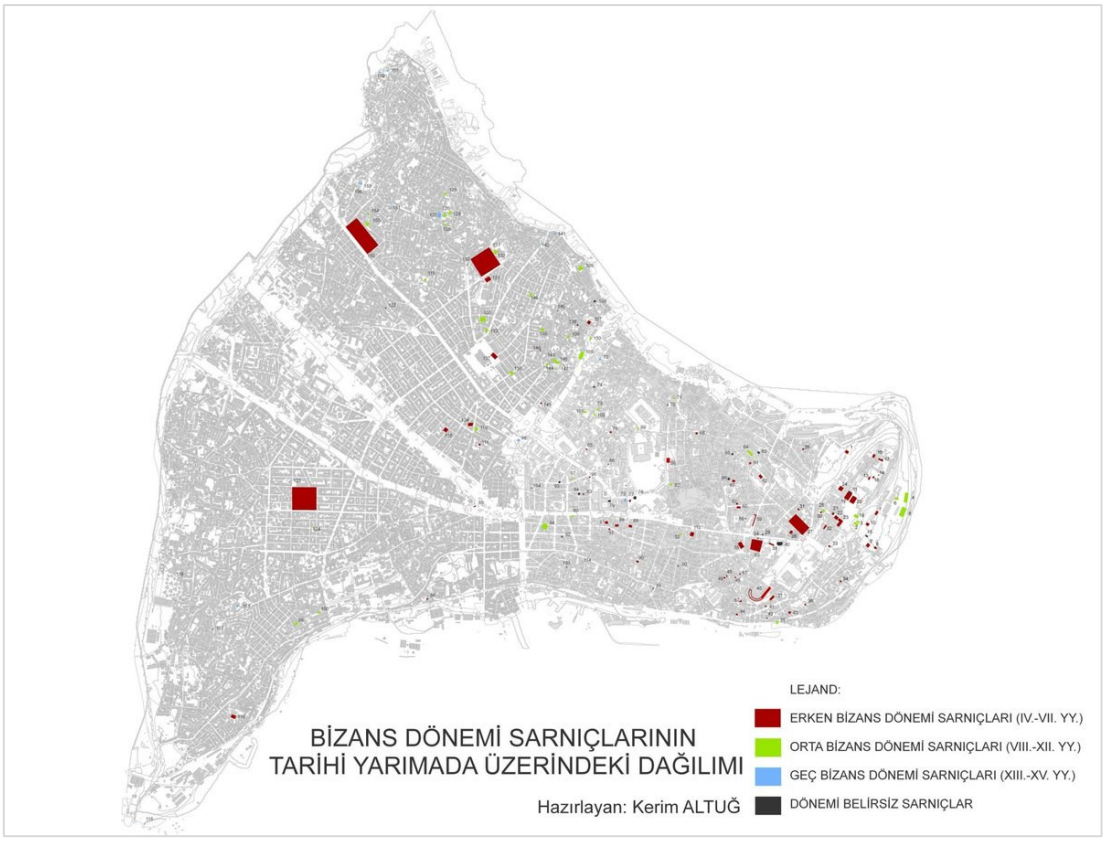



**Figure 3.** Distribution of Byzantine Period Cisterns in the Historical Peninsula (Kerim Altuğ, URL 4)

In the Ottoman period, the cisterns lost their original functions and were used as warehouses. The repairs in the Byzantine cisterns, which were also used in the Ottoman period, can be easily distinguished as they are different from the late Ottoman period technique. Small rubble stones were used on the inner surfaces of the walls of the cisterns and mostly smooth block stones were used on the outer surfaces. On the surfaces where brick is used, the thickness of the mortar is equal to the thickness of the brick (Polat, 2004). In the Republican period, it was also used as a warehouse where the fire brigades sometimes drew water during the great fires. Today, some of the cisterns are used by re-functioning because they have completely lost their functions.

**2.4 Adaptive reuse**

Adaptive use; It carries the historical continuity of the work to present and future generations by re-functioning and changing a historical building and bringing it into a shape suitable for new needs (Kaplan, 2021). It is a survival method used for the sustainability of historical buildings by adapting them. However, in the adaptive use process, sometimes applications that contradict its original function are seen. The new functions given to the old buildings are not related to the original function of the old building. On the other hand, a degraded historical building may need to be adapted (reused) for a new purpose. When change becomes inevitable in buildings, it is necessary to expand their usage capacity with a principled adaptive design (Askar, Bragança, Gervasio, 2021). Revitalizing the old building provides a new life to the building itself and its surroundings. Adaptive reuse prevents the demolition of many historic buildings. For this reason, the renovation and reuse of an existing building is also suitable in terms of cost savings in building materials. Renovating an old building can be more economical in the long run than building a completely new one. With the re-use of the building, socio-cultural continuity can also be ensured (Figure 4-5).



**Figure 4.** Canadian Crystal Museum (URL 5)



**Figure 5.** Elbphilharmonie concert hall (URL 6)

The application of an adaptive reuse approach to bring old buildings back to life benefits the renewal of an urban area by making these buildings usable. Adaptive reuse is one way to salvage a neglected old building. Re-use, which is a means of preserving a building with historical value, brings with it economic and socio-cultural benefits.

Re-functioning is the transformation of a building that has lost its function into something else, while preserving the structural features of the space, and bringing it back to urban life (Figure 6-7). Re-functioning, re-use of existing structures is one of the most discussed issues in architecture today. There are different approaches in re-functioning and it preserves the structure and prepares it for use in a modern way. Refunctioning; preserving the architectural and cultural values of historical and old buildings, making these buildings usable. These structures were to ensure the continuity of the historical texture with new uses suitable for their structural features, transforming themselves and the surrounding space into a living environment. In the new functionality and new addition, many principles have been put forward that should be followed by different researchers. These principles are; space organization, design approach and stylistic criteria are considered important (Sağlam and Tavşan, 2019)

Sağlam and Rabbit gave an explanation of the principles in their study as follows:

- Space Organization: Circulation element, eaves element, Roof completion, Transition element, Facade integration, Facade completion.
- Design Approach: Copy, Affinity, Contrast, Abstract reference, Neutral.
- Formal Criteria: Height (long-equal-short), Color (same-similar-different), Material (same-different), Joint (top-inside-outside), Building line (outward-equal-backward), Detail (plain-medium-ornate), Orientation (parallel-outlier), Visual intensity (high-medium-less).

These principles were used as criteria in the evaluation of the new addition that the Şerefiye Cistern received as a result of the restoration.



**Figure 6.** Venice Flour Factory (URL 7)



**Figure 7.** LocHal Library (URL 8)

**3. Case Study**

**3.1 Material and Method**

In the scope of study; the new addition and reuse issues, which constitute the conceptual basis of the study, and the Cistern structures were examined by literature research. The sample material of the study is the Şerefiye Cistern located in the historical peninsula of Istanbul. First of all, data on the original condition of the Şerefiye Cistern were collected.

Then, the new situation after taking the supplement was analyzed through the plan, sections, visuals and on-site observations, with criteria such as "space organization", "design approach" and "formal features". The findings obtained from the analyzes are presented in the form of a table and the result of the study is presented.

### 3.2 Şerefiye Cistern

***The current situation:***

Şerefiye Cistern, a Byzantine water structure, is located in the void of a building island in the Binbirdirek District of Eminönü district of the Historic Peninsula. Some structures that were on it before were removed with the decisions of the Conservation Board in 2010 and they were made noticeable in the dense structure texture around it. The Şerefiye Cistern, which is located under the old Eminönü Municipality additional service building, does not have a construction inscription. It is thought to have been built during the reign of Theodosius (408 – 450) (Figure 8). Built on an area of approximately 24 meters by 40 meters and with a ceiling height of 11 meters, the Şerefiye cistern contains 45 sail vaults and 32 columns (Yıldırım, 2016) (Figure 8). Semi-worked capitals in Corinthian style with imposts on them are made of marble (Altuğ,2015). The heads are decorated with acanthus leaves. The interior walls of the structure are covered with waterproof plaster and the corners are curved to withstand water pressure. The building remained inactive for a long time without any use. In 2013, a project competition was held for its reuse and Cafer Bozkurt Architecture office won the competition.




**Figure 8.** Şerefiye Cistern entrance structure, plan and section (URL 9)

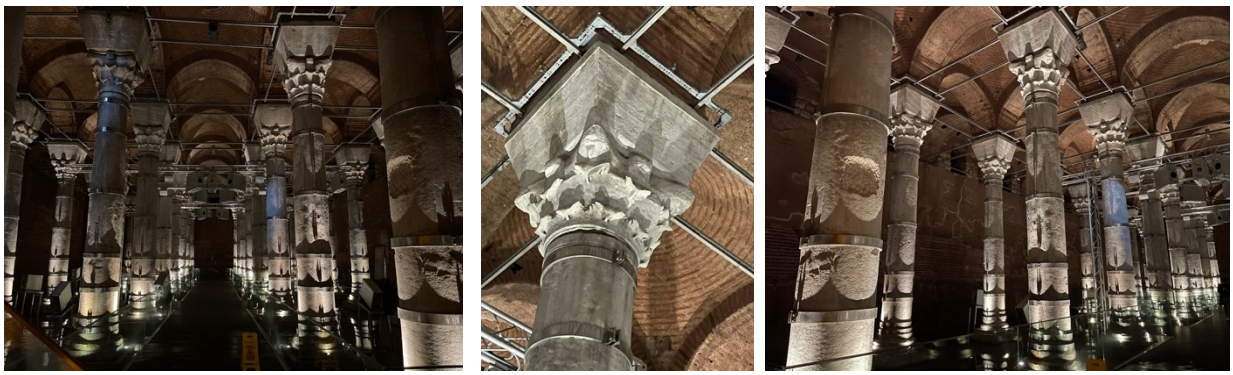


**Figure 9.** Columns and capitals of the Şerefiye Cistern, (Authors, 2022)

***New condition: New addition and reuse***

The Şerefiye Cistern, whose construction period lasted 8 years, was opened for use as a cultural and artistic structure in 2018. In the reuse project of the cistern; An entrance section to the ground floor and stairs and an elevator have been added to the building for descending to the old water storage area (exhibition hall) under the ground. The project was not only considered as an additional and new function to the existing structure, but also as an arrangement of its immediate surroundings. The historical Cistern Square was arranged so that the cistern structure would emerge and be visible. The square is separated from the additional entrance structure using a reflecting pool. Since the historical building is a water structure, the entrance to the cistern was provided over this water element. The entrance structure of the historical cistern is made of light steel system as a transparent and contemporary construction. The design of the additional building was made in proportion to the square and surrounding structures. Natural air circulation in the

building is ensured with the glass façade elements of the additional entrance, where minimal intervention is made on the historical building, and the ventilation shutters on the roof.

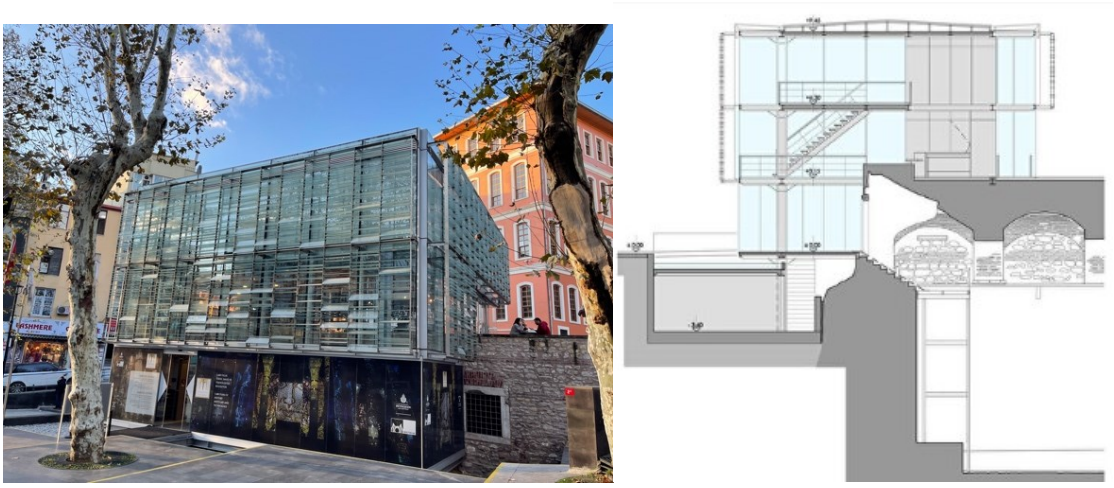


**Figure 10.** Şerefiye Cistern entrance structure and section (URL 10, Authors, 2022)

The historical Cistern Square was arranged so that the cistern structure would emerge and be visible. The square is separated from the additional entrance structure using a reflecting pool. Since the historical building is a water structure, the entrance to the historical cistern is provided over this water element. The entrance structure of the historical cistern is made of light, steel structure as a transparent and contemporary construction. The design of the additional building was made in proportion to the square and surrounding structures. A contemporary structure has been created with minimal intervention to the historical structure and the structure has a Steel structure, glass outer shell, metal roof and wooden flooring.

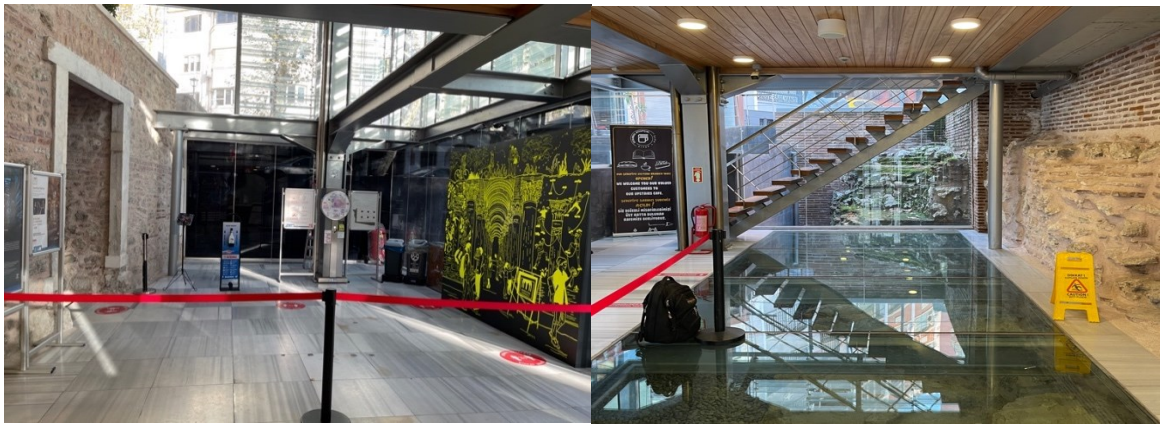


**Figure 11.** Şerefiye Cistern entrance structure and consultation (Authors, 2022)

***In the new venue organization;*** On the ground floor of the three-storey transparent annex, there are functions such as information desk, ticket, book sale, and cafe. On the upper floors; There is storage space, restrooms and a multi-purpose hall for cultural activities such as exhibitions. In the original part of the historical cistern, there were art exhibitions, children's activities and performance areas from various branches of performing arts.

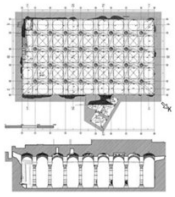
***Design approach;*** The original part of the cistern was interfered in two ways. First; It is an elevator placed for visitors next to the existing steep stairs to reach under the floor . Latter; It is a walking platform that is raised and furnished on the ground of the historical building. This platform is made of moisture resistant wood and steel material. In this intervention, which did not harm the essence of the building , the new additions and materials did not get in the way of the building, by acting neutrally . The cracks in the columns of the cistern were filled with epoxy added repair mortar and the limestone formations were cleaned with precision mechanical methods.

***Formal features;*** The additional entrance structure is higher than the original structure, which is due to the natural location of the cistern, which is a water reservoir. With the transparent surface of the additional entrance building (glass), which is a different material, the visibility of the original building is ensured. The main annex has a transparent and plain surface positioned on the outside of the cistern at ground level. This section is medium in terms of visual intensity.

**4. Findings**

In this study, the new addition and re-functioning of historical buildings are discussed. The new addition and new function of the Şerefiye Cistern, which lost its function as the sample area of the study, were analyzed before and after the restoration. Criteria such as “Space Organization”, “Design Approach” and “Formal Features” were accepted as the analysis parameters of the new addition and re-functionalization of the Şerefiye Cistern. The findings obtained as a result of the analysis carried out with the plan, sections, visuals and on-site observations of the building are given in Table 2.

**Table 2.** Şerefiye Cistern analysis table (Used from Sağlam and Tavşan, 2019 article, URL 11)

| **Şerefiye Cistern** | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Plan** | **Appearance** | **Type of place organization** | | | | | | **Design approach** | | | | | | | | |
|  |  | Circulation Element | Fringe Element | Roof Completion | Transition Element | Facade Integration | Facade Completion | Copying | Affinity | Opposition | Abstract Reference | Neutral | | | | |
| | | | | | | ● | | | | | | ● | | | | |
| | | **Formal criteria** | | | | | | | | | | | | | | |
|  | | **Height** | | | **Colour** | | | **Material** | | **Joint/ location** | | | | | | |
| | | Long | Equal | Short | Same | Similar | Different | Same | Different | Top | In | Out | | | | |
| | | ● | | | | ● | | | ● | | | ● | | | | |
| | | **Building Line** | | | **Detail** | | | **Orientation** | | **Visual Density** | | | | | | |
| | | Out-going | Equal | Back | Simple | Middle | Decorated | Parallel | Inconsistent | A Lot | Middle | Little | | | | |
| | | ● | | | ● | | | | ● | | ● | | | | | |

**4. Conclusion**

Historical buildings that have lost their function all over the world are transformed into prestigious buildings living in the city by giving new functions and making new additions. Design criteria and criteria are important in these studies carried out for adaptive use. Although different design approaches have been adopted in different countries, the starting point of all these is respect for the original identity of the existing structure and sustainable preservation.

In this study; re-functioning, re-use, and especially adaptive use, which is an intervention method for ensuring the continuity of historical buildings, have been examined in the context of the Şerefiye Cistern. The Şerefiye Cistern, which is one of the important water structures of the architectural heritage in the Historic Peninsula, remained non-functional for a long time. As a result of a project competition opened for its reuse in 2013, a new addition was made to the cistern for its new museum-culture function. In the study, the intervention in the Cistern; It was examined whether the building preserves its spatial integrity with the construction technique . When the intervention is evaluated in terms of criteria such as "space organization", "design approach" and "formal features"; It has been seen that the new annex, which was built to meet the needs of the visitors and to provide the entrance, forms an integrity with the historical cistern building. Contemporary construction techniques and glass material selection have shown that the main building does not override its historical identity and integrates with its immediate surroundings.

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# Comparative Analysis of Qajar Historic Houses in Tabriz, Isfahan, Yazd, and Kashan, Regarding their Architectural Forms and Elements

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**Abstract**
There are a lot of precious beautiful Qajar houses in many cities of Iran indicating the high quality of talents and wisdom of their architects. Using a row of columns in the main façade, emphasizing on symmetry axis in the entrance, and replacing the new ornamental patterns with the ancient elements are some of the architectural qualities of this era. This article attempts to answer the question that what are the similar characteristics of Qajar houses in different cities of Iran. For achieving this aim, the history of Iranian houses especially in the Qajar period is studied in Tabriz, Isfahan, Yazd, and Kashan cities. The methodology of this historic survey is comparative and qualitative using the reliable books of libraries and first-hand resources. This article concludes that the architects in that era harmonized the culture of other countries to improve their own values according to their own culture and climate.
**Keywords:** Qajar Historic House; Tabriz; Isfahan; Yazd; Kashan; Iranian Architecture.

## 1. Introduction

Culture is formed in the continuum of time from the minutes of thought and experience. Just as the study of culture in texts is necessary and valuable for the survival and transmission of the culture of people, the study of each of these cultural institutions has the same value, one of which is traditional architecture (Aziz Amen & Nia, 2018). Among the architecture of different buildings, the architecture of houses has a prominent feature to get acquainted with the creations and spatial innovations of past architects. Houses are living evidence of very important periods in the growth and development of Iran. The traditional houses of Iran in the Qajar period, with their delicate and intricate designs derived from strong cultural and religious traditions, have reached their peak of prosperity and wonder, and are excellent examples of the close connection between architecture and their decorations. For example, muqarnas, plaster, mirrors, murals and frescoes, wood mosaics, wood lattices, and stained glass have been widely used in many buildings of this period. During this period, the lancet arches and shouldered arches are obsolete and are replaced by semi-circular arches on the entrance, door and niche. Non-load-bearing false ceilings are removed from the roof of rooms and attics, and vertical and horizontal sunshades are removed from the building architecture. The present article is an exploration to answer the question of what common features Qajar houses have in Iranian cities. For this purpose, first, a brief study is completed on the architectural elements of the historic houses in Iran. Furthermore, with a brief introduction to the history of the Qajar dynasty and the appearance of Iranian cities in this period, some of the main architectural features of the Qajar period are mentioned. Then two case studies among the Qajar houses of Tabriz, Isfahan, Yazd, and Kashan are examined in detail in each city. The list of some Qajar houses in the aforementioned cities of Iran is mentioned in a separate table (Table 1). For studying the similarities of Qajar houses in Iran, four different tables (Tables 2, 3, 4, & 5) are used for the analogy of their architectural forms and elements, the main interior façades, the main plans, and the elevations and sections. The conclusions of this article can be useful for the architects, researchers, and preservationists who care about historic architecture and especially the Qajar Houses in Iran. The research method used in this study is completely analytical and the research tool is a library study referring to first-hand and reliable resources.

## 2. Architectural Elements of Historic Houses in Iran

Iranians moved from nomadism to a permanent lifestyle and built houses for the first time in the time of “Keyumars” and "Hushang". “Keyumars” or “Kiomars” was the first king of the “Pishdadian dynasty” of Iran according to “Shahnameh”, which is a long epic poem written by the Persian poet “Ferdowsi”. The name “Keyumars” means “the living mortal”, “mortal human being”, or “people” in the “Avestan” language. The people led by “Keyumars” stopped migration and began to live in the mountains permanently. With the emergence of two structures of life, migration and permanence living styles, clashes and battles were involved between them. In the first wars, the survivors finally defeated the nomads, and with this victory, the background for further progress and the construction of houses was provided. After the death of “Keyumars”, “Hushang” became the king and his era was the time to build houses. The name “Hushang” or “Hoshang” means “to have good houses” or “someone who provides good houses” in the

"Avestan" language. "Hushang" was the son of "Siyamak" and grandson of "Keyumars" and he was the second king to rule the world according to "Shahnameh" of "Ferdowsi" (Vahidi, 1996, pp. 235-236).

According to "Pirnia", the principles of Iranian architecture can be divided into the following five categories:

- Having a human scale: observing the fit between building spaces and human organs and paying attention to human needs in construction work. It can be seen in various elements of traditional Iranian architecture. For example, if we consider the bedroom, its size is considered according to the different needs of a man and a woman, their child or children, the equipment needed, and so on. Similarly, the function of the room and the placement of elements such as doors, windows, and openings have been selected accordingly and carefully. In other elements, this combination of logic and beauty can be seen too. To place items such as mattresses, quilts, and pillows, and for essential items, niches were installed. For example, to prevent the scorching heat of Iran, the wall was made of two shells or the light was taken from the ceiling;
- Avoiding futility: in Iranian architecture, they tried not to work in vain in construction and avoided extravagance. Work in vain wastes funds and time; besides, from an architectural point of view, it is not beautiful or necessary. For example, the installation of a statue in a building which was common in other countries does not exist in Iranian architecture because it is not useful. Another example is the installation of the pond in the courtyards of Iranian houses, which can be seen in most of them, and it was done to cool the interior space. It was not only for its aesthetic aspect but it was installed for its efficiency;
- Static knowledge, building technology and building materials: in Iranian architecture, all the work is done to make the building stable and steady. It is a collection of calculation and static matters, including materials science, and the selection and use of the most appropriate and minimal materials. In the past, architects relied more on engineering, and in their opinion, the building was beautiful when it showed its statistics. The modular design was one of the criteria that was observed to determine the fit between the components of the building. Using a modular system, the three important stages of design, calculation and implementation of buildings were performed in the best way. So that in a beautiful design, correct calculations and execution were simplified;
- Self-sufficiency: Iranian architects had a great effort to get the building materials they needed from the nearest places as much as possible and they built it in such a way that they did not need the building materials from other places and they were "self-sufficient". This means that the builders have tried to obtain the required materials from the nearest place and at the cheapest price, thus the work has been done more quickly and the materials have been more in harmony with the surrounding nature. Likewise, the buildings that had to be repaired over time, with access to the main materials on site, it was possible to repair them in all stages easily;
- Introversion: one of the beliefs of the Iranian people has been to value personal life and its dignity, as well as the self-esteem of Iranians, which has somehow made Iranian architecture introverted. Introversion has been one of the most important principles in Iranian architecture. Introversion means paying attention to beauty and efficiency in building a house by placing physical spaces around a courtyard and accessing the outside space using the yard. In traditional Iranian architecture, the exterior façade was not considered as much important as interior design. Iranian architects separated the building from the outside world by organizing the spaces of the building around one or more yards, and only a porch or a vestibule connected the interior of the house to the outside of the building (Pirnia, 2008, pp. 26-36).

In the traditional society of Iran, the house is a sacred sanctuary and therefore the inhabitants of this holy place should be safe from the view of outsiders and strangers. For this reason, the central courtyard is all introverted and is in fact the heart and centre of the house. The yard provides light and air for the rooms and interior spaces of the house. In the design of traditional buildings, privacy is maintained and entry is allowed through a gradual process and hierarchy. The elements of Iranian historic houses are as follows:

- Platform: a place on both sides of the entrance, to relax while waiting, and to talk to the visitors;
- Gateway: decorative crescent on the entrance door;
- Door knocker: the entrance doors of traditional houses are double-leafed and wooden, and each leaf has a door knocker;
- Vestibule: it is often octagonal or semi-octagonal in shape or more often quadrangular;
- Corridor: indirect route from the vestibule to the courtyard;
- Yard/ courtyard: the courtyard was a place for various ceremonies such as religious ceremonies, weddings and gatherings of relatives, which was usually square and had a small pond in the middle, along which two flower gardens appeared symmetrically to each side. Yard types are:
    - Orange garden: a small garden with citrus trees is usually covered to prevent the freezing of trees in winter;
    - Outdoor yard: a semi-private space that is assigned for guests and non-relatives;
    - Inner courtyard: one of the most private spaces exclusive to the family members and no stranger has the right to enter;

- Porch: a covered area that connects the yard to the surrounding rooms;
- Windbreaker hall: a place for public gatherings, religious ceremonies and summer residences;
- Three-door room: a room with three doors that plays the role of a living room or sleeping or eating room in spring, autumn and especially in winter;
- Five-door room: a room with five doors is used as a reception room, dining room and meeting room in spring, autumn and especially in winter;
- Official room: this room is for special occasions, important gatherings and formal parties. It was mostly used in spring, autumn and winter;
- Chamber: a room between the hall and the windbreak for rest and sleep on hot summer days;
- Indoor entrance porch: a covered entrance porch (with columns) is a space to relax in summer;
- Hall: for public purposes and religious ceremonies;
- Upstairs: for rest and study in summer, autumn and winter;
- Corner room: a private room for sleeping, main bedroom, for privacy and library;
- A room with a heater: it is located next to the winter room and it has no windows. It had a heater in the room;
- Closet: warehouse, storage space especially for bedding and clothes;
- Kitchen: it is usually square or rectangular. It is located near a reservoir and water well, for easier use of safe water storage. Inside the kitchen, there is an area for cooking and wood storage, there is also a baking oven, and, there are shelves inside the wall for cooking tools and food;
- Toilet: it is located below the level of the rooms and usually in the corner of the yard;
- Bathroom: this place is also low level for two reasons: first, ease of use of water and drainage; second, its heat. The bathroom was divided into two parts: a warm space for changing clothes and a shower for washing (Kateb, 2006, pp. 332-340).

**3. Architectural Characteristics of Iranian Houses in the Qajar Era**

The “Qajar dynasty” (1789—1925) was an Iranian royalty of Turkish origin ruled by “Agha Mohammad Khan Qajar” (1789—1797), “Fath-Ali Shah Qajar” (1797—1834), “Mohammad Shah Qajar” (1834—1848), “Naser al-Din Shah Qajar” (1848—1896), “Mozaffar ad-Din Shah Qajar” (1896—1907), “Mohammad Ali Shah Qajar” (1907—1909), and “Ahmad Shah Qajar” (1909—1925) (Bani Masoud, 2009, p. 7). For obtaining more information about the Qajar dynasty you can read the Master thesis of the author titled “The Conservation and Revitalization of Mirza Mehdi Farashbashi’s House in Tabriz” (Asbagh, 2011, pp. 8-37), and the article derived from it by the author with the title of “Adaptive Reuse of the House of Mirza Mehdi Farrashbashi in Tabriz” (Asbagh, 2021, pp. 506-520).

**3.1 Architecture in the Qajar Period**

The views and perspectives of the ruling Qajar period have a unique resemblance to the French Baroque period. The construction of palaces is a prominent feature of this historic period. There was a large building in the middle of the gardens with lavish decorations, where ceremonies and gatherings were held. The expansion and creation of large parks in the heart of the cities was perhaps the most valuable service of the palace to urban life. The architecture of the Qajar period is highly valued from the point of view of spatial creativity and is in a superior and more developed position than the architecture of previous periods such as “Zandiye” (Zand dynasty 1751—1779) and “Safavid” (Safavid Empire 1501—1736). In the architecture of this period, spatial creations and the variety of spaces increased, new spaces are created, spaces become more open and lighter, and the old patterns of Iranian architecture evolved to expand the space. In short, if we consider the evolution of architecture as the opening, transparency and lightness of spaces, the architecture of this period is considered the stage of evolution of ancient Iranian architecture. On the other hand, when we look at architecture from other viewpoints such as sizes, proportions, shapes and decorations, the architecture of the Qajar period shows a lower status than its previous periods, especially the “Safavid” period. The shapes did not have the previous solidity and new shapes entered the architecture which was superficial and casual. The measurements were not accurate enough, the proportions were in a lower order than the balanced and thought-out proportions of the previous periods (Bani Masoud, 2009, pp. 74-75). During this period, strong towers and fortifications were considered a sign of the city's greatness and the market was the heart of the economy of the city. In terms of the general division of the city, it was divided into three main parts: ancient fortress, county, and suburbs. The fortress was the administrative centre of the city and regulated all the social relations of the city. The mosque, along with other duties, was considered the centre of the city's judicial system. The alleys were narrow and winding and seldom paved, and the old caravanserais were still the main refuge for travellers. The city was divided into different neighbourhoods, and each neighbourhood had its own sheriff who was appointed by the ruler of the city. Aldermen were in charge of the city, and the sheriffs acted as a kind of mayor. New manifestations of urbanization such as gas and electric lights, telegraph wires, and construction and repair of roads had a significant impact on the appearance of cities. The old caravan roads no longer had the capacity to carry European goods. Wide

streets and cobblestones were created with the propagation of carriages (Atazadeh, 2004, pp. 13-14). During the Qajar period, they used semi-circular arches similar to the shape of the handle of a basket which was the Western architectural element. Another example was the removal of insulation in the building. There are many examples in the ancient architecture of Iran, where some roofs and walls were made into two shells to reduce the temperature fluctuation inside the building, the middle layer of which worked as insulation. Such as double-skinned domes, double-skinned roofing, and other examples, but at this time, these methods were abandoned. Another example was the removal of thin walls on the façade of the building. The architects of the past had concluded that the façade of a room should not be exposed to the summer morning sun. Hence, they divided the view of the room with several doors (that is, they made several doors in it, such as three doors and five doors, and a thin wall was built between the doors, which caused a shadow on them). During the Qajar period, the three doors were turned into two doors, and thin walls that were perpendicular to the doors were made obliquely so that the sun shines directly on the doors and the room (Pirnia, 2008, pp. 344-348). The use of a semi-circular arch became more desirable than other composite forms almost from the middle of the Qajar period (Ghezelbash and Abolzia, 1985, p. 9). Architects in Isfahan have been using this shape in the secondary components of the building for a long time. For example, in the main front of houses and residential buildings, semi-circular arches were built above the three-door rooms and door gates. When the semi-circular arch was used more often, it appeared in the main view and became more decorative, and its bearing role is limited and does not reach the level of the previous traditional arches. Semi-circular arches usually appear in regular rows at the edges of porches (Jabal Ameli, 1996, p. 111).

**3.2 Architectural Characteristics of Qajar Houses in Tabriz**

“Tabriz”, “Tavrez”, “Thavrez”, “Tavres”, “Davrez”, or “Da- i- vrez” which means “this is for revenge” or “the place of revenge” is an ancient city in Iran. The oldest mention of the name of Tabriz is written in the inscription of “Sargon II”, the king of “Assyria” in 714 B.C. as “Taroi” or “Taroei” (Tarighat, 2009, pp. 19-23). Tabriz, the capital city of the province, is located in the central part of East Azerbaijan Province, having two civil areas (central & “Khosro Shah”), three cities (“Tabriz”, “Basminj” & “Sardrood”) and 75 villages on the North-West of Iran (Figure 1). Various opinions are suggested as to the historical background of Tabriz; nevertheless, the excavations of 2003 around the Blue Mosque revealed some clues that date back to the early centuries of the first millennium B.C. Being an important place before the Islamic era, Tabriz continued to be a major city in the Islamic era, too. After the Mogul Conquest in the 13th century and the establishment of the Ilkhanid ruling system, Tabriz became the capital city of the State, and some major monuments such as “Shanbe-e-Ghazan” (Pleasure-Dome of Ghazan Khan) and “Rab’e-Rashidi” (an academic quarter) were founded in Tabriz. These events caused Tabriz to contribute to the development of Islamic culture and civilization. The tombs of numerous scholars, artists and mystic writers in Tabriz highlight the significance of the city in the historical development of the science, cultures, and arts in Iran. In the later historical eras, Tabriz played a major role in the establishment of the Safavid Dynasty (1504—1722), and the rise of the Iranian Constitutional temporary era, Tabriz has always been important in the epoch-making events such as the Islamic Revolution of 1979 and the glorious time of defending the country during the imposed war of 1981-1988 (Polat, 2014, p. 37). Due to the proximity of Tabriz to the borderline and several Ottoman attacks on this city, the rulers of the country decided to select another capital instead of Tabriz. Although Tabriz was the living place of the crown prince and royal family during the Qajar period (Omrani and Esmaili Sangari, 2006, p. 94). For more information about the history of Tabriz, you can read the article written by the author titled “A Short Glimpse to the Urban Development of Tabriz during the History” (Asbagh, 2019, pp. 73-83). The loyalty of the traditional architect to the principles and laws of traditional Iranian architecture makes the Qajar houses of Tabriz valuable. The spaces of these houses are arranged horizontally and vertically according to a completely Iranian pattern, and according to a hierarchy, access is from a public to a private area. The entrance doorway, vestibule, hallway and courtyard are the hierarchy of the spaces that allow access to the interior of the house. On the main axis of the courtyard, which faces South or South-East, there is the main space of a five-door room or a three-door room in the form of a cross. Around these spaces, there is a space that often functions as a room or hallway. In the sub-directions, especially on the Eastern side of the building, on a sub-axis perpendicular to the main axis of the building, all the patterns are repeated. Service spaces, such as kitchens, toilets and stables, and sometimes bathrooms, are located on the West side of the building. According to the houses in the city of Tabriz, the building was usually built in three directions in the form of ΓI or two directions in the form of Γ or in two directions facing each other and in some cases in one direction. In houses that are located in three directions, the main spaces of the building are facing to the South, so that due to the cold weather, the maximum benefit can be obtained from sunlight. The spaces that are second in terms of performance are located on the East side of the building and the service spaces are located on the West side of the house. Buildings that are built in two directions, their main spaces are facing to the South, and functionally secondary spaces, such as bathrooms and kitchens, are located on the East side of the building. Buildings that are built in a South or South-East direction usually have little infrastructure and often have one or two main living and sleeping

areas, a kitchen, and service spaces in the corner of the yard. The evolution of the architecture of houses can be divided into two historic periods; the first period: from the early Qajar era to the middle of it, and the second period: from the middle of the Qajar era to the first decade of the first "Pahlavi" era. The main features of the first period are as follows: a) the fit of the plan divisions with the façade; b) the existence of one-storey houses with a flat roof on the ground floor and with arched roof in the basement; c) the existence of main spaces such as five-door room and three-door room with simple or cross forms and hall and chamber on the main axis of the building and springhouse and storage in the basement; d) simple façades without decorations with the framing of brick inscriptions; e) the loyalty of the architects to local and traditional architecture; f) rectangular and sometimes square courtyards with the placement and arrangement of gardens and fountains according to the geometry pattern of Iranian gardens; g) having an entrance space (gateway, vestibule or corridor); h) ignoring the external façades of the building and the lack of windows and openings in the alley or passage. The general characteristics of the second period are as follows: a) the entry of European elements and decorations in the façade; b) the approach of the columnar porch, capitals, doors and windows, inscriptions and entrances, mirror work in the hall and the chamber, murals and wall paintings in the rooms and the motifs used in the decorations according to the European form and shape; c) the use of stairs as a visible and functional-decorative element in the architecture; d) the use of flowers and plants, curved and oval shapes in brickwork (Bani Masoud, 2009, pp. 168-171). Some of the famous Qajar houses in Tabriz are mentioned in Table 1.

**3.3 Architectural Characteristics of Qajar Houses in Isfahan**

Isfahan is one of the very old cities of Iran, the suitable geographical and natural location of this city on the plateau of Iran and the fertile soil and the existence of the famous River, "Zayandeh Rood", have allowed it to be one of the important activities centres of "Aryan" race living in this region in all past eras. Isfahan is a relatively mountainous and vast region in the centre of the plateau of Iran, which is limited to "Kashan" and "Golpayegan" from the North, "Abadeh" and "Behbahan" from the South, to "Yazd" from the East, and to "Chaharmahal Bakhtiari" and "Khuzestan" from the West (Figure 1). "Jean Chardin" (1643—1713), a French jeweller and tourist, has lived in Isfahan for many years (1664—1670 & 1671—1677) and claims that Isfahan is as populous as London (Chardin, 1983). "Jean-Baptiste Eugène Napoléon Flandin" (1809—1889), a French orientalist, painter, archaeologist, and politician visited Isfahan in 1840 and claims that "Isfahan is as big as half of the world". "Adam Olearius" (1599—1671), a German scholar, mathematician, geographer, and librarian who was sent to Iran by "Frederick III, Duke of Holstein-Gottorp" as the secretary to the ambassador published two books about the events and observations during his travels and wrote about Isfahan at the end of the 17th century. "Louis-Francois de Ferrieres-Sauvebeuf" (1762—1814), who was recruited to take charge of secret missions in the Middle East under the "Vergennes" ministry went to Isfahan in 1784, where he recorded his observations and experiments there. "Henry-René D'Allemagne" (1863—1950), a French librarian and historian who was a specialist in decorative arts, visited Isfahan in 1907 and mentioned the general condition of the city and its population in his travelogues (Honarfar, 2008, pp. VII, 1-5). In the houses of the Qajar period of Isfahan, many elements such as the entrance, vestibule, corridor and central courtyard are completely the continuation of previous architectural traditions and have been built as an interior and exterior complex. Sometimes the interior and exterior spaces are designed along the North-South axis and more than one entrance is foreseen in this type of house. Nevertheless, it mainly has the main entrance and a doorway that leads to a special corridor and from there by sub-entrances, it is connected first to the exterior spaces and then to the interior spaces. The main interior and exterior rooms are on the Northside facing the sun. Most of the time, there is a basement on this front and therefore the building in this part is on a higher level than the rest of the sides. The official room, which is located on the North front of the main axis of the building, is the most important architectural space of the house and has played a significant role in creating the rest of the spaces. To create the official room, even, if necessary, the construction of rooms on the East and West fronts is avoided or they are made as minimal as possible. The height of the building on the East and West sides of the yard is shorter than the height of the building on the Northside, and due to the lower height of the building in these two parts, their roofs are sometimes used for terrace uses in spring. There is a central official room on the Southside of the courtyard in some houses, such as the Northside, and there are rooms on either side of it, but it is not high. The Southern front sometimes lacks living spaces. In this case, the springhouse and warehouse are provided in that part. There are spaces in the four corners of the house that light does not enter from any side of the yard. These spaces are mostly less important and are dedicated to second and third-degree uses. In most old houses, kitchens, storerooms, toilets, bathrooms, and staircases are built on these sides and corners. The porch is located in front of the main façade of the building and solves many old problems such as sunshine and rain and the installation of curtains and heavily stained glasses. To make more use of the building on the North front and create double space in that part, the main room rises above the ground and the basement becomes more visible so that the old basement space becomes a ground floor with a yard or slightly descended. The main room is above the level of the courtyard and two stairs will be built on the sides

of the Northern front on the East and West sides of the courtyard to access it, and both stairs will reach the porch. By creating a porch, the first surface is in the main view of the outer edge of the porch, and windows are located on the ground floor in the lower space, and the opening spaces of the porch are located in the upper part to cover the porch roof which is the most logical solution to have a narrower opening that is the width of the porch. Therefore, it is necessary to install a beam on the outer edge of the porch to place a transverse beam on it. This beam itself requires vertical load-bearing elements, and the best solution is the choice of columns. These columns are placed on the brick or stone piers of the ground floor and in addition to ensuring stability and balance in the building, they also become decorative components. Plaster and decorative paintings on plaster are mainly used to cover these wooden columns. In early experiments, only two columns were built in front of the porch in front of the rafters on either side of the middle room, and because the openings of the two columns required a strong load-bearing beam, reinforcement components were installed on top of the beam to prevent bending between them which has a truss-like shape, but because it does not create a suitable and beautiful view, the architects have tried to cover the truss by creating a brick panel in front of it, which gives it a semi-circular form in the middle with a wide and lofty forehead for the view of the upper edge of the porch. This forehead, which was originally reinforced and static, becomes a decorative element, and even when the number of columns exceeds two and becomes a row of columns, this element becomes artificial in the middle which is made only for decoration. The main decorations of this forehead are plaster and painting. The second surface of the façade is located in the main direction at the end of the porch and there are openings for the rooms on that surface. The ultimate façade of the porch consists of a central hall and stained-glass windows or three-door rooms, five-door rooms, and seven-door rooms. Classification and importance of different spaces, creating order in the whole space of the house, using modules in creating scale, observing the main axes, diversity in public and private spaces, caring about the privacy of the surrounding houses and avoiding disturbing and upsetting the neighbours, and the use of local materials are the general features of these houses. In the late Qajar era, houses were usually built on relatively large land so that the courtyard could revolve around it. The buildings of these houses sometimes have one or two floors. The main view usually faces the South and the entrance porch is located in the middle, while the rooms on both sides are located symmetrically on both sides. Indigenous materials such as brick, wood, and sometimes glazed tiles have been used in the decoration of these buildings. The main space or living room and guest room are located in the middle and sometimes receive light from several directions (Jabal Ameli, 1996, pp. 113-127). The iconic houses of “New Jolfa” (an Armenian quarter) in Isfahan belonged to great merchants, clerics and nobles. These houses usually consisted of two parts, summer residence and winter residence, and most of them had a basement in the shady front (behind the sun) where food and beverages were stored. Some of these houses had three floors (Karapetian, 2006, p. 7). Common points of Isfahan (Islamic) houses and “Jolfa” (Christian) houses: a) introverted architecture; b) the entrance and courtyard of the house; c) main façades facing the courtyard (exterior decorations and proportions); d) circulation and connection between rooms and courtyards; e) the combination of main and secondary spaces in ground floor; f) the architectural identity that is dependent of Iranian and Islamic architecture of the same period. Interior decorations in Christian “Jolfa” houses are completely different from Islamic houses in Isfahan. The reason is related to religious issues; in the “Shia Islam” religion, it is not permissible to draw pictures of the human body and face completely (Ayvazian, 1999, pp. 482-483). The name of some of the Qajar houses in Isfahan (both Islamic and Christian) are listed in Table 1.

**3.4 Architectural Characteristics of Qajar Houses in Yazd**

During the “Achaemenid Empire” (549—331 B.C.), the city of Yazd, central Iran, became a trade city at the crossroad of two important commercial routes of the ancient world: one extending from the Far East and India to the heart of the Empire in Susa and the road, branching from the Silk Road, stretching from the Northern part of Empire to the Persian Gulf. According to some historians, the new city of Yazd was founded and given the name of “Eazadan” (Easatis in Greek) or “Yazdangerd” by command of “Emperor Yazdegerd I” (A.D. 339—421) in the “Sasanian” era (224—651). The city was conquered by Muslims in 642. Unlike many historic cities in Iran, the old quarters of Yazd have been relatively conserved and despite the construction of new routes and buildings, there are still thousands of historic residential buildings in the city. The city also contains the largest uninterrupted historic urban fabric in Iran. One of the oldest and most important historic quarters of Yazd is the “Fahadan” quarter. In this quarter, there are still many historic residential and commercial buildings, dating back from at least 200 years to one thousand years (Abouei, 2009, p. 230). All the Qajar houses of Yazd face inwards and their outer walls are left amorphous, poorly cut and borderless, or they are covered by the walls of the neighbours. Another basis of the design of these houses is the connection and fusion of closed spaces of the house with the open space. The decisive dominance of pure geometry over the design of these houses is one of the important common features in them. Geometric order has a clear and explicit effect on all levels of the design, from whole to part. The spaces of the house, while being connected and in harmony with each other in the whole design, have complete independence and to maintain this

independence, they sit next to each other only with an intermediate space. In the composition and arrangement of the spaces, the principle is based on diversity, so that the people of the house are faced with a new space and a place with a different atmosphere at any time. Another feature of the general plan of Yazd houses is the harmonization of their architecture with the harsh climate of the region. Creating deep and shady courtyards in the middle of the building, merging and connecting living spaces with open space, especially emphasizing semi-open spaces in the house, building tall windbreaks, various sun breaks, thickening the walls and arches, placing full-of-water ponds and gardens full of green plants in the yards, laying beds on the ponds and also establishing the scaffolding in the yards, the frequent use of large roofs and basements, are all the arrangements to provide a suitable living environment in the heart of the desert. Separating service spaces from living spaces causes all service spaces, such as kitchens, sanitary spaces, warehouses, and stables, to be out of sight so as not to disturb the peace and comfort of living spaces. Houses in Yazd are divided into several groups in terms of design: in some houses, closed spaces such as a fixed volume are constantly circling around the yard, and in others, important spaces of the house become an independent and distinct part and are usually located on the front of the yard which is full of shadow and the rest of the less important spaces are placed on the other fronts. Sometimes, the main spaces of the house are located in the North and the South of the yard such as two separate buildings, and other spaces in a simple combination are replaced on the Eastern and Western fronts. In several houses, there is evidence of a larger open space (garden) adjacent to the house, which makes the combination of open and closed spaces of the house more pleasant. In all of these houses, the shady front of the yard (the South or the South-West front) is usually the location of the most important spaces of the house, especially its large porch. The fundamental spaces of houses in Yazd always have almost the same form, which has appeared in various combinations. Elements such as porch, hall, three-door room, five-door room, and vestibule maintain their fixed form in various combinations, especially porches, which are often wide and high, have a special character among other spaces and replace the usual halls of the traditional houses. Order and symmetry are the principles of design of each of the mentioned elements both in the general assembly and in the composition of internal components, such as niches, shelves, doors and windows. In houses in Yazd, garden pits are in the middle of the yards which double the beauty of their appearance. The courtyards, which represent the main architectural element of the house, have a simple volume as if a rectangular cube has been pulled out of the total volume of the building, and a simple space has been created with flat interior views without indentation or protrusion inside the building mass. In this case, the architect focuses on the interior, instead of the external volume, and the atmosphere of the yard depends on these views. The design of the façades is based on order, repetition, variety, play with fixed and limited elements, frames and nested frames, and the beautiful combination of repeated frames and arches. The combination of frames with each other, with different sizes, dimensions and shapes in a façade, and the way they locate which appear in different ways up and down or left and right on both sides of the central element of the façade, determine the attractiveness of the courtyard façades. Designing a variety of arches, with narrow and wide openings and various repetitions of an arch in all façades is also one of the tricks that give prestige and charm to façades that do not have more than a few simple elements; and this is a preparation that has been used a lot in the houses in Yazd. Interestingly, the combination of these views does not necessarily coincide with the arrangement of the spaces behind them, and sometimes they are different. The presence of large porches in the form of empty volumes in the middle of the main façade is one of the distinguishing features of houses in Yazd. In most of these houses, in different yards of the house, we encounter the different modules and sizes, which adds to the spatial diversity of the houses (Haji Ghasemi, 2004, pp. 7-8). The traditional interior courtyards of Yazd generally have a square or rectangular shape, stretched along the longitudinal axis of the pond, which is decorated with two gardens symmetrically on either side of the pond. The location of the spaces around the yard also has a special order depending on their uses in the four seasons. Typically, the spaces around the courtyard are living rooms for day and night use, and other spaces such as the kitchen, storeroom, vestibule, and barn are located in the back layer of the rooms facing the courtyard. The function of the spaces around the yard is not based on a specific basis, but responds to different needs according to the different times of the day, month and year. On the other hand, each room has a specific climatic function, and can have a different function, although the following functions are known for different rooms: a) hall and windbreak: congregational room and religious ceremonies, summer residence; b) three-door room: study room, bedroom, dining room, spring residence, autumn residence, and especially winter residence; c) five-door room: family gathering space, party, dining room for family, spring residence, autumn residence, and winter residence; d) official room: guesthouse, dining room, the congregation of elders, spring residence, autumn residence, and winter residence; e) chamber: sleeping room, for resting and relaxing (room located between the two rooms of the hall and the windbreak), summer residence; f) yard: the venue for annual celebrations, weddings, and religious ceremonies, although a five-door room is also used for parties and table setting (Ghezelbash and Abolzia, 1985, pp. 24-25). Some of the famous Qajar houses in Yazd are mentioned in Table 1.

**3.5 Architectural Characteristics of Qajar Houses in Kashan**

Kashan is a city in the northern part of Isfahan province in the centre of the plateau of Iran. Linguists have different ideas about the meaning of the name Kashan; some claim that it means a place full of summer houses built from wood and straw. "Kashaneh" means house in the Persian language and "Kashan" means a type of building like a house. "Pietro Della Valle" (1586—1652), an Italian tourist, wrote about Kashan in his travelogue: Kashan is too hot that it does not have any winter but it has unboreable hot summers. "Sir Thomas Herbert" (1606—1682), an English Nobleman, described Kashan in his travelogue as the second most beautiful and prosperous city in Iran with huge decorative houses, baths, mosques, and bazaars (Khorshidi Fard, 2008, p. 11). "Jean Chardin" (1643—1713), a French jeweller and tourist, believes that Kashan has the best Satin fabric, embroidered woven velvet, gold and silver silk in Iran. "Edward Granville Browne" (1862—1926), the famous British orientalist and Iranologist, who has visited the alleys and bazaars of the historic neighbourhood of Kashan described their beautiful and sturdy copper utensils. "Jane Dieulafoy" (1851—1916), wife of "Marcel-Auguste Dieulafoy" (1844—1920), the French Archaeologist and civil engineer, has visited Kashan and wrote in her book that Kashan is one of the most prosperous and rich cities of Iran with artist people, beautiful houses, and paved alleys (Shateri, 2008, pp. 5, 7, 8). Kashan houses can be divided into three categories based on the construction situation: a) houses that are built as a complex include exterior spaces, interior spaces, crew houses, and spring spaces. Due to the vastness of the building and the high cost of construction and maintenance, these types of houses usually belong to specific and wealthy people in the community who, in addition to the ability to build and construct, also can maintain and preserve them; b) houses that have construction on four fronts. They are built facing the qibla (the direction towards the Kaaba in the Sacred Mosque in Mecca, which is used by Muslims when saying their prayers toward it) and back to the qibla, and on the other two sides, ordinary rooms and warehouses and other secondary importance simple and ordinary places are built, but the height of the building on the two fronts is more than the other parts. There are Often two platforms and a porch and relatively long corridors adjacent to the front door that are residential parts of the house that also have an external aspect. In addition to the courtyard, they also have access through the corridor, so that if a guest or a newcomer, depending on the degree of closeness or friendship, is not allowed to see the courtyard, he will be guided directly into the building from the same access inside the corridor; c) houses that have construction on two fronts facing the qibla and behind the qibla. The general plan of these houses is a tall building facing the qibla (including a five-door room and two corner rooms on either side of the five-door room), the lower floor of which is also underground and always has a rectangular courtyard with a pond and two or four gardens and another building in the opposite direction or behind the qibla, and it has been built either roofed in the middle surrounding with two to four rooms on both sides, or a roofed springhouse with two or four rooms on both sides. The entrance doors of most houses face the qibla, and it never happens that the entrance door leads directly from the alley to the courtyard (Aminian Arai, 1996, p. 254). Common features of Kashan Qajar houses are: a) building the house around the central courtyard; b) construction of the house in the form of a garden pit; c) using the basement as an essential component of the house for living; d) use of porch and open space on the Southern front; e) use the springhouse to relax in the hot season; f) use of moisture from the pool in the middle of the central courtyard to soften the air; g) using the backyard usually behind the Southern front; h) using the vestibule for entering the house; i) use of local materials, clay and mud in the building; j) the plan of the buildings is designed dense and compact; k) all the windows and entrance doors are opened to the central courtyard and there are no windows facing to the outside; l) urban planning method with dense or organic texture; m) use of dome-shaped roofs; n) using a space called the basement in the underground of the house; o) in Kashan houses, examples of local architectural measures for cooling are more visible than heating; p) the use of windbreaks and the important role of the wind in adjusting the temperature inside the house; q) use the terrace to rest and sleep on cool nights in the hot season; r) the direction of the houses in the Northeast-Southwest, North-South, or Northwest-Southeast and even in the East-West direction (Arvin and Niazi, 2006, pp. 85-106). The name of some of the Qajar houses in Kashan are listed in Table 1.

**4. Common Features of Architectural Forms of Qajar Houses in Iran**

For comparing the architectural characteristics of ajar houses in Iran, two case studies are selected in each city. In Tabriz, Behnam house (early Qajar era) and Qadaki house (late Qajar era) are selected. The two case studies in Isfahan are Charmi house and Dr Alam house. Rouhaniyun house and Mortaz house are the selected Qajar houses in Yazd. In Kashan, Bani Kazemi house and Boroujerdiha house are studied. Furthermore, the list of some of the other Qajar houses in Tabriz, Isfahan, Yazd, and Kashan is mentioned in Table 1. Afterwards, the analogy of the architectural forms and elements of the Qajar houses in the aforementioned cities of Iran are compared in detail in Table 2. Then, the main interior façades of each case study in each city are shown in Table 3. Subsequently, the main plans (grand floor and basement or first floor and second floor) of each building are indicated in Table 4. Finally, the elevations and sections of Qajar houses in Tabriz, Isfahan, Yazd, and Kashan are compared in Table 5.

**Table 1.** The List of Some Qajar Houses in Tabriz, Isfahan, Yazd, and Kashan (Developed by Author).

| City | **Name of the Qajar Houses** |
|---|---|
| **Tabriz** | Salmasi, Behnam, Ganjeh-i-Zadeh, Haj Sheikh, Alavi, Mojtahedi, Mashruteh, Qadaki, Sharbat Oghli, Haidar Zadeh, Savjobolaghi, Amir Nezam Garousi, Kalantari, and Mirza Mehdi Farrashbashi House (Key Nejhad & Shirazi, 2006, p. 189). |
| **Isfahan** | Islamic Houses: Angurestan Malek, Charmi, Dr Alam, Wasiq Ansari (Haji Ghasemi, 1998, p. 5). Imam Juma, Shakeri, Salehi (Mehryar), Akaf and Sharif, Kahrangi, Amin, Roghani, Alafchi, and Yazdian House (Jabal Ameli, 1996, pp. 99-127).<br>Armenian Houses in "New Jolfa Quarter": Khajeh Hosp, Karam Khan, Vartans Abkar, Aghanour, and Leon Vakil Al-Dowleh (Zulian or Plasher) House (Karapetian, 2006, p. 6). |
| **Yazd** | Aghazadeh (in Abarkooh City of Yazd Province), Kolahduzha (Water Museum in Yazd), Haj Kazem Rasoulian (Yazd Faculty of Art and Architecture), Nawab Vakil, Mortaz (Yazd Faculty of Architecture and Urban Planning), Shafi'pour (Faculty of Conservation), Solat, Lariha (Museum of Historic Documents), Shoukouhi (Yazd *ICHHTO Research Center), Salar (*ICHHTO Research Center in Meybod City of Yazd Province), Tehraniha (Fahadan Museum Hotel), Golshan (Laleh Hotel, Yazd), Adib al-Mamalik (House and Hotel), Malekzadeh (Converted to a Hotel), Malek-ol-Tojjar (The Queen of Merchants), Akhavan Sigari, Ardakanian, Rouhaniyun, Rismanian, Semsar, Arab Houses Complex, Ouloumiha, Fatehha, Farhangi & Mozaffari, Koroghlu, Gerami, Mehraban Goudarz, Mashruteh (Museum of Photography), Meshkian, and Malek House (Haji Ghasemi, 2004, p. 5). *ICHHTO: "Iranian Cultural Heritage, Handicrafts, and Tourism Organization". |
| **Kashan** | Al-Yasin, Isfahanian, Bakuchi, Boroujerdiha, Bani Kazemi, Tahami, Jahan Arai, Kheyriyeh, Dastmalchi, Reza Hosseini, Sajjadi, Sharifian, Saleh, Tabatabai, Attarha, Alaqheband, Karkhanechi, Mortazavi (Haji Ghasemi, 1996, p. 5, & 2018, pp. 200-255). Ebrahim Khalil Khan Ameri, Hakim Bashi, Haj Ali Kaffash, Daeizadeh, Roin Tan, Golizadeh, Abrisham Chi, Taghavi, Ayatollah Alavi Boroujerdi, Masoudi Far, Shah Yalani, Hashemian, Lajevardi, Mohseni, Ali Soudouri, Haj Mohammad Iraqi (Bagheri), Jahan Arai, Tahami, Refahi, Haj Meshki (Aminian Arai, 1996, p. 268) and Abbasian House (Khorshidi Fard, 2008, pp. 11-54). |




**Figure 1.** The Map of Iran Indicates the Location of Tabriz, Isfahan, Yazd, and Kashan (Polat, 2014, p. 30).

**Table 2.** The Comparative Analogy of Qajar Houses in Tabriz, Isfahan, Yazd, and Kashan with the Analytical Approach of Architectural Forms and Elements (Developed by Author).

| **Subject** | **Tabriz** | **Isfahan** | **Yazd** | **Kashan** | **Description** |
|---|---|---|---|---|---|
| Loyalty to traditional and indigenous architecture | **√** | **√** | **√** | **√** | Continuation of previous architectural traditions |
| Considering the hierarchy entering the house | **√** | **√** | **√** | **√** | Entrance: gateway, vestibule, corridor, courtyard |
| Symmetry in the main and secondary axes | **√** | **√** | **√** | **√** | Symmetry in all of the views and façades |

| | | | | | |
|---|---|---|---|---|---|
| The main front of the building | South/ South-East | North | South/ South-West | North/ South | The location of the main spaces in the house |
| Building orientation | North-South or East-West | North-South | Northeast - Southwest | All the directions | The main direction of the building on site |
| Basement | Southern front | Northern front | √ | √ | Connecting the house to the ground |
| Official room | Southern front | Northern/ Southern front | Southern front | √ | For special occasions, important gatherings and formal parties |
| Five-door room/ Three-door room | √ | √ | √ | √ | living room/ sleeping or dining room |
| Sitting place on the roof | Not used due to the cold climate | East/ West front | - | On one of the 4 sides of the house | It is usually used in the spring season for cooling |
| Springhouse | Northern front | Southern front | √ | Southern front | A room with a pool in the middle |
| Spaces with no light in 4 corners of the building | Kitchen, storage, toilet, bathroom | Kitchen, storage, toilet, bathroom, staircase | Kitchen, storage, toilet, bathroom | Service spaces | Service spaces |
| Introversion | √ | √ | √ | √ | Just an extroverted entrance |
| Diverse and unique entrances | √ | √ | √ | √ | Distinguishment between the entrances of houses |
| 2-leaf wooden entrance door with two door knockers | √ | √ | √ | √ | One door knocker is for men and the other one for women (different sounds). |
| 2 platforms on both sides of the main entrance | √ | √ | √ | √ | It is designed for old people to sit & wait until the door of the house is opened. |
| Entrance vestibule decorations | Arching | Muqarnas/ Arching | √ | √ | Octagonal or semi-octagonal or more often quadrangular |
| Seeing the main view immediately after entering the courtyard | √ | √ | √ | √ | The best view of the building is seen after the light explosion. |
| Roof Coatings | Dome/ Flat | Dome/ Flat | Dome/ Flat | Dome | Due to the climate |
| Porch | Southern front | Northern front | South front/ South-West front | Southern front | A covered area that connects the yard to the surrounding zone |
| **Subject** | **Tabriz** | **Isfahan** | **Yazd** | **Kashan** | **Description** |
| Order and modular design in the whole space of the house | √ | √ | √ | √ | Using modular design |
| Use of indigenous materials | Brick, wood, clay, plaster, straw | Brick, wood, clay, plaster, straw, tiles | Straw, brick, clay, plaster | Clay & mud from the soil of the garden pit | Always using native materials in building the historic houses of this era. |
| Dense and intensive plan of the building | √ | √ | √ | √ | Prevent heat exchange |

| | | | | | |
|---|---|---|---|---|---|
| Central courtyard | √ | √ | √ | √ | In the shape of a square or rectangle |
| Garden in the inner and outer courtyard | √ | √ | √ | √ | The geometric pattern of the Persian garden |
| Pond in the courtyard | √ | √ | √ | √ | In different forms |
| The importance of the spaces on the Southside | Grade 1 Main spaces | Grade 2 Official room | Grade 1 South/ South-West | Grade 1 | Grade-1 spaces are more important than Grade-2 spaces. |
| The importance of the spaces on the Northside | - (Dominant wind direction) | Grade 1 Main spaces, Official room | Grade 2 | Grade 1 | Grade-2 spaces are less important than Grade-1 spaces. |
| The importance of the spaces on the Eastside | Grade 2 Kitchen & service rooms | Grade 3 Rooms | Grade 3 | Grade 2 | Grade-2 spaces are more important than Grade-3 spaces. |
| The importance of the spaces on the Westside | Grade 3 Service rooms | Grade 3 Rooms | Grade 3 | Grade 2 | Grade-3 spaces are less important than Grade-2 spaces. |
| Ignoring the exterior views of the building | √ | √ | √ | √ | The interior views are more important than the exterior elevations except for the main façade & gateway. |
| Lack of window into the alley & passage | √ | √ | √ | √ | Due to the privacy & hierarchy of spaces |
| Decorating & ornaments | Brickwork, flowers & plants, oval curve, mirror work, painting, plastering, moulding | In the guest room: painting, moulding, mirror work, Muqarnas plastering | - | - | The arrival of European decorations in the late Qajar era and the tendency to Simplicity in decorating & ornaments |
| Fireplace | √ | √ | - | - | In the cold climate, there are beautiful fireplaces in the main room of the house. |
| Windbreaker | - | - | √ | √ | For cooling the air |
| Outdoor Yard Location (Public for men) | South | North | - | North | In the shape of a square or rectangle |
| Inner yard location (private for family) | North | South | - | South | Usually smaller than the outdoor yard |
| **Subject** | **Tabriz** | **Isfahan** | **Yazd** | **Kashan** | **Description** |
| Orange Garden (for citrus trees) | - | - | √ | - | Can be covered on the cold days or due to the raining/ snowing |
| How to access water | Aqueduct/ Water Well | “Madi” from “Zayandeh Rood” River | Aqueduct/ Water Well | - | Each branch of the “Zayandeh Rood” River is called “Madi”. |
| Garden pit | - | - | √ | √ | A garden pit is always under the level of the building which gives access light to the basement rooms. |

| | | | | | |
|---|---|---|---|---|---|
| Narrow passages in organic texture | √ | √ | √ | √ | For security and climate reasons |
| Trees and plants | - | - | Pomegranate, fig, red & yellow rose, blackberry | Pomegranate, fig, grape | The yards with trees and plants look like a garden in heaven. |
| Energy needs | High (2011, V19, p.72) | Medium (2011, V19, p.70) | Medium (2011, V19, p.79) | Medium (2011, V19, p.76) | Based on National building regulations of Iran, Volume 19, Energy Saving (2011). |
| Dominant thermal requirement | Heating (2011, V19, p. 72) | Heating (2011, V19, p. 70) | Heating & cooling (2011, V19, p. 79) | Heating & cooling (2011, V19, p. 76) | Based on National building regulations of Iran, Volume 19, Energy Saving (2011). |
| Type of climate | Very cold in winter & hot and dry in summer (2003, pp. 98, 99) | Cold in winter & hot and dry in summer (2003, p. 98) | Medium and dry in winter & very hot and dry in summer (2003, p. 98) | Cold in winter & hot and dry in summer (2003, p. 98) | Based on the book "Climate and Architecture" by "Kasmaei" (2003). |
| Dominant wind direction | North-East / South-West (2003, p. 164) | West/ South-West (2003, p. 152) | North-West/ South-East (2003, p. 191) | North/ East/ South/ North-East (2003, p. 186) | Based on the book "Climate and Architecture" by "Kasmaei" (2003). |

**Table 3.** The Comparison of the Main Interior Façades of Qajar Houses in Tabriz, Isfahan, Yazd, and Kashan (Developed by Author).

| City | **Case Study Number 1** | **Case Study Number 2** |
|---|---|---|
| **Tabriz** |  |  |
| | Qadaki House (Late Qajar era) (Photo by Author). | Behnam House (Early Qajar era) (Photo by Author). |
| **Isfahan** |  |  |
| | Charmi House (Haji Ghasemi, 1998, p. 23). | Dr Alam House (Haji Ghasemi, 1998, p. 65). |

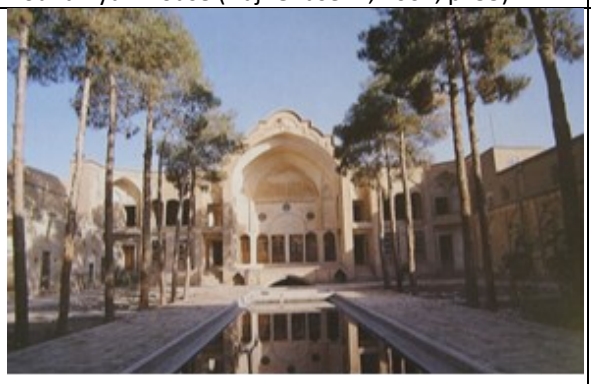
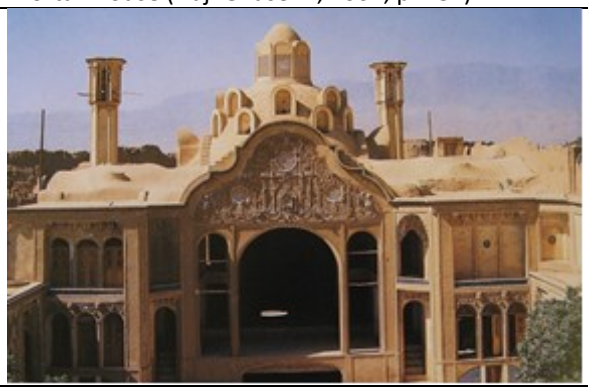
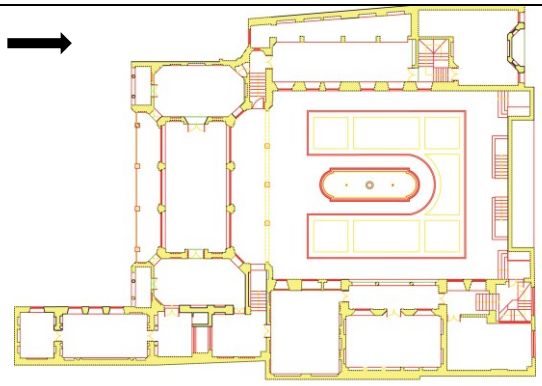
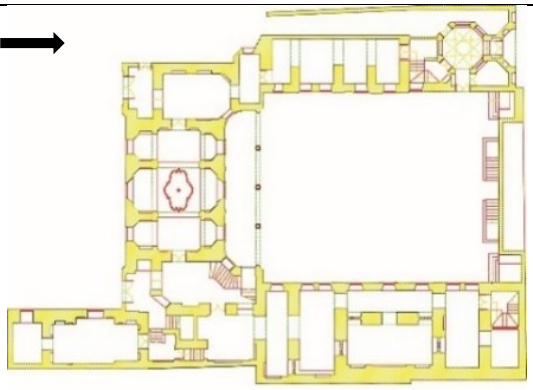
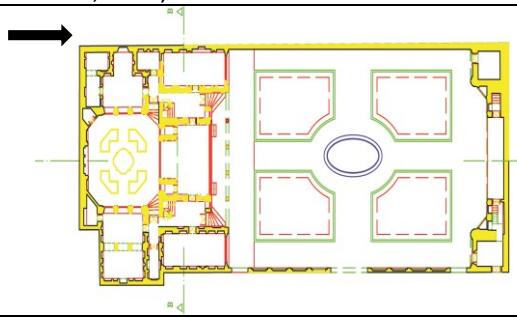
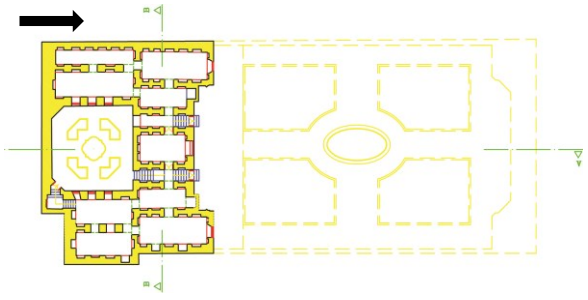
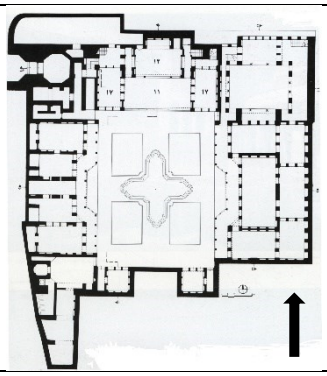
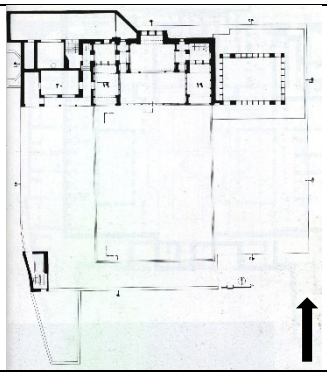
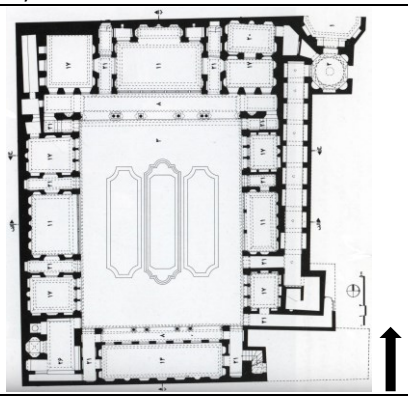
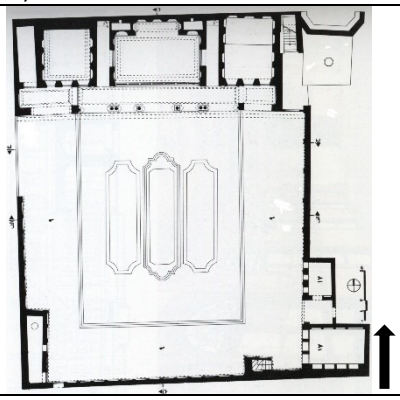
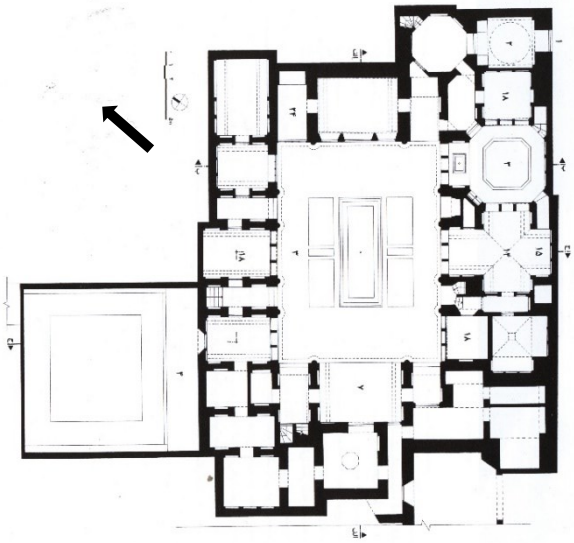
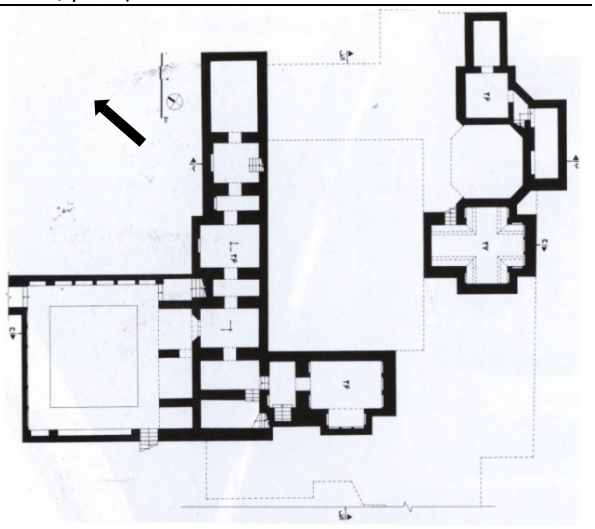
| | | |
|---|---|---|
| **Yazd** |  |  |
| | Rouhaniyun House (Haji Ghasemi, 2004, p. 55). | Mortaz House (Haji Ghasemi, 2004, p. 181). |
| **Kashan** |  |  |
| | Bani Kazemi House (Haji Ghasemi, 1996, p. 47). | Boroujerdiha House (Haji Ghasemi, 1996, p. 35). |

**Table 4.** The Comparison of the Plans of Qajar Houses in Tabriz, Isfahan, Yazd, and Kashan (Developed by Author).

| City | **Main Plan** | **Other Floor's Plan** |
|---|---|---|
| **Tabriz (Qadaki House)** |  |  |
| | Ground Floor Plan of Qadaki House (Archive of the Cultural Heritage Organization of East Azerbaijan Province, 2011). | Basement Floor Plan of Qadaki House (Archive of the Cultural Heritage Organization of East Azerbaijan Province, 2011). |
| **Tabriz (Behnam House)** |  |  |
| | Ground Floor Plan of Behnam House (Archive of the Cultural Heritage Organization of East Azerbaijan Province, 2011). | Basement Floor Plan of Behnam House (Archive of the Cultural Heritage Organization of East Azerbaijan Province, 2011). |

| | | |
|---|---|---|
| **Isfahan (Charmi House)** |  |  |
| | First Floor Plan of Charmi House (Haji Ghasemi, 1998, p. 24). | Second Floor Plan of Charmi House (Haji Ghasemi, 1998, p. 26). |
| **Isfahan (Dr Alam House)** |  |  |
| | First Floor Plan of Dr Alam House (Haji Ghasemi, 1998, p. 66). | Second Floor Plan of Dr Alam House (Haji Ghasemi, 1998, p. 67). |
| **Yazd (Rouhaniyun House)** |  |  |
| | Ground Floor Plan of Rouhaniyun House (Haji Ghasemi, 2004, p. 52). | Basement Floor Plan of Rouhaniyun House (Haji Ghasemi, 2004, p. 54). |

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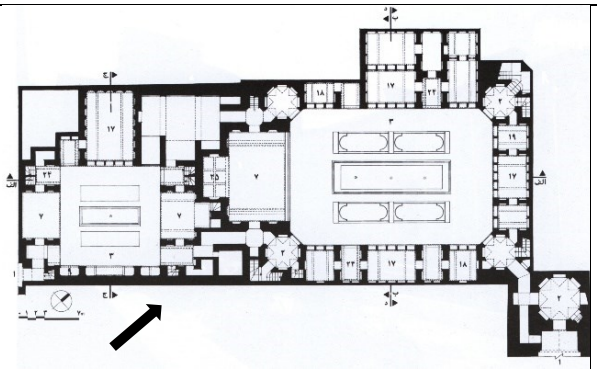
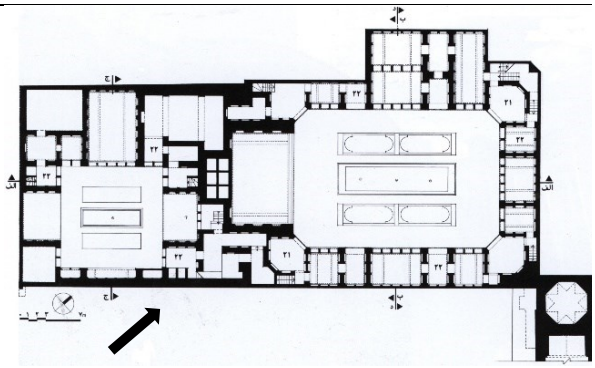
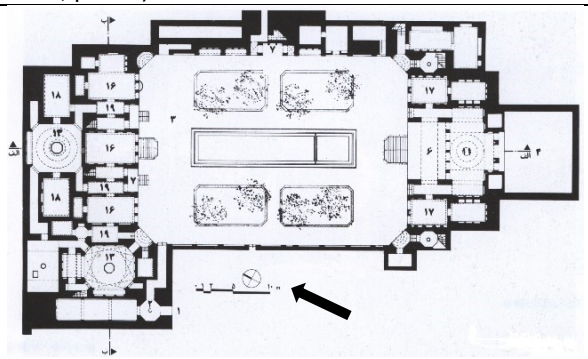
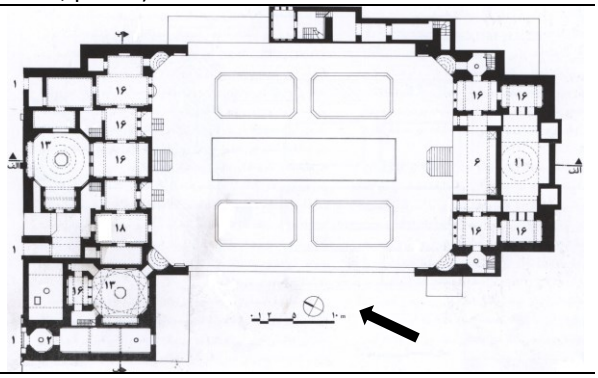
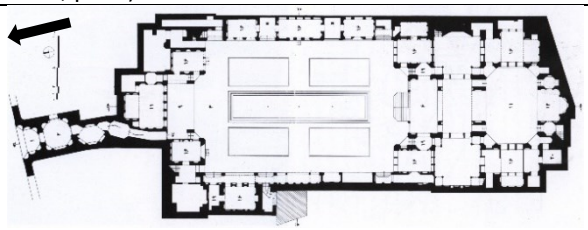
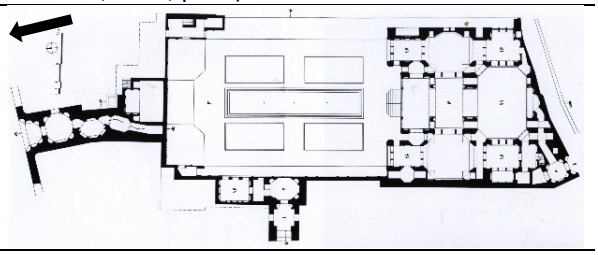
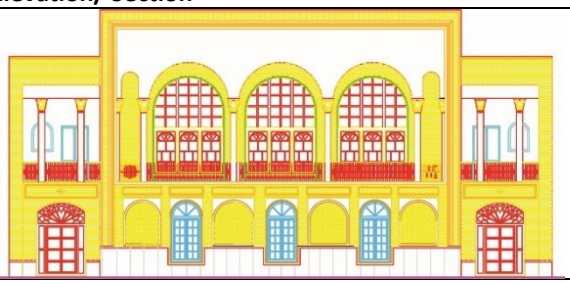
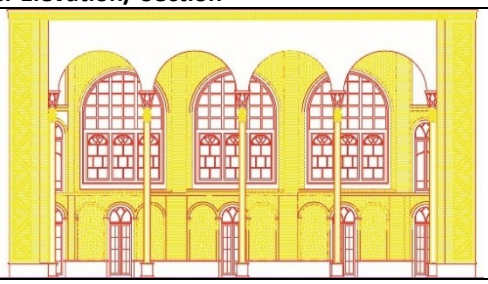
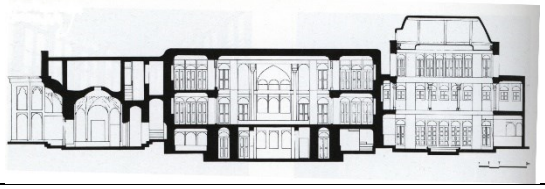
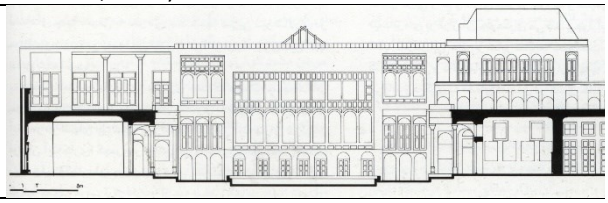
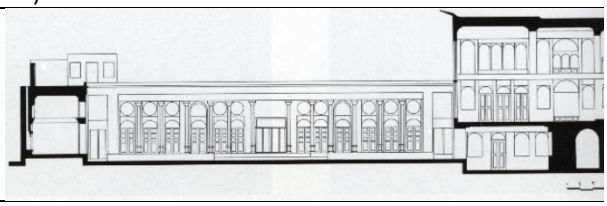
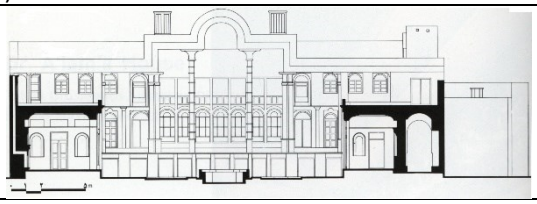
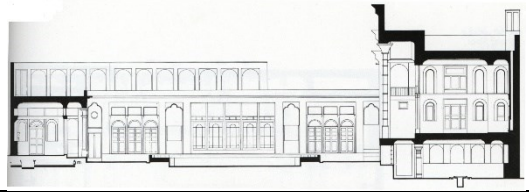
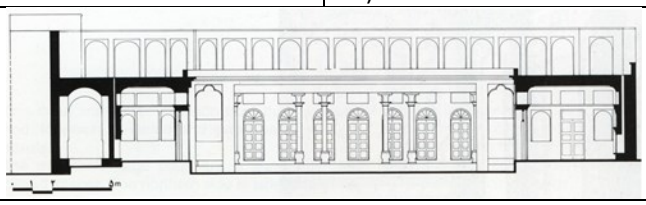
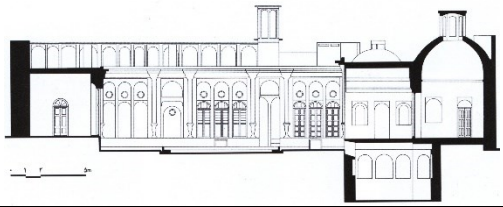
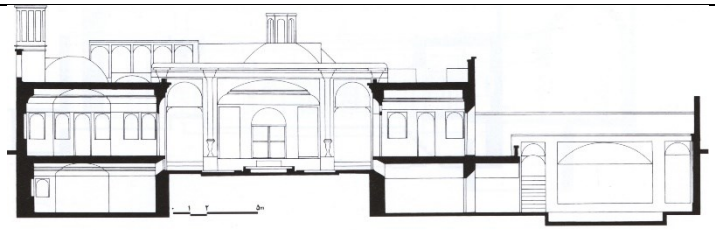
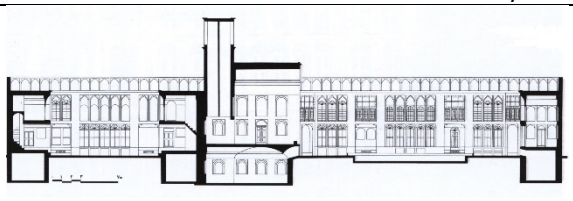
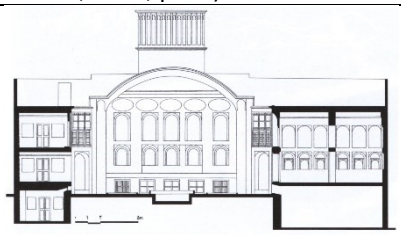
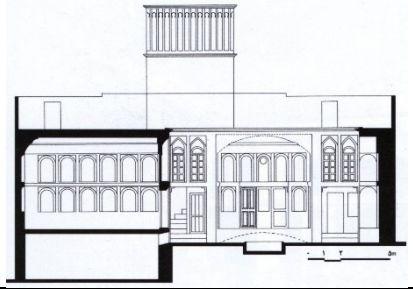
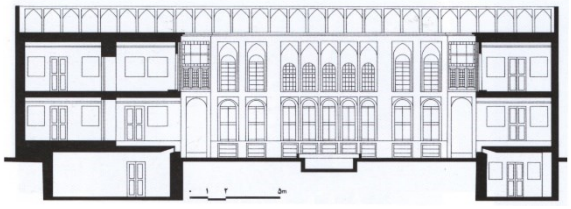
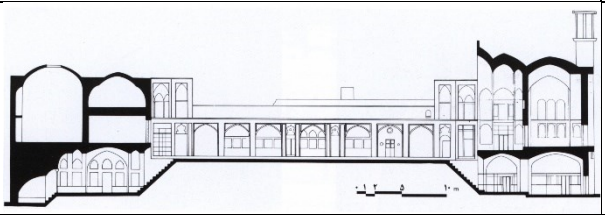
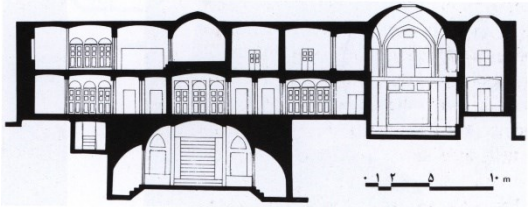
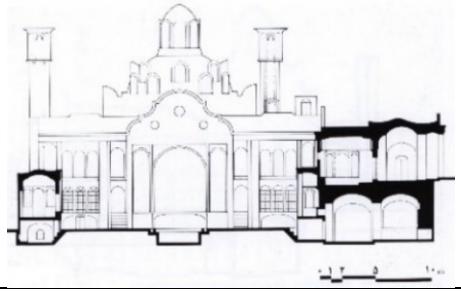
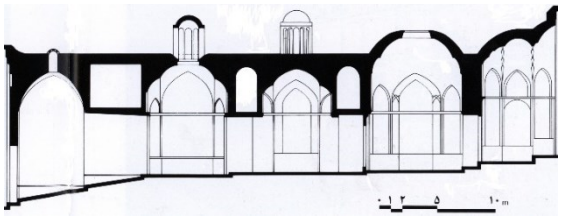
|---|---|---|
| Yazd (Mortaz House) |  |  |
| | First Floor Plan of Mortaz House (Haji Ghasemi, 2004, p. 180). | Second Floor Plan of Mortaz House (Haji Ghasemi, 2004, p. 182). |
| Kashan (Bani Kazemi House) |  |  |
| | First Floor Plan of Bani Kazemi House (Haji Ghasemi, 1996, p. 48). | Second Floor Plan of Bani Kazemi House (Haji Ghasemi, 1996, p. 48). |
| Kashan (Boroujerdiha House) |  |  |
| | First Floor Plan of Boroujerdiha House (Haji Ghasemi, 1996, p. 36). | Second Floor Plan of Boroujerdiha House (Haji Ghasemi, 1996, p. 37). |

**Table 5.** The Comparative Analogy of the Elevations and Sections of Qajar Houses in Tabriz, Isfahan, Yazd, and Kashan (Developed by Author).

| City | Elevation/ Section | Other Elevation/ Section |
|---|---|---|
| Tabriz (Qadaki House) |  |  |
| | East Elevation of Qadaki House (Archive of the Cultural Heritage Organization of East Azerbaijan Province, 2011). | South Elevation of Qadaki House (Archive of the Cultural Heritage Organization of East Azerbaijan Province, 2011). |

| | | |
|---|---|---|
| **Tabriz (Behnam House)** |  |  |
| | North Elevation of Behnam House (Archive of the Cultural Heritage Organization of East Azerbaijan Province, 2011). | South Elevation of Behnam House (Archive of the Cultural Heritage Organization of East Azerbaijan Province, 2011). |
| **Isfahan (Charmi House)** |  |  |
| | A-A Section of Charmi House (Haji Ghasemi, 1998, p. 27). | B-B Section of Charmi House (Haji Ghasemi, 1998, p. 22). |
| |  |  |
| | C-C Section of Charmi House (Haji Ghasemi, 1998, p. 26). | D-D Section of Charmi House (Haji Ghasemi, 1998, p. 27). |
| **Isfahan (Dr Alam House)** |  |  |
| | A-A Section of Dr Alam House (Haji Ghasemi, 1998, p. 69). | B-B Section of Dr Alam House (Haji Ghasemi, 1998, p. 68). |
| |  | |
| | C-C Section of Dr Alam House (Haji Ghasemi, 1998, p. 69). | |
| **Yazd (Rouhaniyun House)** |  |  |
| | A-A Section of Rouhaniyun House (Haji Ghasemi, 2004, p. 52). | B-B Section of Rouhaniyun House (Haji Ghasemi, 2004, p. 53). |

| | | |
|---|---|---|
| |  | |
| | C-C Section of Rouhaniyun House (Haji Ghasemi, 2004, p. 54). | |
| **Yazd (Mortaz House)** |  |  |
| | A-A Section of Mortaz House (Haji Ghasemi, 2004, p. 182). | B-B Section of Mortaz House (Haji Ghasemi, 2004, p. 186). |
| |  |  |
| | C-C Section of Mortaz House (Haji Ghasemi, 2004, p. 184). | D-D Section of Mortaz House (Haji Ghasemi, 2004, p. 186). |
| **Kashan (Bani Kazemi House)** |  |  |
| | A-A Section of Bani Kazemi House (Haji Ghasemi, 1996, p. 50). | B-B Section of Bani Kazemi House (Haji Ghasemi, 1996, p. 50). |
| **Kashan (Boroujerdiha House)** |  |  |
| | B-B Section of Boroujerdiha House (Haji Ghasemi, 1996, p. 42). | C-C Section of Boroujerdiha House (Haji Ghasemi, 1996, p. 40). |

**5. Conclusions**

In general, the architectural features of the houses of the Qajar era can be summarized as follows: a) obsolescence of lancet arches, and shouldered arches, and their replacement with semi-circular arches in the entrance, door inscription, and niche; b) elimination of the non-load bearing false cover from the ceiling of the rooms; c) removal of the attic and corner rooms; d) removal of the vertical and horizontal sunshades; e) use of columns aligned with the outer surface of the main façade; f) creating an element emphasizing the vertical axis of symmetry above the entrance and or on the main façade; g) elevating the building by changing the proportions; h) removing traditional elements and replacing them with similar types; i) using new decorative patterns; j) using semi-circular arches in the

main façade as a decoration and limiting its load-bearing role. In all Qajar houses of Tabriz, Isfahan, Yazd, and Kashan, the loyalty of architects to traditional Iranian architecture can be seen. The architecture of Qajar houses is introverted so that no windows are exposed to the alley and passage, and all the beautiful views of the house are around the inner and outer courtyards. The entrance to all these houses is following the hierarchy, and the vestibule space prevents a direct view into the privacy of the house. After the main entrance, passing through the vestibule and the corridor, we reach the courtyard, which at first glance shows the main view of the building. Due to the darkness in the vestibule space and corridor, when entering the main yard, the visitor experiences the explosion of light and observes the most elaborate decorative elevation of the building. The yard is the heart of the house, which, with its pond and gardens, softens the interior of the house like a small paradise. Around the courtyard, first-class spaces that need light, such as the hall, official room, three-door rooms and five-door rooms, are arranged in an orderly manner, and service spaces such as the kitchen, staircase, storage, barn, toilets, and the bathroom are located in the back layer of the rooms facing the yard or in the four corners of the house that has no access to direct daily light. Symmetry, order, and modular design have been observed in all these houses and factors such as water, sunlight, wind and climate have been considered. In Yazd and Kashan, with a hot and dry climate, they adjust the hot air of the house by using windbreaks, and in Tabriz and Isfahan, with a cold climate, we see beautiful decorative fireplaces in the wall of the main spaces of the houses. Also, the construction of a garden pit in Yazd and Kashan is a solution for accessing aqueduct water at lower depths. In Tabriz, the Northeast-Southwest direction has been used for the axis of the houses. Nevertheless, In Isfahan, the Northwest-Southeast direction has been used, while In Yazd, the Northeast-Southwest direction has been used for the axis of the houses. In Kashan, no specific direction can be considered, because the houses have been built inside the ground and the internal temperature of the earth in combination with the cooling resulting from the transfer of the wind flow by the windbreaks to the basement has been used to adjust the temperature and provide natural comfort conditions which are less affected by sun radiation. Altogether, it can be concluded that the architects and artists of the Qajar era did not merely imitate the principles of Western architecture and art, but also adapted and applied those principles to the principles of Iranian architecture, which is one of the valuable approaches of Qajar art and architecture.

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**Conflict of Interests**
The author declares no conflict of interest.

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# The Role of Cultural Heritage Tourism in Regenerating Old Muharraq in Bahrain

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**Abstract**
The historic city of Muharraq in Bahrain encompasses a unique cultural heritage. Since the discovery of oil in 1932, Old Muharraq started to be abandoned by its original inhabitants who moved to the periphery. Due to neglect, the old houses were decaying and collapsing. In order to prevent further losses, the government launched several rehabilitation projects in Muharraq. The pearling path is one of these significant regeneration projects that will be explored here. This paper focuses on the role of cultural heritage tourism and its implications for urban regeneration in old Muharraq. The methodology used is based on the case study approach. A comprehensive onsite study was carried out to identify the challenges of urban regeneration. In addition, a number of informal interviews were conducted with Bahrain Authority for culture and Antiquities representatives. The paper concludes with a number of recommendations to revive old Muharraq via a sustainable cultural heritage tourism strategy.
**Keywords:** Urban Regeneration, Cultural Heritage Tourism, Identity, Sustainability.

## 1. Introduction

In the field of urban planning and design, the concept of urban regeneration is challenging for both scholars and practitioners. Urban regeneration which is also called urban renewal or urban redevelopment is a multi-sided field. This requires deep theoretical vision in addition to act to solve social, economic, physical, and environmental problems causing the urban environment in vibrant cities (Lak, Gheitasi, & Timothy, 2019). Urban renewal planning can be applied through rehabilitating heritage areas and historic buildings. The latter can have a significant role in urban regeneration through highlighting the local identity, sense of place, and promoting residents' sense of belonging.

The term 'Regeneration' is usually connected to economic development, as it ignores the local conditions that lead to renewal. It is obvious that heritage and urban redevelopment are essentially linked, however, the different aspirations of various stakeholders may be concealed through simple assumptions about their connections. (Timothy, 2011, Amen & Nia, 2020 ) defined heritage as "elements of the past that are positioned for, or utilized in contemporary situations, is mobilized for a variety of present objectives and public policy purposes". Urban regeneration is a tool used to mobilize tangible and intangible heritage. Additionally, cultural heritage tourism has been developed by cities as a strategy to create jobs and produce new sources of income, as well as improving cultural opportunities and quality of life for residents (Uysal & Özden, 2011, Al-Dujaili & Amen, 2018 ). The relationship between cultural heritage tourism and urban regeneration has been highly mentioned in academic studies, however, it has not been well examined in the context of the Gulf.

This paper investigates the concept of cultural heritage tourism in the context of urban regeneration, and examines how can cultural heritage tourism play a significant role in regenerating old Muharraq city, Bahrain. The historic city of Muharraq has a rich historic culture due to its long-time cultural industries which included pearl diving, ship building and Bahraini art of "Kurar" (a form of embroidery using a golden thread). These various cultural assets can be utilized to develop cultural heritage tourism in the city and bring life back to it. Correspondingly, the government launched several rehabilitation projects in Bahrain which included the pearling path project in old Muharraq. The paper focuses on this project as a case study and comes up with a list of lessons learnt.

## 2. Materials and Methods

The method adopted in the paper is a case study approach to investigate how urban regeneration affected the development of old Muharraq city in Bahrain, through cultural heritage tourism. The case study approach gives a better understanding of specific issues needed to be highlighted through looking into real-world examples. Muharraq city represents a unique case which needed to be described and investigated to provide knowledge of the role of cultural heritage tourism in urban renewal. The paper uses secondary sources and documents in addition to in- depth field studies and observations, as well as informal interviews with representatives from Bahrain Authority for Culture and Antiquities. The structure of the paper includes first literature review which explores the concepts of cultural heritage tourism and urban regeneration and the interconnection between them. Then the paper will examine in-depth the pearling path project in old Muharraq and will finally come out with a list of lessons learnt for a sustainable cultural heritage tourism strategy.

**3. Cultural heritage Tourism and Urban Regeneration**

The process of tourism has been widely used as a tool for growth and evolution all over the globe because of its capability to generate more jobs, increase tax incomes, encourage commercial activities, refine infrastructure and recreational opportunities, encourage residents, and overall improve the quality of life in a specific destination. cultural heritage tourism can activate economic development more than any other types. It is suited to enhance cultural attractions, protecting heritage, renew old urban quarters, injecting a sense of community pride, identity and solidarity. Historic cities have always had a competitive advantage in the tourism sector. The reason behind that is their unique marketable cultural heritage resources which attract large segments of travelers (Lak et al., 2019).

Jolliffe and Smith defines tourism as a widespread international activity and a defining characteristic of contemporary societies. They also mentioned that cultural heritage tourism is a part of the tourism activity that uses shared heritage of localities to develop products that may attract visitors to an area. Currently, cities with decline in traditional economies seek to identify heritage as a resource for economic development and regeneration through tourism. Heritage is a mode of cultural production in the present that has resources to the past. The notion of heritage has evolved from a focus on values, traditions and ideas to a direct association with the material cultural heritage of societies (Jolliffe & Smith, 2001)

Culture-led regeneration has many significant social and economic impacts which includes; creating employment, attracting more visitors and boosting the tourism sector, boosting local business, stimulating and supporting creative sector growth, developing the skills, knowledge and confidence of residents, enhancing community cohesion and pride, bringing enjoyment to residents and therefore supporting enhanced resident health, attracting inward investment, and enhancing the area's image in addition to help attract skilled people and business investment (Hatch Regeneris, 2019)

In recent years, some heritage tourism and urban renewal global trends have emerged. One of these trends is to increase government interest in heritage tourism which is obvious looking to the efforts of administrators to reorganize economic structure. This points out that there is a shift from traditional production towards service-based economies, which directly effects the relationship between urban heritage and tourism (Lak et al., 2019).

Cultural heritage-based tourism is a type of tourism that is related to a regions' culture, specifically its lifestyle, history, art, architecture, religion, and all what defines life in that specific region. Moreover, in cities it includes culture; facilities such as museums, theaters, and sports. In the 1970s much focus on the role of culture and heritage in the field of urban development started. In specific, when the first urban redevelopment projects began to commodify cultural facilities as tourism attractions, improved urban images began to emerge (Lak et al., 2019).

Since the World Heritage List gives the opportunity to promote tourism, many countries prepared lists of their cultural and natural assets to be considered by the International Council on Monuments and Sites (ICOMOS) for inclusion on the UNESCO list. The reason behind that is the increasingly visible branding linked with UNESCO. UNESCO World Heritage Lists includes many cultural and natural sites. Branding a country's heritage by UNESCO, is an opportunity for the site to be recognized globally as an impressive example of human heritage. Therefore, its economic value will increase owing to the site's significance, sacredness, and charm. On the national level, specific countries created competitive branding programs for national heritage (Lak et al., 2019).

Expectations from cultural tourism often go beyond short-term benefits that cities seek long lasting and sustainable changes in the built environment and adapt culture led urban regeneration as an urban policy. In the long run, culture led urban regeneration is assumed to contribute in urban economy, conservation and promotion of urban heritage, redevelopment of city centres, revival of former industrial zones and waterfront sites. Culture led urban regeneration is also considered as a tool to protect and promote cultural diversity. Similarly, cultural heritage tourism adds value to the area by promoting the existing ethnic and cultural identity (Uysal & Özden, 2011).

**5. Cultural Heritage Tourism in Old Muharraq**

Al Muharraq is one of the islands of Bahrain archipelago, in the Arabian Gulf (Figure 1), and was the former capital of the Kingdom of Bahrain from 1810 until 1932. It is situated on the northeast of the island and is linked to Manama, the capital city by three causeways (Figure 2). It is the third largest city in Bahrain; with an area of 66.74 Sq. Km and a total population of 268,626 on 2018 (Survey and Land Registration Bureau, 2018).

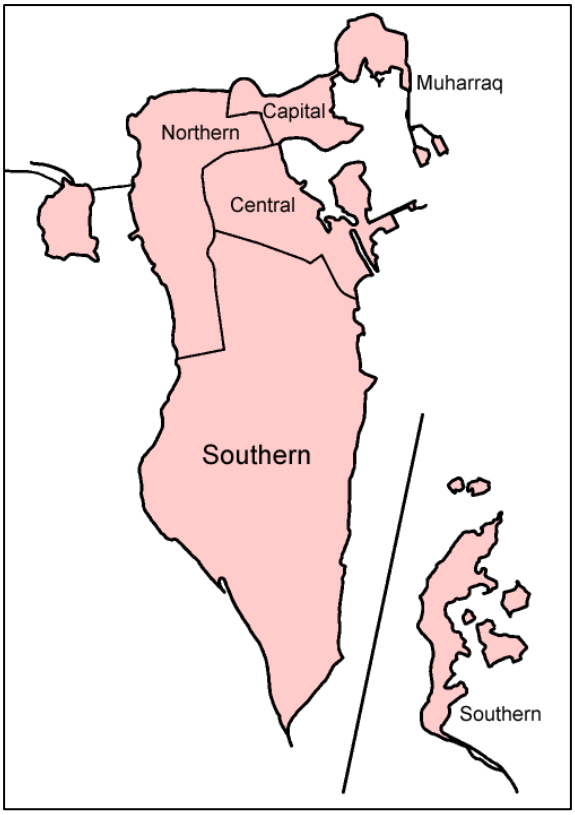



**Figure 1.** Map of Bahrain showing the location of Al Muharraq city (https://favpng.com).

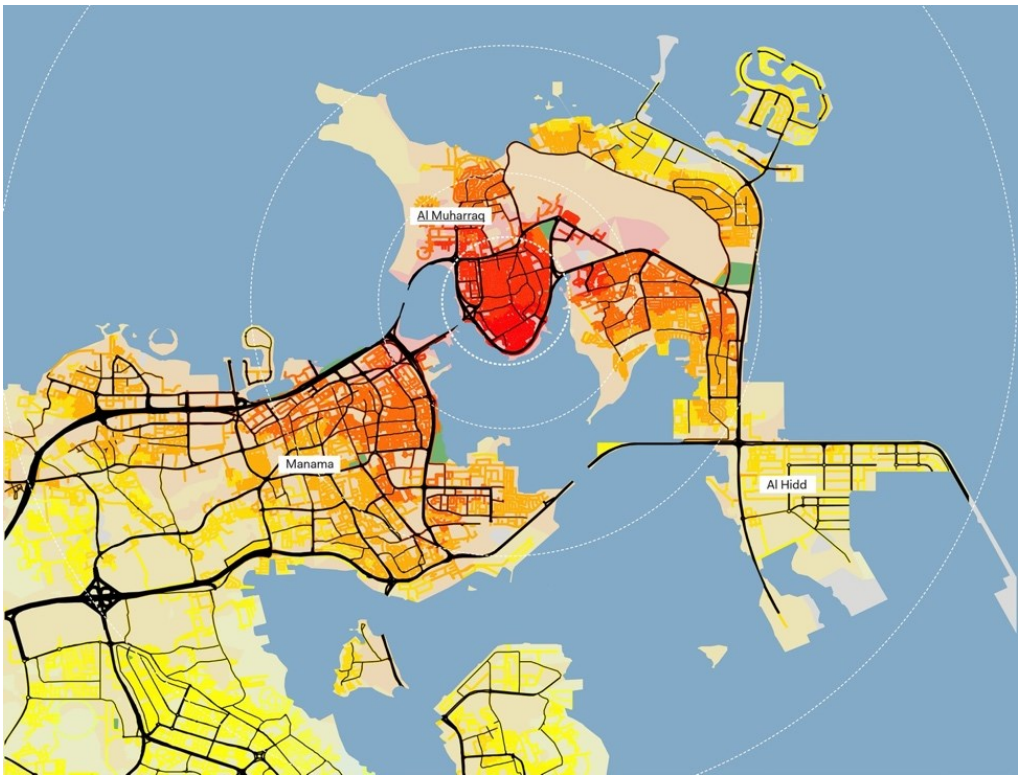



**Figure 2.** Muharraq Accessibility Map (https://www.systematica.net/project/bahrain-pearling-testimony-unesco-site-mobility-study/).

The city has unique architectural characteristics with an organic urban fabric. The organic and compact urban fabric, which evolved with time, displays a harmony with the prevailing cultural, natural requirements and linked different parts of the city together. The appearance of its condensed urban fabric consists mainly of narrow alleys

(Sikkas) (Figure 3 and 4) and courtyard houses (Yarwood, 2005, 2011).



**Figure 3 & 4.** Narrow Alleys in old Muharraq (Author, 2020).

As many other traditional Arab cities, the evolution of Al Muharraq went through a long process of innovations, adjustments and refinements. It has a traditional architecture expressing the interaction between the society and the natural environment. It used local resources to respond to a complex of interconnected social, cultural, spiritual, religious, economic and physical requirements. This resulted in establishing a strong unity between culture and the built environment, and between the man-made and the natural environments. Besides having buildings with functional and economic values, it reflected many intangible cultural symbols and meanings. Therefore, a visual image was established with the use of available materials and talents along with expressive forms and elements (Yarwood, 2005, 2011).

Just like any other Arab city, urbanization in Muharraq city was affected by traditional tribal measures and therefore it shares many physical characteristics of Arab Islamic cities (Figure 5). With its unique organic form and architecture that is manifested in the urban network of houses, mosques and trade complexes, the city can be considered as one of the remaining models of the traditional Gulf urbanization (Alraouf, 2014).

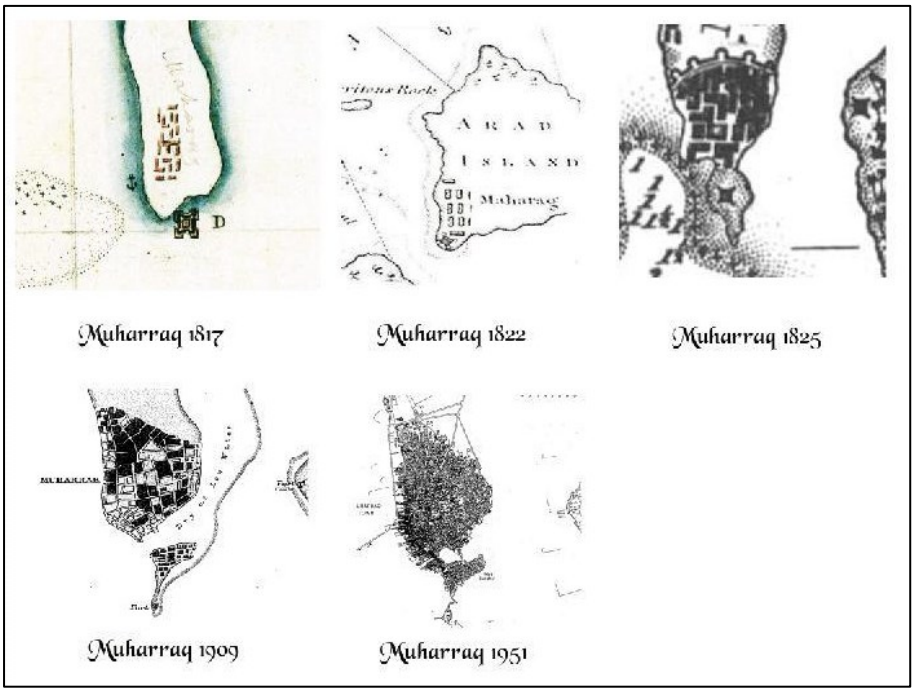



**Figure 5.** The Evolution of Muharraq From 1817 Until 1951 (AlSulaiti, 2009).

Although Bahrain has settlements from much earlier periods, the current architectural development of Muharraq is a result of a period with flourishing economy which was based on pearl trading during the second half of the 19th century and until the middle of the 20th century. The wealth of the pearl economy brought knowledge of new building techniques and materials to the city. After the discovery of oil in 1930s, the traditional domestic architecture made of palm leaves and mangrove were replaced with stone masonry in addition to other materials imported from outside (Alraouf, 2014).

As a result, the local construction techniques which consisted of thick walls and small openings has been developed progressively to a trabeated system. The system consisted of columns made of stone and attached by beams and tie beams made of palm trees or mangroves called danchal filled with coral stone panels called furush, while the roof was made out of bamboo (Figure 6). For decoration, gypsum was used to create decorative panels, cornices, or it was even mixed with lime and other additives to be used as a plaster or mortar (Chemali, 2017). Later, other construction materials were introduced into the area by the British with respect to the vernacular architecture. Mortar and plaster was replaced by Portland cement, reinforced concrete or metal beams were a substitute for palm trees, mangroves, coral stones and bamboo. This construction system disappeared slowly with the decline the pearl industry since the 1930s (Motisi et al., 2019).

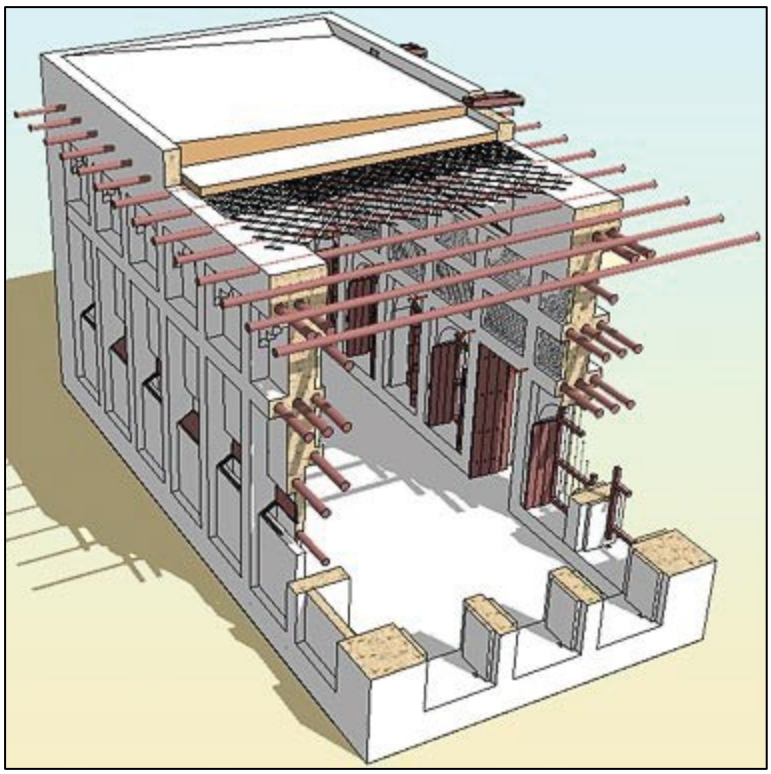


**Figure 6.** Sketch of the traditional construction system showing a typical elaborately designed room (http://catnaps.org/islamic/gulfarch3.html).

**5.1. The Pearling Path: Testimony of an Island Economy**

During the past decade, the government authorities in Bahrain conducted several urban revitalization projects across the city of Muharraq which included the pearling path project. The project represents the pearling era in Muharraq which was globally well known to be the most significant pearling society and economy for many centuries (Ministry of Culture & Information, 2011). The project has first initiated as a series of restoration and adaptive reuse of restoration and adaptive reuse of a number of edifices under the Sheikh Ebrahim Centre for Culture and Research. It then evolved into a comprehensive programme entitled Pearling Path, Testimony of an Island Economy. The aim of the project is to focus on the history of the town with the pearling industry in addition to rebalancing the demographics through attracting local Bahraini families to come back to the town through improving the environment and providing community and cultural venues (Aga Khan Award for Architecture, 2019).

To give adequate account of the importance of this grand island narrative, the proposed theme emphasizes on human interaction with the environment and modes of subsistence, represented in a human and economic system based on the exploitation of a natural sea resource. In this manner, the site is the first listed site to include an

economic form of sea-use since the addition of sea-use criterion in 2005. It includes underwater cultural heritage components which are considered rare on the World Heritage List. This is, in addition to its vernacular architectural testimony consisting of structures reflecting the last stage of the pearling economy in the late 19th and early 20th century which is considered as a symbolic property in a typological framework being the first in the Arab Region (Ministry of Culture & Information, 2011).



**Figure 7.** Aerial view of Muharraq in the 1960s (Ministry of Culture & Information, 2011).

The overall vision of the project focused on stimulating culture in social and economic development. Therefore, in the assessment process of the project, significant factors were recognised; economic, social and cultural factors. The project main goals is property conservation using international standards, offering public accessibility to the site, providing knowledge about the economic, social and cultural area context, as well as fostering a community based approach to solve urban issues. The project also aims to document the stories and practices of the pearling era to preserve its memory (Bahrain Authority for Culture and Antiquities, 2017).

The buildings visibly indicate the major social and economic roles and institutions associated with the pearling cultural tradition and the wealth it generated between the second century and until the 1930s. In 2012, the Pearling Path was designated by the UNESCO as a world heritage site. The listed building includes a residence of wealthy merchants, shops, storehouse and a mosque. Memories of the pearling industry are evoked in these buildings and its supporting social and economic structures along with the cultural identity it created. The importance of the creation of the pearling path goes beyond reconstruction, it is hoping to improve the economy by developing cultural heritage tourism as well as making Muharraq a more pleasant place to live in (UNESCO, 2012).

The property includes a serial site of 15 property components, encompassing maritime sites, seashore site, and urban properties. The maritime site includes 3 offshore oyster bed located in the northern territorial waters of Bahrain, while the seashore consists of the Bu Maher fort located at the southern tip of Muharraq island, were boats used to set off for the oyster beds, while the urban sites consist of 11 architectural properties encompassing 17 architectural structures (Figure 8 and 9) (Ministry of Culture & Information, 2011).

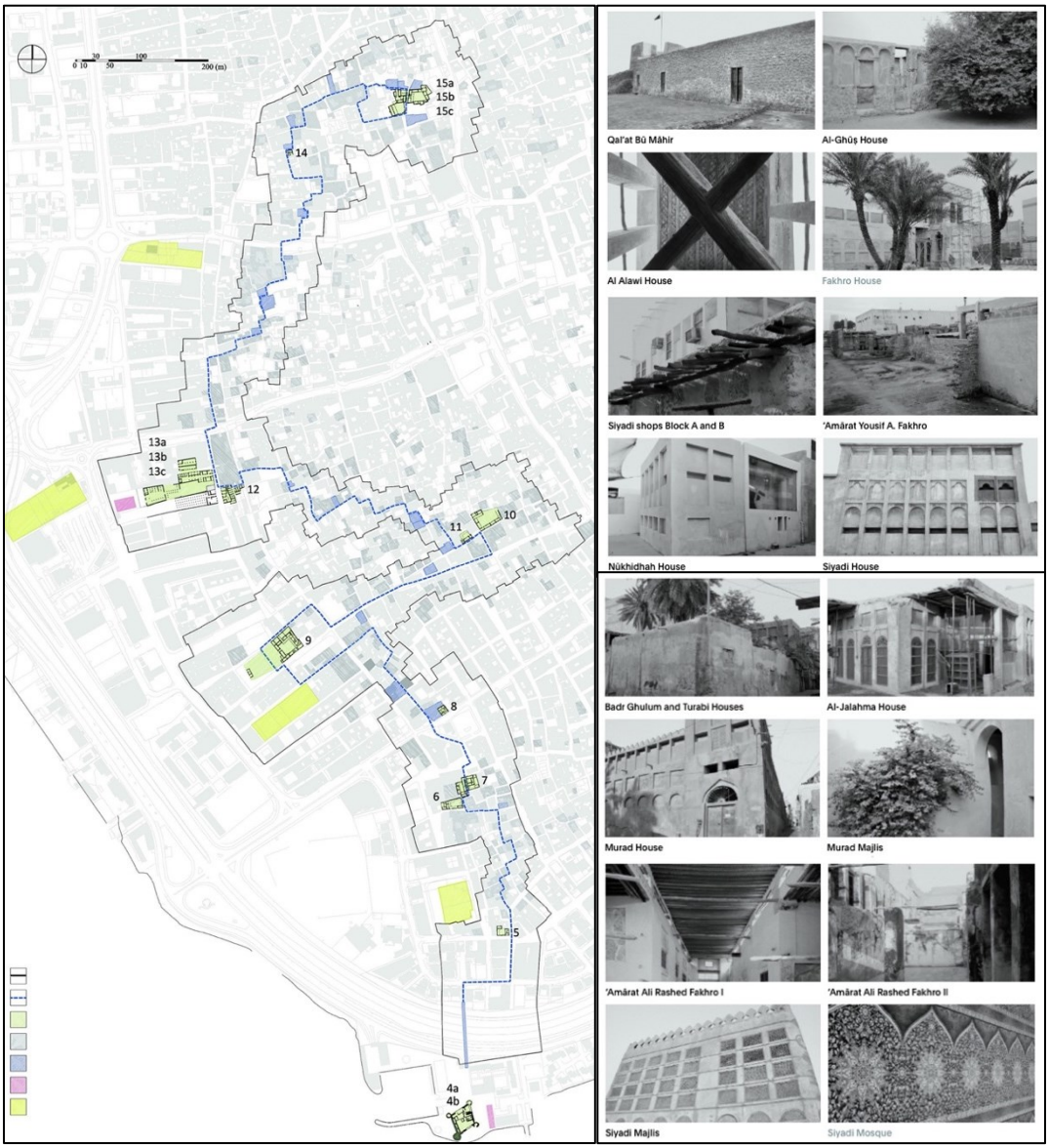



**Figure 8.** A Map Showing the location of the buildings (Bahrain Authority for Culture & Antiquities, 2019).
**Figure 9.** Pictures of some of the houses in the sites (UNESCO, 2012).

The preservation of the sites and numerous buildings in addition to upgrading their facades and the construction of four new buildings was facilitated by private-public partnerships (Figure 10). All of these sites were connected through a visitor pathway, with vacant demolished plots left as public spaces. The process of restoration/preservation of the traditional buildings consisted of reinstating lost wind towers which were built for natural ventilation purposes, while the used materials were similar to the originals such as; reused coral stone from demolished structures, wood and terrazzo which was used extensively for street furniture consisting of flecks of oyster shells. Additionally, to further symbolize pearls and assist way-finding, spherical white streetlamps were added (Figure 11) (Aga Khan Award for Architecture, 2019).



**Figure 10.** Pictures of some of the houses in the sites (Author, 2020, 2019).



**Figure 11.** Open space in old Muharraq (Author, 2019).

The finance of the project included both the public and private sector. The framework included façade upgrade, the addition of visitors and experience centres, public spaces, the pearl museum, the creation of cultural festivals and boat trips to the fort and seashore, in addition to four multi-storey carparks (Bahrain Authority for Culture and

Antiquities, 2017). The chosen sites are considered to be vulnerable, therefore extensive work was needed to ensure satisfactory stability. The original fabric was restored with great care with the usage of traditional materials and processes to ensure the provision of tangible links to that period (Figure 12 and 13) (UNESCO, 2012).

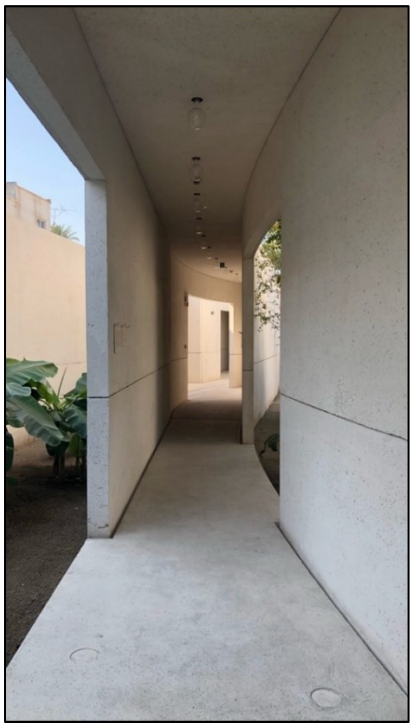


**Figure 12.** Renovated House old Muharraq (Author, 2020).



**Figure 13.** Narrow Alleys in old Muharraq (Author, 2019).

In addition to the preservation of the existing buildings, new building was built to ensure better visitor experience. These new buildings respected the scale of the historic environment and the street lines, however, it focused on making bold contemporary architecture (Figure 14 and 15) (Aga Khan Award for Architecture, 2019).



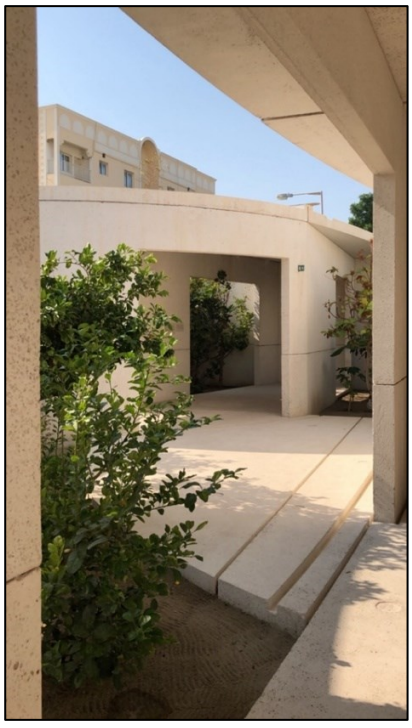


**Figure 14 and 15.** Green pavilion (Author, 2020, 2019).

A holistic approach was set to rehabilitate old Muharraq under two key perspectives, legal and societal. The creation of new laws was needed to constrain unplanned construction and population, to avoid the decline of the urban fabric and to safeguard the sites (UNESCO, 2012). The project is still under progress in three different layers; area conservation, urban renewal and visitor facilities (Bahrain Authority for Culture and Antiquities, 2017). The current efforts focuses on the preservation of the structure of the existing buildings with respect to The International Council on Monuments and Sites (ICOMOS) and The International Scientific Committee on the Analysis and Restoration of Structures of Architectural Heritage (ISCARSAH) restoration principles (Motisi et al., 2019).

Many of the existing buildings are still owned by the families related to the pearling community, which is considered as an asset added to the value of the property. This asset includes the memory of these families and therefore needed to be protected. Consequently, these families have become key partners in the preservation of the project and have signed long-term legal agreements to understand the requirements of usage and conservation (Ministry of Culture & Information, 2011).

## 6. Lessons Learnt

From this case study, a number of lessons can be learnt;

- The introduction of the tourist pathway to regenerate Muharraq.
- The utilization of the geographical location and historic value of the city, as the site visibly indicates the social, economic and cultural values;
- To understand the tangible and intangible values of the social, economic, and cultural factors;
- To improve the economy through cultural tourism and improve sustainability;
- The protection of vulnerable sites and the organic urban fabric through maintaining integrity which is achieved by stabilizing the restoring these sites;
- The usage of traditional materials and processes in the restoration to provide tangible links to the pearling era;
- To set a holistic approach to preserve the historic characters of Muharraq under two key perspectives, legal and societal;
- The addition of new laws to limit the increase of unplanned construction and population to avoid the deterioration of the heritage buildings and urban fabric;
- The refurbishment of houses with good structures while the deteriorated houses were removed and reconstructed;
- The inclusion of both public and private sectors to finance the project;
- The conserve the property components with international standards;
- The development of a community-based approach to deal with urban issues.

## 7. Conclusions

To conclude; the importance of the usage the existing social and cultural assets of a city and understanding its tangible and intangible values is essential in its renewal process. It is also important to set a holistic approach with the involvement of different stakeholders including the authorities, private sector and the community. The approach should set new laws to prevent further deterioration of the cultural assets, to increase the local economy, and ensures residents satisfaction and to improve the quality of life in the city.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Form and Function in The Pearl-Qatar Artificial Island Development

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**Abstract**
The Pearl is an artificial island development in Doha, Qatar. Artificial island means land reclamation or landfill, creating new land from lakebeds, riverbeds, oceans, and seas. Doha grew rapidly over the last half-century due to urbanization and globalization. Most research focuses on (sub)urban expansion to the north, west, and south from its coastal origins on Doha Bay. However, urban growth also occurred eastward through land reclamation projects from the Arabian Gulf for Al Corniche, the West Bay business district, Hamad International Airport, large parts of Lusail City, and The Pearl-Qatar. We present a morphological study of urban form and function in The Pearl-Qatar. It includes well-established representations such as figure-ground analysis, pedestrian sheds, ground-level land uses, and active/inactive frontages mapping. We argue there is a clear formal and spatial logic in the planning, intimately tied to The Pearl-Qatar's socio-economic status as an exclusive residential area of Doha.
**Keywords:** Development; Land Use; Morphology; Reclamation; Urban.

## 1. Introduction

Qatar is a peninsular nation located in the Persian/Arabian Gulf with a total land area of 11,571 km² characterized by hot, humid summers and mild winters. Like other gulf cities, the country encountered rapid urbanization due to the rise of the oil and gas exporting industry leading to a shift in lifestyle and economy in the late 20th and early 21st centuries (Wiedmann, 2012). The country transformed from patches of fishing villages along the coastline in the 18th century to an oil-producing country after the 1950s, focused on the capital city of Doha (Scholz, 1999). The economic growth has evoked in parallel the increase in population and urban development in Doha, which increased nearly five times from 1970 to 1997. According to the latest census, the current population is over 2.8 million people. Two factors drove this increase in population. First, growth in life expectancy due to the enhanced healthcare system, so births exceeded the number of deaths. Secondly, many migrants moved to Qatar, either as long-term residents or short-term construction workers assigned for specific projects. Today, Qataris represent only 10% of that population. (Planning and Statistics Authority, 2022). The high percentage of expatriates and migrants (90%) influenced the planning strategies of the city to cater to varying cultures and diverse backgrounds. Since the beginning of the oil-production era, Qatar's development framework shifted from focusing on the local context and the surrounding region to the global context. City planning began to purposefully implement elements to attract people to live and work in Qatar. This planning approach also helped position Qatar within the spectrum of the global economy.

Initially, the approach to urbanization was slow and subtle, without a well-harmonized process. During the 1970s, British consultant Llewelyn Davis introduced the first masterplan and zoning maps of Doha. It established the ring road structure of Doha, where every ring road would define a specific type of zoning. This planning framework consequently laid the groundwork for the suburban sprawl of Doha (Wiedmann et al., 2012). The compounded effect of increased population and the continuous growth of the oil industry evoked an exponential rate of urban expansion from around 130 hectares in 1970 to more than 7,100 hectares by 1995 (Al-Buainain, 1999). Rapid urban growth between the 1970s and the 1990s included constructing mid- and high-rise buildings, road infrastructures, residential districts, and land reclamation along the coastline to develop new districts such as the West Bay business district. The early 21st century witnessed a thriving real estate sector, where Gross Domestic Product (GDP) growth averaged 24.6% between 2003 and 2006, tripling in only four years (Euromoney Institutional Investor, 2008). During this period, various investment opportunities arose intending to reduce the country's long-term dependence on oil and gas exportation, such as health care, housing, and education. These new industries shaped and facilitated continuous urban growth. Urban expansion in Doha occurred in all directions from its historical origins, focusing on high rise towers, iconic buildings and museums, highway structures, industrial cities, new districts such as Lusail City, and reclaiming more land along the coastline to develop new projects such as the Hamad International Airport, Hamad International Port to the extreme south, and The Pearl-Qatar island to the north

Doha is going through another development phase to host the FIFA World Cup 2022. This event aims to assert Qatar's image and economic status to the world after another chapter of urban intensive expansion and development. It includes the design and construction of eight new stadiums. It also includes supporting amenities to welcome visitors to the event,

such as accommodation facilities (hotels, apartment towers, and temporary structures), transportation infrastructure (highways and the metro), and urban design elements like pedestrian overpass bridges and cycling/pedestrian paths. According to an edition of the Lonely Planet (2008) guidebook, Doha was one of the dullest places on Earth (Alraouf, 2018; 62). In reaction to this perception, the country realized the value of promoting a brand image to gain a share of international consumers, businesses, and tourists, which relates the economic value of the city of Doha to its image in the world. As a result, the country sought to replace this negative impression by purposefully investing significant revenue from the oil-gas industry into the city's infrastructural expansion and developing new districts through private-public partnerships (Wiedmann, 2012). A 'plain' urbanscape arose from globalization, construction standardization, and rapid urbanization (Aziz Amen & Nia, 2017). Qatar consequently relied heavily on commissioning iconic, impressive architecture – competing skyscrapers in West Bay populated with 'star' architects' buildings – to rebrand its capital city. Another component was the construction of new areas for work and recreation catering to the global market (Adam, 2009). On a larger scale, the city also expanded its periphery eastward into the shallow coast to accommodate new districts with distinctive features to stand out compared to the rest of the city. One of the most notable is The Pearl-Qatar (Figure 1), an artificial island located 350 meters offshore in northeast Doha (Figure 2). The island consists of fourteen districts on 4 million square meters ($m^2$) of reclaimed land in a medium-density residential zone mixed with retail/commercial land uses (The Pearl-Qatar, 2021).




**Figure 1:** a) aerial rendering of The Pearl-Qatar (Source: CallisonRTKL); Views of b) Viva Bahriya; c, d, e) Porto Arabia; f) Medina Centrale (Source: Authors).




**Figure 2:** a) Qatar location within the Gulf region and, b) The Pearl location within Qatar (Source: Google Maps/Edited by Authors).

The private real estate company, United Development Company (UDC), is the Pearl-Qatar master developer and management entity. UDC announced The Pearl-Qatar development in 2004 with an initial project cost of US $2.5 billion and a construction build-out date of 2012, later revised to 2018. However, the project is still under construction today in 2022, with a projected final construction cost of US $15 billion. The total land area of The Pearl-Qatar is about 4.0 $km^2$ (400 hectares or 4 million square meters and 988 acres). There are an estimated 27,000 residents in 2018, so it operates at about 60% capacity today. At construction build-out, it will have a capacity of 18,831 dwellings for 45,000 residents. It will possess a population density of 11,250 people per square kilometer ($km^2$), like Lyon, France, in Europe and Washington, DC, in the USA. It will be 47 du/hectare or 20 du/acre in terms of housing density, which is the standard zoning definition of Medium Density Residential. The Pearl-Qatar utilizes residential pods involving zoned separation

between residential land and building types. These include apartment high-rises, above-shop apartments, and single-family residential villas. Because The Pearl-Qatar is an island, it possesses 32 kilometers of coastline.
Callison Architecture is the conceptual designer and master planner of The Pearl-Qatar. An objective of their design was to ensure this artificial island stood out in both Qatar and the Gulf Region to attract international visitors and investors. In parallel, the government changed land regulations to allow non-Qataris property ownership rights in the project (The Peninsula, 2020). Although the project seeks to address an international audience, the name serves as a symbolic link to the area's historical features as a pearling site in the Pre-Oil era, and parts of the island layout itself resemble a string of pearls (Rizzo, 2019). Middle- and higher-class communities are the market target of The Pearl-Qatar. According to CEO Ibrahim Alothman, an exclusive luxury experience is a design aim of The Pearl-Qatar, priced for a particular class of buyers, residents, and tenants (The Peninsula, 2021). The approach influenced the site location within Metropolitan Doha and the design and planning of the island itself.

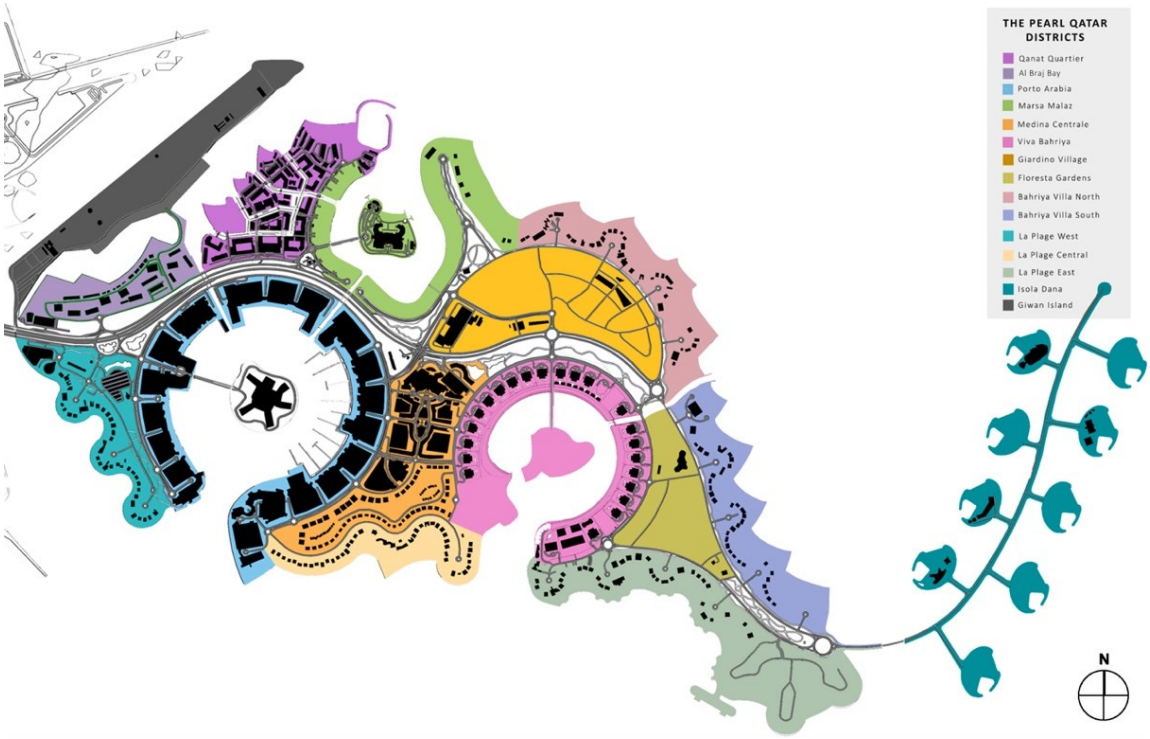


**Figure 3**: Map of The Pearl showing the districts (Source: Authors).

The Pearl officially includes 12 districts. However, it is effectively 15 districts organized around the only access road running the island's length from the mainland, i.e., Pearl Boulevard (Figure 3). Each of the fourteen districts has a distinctive architectural style. Marketed as "the Riviera of the Middle East" – a reference to the French Riviera towns of Côte d'Azur and Saint-Tropez - the architecture of The Pearl is more characteristic of Arabic and Italian culture. The most important in terms of land use mixture and public use (residents and visitors) are Porto Arabia (in blue) and Qanat Quartier (in purple) on either side of Pearl Boulevard on the west side of the island, and Medina Centrale or the town center in the central part of the island south of Pearl Boulevard. Al Braj Bay, to the west of Qanat Quartier, has a mixture of high-rise hotels and apartment buildings with some townhomes lining the coastline and a canal. Viva Bahriya (in pink) is to the immediate east of Medina Centrale. Giordano Village (in dark orange) will form another neighborhood center to the north of Pearl Boulevard/Medina Centrale when complete. It is under construction now during the later phases of development. There is a hotel island (Qiwan Island in grey) to the northwest of Qanat Quartier, which began construction in 2020. The other districts primarily consist of single-family residential uses (villas) of varying lot sizes, including Marsa Malaz (with the luxury Kempinski Hotel Island at its center to the east of Qanat Quartier) and the Florestra Gardens and various La Plage districts.
The largest, nearest district to the mainland is Porto Arabia. It has the most direct connection to the rest of the city of Doha. On the other hand, the district furthest from the mainland is Isola Dana ('rare pearl island') at the northeastern edge of the island, with nine villa islands reserved for the Al-Thani royal family. Hence, it is the most exclusive, inaccessible (due to security) residential area at The Pearl. Eleven of the 14 districts possess a direct connection to the waterfront, and the remaining three serve as internal transitional areas between each promenade. The town center, Medina Centrale (highlighted in orange in Figure 3), is at the island's center with the largest land area in two dimensions. It connects

significant parts of the island, serving as a critical locational connection and buffer between those parts to collect, contain, and distribute users. Once completed, there will be 4,700 apartments in 31 towers in Porto Arabia (+/-151 apartments in each tower), accounting for 25% of all housing in The Pearl-Qatar. There are 28 towers in Viva Bahriya with 1,780 apartments, accounting for 9.5% of all housing in The Pearl-Qatar. Porto Arabia and Viva Bahriya account for 35% of the housing in The Pearl-Qatar. There are another 538 above-shop residential units and 500 low-rise residential villas in Medina Centrale (1,038 in total). Medina Centrale, Porto Arabia, and Viva Bahriya account for 40% of all housing in The Pearl-Qatar. There will be 977 residential apartments in 31 buildings (32 per building) and 188 townhouses in the Qanat Quartier, 1,165 in total. The Qanat Quartier accounts for 6% of the housing in The Pearl. There is 322,000 $m^2$ of retail space in the Qanat Quartier. There are low-density residential, high-rise hotels, and community facilities in the other districts. The overall layout and individual districts carefully mediate between the public and private realms in each district, which we discuss in subsequent sections in more detail.

This paper aims to present the results of analysis of the urban morphology and functional characteristics of The Pearl-Qatar. We will identify its design and planning strategies as a contemporary urban development more clearly and how various socio-economic factors came into play to influence its spatial and functional logic in pursuit of residential exclusivity in Doha.

**2. Methodology and Materials**

The morphological study of the physical form and function of The Pearl in this paper utilizes highly accurate graphical mapping representations based on specific parameters such as ground-level land uses, pedestrian sheds, and active/inactive frontages. The authors compiled the data based on on-site surveys in Spring 2021. The purpose is to develop accurate data visualizations about design and planning in the layout of The Pearl, which we translate into quantitative numerical data in various manners. The purpose is to reach objective results about how these physical and functional parameters might relate to the socio-economic factors influencing the urban morphology of The Pearl.

Besides this data collection, we searched the literature as a resource for information about the historical process of urbanization in Qatar and its contextual influence leading to the creation and urban development of The Pearl. Due to its contemporary nature and a lack of significant studies about The Pearl to date, some literature review focuses on reporting in popular media outlets such as *The Peninsula* and Gulf Times newspapers. Based on satellite images and maps from Google Earth and Google Maps, we created detailed plans of the development to facilitate the data visualization presented in this research. These detailed plans were the basis for on-site surveys of physical and functional characteristics. We also review the historical emergence of The Pearl Island development from the Persian/Arabian Gulf coastline and its subsequent phasing. We also use extensive photographic documentation to verify on-site data collection regarding ground-level land uses and active/inactive frontages for each built structure on the island. We define an active frontage as any building façade utilizing windows and doors, enabling access or visual interaction between public spaces and the interior of buildings, including retail outlets and residential lobbies. Anything that operates as an effective blank wall with no or minimal opportunities for interactions at street level is an inactive frontage. The data visualization is the primary basis for our data analysis of form and function in The Pearl.

The first part of the analysis focuses on form, i.e., urban morphology of the physical attributes and layout of the built environment regardless of the functionality or zoning. We use the figure-ground representation to analyze block sizes, the street network, and building patterns in the spatial layout. The second part investigates function based on the pattern of ground-level land uses and active/inactive frontages on the island. This part also addresses the vertical dimension of the development by reviewing a building height survey of the island. The last part reviews quantitative information about socio-economic factors and how they might relate to the spatial logic and physical attributes of The Pearl. We achieve this by layering this analysis with the morphological and functional results in a qualitative manner.

**3. Data Analysis and Results**

Land reclamation is one of the most popular development tools in the Gulf region for promoting a particular brand image of a city. According to de Lange (2014), urban projects with a land reclamation proposal in the Persian/Arab Gulf are highly economically and socially feasible despite rising global concerns about the environmental impacts and high risks of endangering marine life due to such projects. The land reclamation process is an affordable and economically efficient option for new urban development due to technological advances tied to the availability of the necessary financial assets. It is one of the reasons that such attractive opportunities exist for international investors in Qatar and the Gulf Region. Many vital locations in Doha along the Arabian/Persian Gulf coast were land reclamation projects, including Al Corniche, West Bay, the site of the Qatar National Museum, Hamad International Airport, and large parts of Lusail City.

The location for The Pearl development in northeast Doha was a shallow part of the Persian/Arab Gulf, which was a pearling location in the Pre-Oil Era (Adham, 2009). The reclamation process began in 2004, extending 350m eastward from the existing coastline (Figure 4). By 2006, the infill of the entire area was complete, and new lands emerged above the water levels, but without outlining the final edges of the masterplan. The next stage involved an excavation process

in defining the promenades of the island and creating the ''string of pearls' resemblance of the overall layout, including the single roadway connection (Pearl Boulevard) to the mainland, which was complete by 2007-2008. Consequently, construction of residential towers and retailers began in addition to more private elements such as waterfront villas.

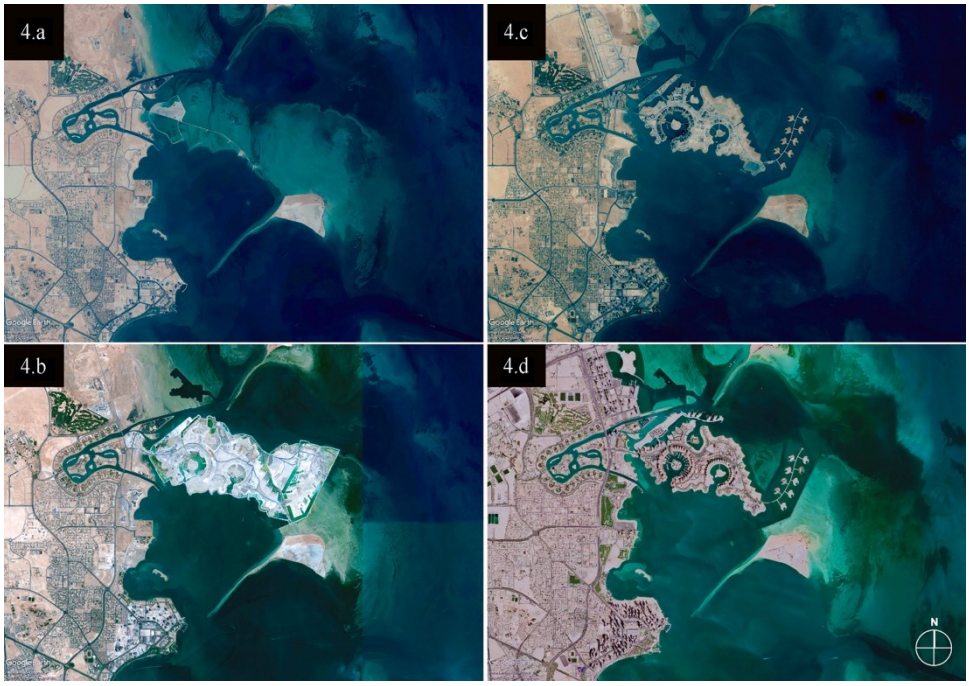


**Figure 4:** Satellite images of land reclamation process in The Pearl over time in a) 2004, b) 2006, c)2008, and d)2022 (Source: Google Earth).

Based on the satellite images, the Porto Arabia and Qanat Quartier districts were primarily complete by 2013. These two districts incorporate some of the most intensive mixed-use residential and commercial land-use patterns in the entire development. Porto Arabia and Qanat Quartier accommodated the inflow of the first users and residents of the island development. Since then, the remaining districts have been under construction. The promenade section of Porto Arabia opened in 2013. However, the construction of a new resort hotel on the central island of the Porto Arabia marina only began in 2019. The most recent satellite image (2022) demonstrates that much of the island has either completed or begun development and building construction. There are also a few vacant lands with construction timelines in later phases, including the last piece of land in Qanat Quartier and individual, privately-owned lots in the low-density residential districts.

The contiguous area associated with Pearl Boulevard and frontage roads is about 0.5 $km^2$. The primary role of Pearl Boulevard is to collect and distribute vehicular movement to the various districts on the island. Each of these districts possesses a similar metric size. Qanat Quartier is about 0.3 $km^2$. Medina Centrale is about 0.2 $km^2$. It is about 0.5 $km^2$ if we include the La Plage Villas Centrale area to the south. The area devoted to free-standing villas is 2 ½ times larger than Medina Centrale itself. The contiguous land area associated with Medina Centrale/La Plage Villa Centrale, west Porto Arabia, and east Viva Bahriya is about 1 $km^2$. The metric area associated with Porto Arabia, including the marina, is about 1.1 $km^2$. However, 40% of this area (0.46 $km^2$) is water, and 60% is land. Central island equals 80,000 $m^2$. It is 69% larger than the area of Viva Bahriya. The area associated with Viva Bahriya is smaller at about 0.65 $km^2$. However, 35% of this area (0.23 $km^2$) is water, and 65% is land. Its central island equals 60,000 $m^2$. La Plage Villas West is 0.18 $km^2$. The Al Abraj Bay to the immediate north is the same size (0.17 $km^2$). Kempinski Island to the east of Qanat Quarter is 50,000 $m^2$. The metric area of Bahri Villas North and Giardino Village to the island's east is 0.92 $km^2$. The metric area of Florestra Gardens, La Plage Villas East/La Plage to the east of Viva Bahriya is 1 $km^2$.

The Pearl is a contemporary zone in Doha, which does not contain any historical elements other than the historical importance of the location itself as a pearling site. The development progress went according to the phasing in the masterplan, unlike other parts of Doha. The city grew in a semi-organic manner over time where certain historical areas influenced the subsequent formation of the larger urban area, especially Msheireb and Souq Waqif. The latter underwent a restoration project in 2004-2008 to preserve and highlighted the city's historical identity (Ferwati, 2019; Tannous, 2020; Major & Tannous, 2020). Primarily, this meant that road infrastructure adapted to these older areas to maintain the historic importance of Old Doha.

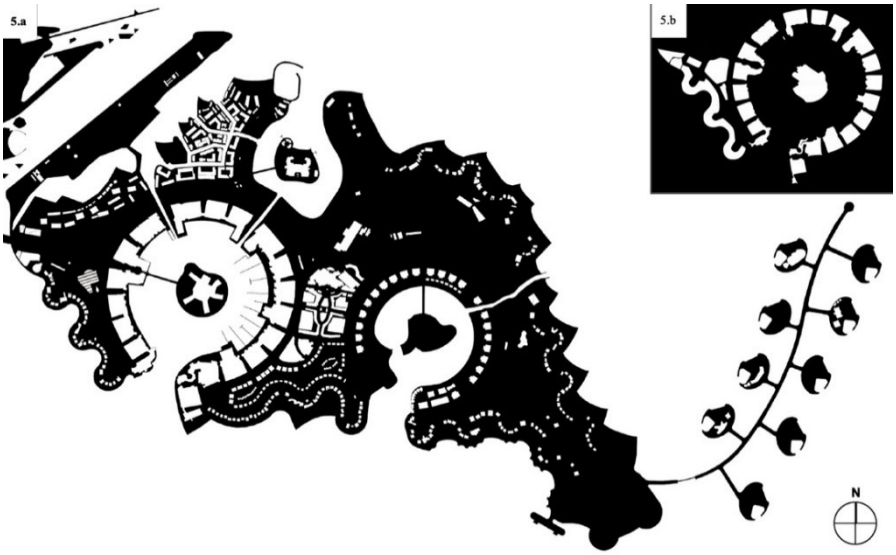


**Figure 5:** Figure-ground representation with space in black and built forms in white with the outline of the coastline for a) The Pearl and b) close-up view of the Porto Arabia district in 2021 (Source: Authors).

The planners created a new urban layout resulting in a highly formal and organized geometric composition for the Pearl. It utilizes both its 'string of pearls' concept and radial geometry to maximize the number of properties and buildings with waterfront views (Figure 5). Most free-standing buildings and urban blocks are rectangular in shape. Most articulate minor additions or subtractions from the rectangular shape as needed to form the constructed building footprint. For example, many towers in Porto Arabia extend outward towards the promenade to provide more space for retail land uses. By comparison, urban blocks in Medina Centrale utilize chamfered corners to locate retail entrances at the street corner to increase the chances of attracting passing customers. Some districts have continuous, elongated blocks due to compound walls for low-density single-family residences and villas, such as the Le Page districts. In this sense, these residences and villas orient to the waterfront with continuous fencing on the street side. The villas on the east side of the island have a more extensive beachfront than the villas' sizes, unlike those on the west side. Those on the west side have shorter shorelines and a higher floor-area ratio. The scale of urban blocks gradually decreases from the west to the east. Urban blocks in Porto Arabia are the largest. There are three ranges of block sizes between 11,000 $m^2$ and 20,000 $m^2$. A few of these blocks include commercial activities at the ground level and extend outward to between 21,000 $m^2$ and 30,000 $m^2$. The largest is 52,000 $m^2$, i.e., is the hotel nearing completion at the center of the Porto Arabia marina. On the west side of Porto Arabia is a sizable mosque under construction. The western streets and this large block will operate as an additional barrier between the private villas to the west and the more public areas of Porto Arabia.




**Figure 6:** a) Ground-level land use map of The Pearl and b) close-up view of Porto Arabia ground-level land use map (Source: Authors).

The figure-ground representation of The Pearl also demonstrates the significant allocation of land for Pearl Boulevard and its associated frontage roads. It has the effect of making most districts extremely walkable on their own. However, the degree of space between each one – especially north-south due to Pearl Boulevard and frontage roads – makes walkability from district to district more problematic. It makes The Pearl very car dependent as a whole. From one degree to another, each district intentionally isolates itself from its neighboring district. Even when districts are relatively close, sidewalk provision (or the lack thereof) separates them from one another, for example, between Qanat Quartier and Al Abraj Bay. The inward-oriented nature of districts with commercial/retail land uses such as Porto Arabia, Medina Centrale, and Qanat Quartier to ensure residential privacy reinforces this district separation.

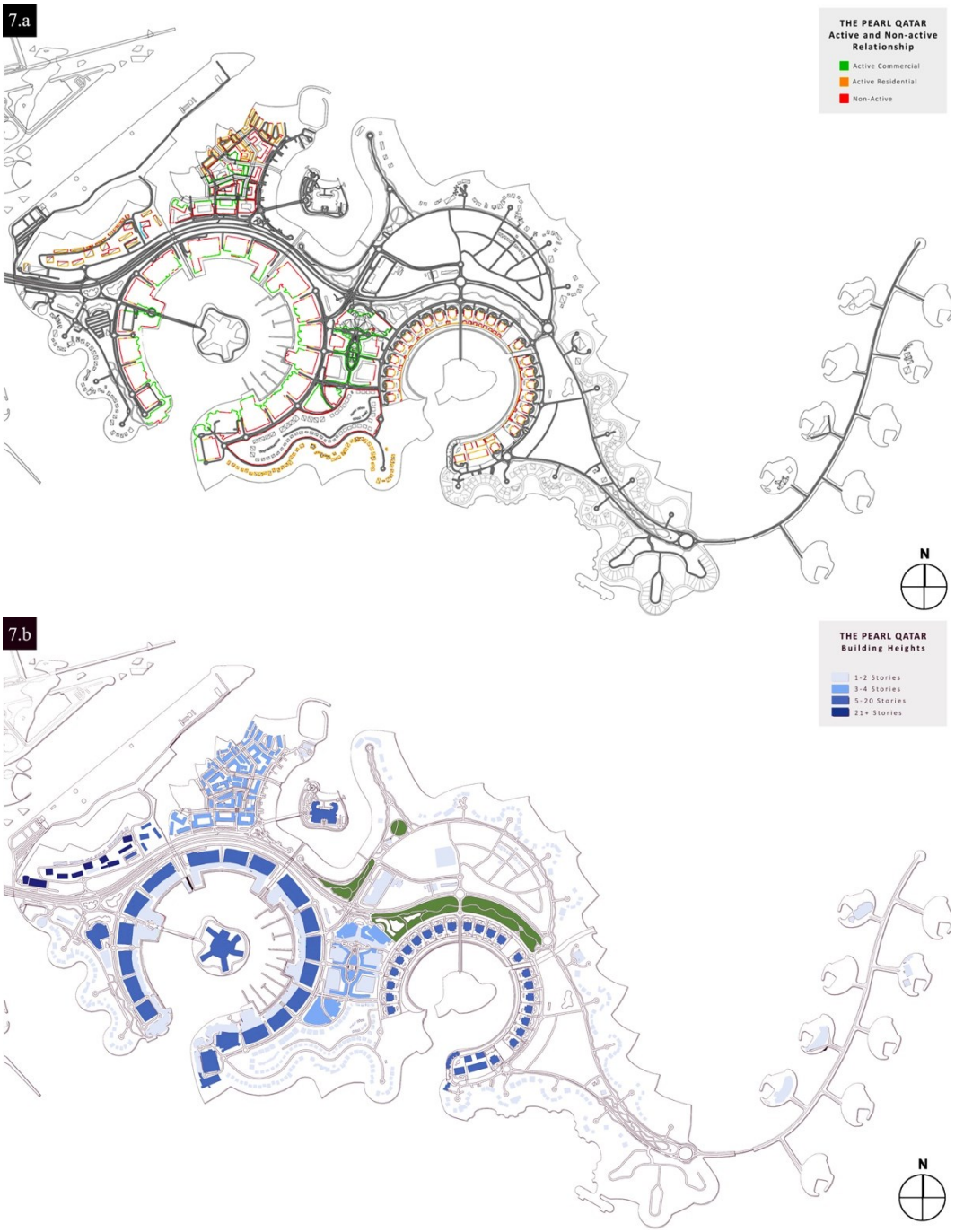


**Figure 7**: a) Active and non-active frontages and b) building heights at The Pearl (Source: Authors).

The dominant land use at The Pearl is residential, which varies in density from one district to another (Figure 6). High-density residential towers line the coastal promenades such as Viva Bahriya and Porto Arabia due to their waterfront views. These towers' ground-level and several stories (4-5 stories) contain parking garages. There are low-density residential units along many external edges of the island (in yellow in Figure 6). The remaining land uses include

commercial and retail spaces, a petrol station, hotels, restaurants, cafes, a grand mosque (under construction), and a smaller mosque on Pearl Boulevard at the eastern part of the island. There is a sizable portion of land still vacant or under construction on the island.

Porto Arabia relies heavily on a mix of internal (pedestrian) and external (vehicular) traffic to function since it is the largest district most approximate to the entry road (Pearl Boulevard). A close examination of ground-level land uses in Porto Arabia, especially along the promenade, reveals that public land uses comprise more functions than private spaces (53.4% of all activities) (refer to insert of Figure 6).

Of these, 26.9% consist of retail stores, 19.7% are cafes and restaurants, and 6.8% contain commercial services such as gyms, beauty salons, and banks. Although a large portion of the Porto Arabia area operates, 18.4% of its commercial/retail spaces remain vacant. Most vacancies occur at the southern edges of the promenade, which is further away from the entry points to the area and Medina Centrale itself. Cafes and restaurants almost exclusively occupy any urban block extensions towards the promenade, which pedestrians heavily use in most evenings and pleasant weather during the daytime. These cafes and restaurants further activate the promenade with outdoor seating using terraces or tables directly onto the promenade itself.

The active and inactive frontages pattern reflects the inward orientation of individual districts in The Pearl, especially in Porto Arabia, Viva Bahriya, Qanat Quartier, and Medina Centrale (Figure 7). Blank walls tend to orient outward to the edges of individual districts and frontage roads. It is an approach that provides an additional layer of privacy and exclusivity tailored to each district. It even occurs in the town center of Medina Centrale, where most active frontages project inward toward the central part of the area. Facades along with streets defining the edge of the district and its neighbors (Porto Arabia to the west and Viva Bahriya to the east) mainly consist of blank walls except for access points to parking garages. In some ways, it is uninviting when someone is 'outside' of the district.

The active/inactive strategy in Medina Centrale emphasizes compactness in the absence of any waterfront orientation. Each district tailors its attractions to a specific type of user, specifically altered to their needs. For example, Viva Bahriya is an exclusive residential zone catering to families in high-rise towers where the privacy is the main priority. All entrances to the Viva Bahriya towers are elevated well above typical street level with tower amenities facing inward toward the beach but completely out of view for any promenade users. The residential towers in Viva Bahriya also group closely together to create an additional visual barrier from the rest of The Pearl to its promenade. Pedestrian access to the Viva Bahriya promenade is extremely uninviting (through a narrow alleyway with high, blank walls) and restricted to residents-only during daytime hours. Security guards ensure only authorized persons access the Viva Bahriya promenade during the day. After dusk, anyone is free to visit that promenade and private beach. The pattern persists in Viva Bahriya, where street-level facades are entirely blank (except for landscaping) due to the elevated platform entry points to the towers. These entry points are far less accessible and invisible from the street level except for the entry road itself. The inward orientation of Viva Bahriya consists of cleverly positioned balconies and terraces of residential townhouses to overlook the promenade with active residential facades. It is a feature that contributes to a feeling on safety on the less-used Viva Bahriya promenade.

In contrast to Viva Bahriya, the Porto Arabia promenade is open 24 hours a day to anyone who might care to visit. A diverse mixture of residents and visitors always use this promenade, especially in the evening and pleasant weather months (December-April). Each tower in Porto Arabia contains commercial land uses at ground level with residential units on other floors in the twenty-story, high-rise buildings. Access points to the Porto Arabia promenade are wider, some allowing vehicle drop-offs. There are multi-story parking levels specifically available for the public. The lobby entrances to the Porto Arabia residential towers are also at street level, unlike the elevated access to the towers at Viva Bahriya. Of course, the Porto Arabia promenade is also significantly closer to the main road and 'gates' directly accessing the island, i.e., Pearl Boulevard. Viva Bahriya is comparatively deeper (in terms of metric distance) and most isolated on the other side of Medina Centrale. The overall effect is a more welcoming environment for visitors on the Porto Arabia promenade. Indeed, Tannous et al. (2020 & 2021) concluded that the Porto Arabia promenade was significantly oversized for its degree of accessibility in their study about green/blue spaces (parks and promenades) within Metropolitan Doha. They argue this by design because Porto Arabia with its array of commercial, retail, and restaurant/café land uses serves as the most significant attractor of The Pearl to draw visitors from further afar in north Doha (Tannous et al., 2020 & 2021).

The inactive frontage strategy in Porto Arabia is also clear, where all rear sides of the residential towns have blank walls on the first four or five stories for the parking garages. Nonetheless, at least one side of each residential tower is an active frontage where there are entrance lobbies to the residential building. There is usually a ground-level exit for the opposite tower's parking garage opposite the tower's drop-off area and lobby. Of course, all restaurants and cafes have active frontages on the promenade side, whereas there is more variation for retail stores, depending on their type of sold product. For example, some shops have adaptive frontages whereby curtains close during the day due to the harsh climate but open during the evening. It is especially true of furniture stores, which require some protection from sun exposure during the day.

The Porto Arabia and Viva Bahriya districts prioritize pedestrians only along their main organizing principles: promenades and internalized water bodies; a marina for Porto Arabia and a beach for Viva Bahriya (refer to Figure 1b and 1d). The circular layout focuses these residential districts inward to promote water views for many residential units. Peak activity occurs along the promenades with the outer part of the circular layout on the other side of the buildings characterized by vehicular access to the towers in both districts. In the residential villa districts of The Pearl, they are technically active residential due to the presence of front doors. However, their actual active frontages situate on the waterfront segment of the faces. The street side is primarily used for parking only.

Medina Centrale consists of medium-rise buildings (maximum of five stories) with a commercial retail/residential mix (housing units above shops) to generate a lively on-street experience for people living and visiting the town center (refer to Figure 7b). The tallest buildings in Medina Centrale are for residential uses, not commercial ones. The layout of Medina Centrale enables different transport modes including pedestrians and vehicles. However, the paving and elevated crosswalks significantly slows down vehicular traffic at the very center of the town center (refer to Figure 1f).

**4. Discussion**

The Pearl came to the market as an opportunity to attract foreigners to invest and live in Qatar, thereby seeking to facilitate Doha's economic diversification. The architectural styles in the project's districts were a mixture of Mediterranean, European, and Arabic cultures designed to help achieve this attraction (Ferwati, 2019). The contrasting yet cohesive blend of styles created a strong visual impact that stood out from the rest of Doha. Promotion of The Pearl as an exclusive residential area of Doha was always prevalent, which means only a specific class of users could afford to live on this island. It is a socio-economic status directly influencing the design and planning of the island, sculpting every aspect of its physical form to fit this purpose.

The strict, formal segregation between low-density, private residential villas and public space fulfills this goal by seperating commercial activities and residential access, even though the linear distance between districts might be less than 500m – a reasonable walking distance in the hot climatic conditions of Qatar – but actual travel distance might be more than three times the linear distance (1,700m) using the vehicle. Buffering zones between districts usually constitute four-lane roads with a central median and a generous green belt. Another element serving exclusivity and privacy in the project is the pattern of active and inactive frontages. When moving throughout The Pearl, all residential towers have blank frontages on the street side and the active ones on the waterfront side. It helps to ensure the separation of non-residents from low-density residential areas. Like most waterfront properties, villas will sea views in The Pearl possess a higher cost per $m^2$ than those with only land views and much higher prices than high- and mid-rise apartments. Most waterfront villas concentrate on the east and northeast portions of the island, furthest away from high-rise and mid-rise buildings with higher densities to maintain an additional degree of exclusivity. Another parameter intensifying this gap further is building heights. All high-rise towers are side-by-side to create a solid facade and block any visual connection from 'outside' into the promenades.

However, these socio-economic factors influencing the layout in the masterplan of The Pearl tend to fade at street level. It is especially true of those with active frontages like Medina Centrale, Porto Arabia, and the Qanat Quartier, all of which possess commercial and retail land uses relying on and catering to external and internal traffic flows, residents and non-residents alike. These districts contain everyday activities such as cafes and restaurants, which attract a variety of user groups, more often during the weekends than on weekdays and continuously during the evenings except in the harshest summer months. The master developer could implement a few actions to achieve even more street life and liveliness in The Pearl, including:

- Incrementally shift to more mixed-use districts instead of strictly separating the private residential and public, commercial realms. It would require more commercial activities in some districts to enhance the user experience of both residents and non-residents. Medina Centrale has several opportunities to implement more active frontages along its edges with the careful remodeling of parking garages at ground level to incorporate small retail units.

- Implement more medium density, mid-rise buildings that fit the human scale to improve social presence and potential street interactions. Newly constructed districts might not contain residential towers with 20+ floors preventing visual connectivity and increasing isolation between distinct parts of the district.

- Lastly, reducing car dominance to create more pedestrian-friendly streets would strengthen the connection between districts, especially by adding more pedestrians-only zones and, perhaps, implementing a local tram network to service to and between different districts of The Pearl. It would increase access through the island and have the added benefit of reducing traffic congestion on Pearl Boulevard itself.

The human-scale design of public spaces incorporating mixed uses and moderating vehicular traffic will help to create more lively spaces. Diverse cultures would interact, and people from different social backgrounds would co-exist in the urban areas of The Pearl (Muneerudeen et al., 2016). These recommendations could also significantly contribute to the economic value of the island's properties, where studies show that streets with people influence the wayfinding process of others, where they choose to move towards crowds, and after that, people themselves operate as the attractors and generators of public life (Peponis, 1990; Dalton, 2011).

**5. Conclusion**

Until the 1960s, Qatar consisted of traditional settlements responding to users' social and practical needs, which included protection from the harsh climatic conditions and the socio-cultural necessity of privacy. Many of the original cultural intent in urban form needs persist today as the design of the new neighborhoods increasingly relied on modern solutions conveniences since the late 1970s (Alraouf, 2018). After discovering oil in the late 1950s, Qatar witnessed major transformational activities that completely changed the urbanscape from dense low-rise settlements and fishing villages into a modern city with sizeable real estate mega-projects and extensive road infrastructures. Subsequently, decision-makers adopted a strategic plan for the city to elevate Qatar into the global economy by establishing a brand image for Doha designed to appeal to foreign investors and new residents (Salama and Wiedmann, 2013). The process began with intensive construction projects throughout the city, including a new airport, an expansive highway and ring-road system, the Doha Metro rail network, and more investment in architecturally iconic buildings and museums. Additionally, land reclamation extended the seashore in projects such as West Bay, Lusail City, and The Pearl.

The Pearl-Qatar is one of the most recognizable elements of the rebranding of Qatar as an international hub of business, tourism, and culture. It was one of the first areas offering foreigners freehold ownership of property in Qatar (The Peninsula, 2020). UDC advertised The Pearl as an exclusive luxury residential district in Doha catering to the population's middle- and upper-class segments, especially Qatari, Arab, and Western professionals. Its target audience of these constituencies is a crucial element in shaping the form and function of the individual districts and the whole of The Pearl. The island's designers and planners created a well-defined degree of separation between each district's public and private realms through the planned layout. It included several methods like implementing vast roads that are not pedestrian-friendly, separated by impenetrable vegetation. Another type of barrier occurs between districts in constructing some out-of-scale buildings in The Pearl-Qatar.

Moreover, almost all active frontages and functions face inward away from the main roads. In residential-only areas such as Viva Bahriya, access to the residential towers is above the ground level, with tightly situated residential towers forming a visual barrier in further accentuating exclusivity. It occurs throughout The Pearl to achieve high privacy and exclusivity for its residents. However, social barriers fade on the street level, especially in mixed-use, semi-public districts like Porto Arabia and Medina Centrale. Using The Pearl-Qatar as its principal case study, this study shed some light on city branding and the resulting consequences of this process (such as building entirely new neighborhoods by land reclamation). It also focused on the links between physical and intangible attributes found in a built environment, adding to our knowledge of Doha's most well-known, recent contemporary development.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# The typo-morphological facade of the catholic churches of S. Miguel, Azores

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**Abstract**
This paper intends to present the research results that comprised a comparative facade analysis of 41 parish and non-parish Catholic churches on the island of S. Miguel, Azores, built during the 18th and 19th centuries. The research highlights the existence of a facade typology expressed in the formal similarities between them.
The matrix composition and the ornamental elements present on the 63 churches' facades were analysed and studied in detail in 41 churches, mapped and characterised by the elements that compose them. These are grouped into categories, allowing to establish and synthesise a typology, called the *micaelense* model facade, according to the composition principals present in the facades.
The analysis method, the reading of the forms of the churches' facades, and the metric survey of these were based on old and current photographic records, supported by a comparative analysis elaborated and organised from tables and synthetic schemes systematised in vector drawings (graphic representations made in CAD).

## 1. Introduction

The study presented in this paper demonstrates the existence of a model of the *micaelense* church, and exposes the methodology used in the master's dissertation in architecture entitled "*Uma tipologia de fachada na igreja micaelense (1728-1882)*" (Vieira, 2019), which evidences the existence of the main facade typology in parochial and non-parochial Catholic churches on the island of São Miguel, Azores, built during the 18th and 19th centuries.
This study focuses on the morphology of the church's most significant component, the facade, that carries paramount symbolic importance and is a rich source of information in historical, cultural, spatial, temporal, social, ethical, moral, and aesthetic terms, transmitting a particular way of a people's culture.
This research aims to confirm a concept for this facade typology that emerges through the similarities between 41 parish and non-parish church facades. An analysis of the matrix composition and the ornamental elements present on the church's facades is thus developed by mapping, characterising, and grouping the elements that compose them into categories. In this scope, it was necessary to make new graphical schemes due to the complexity of Vieira's (2019) previous research and the size of the graphical analysis tables to present a synthesis of the work.
The work synthesis will contribute to the knowledge of the distributive composition of the elements that design the facade, namely the central body, the tower, and the baptistery.

## 2. Material and Methods

The research starts with a comparative analysis of 63 parish and non-parish churches on the island of São Miguel, dating from the 18th to the 19th century, focusing on 41 churches whose facades present a morphological composition model (Vieira, 2019).
To assess the method, we studied the facades and plants of the selected churches through a comparative analysis using old and current photographic records. Due to the scarcity of original technical drawings of the churches, the photographic elements were worked through CAD software. The churches were drawn with the rigour that the photographic features allow.
The analysis and reading method of the forms focus mainly on the direct church facades observation, as in Quintão's (2015) study, in which facade interpretation was based on drawings analysis.
In this way, the study focuses in detail on the comparative analysis of the facades from the elaboration and organisation of schematics and synthesis drawings systematised in vectorial drawings (graphic representations made in CAD).

## 3. Literature Review

The literature review has shown the paucity of scientific studies that focus on the composition facade and technical drawings concerning the churches under investigation.

Despite the diversity of authors/ chroniclers from various eras (16th century with Frutuoso (2011), 17th century with Mont'Alverne (1960-1962), 18th century with Cordeiro (1866), 19th century with Canto (2000), 20th century with Dias (1949-1950), 21st century with IAC and SIPA) who reflect on the theme of religious architecture in São Miguel and the Azores. These works focus on the historical part, building contextualisation, inventory, and characterisation, and rarely present a study on the reason for the existence of a church facade design replication, except Caldas (2011; 2012).

However, despite this lack of scientific studies on our research topic, the theories of these authors motivated this research. Through this Literature Review, we clarify several issues that led to our study, namely:

i) the existence of a particular way of living and people culture of the lower layers of society, as stated by Ataíde (2011);
ii) the idea of a " *micaelense* facade type" presented in a short investigation by Caldas (2011);
iii) the analysis of the drawings for reading the facades, through the work of Quintão (2015);
iv) and the historical framework of religious architecture in Portugal according to the analysis developed by Kubler (1988).

**4. Theoretical framework**

It is essential to mention that from the literature analysed for this study, five elements were extracted, which in our view, are central and structure the *micaelense* churches, namely: i) heritage; ii) authorship; iii) the facade; iv) the plant; v) the building material, which influences the facade and the plant.

Heritage is determined by island settlement, seismic activity, and Franciscan influence, which determined the image of the settlements, and the isolation that allowed a "crystallisation" of certain devotions brought from mainland Portugal (Almeida, 2012; Costa, 2012).

Regarding the authorship that includes architects, constructors, and masons of religious buildings on the island of São Miguel, we only have the list drawn up by Ataíde (2011), and nothing can confirm its veracity, being aggravated by this lack of correlation with the list of Portuguese architects drawn up by Viberto (1922). In addition, many names are still unaccounted for, which makes research difficult, as we cannot justify the relationship of similarity between the churches through their authors (architects/constructors). We can only highlight the name of the vicar João de Sousa Freire as a possible creator of the Ribeira Grande parish church's scratch, considered the island's mother church.

According to Caldas (2011), these buildings are not the work of an architect, but rather made by local builders who adapted a compositional structure seen elsewhere or who all started from the same model established in the 18th century on the island and developed by an architect.

The facade is composed of three distinct volumes, the central body, the tower, and the baptistery (Caldas, 2011), which read as a whole regardless of their compositional logic. The central body is a reflection of the plant (nave body/naves), whose constructive structure depends on the interior since the compositional elements of the facade correspond to the architectural/constructive elements that structure the plant. In other words, the pillars or columns correspond to the pilasters and the naves to the bay.

The plant is composed of three-naves for larger-scale churches, whose central nave is wider and taller than the sides or is composed of single-nave for smaller-scale churches, characterised by being an archaic construction for its construction time (18th and 19th century) (Caldas, 2011).

The material, basalt stone, endogenous to the island is characterised by its color that in contrast with the white wall facades, highlights the black color, increasing its light-shadow contrast, transmitting an impactful image and easy to memorise (Ataíde, 2011).

This analysis justifies the methodology used to justify the existence of a "model facade", which is due to the similarity verified between facades, and which expresses a notion of image systematically adopted on the island of São Miguel.

**5. "Model Facade" Concept**

This facade starts from concepts already defined by Caldas and Sousa who suggest the following terminologies: " baroque *micaelense* (from the island of São Miguel) facade " (Caldas, 2011), " a type of *micaelense* facade " (Caldas, 2012) and " facade with baroque *micaelense* ornamental elements " (Sousa, 1986).

Due to the terminological inconsistency, Vieira (2019) establishes the concept of " model facade ", a concept that is divided into two words, facade, which represents the object of study, and model due to Rossi's classification (1995) that defines and argues that the designation "model" refers to a precise (architectural) object that can be repeated and copied as it is.

Therefore, the concept of "model facade" (Vieira, 2019) applies to any facade with baroque *micaelense* ornamental elements whose compositional matrix is a classical referent and which conveys the notion of analogous image, which

is a consequence of its material (natural basalt stone on a white background) and its construction system (adapted to the endogenous material of the island). Therefore, the churches with "model facade" present:

i) baroque style ornaments defined by a pediment made up of volutes;
ii) a counter-curved cornice;
iii) a flat facade, and a compositional mix of classical elements, determined by the facade that reflects the floor plant;
iv) the trilithon structure (bay, level and entablature);
v) the elements that form the trilithon structure with the same expression;
vi) the double pediment (larger pediment surmounted by the smaller pediment) (Figure 1).



**Figure 1.** S. N.ª da Estrela parish church in Matriz, Ribeira Grande municipality (Developed by Author)

However, this analogous image is not only restricted to "model facade" churches, but also to the heritage and legacy of other facades, with various facade typologies emerging. Although there is a common image that extends to all existing churches on the island, due to the material used, we find different characteristics, which leads us to apply different designations, verifying the existence of churches whose facade conveys an image of "family", for having one of the classifications mentioned above (Baroque ornamentation or compositional matrix of classical reference), and even "non-standard" facade verifying the absence of the two classifications listed above, remaining only the material - basalt stone - but with another function, not structural but aesthetic.
Our reflection will focus exclusively on summarising the schemes for churches with a model facade.

**6. Synthesis Schemes**

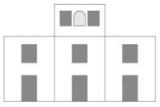
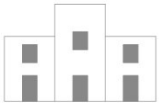
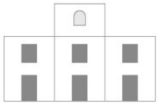
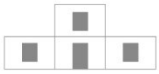
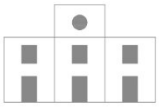
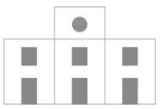
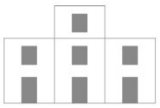
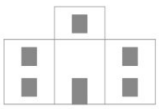
As a starting and framing point, it was necessary to organise the case studies inserted in the 18th and 19th centuries, in chronological order according to the date of construction/refurbishment of the facade, and cross-check them later with the typological classification attributed to each building according to the facade composition (i) model churches; ii) family churches; iii) non-standard churches) (Vieira, 2019).
Thus, there are 26 parish and non-parish churches in the 18th century, of which 18 are model churches, 7 are family churches and 1 isolated case of the non-standard church, and 37 parish and non-parish churches in the 19th century, of which 23 are model churches, 6 are family churches and 8 are the non-standard church.
Thus, we can observe that the church typology with model facade is inserted in the eighteenth and nineteenth centuries, with its first construction of a three-nave church in 1728 with the N. .ª da Estrela parish church in Matriz, Ribeira Grande municipality and its last construction in 1882 with the N. S. ª do Rosário parish church in Achadinha, Nordeste municipality and for churches with single-nave, its first construction in 1728 with the Santa Clara parish church in Santa Clara, Ponta Delgada municipality and its last construction in 1865 with the N. S. ª do Amparo parish church in Algarvia, Nordeste municipality.
To better understand the 41 churches that present a model facade, we tried to establish visual and metric relationships among the various elements that compose the facade, the central body, the tower, the baptistery, and their distribution in the territory.

**6.1 Central Body**

To understand the distributive composition of the elements that design the facade, direct observation and comparison was made to the various photographs of the different churches. For that, Scheme 1 was created that

analyses the architectural and artistic structure of the central body, excluding the tower and baptistery bodies that are seen as independent bodies that mostly do not follow the metric of the central body of the facade.

**Scheme 1.** Typological classification (model) (Developed by Author)

| Typology | Model Facade | | |
|---|---|---|---|
| Composition | 3 Naves | 3 Naves | 1 Naves |
| | 3 Bays<br>3 Levels<br>2 Entablatures | 3 Bays<br>2 Levels<br>2 Entablatures | 1 Bay<br>1 Level<br>1 Entablature |
| Elements | <br>3 Doors<br>3 Windows<br>1 Niche between windows | <br>3 Doors<br>2 Windows + 1 Half height window | <br>1 Door<br>1 Oculus under |
| | <br>3 Doors<br>3 Windows<br>1 Niche | <br>1 Door 2 Windows<br>1 Window | <br>1 Door<br>1 Window under<br>1 Niche over |
| | <br>3 Doors<br>3 Windows<br>1 Oculus | <br>1 Door 2 Windows<br>1 Window under | <br>1 Door<br>1 Window under<br>1 Oculus over |
| | <br>Elements of old building | <br>Elements of old building | <br>1 Door<br>1 Window over |
| | <br>3 Doors<br>3 Windows<br>1 Window | <br>1 Door<br>1 Window | <br>1 Door<br>1 Window between |
| | <br>1 Door 2 Windows<br>2 Windows<br>1 Window | | |
| Window Type: | ▪ Oculus ▪ Fenestration ■ Window ▯ Niche | | |

Given the complexity of this scheme and the fact that it was the starting point for the analysis of the church's facades in São Miguel, it was necessary to use synthetic drawings to represent the compositional and metric logic of each facade. Thus, Scheme 1 is divided into three groups according to the number of naves (plant) and the number of bays (bay is the structuring part that corresponds to the filling surface between the supporting elements and is expressed as a wall. It is always found in odd numbers, with the central bay standing out for its importance because its width is greater than the other side bay (end or middle) (Quintão, 2005)), levels (is the unstructured part between two horizontal elements. Morphologically, the level corresponds to a floor, but it is not so linear, because a facade may contain more floors and represent only a smaller number of levels (Quintão, 2005)), and entablatures (entablature is the third element that builds the portico / trilithic, understood as a horizontal element. The entablature makes the separation of the remaining components of the facade and is composed of architrave, frieze, and cornice, varying according to the order to which it belongs (Quintão, 2005; Rodrigues, 2002)) (facade). Next, each group is organised and classified according to the elements that make up the facade. According to the type and number of spans (doors, windows, and recesses), the configuration of the spans' lintel (straight or curved), and the location of the spans along the bays and levels.

Through Scheme 1, we can see that the model facade follows the various scales of construction occurring on the island, from three-nave main churches to the more humble and smaller churches of only single-nave.

Thus, the model facade is the one that always presents, in churches with three-naves, a compositional matrix of three bays, three levels, and two entablatures (i); or a compositional matrix of three bays, two levels, and two entablatures (ii); in churches with single-nave, a compositional matrix of one bay, one level and one entablature (iii). (Figure 2).



**Figure 2.** Group i) Church of Lomba da Maia (left); Group ii) Church of Lomba da Pedreira (central); Group iii) Church of São Vicente Ferreira (right) (Developed by Author)

Group i) of a compositional matrix of three bays, three levels, and two entablatures, is organised:

- On the first level, of access, by three doors, one corresponding to each bay, whose central door stands out from the rest by its size or by a door between windows in a higher position.
- On the second level, for lighting, by three windows each one topping a door, and the openings can all be of the same size or the central opening can be larger than the others.
- On the third level, the nave is illuminated by a niche bearing an image of the oracle, between windows (or not) or a central oculus or by a window identical to the windows on the lower level.

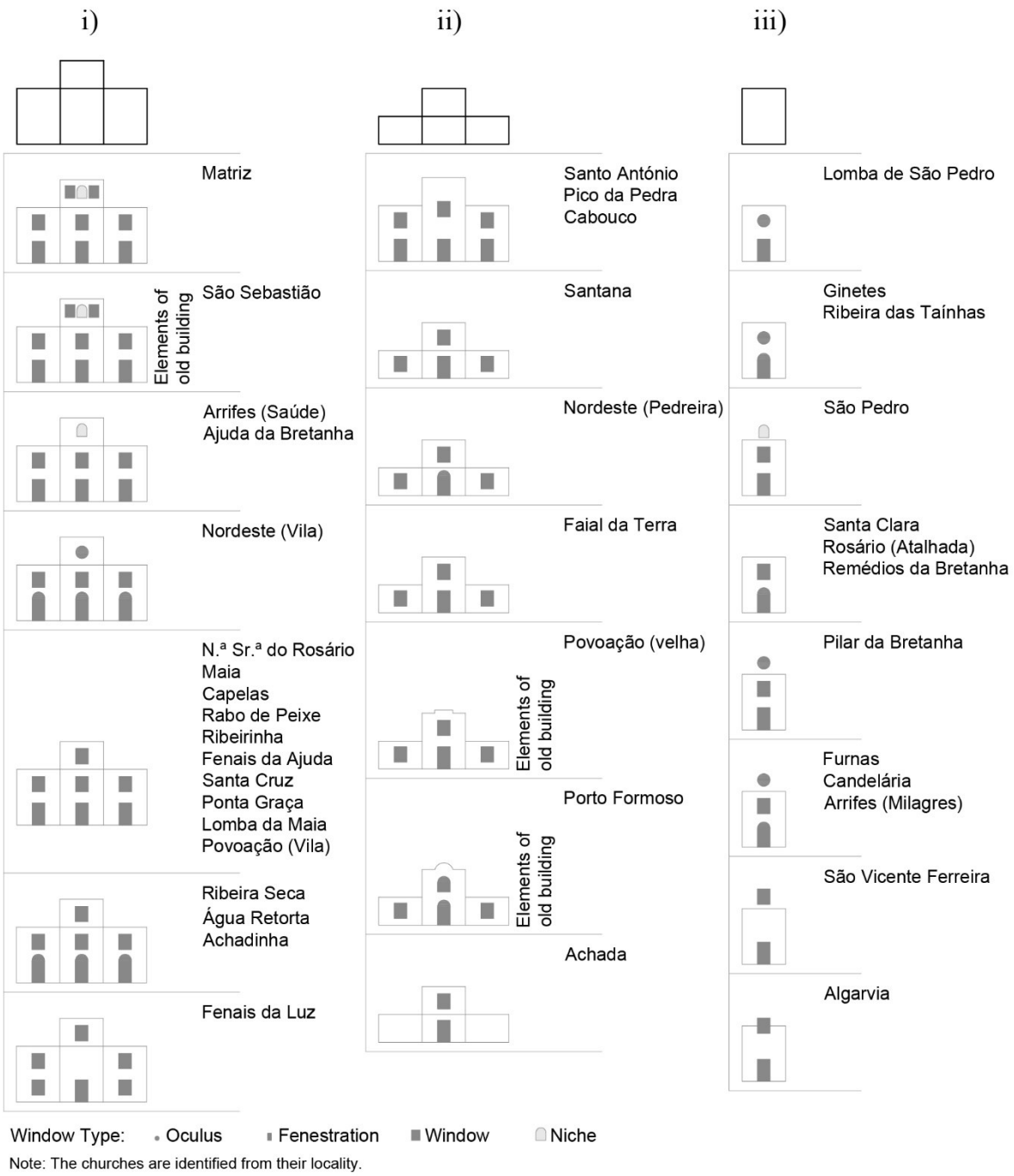
Group ii) of a compositional matrix of three bays, two levels, and two entablatures, is organised:

- On the first level, access, by three doors, one corresponding to each bay, whose central door stands out from the rest by its size or by a door between windows in a higher position, corresponding to each bay, or even by only one door in the central bay.
- On the second level, to illuminate the nave, with three windows; the openings may all be of the same size, or the central opening may be larger than the others, and in these cases, the central opening may or may not interrupt the first entablature.

And group iii) of a compositional matrix of a bay, a level, and an entablature, for churches of single-nave, is organised:

- On the first level, access, is by a single door topped by an oculus or a window. There are also situations where there is a window, an oculus or a niche above the entablature, or a window that interrupts the entablature due to its size.

**Scheme 2.** Characterization of the central body (Developed by Author)




We highlight in both groups situations where the facade takes advantage of constructive elements from a previous construction by adapting these elements to the new facade reformulation.

Thus, according to Scheme 2 in group i) we can observe seven variants of architectural structure, where:

-In the first row, 3 doors, 3 windows, and 1 niche between windows fit the N. S. ª da Estrela parish church in Matriz.

-In the second row, we present an architectural structure identical to the previous one, however, it adds the adaptation of elements of the old construction, which fits the São Sebastião parish church in São Sebastião. Due to the aesthetics of the Manueline portal, there is an adjustment in the second level where the central window is replaced by two central windows. Moreover, its current facade was the target of restorations and maintenance and changed in the twentieth century with the demolition of the niche and windows, on the third level, for the reintroduction of a rose window, with the principle of aesthetic reintegration of the primitive gothic style church.

- In the third row, 3 doors, 3 windows and 1 niche, we can see the N. S. ª da Saúde parish church in Arrifes and the N. S. ª da Ajuda parish church in Ajuda da Bretanha.
- In the fourth row, with 3 doors, 3 windows, and 1 oculus, we can observe the isolated case of São Jorge parish church in Nordeste.
- In the fifth row, 3 doors, 3 windows, and 1 window, we can observe the most significant composition, with 10 cases, the Church of N. S. ª do Rosário, the Church of Maia, the Church of Capelas, the Church of Rabo de Peixe, the Church of Ribeirinha, the Church of Fenais da Ajuda, the Church of Santa Cruz, the Church of Ponta Garça, the Church of Lomba da Maia and the Church of Povoação (Vila).
- In the sixth row, we have an architectural structure identical to the previous one, however, on the first level of access, the doors are composed of the carved lintel, fitting the churches of Ribeira Seca, Água Retorta, and Achadinha.
- In the seventh row, 1 door flanked by windows, 2 windows, and 1 window we can observe the isolated case of the N. S.ª da Luz parish church in Fenais da Luz, which despite having a plant composed of three-naves and a facade with three levels, its facade height is lower than the other cases present in this group, so the access portal occupies the first two levels not allowing the alignment of 3 windows on the second level.

In group ii) we can observe seven variants of architectural structure, where:

-In the first row, 3 doors, 3 windows, composed of 2 side windows and 1 central window, slightly elevated interrupting the entablature, we can see the churches of Santo António, Pico da Pedra, and Cabouco.
-In the second and third row, 1 door flanked by windows and 1 window, fit the Church of Santana with a straight lintel door and the N. S. ª da Luz parish church in Nordeste (Pedreira) with a curved lintel door.
-In the fourth row, 1 door flanked by 2 windows and 1 slightly elevated window interrupting the entablature presents the N. S.ª da Graça parish church in Faial da Terra.
-In the fifth and sixth row, we present an architectural structure identical to the previous one, however, there is the adaptation of elements of the old construction that for this reason interrupt not only the entablature but also change the shape of the horizontal entablature that forms the pediment, it means, instead of being a horizontal entablature this one follows the shape of the span, therefore, in the case of the N. S.ª do Rosário non-parish church in Povoação (velha) the entablature is broken linearly, and in the case of the N. S.ª da Graça parish church in Porto Formoso the entablature is broken in a curved shape.
-On the seventh row, with 1 isolated door on the first level and located in the central bay, topped by 1 window on the second level, we can see the N. S. ª da Anunciação parish church in Achada.

In group iii) we can observe eight variants of architectural structure, where:

-In the first and second row, 1 door topped by 1 oculus, enchase the São Pedro non-parish church in Lomba de São Pedro, with a straight lintel door, and the São Sebastião parish church in Ginetes and the Menino Jesus parish church in Ribeira das Tainhas with a curved lintel door.
- In the third row, 1 door topped by 1 window, crowned by a pediment with 1 niche, fits the São Pedro parish church in São Pedro.
- In the fourth row, 1 door topped by 1 window, we can see the Santa Clara parish church in Santa Clara, the N. S. ª das Necessidades parish church in Rosário (Atalhada) and the N. S.ª dos Remédios parish church in Remédios da Bretanha.
- In the fifth and sixth row, 1 door topped by 1 window, crowned by a pediment with 1 oculus, are the N. S. ª do Pilar parish church in Pilar da Bretanha with straight lintel door and the churches of Santana in Furnas, N. S. ª das Candeias in Candelária and N. S. ª dos Milagres in Arrifes with curved lintel door.
- In the seventh row, 1 door topped by a pediment with 1 window, is the São Vicente Ferreira parish church in São Vicente Ferreira.
-In the eighth row, we present an architectural structure identical to the previous one, however, the window located in the pediment interrupts the entablature, fitting the N. S. ª do Amparo parish church in Algarvia.

**6.2 Tower**

Although the body of the tower and the baptistery are seen as independent elements concerning the central body and in some cases are subsequent constructions to the construction of the remaining church, the tower is a fundamental element for its functional character of communication (religious acts and notices). Thus, its reading cannot be indissociable, regardless of not following the metric of the central body of the facade.

**Scheme 3.** Characterization of the tower body (Developed by Author)




Note: The churches are identified from their locality.

Thus, Scheme 3 specifies the study of the tower morphology divided into two groups according to the number of naves and consequently divided according to their location (The ideology of location (right or left) assumes that any object is observed from within and never observed from the outside, so the observer is positioned inside the church facing the main door).

To read the body of the tower, we resorted again to synthesis drawings that represent the compositional and metric logic of the facade. Thus, the respective drawings show the body of the tower divided into two levels separated by an entablature. At the lower level, also called body or tower-bay, we will have the study regarding the type, number, typology/ format (window, oculus, fenestration), and the disposition of the openings. And on the second level, also called the crowning, we will have the part corresponding to the belfry composed of one or two windows, crowned by a balustrade or a dome roof.

Generally, towers with or without spans are presented.

- In the cases of towers with an oculus, these vary in number, with towers with one, two, three, and four oculi, whose shape can be circular or heart-shaped, and also with simple or richly carved stone frames.
- In the case of towers with fenestrations, small openings, are usually rectangular, and these vary in number with towers appearing with one, two, and three fenestrations, centered or aligned to one side.
- In the case of towers with windows, these vary in number, with towers appearing with two or three centered windows, presenting an identical configuration to the windows of the central body.

Through Scheme 3, we can see that thirteen variants of the architectural structure of the tower occur, alternating in both location and scale of the church, where:

For churches with a window in the crowning, we can observe:

- In the first row, with an empty nave located on the left, are the churches of Ginetes and Candelária. For single-nave churches and the churches of São Sebastião, Fenais da Luz and Pico da Pedra for three-naves churches.
- In the second row, with 1 oculus, located on the left, the churches of São Vicente Ferreira and Lomba de São Pedro for single-nave churches, and the churches of Ajuda da Bretanha and Achada for three-nave churches.
- In the third line, with 2 oculi, located on the left, the church of Ribeira das Tainhas for single-nave churches and the churches of Nordeste (Pedreira) and Achadinha for three-naves churches. And located on the right are the churches of Santa Clara and Arrifes (Milagres) for single-nave churches and the church of N. S. ª do Rosário for three-naves churches.
- In the fourth row, with 3 oculi, the most significant composition, with 11 cases, but presents a greater variety of frame shapes, with 4 round windows in the shape of an inverted heart, 4 with a simple frame, 2 with worked frame. Located on the left, the church of Algarvia for single-nave churches and the churches of Santo António, Ribeira Seca, Ponta Garça, Lomba da Maia, Ribeirinha, Cabouco, Povoação (Vila) and Santana for three-naves churches. And located to the right are the churches of Porto Formoso and Faial da Terra for three-naves churches.
- In the fifth row, with 4 oculi, the isolated case of the church of Rabo de Peixe, with its tower on the right.
- In the sixth row, with 1 fenestration, located on the left, the church of Pilar da Bretanha for single-nave churches and the churches of Ajuda da Bretanha and Achada for three-naves churches. And the one located on the right, the church of Rosário (Atalhada) for single-nave churches, and the churches of Arrifes (Saúde) and Água Retorta for three-nave churches.
- In the ninth row, with 2 fenestrations, located on the left and for three-naves churches, the church of Capelas, which besides the balustrade crowning presents a dome roof, and the churches of Povoação (velha) and Nordeste (Vila).
- In the eleventh row, with 3 fenestrations, located to the right and for single-nave churches, Furnas' church.
- In the twelfth row, with 2 single frame windows, located to the right and for single-nave churches, São Pedro church.
- In the thirteenth row, with 3 windows of the identical frame to the windows of the central body, for three-naves churches, located on the left the churches of Maia and Fenais da Ajuda and located on the right the church of Santa Cruz.

For churches with two windows in the crown, we can observe:

- In the eighth row, with 1 fenestration, located on the left, an isolated case is the São Sebastião church, which besides the balustrade crowning presents the addition of a new body, built in the 19th century, crowned by a roof that houses the clock.

- In the tenth row, with 2 fenestrations, located on the right, is the N. S. ª Rosário church.

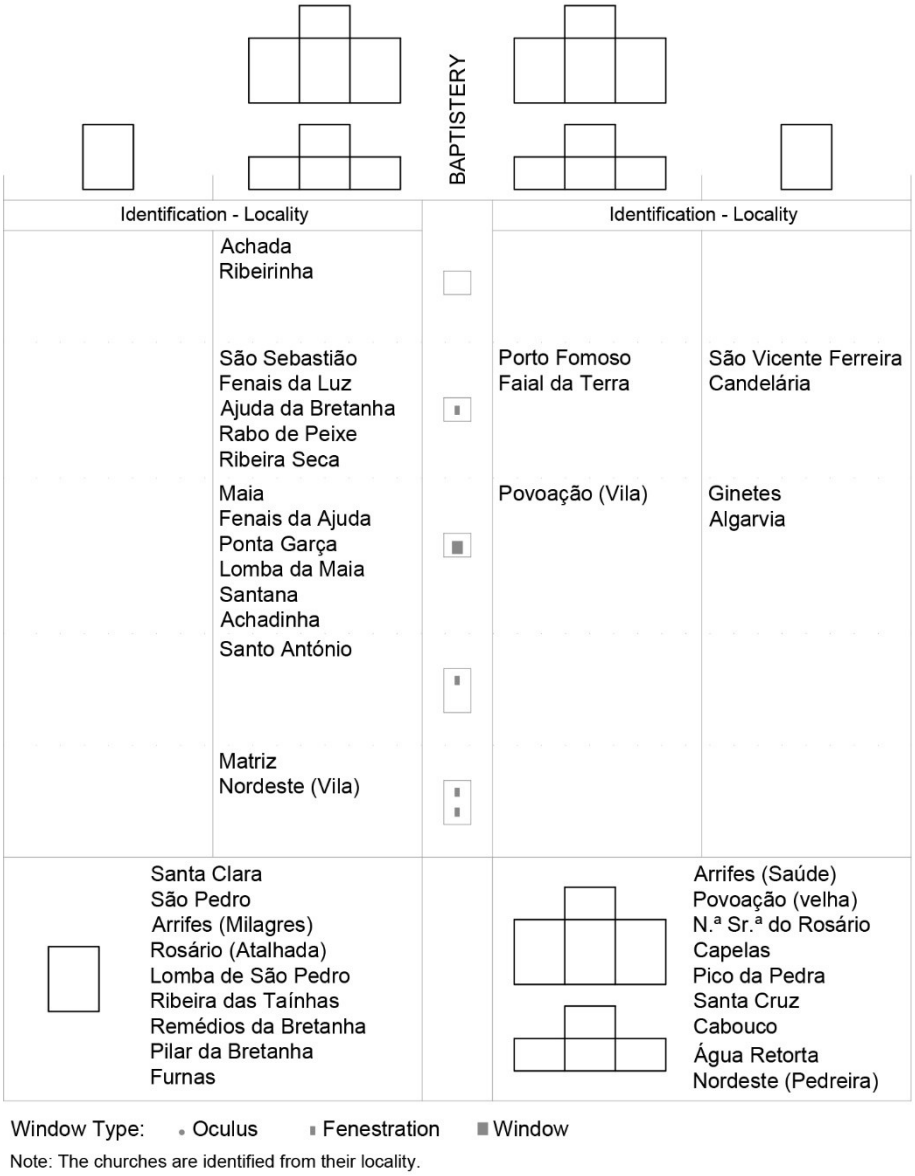
For churches with four windows in the crown, we can observe:

- In the seventh row, with 1 fenestration, located on the right, isolated case of the church of Matriz, whose lower windows are aesthetic.

**6.3 Baptistery**

Likewise, the body of the baptistery presents itself as an independent construction in the overall facade, whose presence is less foreshadowed.

**Scheme 4.** Characterization of the baptistery body (Developed by Author)




This way, Scheme 4 specifies the study of the morphology of the baptistery, dividing it into three groups according to the number of naves and the absence of the body. This scheme is consequently organised similarly to the tower study, divided according to its location, the type, the number, the typology/shape, the arrangement of spans, and the number of levels.

Generally, baptisteries are presented with or without openings and composed of one or two levels. In the cases of single-level baptisteries, these display only a single central opening, of the fenestration or window type, the latter being able to have a simple frame or a worked frame identical to the frame of the windows of the central body. In the case of two-level baptisteries, these feature one or two centered single-framed windows.

Through Scheme 4, we can see that most churches do not present baptistery in the facade composition with 9 cases for both church scales. Thus, there are 3 cases of non- parish churches, Lomba de São Pedro, Furnas and Povoação (velha). And 15 cases of parish churches whose baptistery is inside the church or markedly recessed, presenting itself in a second plant not part of the composition of the facade, as is the case in churches of Santa Clara, São Pedro, Arrifes (Milagres), Rosário (Atalhada), Ribeira das Tainhas, Remédios da Bretanha, Pilar da Bretanha, Arrifes (Saúde), N. S. ª do Rosário, Capelas, Pico da Pedra, Santa Cruz, Cabouco, Água Retorta, Nordeste (Pedreira).

In the cases of churches that feature a baptistery body on the facade, we can see five variants of architectural structure, alternating in both location and scale of the church, where:

- In the first row, with an empty bay, located on the left and slightly indented, for three-naves churches, the churches of Achada and Ribeirinha.
- In the second row, with 1 fenestration, located to the left and slightly indented, for three-naves churches, the churches of São Sebastião, Fenais da Luz, Ajuda da Bretanha, Rabo de Peixe and Ribeira Seca. And located to the right for single-nave churches, the churches of São Vicente Ferreira and Candelária.
- In the third row, with 1 window, the most significant composition for three-naves churches and located on the left, we can observe with simple frames the churches of Ponta Graça, Lomba da Maia, Santana, Achadinha and with frames identical to the windows of the central body and tower, the churches of Maia, Fenais da Ajuda. And located on the right are the churches of a single-nave, the churches of Ginetes and Algarvia.
- In the fourth row, with two levels and with 1 fenestration on the second level, located on the left, the isolated case of the Church of Santo António.
- In the fifth row, with 2 fenestrations one for each level, located on the left, are the churches of Matriz and Nordeste (Vila).

**6.4 Metric**

The analysis of the model facade is not only restricted to the characterisation of its morphology through the synthesis drawing but is also understood about the metric of these three bodies (central body, tower, and baptistery).
Scheme 5 was developed to show that the similarity between these various model facades is not only visual but also metric. In this way, the table is divided by its various bodies, presenting the width of each body, in meters, to better analyse the number of existing cases.

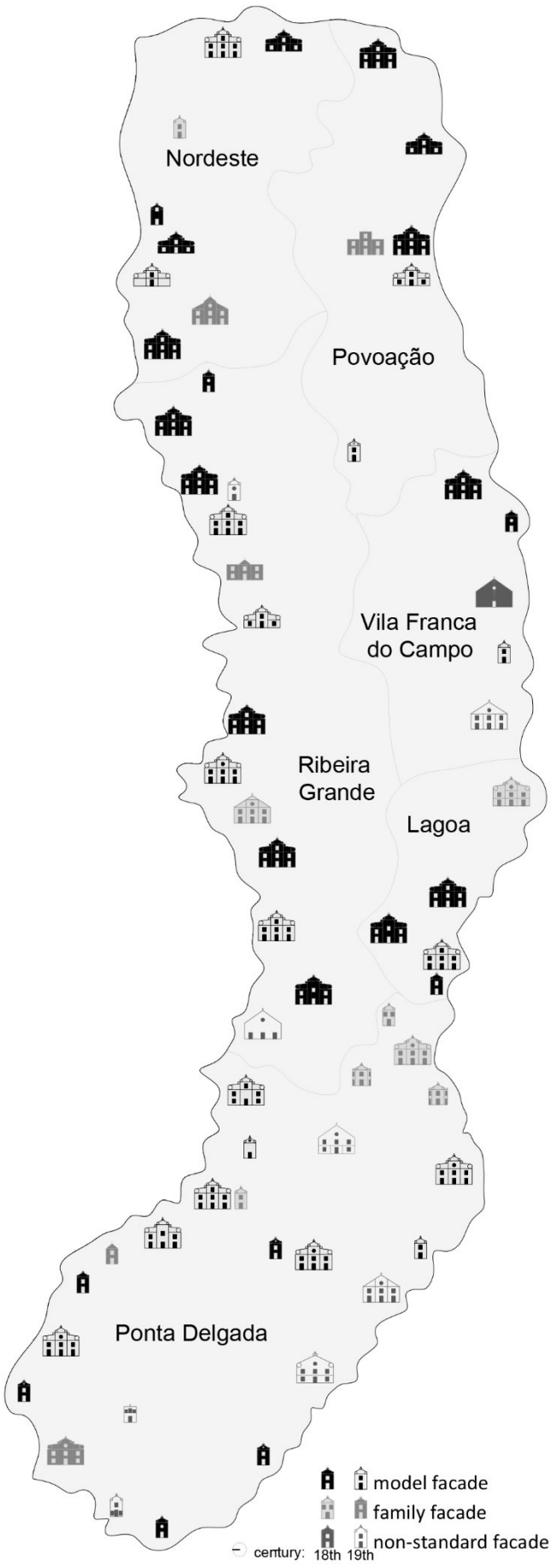
**Scheme 5.** Measurement relationship of the various facade bodies - Analysis of case numbers (Developed by Author)

| Measurements (meters) | | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | Central Body | 3 naves | | | | | | | | | | | 2 | 2 | **7** | **7** | 2 | 3 | 2 | 1 |
| | | 1 nave | | | | | | 2 | **6** | 2 | 2 | 1 | | | | | | | | |
| | Tower | 3 naves | | **12** | **11** | 2 | 2 | 1 | | | | | | | | | | | | |
| | | 1 nave | 2 | **9** | | | | | | | | | | | | | | | | |
| | Baptistery | 3 naves | | 6 | **8** | 4 | | | | | | | | | | | | | | |
| | | 1 nave | 1 | 1 | **4** | | | | | | | | | | | | | | | |

The measurements oscillate according to the scale of the church, they correspond to churches with single-nave or three-naves.

In this scheme we highlight the measures that are most often repeated, concluding that:

- The size of the central body varies from seven to eighteen meters or twenty-one meters, with three-nave churches presenting seven cases with fourteen meters and fifteen meters, and single-nave churches presenting six cases with eight meters.
- Tower size ranges from two to seven meters, with the most common case being a three and four meters tower in both church plants, with 12 cases of churches presenting a width of three meters and 11 cases for churches presenting a width of four meters churches of three-naves and with 9 cases for single-nave churches.
- The size of the baptistery in both scales shows a front dimension of two to five meters or seven meters, with the measure of four meters being the most common in both church plants, with 8 cases for three-nave churches and 4 cases for single-nave churches.




**6.5 Location**

Unsurprisingly, the location of each church on the island was also studied according to their typological distribution, through Figure 3, and according to the typological classification assigned to each building according to the composition of the facade (Vieira, 2019).

Thus, for each church facade (only the central body) a synthesis and schematic design is produced, developed from two principles, the compositional matrix (bays, levels, and entablements) and the configuration of the pediment through its ornaments (baroque (counter-curved) or triangular pediment). Consequently, the synthesis designs of church facades are divided into three representations:

i) churches with a model facade;
ii) churches with family facade;
iii) churches with non-standard facade;

First, we can see that the municipality with the largest number of parish and non-parish churches is Ponta Delgada, with 25 cases, of which 13 are churches with a model facade, 7 are churches with a family facade, and 5 are churches with a non-standard facade. Following the municipality of Ribeira Grande with 14 cases, 10 are churches with model facade, 2 are churches with family facade and 2 are churches with non-standard facade. With a smaller number, we have the municipality of Nordeste with 8 cases, of which 6 are churches with model facade and 2 are churches with family facade, not presenting any case of churches with non-standard facade. Following is the municipality of Povoação with 6 cases, 5 are churches with model facade and 1 church with family facade, not presenting any case of churches with non-standard facade. And finally, the municipalities of Vila Franca do Campo and Lagoa both with 5 cases. Thus, the municipality of Vila Franca do Campo presents 3 churches with model facade and 2 churches with non-standard facade, not presenting any case of churches with family facade. And the municipality of Lagoa with 4 churches with a model facade and 1 church with family facade, presenting no case of churches with non-standard facade.

**Figure 3.** Typological distribution of the churches' facades on São Miguel Island (Developed by Author)

Secondly, although the Ponta Delgada municipality has the most churches with a model facade, it is in the Povoação and Lagoa

municipalities that this type of facade has the most presence, as can be seen in Scheme 6, which shows the relationship between the three models of facade in the six municipalities of the island, first globally and then individually.

**Scheme 6.** Model facade ratio (global and individual - Percentage) (Developed by Author)

| % by municipality | Ponta Delgada | Ribeira Grande | Vila Franca do Campo | Nordeste | Povoação | Lagoa |
|---|---|---|---|---|---|---|
| Model Facade | 52% | 71% | 60% | 75% | 83% | 80% |
| Family Facade | 28% | 14% | - | 25% | 17% | 20% |
| Non-standard Facade | 20% | 14% | 40% | - | - | - |

| % globally | Ponta Delgada | Ribeira Grande | Vila Franca do Campo | Nordeste | Povoação | Lagoa |
|---|---|---|---|---|---|---|
| Model Facade | 32% | 24% | 7% | 15% | 12% | 10% |
| Family Facade | 54% | 15% | - | 15% | 8% | 8% |
| Non-standard Facade | 56% | 22% | 22% | - | - | - |

In the Nordeste, Povoação, and Lagoa municipalities, there are no cases of churches with non-standard facade in both centuries, and in the municipality of Vila Franca do Campo, there are no cases of churches with family facade in both centuries.
In summary, we can observe that the facade that prevails in all municipalities is the model facade.
And third, in Scheme 7, there were 26 parish and non-parish churches in the 18th century, of which 18 are model churches, 8 are family churches, and 1 isolated case of non-standard church, and 37 parish and non-parish churches in the 19th century, of which 23 are model churches, 5 are family churches and 8 are non-standard church.

**Scheme 7.** Number of cases per century (Developed by Author)

| no. of cases | | Ponta Delgada | Ribeira Grande | Vila Franca do Campo | Nordeste | Povoação | Lagoa | Total |
|---|---|---|---|---|---|---|---|---|
| Model Facade | 18th | 8 | 4 | 1 | 2 | 2 | 1 | 18 |
| | 19th | 5 | 6 | 2 | 4 | 3 | 3 | 23 |
| Family Facade | 18th | 4 | 1 | - | 1 | 1 | 1 | 8 |
| | 19th | 3 | 1 | - | 1 | - | - | 5 |
| Non-standard Facade | 18th | - | - | 1 | - | - | - | 1 |
| | 19th | 5 | 2 | 1 | - | - | - | 8 |

**7 Results and Discussions**

With this research, it was possible to analyse and synthesise a facade typology among the various parish and non-parish churches on the island of São Miguel, Azores, and simultaneously map and establish a model of the *micaelense* facade, according to the composition principles present in the analysed facades.
The concept of a model facade has been precisely defined, through the facts presented throughout the graphic diagrams and summary drawings. Therefore, the concept of a model facade applies to any facade with baroque *micaelense* ornamental whose compositional matrix is a classical reference and conveys the notion of a unifying image, which is also a consequence of its construction method.
Thus, the model facade is marked between 1728 and 1882, a period in which a large number of churches with identical compositions appear (41 parish and non-parish churches). These churches follow the model of the mother churches of Ribeira Grande (1728) and Ponta Delgada (1733) which were designated by Ataíde (2011) and Caldas (2011) as mother churches because they served as an example and model for all other churches that were built on the island.
Thus, the model facade is the one with the central body:

i) a compositional matrix of three bays, three levels, and two entablatures, for three-naves churches;
ii) a compositional matrix of three bays, two levels, and two entablatures, for three-naves churches;
iii) a compositional matrix of one bay, one level, and one entablature, for single-nave churches (Figure 4).

It is important to emphasise that the construction material of the facades contributes to the materialisation of an image that is easy to remember, reinforcing the imposing nature of the church. The facade reflects the floor plant, whether in larger or smaller scale churches.
Although there is a common image of the church facade in São Miguel that extends to all existing churches on the island, due to the material used, we find different characteristics, which leads us to apply distinctive designations. In this way, we verify the existence of two more facade images that have a greater or lesser degree of comparison with the model facade image.
After analysing the rules that make up the facades of the churches on the island of São Miguel, separately, according to the central body, the tower, and the baptistery, design tendencies were evident.

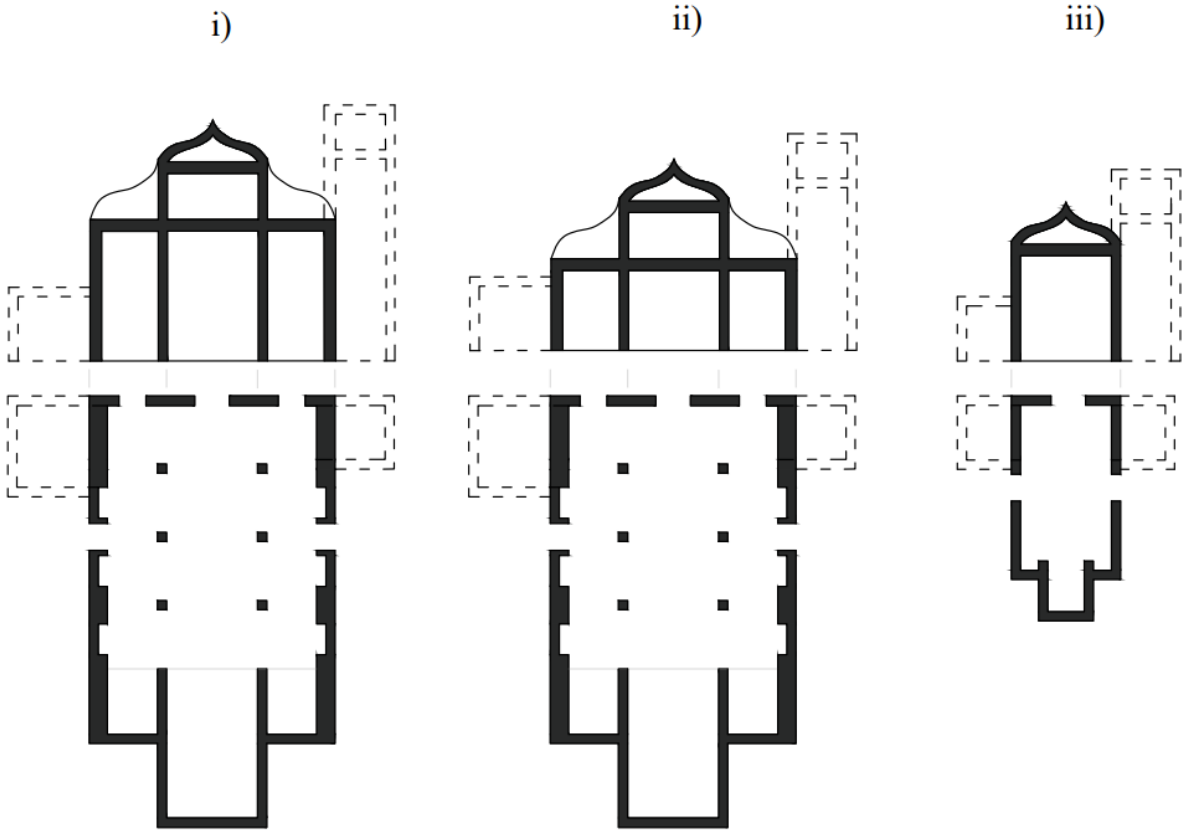



**Figure 4.** Typology of churches in *micaelenses* with a model facade Source: (Vieira, 2019)

Thus, the model facade presents only one tower and most are located primarily on the left, but exceptionally, due to lack of deployment space, the construction of the tower is done on the right. It was observed that the tower is divided into two levels, being the upper level, crowned by a belfry leaked, on each side, by a window in a perfect round arch, usually set on pilasters, finished by a balustrade, and the lower level presented by the two most significant situations and those present distinct logics and compositions. The tower is composed of three windows that relate to the facade of the central body from its alignment, size, or decoration of the frame of the spans, and the tower is composed of three oculi that are in no way related to the facade of the central body, however, is the most significant model (Figure 5).
As for the baptistery, it is located on the right, with a simple composition, composed of only one window, which usually follows and relates to the facade of the central body from its alignment or decoration of the frame.
The facades understudy assumes formal characteristics in the central body of the church, as a rule, completely autonomous in relation to the tower and the baptistery, whose entablature alignments and proportion of the facade lighting spans are in different harmonies.
In addition to the visual analysis and direct comparison between the various facades, a quantitative evaluation was carried out through a metric survey of the width of the facade, highlighting the measures that are most repeated in three-bays and single-bay churches. Remember that these constructions did not follow the metric system, but units of measurement such as the palm, the foot and the inch. The use of these measurements will certainly bring more accurate conclusions.

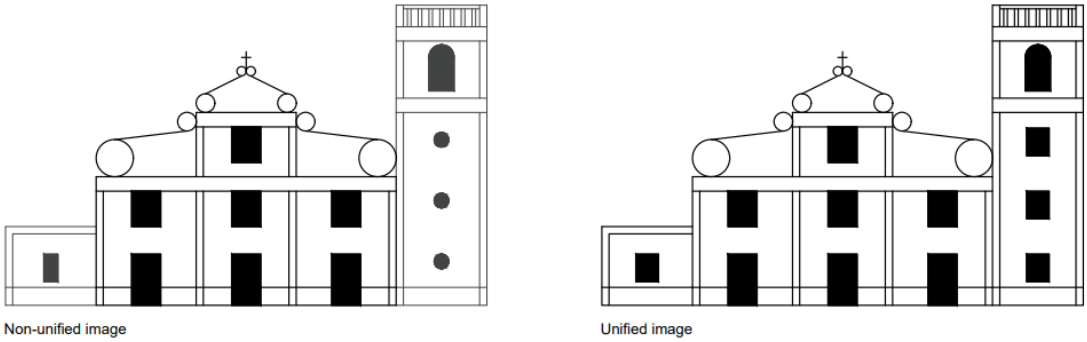



**Figure 5.** Comparison of the facade composition (central body vs. tower) Source: (Vieira, 2019)

Regarding the size of the central body of the facade, it was observed that this varies between seven to eighteen meters or twenty-one meters, with churches with three naves generally presenting fourteen and fifteen meters wide and churches with one nave generally presenting facades eight meters wide.
About the dimension of the tower, this varies between two to six meters, being the most common case the tower with three and four meters in both church plants. The baptistery, in both scales, presents a front dimension of two to five meters or seven meters, being the dimension of four meters the most common in both church plants.
This landscape profile conveyed by the various churches with model facades is present in small and large urban and rural centres, spreading evenly throughout the territory. It was also possible to see that in the parishes that have more than one church, it is the parish church that presents the facade with the model composition.

**8. Conclusion**

In accordance to what was initially proposed with this study, it was possible to analyse and synthesise a typology among several churches on the island of São Miguel through graphic and analytical design creating schemes conceived using a photographic survey accompanied by notes and synthesis drawings for the interpretation of a common facade concept on the island of São Miguel.
Despite the absence of original technical drawings and/or reproductions, or even in the absence of means, mechanisms, and knowledge for the elaboration of accurate, fast, and effective architectural surveys, it was possible from photographs with the aid of synthesis drawing to elaborate a theory and a concept.
In this work, it was only possible to make an initial and primary analysis regarding the understanding of these facades through synthesis drawings. However, it serves as a motto for future research, since it intends the enrichment of Azorean culture and history, through the decomposition (of the facade) of an element (church) that is part of the identity of the people and presents a methodology that relies on computational tools to aid the substantiation of the model facade concept, due to the scarcity of data and documentary gaps and the absence of references on the subject.
This work raises several questions, like understanding the origin of this type of facade in the parish and non-parish Catholic churches on the island of São Miguel, who its authors are, as well as to understand the means of transmission and transformation of the classical and baroque decorative elements.

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# Application Of Genetic Algorithm Classification Approach to Study Urban Streets Morphology at Neighborhood Scale

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**Abstract**
Today's cities worldwide are facing several new challenges with the spread of advanced digitalization and information technologies. As science and innovation are going digital, urban planning is highly concerned and should follow up with this global numerical transition. Urban planners should make use of the potential of new technologies to develop better and smarter urban forms responding to the new challenges and issues. The study uses artificial intelligence techniques based on genetic algorithms and supported by statistical data upon 20 indicators applied on 450 street segments in different urban fabrics in Fez city aiming to classify and simulate urban streets morphology. Machine learning can have the power of solving complex issues that humans alone cannot. The results using the potential of Machine Learning techniques can be a framework for decision makers to help them thinking about an intelligent planning process matching today challenges while taking advantages of new technologies.
**Keywords**: Machine Learning; Genetic Algorithm; Urban Street Morphology.

## 1. Introduction

The colonial urban model is a founding model both historically and technically of many ex- colonized cities in the world. The French colonialism in Morocco has been a major catalysis that has drastically affected both social and spatial characteristics of Moroccan space and has gradually affected the local lifestyle following a long transformation process. Being the main catalyst of the shift from the traditional enclosure and closeness to the extreme exposure and openness, colonialism has used planning as a tool to reinforce centralization of power, increase social segregation, expressing superiority, strength and control over local people.
Street space is the essence that gives strength and vitality to urban communities and the basis of developing and growing economies (Amen,2022; LUU, 2021). Therefore, planning pleasant and convenient street space is a matter of uttermost significance. Streets in Moroccan cities are suffocating, facing increasing stress and pressure. This study focuses on a particular city in Morocco, Fez, a patchwork piece of art, hosting completely divergent urban fabrics and structures being the old city, which is unique in terms of its urban fabric, spatial form, ornaments and details on both architectural and urban level and the new town, which is rival and exotic, introduced during the colonization of Morocco between 1912 and 1956 based on the French urban style and vision. Other fabrics are presented as post-colonial urban extensions, either informal settlements or planned new districts, highly influenced by the French urban principles and planning solutions introducing new street arrangements that were mostly incompatible with the local context.
This research is aiming to define, through a comparison analysis of colonial and post-colonial streets spaces, how colonialism and western urban inspired solutions have affected today's urban space and planning practices in Moroccan dual cities especially at street level in order to help think about an innovative development of streets that match the local atmosphere and today's socio-economic reality of Moroccan post-colonial cities while subscribing to the modern context benefiting from the added value of the new technologies.
The nature of this research is both qualitative and quantitative focusing on the empirical data analysis studying the spatial components putting forward the importance of new technologies and computational tools such as Artificial Neural Network and Genetic Algorithm in studying urban streets morphology for classification at neighborhood scale automatically tracing the similarities and contrasts between different urban areas. This can help decision makers to reveal several interpretations of planning dysfunctions and predict relevant planning solutions in a way to create vibrant and liveable Streets.

### 1.1 Research Background and Cases Studies

This study focuses on the city of Fez in Morocco, a patchwork piece of art hosting completely divergent urban fabrics. Before the French occupation to Morocco in 1912, only the old Medina existed, constituting a single homogeneous urban core. After the independence in 1956, the city of Fez had a huge urban expansion especially in the neighbouring rural communes and along the mains axis connecting Fez to the other regions.
Fez is hosting divergent urban fabrics being:

- The Medina: which is founded twelve hundred years ago, one of the most conserved historical towns, listed as World heritage sites by the UNESCO (1981). with about 3000 historic monuments a high number of historic buildings.
- The new town "la Ville Nouvelle", which is rival and exotic, introduced during the colonial period between nineteen twelve (1912) and nineteen fifty-six (1956) based on the French urban principles and vision.
- Other fabrics are manifested as postcolonial urban extensions mostly residential, generated after the independence as the city of Fez had a huge expansion especially coming from the neighbouring rural regions.

Statistical analyses are based upon 20 indicators applied on 450 street segments in three different urban fabrics between the colonial and post-colonial districts in the city of Fez:

- *The first Case study* is called Agdal- the ex-colonial center which is hosting only 16% of the total population with the highest concentration of public facilities, attracting more and more pressure from its surroundings.
- *The second case study:* Narjis district, recently planned according to a grid as an extension to the city, with 10% of the total population relatively placed in a dense built frame.
- *The third Case study:* Bensouda district, post-colonial district that was developed in a very short time without a prior planning, hosting 28% of the total population, highly dense, located at the edge of the city suffering from major urban issues, being disconnected, segregated from the other entities.

**Table1.** Streets segments selection in the three studied cases.

| Data collection | Street segments | Selected segments after selecting | percentage |
|---|---|---|---|
| Case I - Agdal | 253 | 224 | 88.53% |
| Case II- Narjis | 100 | 95 | 95% |
| Case III -Bensouda | 135 | 134 | 99,25% |
| Total | 488 | **453** | 92.82% |

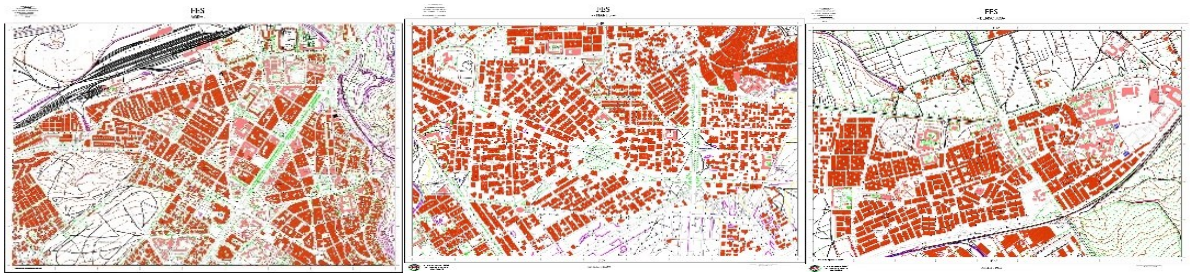

**Figure 1.** Fig. Fez- Cases studies (1) Agdal- the ex-colonial center, (2) Narjis, recently planned according to a grid as an extension to the city, (3) Bensouda, post-colonial district, developed in a very short time without a prior planning.

### 1.2 Research Aim

This research is aiming to define, the duality of Fez Street space and how colonialism has affected today's urban space and planning practices in Moroccan dual cities via a comparative study of three major districts between the ex-colonial center and two different post-colonial districts in terms of urban form targeting accessibility mobility and connectivity at neighbourhood scale and urban design qualities and physical features at street scale. The contrast and similarities between the areas are clearly traced and will reveal several planning dysfunctions.

## 2. Materials and Methods

### 2.1 Data sources

Data sources are hybrid. Up to 10000 data were collected based on surveys, Satellite data using OpenStreetMap's, axial maps Data using space syntax tools and then on-site observations permitted the acquisition of accurate information regarding the following indicators:

**Table 2.** Indicators used for this classification study

| | |
|---|---|
| **Street connectivity** | Connectivity<br>Nodes counts<br>Integration |

| | |
|---|---|
| **Physical features of the street** | Street Width<br>Street Length<br>Sidewalk<br>Number of lanes<br>Building height |
| **Qualitative Measurements** | Street Planting<br>Usage |
| **Land use** | Small business<br>Coffeeshops<br>Education<br>Religious<br>On street-Parking<br>Other facilities |
| **Transportation** | Bus stations<br>Number of lines<br>Bicycles lanes |

**2.3 Machine Learning methods for Data classification, clustering, and prediction: Overview**

In urban planning, the computational models have been used with co-occurrence with the geospatial analysis in several means such as classification, clustering, and prediction.

- **Classification** to recognise land-use patterns extracting green areas from satellite images by machine learning that can be easily used to perform any spatial analysis.
- **Clustering** techniques which are frequently adopted to generate model indicators of urban forms. A clustering analysis aims to split up a data set into different groups (clusters) that should be meaningful for the study under a supervised or unsupervised learning methods. This can be related to multiclass classification as well, for the fact that, the cluster labels are not given for learning, and the computer should understand the data itself, interpret and classify into different clusters (Barlow, 1989). In urban planning, clustering techniques are frequently adopted to generate model indicators of urban forms, for instance urban land use, urban tenure, and urban fabrics (Li. X, 2020).
- **Prediction** is frequently using spatial regression algorithms to help to predict future change and model future urban development.

This research is both qualitative and quantitative, based on secondary and primary data, surveys, satellite data, using computational tools such as ANN, Genetic Algorithms classification approach in studying urban streets for classification that help us think about adequate planning solutions in a way to create adaptive and liveable cities. Genetic algorithms are bio-inspired computational algorithms seeking to solve complex problems using models of biology providing efficient operation in flexible and mutating environments. The model of this study is inspired from the "Fisher's Iris data set using both R and Python languages illustrating usages and visualizing the model results.

Above ten thousand (10 000) Statistical data are collected, filtered, to be prepared for classification and clustering analysis. Today, Urban data collection and structuring is an area of high demand, especially for ML-based applications (Amen,2021). *"Without the data, ML models can neither be trained nor calibrated"* (Al-Garadi et al., 2020; Jordan and Mitchell, 2015). According to Tekouabou S.C.K, Diop. El, Azmi.R, Jaligot.R, Chenal.J(2021), Models needs careful adjustment, and a quiet big amount of data to give accurate results. Both the computational model used and the volume of the data matter to reach the best performance. The computational models are progressing day by day due to the rapid digital transformation all over and the huge amount of data. Models are increasingly becoming complex to be more performant.

The methodology followed is based first on Space syntax tools to compare the level of integration and streets connectivity of the three cases. Depthmap is used to generate axial maps and graph analysis of both macro and micro scale of the city components. Processing and analyzing the numeric collected data are based on statistical computational tools such as R studio using R language and Spyder (IDE) in Phyton included in "Anaconda" which is open source and accessible for all. Data classification is based on Genetic Algorithm inspired from the code of Iris flower data set on python.

Satellite imagery is also a powerful tool that provides a big amount of data based on an accurate representation of the ground reality. It comes up with precise data at high resolution and recently became more and more available. The AI computational models are progressing day by day, increasingly becoming complex and more performant.

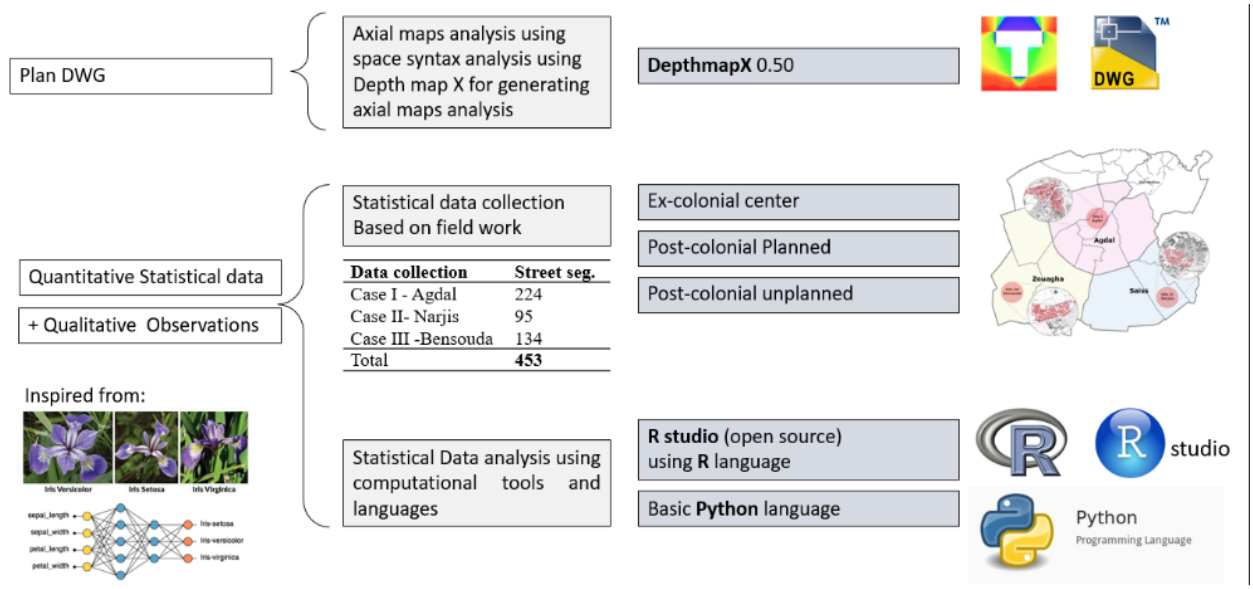


**Figure 2.** structure and methodology of the study (Developed by Author).

### 3. Data Analysis and Results

Data analysis is organized in several steps using computational tools to analyse the similarities and differences of the selected districts. Applying quantitative analytical methods on these areas will show similarities and analogies between colonial and post-colonial areas and will demonstrate how street network integration level is related to their liveability and success in a continuous changing process. Beside axial map analysis, on field qualitative observations complete data to reach a comprehensive analysis result.

Using of DepthmapX, various macro scale spatial variables can be calculated and visualized. Studying the integration help to predict how streets are used by pedestrians based on how it is accessible to them, a well-integrated and easily accessible street should be in theory highly frequented (Hiller, 2003). The ex-colonial center 'Agdal', scores the highest connectivity and integration values with a shallow urban structure, followed by the second post-colonial planned district then the third unplanned is the most isolated network with relatively the highest depth. Based on nodes counts of axes, we calculate how the axial lines are connected to each other. It also computes the street network measures and the plan according to the level of correlation of these street spaces.

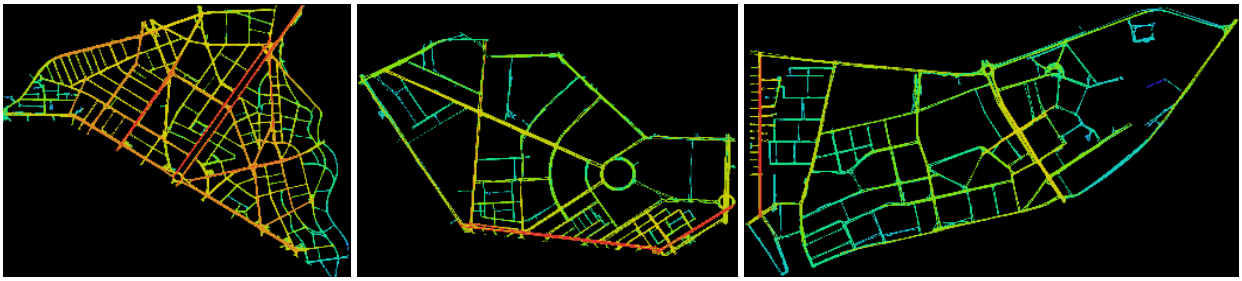

**Figure 3**. Integration level of the 3 cases studies based on DepthmapX tool (site 1: Agdal, Site 2: Narjis and site 3: Bensouda)

Comparing the Local and global integration values of Bensouda, one can note that the highest integration value R3 (7,44762) in Bensouda quarter is much higher than its global integration at radius n (3,7245). This shows that the quarter is poorly intelligible. In the previous cases the difference between R3 and Rn is less obvious. The higher the correlation between local R3 and Rn in an area, the more it is intelligible. According to axial map analysis, Agdal (site1) as well as Narjis (site 2) are more intelligible than Bensouda (Site 3).

Analysing axial maps generates the integration values of each district based on number of segments', their length, and intersections with other lines. Combining these data, axial maps reveal integration level and intelligibility with other spatial features. The city segments are shown as axial lines sorted from the shortest to the longest assigning a range of colours from red to blue, where red is the most integrated segment and blue is the most isolated one. Based on the data generated from these maps, the comparison of the street's length and integration level of the three case studies have been done using Spyder(python3.5) software27, based on a test after 1000 iterations. The result of this

test is showing a similarity in terms of integration between Narjis and Agdal while Bensouda is contrasted from both with lower integration and a deeper urban grid can be similar to the traditional structure. The shallow urban structures such as ex-colonial center, “Agdal” have high street network integration rate.

### 3.1 Mapping Street Frontage

Mapping the street frontage use and relating it to the integration analysis above, shows how streets are used. well integrated and easily accessible streets in the three cases are hosting the most of economic activities and are thus highly frequented. We also note that Agdal (Site 1) scoring the highest concentration of public facilities, administrations, and commercial activities. site 2 is less active than site 1, while -Site 3- is ranking in the last position and extremely dependent on the city center.

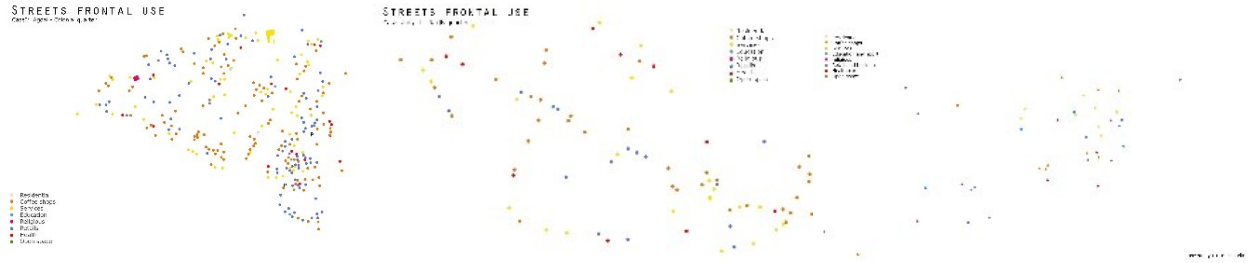


**Figure4.** Mapping Street frontage use in the 3 cases studies (site 1: Agdal, Site 2: Narjis and site 3: Bensouda)

Summary of the analogies and differences between the 3 cases shows a failure of urban planning is reflected in several aspects, based on a mono-centric system while other entities are spatially segregated with a poor access to facilities with a considerable dependence on the center.

### 3.2 Mapping Street Planting

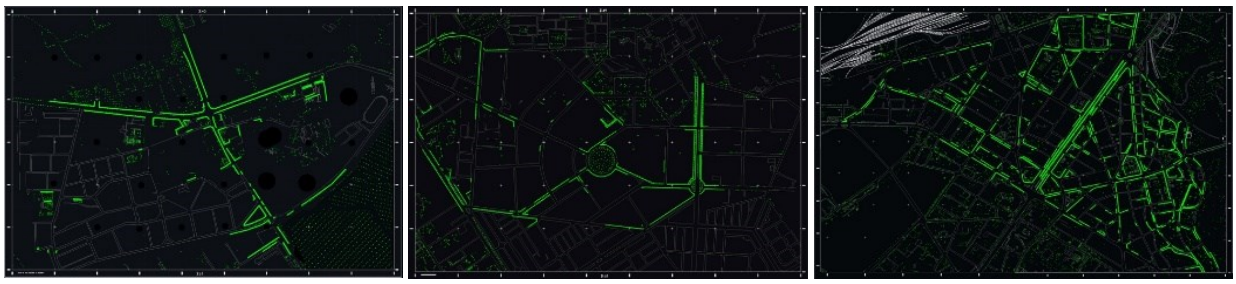

**Figure 5.** Mapping Street planting in the three studied areas (site 1: Agdal, Site 2: Narjis and site 3: Bensouda)

Mapping street tree planting, using satellite data shows a significant gap also between ex-colonial site streets canopy planting and the post-colonial ones with a percentage of 58% in site 1, Meanwhile, 34% in site 2 and 9% only in site 3 (Bensouda).

**Table 3.** Summary of statistical Data Site 1 (Agdal, ex-colonial center)

| Categories | variables | Max. | Min. | Mean | Std. |
|---|---|---|---|---|---|
| Street connectivity | Connectivity (Con) | 22 | 1 | 5.667 | 4.162638 |
| Physical features of the street | Street Width (SW) | 45 | 4 | 8.748 | 4.309221 |
| | Street Length (SL) | 1426,24 | 18,28 | 223.28 | 199.9758 |
| | Sidewalk (SS) | 66 | 3 | 7.7768 | 5.443855 |
| | Number of lanes(NL) | 6 | 1 | 2.341 | 0.7416158 |
| | Building height (BH) | 23 | 0 | 12.76 | 5.074634 |
| Qualitative Measurements | Street Planting (SP) | 1 | 0 | 0.583 | 0.860063 |
| | Cycling infrastructure | 0 | 0 | 0 | -- |
| Land use | Small business (SsB) | 36 | 0 | 4.735 | 6.43449 |
| | Coffee shops (Cof) | 24 | 0 | 1.179 | 2.528063 |

| | | | | | |
|---|---|---|---|---|---|
| | Education (Edu) | 4 | 0 | 0.2398 | 0.6310423 |
| | Religious (Rel) | 1 | 0 | 0.09545 | 0.2927227 |
| | Other facilities (Ser) | 11 | 0 | 0.9775 | 1.840288 |
| | On street-Parking (PA) | 1 | 0 | 0.7578 | 0.4293498 |
| Transportation | Bus stations (Bus) | 4 | 0 | 0.1883 | 0.6080899 |
| | Number of lines (BusL) | 11 | 0 | 0.3587sd | 1.374315 |

**Table 4**. Summary of statistical Data Site 2 (Narjis, Post-colonial, recently built quarter)

| Categories | variables | Max | Min. | Mean | Std. |
|---|---|---|---|---|---|
| Street connectivity | Connectivity (Con) | 17 | 1 | 4.606 | 2.99181 |
| Physical features of the street | Street Width (SW) | 30 | 5 | 9.532 | 5.96892 |
| | Street Length (SL) | 1018.29 | 37.24 | 214.94 | 193.027 |
| | Sidewalk (SS) | 15 | 2 | 5.074 | 2.775621 |
| | Number of Lanes(NL) | 4 | 1 | 1,84 | 0.9075927 |
| | Building height (BH) | 18 | 8 | 13.2 | 2.498621 |
| Qualitative Measurements | Street Planting (SP) | 1 (yes) | 0 (no) | 0.3404 | 0.4763931 |
| | Cycling infrastructure | 0 | 0 | 0 | -- |
| Land use | Small business (SsB) | 42 | 0 | 3.34 | 6.168866 |
| | Coffee shops (Cof) | 9 | 0 | 0.8936 | 1.925874 |
| | Education (Edu) | 1 | 0 | 0.1064 | 0.3099804 |
| | Religious (Rel) | 1 | 0 | 0.6383 | 0.2457602 |
| | Other facilities (Ser) | 5 | 0 | 0.3723 | 1.126266 |
| | On street-Parking (PA) | 1(yes) | 0(no) | 0.5106 | 0.5025672 |
| Transportation | Bus stations (Bus) | 3 | 0 | 0.2021 | 0.6148658 |
| | Number of lines (BusL) | 8 | 0 | 0.4574 | 1.493102 |

**Table**.**5** Summary of statistical Data Site 3 (Bensouda, Post-colonial- Unplanned district)

| **Categories** | **variables** | **Max** | **Min.** | **Mean** | **Std.** |
|---|---|---|---|---|---|
| **Street connectivity** | Connectivity (Con) | 14 | 1 | 4.173 | 2.2378 |
| **Physical features of the street** | Street Width (SW) | 867.91 | 27.08 | 188.20 | 3.404174 |
| | Street Length (SL) | 24 | 4 | 7.609 | 145.8871 |
| | Sidewalk (SS) | 23 | 0 | 5.564 | 4.19479 |
| | Number of lanes (NL) | 4 | 1 | 1,925 | 0.6230918 |
| | Building height (BH) | 15 | 0 | 10.12 | 3.455425 |
| **Qualitative Measurements** | Street Planting (SP) | 1(yes) | 0(no) | 0.09023 | 0.2875878 |
| | Cycling infrastructure | 0 | 0 | 0 | -- |
| **Land use** | Small business (SsB) | 30 | 0 | 0.2256 | 3.498055 |
| | Coffee shops (Cof) | 14 | 0 | 0.2256 | 1.306258 |
| | Education (Edu) | 1 | 0 | 0.1278 | 0.3351511 |
| | Religious (Rel) | 1 | 0 | 0.07519 | 0.2646914 |
| | Other facilities (Ser) | 4 | 0 | 0.1888 | 0.6758875 |
| | On street-Parking (PA) | 1(yes) | 0(no) | 0.8346 | 0.3729581 |
| **Transportation** | Bus stations (Bus) | 2 | 0 | 0.03759 | 0.2271702 |
| | Number of lines (BusL) | 1 | 0 | 0.03008 | 0.17144 |

Clustering analysis based on machine learning studies the design of algorithms that can learn based on artificial neural network tasks. *(This research has used as a reference, genetic algorithm on iris flower data set python).* These tasks are learned via available data of Site 1,2,3, (supervised learning) that were observed and collected from satellite-based sources, axial maps and surveys.

The clustering analysis and the comparison of the streets' physical features and integration level of the three case studies are done using computational coding language python based on a test after 1000 iterations. (72 entries, 10 for testing)

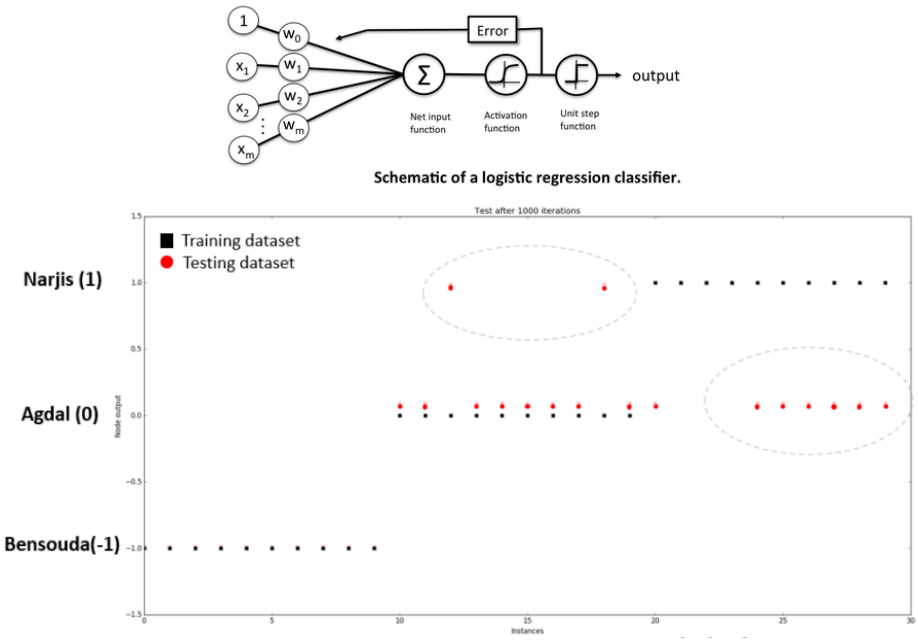


**Figure 6**. Result after testing and comparing variables in the three different sites: Agdal (0), Narjis (1) Bensouda (-1), (72 entries, from which 10 were for test) (Developed by Author).

$$\tanh x = \frac{e^{x}-e^{-x}}{e^{x}+e^{x-}} = \frac{e^{2x}-1}{e^{2x}+1} = \frac{1-e^{-2x}}{1+e^{-2x}}$$

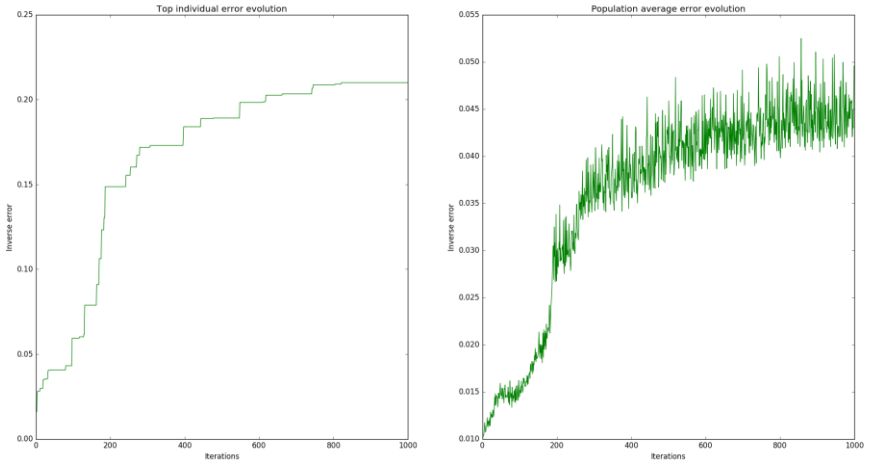


**Figure 7.** Inverse error - error correction by back propagation using python language

The result of this test, it is showing a similarity in terms of integration and physical features between (site 1) the colonial center and the post-colonial recently built quarter (site 2), while the post-colonial unplanned spontaneous settlements (site 3) is contrasted from both with lower integration and a deeper urban grid which can interpreted also to be similar the traditional structure.

The newly developed extensions are similar in structure however depend on the center and generating a real break in the city following a policy that is still favouring the center and increasing the existing socio-spatial gap between different entities of the city. Interestingly, unplanned settlement is comparable to the traditional structure, might indicates the unconscious choice and willing of people of low- and middle-income class, of enclosure, privacy and togetherness while maximizing land efficiency to a large extent.

**4. Conclusion**

The rapid pace of digital transformation is setting every day's life activities with artificial intelligence. computer scientists have been putting countless efforts in making machines able to see and understand the world same as human do. Machine learning can help finding strong correlations among data that must be given more attention, having the potential of solving complex issues that humans alone cannot.

Modern planning should increasingly get inspired of the advantages of new technologies adopting artificial intelligence (AI) techniques to support liveability dimensions and secure vitality and sustainability. Urban planning can benefit from the advantage of new technologies to enhance spatial analysis quality. Using the computational tools to compare the ex-colonial urban fabric with the post-colonial districts in terms of connectivity and physical features; shows that recent planning is still highly influenced by the planning regulations elaborated during the colonial period generating several urban dysfunctions.

Machine Learning methods can help efficiently in simulation and classification studies that can improve the performance processes of today's urban planning and support decision makers in developing an intelligent process of planning turning today's challenges into tomorrow opportunities.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Architectural Projects Prepared Through National or International Design Project Competitions on Archaeological Sites as Contemporary Additions

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**Abstract**
Cultural heritage is the most important factor in the formation of urban identities. The construction of new buildings in archaeological heritage areas as well as in the historical environment maintains its currency as a subject that continues to be discussed within the context of conservation. Regarding the protection and presentation of archaeological heritage sites, the need for articulation of service structures such as visitor centers, museums, sales units, WC volumes, experience/activity areas and excavation houses within the protected areas arises over time and defined by the regulations and declarations accordingly regarding the construction of new buildings in the historical environment and archaeological heritage areas. The aim of the study is to examine the building principles, design criteria and conservation approaches of the contemporary constructions/annexes designed through national or international design competitions in archaeological sites regarding the national and international conservation policy.
**Keywords:** Preservation of Archaeological Sites, Contemporary Additions to Historical Environment, Design Competitions in Historical Environment.

## 1. Introduction

thousands of years of history of the countries have provided the formation of heritage values at different scales.
The archaeological heritage is a universal value, and its preservation should not be left to chance. It is a universal feature to transfer the archaeological values that have reached the present day to the future and to increase the awareness of conservation. The construction of new buildings in archaeological heritage areas as well as in the historical environment maintains its currency as a subject that continues to be discussed within the context of conservation. Accordingly, regulations and declarations regarding the construction of new buildings in the historical environment and archaeological heritage areas have been published, and the legislation has been stretched according to today's conditions.
Regarding the protection and presentation of archaeological heritage sites, the need for articulation of service structures such as visitor centers, museums, sales units, WC volumes, experience/activity areas and excavation houses within the protected areas arises over time.
Within or around the protected areas over time regarding the protection and presentation of archaeological heritage sites; there is a need for articulation of service structures such as Museums/Archaeoparks, Visitor Centres, Travel Routes/Walking Paths, Protective Roofs, Sales Units, Cafes/Recreation Areas, WC Volumes, Experience/Activity Areas, Security, Entrance and Reception Areas, Excavation Houses.
The study aims to examine the building principles, design criteria, and conservation approaches of the contemporary constructions/annexes designed through national or international design competitions in archaeological sites regarding the national and international conservation policy.

## 2. Material and Methods

Today, archaeological relics are exhibited in situ, and an integrated conservation model is preferred.
Within the scope of the "Recommendation on International Principles to be Applied in Archaeological Excavations" published by UNESCO in 1956, it has been suggested to the member states that archaeological excavations be subject to permission, training activities should be carried out to respect the archaeological relics, and the supervision of the restoration works to be carried out in the archaeological relics.
Archaeological excavations were mentioned in Article 15 of the "Venice Charter" published in 1964, and it was emphasized that archaeological excavations should be carried out according to the decisions and scientific standards defined by international principles. The importance of preserving archaeological relics was mentioned. In addition, reconstruction was not considered appropriate, and the anastylosis method was accepted. (ICOMOS, 1964).
In the " European Convention on the Protection of the Archaeological Heritage ", which was issued by the Council of Europe in 1969 but revised in 1992, a roadmap for planning was drawn for excavations in archaeological sites.

In the "Charter for the Protection and Management of the Archaeological Heritage" published by ICOMOS in 1990, it was stated that the archaeological heritage constitutes the basic document of human activities in the past and is the material heritage obtained by archaeological methods. At the same time, it has been stated that it includes all kinds of relics including places, abandoned structures, soil, and underwater sites that reflect all kinds of traces and activities of human existence, and all movable cultural material in connection with them (ICOMOS, 1990).
Within the scope of the " The ICOMOS Charter for the Interpretation and Presentation of Cultural Heritage Sites" published by ICOMOS in 2008, the issues related to the adoption of the concept of heritage by the society were emphasized. Community adoption of the archaeological heritage has formed the main task of archaeologists and relevant conservation experts.
“Settlements and ruins from past civilizations constitute our historical environment. Many details about the social and economic structure, philosophy of life and aesthetic sensitivity of past civilizations are hidden in these circles” (Ahunbay, 2017).
In the method of the study, primarily a literature review was carried out. After the literature review, contemporary structures/additions obtained through national or international architectural project competitions in archaeological sites in various countries were selected within the scope of the study. Even if the competition project has been concluded, buildings that have not been completed and are not open to visitors are excluded from the scope. Structures built outside the archaeological site or protected area are also excluded.
Within the scope of the study, architectural competition projects were examined under two headings as structures built in archaeological areas located at the periphery or outside of the urban fabric and structures built in archaeological areas within the urban fabric. Architectural structures include Museums and Visitor Centers. Protection roofs, excursion platforms, open space arrangements and experimental archaeology areas are excluded from the scope. Two structures from Turkey, one from Greece and one from Croatia were included in the study for analysis. Two examples are structures built in archaeological areas located at the periphery or outside of the urban fabric and two examples are structures built in archaeological areas within the urban fabric.

**3. Contemporary Annexes in Historic Environment and Archaeological Heritage Sites**

The concept of contemporary annex has emerged to ensure that these structures or areas can be transformed into living spaces again due to the loss of their functionality as a result of the inability of historical buildings or historical areas to keep up with today's conditions and requirements (Zeren, 2010).
According to Zeren, two concepts form the basis of the design criteria of the contemporary building. These are style and proportion. One of the basic principles of the new building, which will be built in a historical texture or an archaeological heritage site, is to respect the characteristics of the area where the building will be built in terms of scale and proportion. The new building should also connect with its surroundings (Zeren, 2010).
Michael Davies has proposed five different approaches to the design of new buildings in the historical environment: Emulation Approach, Traditionalist Approach, Arrogant Approach, Current Approach, and Implicit Approach. In the Greater Philadelphia Conservation Agreement published in 2007, four different approach models were envisaged for the design of new buildings in the historical environment: Authentic Copying, Discovery in a Style, Abstract Reference and Intentional Contrast (Pasin, Varinlioğlu, 2018).
For the features of the new building to be built in a historical texture or an archaeological heritage site, Zeren has adopted four different approaches: Imitation of Style, Emulation of the Traditional, Respectful Approach and Contrary Approach (Zeren, 2010).
Contemporary annexes built in archaeological sites are produced by the competition method today. While the project work of contemporary buildings to be built in archaeological sites is usually given directly to architectural offices, the creation and announcement of architectural projects through competitions has recently been on the agenda in terms of the emergence of different ideas and approaches.
Kolumba Museum, Archaeological Pavilion and St Antony Industrial Archaeological Park from Germany, Villa Romana La Olmeda and Cartagena Archaeological Park Cover from Spain are some examples of architectural projects prepared through national or international design project competitions on archaeological sites as contemporary additions which are outside the scope of the study.
When the historical process of architectural competitions in the world is examined, it is possible to see its development over time. In the 20th century, architectural project competitions became universal and the power of the competitions in the architectural environment increased. Architectural project competitions have increased in importance over time, as they form the focus of tourism in the national and international sense, as well as stating the importance of the place and period in which they are held (Eraydın, Arslan, 2021).

**4. Conservation of Archaeological Sites and Their Relationship with The Urban Fabric**

Archaeological sites can be located within the urban fabric as well as outside the urban fabric. This situation leads to the emergence of various potentials and threats in the protection, exhibition, and transfer of archaeological sites to future generations.

Situations such as dense urbanization, property problems, expropriation costs, the boundaries of the archaeological area, and the characteristics of the emerging movable/immovable cultural assets cause uncertain and various difficulties during the construction of contemporary annexes on archaeological sites in the urban fabric. In this case, it emerges as a result of making a solution together with archaeological relics for the structures needed for the protection and transfer to the future of archaeological sites located in dense and complex areas within the urban fabric. Therefore, these structures are often built on archaeological relics. Due to this situation, which also forces the designer, different conservation problems and discussions come into question.

Contemporary annexes such as museums or visitor centers to be built on archaeological sites located outside the urban fabric can be built outside the archaeological site, not on the archaeological relics, due to the sparse construction and wide usage areas around the archaeological site. These structures are sometimes built on the periphery of the archaeological site and sometimes at a certain distance. In this case, the archaeological relics are not damaged. After the information that needs to be given to the visitors is conveyed, the archaeological site is experienced. These areas can also be considered as buffer zones.

Structures built on archaeological relics bring along various conservation problems. It is of great importance that experts from different professions and disciplines meticulously carry out the design and construction process together. The coexistence of the relics and the building cannot be ensured in the structures built in a different place from the archaeological relics. Thus, the situation of being detached from the context of the information to be transferred may occur. The purpose of the contemporary annexes is for the visitors to obtain information from the relevant unit and to visit and experience the area with that information. Since these structures are built in an area far from archaeological relics, some visitors choose between the archaeological site and the museum/visitor center structure. The decrease in the number of people visiting the archaeological site and the museum/visitor center together may cause the building to not serve its purpose.

**Table 1.** Archaeological Sites and Their Relationship with The Urban Fabric

| **Archaeological Sites and Their Relationship with The Urban Fabric** | | |
|---|---|---|
| *Location* | *Oppurtunities* | *Threats* |
| ***In The Urban Fabric*** | ● Increasing awareness of the Archaeological site by area users<br>● Easy for visitor access<br>● Contributing to city life during tourism activities | ● Difficult to control and protect the archaeological site<br>● Urbanization and zoning activities<br>● Intensive construction and wrong planning<br>● Infrastructure works |
| ***Outside The Urban Fabric*** | ● Not to be exposed to the wrong consequences of urbanization<br>● The sparse nature of development activities | ● Difficult to control and protect the archaeological site<br>● Reduction in the number of visitors |

**5. Examples of Contemporary Annexes in Archaeological Sites**

Within or around the protected areas over time regarding the protection and presentation of archaeological heritage sites; there is a need for articulation of service structures such as:

- Museums/Archaeoparks,
- Visitor Centers,
- Travel Routes/Walking Paths,
- Protective Roofs,
- Sales Units,
- Cafes/Recreation Areas,
- WC Volumes,
- Experience/Activity Areas,
- Security,
- Entrance and Reception Areas,
- Excavation Houses.

Museums are important facilities by transferring the knowledge of all kinds of heritage (Hussein, 2017). Therefore, museums and visitor centers play a significant role in the protection and presentation of archaeological heritage sites.

Within the scope of the study, museum/visitor centers were examined under two headings: **structures built in archaeological areas located at the periphery or outside of the urban fabric** and **structures built in archaeological areas within the urban fabric**.

**Table 2.** Archaeological Sites and Contemporary Annexes in terms of their Location

| **Archaeological Sites and Contemporary Annexes in terms of their Location** | |
|---|---|
| ↙ | ↘ |
| *Structures Built in Archaeological Areas Located at the Periphery or Outside of the Urban Fabric* | *Structures Built in Archaeological Areas Within the Urban Fabric* |

### 5.1 Structures Built in Archaeological Areas Located at The Periphery or Outside of The Urban Fabric

#### 5.1.1 Yeşilova Mound Visitor Center



**Figure 1.** Yeşilova Mound Visitor Center, İzmir/Turkey (Cemal Emden)

**Table 3.** Imprint Information

| **Yeşilova Mound Visitor Center** | |
|---|---|
| Location | Izmir, Turkey |
| Type Of Competition | National Architectural Project Competition |
| Year Of Competition | 2010 |
| İnstitution That Opened the Competition | Izmir Bornova Municipality, Turkey |
| Winners | Studio Evren Başbuğ Architects + SCRA Architects |
| Commissioning Date | 2014 |

A free-participation, one-stage, national architectural project competition has been announced by the Izmir Bornova Municipality for the visitor center of the Yeşilova Mound archaeological site located in the Bornova district of Izmir. The architectural competition was held in 2010. The partnership of Studio Evren Başbuğ Architects and SCRA Architects won the first prize in the competition. The visitor center was opened in 2014.

The visitor center is built on the 3rd degree archaeological site, which is next to the 1st degree archaeological site where the archaeological excavations are still carried on.

Yeşilova Mound Visitor Center is an example of archaeological site outside the urban fabric. It is located in an area where the residential texture is not dense. The parcels adjacent to the 1st-degree archaeological site were expropriated by the relevant municipality and declared as a 3rd degree archaeological site.

As a result of the excavations carried out since 2005 in the Bornova district of İzmir province, it has been revealed that Yeşilova Mound is one of the oldest known settlements in the Aegean Region. The said area, together with Yassıtepe Mound and İpeklikuyu Mound, constitutes the prehistoric settlement area of İzmir (Derin, 2010).

The Visitor Center is a steel structure made of H-frames resting on a concrete basement. Steel frames are sheathed externally with modern materials (glass fiber reinforced concrete panels and multilayer polycarbonate sheets). The building has two floors. Activity and meeting rooms are located on the ground floor, while exhibition spaces are located on the upper floor. The excavation house is located inside the Visitor Center. It is the area where the delegation of the excavation team carries out the recording, restoration, photography, and publication works related to the excavation. Special study rooms for the technical team are located on the mezzanine floor of the building. The works of the excavation team can be watched by the visitors, and the workshop and exhibition areas can be visited. The building has three different functions. These are divided into museum, archaeological lalboratories and general services. When the interior architectural setup of the building is examined, a ramp consisting of keywords is used to reach the upper level, information about the archaeological heritage area is obtained in different exhibition areas, and then the building takes the visitors into the open air. The works carried out in the archaeological site can be observed from this open area. The works carried out in the archaeological site can be observed from the large exhibition space on the upper level. A fire tower/torch was designed to refer to the image of fire, which is important for life in İzmir. In addition, the excavation house located on the ground floor of the building opens to the courtyard at the back, and the works carried out in the excavation house can be observed by the visitors.

Yeşilova Visitor Center hosts experimental archeology applications that have been frequently encountered in recent years. Within the framework of a program called "Time Travel", students from different age groups visit the archaeological heritage site. In the "Time Travel" program, which was initiated as an international project, a Neolithic village integrated with the archaeological site was created. It is an important program that strengthens cultural identity (Derin, 2010).

Considering the criteria for designing new structures in archaeological sites, it can be said that Yeşilova Visitor Center is quite different from the Neolithic Period archaeological heritage area in terms of texture, color, and material, and even dominates the archaeological heritage site. On the other hand, the visitor center has been deemed worthy of many awards.

When the competition specifications are examined, the national and international policy decisions such as the Law on the Protection of Cultural and Natural Assets, Venice Charter or Charter for the Protection and Management of the Archaeological Heritage regulations and laws on the archaeological site are not included in the specification of the competition. Information on the history and characteristics of the archaeological site is given in the specification. Detailed drawings are also included in the specification.

As the surrounding of the archaeological site does not have a dense urban texture and the excavations are continuing, the visitor center was built on a separate parcel on the border of the 1st-degree archaeological site. As a result of the visitor center being built next to the archaeological finds rather than on top of it, the archeological relics were not damaged within the scope of the project, which provided visual communication between the visitors and the archaeological site.

Although it did not damage the archaeological relics, when the scale and material of the building are evaluated, it can be said that it far surpasses the archaeological finds and has become a symbol in the area. It has been observed that visitors come to the site even just to visit the building.

The archaeological site is a major reference for both the architectural organization and the design of indoor and outdoor spaces. This strengthens the bond that the building has established with the archaeological site and ensures that it continues to exist in a qualified and appropriate way.

**5.1.2 Troy Museum**



**Figure 2.** Troy Museum, Çanakkale/Turkey (Emre Dörter)

**Table 4.** Imprint Information

| **Troy Museum** | |
|---|---|
| Location | Tevfikiye, Çanakkale, Turkey |
| Type Of Competition | Free-Participation, One-Stage, National Architectural Project Competition |
| Year Of Competition | 2011 |
| İnstitution That Opened the Competition | Ministry of Culture and Tourism |
| Winners | Yalın Architecture |
| Commissioning Date | 2018 |

A free-participation, one-stage, national architectural project competition was announced in 2011 by the Ministry of Culture and Tourism to preserve and exhibit the archaeological artifacts excavated from the Troy Archaeological Site. Another purpose of the museum is to make the region and Çanakkale a center of attraction and to develop the area socially and economically. 132 projects were submitted to the competition. The results of the competition were announced in the same year. Yalın Architecture won the competition. The Troy Museum was opened in 2018.

Troy Ancient City is known as an important trade settlement. It has a deep-rooted history with Homer's Iliad and Trojan legends (Büyük, Can, 2021). The Ancient City of Troy was included in the UNESCO World Heritage List in 1998. An area of 13350 hectares, including the borders of the ancient city, before being included in the UNESCO World Heritage List, has been declared as a Historical National Park. Tevfikiye village, where the Troy Museum is located, is located within the boundaries of the Historical National Park. (World Heritage Sites of Turkey, 2009). The project area is located on the periphery of the 1st-degree archaeological site boundary, within the 3rd-degree archaeological site. National Park refers to natural parts with national and international rare natural and cultural resource values (National Parks Law, 1983). The fact that the ancient city of Troy is a world heritage has enabled the conservation and planning processes to be carried out in and around the archaeological site to be evaluated in an international framework. The fact that it hosted the Trojan War, and many civilizations is an element that makes the area a historical national park (Salcan, Tokay, 2017).

The construction area of the museum is 11.000 m². The museum structure includes exhibition areas, storage units, administrative units, and social areas. Landscape work was carried out around the museum, which consists of 4 floors, with a texture like the fields around it (Yıldız Kuyrukçu, 2021). The ground floor of the museum is reached by descending the ramp. The ground floor is completely underground but can receive natural light through ceiling openings. In the exhibition located on the ground floor, the layers of the Ancient City of Troy are explained, and brief information about the excavations is conveyed with the small artifacts unearthed during the excavation. On the first floor, a chronological description of the Troy region belonging to the Bronze Age is carried out. On the second floor, there are narratives about the Archaic Period and the Trojan War epic. Various statues, sarcophagi and marble works are on display. On the third floor, information about the Ottoman period is explained through pottery, stone, and coins. Since the 19th century, information on the history of excavations is conveyed. A separate exhibition area is also included for lost heritage (Yıldız Kuyrukçu, 2021).

When the architectural features of the museum are examined, it is observed that the building has a very plain language. Keeping the ground floor under the ground and covering it with landscaping reduced the apparent height of the museum and enabled it to have a scale closer to the human scale. When the location of the museum is examined, it is seen that the surrounding area is quite open, there is no dense construction around it, and there are usually fields around it. It is stated that the fields usually form a regular grid system in the form of a square, this arrangement is an example of the landscaping around the museum, and thus the museum establishes a strong bond with its context. For the façade, a color tone was chosen inspired by the color of the terracotta products obtained during the excavations, and rusted metal material was used to strengthen the connection between the past and the future. All materials were chosen naturally in the museum, and no covering material was used on the structure. In terms of lighting, natural light was used, and studies were carried out to prevent deterioration of works from lighting (Yıldız Kuyrukçu, 2021). It can be said that the building is compatible with the region as the museum is compatible with the topography, use of natural lighting, compatible with the surrounding texture, a simple form language, the material is tactile and its scale is compatible with the environment and human scale (Yıldız Kuyrukçu, Alkan, 2019).

The construction of the museum building on the third-degree archaeological site, outside of the first-degree archaeological site where there are no archaeological relics, prevented the destruction of the archaeological area, which shows the value of universal cultural heritage. In addition, the visit of the visitors to the area after getting information from the museum structure will help strengthen the awareness of conservation and their knowledge of the area.

Within the project specifications, the map of the excavation area, the conservation plan and the explanation report, the decisions of the Conservation Board and the Principal Decision on the Protection and Use Conditions of Archaeological Sites No. 658 were given. However, within the specification, there is no clear and explanatory text regarding which national or international conservation laws/regulations the competitors should submit projects (Troy Museum Architectural Project Competition Specification, 2011). Although the museum structure is related to an area on the UNESCO World Heritage list, ICOMOS regulations are not included in the competition specifications. In addition, UNESCO or related institutions did not become any stakeholders during the project process.

### 5.2 Structures Built in Archaeological Areas Within the Urban Fabric

#### 5.2.1 The New Acropolis Museum



**Figure 3.** Acropolis Museum, Athens/Greece (Nikos Daniilidis)

**Table 5.** Imprint Information

| **The New Acropolis Museum** | |
|---|---|
| Location | Athens, Greece |
| Type Of Competition | International / By invitation (4th one) |
| Year Of Competition | 2000 (before that in 1976,1979,1989) |
| İnstitution That Opened the Competition | OANMA (Organisation for the construction of the New Acropolis Museum) |
| Winners | Bernard Tschumi and Michael Photiadis |
| Commissioning Date | 2009 |

The New Acropolis Museum is an archaeological museum in Athens, Greece. Acropolis was included in the UNESCO World Heritage List in 1987 (Report of The World Heritage Committee,1987). The museum is within the buffer zone area approved by UNESCO, which also specifies the boundaries of protection (2009).

The Project by Bernard Tschumi was selected as the winning project in the fourth competition. Until the architectural projects of the building were finalized, 3 competitions were held (Paisiou, 2012).

The first architectural competition to design a new museum was held in 1976 and was limited to participants from Greece. The Ministry of Culture was the initiator of the first competition. The 1976 competition and the one in 1979 failed to produce any results because the plots of land selected for the proposed constructions were deemed unsuitable. The third competition was held in 1989, which was an international competition, a two stage ideas competition. The third competition was implemented according to International Union of Architects UIA- UNESCO) regulations (Paisiou, 2012).

3 projects were in the final, as a result, the competition was won by the Italian architects, Manfredi Nicoletti and Lucio Passarelli. Because of the archaeological relics on the site, which were discovered during foundation excavation, the work has stopped, and it was decided to cancel the competition (Paisiou, 2012).

The fourth competition was held in 2000 and it was open only to architectural practices by invitation. The competition was implemented according to national and international laws. Tschumi, in collaboration with the Greek architect Michael Photiadis won the competition (Paisiou, 2012).

During the Project, suitable locations for the foundation pillars were identified and the new plans set the building high above the ground on pillars. As the museum is built over an archaeological site, some parts of the floor use glass to let the visitors see the excavations below (Han,2021). Natural light plays a major role in the museum (Beresford, 2015). Another important feature of the museum building is the relationship with the Parthenon. The Parthenon is an important reference for the museum (Han, 2021). Acropolis Hill is a major inspiration for the interior design. visual communication has been tried to be provided throughout the building (Jakobsen, 2012).
It can be said that the Acropolis played a major role in the design of the building, and that there are traces of the heritage site from the structural system of the building to the interior design.
The building has been the target of criticism and comments from the moment it was built. Interpretations reflecting very different perspectives on the building were made. Professional critics were divided into three. For some critics the building was good inside but disappointing outside, for some critics it was an admirable building and for some critics the building was a fiasco, because of the solution to the problem of building on the archaeological site (Horáček, 2014). Also, in 2007, another controversy erupted in the site, which was about the demolition of two historic buildings in front of the museum. The two buildings had to be de-listed from the Greek Government, according to Bernard Tschumi's suggestion. One of the buildings was architecturally a Neo-Classical, the other was an Art Deco example. Protest came from INTBAU and ICOMOS against the demolition (Horáček, 2014).
The museum structure is in the center of Athens, in a location where the urban fabric is very dense. It is a universal task to transfer the archaeological relics and knowledge that have emerged in the city center and have survived to the present day. There is no possibility of the relocation of the said finds. The ruins must be preserved in situ, but in an environment where there is a dense urban texture, it was inevitable to solve the conservation action together with the archaeological relics. The museum structure can also be evaluated as a protective shelter. The museum structure, which is tried to be solved together with the archaeological relics, has brought along many discussions about the conservation process, which also has various difficulties for the designer.
Considering the location and surroundings of the museum, every point around it can be considered as potential archaeological sites. This situation, which can be described as a great value and potential, can sometimes appear as a threat in the design and construction processes. It is highly unlikely that no archaeological finds will be found in the planned location during the archaeological sounding works to be carried out to build the museum building on an area other than the archaeological finds. In addition, the 3rd project competition for the museum structure was canceled as new archaeological finds were found during the foundation excavations.
The museum is built on a parcel where the former military hospital, a small church and some apartment houses were on. Another 25 buildings were demolished to open place to the museum (Horáček, 2014).
Although the archaeological relics were affected by the construction activities during the construction of the museum structure when the resultant structure is observed, the visit of the visitors to the building together with the archaeological relics can be effective in increasing the value and awareness of the archaeological site, and in raising the awareness of conservation in the visitors.

**5.2.2 Narona Archaeological Museum**



**Figure 4.** Narona Archaeological Museum, Vid/Croatia (Boris Cvjetanovic)

**Table 6.** Imprint Information

| **Narona Archaeological Museum** | |
|---|---|
| Location | Vid, Republic of Croatia |
| Type Of Competition | Architectural and Urban Competition |
| Year Of Competition | 2001 |
| İnstitution That Opened the Competition | Ministry of Culture |
| Winners | Radionica Arhitekture / Goran Rako |
| Commissioning Date | 2007 |

The museum is in a village of Vid, in the Republic of Croatia. Narona was an ancient settlement on the eastern Adriatic coast which was also an important center during the late Roman period. The museum was built on the archaeological relics of a Roman temple from the late first century B.C. Many archaeological excavations and rescue excavations were carried out since 1877. In 2001, an architectural and urban competition was held for the Narona Museum. Radionica Arhitekture/Goran Rako won the competition. The construction of the building was financed by the Ministry of Culture of the Republic of Croatia (Glučina, 2015).

The Narona Archaeological Museum is referred to as the first museum building in the Republic of Croatia which is an On-Site Museum. The museum opened its doors in 2007. During the time, new archaeological investigations in Narona were held and a great number of relics were found. In 2014, a legalization work was done about establishing the cultural in endangered areas. The museum is in the center of the village, under the hill. The building was built on the ruins of ancient buildings, considering the slope of the hill behind it. The ancient architectural relics are presented in situ. Also, an ancient mosaic floor is presented in situ in a room. The indoor permanent exhibition is organized on three levels. The reception and souvenir shop are located on the first level. On the second level, statues of Roman emperors are exhibited. On the third which is the last level in the museum, archaeological findings are located which were discovered during the archaeological investigations. There are also terraces which give panoramic views of Vid (Glučina, 2015). International Council of Museums made a recommendation to The Ministry of Culture, to associate the central advisory museum with its tasks (Lukic, 2011).

When the architectural design of the building is examined, it can be said that it is compatible with its surroundings in terms of building scale, and the facade material and color are chosen in harmony with the square and street where it is located. It is observed that the mound behind the architectural design was formed by foreseeing, thus stratification occurred in the building.

Reinforced concrete and exposed steel were used in the construction. Narrow plastic panels were positioned to let a diffused light in (Halaç, Abacı, Dağlı, 2021).

The museum structure was built on the finds to be preserved in situ since the archaeological relics are in the residential fabric. Topographic conditions were also considered during the design of the museum structure.

No information or document could be found that the international regulations were guiding during the design of the building.

**6. Conclusions**

During the formation of urban identities, cultural heritage is the most important factor. It is a universal duty to transfer the archaeological heritage values that have survived to the present day to the future and to increase the awareness of conservation.

The more information visitors can learn about archaeological heritage sites, the higher the conservation awareness and conservation value will be. Thus, there is a need for contemporary structures such as museums, visitor centers, or experimental archaeological sites.

When the structures built by the competition method are examined, it can be said that the reflections of the ideas from the archaeological remains are strong, and thus very valuable architectural structures are produced. The structures that emerged with a strong design idea by being designed together with the archaeological remains can later become important architectural works. It can be said that the buildings designed with a strong idea attract more visitors, so that visitors are more willing to access information about both the heritage site and its surroundings. Such examples are very important as they are structures that convey historical texture and conservation awareness to people. The strong architectural aspects of the buildings examined within the scope of the study can be considered as a factor that also ensures that the archaeological heritage site attracts visitors. While visiting the architecturally contemporary building, information about the archaeological heritage site is obtained through modern exhibition methods, thus strengthening the bond that visitors establish with past civilizations. Such structures must be integrated with the area to increase the value and conservation awareness of the archaeological heritage site.

The competition projects for the protection of archaeological sites, which are universal heritages, and their transfer to the future, is of great importance in the creation of original and high-value-added designs.

One of the most important steps in this process is to comply with the international regulations on protection. In some conservation processes, it is possible to carry out studies by following per under international regulations, while in some cases it cannot.

In Troy, settlement took place in a certain and limited area in the form of layers. Since the archaeological area is located outside the urban fabric and there are parcels around it that can be expropriated, the museum structure was built outside the archaeological area. This situation created an opportunity to preserve the relics in situ and to convey information about the site to the visitors before visiting the archaeological site. The fact that the layered settlement of the Ancient City of Troy was also layered within the museum structure, ensured that the museum structure formed a strong bond with its surroundings and that the building had an architectural language suitable for its context. When the materials used in the building are also examined, the bond that the building establishes between the past and the future is quite strong.

On the other hand, it has emerged that the structures such as museums and visitor centers, which are needed for the preservation and transfer to the future of archaeological sites located in a complex area and within the urban fabric, such as the Acropolis, must be solved together with the archaeological relics. This situation has brought different protection problems as well as challenging the designer. When the layout of the Acropolis Museum in the exhibition areas, the gridal system and the aspects of the building's facade are examined, it can be said that the Acropolis played a major role in the design of the building and that there are traces of the heritage area from the structural system of the building to the interior design. It can be said that this situation strengthens the bond that the visitor establishes between the museum structure and the surrounding heritage site.

The presence of the archaeological site within or outside the urban fabric brings along different potentials and threats as a conservation problem. The studies carried out in the preservation and transfer of archaeological relics to the future may therefore differ accordingly.

Considering that archaeological sites are universal cultural heritages, all kinds of conservation activities planned for these heritage sites should be carried out by authorized conservation bodies within the framework of national or international conservation laws, and interventions to the area should be carried out openly to the public, and their suggestions and opinions should be sought. In this direction, national or international architectural project competitions should be considered as very important processes that serve this purpose. Thus, all kinds of positive interventions set an example for other archaeological sites, and all kinds of negative interventions are provided with the opportunity to be overtaken promptly on time.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Theories of Conservation and Scientific Restoration from Gustavo Giovannoni's Point of View

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**Abstract**
"Gustavo Giovannoni" (1873–1947), the Italian architect, urban designer, and restorer who was born in Rome and studied Civil Engineering at the University of Rome, became the Professor of Architecture Department in 1905 and latterly the dean of the same university (1913–1935). He edited a set of regulations that were adopted in the "Athens Charter" later in 1913. His four main principles are restoration by consolidation, installation, liberation, completion, or renovation. Although he established a scientific centre for studying history of architecture and published several articles in various architectural journals, there is little literature about his biography and theories of conservation and scientific restoration. This article tries to enlighten how his theories affected the history of conservation. For this aim, his biography and theories are mentioned in detail. The methodology of this article is a qualitative survey using the reliable books of libraries and first-hand resources and references.
**Keywords:** Gustavo Giovannoni; Conservation; Scientific Restoration; The Athens Charter; International Charters; Camillo Boito.

## 1. Introduction

"Gustavo Giovannoni" established scientific restoration after correcting and completing the principles of "Camillo Boito". He saw a conflict between the two concepts of life and history. The first meant meeting the requirements of modern life and development, and the second meant respecting the historic and artistic values as well as the environment of the historic cities. He proposed the theory of pruning the urban fabric to modernize the historic sites, which included keeping traffic away from the historic sites, preventing them from being cut off by the streets, improving the social and health conditions, and protecting the historic buildings. The present article is the result of research on the theories of Gustavo Giovanni and their effect on the theoretical foundations of restoration. This article tries to answer the question of what effect the theories of "Gustavo Giovannoni" had on the "Athens Charter" and followingly on the theories of conservation and restoration. To find out the answer to this question, at first the biography of "Gustavo Giovannoni" and his thoughts and ideas, and then the thoughts of "Camillo Boito", which have had a great impact on Giovannoni's ideas are studied. Afterwards, the scientific restoration was explained that "Gustavo Giovannoni" found for the first time in refining and completing the theories of "Camillo Boito". Then, the "Athens Charter" and its resolutions were stated and an attempt was made to examine the impact of the theories of "Gustavo Giovannoni" on that resolution. The research method was completely analytical using the library and first-hand reliable resources and references.



**Figure 1.** "Gustavo Giovannoni" (Left:URL1, right: URL2).

## 2. Biography and Theories of "Gustavo Giovannoni" and "Camillo Boito"

### 2. 1 Biography of "Gustavo Giovannoni"

"Gustavo Giovannoni" was an Italian architect, urban designer, author, and architectural historian who was born in Rome in January 1873 and died in Rome in July 1947 at the age of 74. He graduated from the University of Rome in 1895 with a degree in civil engineering and received a degree in public health before studying traditional art and architecture under the supervision of "Adolfo Venturi" (1856–1941), the Italian art historian. In 1899, he was a pupil and assistant of "Guglielmo Calderini" (1837–1916), the Italian architect, in the School of Engineering, and in 1905, he became a professor of architecture. Strong technique along with traditional art led him to major in restoration and major urban redevelopment projects. In 1910, he became a representative of "AACA" ("Associazione Artistica Fra i Cultori di Architettura"), which was founded in 1890 to spread awareness of cultural and historical heritage and promote the theoretical foundations of restoration in Rome. His theories, which originate from his artistic and technical experience, can be seen in his work when he was working simultaneously in part of "Caprera" in Rome (1907–1911) and in "Peroni's House" in 1909, while he was the head of a company, he also obtained the chair of General Architecture at the Faculty of Engineering of Rome in 1913. The research done by "Antonio Da Sangallo ii Giovane" (1484–1546), an Italian architect who combined archaeology with the scientific arts, sparked interest in "Gustavo Giovannoni". The idea of Renaissance architecture inspired "Gustavo Giovannoni" to pursue architectural education. In 1918, he founded "SSA" through the "AACA" and then gave a conference on the restoration of historic buildings at the "Instituto University", and he became the dean of the faculty from 1931 to 1935 (URL1).

"Gustavo Giovannoni" was an architect and a member of the Academy and special member of "LAZIO" ("Società Sportiva Lazio" or "Lazio Sport Club"). He was one of the leaders of the association in the main branch of the "Vittorio Veneto" headquarters at the age of 20. In 1913, he became a professor of architecture at the University of Rome, and together with "Marcello Piacentini" (1881–1960), an Italian urban theorist, he published the journal "Architecture and Decorative Arts" ("Architettura e Arti Decorative") in 1921. He was one of the most passionate preachers of the Faculty of Architecture in Rome, where he taught courses about the restoration of historic monuments. From 1921 to 1926 he was in charge of the Roman section of the "CAI" (Italian Alpine Club). From 1927 to 1935 he was the director of the School of Architecture in Rome and founded the Centre for the Studies of the History of Architecture. He published the journal "Palladio" in 1937. He is the author of many articles such as "Through the History of Architecture" in 1913, "Deep Understanding of the History of Architecture", "Articles on Renaissance Architecture" in 1931, and "The Restoration of Historic monuments" in 1945. His architectural achievements include the "Torlonia Building", the establishment of "Birra Peroni", the "The Church of the Guardian Angels in Rome", and the "Torlonia Villa" in "Formia". Recognizing the history of architecture in combination with a treasure trove of technical information, "Gustavo Giovannoni" linked the fields of restoration of cultural heritage, urban planning, and architecture. As a scholar, researcher, and urban designer, he paid attention to the relationship between new and old contexts in the urban fabric of large cities. The two of his fundamental interventions are entitled "old city and new construction" and "dilution of old buildings". He was also one of the first conservationists with the message of protecting the natural landscape in 1939 (URL2).

### 2.2 Theories of "Gustavo Giovannoni"

"Gustavo Giovannoni" proposed principles in the field of urban restoration as follows: first: urban separation which is the separation between old and new cities; second: spatial separation which is the separation between living and active urban context with dead and inactive parts. The goal of his intervention in the ancient context is to improve the performance and function of the city concerning living and dynamic parts. His proposed use of historic buildings and sites is based on the division of the buildings into two categories: dead and living. The function of the museum was suggested for the dead parts and the revival and restoration of the urban texture for the living parts were considered. His method of action was an improvement and modernization, and his intervention method was the method of urban reconstruction and the comprehensive method of urban restoration (Habibi, 2002, p. 42).

In 1920, "Gustavo Giovannoni" chaired the "Committee for the Preservation of Italian Art and Antiquities". His collection of instructions on the urban fabric adjacent to the historic monuments was later illustrated and published in the "Athens Charter" in 1931. He did not believe in modern architecture and considered it without style and believed that we should not build a modern building next to a historic and ancient building because he considered it a betrayal of the ancient style. He believed that we could build a building next to the ancient architecture or complete a part of a building that has been destroyed, but we should take the style of that historic building and then make it as simple as possible. In short. The building should be free of decorations and all its components should be schematic and simple. We have to construct a "NEUTRE" building, that is, neutral and indifferent (Khatouni, 2006).

In the twentieth century, the development and potential application of modern scientific methods and techniques in the field of conservation were accepted by the official world conservation circles. At the end of the "Athens Charter" in 1931, for example, they advised "the rational use of all resources for the use of modern technology,

especially reinforced concrete." The Italian Declaration in 1932, presented by “Gustavo Giovannoni”, also suggests: that “research results should be used in complex and detailed activities related to the protection of dilapidated structures, and experimental and self-extracting solutions should be discarded in favour of scientific solutions." According to the “Venice Charter”, "in the protection and restoration of monuments, all the sciences and technologies that can help to study and preserve the architectural heritage should be used." It is interesting to note that the Italian classification proposed by “Gustavo Giovannoni” was called "scientific restoration", which many conservatives later used to describe their work (Jokilehto, 2008, p. 325).

**2.3 Theories of “Camillo Boito”**

“Camillo Boito” (1836–1914), was an Italian architect and writer born in Rome and died in Milan. He was the first person who replaced the adherence to the formal-stylistic features of the buildings under construction by paying attention to the architectural concepts in revitalization. “Camillo Boito” is best known as a cultural and social figure as an architect and restorer of historic buildings. Perhaps his mastery of various aspects of the restoration of historic buildings and the development of a relatively broad framework for them can also be attributed to this issue.

Similarly, greater interest in ancient buildings is seen as a historic document in the writings of “Camillo Boito”. Nevertheless, contrary to more popular theories and those who have worked more on architectural restoration, revitalizing, reconstruction, and adaptive reuse of the historic monument, whether it is an abandoned and half-ruined building or it hardly survives in the urban context and it has lost its original function, is the core of his speech; the historic monument must cross the boundaries of time and always play an active role in the lives of people. It does not mean paying attention to anything but the renewal and survival of the building, but to immerse oneself in the elegance and cultural content of architectural restoration works to the extent that the culture of the last century was able to recognize it, which is a complementary and inseparable recipe. If we want to introduce the main purpose of “Camillo Boito” concerning what has emerged as the most prominent points of the ideas of architectural restoration theorists, it will be briefly as follows:

- preserving and maintaining the original condition of the building at the time of any additional construction interventions, reconstruction, or local structural changes;
- deciding and accepting responsibility through study, science, and documentary studies, and responding to living needs instead of previous interventions and mental excavations and free conclusions and arbitrary designs have been done.

“Camillo Boito” took his ideas about architectural restoration to the last level and by publishing and discussing them, provided the best basis for establishing valuable theories that are the basis of architectural restoration today. In 1913, the “Athens Charter” on restoration, which led to the first charter of architectural restoration, reflected many thoughts of “Camillo Boito”. In terms of the importance of the proposed set of eight points of view of “Camillo Boito”, and also because it can introduce the first codified and systematic theory of architectural restoration, they are narrated as follows:

- distinguishing between the old style (existing and used in the building) and the new style that is used in the reconstruction of a building;
- distinguishing between new building materials and building materials that have been used in the past;
- do not use corners, angles, and decorative surfaces - in new sections of the - buildings subject to restoration;
- creating an exhibition or museum of elements, sections, or pieces of the historic building that were not reused during the reconstruction of a section, inside or near the restored building;
- engraving the date of restoration work at a point of the building or using a contract mark on the reconstructed parts and elements;
- installing the inscription on the restored building;
- describing and justifying the different stages of the restoration work along with the photo and plan and placing it in the building or near it, and attempting to identify the monuments by the social media;
- trying to identify and introduce the restored building on a great scale (Falamaki, 2008, pp. 23-25).

“Camillo Boito” was important in the formulation of modern Italian politics in two ways: first, through his profession within the framework of Italian administrative institutions, his main interest was the modernization and the establishment of an efficient administrative and a formal system in the Italian government and he was considered responsible for historic buildings. Second, he helped popularize the adoption of an effective and informed policy for the protection and restoration of historic buildings in the form of a charter, which itself became a standard reference (Jokilehto, 2008, p. 222).

**3. “Scientific Restoration” and Explanation of Specialized Words**

In 1910, on the occasion of the exhibition of measured drawings organized by the members of the “Italian Association of Art, Culture and Architecture”, the newly appointed director of the association, “Gustavo Giovannoni”, drew the attention of the audience to the importance of “minor architecture” to the realization of the continuity of the urban fabric of a historic city, and he became an urban planning expert in Rome. From 1927 to 1935, he was the director of the “School of Architecture” in Rome and played a key role in the establishment of an independent faculty of architecture, where he taught the restoration of historic monuments from 1935 to 1947. In his teachings and writings, “Gustavo Giovannoni” reinforced the principles of modern Italian conservation and, while emphasizing a critical scientific point of view, laid the foundation for "Scientific Restoration" (“Restauro Scientifico”). This policy was applied not only to the historic monuments, but to all historic buildings in general, and even became the basis for a new approach to the historic sites and the historic neighbourhoods of the ancient cities.

The principles proposed by “Joseph Hermann Stübben” (1845–1936) in his work entitled “Der Stadtebau” (1890), according to which the modern city should be expanded over the existing historic city by using the existing conditions, led to, the 1908 master plan, which caused new streets and roads appear or built in Rome. “Gustavo Giovannoni” has been critical of these proposals since 1913. He saw a conflict between the two concepts of life and history, each of which required a different approach. One meant meeting the requirements of development and modern life, and the second meant respecting the historic and artistic values as well as the environment of the ancient cities. He believed that "minor architecture" represented the mentality of the ordinary people and their ambitions more than the luxurious and majestic palaces. In Rome, a lot of research was done on the history and typology of the texture of the “Renaissance neighbourhood” (Quartiere del Rinascimento). He emphasized the fact that the city has developed over time and different styles have been represented in different eras. “Gustavo Giovannoni” like “Camillo Sitte” (1843–1903), (Falamaki, 2008, pp. 21-23) the Austrian architect, painter, and urban theorist, emphasized visual values, aesthetics, and sudden surprises due to the contrast between the magnificent palaces and the "minor architecture" and "architectural order" that should be studied obsessively.

During this period of the prevalence of futuristic and pragmatic designs, “Gustavo Giovannoni” was often alone in defending historic cities. Following a compromise, he formulated a theory for the modernization of historic sites, respecting their ancient identities, under the title of "pruning" the urban fabric, which kept the area of historic sites away from circulation, preventing them from being cut off by the streets, including improving social and health conditions and protecting historic buildings. To achieve this, he proposed the demolition of less important structures to create more space for essential services.

It is interesting to compare the approach of “Gustavo Giovannoni” with the final decisions of the “CIAM” (Congrès Internationaux d'Architecture Moderne) or “International Congresses of Modern Architecture” in Athens in 1933. These decisions were later gathered and edited by “Le Corbusier” (1887–1965), the Swiss-French architect, designer, painter, urban planner, and writer. They accept and recommend the protection of past architectural values if they are in accordance with the public interest and do not cause unhealthy conditions for the inhabitants living in historic sites. To avoid destruction, it was proposed to limit the main load of circulation outside of the important historic zones, and if the demolition of old buildings is justified for health and hygiene reasons, should allow the building of green spaces and individual architectural values should also be emphasized.

“Gustavo Giovannoni” was consulted in the revision of the 1908 master plan of Rome, as well as the master plans of other cities, such as Venice, Bari, and Bergamo, in which the concept of "pruning" was implemented. Although this idea seemed like a reasonable compromise on all sides, it was not always easy to implement, and even in the best of cases, the newly opened areas lacked architectural identity.

During Fascism, “Mussolini” considered himself the same as the ancient Roman emperors, and despite the destruction of the "Medieval slums", displayed classical Roman monuments, such as “Emperor Trajan's Square”, “Royal Palace” (Via dei Fori Imperiali) (1924), the “Arch of Janus”, the “Temples of Fortuna Virilis”, “Vesta”, and the “Marcellus Theatre” which formed “Via del Mare”, and the “Church of Santa Rita” was relocated (1932). The excavation and restoration work was carried out under the supervision of “Antonio Munoz” (1884–1960), who was responsible for most of the work done on the historic monuments following the established principles of the Mussolini period. The “Largo Argentina” site with four temples from the Roman Republic era was excavated in 1928, and the area around “Agusteum”, where the new “Ara Pacis” exploration work was specially covered during 1931–1932. They built new streets in the city; Like the “Via Della Conciliazione” in front of the “San Pietro” façade, which destroyed the ancient “Borgo” (1936–1950). Although Rome took on a civic appearance as a result of such operations, it still retained its historical perspective and showed no trace of modern high-rise buildings.

In addition to researching urban planning, “Gustavo Giovannoni” has been a member of the “High Council of Fine Arts” (“Consiglio Superiore Delle Belle Arti”) for more than 25 years and also had other commissions on his résumé. He also worked with government and city officials to restore historic buildings. His view of restoration differed from that of earlier Italian theorists, who saw it as a cultural category related to the evaluation, and rehabilitation of

historic buildings, taking into account the context of all important periods, rather than restoring them to their ideal form. He considered the theory of “Eugène Viollet-le-Duc” (1814–1879), (Falamaki, 2008, pp. 15-18) "unscientific" which was the cause of distortions and arbitrary interventions, according to which every building was built by an architect at a certain point in time, and its premise is that the architect who repairs and builds the building, can understand the ups and downs of the historic monument and also its style in the past, which of course they no longer have a sense of. Given the use of modern architectural forms in historic buildings that were prevalent until the neoclassical period (Amen, 2017), “Gustavo Giovannoni” believed that this work was not successful in the modern era due to the lack of a modern and appropriate style and the lack of sensitivity to their use. The concepts of his theory were consolidated in line with the criteria of “Camillo Boito” and their final form was presented in his work entitled “Questioni di Architettura Nella Storia e Nella Vita” (“Questions of Architecture in History and Life”). He emphasized preservation, conservation, and consolidation, and considered the use of modern technology when consolidating (if necessary) as permissible. The main goal should be to preserve the originality of the structure and to observe the whole "artistic life" of the monument, and not just its identity in the early stages of construction. Any subsequent additions must be dated and viewed more as an integral part of the whole mass than as a decoration part. In addition, these attachments must be documented based on fully reliable data. He introduced these principles at the Athens International Congress in 1931 and thus played an important role in drafting the final conclusion, the so-called "Athens Charter". Upon his return to Rome, he drafted an Italian charter entitled “Norme per il Restauro dei Monumenti” (“Rules for the Restoration of Monuments”), which was approved by the “Office of Antiquities and Fine Arts” in December of that year and then officially published in January 1932. In comparing the spirit of these principles with the ideas of “Camillo Boito”, which considered the monument primarily a historic document, he offered a much more comprehensive view that included architectural, historical, environmental, and structural aspects of the building. He later revisited his Italian charter, interpreting it for historic monuments. “Gustavo Giovannoni” considered restoration in four ways: a) restoration by consolidation; b) restoration by reconstitution of components (recomposition or anastylosis); c) restoration by liberation; d) restoration by completion or renovation. He agreed with “Camillo Boito” that the restorations should not be visible, and he considered it possible by resorting to using modern methods and technology; such as cement grout or the use of invisibly reinforced concrete or metal structures as earthquake protection. Nevertheless, at the same time, he emphasized that modernization should not go to extremes that would damage the structure. He did not refuse the demolition of the “bell towers of Pantheon”, the destruction of newer structures of “Parthenon”, the restoration of the “Masion Carree” in “Nimes”, and the restoration of the “Curia” in Rome, because he believed that what was discovered was much more important than what was lost. Despite agreeing with the content of the book of “John Ruskin” (1819–1900) (Falamaki, 2001, pp. 18-20), “The Seven Lamps of Architecture” (May 1849), and considering it impossible to recreate ancient architectural monuments, he, like “Camillo Boito”, believed that after the sixteenth century, modern buildings were built with such perfect technology that it was easy to recreate them. In 1938, another set of guidelines was published to complete the criteria and standards developed in 1932. The new text was compiled by a panel of experts, including “Gustavo Giovannoni” and “Guglielmo De Angelis d’ Ossat” (1907–1992), who was later appointed general director of the “Office of Antiquities and Fine Arts”, and the founder of the “Faculty for the Study and Restoration of Historic Monuments at the University of Rome”. He was also one of the main contributors to the creation of international courses at “ICCROM” (The “International Centre for the Study of the Preservation and Restoration of Cultural Property“). In the above-mentioned series of guidelines, special emphasis on administrative aspects, regular preservation, and timely repairs, immediate and methodical protection of the site and archaeological findings, the need for on-site protection, and protection of the authenticity of urban context with historic and artistic values have been done. In addition, it was proposed to strictly ban construction in accordance with "historical styles" even in the areas without special monuments or historic landscapes. In the following year, 1939, a new law was passed in Italy to protect the objects of artistic and historical significance, as well as another law to legally protect sites of natural beauty (Jokilehto, 2008, pp. 242-245; Jokilehto, 1986, pp. 351-356).

**3.1 Anastylosis**

(Oxford Dictionary: Greek word for restoration) refers to a type of restoration in which the current blocks of historic material are restored or rebuilt in their original location. This is usually the case with "dry masonry", where the building material is mortar-free and with a minimum amount of fresh material (usually not more than 10%) distinguishable from the original (by close inspection), but should not distort the overall appearance (Jokilehto, 2008, p. 348). (Merriam-Webster Dictionary) Definition of anastylosis: the reconstruction of a monument from falling parts (URL3).

**3.2 Restoration**

(Oxford Dictionary) the work of repairing and cleaning an old building, a painting, etc. so that its condition is as good as it originally was (URL4). Restore means making up for anything that has already been taken away or lost. Restoration is one of the key concepts in connection with the conservation and protection of cultural heritage and has found special meanings in various fields (Jokilehto, 2008, p. 348). Restoration generally means intervention that makes it possible to recycle the performance of human activity products. The purpose of restoration in practice will be to recycle product performance. Therefore, the nature of restoration work will focus only on achieving this goal. But in the case of works of art, even in cases where they are functional (such as architecture and objects of so-called applied arts in general), restoring the functional nature is a secondary part of the restoration and never a primary or fundamental aspect of respect. Restoration is a methodical moment in which a work of art is recognized at that moment in its physical existence and its aesthetic and historical nature in terms of its transfer to the future. The goal of restoration should be to re-establish the potential unity of the work of art as long as this is possible without resorting to artistic or historical exchange and without removing all traces of the passage of time on the work of art (Hanachi, 2008, pp. 37-41).

**3.3 Consolidation**

Consolidation, seemingly inattentive and unrelated to the problems we saw in each of the other types of restoration, and pursuing the specific and limited goal of ensuring the ossification strength of the building, is used against the living force of internal functions and external phenomena - from earthquakes and wind and snow forces - to respond to "static" lateral erosive phenomena. Intervention in the physical condition of the building to strengthen and ensure the stability of building complexes is done at the following levels: building materials (reinforcement or local replacements), building elements (strengthening or replacement of weakened or disproportionate element or part), and general skeleton (adding the resistance of the building against internal and external forces, in a general way). Consolidation, especially if it is not based on local interventions and is presented as a general action for the building, provides the best opportunity to intervene in other general features and functions of the building and can cause a change and create a physical change following the new needs of the building. It seems that confirming that the consolidation work is limited to strengthening the structure of the building and replacing the damaged elements or parts of the building means avoiding interfering with other features of the building (Falamaki, 2001, pp. 42-43). Definition of consolidation: the action or process of making something stronger or more solid, the action or process of combining several things into a single more effective or coherent whole (URL5). (Oxford Dictionary) consolidation: the act or process of making a position of power or success stronger so that it is more likely to continue (URL6).

**3.4 Supplementary Restoration (as Completing an Unfinished Work)**

The supplementary restoration takes place when the building is deficient in some parts. Reconstruction of the lost parts of the ancient building is done to complete the physical existence and function of the building and to participate in the public life of the urban environment. According to the extent and importance of the lack of elements and building parts, and concerning the characteristics of the physical environment and the richness of architecture-culture in the building environment, this type of restoration is one of the most difficult and delicate issues (Falamaki, 2001, p. 41).

**3.5 Reconstruction**

(Oxford Dictionary) the process of changing or improving the condition of something or the way it works; the process of putting something back into the state it was in before (URL7). New construction is based on historical documents and uses mostly new materials that are likely to be combined with existing historical material (as a witness or historical record). In the “Burra Charter”, reconstruction means restoring a place to a previously known state, and its difference from restoration is the import of new materials into the tissue (new materials can include recyclables from other places, but this should not harm the cultural or place prestige) (Jokilehto, 2008, p. 349).

**3.6 Safeguard**

(Oxford Dictionary) to protect something/somebody from loss, harm or damage; to keep something/somebody safe (URL8). The term is used in a general sense to denote a variety of operations from support to the restoration that is necessary to preserve cultural heritage with respect (Jokilehto, 2008, p. 347).

**3.7 Protection**

(Oxford Dictionary) the act of protecting somebody/something; the state of being protected (URL9). Legal and administrative procedures are necessary to provide the appropriate conditions for the preservation of a historic monument or a heritage site in its context. It also indicates the necessary technical operations, such as the

construction of a shelter to protect an area or object from human encroachment or atmospheric factors (Jokilehto, 2008, p. 347).

**3.8 Conservation**

(Oxford Dictionary) the protection of the natural environment (URL10). "The object of conservation is to prolong the life of cultural heritage and, if possible, to clarify the artistic and historical messages therein without the loss of authenticity and meaning. Conservation is a cultural, artistic, technical and craft activity based on humanistic and scientific studies and systematic research. Conservation must respect the cultural context" (ICOMOS, Guidelines for Education and training in the conservation of Monuments, Ensembles and Sites, 1993, Article 3) (URL24). Conservation is a key concept that implies a process that includes the types of operations required to preserve cultural heritage. The scope of such operations may vary depending on the type of legacy involved. Conservation can be used as a technical term to denote the specific improvement needed to extend the life of a cultural heritage site and can refer to restoration, repair, and maintenance projects (Jokilehto, 2008, p. 347).

**3.9 Preservation**

(Oxford Dictionary) the act of keeping something in its original state or good condition (URL11). In general, it indicates all the necessary operations to maintain the current state of a structure or place and prevent its collapse. In the "Burra Charter", preservation means the continuation of the texture of a place in its current state and the slowing down of its qualitative decline (Jokilehto, 2008, p. 348).

**3.10 Maintenance**

(Oxford Dictionary) the act of keeping something in good condition by checking or repairing it regularly (URL12). It means continuous or regular care of the texture and a structure or an area. In the "Burra Charter", maintenance means continuous and supportive care for the texture and array of a place and must be distinguished from repair because repair involves restoration or reconstruction (Jokilehto, 2008, p. 348).

**3.11 Repair**

(Oxford Dictionary) to fix something that is broken, damaged, or torn (URL13). The act of restoring a part of a building that is broken or part of it in poor condition to normal condition (Jokilehto, 2008, p. 349).

**3.12 Rehabilitation**

(Oxford Dictionary) the process of returning a building, place, or area of activity to its previous good condition (URL14). Returning a building or part of a city to its normal state is usually accompanied by new and compatible uses or functions (Jokilehto, 2008, p. 349).

**3.13 Revitalization**

(Oxford Dictionary) the process of making something stronger, more active, or healthier (URL15). Give new life and function to a thing or an area (Jokilehto, 2008, p. 349).

**3.14 Renovation**

(Oxford Dictionary) the act or process of repairing and painting an old building, piece of furniture, etc. so that it is in good condition again (URL16). Return something to normal, revive something. In architecture, the purpose is to renew the appearance of the work while the core of the work is ancient (Jokilehto, 2008, p. 349).

**3.15 Reorganization**

(Oxford Dictionary) the act or process of changing the way in which something is organized or done (URL17). A change in the way you organize or do something (Jokilehto, 2008, p. 349).

**3.16 Reuse**

(Oxford Dictionary) to use something again (URL18). Reusing something that often serves another purpose is usually a better option than destroying or abandoning it (Jokilehto, 2008, p. 349).

**3.17 Rebuilding**

(Oxford Dictionary) to build or put something together again (URL19). Rebuild another building or structure due to damage or destruction (Jokilehto, 2008, p. 349).

## 4. The International Charters for the Conservation of Historic Buildings and Sites

### 4.1 The "Athens Charter"

By the end of World War I, the 1919 Peace Conference caused the founding of the United Nations, an organization for international participation headquartered in Geneva. Within this new organization, an international committee for intellectual participation was formed, the first meeting of which was convened in 1922. In 1926, the aforementioned committee established the Paris-based Office of International Museums, which included activities such as publishing the scientific "Journal Mouseion" (since 1917), promoting museum-related activities, preserving works of art, and organizing international meetings were on the agenda. Another meeting was held in Athens on October 21-30, 1931 to discuss issues related to the protection of architectural monuments.

At the Congress in Athens the following seven main resolutions were made and called "Carta del Restauro":

- international organizations for restoration on operational and advisory levels are to be established;
- proposed restoration projects are to be subjected to knowledgeable criticism to prevent mistakes which will cause loss of character and historical values of the structures;
- problems of preservation of historic sites are to be solved by legislation at the national level for all countries;
- excavated sites which are not subject to immediate restoration should be reburied for protection;
- modern techniques and materials may be used in restoration work;
- historical sites are to be given strict custodial protection;
- attention should be given to the protection of areas surrounding historic sites (URL20).

The "Athens Charter" was chaired by "Jules Destree" General Director of the Office of International Museums and was attended by about 120 delegates from 23 (mostly European) countries, including "Gustavo Giovannoni" from Italy, "Léon-Paul Fargue" (1876–1947), (a French poet and essayist) from France, "Leopoldo Torres Belbas", (a Spanish archaeologist) from Spain, and "Sir Cecil Harcourt-Smith" (1859–1944), (a British archaeologist and museum director) from England. The sessions covered seven main chapters: general strategies and principles, legal and executive criteria, aesthetic aspects, restoration materials, deterioration of monuments, conservation methods, and international participation. Special recommendations were also made for the restoration of the "Acropolis" monuments. The general tendency was to stop stylistic restoration and support the protection and care of monuments by preserving the styles of all periods. The final statement of the conference stated: "regardless of the specific types of cases, each with a different solution, we note that in different countries, there is a general tendency to abandon the restoration completely and turn to the constant maintenance of the building to ensure their protection and conservation. Due to erosion or destruction, restoration seems inevitable, it is recommended not to ignore the style of any period while preserving the historic and artistic works of the past. The congress considers the function and use of the historic buildings are necessary to preserve their historic or artistic identity". Special attention was also paid to the role of society in the protection of historic monuments and even the discussion of extending the appropriate rules of private property, as well as emergencies. Efforts to preserve the monuments in their original place and to preserve their "scenic" identity were also deemed necessary. The use of new technology, such as the use of reinforced concrete, has been confirmed, and it has been considered to cover new reforms to preserve the identity of the historic monument. In dilapidated buildings, the original parts must be placed in the original position by the method of anastylosis and new materials should be identified. To strengthen the principle of protection of historic works of art, an emphasis was placed on international participation, and an international centre was established to document documentaries and popularize public education. The recommendations were communicated to the International Committee of Cultural Partnerships as well as to the member states of the "United Nations". The same recommendations were later applied to the "Athens Charter", which led to a drastic change in attitudes toward historic monuments and was considered the first international document to promote new conservation policies. The "Athens Charter" was an example that was later used by "Gustavo Giovannoni" in setting the Italian standards for restoration (Jokilehto, 2008, pp. 310-311).

"Camillo Boito" declared the issue of replacing architectural concepts with formal and stylistic features in the restoration of historic buildings for the first time. He proposed the creation of new functions and applications in historic buildings, to revitalize them and keep them alive. Theories about the value relationship between historic buildings and the environment or texture around them were proposed by "Camillo Sitte"; the need to use documentary evidence and drawings in the restoration by "Luca Beltrami" (1854–1933), (Falamaki, 2001, pp. 20-21) and the design of two types of scientific and artistic restoration of the dead and the living monuments by "Gustavo Giovannoni" were all in the process of developing restoration theories. The "Athens Charter" reflects many thoughts of "Camillo Boito". The resolution calls on governments to cooperate extensively and permanently in promoting the protection of artistic and historic monuments. Here are some of the highlights of the "Athens Charter" and its goals:

- belief in the use of institutions and groups with skills in the field of restoration without prejudice to public international law;

- saving the masterpieces;
- ways and methods of intervening in historic buildings;
- principles and doctrines for the conservation of historic buildings and monuments;
- special solutions for conservation and symbolizing regular and continuous maintenance of the protection of the historic building;
- respect for historical eras and styles used in historic buildings;
- continuation of the historic monument by giving it a suitable function and use;
- legislation for the conservation of buildings of historical, artistic, or scientific value, special legislation following local conditions, and the state of public opinion;
- emphasis on public (government) officials having special powers to protect historic buildings in an emergency;
- paying attention to the method of anastylosis (placing the original recycled elements in the original place) and the use of new materials and the recognizability of materials used in this operation;
- where it is no longer possible to preserve the finds after the archaeological excavation has been completed, what remains will be buried again;
- paying attention to the mapping or drawing the original plan of the historic monument;
- the use of modern materials to strengthen and consolidate the historic building;
- cooperation between restorers and conservationists of historic monuments, physicists, chemists, and experts in natural sciences, etc. to maintain and operate the historic building;
- do not remove the memorial sculptures from their original location (protection of the original models);
- considering the physical shape of the city, especially in the vicinity of historic buildings (considering the environment for monuments);
- beautifying the environment and creating green space in harmony with historic sites in their vicinity;
- prohibition of affixing any announcement or advertising poster, installation of any electrical poles and telephones, any industrial workshop that produces noise and imposed on the environment, near historic buildings and artistic monuments;
- the need to publish a list of national monuments in different countries by relevant institutions or organizations;
- collecting and archiving documents related to historic monuments by the relevant administration and distributing and using information related to the historic building by this office;
- the best guarantee for the preservation of the historic buildings, monuments, and artworks can be rooted in the compassion and respect of the people, educating the children and young people by official experts to prevent the vandalism and deterioration of the historic buildings and monuments;
- to motivate and encourage children and young people to understand the meaning and concept of historic buildings and monuments and make them interested in protecting and supporting this evidence of civilization.

Even in Article 68, which refers to the reorientation of vital lines of movement and relocation of centres in the historic context, these measures are proposed looking at single historic buildings (architectural values) and their purpose is to preserve and the protection of valuable historic architecture or historic monuments. Article 69 refers to the demolition of slums around historic buildings, Article 70 refers to the non-use of past styles in new buildings, and Article 82 states that: scientific urban planning is not two-dimensional but three-dimensional. By using the element of height, a solution for modern traffic will be found, and even by using the free spaces that are obtained, a solution will be found in recreational and leisure activities. In general, in the discussions and materials raised in the "Athens Charter", except for Articles 70 and 82, almost all of its approved materials relate to how to deal with a single monument or historic building, which is the main subject of this resolution (Moradi, 2006).

**4.2 The "Venice Charter"**

In 1957, "UNESCO", together with high-ranking French officials, held an international meeting with architects and technicians in charge of historic monuments. About 25 countries participated in the meeting, and topics such as the need for multidisciplinary participation and expert training were emphasized. The French also criticized the use of modern elements in oversimplified form, which differed greatly from the original decorative designs. Following the meeting, the Italian government invited conservation technicians and architects to a meeting on May 25-31, 1964, attended by more than 600 people from 61 countries and representatives of international organizations, "UNESCO" ("The United Nations Educational, Scientific and Cultural Organization"), "ICOM" ("International Council for Museums"), "ICOMOS" ("International Council for Monuments and Sites"), and the "Council of Europe". The important result of this meeting was the drafting of the "International Charter for the Protection and Restoration of Monuments and Sites", known as the "Venice Charter", which is considered a revised form of the "Athens Charter" in 1931. This charter was drafted based on Italian standards and the declaration of "Gustavo Giovannoni". It also reflects the current debate among advocates of conservation and restoration (URL21).

Although "buildings" were still emphasized, the concept of "historic monument" was generalized to include historic urban and rural areas, and the division of monuments into "living" and "dead" was considered unfounded. The concept of architectural cohesion received special attention at the “Venice Charter”, but at the same time, historical originality and integrity were emphasized, especially since in the post-war period, stylistic reconstructions were overemphasized. Several speakers emphasized the inherent nature of any cultural heritage site, emphasizing the fact that a charter could only serve as a guide and could not be considered a legally binding alternative without criticism. The “Venice Charter” was adopted the following year as the main guiding document by “ICOMOS”, which was founded in the same year. The “Venice Charter” has been translated into many languages of the world and has led to the issuance of charters, and the issuance of numerous other recommendations and instructions on various aspects of the protection and conservation of cultural heritage. On the other hand, this charter is considered the main reference for the assessment of heritage sites for inclusion in the “UNESCO World Heritage List” (Jokilehto, 2008, p. 315).

### 4.3 The “Burra Charter”

One of the most well-known documents inspired by the “Venice Charter” is the “Burra Charter” (URL22), drafted in 1979 by “ICOMOS Australia”, and edited in 1981, 1988, 1999, 2004, and 2013 (URL23). The “Burra Charter”, while relying on the “Venice Charter”, introduces the concept of "place" instead of "monument and neighbourhoods"; in other words, it emphasizes the less tangible aspects of cultural importance, the connections and meanings that places have for people, and the need for people to participate in the decision-making process. However, it's necessary to point out that the purpose of such a comprehensive charter should be well understood and should not be used merely to justify its applications (Jokilehto, 2008, pp. 315-316).

## 5. Conclusions

“Gustavo Giovannoni”, a successful Italian architect and restorer, established “scientific restoration” and introduced the principle of pruning by completing and refining the theories of “Camillo Boito”. He proposed a theory for the modernization of historic sites by observing their old identity, keeping away the main circulation paths from historic sites, preventing them from being cut off by the streets, improving social and health conditions, and protecting historic buildings by destroying the less important structures to create space. He considered the theory of “Eugène Viollet-le-Duc” to be unscientific and to cause distortions and arbitrary interventions. But like “Camillo Sitte”, he emphasized visual values and sudden surprises due to the contrast between the magnificent palaces and the “minor architecture” and the architectural order, which must be studied obsessively. Influenced by the theories of “Camillo Boito”, which distinguished between the old style and the new style used to regenerate a historic monument, he saw a conflict between the two concepts of life and history. Life means meeting the requirements of modern development and life, and history expresses the observance of historic and artistic values and the environment of ancient cities. The city has developed over time and different styles have been represented in different eras. According to “Gustavo Giovannoni”, the main goal should be to preserve the originality of the structure and observe the whole artistic life of the memorial, not just its identity in the early stages of construction. Any subsequent additions must be dated and viewed more as an integral part of the whole mass than to decorate it. “Gustavo Giovannoni” recommends documenting based on reliable data. He also believed that in modern times, due to the lack of a modern and appropriate style and the lack of sensitivity to their use, architectural forms are not successful. He emphasized conservation, repair, and consolidation, and considered it permissible, if necessary, to use new technology when consolidating. “Gustavo Giovannoni” like “Camillo Boito” preferred that the restorations not be visible by using modern methods and technology, such as the use of cement mortar or invisible metal or reinforced concrete structures as protection in case of an earthquake, but he did not approve of the excess of modernization that caused the structure to be damaged, which is not permissible according to him. His 4 important principles are 1. strengthening, 2. anastylosis, 3. liberation, and 4. completion or modernization. A meeting was held in Athens in October 1931 to discuss issues related to the preservation of architectural monuments, attended by “Gustavo Giovannoni” representing Italy. The sessions covered seven main chapters: general strategies and principles, legal and executive criteria, aesthetic aspects, restoration materials, deterioration of monuments, conservation methods, and international participation. This charter was drafted based on Italian standards and the declaration of “Gustavo Giovannoni”.

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**Conflict of Interests**

The author declares no conflict of interest.

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# The Impact of Place-making to Revitalize the Identity of Coastal City

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**Abstract**
Coastal public space is one of the characteristics that distinguish those cities and towns. Recently, most of the coastal spaces have been similar and lost their identity during the rapid growth. The paper explores the absence meaning of in the identity of the coastal public space and the role of the Place-Making tool in revitalizing their identity. The paper studies the formation of coastal public space and how the role of place-making enhanced their local identity. The paper aims to achieve Design Guidelines for coastal public spaces based on a case study analysis. Descriptive, analytical, and case study methodologies are used to achieve the research aims. The paper starts with a literature review. Then, it analyses five international and local experiences in developing coastal public spaces, exploring the role of place-making in revitalizing the identity of coastal public spaces. Finally, the paper ends up with Design Guidelines for developing coastal public spaces.
**Keywords:** Identity; Coastal public space; Coastal city; Place-making.

## 1. Introduction

Coastal public space is a feature of urban coastal communities and a distinguishing feature of coastal cities, as it witnesses community-based communication. The importance of place identity or individuality has been disregarded, resulting in many similar metropolitan designs. Let us look closely at the current state of coastal cities. The loss of identity can be traced back to several causes that have been overlooked for far too long: (1) similarity in city design in general and coastal public space in particular despite natural distinctiveness and local lifestyle; (2) failure in design and management for a rich public space regarding activities, space forms, and time efficiency; (3) lack of appreciation and awareness for place identity regulations for construction and design systems. Many researchers have discussed coastal public spaces to organize space through the form of public spaces, but they ignore the identity of these spaces. Because places are related to the value of the urban environment in terms of the natural environment, the built environment, and the human factor, we examined material and immaterial values to develop a set of designs for the place's identity using place industry, as it is based on art and culture to form an urban space around arts and cultural activities related to the region's culture. Therefore, this study explores place-making to enhance the coastal public space by analyzing numerous global and local experiences to design guidelines and provide architects with an effective supporting tool to revitalize the identity of coastal public spaces. (Wyckoff, M. A, 2015) (Silberberg, S, 2013).

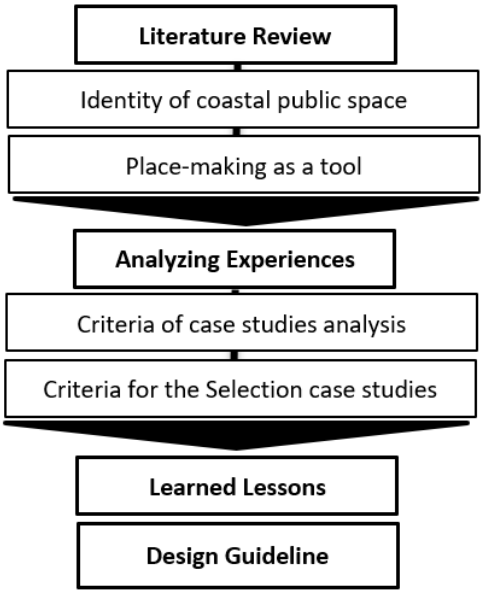


**Figure 1.** Structure of the Study (Developed by Author).

**2. Identity of Coastal Public Spaces**

The term identity refers to the characteristics that define a particular thing. Furthermore, a city's natural and artificial features and its social, cultural, and historical characteristics are classified as an urban identity. The most obvious and impressive of these characteristics is the city's identity, and each feature distinguishing one city from another and making it appear differently is a city's identity component. (SAĞLIK, E, 2017).

The requirement for a city identity is crucial because it balances constant and changing aspects, such as people and events, linked by a reciprocal link that distinguishes a specific city. (Lynch, K, 1960).

The continuity of the identified conditions plays a role in establishing an identity. The following are a few of these conditions: (SAĞLIK, E, 2017).

- Cultural heritage or traditions,
- The quality and character of society's needs,
- Factors caused by geographical, climatic, and topographic conditions,
- Technology produced by the nation,
- The ability to adapt to changing conditions.

A city's identity is a historical phenomenon shaped by physical, cultural, socioeconomic, historical, and formal variables. It determines whether any type of city planning is adequate, sufficient, and correct, and it is produced through time and changes with time in each city. There is a need to create a holistic urban plan comprising ecological, social, cultural, and aesthetic dimensions with economic conditions to preserve a city's preservation and development. (Ogurlu, I, 2014).

**2.1 Urban Identity**

Urban identity is a blend of the physical heritage, local culture, and geographical context, overlaid with perceived remembrances. Furthermore, "city identity is a combination of the aspirations and experiences of citizens and those who visit. The sense of place and identity is reflected in understanding the wider city region and specific physical locations. (Evans, B, 2011).

Urban identity components

A city's identity belongs to it, making the city different from others, adding value to that city, and is the entirety of city-specific components. These components are also crucial features in forming a city's identity. The concepts constituting urban identity are gathered under two primary headings as environmental and social identity. The elements of city identity are (SAĞLIK, E, 2017; Nia, & Suleiman, 2017):

**A. Natural:** These identity elements originate from the natural environment from topography, climate, water elements, geological, and general location conditions.

**B. Human:** These identity elements originate from humans, comprising individuals and society. These are also sub-elements belonging to demographic, institutional, and cultural structures

**C. Human-made**: These identity elements originate from the human-made landscape, comprising artificial environmental elements, action areas arising from ongoing human needs in the city, and human-made objects.

**2.2 Costal Public Spaces**

A coastal public space is a feature of urban coastal communities and a distinguishing aspect of coastal cities and is an element that brings people together and enhances social life. It is critical to explore natural values and human and human-made qualities from which suitable designs for the space can be derived to comprehend this space completely. These values and qualities directly influence human perception—they have brought an outstanding atmosphere to the community and place. They have reflected an indispensable need for outdoor public spaces in the city through the local people's daily activities and periodic festivals. Furthermore, while identifying social elements, cultural-historical factors strongly linked to today should receive more consideration. (Ha, T. T. V,2018).

These factors include local people and their activities. Community roles provide intangible value through communication, neighborhood relationships, greetings to relatives, and social relationships created by age, occupation, and lifestyle. Citizens' social activities are identified through history, architectural heritage, and/or living habits.

Factor forming the identity of coastal public space: (Ha, T. T. V, 2018)

Coastal public space identity is related to the value of the urban environment in terms of the natural environment, the built environment, and d the human factor.

**A. Natural:**

- Topography and soil;
- Weather, climate, the cycle of disasters;
- Hydrological conditions: water edge, submerged area, saline intrusion;

**B. Human:**

- Diversity of population;
- Cultural customs of communities;
- Local economy;
- Daily activities.

**C. Human-made:**

- Street system;
- Beachfront block;
- Building form;
- Facilities in public space.

### 3. Place-making as a Tool

Architects and planners started using the term place-making in the 1970s to describe the process of creating spaces, squares, public parks, streets, and waterfronts that would attract people because they are fun and exciting (Motloch, J. L, 2000), according to Bernard Hunt, and have appealed to many designers, including Jean Jacobs .and William Holly White was one of the designers of cities that care about people in the 1960s. Jacob called for the return of citizen ownership of the streets to benefit from the places, and White emphasized the essential elements to create a social environment in public places. Since 1970, Jacob and White's approaches to urban revival have been applied, and they called it place-making (Al Amry, Ahmed Yousef and Anfal Azzam, 2014). Place-making seeks to improve public spaces in towns and cities by involving the community in the design, experience, quality, identity, or character of a place and creating welcoming places for citizens, facilitating social interaction, and being aesthetically pleasing. (PPS & UN-HABITAT, 2012), (Council, M. P, 2008).

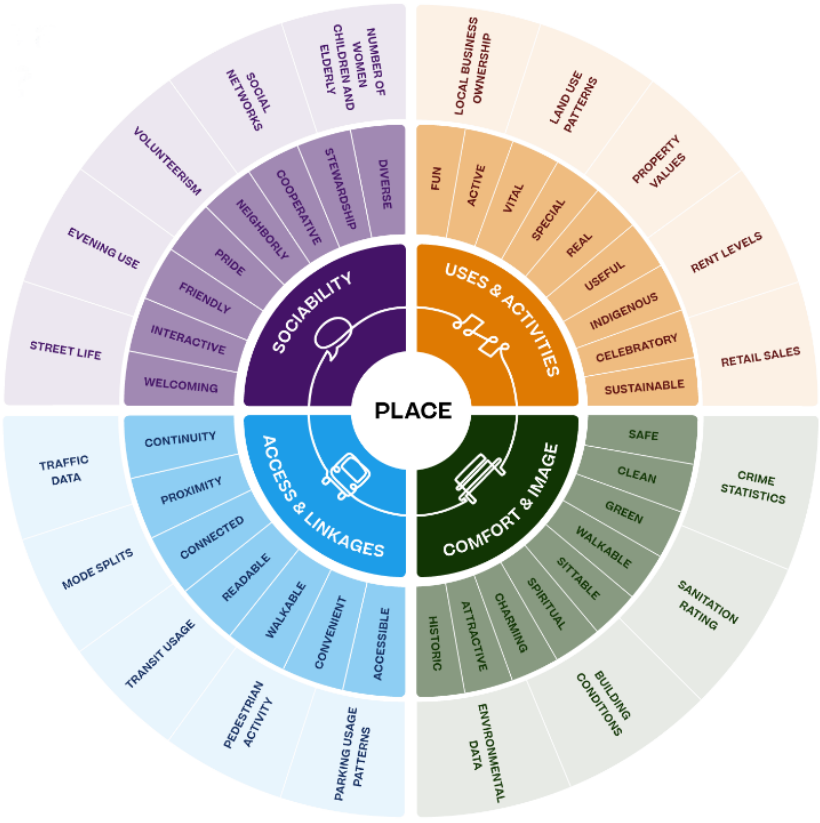


**Figure 2.** Place-making Diagram by PPS

### 3.1 Place-Making Criteria

The Project for Public Spaces created the Place Diagram, and it includes four sections: Access & Linkage, Comfort & Image, Uses & Activities, and Society. These sections serve as the cornerstones of place-making applications.

- **Access and Linkage**

A space should be visually and physically connected to its surroundings. A successful public space is visible, accessible, and easy to navigate. The space should be visible from a distance, have plentiful parking, and ideally can accommodate public transportation. (Council, M. P, 2008).

- **Comfort and Image**

Comfort and image are crucial factors in deciding whether a location will be used. Safety, cleanliness, and a comfortable place to sit influence people's perception of comfort, whereas image includes the sense of adjacent structures and a location's character or charm, and more concrete concerns like finding a comfortable place to sit (Council, M. P, 2008).

- **Uses and Activity**

Pleasant social gatherings, free outdoor concerts, group art exhibits, and other activities occurring at a place are fundamental building blocks for using a space—they are why people visit in the first place and why they return. Activities can also help make a place special or unique, leading to group pride. (Council, M. P, 2008), (Tibbalds, F, 2012).

- **Sociability**

Sociability is a challenging but undeniable quality to achieve in a location. People feel a greater sense of place or connection to their neighborhood and places that foster social interactions when they see friends, meet and greet their neighbors, and feel comfortable. (Tibbalds, F, 2012).

### 3.2 The Relation Between Place-Making and Identity of Place to Improve Coastal Public Space:

The matrix shows the relationship between place-making and identity.

**Table 1.** Relation between place-making and identity, adaptive by author

| Place-making | | | Place-Making Indicator | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Access and Linkage | | | | | | Comfort and image | | | | | | Uses and Activity | | | | | | Sociability | | | | | | | |
| identity | | | Continuity | Connected | Readable | Walkable | Convenien | Accessible | Safe | clean | Sittable | Spiritual | Attractive | Historic | fun | Active | Special | Real | Useful | Celebrator | Sustainabl | Diverse | Cooperativ | Neighborly | Friendly | Interactive | Welcomin |
| Identity of place indicator | Natural elements | Topography and soil | | ● | | ● | | ● | ● | | | | | | ● | ● | | | | | ● | | | | | | | |
| | | Weather, climate, the cycle of disasters | | | | ● | | | | | | | | | ● | ● | | | | ● | | | | | | | | ● |
| | | Hydrological conditions | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Ecology system | | | | | | | | | | | | | | | | | | | ● | | | | | | | |
| | Non-physical elements | Diversity of population | | | ● | | | ● | | | | | ● | | | ● | | | ● | ● | | ● | | ● | ● | | | |
| | | Cultural customs of communities | | | | | | | | | | | | ● | | | ● | | | ● | | | | | | | | |
| | | Local economy | | | | | | | | | | | | ● | | | | | ● | | ● | | ● | | | ● | | |
| | | Daily activities | | | | | | ● | ● | ● | ● | | | | ● | ● | | | | ● | | ● | | | | | | ● |
| | Physical elements | Street system | ● | ● | ● | ● | ● | | | | | | | | | | | | | | | | | | | | | |
| | | Beachfront block/ lot forms | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Building form | | | | | | | | | | | ● | ● | | | | | | | | | | | | | | |
| | | Facilities in public space | | | | | | | ● | ● | | | | | | | | | | | | | | | | | | |

**4. Analyzing of Global and Regional Experiences**

This part deals with developing coastal public space by analysis of global and local experiences of similar cities that were able to use place-making by studying the methods of using place-making in development and the extent of their success in developing coastal public spaces and enhancing the identity of this place.

The case studies will be selected according to the following factors:

- Development of public spaces attached to the coast "Coastal public spaces",
- Different geographical locations and along different seas and oceans,
- Used permanently or temporally and have activated vital projects.

Therefore, five leading successful case studies were chosen:

1. Konyaalti coastline, Antalya, Turkey;
2. Wilmington coastline, Los Angeles, California;
3. Tel Aviv coastline, Tel Aviv, palatine;
4. Puerto Vallarta Coastline, Mexico;
5. Jeddah's coastline, Jeddah, Saudi Arabia.

**4.1 Criteria of Case Studies Analysis**

The methodology used in analyzing the project of the case study undergoes four main steps.

- **Defining** the selected project.
- **Documenting & analyzing** the project.
- **Urban, Place-making, and identity** analysis for the project.
- **Pros and cons** of the analysis.

**4.2 The Analysed Project**

In this part, we will analyze five similar city experiences, varying between global and regional experiences.

**4.2.1 Konyaalti coastline, Antalya, Turkey**

The Antalya Konyaalti coastline is vital for the city of Antalya, Turkey, and the world and is 7.5 km long, allowing sea and coastal use within the city(DİPOVA, N. 2016).

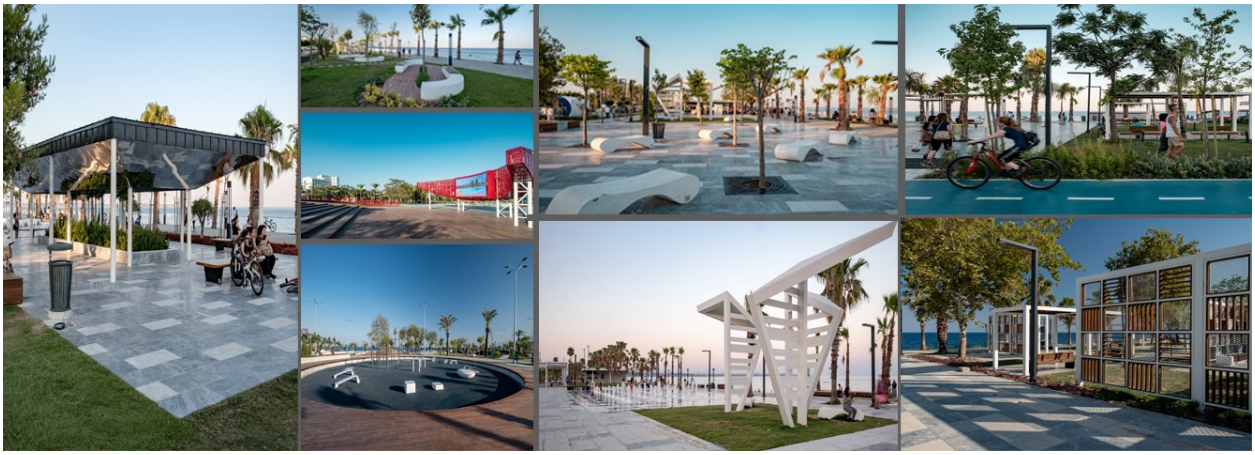

**Figure 3.** Konyalti Coastline Development

**The main drive of the project was:**

- Reduce the domination of the highway dividing the coast and settlement behind it.
- Strengthen the relationship between the residential neighborhood and the coastline.

**Table 2.** the Analysis of Konyaalti Coastline

| **Project definition** | | | |
|---|---|---|---|
| **Site location** | On the Mediterranean | **Project scale** | City scale |
| **Designer name** | OZER/URGER Architects | **Development date** | 2018 |
| **Facts** | The width of the promenade is about (40m)<br>The width of the sand is about (50m)<br>The width of the street is about (20m) | | |

| | | | | | |
|---|---|---|---|---|---|
| **Project brief** | | Konyaalti, one of Antalya's key districts, has a long history dating back to the Lycian period. Konyaalti is a district on Antalya's western outskirts that is known for its Konyaalti beaches. | | | |
| **Urban Analysis** | | | | | |
| **Classification of Coastline** | | **Closing** | Open | **User** | Public |
| | | **Hierarchy** | Major | **Form** | Irregular |
| **Human Activities** | | **Movement activities** | Paths for the pedestrian and path for the vehicle | | |
| | | **Settlement activities** | When people see friends, meet their neighbors, and feel comfortable interacting with strangers. | | |
| **Place-making analysis** | | | | | |
| **Access and Linkage** | **Accessible** | The main path: Akdeniz Street along to the coastline. (The Mediterranean Avenue) | | | |
| | **Convenient** | The different mean of transportation is used to access the coastline by cars, bicycle, and buses. | | | |
| | **Walkable** | The traffic slowed down and the Mediterranean Avenue became a more pedestrian-friendly route. | | | |
| | **Readable** | For various users, architectural ideas providing an accessible and perceptible area have evolved. | | | |
| | **Connected** | Konyaalti coastline is connected to the city by the Akdeniz Street “Mediterranean Avenue “ | | | |
| | **Continuity** | The Konyaalti coastline is 7.5 km long and allows sea and coastal use within the city. | | | |
| **Uses and Activity** | **Fun and active** | The Coastline includes parks, walkways, recreation, and green areas with 5,000 new trees planted. | | | |
| | **Vital** | The coastline is vital, and the Museum Square is the entrance gate to the coastline for the citizens of Antalya. The beach park is a crucial and active point of the coastline and includes shopping, F&B, and entertainment facilities. The Olbia Square on Dumlupinar Avenue was planned as a city square that acts as a gateway, providing sports, entertainment, and cultural activities. | | | |
| | **Special** | There is a significant film studio that could rival the likes of Universal Studios in the United States. | | | |
| | **Useful** | The activities in the coastal area were placed on a wide strip parallel to the Mediterranean Avenue. This design idea also provided the flexibility to add and remove menu items according to requirements and demands. | | | |
| | **Celebratory** | The recreational, cultural, and sporting activities offered to the residents of the settlements were added to the project along the coast. | | | |
| | **Sustainable** | The coastline is sustainable by reducing the movement of vehicles and the use of bicycles, as well as the green areas that extend along the coast | | | |
| **Comfort and Image** | **Safe &Clean** | It is safe for people of all ages and clean of any pollutants including car exhaust or garbage. | | | |
| | **Green** | The green corridors between the residential areas in the north were extended to the shore and were terminated with the green areas on the coast. | | | |
| | **Walkable** | It can be walked in because the movement of vehicles is separated from pedestrians | | | |
| | **Attractive** | The Konyaalti coastline contains amenities, including:<br>Modules with various functions are used to create urban landscape features. Urban furniture, shadow elements, activity spots, water, and plantation landscaping serve as seating and reclining functions within the hard, semi hard, and soft landscape surfaces. | | | |
| | **Historic** | The historical element was not fulfilled | | | |
| **Sociability** | **Diverse** | Many activities included the coastline | | | |
| | **Stewardship** | Under the supervision of the governorate | | | |
| | **Cooperative& Friendly** | Through the various activities that take place on the coast | | | |
| | **Welcoming** | The population spikes due to numerous visitors during the tourist season—it welcomes 15 million people on average per year. | | | |
| **Identity analysis** | | | | | |

| | | |
|---|---|---|
| **Natural** | **Topography and soil** | Sand, sea, and mountain |
| | **Weather** | The summers are hot, humid, arid, and clear and the winters are long, cold, wet, and partly cloudy. |
| | **Hydrological conditions** | The sea temperature ranges between 15°C and 28°C. |
| **Human** | **Diversity of population** | During the tourist season, Antalya's population spikes due to a large number of visitors, because every year it welcomes 15 million people on average. |
| | **Cultural customs** | The culture of this city is a mix of Romans and Greeks.<br>Throughout the year, festivals are held to promote the city's culture. |
| | **Local economy** | A mixture of tourism, agriculture, and trade |
| | **Daily activities** | There are many great daily water activities, such as yacht and boat tours, parachute tours, and paragliding. |
| **Human-made** | **Street system** | The street is parallel to the sea |
| | **Beachfront** | Variety in scale regarding building functions |
| | **Building form** | Depending on aesthetics and the economy |
| | **Facilities in public space** | Urban facilities serving current activities |
| **Revitalize identity** | | |
| **Natural** | Enhance the visibility of prominent elements such as the mountains and sea | |
| | Creating visual corridors by connecting the city and coastal public space using the sea-heading street system | |
| **Human** | Organizing periodic activities:<br>▪ sand festival | |
| **Human-made** | Using natural hues such as blue from the sea, green from foliage, yellow from sand, brown from mountains, and white/blue from the sky. | |

| **Pros and Cons of Konyaalti Coastline** | |
|---|---|
| Improving the accessibility to the coastline | There is no play area for children |
| Separating the movement of pedestrians and vehicles, and creating a bike path | Lack of Effective management. |
| This design idea also provided the flexibility to add and remove menu items according to requirements and demands | lack of Enhancing a local identity of the place based on art and culture; |
| Considerate design for people with disabilities | The design did not show the cultural identity of the city, which mixes Roman and Greek cultures |
| Creating strong relationships between society and the place | |

### 4.2.2 Wilmington Coastline, Los Angeles

The Wilmington Waterfront Promenade has finally broken ground after years of close collaboration between Sasaki, the Port of Los Angeles and its staff, and community members. The project, dubbed Wilmington's Window on the coastline, is the next step in implementing the Wilmington coastline Master Plan to create a natural buffer between the Wilmington community and port operations (Cisneros, H, 2019).




**Figure 4.** Wilmington Coastline Development

**The main drive of the project was:**
The inaccessible industrial port is transformed through design intervention into a place meant for people, where a community can meet the water's edge.

**Table 3.** The analysis of Wilmington Coastline

| | | | | | |
|---|---|---|---|---|---|
| **Project definition** | | | | | |
| **Site location** | | On the Pacific Coast | | **Project scale** | City scale |
| **Designer name** | | Sasaki Associates | | **Development date** | 2020 ended in 2023 |
| **Facts** | | The width of the promenade is about (60-205)<br>The width of the Coast is about (30-100)<br>The width of the street is about (15) | | | |
| **Project brief** | | The project, which has been planned for more than 15 years, would see an abandoned industrial site near Banning's Landing Community Center transformed into a nine-acre park for locals. The open space will contain a public pier and dock, a playground, parking, and facilities, in addition to a new boardwalk around the port. | | | |
| **Urban Analysis** | | | | | |
| **Classification of Coastline** | | **Closing** | Open | **User** | Public |
| | | **Hierarchy** | Major | **Form** | Irregular |
| **Human Activities** | | **Movement activities** | Two Paths for the pedestrian and a path for the vehicle | | |
| | | **Settlement activities** | When people see friends, meet their neighbors, and feel comfortable interacting with strangers | | |
| **Place-making analysis** | | | | | |
| **Access and Linkage** | **Accessible** | The main path: Two bridges for pedestrians and a path for the vehicle. | | | |
| | **Convenient** | The main transportation on the path: cars, buses, and boats | | | |
| | **Walkable** | The coastline promenade would be the central public amenity of the Avalon coastline District; it contains public squares for pedestrians along the coastline. | | | |
| | **Connected** | The Pacific Harbor Rail Line connects the coastline to the city.<br>The coastline promenade will be connected via a pedestrian bridge over the adjacent railroad tracks to a second park currently under development at Avalon and Harry Bridges Boulevard. | | | |
| | **Continuity** | Wilmington coastline continues with a length of 0.5 km | | | |
| **Uses and Activity** | **Fun & active** | The coastline includes a linear promenade, a public pier with shade structures and family-style picnic tables, a children's play area, and ample plaza and lawn spaces for gatherings and performances. | | | |
| | **Vital** | The coastline considers a major maritime industry powerhouse. As the busiest container port in North America, and a major source of economic vitality for the neighborhood and region. | | | |
| | **Special** | The coastline will now host new opportunities for recreation, gathering, and leisure that could not happen along the industrial coastline before and which will create a sense of belonging for the community of Wilmington along their coastline. | | | |
| | **Useful** | The coastline will contain a playground for recreational, cultural, playing, and sporting activities and a seating area for eating and taking pictures. | | | |
| | **Celebratory** | The coastline will contain an outdoor plaza for gatherings and events. | | | |
| | **Sustainable** | ---------- | | | |
| **Comfort and Image** | **Safe &Clean** | Wilmington coastline will contain amenities, including:<br>Seating area, parking, and restrooms. | | | |
| | **Green** | Coastline will contain11 acres of green open space | | | |
| | **Walkable** | It can be walked in because the movement of vehicles is separated from pedestrians | | | |
| | **Attractive** | It is attractive because it is suitable for all members of society and of all ages and contains the services they need | | | |
| | **Historic** | ---------- | | | |
| **Sociability:** | **Diverse** | Many activities included the coastline | | | |
| | **Stewardship** | Under the supervision of the governorate | | | |

| | | |
|---|---|---|
| | **Cooperative& Friendly** | Through the various activities that take place on the coast |
| | **Welcoming** | The coastline has become a vital attraction center of the region.<br>Visitors can traverse the open plane of lawn ahead, spill out onto the promenade that doubles as a stage, and arrive at a place to sit on the terraced sculpture of rough-hewn stones cut from sparkling onyx that step down to meet the water, offering unobstructed views over the harbor. |
| **Identity analysis** | | |
| **Natural** | **Topography and soil** | Sea and Soil |
| | **Weather** | Humid subtropical climate |
| | **Hydrological conditions** | In the Northern Hemisphere, the waters of the Pacific Ocean move in a generally clockwise direction, and the Northern equatorial currents are warm. |
| **Human** | **Diversity of population** | Wilmington has a vibrant and diverse ethnic population, contributing to the many ethnic festivals every spring and summer. |
| | **Cultural customs** | It contains several cultures because it has a diverse Iraqi population. |
| | **Local economy** | It is a mixture of industrial and tourism due to its proximity to the ocean and vibrant nightlife. |
| | **Daily activities** | Ethnic festivals every spring and summer |
| **Human-made** | **Street system** | The street parallel to the sea |
| | **Beachfront** | Variety in scale regarding building function |
| | **Building form** | Depending on aesthetics and economy |
| | **Facilities in public space** | Urban facilities serving current activities |
| **Revitalize identity** | | |
| **Natural** | Inspired by the rich cultural and ecological diversity, the park uses a significant introduced topography to create a dramatic terraced landscape that mimics the native coastline and helps buffer the park from industrial operations. | |
| **Human** | Enhancing cultural identity in open squares by periodic festivals, theatrical performances, and concerts | |
| **Human-made** | Enhancing the activities of the local population from industry and commerce by restaurants and kiosks for fast food, including the construction of a new plaza to support the Banning's Landing Community Centre. | |
| **Pros and Cons of Wilmington Coastline** | | |
| Pedestrian-oriented features and a waterfront park and promenade | | No bike path |
| Commercial/industrial and retail development, | | Lack of daily water activities such as yacht and boat tours, parachute tours, and paragliding. |
| The promenade serves as a regional draw and attracts visitors to the Wilmington coastline | | |
| Enhancing the activities of the local population from industry and commerce | | |
| Involvement of the local community to ensure that the community's imprint is entered into the design details and amenities. | | |

**4.2.3 Tel Aviv Coastline, Tel Aviv, palatine**

The project transformed this historical blockade by creating a new continuous interface that enables free pedestrian flow to and from the sandy beach throughout the city's central coastline and serves as the main coastline public space of the entire metropolitan area (Rosenberg, E, 2016).

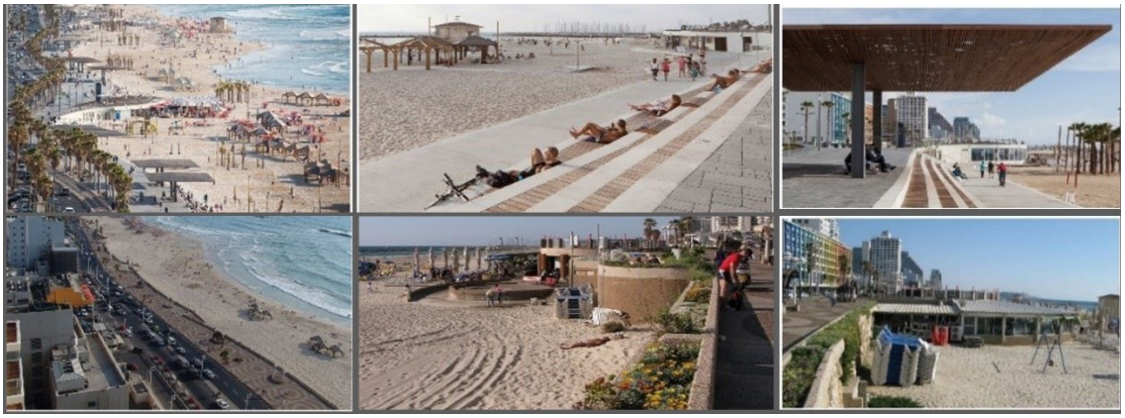

**Figure 5.** Tel Aviv Coastline Before and After Development

**The main drive of the project was:**

Transform this historical blockade by creating a new continuous interface that enables free pedestrian flow to and from the sandy beach, throughout the city's central coastline.

**Table 4**. The analysis of Tel Aviv coastline.

| | | | | | |
|---|---|---|---|---|---|
| **Project definition** | | | | | |
| **Site location** | On the Mediterranean Sea coast | | **Project scale** | City scale | |
| **Designer name** | Mayslits Kassif Architects | | **Development date** | 2018 | |
| **Facts** | The width of the promenade is about (20-35m)<br>The width of the sand is about (45-60m)<br>The width of the street is about (15m) | | | | |
| **Project brief** | The central promenade of Tel Aviv's new Bauhaus city has played a vital role in defining the city's ever-changing link to its beach since its birth in the late 1930s. The elevated boardwalk served as a barrier between the city and the beach throughout its existence. | | | | |
| **Urban Analysis** | | | | | |
| **Classification of Coastline** | **Closing** | Open | **User** | Public | |
| | **Hierarchy** | Major | **Form** | Irregular | |
| **Human Activities** | **Movement activities** | Paths for pedestrians and a path for vehicles | | | |
| | **Settlement activities** | When people see friends, meet their neighbors, and feel comfortable interacting with strangers | | | |
| **Place-making analysis** | | | | | |
| **Access and Linkage** | **Accessible** | The main path: Two paths for pedestrians, a path for vehicles, and a path for bicycles | | | |
| | **Convenient** | The main transportation on the path: are cars and bicycles. | | | |
| | **Walkable** | Tel Aviv promenade is divided into different two levels: The Upper promenade average 2.5 height above sea level and adds a new accessible lower walkway to enable the disabled, the elderly, toddlers, and strollers, to reach the beach all along from a public space of equality. | | | |
| | **Readable** | Architectural ideas that provide an accessible and observable area have evolved for many types of users. | | | |
| | **Connected** | The coastline is connected to the city by Retsif Herbert Samuel St. | | | |
| | **Continuity** | Tel Aviv coastline continues with a length of 2 km | | | |
| **Uses and Activity** | **Fun and active** | Sitting platforms and large shaded areas, playground for recreational, playing, and sporting activities, and seating area for gathering for eating and taking pictures | | | |
| | **Vital** | Serves as the central coast public space of the entire metropolitan area to host many new visitors and create a hospitable and lively public domain for this large dense urban area | | | |
| | **Special** | The promenade had become an essential melting pot for a new urban culture, with spontaneous bands of acrobats, backgammon players, young parents, runners, and others turning it into a single social platform. Its generous, welcoming domain, which is open to all, produces an exceptionally multicultural and heterogeneous environment | | | |

| | | |
|---|---|---|
| | **Useful** | Recreational areas on the stretch of land between the promenade and the water. These recreational areas hold sports facilities, various game courts, playgrounds, and relaxation areas under the palms. |
| | **Celebratory** | ---------- |
| | **Sustainable** | ---------- |
| **Comfort and Image** | **Safe &Clean** | On the coastline, you can enjoy the seaside, take a break from the hectic city, relax, read quietly, or play together in front of the open horizon—this public space is the clock hub of activity. |
| | **Green** | ---------- |
| | **Walkable** | It can be walked in because the movement of vehicles is separated from pedestrians. |
| | **Attractive** | The Tel Aviv coastline contains amenities, including coastal cafes and beach services buildings, terraced sitting platforms and large shaded areas. |
| | **Historic** | ---------- |
| **Sociability** | **Diverse** | Many activities included the coastline |
| | **Stewardship** | Under the supervision of the governorate |
| | **Cooperative& Friendly** | Through various activities taking place on the coast |
| | **Welcoming** | Welcoming urban balconies which connect seamlessly to the main walkway. |
| **Identity analysis** | | |
| **Natural** | **Topography and soil** | Sand, sea |
| | **Weather** | Tel Aviv has a Mediterranean climate, with hot and humid summers, warm and sometimes cool spring and autumn, rainy winters, and bar |
| | **Hydrological conditions** | The sea temperature ranges between 15°C and 28°C |
| **Human** | **Diversity of population** | The new promenade became a host to over 9 million visitors a year, The population varies between tourists and neighboring residents |
| | **Cultural customs** | It is considered a cultural oasis in the region, after several attempts by its Arab residents to adhere to Arab culture and identity through music, plastic art, cooking, and other arts. Among the most important of these attempts was the Jaffa Festival for Palestinian Culture and Heritage |
| | **Local economy** | a mixture of industrial, agriculture, and trade |
| | **Daily activities** | ------- |
| **Human-made** | **Street system** | The street is parallel to the sea. |
| | **Beachfront** | Variety in scale regarding building functions. |
| | **Building form** | Depend on aesthetics and economics. |
| | **Facilities in public space** | Urban facilities serving current activities. |
| **Revitalize identity** | | |
| **Natural** | Preserving and enhancing spaces for cultural and spiritual practices including, beach, and water surfaces. | |
| | Protecting the visibility of natural landmarks and the beachfront enhances the visibility of prominent elements such as the sea | |
| **Human -made** | Enhancing local habits of coastal community<br>Enhancing festivals by organizing periodic activities | |
| **Pros and Cons of Tel Aviv Coastline** | | |
| Improving the accessibility to the coastline | | There is no play area for children |
| Enhancing local habits of coastal community | | Few restaurants and fast food kiosks |
| Enhancing festivals Organizing periodic activities | | |

### 4.3.4 Puerto Vallarta Coastline, Mexico

A remodeling project of the Malecon was conducted as part of a plan to refurbish Puerto Vallarta's historical center. This is the port's core, with a half-mile-long boardwalk connecting the town to the sea as the primary attraction. For many years, automobiles have primarily used the Malecon, making it dangerous and inconvenient for walkers. An automobile barrier ran the length of the Malecon, distorting its original use as a large area near the sea (Puerto Vallarta Seafront, 2014).

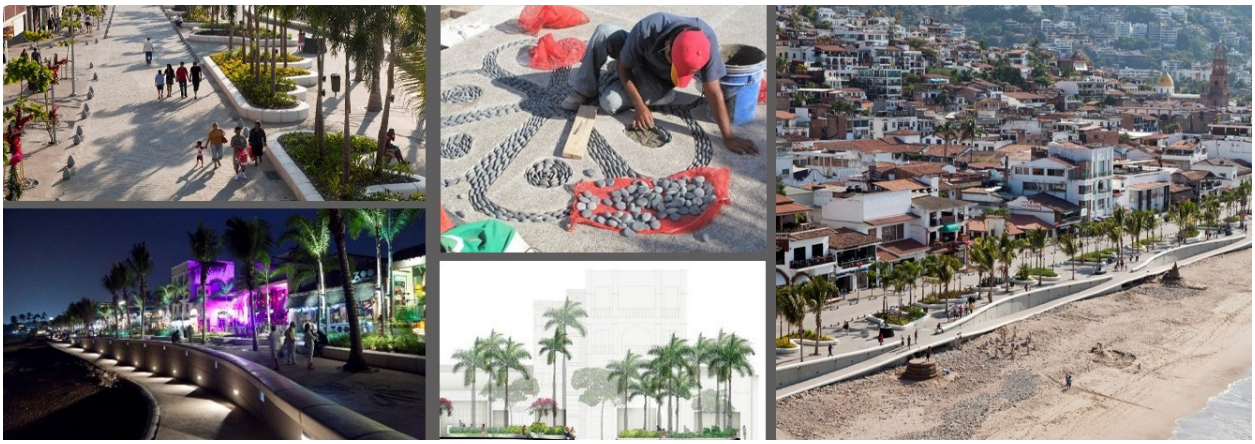

**Figure 6.** Puerto Vallarta Coastline Development

**The main drive of the project was:**

- Enhance the local identity of Puerto Vallarta and promote its position in today's tourism industry.

Pedestrians and their comfort prioritized

- Pedestrians and their comfort prioritized.

**Table 5.** The analysis of Puerto Vallarta Coastline

| | | | | | |
|---|---|---|---|---|---|
| **Project definition** | | | | | |
| **Site location** | Puerto Vallarta,Mexico | | **Project scale** | City scale | |
| **Designer name** | Trama Arquitectos | | **Development date** | 2011 | |
| **Facts** | The width of the promenade is about (10-20)<br>The width of the sand is about (15-20)<br>The width of the street is about (10-15) | | | | |
| **Project brief** | This is the port's core, with a half-mile-long boardwalk connecting the town to the sea as the primary attraction. For long years, the Malecon had been mostly used by automobiles, making it dangerous and inconvenient for walkers. | | | | |
| **Urban Analysis** | | | | | |
| **Classification of Coastline** | **Closing** | Open | **User** | Public | |
| | **Hierarchy** | Major | **Form** | Irregular | |
| **Human Activities** | **Movement activities** | Path for the pedestrian and bicycle and path for the vehicle | | | |
| | **Settlement activities** | When people see friends, meet their neighbors, and feel comfortable interacting with strangers | | | |
| **Place-making analysis** | | | | | |
| **Access and Linkage** | **Accessible** | The main path: Path for pedestrians and bicycles, Half of the waterfront has a car path. | | | |
| | **Convenient** | The main transportation on the path: cars, bicycle | | | |
| | **Walkable** | The coastline included a marine walk and pedestrian path | | | |
| | **Readable** | For users, architectural ideas that give an accessible and perceptible area have evolved. | | | |
| | **Connected** | Puerto Vallarta coastline is connected to the city by the promenade | | | |
| | **Continuity** | Puerto Vallarta coastline continues with a length of 0.5 km | | | |
| **Uses and Activity** | **Fun and active** | There are several shops along the coastline, a seating area, a square, and an amphitheater | | | |
| | **Special &Useful** | Walking, cycling, and relaxing in front of the sea. | | | |

| | | |
|---|---|---|
| | **Sustainable** | -------- |
| **Comfort and Image** | **Safe &Clean** | Several ramps were conceived that made it possible to go down to the beach from the Malecon. A gently declining slope makes it possible to get 100% of users, disabled included, to the beach. |
| | **Green** | On the side of the shops, some almond trees were planted to ring a great and gentle shadow. |
| | **Walkable** | It can be walked in because the movement of vehicles is separated from pedestrians. |
| | **Attractive** | The floor design of the pedestrian areas of the Malecon was projected to be a washed concrete mat with silhouettes of the Huichol cosmology made with handcrafted pebble stones inlaid in concrete.<br>The sculptures that were situated there were refurbished and moved to the north side as a visual factor at the end of the perpendicular streets to the Malecon. |
| | **Historic** | ---------- |
| **Sociability** | **Diverse** | Many activities included the coastline. |
| | **Stewardship** | Under the supervision of the governorate. |
| | **Cooperative& Friendly** | Through the various activities that take place on the coast. |
| | **Welcoming** | A romantic atmosphere was created through the “The Moonlight effect” and it became a place where locals and tourists can mingle under the local vegetation with a view of the ocean, both day and night. |
| **Identity analysis** | | |
| **Natural** | **Topography and soil** | Sea and sand |
| | **Weather** | Tropical, very pleasant, sunny, and warm most days of the year, stormwater precipitations |
| | **Hydrological conditions** | The intense waves created from strong tropical storms |
| **Human** | **Diversity of population** | It varies between locals and tourists |
| | **Cultural customs** | Puerto Vallarta is home to several major annual festivals. |
| | **Local economy** | Nearly 50% of the workforce is employed in tourism-related industries: hotels, restaurants, personal services, and transportation. In addition to agriculture and industry |
| | **Daily activities** | Swimming, walking, and watching the sunset from the park and the view of the locals and tourists on the ocean day and night. |
| **Human-made** | **Street system** | The street parallel to the sea |
| | **Beachfront** | Variety in scale regarding building function |
| | **Building form** | Depending on aesthetics and economy |
| | **Facilities in public space** | Urban facilities serving current activities |
| **Revitalize identity** | | |
| **Natural** | To solve the water precipitations, the rainfall water that runs along the perpendicular streets to the ocean was captured underneath the Malecon so it could be diverted to the sea. | |
| | For the intense waves, The new wall was proposed in reinforced concrete based on oceanography calculations with projections up to 100 years. | |
| **Human** | Palm plays an important role in creating a green corridor. | |
| | Forming small and cozy spaces which are suitable to culture. | |
| **Human-made** | It has kept its local character by embracing the traditional river stone paving technique with a design inspired by the local Huichol culture. By claiming the identity and tradition of today in the heart of Puerto Vallarta, the Malecón coastline exemplifies a role model in the Mexican Region. | |
| **Pros and Cons of Puerto Vallarta Coastline** | | |

| | |
|---|---|
| Return pedestrian traffic to the park again and separate it from car traffic | Lack of Effective management. |
| Respecting the natural identity of the region and finding solutions to the problems it causes | |
| Creating strong relationships between society and the place | There is no play area for children |

**4.3.5 Jeddah's Coastline, Jeddah, Saudi Arabia**

The Jeddah coastline is considered one of the prominent landmarks of Jeddah city and a vital entertainment destination facility for both Jeddah residents and visitors. This mega project, which started in 2011 to enhance and develop Jeddah's waterfront, aims to accomplish many goals through four main projects. (NASSAR, U. A, 2020).



**Figure 7.** Jeddah Coastline Development

**The main drive of the project was:**

- Connect the coastline as one design unit with different functions and public and social services.
- Reuse current cultural assets in future visions.
- Provide entertainment and social spaces for all family members and social classes.
- Assure safety and enjoyment for visitors and users and provide safe locations for different hobbies.
- Apply approved transportation studies to facilitate traffic in the promenade area.
- Provide a sound infrastructure system for electricity, sewage, water supply, and drainage.
- Redesign the commercial outlets to support the identity of the space.

**Table 6.** The analysis of the Jeddah Coastline

| **Project definition** | | | | |
|---|---|---|---|---|
| **Site location** | On the eastern coast of the red sea | | **Project scale** | City scale |
| **Designer name** | Dietmar Kamphans, KLA Kamphans LandscapeArchitecture GmbH | | **Development date** | The initial stage in 2012<br>The second stage in 2013 |
| **Facts** | The width of the promenade is about (10-115m)<br>The width of the sand is about (20-45m)<br>The width of the street is about (10m) | | | |
| **Project brief** | Jeddah coastline has a long history since the sea has been the primary tourist destination in Jeddah. Residents of Jeddah have always planned their entertainment programs and activities near the Red Sea.<br>Jeddah Corniche is 45 km long and it has been first constructed by Mohammad Saeed Farsi back in 1973. | | | |
| **Urban Analysis** | | | | |
| **Classification of Coastline** | **Closing** | Open | **User** | Public |
| | **Hierarchy** | Major | **Form** | Irregular |
| **Human Activities** | **Movement activities** | paths for the pedestrian and paths for the vehicle | | |
| | **Settlement activities** | When people see friends, meet their neighbors, and feel comfortable interacting with strangers | | |

| **Place-making analysis** | | |
|---|---|---|
| **Access and Linkage** | **Accessible** | The main path: Faisal Bin Fahd Street less than 300 meters from the new Jeddah coastline |
| | **Convenient** | The main transportation on the path: boats, cars, bicycles, and buses. |
| | **Walkable** | Some services and elements have been added for the first time to Jeddah's façade, equipped with services suitable for all categories and ages. Areas include the marine walk and bicycle route and the long pedestrian bridge in the kingdom (650 m long) that links Corniche and Prince Faisal Bin Fahad Streets. |
| | **Connected** | Jeddah's coastline is connected to the city by Cornish Street Faisal bin Fahad Street. |
| | **Continuity** | Jeddah coastline continues with a length of 4.2 km |
| **Uses and Activity** | **Fun and active** | Jeddah's coastline has a variety of land use: open museum and mosque, water park, sand beach, marina, open-air celebration center, public park, open-air restaurants, kids' playgrounds, family entertainment, different playgrounds, fun cities, restaurants, buffets, hotels, motels, and beach cabins for visitors. |
| | **Vital** | Jeddah's coastline has a variety of land use: open museum and mosque, water park, sand beach, marina, open-air celebration center, public park, open-air restaurants, kids' playgrounds, family entertainment, different playgrounds, fun cities, restaurants, buffets, hotels, motels, and beach cabins for visitors. |
| | **Special** | Some services and elements have been added for the first time to Jeddah's façade, equipped with services suitable for all categories and ages. Areas include marine walk, bicycle route, sports club, finishing area, open-air gym, playgrounds, water games, chess games, and cafes (Jeddah Chamber of Commerce). |
| | **Useful** | There are also facilities available for different hobbies, such as hunting, beach games, and swimming. Services available are suitable for all community members, including people with disabilities, blindness, and deafness. |
| | **Celebratory** | The coastline will contain an open-air celebration center for gatherings and events |
| | **Sustainable** | --------- |
| **Comfort and Image** | **Safe &Clean** | This street functions as an open-air museum filled with art features. Its green corridor creates an urban park fully equipped with seating furniture, playground equipment, and a 5-m promenade that meanders through and around the art features. |
| | **Walkable** | It can be walked in because the movement of vehicles is separated from pedestrians. |
| | **Attractive** | Jeddah's coastline contains amenities.<br>The project incorporates using an advanced system, including a sound system, control system, Wi-Fi network, and lighting poles. Other services to enhance user comfort include bathrooms, sessions powered by USB ports, and food shacks. It also incorporates a robust infrastructure, including drainage systems, a water network, and a power grid. |
| | **Historic** | ---------- |
| **Sociability** | **Diverse** | Many activities included the coastline |
| | **Stewardship** | Under the supervision of the government |
| | **Cooperative& Friendly** | Through the various activities that take place on the coast |
| | **Welcoming** | The design is perfect for the site, as the beach is bustling with vacationers. Its vibrant color scheme and dynamic form have made it a hit with many who live in or visit Beni dorm. |
| **Identity analysis** | | |
| **Natural** | **Topography and soil** | Sea, Sand |
| | **Weather** | Jeddah has a hot, desert climate with high humidity |
| | **Hydrological conditions** | Unstable diurnal tides |
| **Human** | **Diversity of population** | Most citizens are Sunni Muslims. |
| | **Cultural customs** | Jeddah is distinguished by its cultural heritage and the diverse Saudi heritage, and it has a history that extends to 3000 sciences |

| | | |
|---|---|---|
| | **Local economy** | Jeddah depends on tourism |
| | **Daily activities** | Diving in the Red Sea, relaxing on the sand and visiting the coastline |
| **Human-made** | **Street system** | The street parallel to the sea |
| | **Beachfront** | Variety in scale regarding building function |
| | **Building form** | Depending on aesthetics and economy |
| | **Facilities in public space** | Urban facilities serving current activities |
| **Revitalize identity** | | |
| **Natural** | Enhance the visibility of the sea | |
| **Human** | Human-enhanced cultural identity in open squares by periodic festivals, theatrical performances, and concerts | |
| **Human-made** | Jeddah's coastline has helped revive the ancient tradition of gathering their families and spending their day relaxing on the waterfront by providing convenient and comfortable seating. | |
| **Pros and Cons of Jeddah Coastline** | | |
| Improving accessibility | | Lack of effective management. |
| Creating solid relationships between society and the place | | |
| Enhancing the daily activities of the population | | Lack of parking facilities |
| The promenade serves as a regional draw and attracts visitors to the Jeddah coastline | | |

**4.3 Learned Lessons**

1. Improving the coastline through place-making can attract investors and tourists to the area, revitalizing the local economy. Furthermore, it draws highly skilled individuals who play a significant role in the new economy, enhancing the city's economic competitiveness.
2. Developing the coastline through place-making also promotes social justice by combining different dwelling types for different income levels within the same region and providing low-cost entertainment in coastal public spaces.
3. Developing the coastline through place-making enhances a local identity based on arts and culture because it seeks to shape the urban environment around arts and cultural activities relevant to the region's culture.
4. Place-making promotes an active and healthy lifestyle by creating sustainable environments. It encourages people to walk, bike, or take public transportation instead of driving, minimizing pollution.

**4.4 Design Guideline**

The design guidelines were established to lead the design proposals that will be developed accordingly and provide architects with an effective supporting tool to revitalize the coastal public space identity.

The design guidelines primarily emphasize defining the existing site potentials and assets of the studied area to use them as a cornerstone for the design proposals. Besides, a group of guiding points was set and distributed mainly in terms of accessibility, uses and activities, comfort and image, sociability, and identity as focal points as the following

**Table 7.** Design Guideline for Coastal Public Space

| In terms of Access and Linkage | In terms of uses and Activity | In terms of Comfort and Image | In terms of Sociability | In terms of identity |
|---|---|---|---|---|
| Improving accessibility. | Provide an active recreation coastline | The space is comfortable and has a good image. | Creating strong relationships between society and place. | Enhancing the local identity of the place based on art and culture. |
| Availability. | People have engaged in inactivity. | The suitability of a place, its shape, and its capacity within the behavior of the user. | Public perception of need. | The quality and character of society's needs. |
| Controlling the movement of | Having features that attract the visitor. | The factor of comfortable | Effective link. | Consider the Factors caused by geographical, |

| | | | | |
|---|---|---|---|---|
| people within the void. | | "Environmental-social-physical" | | climatic, and topographic conditions. |
| Adding a bicycle laneway. | Function. | The place makes a good first impression. | Create a shared community vision of the coastline. | Enhancing activities of local people, from daily activities to periodic festivals through history, architectural heritages or and living habits. |
| Separating the movement of the pedestrian and vehicle. | Integrated seasonal activities into each destination. | Are there enough places to sit? Are seats conveniently located? | Stakeholder participation. | |
| Creating floating promenades and platforms to define a new path and edge. | More activities that are going on and that people have an opportunity to participate | Provide Parking facilities. | Effective management. | |

**5. Conclusions**

Coastal public areas have helped shape and define the values of coastal cities. The identity of this place is a balanced blend of natural values, people, and the built environment. Establishing regulations that encompass physical and nonmaterial things will aid in returning the inherent values that have gradually vanished. Furthermore, the criteria's application should be more flexible. Although the significance of each aspect might change depending on the context, this effort will help add more value to the tradition and preserve it for future generations.

Place-making has many objectives (urban and economic goals, social and societal goals, environmental and health goals)

- They ensure easy access for all public along the coastline, particularly on foot and bike in Jeddah, allowing people to interact directly with the watercourse.
- They provide diverse water-dependent and related uses with multifunctional activities around the clock and throughout the year.
- Revitalizing and creating vital and flexible public spaces, embracing nature, and showcasing the local identity provide adaptable proper amenities.
- They fulfill the community's needs and visions and ensure public participation through the design processes when people are asked about the activities they want to practice. Furthermore, erudite management will maintain this vision and link it with a broader network.

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# The Evaluation of The Identity Features / Characteristics at Urban Waterfront Zones; The Case of Terme

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**Abstract**
Coastal settlements generally have various geographical features compared to other settlements. The social and spatial change of the coast in such settlements is related to the "land use strategy" of this environment. These changes guide the settlements and bring them to be dynamic in the architecture and urban space during the historical process. This study is " obtained from the thesis named The Evaluation of The Identity Features /Characteristics at Urban Waterfront zones; The Case of Terme". In this study, the role of the coastal zone, which acts as a border and threshold in the formation of urban identity, is discussed through the town of Terme, which has a stream running through it and has a coastline also. The survey study conducted in the area is analyzed with the Kruskal Wallis test. Along with these analyze, the effect of the coast on the urban identity was emphasized.
**Keywords:** Coast, Identity, Stream, Urban Identity, Terme

## 1. Introduction

"Water is a source of life, strength, comfort, and pleasure, a universal symbol of purification and renewal. Like a primitive magnet, water attracts a primitive and deep-rooted part of human nature. More than any other element besides trees and gardens, water has the greatest potential to form an emotional connection between man and nature in the city (Spirn, 1984)."

All living things, most notably humans, who have a role in the construction of civilizations, have always been in an inner connection with water. This relationship between water (oceans, seas, lakes, streams) and settlements has been in existence since ancient civilizations. When we look at water resources, 'flowing waters' such as streams have a distinctive place in terms of transportation, security, energy, agriculture, trade, and recreation as they are the life source of many cities (Nia & Suleiman, 2017). Water is one of the most basic human needs. For this reason, it is seen that the birth and rooting, and growth of many civilizations took place in coastal areas. The coastal settlement, which first started to meet the basic needs, continues to reinforce its importance with the effect of the dynamics that have changed over time. With the use of coastal areas for economic, aesthetic, functional, and social reasons, it has been seen that the city has developed in these areas. The water element, which is seen as an important factor in cities' development and planning process, has been seen as the most important social, economic, and aesthetic resource from past to present. These resources primarily provided economic benefits to the city, and then supported its aesthetic development. At the same time, the city's water areas create the city's social living spaces due to human nature's longing for water and the desire to establish a relationship with water.

The existence of the coast; is seen as an important natural identity component in terms of the development of the city and the formation of its identity. The usage patterns of coastal spaces determine the spatial setup, perception, and meaning of cities (Demiralp, 1998). It is possible to classify the cities settled by the water as formal cities and in this type of city; borders, slope, water features, vegetation, and geological forms seem to play a role in identity (Çöl, 1998).

In the social ecosystem, the individual has tried to search for his own space from the moment person interacts with the community and to create a place where the person can rebuild his existence and identity to ensure its continuity (Cresswell, 2004). The definition of a 'space' as a 'city' took place over a long period. In this process, the geographical content, cultural level, architecture, local traditions, lifestyle, and historical past of the city are the elements that form and shape the city (Suher, 2006). Many variables distinguish cities from others and enable them to be defined and named with their unique characteristics. Lynch (1981) states that these features that differentiate cities form the identity of the city. Coastal areas, which play an important role in the formation of urban identities, contribute greatly to the preservation of urban identity, architecture, and culture-specific in the region. In addition, this contribution positively affects urban development, livability, and the economy. The coast is an important boundary for settlements, as well as an interaction belt. Coasts are dynamic environments where settlements open out, interaction takes place, and land and water are geographically separated from each other. As an image of the city, Karabey (1978) discussed the coast over its geographical formation and formation process

and defined it as "a priority area of action where consumption and losses occur the most, production relations are determined, and which has a potential that creates high and rapid yields".

**2. Material and Methods**

within the scope of the study,in line with the examination of the 'identity element in coastal settlements' proposed, a two-stage study (theoretical and practical) was carried out. In the first stage of the study, research was conducted on the literature and analysis methods to provide the theoretical and conceptual infrastructure. Urban identity and coastal concepts form the conceptual framework of the study.

This study is aimed to analyze the physical structure of the stream coastal areas in the sample area in an analytical and theoretical framework, based on the effects of the space on human behavior, and to discuss it through the concepts of identity and coast.

In the study, the water element is primarily discussed and the importance of the water element has been emphasized since the beginning of the formation of cities. When the development processes of the cities are examined, it is seen that the water element has great importance for the cities and is an important component of their identities. For this reason, the concepts of coastal zone and urban waterfront are discussed.

In this context, the sample area of the study is the city of Terme, which has rich features in terms of the water element and at the same time, the stream passes through the city center and divides the city into two parts. Within the scope of the study seeks an answer to the problem of identity created by the stream in coastal settlements and the integration of the stream in the city. This constitutes the second phase of the study. At this practical stage, a field study was conducted by preparing survey questions on the concepts of coastal and urban identity. Along with the survey study, the relationship of the coast with the city was examined by taking the opinions of the citizens, and evaluations were made on the identity element in the coastal settlements.

Social data analyses that were obtained through a survey study, were first conducted in the city of Terme, which is the research area. The survey study was carried out in two stages. The first stage consisted of a survey conducted with people living in the region, who lived and experienced the part of their lives. The second stage covers the survey study with the determined focus group, which constitutes the supporting study. This determined focus group consisted of people who lived in Terme at a certain period of their lives but are not living now.

Through the concept of identity of urban coastal areas, it has been evaluated with assumptions such as "Coastal areas are urban public spaces that are important for the citizens" and "Urban morphology affects the use of the coast". As a hypothesis, it was determined that "the strong establishment of the city-shore relationship makes the coast a dominant element in the identity of that city".

Within the scope of the study, answers to the following research questions are sought:

- To what extent is the public use potential of the coasts covered?
- What are the criteria to be used in the identification of coastal areas?
- What is the level of interaction of the cities developing around the stream with water?

**3. The Identity Features / Characteristics at Urban Waterfront Zones**

***'Identity'***

According to Lynch, identity is defined as all the features created by nature or by humans to distinguish all beings from similar ones, but it also expresses the difference and originality of an entity from other entities.

Hall argues that identity is a process and "not a fixed point, but also the relation of the other to oneself and vice versa" (Hall, 1989). This expresses the reflexive nature of identity; therefore, the meaning of identity can be expressed and understood with the “concept of reflection” (Williams, 1989, p. 72). Ertürk also expresses the concept of identity as 'the state of being unique (Ertürk, 1996).

When considered with the place, the concept of identity can be defined as a basic feature that is affected by these experiences that affect people's experiences. Proshansky (1978) defines place identity as a complex pattern that combines the identity of place and person in its structure as determined by the preferences, expectations, feelings, values, and beliefs of people in their relations with the natural and structured environment, the physical world and other people. The needs that serve the purpose of the place, as well as the tastes and preferences of the people have great importance in the emergence of the identity of a place (Proshansky, H.M., Fabian, A.K., And Kaminoff, R., 1995).

***'Urban Identity'***

With the increasing rate of urbanization worldwide, raising awareness about the importance, difference, and meaning of urban identity becomes an important issue. Talking about the concept of urban identity, Proshansky(1983) uses the following expressions: The built environment has great importance on how the people living in the city express themselves in the society. After all, place identity is part of self-identity. Place identity arises from direct experience with the physical environment. Therefore, it reflects the social, cultural, and ethnic

aspects of the place. It is also central to one's well-being, as it helps preserve self-identity and facilitate adaptation to changing circumstances. Nevertheless, urban identity is defined by various shapes and means that show the dynamism of this phenomenon (Cheshmehzangi, 2012).
While Canter (1977) and Punter (1991) express the components of place identity that make urban spaces successful and effective as activities, physical environment, and perception; Montgomery (1998) elaborates on these parameters and mentions the existence of paradigms that form the identity of a place through their relations with each other.




**Figure 1.** Identity Components of Place (Montgomery, 1998).

***'The Concept of The Coast and The Relationship of Identity'***
Throughout history, the coasts have functioned as a social and economic interaction area for people; It has been one of the basic geographical elements that shaped the settlements and influenced the lifestyle.
The existence of the coast; is an important natural identity component in the development of the city and the formation of its identity. The usage patterns of the coastal space determine the spatial setup, perception, and meaning of the cities (Demiralp, 1998).
Coasts have been one of the important physical factors for humanity and urbanization throughout history. The coasts have always positively affected the cities they are connected to, whether in terms of making social and economic contributions to the city, providing recreational opportunities, and meeting the secondary needs of people due to their aesthetic values (Erkmen, 2015).
Historical, cultural, and natural values form the characteristic settlement form and identity of the city together with the surrounding spaces on the city scale. It is possible to express the factors that primarily affect the identity formation of cities as topography, having a natural harbor and coast, cultural structure, and historical past. The urban functions and the structure of the city, which are formed depending on these elements, contribute to the formation of the identity of that city. When the identity elements originating from the natural environment are examined, it is seen that the water element is one of the important elements that make up the urban identity. Due to its natural structure, many cities form their structures with the water element they contain, and these structures are reflected in the identity of the city.

**4. The Case of Terme**
In this part of the study, the analysis of the sustainability of the urban identity in terms of coastal areas was carried out over the city of Terme, which was chosen as the sample area. To be able to evaluate the Terme settlement, primarily the data obtained by literature research and analyses about the location of the city, its natural features, historical development, physical, demographic and economic structure were compiled.
***'Location and General Features of Terme City'***
Terme district is located within the borders of Samsun province. Samsun province, which is located in the middle of the Black Sea coastline between the deltas where Yeşilırmak and Kızılırmak streams flow into the Black Sea, has a surface area of 9,083 km². Geographically, it is between 40° 50' - 41° 51' north latitudes, 37° 08' and 34° 25' east longitudes. The province of Samsun, where the Black Sea is located in the north, is surrounded by Ordu in the east, Sinop in the west, Tokat and Amasya in the south, and Çorum in the south-west.

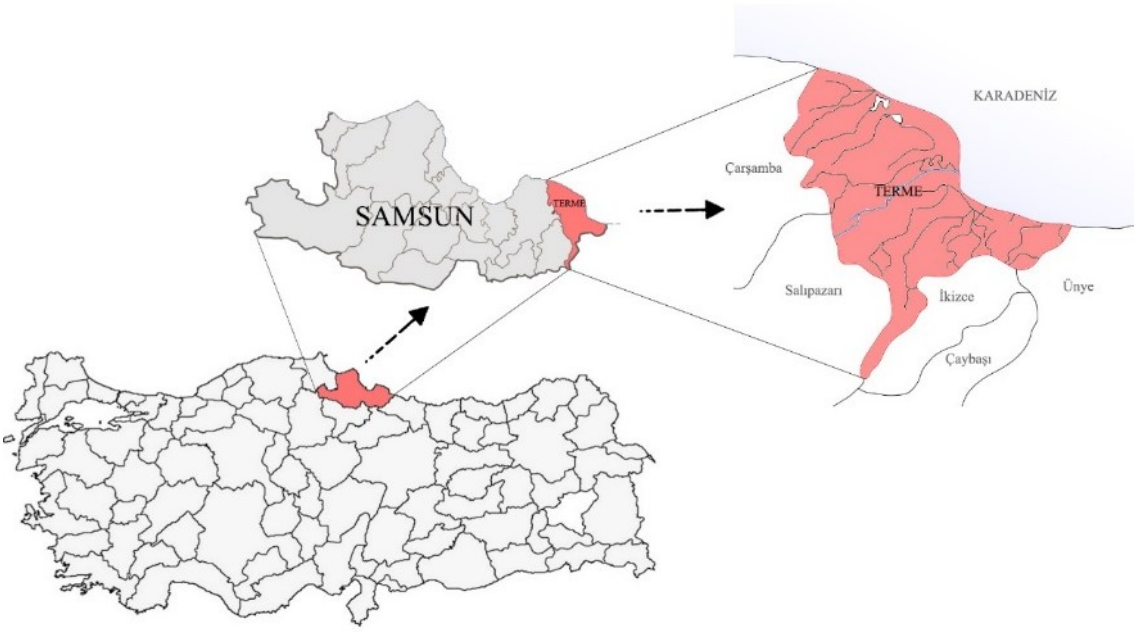


**Figure 2.** Location Map of Terme City (Developed by Author).

Terme is in the Central Black Sea part of the Black Sea Region, 3-5 km from the sea. It is a district of Samsun province established inside. Its distance to Samsun is 58 km. There are the Black Sea in the North of the district, Ünye and İkizce in the East, Akkuş in the South, and Salıpazarı and Çarşamba Districts in the West. The coastal plain stretches in the north, the Canik Mountains are in the south, and its highest point is 450 meters. The Terme Stream, which originates from the Black Forest, divides the district into two in the middle and flows into the Black Sea. Akgöl and Simenit lakes, which are connected by natural channels, are located in the area close to the sea between the Black Sea and Terme district. Terme is the district of Samsun with the longest coastline.

***'Terme Coastal Settlement'***

Terme has a very rich structure in terms of hydrological elements and water. There are many lakes, streams, and canals in the district of Terme, which run through the Terme Stream, which irrigates the paddy fields. Simenit Lake, Akgöl, and Terme Stream are expressed as the most important hydrological elements. Hydrological elements in Terme's current plan; It is possible to list two drying channels, swamps, and Terme Stream. Considering these data, 0.5% (6Ha) of the center is canals, 1.6% (19Ha) is marsh and 1% (11Ha) is Terme Stream. Considering the positions of the swamps, it is seen that they are very close to the settlement.

When the close surroundings of Terme and the Terme Stream Basin are examined; The most important hydrological elements of the region; are the Black Sea, Terme Stream, Kocaman Stream, Simenlik Lake, and Akgöl. In this study, Terme Stream and its surroundings are discussed.

When Terme Stream and its surroundings are considered in terms of their relationship with the water element, it is possible to express them as disconnected spaces in the city where the citizens can interact. It is possible to state that the main reason for this is that this area does not have integrated planning with the city and the flood problem has not been resolved. Flood events occur as a result of effective precipitation in a short time. Floods, which occur mostly in summer, cause many casualties but also cause great damage to agricultural areas and cultivated products, workplaces, residences, and roads. Due to these reasons, it is possible to say that the coastal connection could not be established in and around the Terme Stream.

**5. Terme Coastal Settlement in the Context of User Perception**

In the light of the data obtained as a result of the literature review on the field, a survey was conducted with the people in the field. With these interviews, the awareness of the participants about the coastal areas in the city was determined, and inferences were made about the effect of the stream element on the urban identity and the sustainability of this identity.

Qualitative and quantitative research methods were used in this study. Field research and literature review constitutes the qualitative method of the study, and the statistical results obtained with the questionnaire applied in the study area constitute the quantitative method.

With these analyzes and survey work, the awareness of the users about the coastal and water element in the city was examined and the effect of the water element, which is an important element in the identity of the city, was investigated.

***'Survey Work'***

In line with the concepts of coast and identity examined in the research, the survey questions are grouped and addressed. With the grouped survey questions, survey questions were designed with the indicators planned to be determined and the components obtained, specific to the study area.

The survey was carried out at the points indicated on the map. These points were built around the market area and the square, together with the two sides of the stream.



**Figure 3.** Terme stream and surveyed areas (Developed by Author).

Within the scope of the study, questions were prepared to express the effect of the use of the coast on the identity of the city and the awareness of the stream on the user in the city of Terme, which was determined as the sampling area. These question groups are as follows;

- Understanding User Profile (Demographic Structure)
- Coastal Perception
- Terme Coastal Areas
- Concept of Identity
- Perception of Space

First of all, physical analyzes made in the study area are included. The stream and its surroundings are handled spatially and the relationship between the stream bank and its surroundings is revealed in the section analysis.

Secondly, in the research studies, in line with the statistical information of the survey results in the study area and the hypotheses of the study, the inferences for testing the statistically significant difference for the determined groups were evaluated with the help of the Kruskal Wallis test, relations and group difference analysis. The evaluation of the results of the survey study was also carried out in two stages.

The research is a cross-sectional type of research. The data obtained through the questionnaire were analyzed in a computer environment using IBM SPSS Statistics version 25.0. In the study, the level of significance was taken as $\alpha = 0.05$.

At this stage, an answer is sought to the question of whether the answers given for "Living in Terme" and "Not Living in Terme" are significantly different, and therefore, a difference analysis has been put forward. Firstly, frequency (frequency) and percentage distribution information are given for demographic and general information about the participants in the survey. To test the hypotheses and to determine which test is suitable for this, it was tested whether the distribution of the data was normal. Kolmogorov-Smirnov and Shapiro-Wilk normal distribution tests, which are included in the SPSS program, were performed. As a result of these tests, since the dimensions of

the items obtained from the scales were not normally distributed ($p<0.05$), non-parametric methods that did not require normal distribution were used in the analyses.

• The expression "People Living in Terme" refers to individuals still living in Terme.

• The expression "those who do not live in Terme" refers to individuals who have lived in Terme at a certain period of their life and have experienced the area.

***'Results'***

**5.1 Group Difference Test Results by Frequency and Percentage Distribution of Demographic Characteristics and by Participant Group**

In this section, the frequency and percentage distribution of demographic characteristics and the results of the group difference test according to the participant group were examined.

**Table 1.** Questions About the Concept of Demographic Characteristics and Statistical Data

| | **Participant Group** | | | |
|---|---|---|---|---|
| | **Those Who Do Not Live İn Terme** | | **People Living in Terme** | |
| | **n** | **%** | **n** | **%** |
| **Age** | | | | |
| 18-29 years | 13 | 19,7 | 124 | 32,6 |
| 30-45 years | 24 | 36,4 | 166 | 43,7 |
| age 46 and over | 29 | 43,9 | 90 | 23,7 |
| **Gender** | | | | |
| Woman | 25 | 37,9 | 174 | 45,8 |
| Boy | 41 | 62,1 | 206 | 54,2 |
| **Educational Status** | | | | |
| Primary education | 1 | 1,5 | 67 | 17,6 |
| High school | 14 | 21,2 | 206 | 54,2 |
| University | 38 | 57,6 | 99 | 26,1 |
| graduate | 13 | 19,7 | 8 | 2,1 |
| **Job** | | | | |
| Private sector | 19 | 28,8 | 93 | 24,5 |
| Public | 16 | 24,2 | 36 | 9,5 |
| Independent | 5 | 7,6 | 34 | 8,9 |
| Housewife | 11 | 16,7 | 83 | 21,8 |
| Student | 3 | 4,5 | 68 | 17,9 |
| Retired | 10 | 15,2 | 43 | 11,3 |
| Unemployed | 2 | 3,0 | 23 | 6,1 |
| **What is your reason for being in Terme?** | | | | |
| Residence | 39 | 59,1 | - | - |
| work | 3 | 4,5 | - | - |
| Visit | 24 | 36,4 | - | - |
| **How often do you visit Terme?** | | | | |
| Every week | 9 | 13,6 | - | - |
| 1 time per month | 14 | 21,2 | - | - |
| 1 time per year | 40 | 60,6 | - | - |
| more than 1 year | 3 | 4,5 | - | - |
| **How long have you been living in Terme?** | | | | |
| 1-5 years | - | - | 4 | 1,1 |
| 5-10 years | - | - | 9 | 2,4 |
| 10-20 years | - | - | 92 | 24,2 |
| 20 years and above | - | - | 275 | 72,4 |
| **Where do you reside?** | | | | |
| Bahcelievler District | - | - | 45 | 11,8 |
| Cay District | - | - | 128 | 33,7 |
| Fenk District | - | - | 88 | 23,2 |

| | | | | |
|---|---|---|---|---|
| Yali District | - | - | 34 | 8,9 |
| New Neighborhood | - | - | 85 | 22,4 |

- While the majority of the participants in the “those who do not live in Terme” are in the age group of 46 and over with a rate of 43.9%, the majority of the participants in the “People Living in Terme” are in the age group of 30-45 with a rate of 43.7%.
- The majority of the participants in the “those who do not live in Terme” and “People Living in Terme” are male.
- The majority of the participants in the “those who do not live in Terme” have a university education with a rate of 57.6%, and the majority of the participants in the “People Living in Terme” have a high school education with a rate of 54.2%.
- The majority of the participants in the “those who do not live in Terme” work in the private sector, with a rate of 28.8%, and the majority of the participants in the “People Living in Terme” with a rate of 24.5%.
- The majority of the participants in the People Living in Terme group reside in Terme with a rate of 59.1%. The majority of the participants in the “those who do not live in Terme” visit Terme once a year with a rate of 60.6%.
- The majority of the participants in the “those who do not live in Terme” have been living in Terme for 20 years or more, with a rate of 72.4%. The majority of the participants in the “People Living in Terme” reside in Çay Mahallesi with a rate of 33.7%.

**5.2 Frequency and Percentage Distributions for the First Part Questions of Coastal Perception and Group Difference Test Results by Participant Group**

In this section, the frequency and percentage distribution results of the first part of questions on the coastal perception and group difference test results by participant groups are examined.

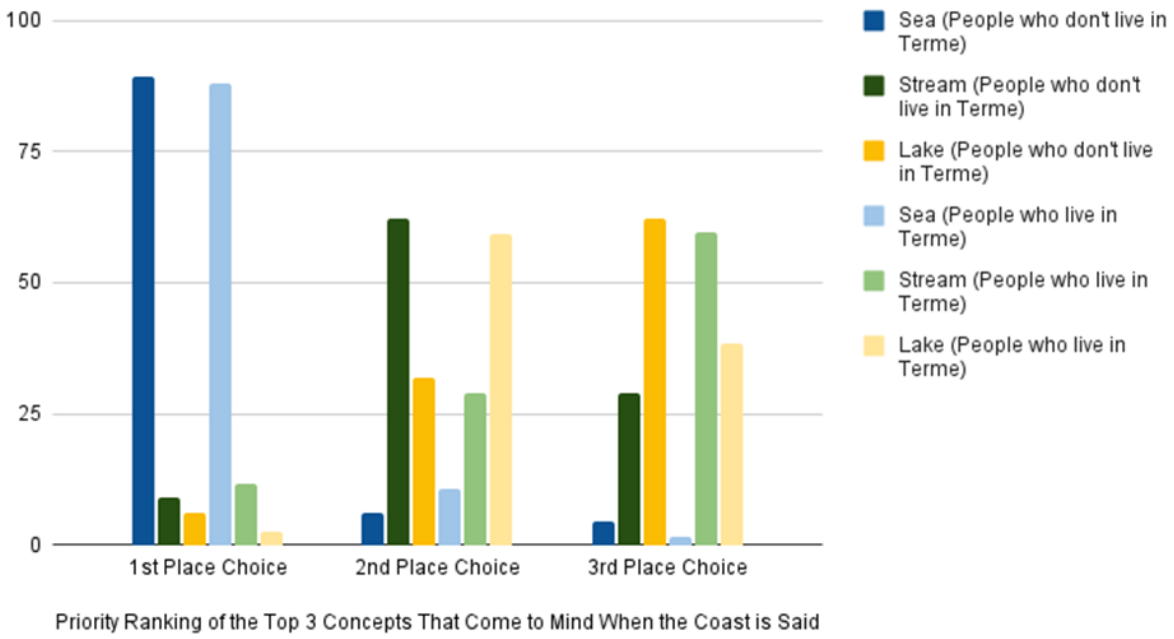


**Figure 4.** Priority Ranking of The Top 3 Concepts That Come To Mind When The Coast is Said (Developed by Author).

- When the coast is mentioned, 89.4% of the participants in the "Do Not Live in Terme" group think of the sea first, 62.1% think of the stream in the second place, and 62.1% of them think of the lake in the third place.
- When the coast is mentioned, 87.9% of the participants in the "Living in Terme" group think of the sea in the first place, 59.5% of them think of the stream in the third place, and 59.2% of them think of the lake in the second place. The priority order of the stream and lake concepts shows a significant difference between the participant groups.

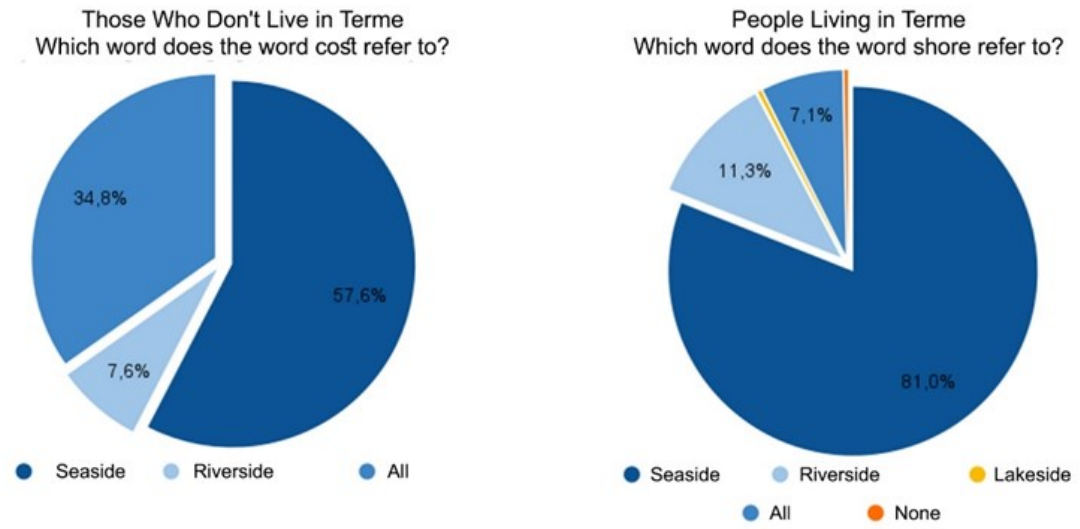


**Figure 5.** Those Who Don't Live in Terme Which Word does Cost Refer To? (Developed by Author).

- The word 'coast' refers to the seaside for both groups. The expression of the word coast shows a significant difference between the participant groups.

### 5.3 Frequency and Percentage Distributions for the Second Part Questions of Coastal Perception of Terme and Group Difference Test Results by Participant Group

In this section, the frequency and percentage distribution of the terme coastal perception of the second part questions and group difference test results by participant groups are examined.

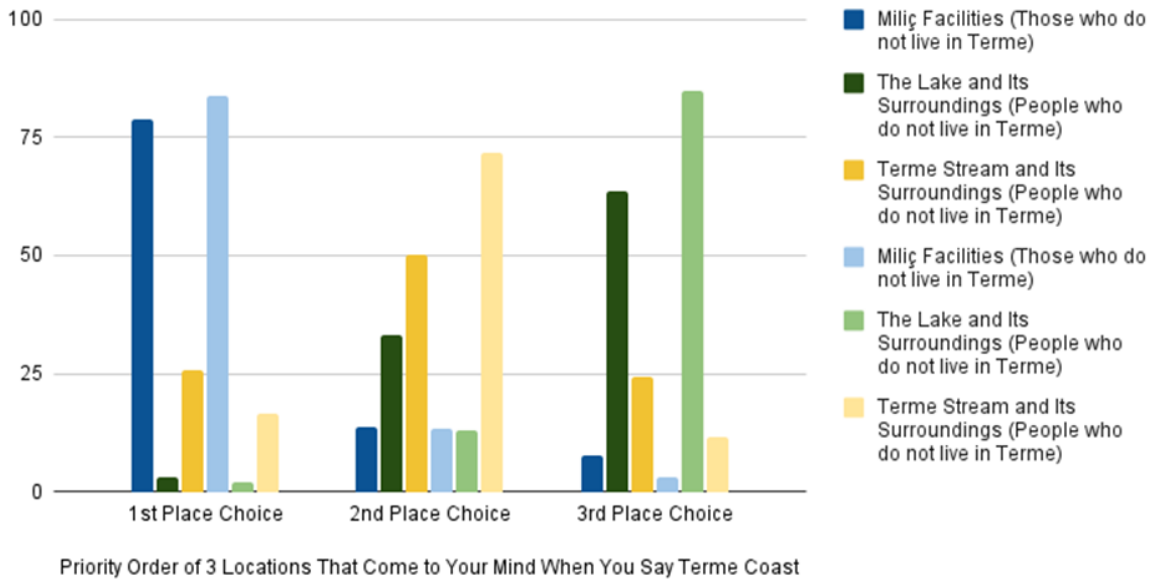


**Figure 6.** Priority Order of 3 Locations That Come to Your Mind When You Say Terme Coast (Developed by Author).

- When the 'Terme coast' is mentioned, miliç facilities (seaside) come to mind for the participants in both groups. The expression of the word coast shows a significant difference between the participant groups.

### 5.4 Frequency and Percentage Distributions for Identity Concept Questions and Group Difference Test Results by Participant Group

In this section, frequency and percentage distributions for identity concept questions and group difference test results by participant group results are examined.

**Table 2.** Questions About the Concept Of Identity And Statistical Data

| | Participant Group | | | | P |
|---|---|---|---|---|---|
| | Those Who Do Not Live İn Terme | | People Living in Terme | | |
| | n | % | n | % | |
| **Order of priority of the most prominent and striking places of Terme** | | | | | |
| **Square** | | | | | |
| 1st place preference | 26 | 39,4 | 159 | 41,8 | 0,065 |
| 2nd place preference | 19 | 28,8 | 170 | 44,7 | |
| 3rd place preference | 10 | 15,2 | 29 | 7,6 | |
| 4th place preference | 9 | 13,6 | 16 | 4,2 | |
| 5th place preference | 2 | 3,0 | 6 | 1,6 | |
| **Terme Stream and Its Surroundings** | | | | | |
| 1st place preference | 19 | 28,8 | 40 | 10,5 | 0,000* |
| 2nd place preference | 30 | 45,5 | 84 | 22,1 | |
| 3rd place preference | 8 | 12,1 | 230 | 60,5 | |
| 4th place preference | 3 | 4,5 | 17 | 4,5 | |
| 5th place preference | 6 | 9,1 | 9 | 2,4 | |
| **Seaside** | | | | | |
| 1st place preference | 23 | 34,8 | 197 | 51,8 | 0,001* |
| 2nd place preference | 14 | 21,2 | 98 | 25,8 | |
| 3rd place preference | 19 | 28,8 | 53 | 13,9 | |
| 4th place preference | 9 | 13,6 | 29 | 7,6 | |
| 5th place preference | 1 | 1,5 | 3 | 0,8 | |
| **Forests** | | | | | |
| 1st place preference | 4 | 6,1 | 12 | 3,2 | 0,000* |
| 2nd place preference | 4 | 6,1 | 21 | 5,5 | |
| 3rd place preference | 22 | 33,3 | 26 | 6,8 | |
| 4th place preference | 18 | 27,3 | 82 | 21,6 | |
| 5th place preference | 18 | 27,3 | 239 | 62,9 | |
| **Market place** | | | | | |
| 1st place preference | 3 | 4,5 | 11 | 2,9 | 0,000* |
| 2nd place preference | 11 | 16,7 | 17 | 4,5 | |
| 3rd place preference | 14 | 21,2 | 39 | 10,3 | |
| 4th place preference | 29 | 43,9 | 230 | 60,5 | |
| 5th place preference | 9 | 13,6 | 83 | 21,8 | |
| **Why do these places grab your attention?** | | | | | |
| **To be central** | | | | | |
| Yes | 40 | 60,6 | 202 | 53,2 | 0,263 |
| No | 26 | 39,4 | 178 | 46,8 | |
| **Being Reachable** | | | | | |
| Yes | 9 | 13,6 | 212 | 55,8 | 0,000* |
| No | 57 | 86,4 | 168 | 44,2 | |
| Yes | 16 | 24,2 | 67 | 17,6 | 0,203 |
| No | 50 | 75,8 | 313 | 82,4 | |
| **Being Active and Intense** | | | | | |
| Yes | 1 | 1,5 | 39 | 10,3 | 0,022* |
| No | 65 | 98,5 | 341 | 89,7 | |
| **Where are the places/areas/regions where you spend most of your time in Terme?** | | | | | |
| Square | 23 | 34,8 | 181 | 47,6 | 0,456 |
| Terme Stream and Its Surroundings | 15 | 22,7 | 32 | 8,4 | |

| | | | | | |
|---|---|---|---|---|---|
| Seaside | 19 | 28,8 | 25 | 6,6 | |
| Cafes | 5 | 7,6 | 34 | 8,9 | |
| Market place | 4 | 6,1 | 88 | 23,2 | |
| None (I'm spending time at home) | - | - | 20 | 5,3 | |
| **What is the reason you spend most of your time in these areas?** | | | | | |
| to be central | 27 | 40,9 | 136 | 35,8 | 0,027* |
| Being Reachable | 14 | 21,2 | 77 | 20,3 | |
| Being Calm and Peaceful | 22 | 33,3 | 57 | 15,0 | |
| Being Active and Intense | 3 | 4,5 | 46 | 12,1 | |
| Shopping | - | - | 58 | 15,3 | |
| Child park | - | - | 6 | 1,6 | |

- One of the most prominent and most striking places in Terme, the square was placed in the first place by 39.4% of the participants in the group of those who do not live in Terme, and 44.7% of the participants in the group of those living in Terme, in the second place.
- One of the most prominent and striking places in Terme, Terme Stream and its surroundings were placed in the second place by 45.5% of the participants in the Non-Terme group, and by 60.5% of the participants in the Terme-Living group in the third place.
- The priority order of Terme Stream and its surroundings shows a significant difference between the participant groups.
- The seaside, one of the most prominent and most striking places in Terme, was placed in the first place by 34.8% of the participants in the group of those who do not live in Terme, and 51.8% of the participants in the group of those living in Terme. The priority order of the seaside shows a significant difference between the participant groups.
- Forests, one of the most prominent and most striking places in Terme, were placed in the third place by 33.3% of the participants in the group of those who do not live in Terme, and 62.9% of the participants in the group of those living in Terme in the fifth place. The priority order of forests shows a significant difference between the participant groups.
- One of the most prominent and most striking places in Terme, 43.9% of the participants in the group of those who do not live in Terme placed the marketplace in the fourth place, and 60.5% of the participants in the group of those who live in Terme placed it in the fourth place. The priority order of the marketplace shows a significant difference between the participant groups.
- The majority of those who do not live in Terme and the majority of the participants in the priority group say that these places attract their attention because they are central. While the majority of the participants in the group of those who do not live in Terme say that these places do not attract their attention because of their accessibility, the majority of the priority group says that they attract their attention because they are accessible. The reason why it is "accessible" shows a significant difference between the participant groups. The majority of the participants in those who do not live in Terme and their priority groups stated that the reason why these places attract their attention is not that they are quiet and peaceful. The majority of the participants in the People Who Don't Live in Terme and Those Who Live in Terme stated that the reason why these places attracted their attention was not because of their mobility and density. The reason for "it is active and busy" shows a significant difference between the participant groups. Participants in the group of those who do not live in Terme spend most of their time in the square with a rate of 34.8%, and those in the group of those living in Terme with a rate of 47.6%. 40.9% of the participants in the group of those who do not live in Terme and 35.8% of the participants in the priority group spend their time in these places; since they are the most central. The reason for spending the most time shows a significant difference between the participant groups.

**5.5 Frequency and Percentage Distributions for Space Perception Questions and Group Difference Test Results by Participant Group**

In this section, frequency and percentage distribution of space perception questions and group difference test results by participant group were examined.

**Table 3.** Questions About Space Perception and Statistical Data

| | Participant Group | | | | P |
|---|---|---|---|---|---|
| | Those Who Do Not Live İn Terme | | People Living in Terme | | |
| | n | % | n | % | |
| **Terme is a settlement with the identity of a coastal city.** | | | | | |
| I strongly disagree | 3 | 4,5 | 14 | 3,7 | 0,093 |
| I do not agree | 15 | 22,7 | 142 | 37,4 | |
| I'm undecided | 12 | 18,2 | 34 | 8,9 | |
| I agree | 29 | 43,9 | 176 | 46,3 | |
| Absolutely I agree | 7 | 10,6 | 14 | 3,7 | |
| **Terme Stream passing through your city creates the identity of the city.** | | | | | |
| I strongly disagree | - | - | 4 | 1,1 | 0,000* |
| I do not agree | 3 | 4,5 | 91 | 23,9 | |
| I'm undecided | 7 | 10,6 | 63 | 16,6 | |
| I agree | 38 | 57,6 | 191 | 50,3 | |
| Absolutely I agree | 18 | 27,3 | 31 | 8,2 | |
| **How much time do you spend in the coastal area of Terme Stream, which runs through your city?** | | | | | |
| A few minutes | 9 | 13,6 | 47 | 12,4 | 0,024* |
| less than half an hour | 16 | 24,2 | 112 | 29,5 | |
| Half an hour | 18 | 27,3 | 179 | 47,1 | |
| over an hour | 23 | 34,8 | 42 | 11,1 | |
| **Terme Stream, is stream an important factor when you come to the coastal area?** | | | | | |
| Yes | 38 | 57,6 | 81 | 21,3 | 0,000* |
| No | 28 | 42,4 | 299 | 78,7 | |
| **Terme Stream and its surroundings passing through your city do not appeal enough to the users in terms of functional diversity.** | | | | | |
| I strongly disagree | 4 | 6,1 | 8 | 2,1 | 0,002* |
| I do not agree | 4 | 6,1 | 19 | 5,0 | |
| I'm undecided | 5 | 7,6 | 9 | 2,4 | |
| I agree | 20 | 30,3 | 83 | 21,8 | |
| Absolutely I agree | 33 | 50,0 | 261 | 68,7 | |
| **The Terme Stream and its surroundings, passing through your city, have an arrangement in the socio-cultural context (the water culture that the stream brings to the citizens (fishing, walking habits by the stream, the habit of using the riverside for rest and sightseeing purposes.. etc.) that the citizens of the city will fully benefit from.** | | | | | |
| I strongly disagree | 19 | 28,8 | 183 | 48,2 | 0,000* |
| I do not agree | 24 | 36,4 | 146 | 38,4 | |
| I'm undecided | 15 | 22,7 | 19 | 5,0 | |
| I agree | 7 | 10,6 | 22 | 5,8 | |
| Absolutely I agree | 1 | 1,5 | 10 | 2,6 | |
| **Terme coastal area has sufficient features in terms of spatial characteristics.** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| I strongly disagree | 25 | 37,9 | 143 | 37,6 | 0,445 |
| I do not agree | 28 | 42,4 | 199 | 52,4 | |
| I'm undecided | 9 | 13,6 | 17 | 4,5 | |
| I agree | 3 | 4,5 | 14 | 3,7 | |
| Absolutely I agree | 1 | 1,5 | 7 | 1,8 | |

- “Terme is a settlement with the identity of a coastal city.” While the participants of the People Who Don't Live in Terme group gave the most "I agree" answers with 43.9%, the participants of the People Living in Terme group gave the most "I agree" answers with 46.3%.
- “Terme Stream passing through your city creates the identity of the city.” While the participants of the People Who Don't Live in Terme group gave the most "I agree" answer with 57.6%, the participants of the People Living in Terme group gave the most "I agree" answer with 50.3%. “The Terme Stream, which runs through your city, creates the identity of the city.” The answers to the proposition show a significant difference between the participant groups.
- “How much time do you spend in the coastal area of Terme Stream, which runs through your city?” While those who do not live in the Terme group gave the most the answer "More than one hour" with 34.8%, the participants of the group living in Terme gave the most answer "Between half an hour" with a rate of 47.1%. “How much time do you spend in the coastal area of Terme Stream, which runs through your city?” The answers to the proposition show a significant difference between the participant groups.
- “Terme Stream, is stream an important factor when you come to the coastal area?” While the participants of the People Who Don't Live in Terme group gave the most "Yes" answer with 57.6%, the participants of the People Living in Terme group gave the most "no" answer with 78.7%. “Terme Stream, is tea an important factor in your coming to the coastal area?” The answers to the proposition show a significant difference between the participant groups.
- “Terme Stream and its surroundings passing through your city do not appeal enough to the users in terms of functional diversity.” While the participants of the People Who Don't Live in Terme group gave the most "Strongly Agree" answer with 50%, the participants of the People Living in Terme group gave the most "Strongly Agree" answer with 68.7%. “The Terme Stream and its surroundings passing through your city do not appeal to the users enough in terms of functional diversity.” The answers to the proposition show a significant difference between the participant groups.
- “The Terme Stream and its surroundings, passing through your city, have an arrangement in the socio-cultural context (the water culture that the stream brings to the citizens (fishing, walking habits by the stream, the habit of using the riverside for rest and sightseeing purposes.. etc.) that the citizens of the city will fully benefit from.” While the participants of the People Who Don't Live in Terme group gave the most “I Disagree” answers with 36.4%, the participants of the People Living in Terme group gave the most “Strongly Disagree” answers with 48.2%. In the socio-cultural context (the water culture that the stream brings to the citizens (fishing, walking habits by the stream, the habit of using the riverside for rest and sightseeing purposes, etc.) it has an arrangement that the citizens can fully benefit from.” There is a significant difference between the participant groups. shows.
- “Terme coastal area has sufficient features in terms of spatial characteristics.” While the participants of the People Who Don't Live in Terme group gave the most "Disagree" answers with 42.4%, the participants of the People Living in Terme group gave the most "Disagree" answers with 52.4%.

**5. Conclusions**

From the past to the present, the phenomenon of water has been seen as an important factor in the development of the city in terms of its contribution to the development of residential areas, and the visual, economic, and cultural values it adds to the city. Cities settled on the coast benefited from water as an element that shaped their identity, economic structure, and mode of transportation.

It is possible to express the city of Terme as a city with rich resources in terms of water elements. These water elements appear as important identity elements of the city. However, it is seen that these areas cannot be used effectively as a result of wrong construction and planning. The awareness of the citizens about that place is gradually decreasing. It is stated that cities with high natural resource potential such as Terme will make significant contributions to the city and the people of the city in terms of economic and social life. At this point, institutions should take decisions primarily on the point of establishing the relationship of the stream with the city and its inhabitants. With these decisions to be made for the Terme stream and its surroundings, negative uses should be prevented and measures should be taken to increase the contribution value of the city.

One of the biggest problems of the stream and its surroundings is the lack of continuity and suitable usage conditions. In addition to these, the use of the coast is low, there are idle areas and the coastline cannot be used uninterruptedly. Although Terme Stream is a remarkable element for the city, it cannot establish a relationship with the citizens. In the studies to be carried out on the area, solutions should be brought to these points as a priority. It is foreseen that the easy access to the stream coastal area will increase the perceptual value of the area by enlarging the user profile and establishing relations. Changing the viewpoint of the citizens to the area is possible with the increase of usage areas and effective planning. With these planning studies, the aims are;

- Reducing flood damages
- Protecting the buffer zone on the riverbank
- Preventing water quality and transport of fertile soils
- Connecting the citizens with the natural elements along the stream and its surroundings.
- Ecosystem protection: Conservation of natural vegetation and aquatic habitat and improvement of degraded areas,
- Ensuring the protection of cultural landscape values: Protecting areas with historical and social values,
- Rehabilitation of misused resources: Improving water quality, stopping inappropriate behavior such as littering, and establishing a program for replanting.
- Recreation: Determination of current and potential recreation areas and activities,
- Linear pathways: Sorting the walking and cycling pathway networks that connect to the activity areas of the city along the stream, determining the main lines of the passages for situations such as street intersections in this connection,
- Outline of landscape design: laying out standards for building techniques, vehicle entrance, parking lots, stream structures, park furniture, and determining planting techniques,

should be in shape.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Morphological Changes in *Kampung* Pahandut of Palangka Raya City in Response to the Cultural Shift of Riverside Communities

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**Abstract**
Palangka Raya, the capital city of Central Kalimantan, Indonesia, had been rapidly transformed and triggered the morphological changes in both the environment and architectural order. The urban growth caused the morphological transformation, and in effect, the city of Palangka Raya continuously displayed symptoms of urban deterioration. Modernization engendered the city to lose the architectural identity of *Rumah panggung* (stilt houses) and suffers the environmental disorder. There has been a tendency in the city orientation to shift into an ordinary "land city". Focusing on the oldest part city in *Kampung* Pahandut, we conducted a field survey to map the situation on the ground. We also generated 3D mapping using the drone to obtain precisely the morphological pattern of the area. The study revealed that the condition of the waterfront environment is constantly changing. The community that lives adjacent to Kapuas River must adapt to environmental conditions by utilizing the strategy of architectural adaptations of adjustable, refillable, and movable. Although the city of Palangka Raya transformed into a land-based city and left behind the riverfront area, in the oldest part of the city at kampung Pahandut, the community still maintains the Kahayan River as the source of people's daily lives.
**Keywords:** Transformation; morphology; Kampung Pahandut; Culture; Riverside.

## 1. Introduction

Cities in Kalimantan have unique geographical conditions that grow from the banks of rivers and surround by swamps and wilderness. The cities in Central Kalimantan Province are: Palangka Raya, Kuala Kapuas, Kasongan, Kuala Kurun, Sampit, Pangkalan Bun, Lamandau, Sukamara, Muara Teweh, and Buntok. They are known as "River City" because they are divided by rivers that still hold the role of the community's lifeblood and source of life. The growth of the riverside area organically forms a linear circulation pattern following the river so that it affects the morphological pattern of the cities.

Palangka Raya City is the capital of Central Kalimantan Province, divided by the Kahayan River, one of the longest rivers in Central Kalimantan Province. The Sebangau River and Rungan River are branches of the Kahayan River that meander tributary patterned with a mountain. Bukit Jehan, located on the southwest is an embryo of downtown Palangka Raya. It is unique historically because it became the first city deliberately designed by Soekarno. Its position is at the corner of the Kahayan River and adjacent to the indigenous Dayak tribal settlement, namely *Kampung* Pahandut. In historical records, the first pole of the construction of Palangka Raya City was carried out on July 17, 1957, by the president of the Republic of Indonesia, Ir. Soekarno. This event became the momentum and marked the starting point of Palangka Raya city as the city of *'Modal'* and *'Model'* or a city with sacred meaning because the invaders never colonized it.

However, the development of Palangka Raya city is constantly undergoing a transformation from a waterside city to a land-oriented city. The city experiences symptoms of changes in the natural elements and forms a new type of architectural building. As a result, the city tends to abandon the culture of riverside life. When the function of the river changes, the awareness, and association of Palangka Raya with the river also changes. Like other cities or settlements in Central Kalimantan, Palangka Raya grows and develops into an ordinary city that leaves its identity as a riverfront city and fades its authenticity.

This study will enrich the diversity of urban spatial formation in Indonesia during the periodization of development. Many cities in Indonesia grow and develop as the products of urban struggle adapting to the rapid growth. It aligns with Kostof's theory (1991) that distinguishes the geometric shape of cities into a planned city and an unplanned city.

By interpreting the development of the old city of Palangka Raya in the riverside area at *Kampung* Pahandut, this study aims to reveal the adaptation strategies that affected the configuration of the riverfront settlement as the consequences of the urban morphological changes. This research will enrich the theory of morphological transformation of the waterside area due to economic, social, and cultural changes that affect the way people living and settling in the waterside area.




**Figure 1.** Location of Study, *Source:* Authors, 2022

## 2. Literature review

### 2.1 Special Physical Transformation

Various disciplines of urban planning, regional planning, urban design, urban geography, urban environment, urban buildings, and architecture are mainly concerned with the urban form as the agents responsible for their transformation. Urban form refers to the main physical elements that structure and shape the city; they consist of the streets (and squares), urban plots, and buildings (Olievera, 2016, Aziz Amen & Nia, 2018). Meriam Webster mentioned the definition of transformation as an act, process, or instance of transformation or being transformed. According to Anderson and Anderson (2001), transformation is the radical shift from one state of being to another. Transformation is not synonymous with change or other words, *"transformational change is not constant, but rather starts, cycles, and stops in a somewhat predictable pattern" (*Poutiatine, 2009, p. 5; LUU, 2021).

The building transformation deals with the process of adaptation. Schmidt et al. (2016) defined building adaptation as postponing the demolition phase of a building while increasing its excellent or desirable life span through its "ability" to change and adapt itself to different circumstances. In the adaptation, there are three essential elements: (1) differences or a feature seen as the embodiment of a transformation, (2) an element of characteristic or identity as a reference in the transformation process, and (3) a historical element bound to a different unit of time. The physical and spatial transformation can be seen in the transformation of land use and the characteristic of buildings and streets (Schmidt et al. 2016, Amen,2022). Urban transformation expresses entire strategies and actions to improve the economic, social, physical, and environmental conditions of damaged and collapsed urban areas (Carmona, 2021). Diverse processes of transformation, which lead to altered urban functions and new local needs and opportunities, constantly influence cities.

Urban land use comprises activities in certain places and a certain level of spatial accumulation, which is indicated by their density, intensity, and concentration. Urban land use historically formed through the transformation process due to the accumulation of activities. For example, the road network is developed through the transformation process of the design and function of the road (Gallion, 1988, Amen & Nia, 2020). Changes in activities trigger the transformations of the land use pattern. Changes in connectivity trigger the transformation of road and street patterns (Buchanan, 1988). Finally, the change in building function and density generated the transformation of settlements.

The level of transformation consists of three types (Gordon 2012): (1) major transformation that occurs on a broad scale-and changes the spatial pattern of existing regional space, and the transformation dominates several areas. (2) Minor transformation is a form of transformation on a small scale or transformation that occurs in only a few parts

and does not change the initial condition of space or the surrounding environment. Finally, (3) fully transformation or a form of transformation that radically and totally changes the whole. In the latter case, the original form of the space pattern or the initial condition of the area can no longer be recognized.

**2.2 Riverfront as the City Determinant Factor**

Many cities consist of four natural determinants (1) waterfront, (2) hilltop and ridge, (3) the flat, and (4) open prairie (Morris, 1994). However, the waterfronts have a solid link with the water in the early settlement of many cities. The birth of the cities cannot be separated from the existence of rivers, canals, and watercourses in the urban space. Morris (1994) highlighted three topographical characteristics of cities established in the waterfront area. They are (1) the seafront, (2) island and peninsular origins, and (3) riverbank origin. Kostof (1991) recognized the seafront as the natural harbour and the riverbank as the riverine settlement. During the early days of many old cities, water was the primary mode of transportation. The strategic location of the waterfront is situated at an intersection between the land and the water. It provides high accessibility to the traders and their customers. As a result, the waterfront has become the centre of commercial activities and cultural concentration. Trading activity boosts the economic function of a place, and consequently, the waterfront becomes one of the determinants for a city to grow. These phenomena are common in Western, Middle Eastern, and Asian countries (Rafferty and Holst, 2004; Hoyle, 2001; Morris, 1994). According to Hoyle (2002), due to the immediacy of the water since ancient times, many cities use the waterfront as a 'window on the world' and the city's 'front door' in the competition for commerce and trading. However, the glory of the waterfront in many cities does not last long. Many of them soon experience a decline in their response to water dan shift their orientation to the hinterland. The decline of the waterfront is a worldwide phenomenon that occurs in many cities. It is caused by the industrial revolution, technological changes, the introduction of the land-based transportation system, de-industrialization, and flooding.

**2.3 Urban Kampung**

According to Wiryomartono (1995), the Urban *Kampung* is a settlement that grows in urban areas without infrastructure planning and the city's formal economic network. According to Wijanarka (2001), kampungs are settlements in urban areas spatially formed over a very long period and resided by the community who are predominantly indigenous and homogeneous. Kampung settlements in the context of urban areas have long been endured as part of urban development. Their development is always influenced by various factors, namely socio-cultural, economic, political, technological, and natural factors. These factors can drastically erase kampungs and thus eliminate the characteristics of the city. On the contrary, the existence of kampung can enrich the characteristics of the city. The rise and fall of kampung can display the cultural characteristics of the city from time to time.

Back (1998 in Setiawan, 2010) explains that urbanization triggered the process of *kampungization*. It occurs because the local government failed to manage the urbanization process properly. People from rural areas who migrated to cities have not been able to enter the urban industrial and formal sectors. Urban kampung is generally characterized by relatively dense settlement and sometimes overcrowding. The population earns a living in the informal sector. They spontaneously built their shelters in the absence of urban service facilities, such as clean water, sanitation, and drainage (UN Habitat, 2006: 30).

Setiawan (2010) defines the establishment of kampung as a dynamic formation process by a group of people who are generally poor. They provide their own houses, control their environment, and work together to improve their living condition. The urban kampung in big Indonesian cities is widely recognized as part of urban settlements forming a high population density with the social dynamics and vulnerable to changes due to the urban development.

According to Tikson (2005 in Latif, 2011), the urban kampung transformation can be interpreted as a deliberate economic, social and cultural transformation through top-down policies and strategies toward the desired direction decided by the local authorities. The kampung transformation also continually occurred along with the city's growth and development. Therefore, transformation at kampung can be included spatial, demographic, and socioeconomic transformations.

**2.4 Architectural Adaptation**

Schmidt et al. (2016) explain that there are six strategies or types of transformations in the process of building adaptation. Since they applied for building, the adjustment should be adapted concerning the group of buildings. They include:

***(1) Adjustable***

In this section, adaptation is in the form of rearrangement of furniture in a room to accommodate different functions. In other words, in the form of changes to processes and users. In this case, the main change is what is

the content in space. Changes in filler elements, in this case, can be physical elements that make up the space, whereas physical characteristics can be fixed elements, semi-fix elements, and informal elements.

***(2) Versatile***

The application of adaptation changes the spatial layout in space for variations of activities. In this case, the design of both the filler and space-forming elements should be adjusted to accommodate the new activities. Changes concern the filler elements (stuff) and the spatial planning (space plan). The change of filler element consists of the fixing element, the semi-fix element, and the informal part. The spatial changes can be observed through changes in shape and factors that can be defined as the element of space, such as horizontal and vertical elements.

***(3) Refillable***

Refillable adaptation is the ability of the building to change, consisting of space, service, and building skin. It will usually affect the aspects of building legality, environmental conditions, technology, and materials (change of performance). The changes that occur are: (1) the layout (space plan), (2) functions that are served by the space, and (3) the skin/façade. The modifications can be viewed from the physical elements. They form the emergence of spatial room and the activities that occur in the area concerning the function and usefulness of the observed site.

***(4) Convertible***

They adapted buildings by changing spaces according to market demands, social demands, and new ownership. Changes in this adaptation are related to the layout (space plan), functions served by space, and the skin/ facade. However, unlike the previous form of transformation, which is refillable, this convertible is more of an extended change. It occurs in buildings or on larger scales instead of buildings' elements where changes are the usability over a more extended period.

***(5) Scalable***

Adaptation occurs by changing the size of the space or changing of size in existing case studies. It often occurs due to market conditions, budget changes, and social conditions that require a smaller or larger room. Changes are included the layout (space plan), the function served by the space, the skin/ facade, and the structure. This change occurs because the area needs to accommodate new activities that are larger or more varied so that it needs to be changed structurally, and the skin needs to change in size.

***(6) Movable***

Movable is the rarest adaptation because it concerns the change in location of the building. It has principles such as easy establishment and rapid dismantling. It relates to the components' refillable, structural solution, access, and scale and affects the structure (structure) and the site (site). The changes are viewed on a structural system that supports infrastructure and accommodates activities.

## 3. Methods

This research will reveal the causal relationship between the morphological form of the *Kampung* Pahandut waterside area and changes in local people's everyday spatial usage triggered by economic, social, and cultural factors. The arrangement and diversity of the urban form of Kampung Pahandut are principally examined through analyses of two aspects: the pattern of streets and the typology of building using the strategies defined by Schmidt et al. (2016). The outcomes of these morphological studies highlight the importance of the built environment of the riverfront and provide opportunities for defining the local identity of Palangka Raya. Furthermore, recognizing the meaning and formulation of urban morphological changes in the riverfront area also will be helpful for the government before enacting the program of improvement, especially for the waterfront cities widely found on the island of Kalimantan.

## 4. Result and Discussion

### *The initial settlement of Kampung Pahandut*

The history of the Kahayan riverside settlement area dates back to the 18th century, before establishing Palangka Raya as the capital of Central Kalimantan. " *Kampung/lewu* Pahandut" was the name of the initial settlement located at the Kahayan Riverbank area. Pahandut originates from the word Pa-Handut, meaning Handut's father. He was known as one of the Dayak settlers who opened the wilderness site for building temporary residences. The local inhabitants mention that the embryo of *Kampung* Pahandut is now at the location of the Rambang port pier. To the southwest of *Kampung* Pahandut, there is an area called *Danau Seha* (Seha Lake) that used to be a lake-front settlement consisting of stilt houses. However, the water had disappeared, and now the area had transformed into an ordinary landed housing. A transcribed record of the Dayak Tumbang Anoi Peace meeting in 1894 mentioned that the initial settlement in *Kampung* Pahandut consisted of eight longhouses called (Betang or Dayak traditional houses) of which five families inhabited each house. The number of residents was estimated to be 40 families living at the

longhouses facing the Kahayan River (Palangka Raya City Government, 2003: 20). Report in 1957 mentioned that there were about 21 houses with about 250 people who lived in the *Kampung* Pahandut area (Usop, 1996 in Wijanarka 2001). The history of this riverside settlement area is also recorded in the report of Zacharias Hartman, an official of the Dutch East Indies Government, who was traveling down the Kahayan River and Kapuas River in October 1823. His notes become references in the History Book of Palangka Raya City (Palangka Raya City Government, 2003: 20).

The position and the geographical settings attracted the pioneer settlers of "*Kampung* Pahandut "and they decided to settle there. The area was easily accessed to the water source for daily activities. The navigable river of Kapuas River was also important since the community is still dependent on the river for transportation. The river is the lifeblood of the economy and the source of livelihood. The correlation between riverfront land as a place to live and the role of the existing river as a transportation infrastructure had a massive influence on the community. As a result, it formed unique social and cultural patterns so that the city of Palangka Raya was known as the "City of Water." (RUTRK Kota Palangka Raya 1999-2009). Figure 2 shows old photos depicting some conditions of *Kampung* Pahandut in the past.




**Figure 2.** *Kampung* Pahandut in the past

(a) Village street in Pahandut in 1929 (This village lies on a sandy hill, a dune, and on the edge of a marshy area).
(b) The village of Pahandut in 1924 (In the foreground is a small hut for bathing, boats, and trading posts). The other houses were provided as logs for strangers who passed through.
(c) The 'Batang' (places for tying up the boats) in Pahandut in 1924. Small houses for bathing were built on the same structures. The motorboat belonged to a Dutch official.
(d) Pahandut (Kahajan) lower part of the village in 1928
(e) Pahandut Landscape (in the background of the Kahajan River) in 1929.
(f) The landing place and stairway led up to the missionaries' compound in 1929.

*Source: University of Southern California Libraries*
*(a) https://doi.org/10.25549/impa-m21636; (b) https://doi.org/10.25549/impa-m21699; (c) https://doi.org/10.25549/impa-m21867; (d) https://doi.org/10.25549/impa-m55972; (e) https://doi.org/10.25549/impa-m21637; (f) https://doi.org/10.25549/impa-m22200*

***The current situation***

Kahayan River has a riverside width of 200 m that becomes the unique setting for the daily activities of residents who live on the riverbank. The site physically formed the settlements that naturally developed into an organic pattern and formed into elongated settlements following the shape of the river. The house's orientation faces the river, indicating that the river becomes the centre of daily activities. Figure 3 shows the conditions of *Kampung* Pahandut in the present.



Figure 3. **Aerial Photo in *Kampung* Pahandut,** *Source: Observation Field, 2022.*

***Street Pattern***

Based on material usage, streets in *Kampung* Pahandut are divided into (a) asphalt roads, (b) unpaved streets (dirt streets), (c) wooden bridge/*titian*, (d) combination of wood colonnaded and concrete paths, (e) concrete path, and (f) floating path. The formation of the circulation and the environmental patterns are organically and naturally follow the form of the river, which creates linear circulations in combination with the formal road. The government developed the latter to connect Kampung Pahandut with the surrounding area. As a result, the circulation formed a hierarchical pattern as follows:

a. *Jalan aspal* is a formal asphalt road that is immediately accessible to Kampung Pahandut and enables vehicles to approach rivers with road patterns following the topographical conditions of the environment. The road width is 6-8 meters.
b. *Jalan Tanah is* an unpaved or dirt street naturally made to enable people to access the slope area that becomes a transitional zone between the highlands and the wetland. The street width is 1,5 to 2 meters.
c. *Kayu bertiang* or *titian* is a wooden bridge that becomes the primary pedestrian access inside the residential area at the riverside of the Kahayan River. They were formed into the organic linkage that connects one building to others and between the residential area and the other main *titian*. Titian wooden poles were constructed using hardwood/iron materials with varying sizes of 5/10, 6/12, and 10/10 centimetres. The bridges formed into a path with a width of 1.5 to 2 meters. The floor materials use hardwood (*kayu besi/ulin/tabalien*) with the height varies according to the contours of the area ranging from 1.5 to 4 meters.), with the height varying according to the area's contours ranging from 1.5 to 4 meters.
d. *Kayu bertiang lantai beton* is like *kayu bertiang* but the floor was made from concrete.
e. *Cor Beton* is a concrete road that becomes a transition between an asphalt road and a wooden path (*Kayu bertiang/titian*). This path landed on the ground soil with a slope angle ranging from 15 to 30 degree.
f. *Batang* is a floating street that is not permanent and becomes the primary access connecting the floating house (*Huma lanting*) to the titian road.

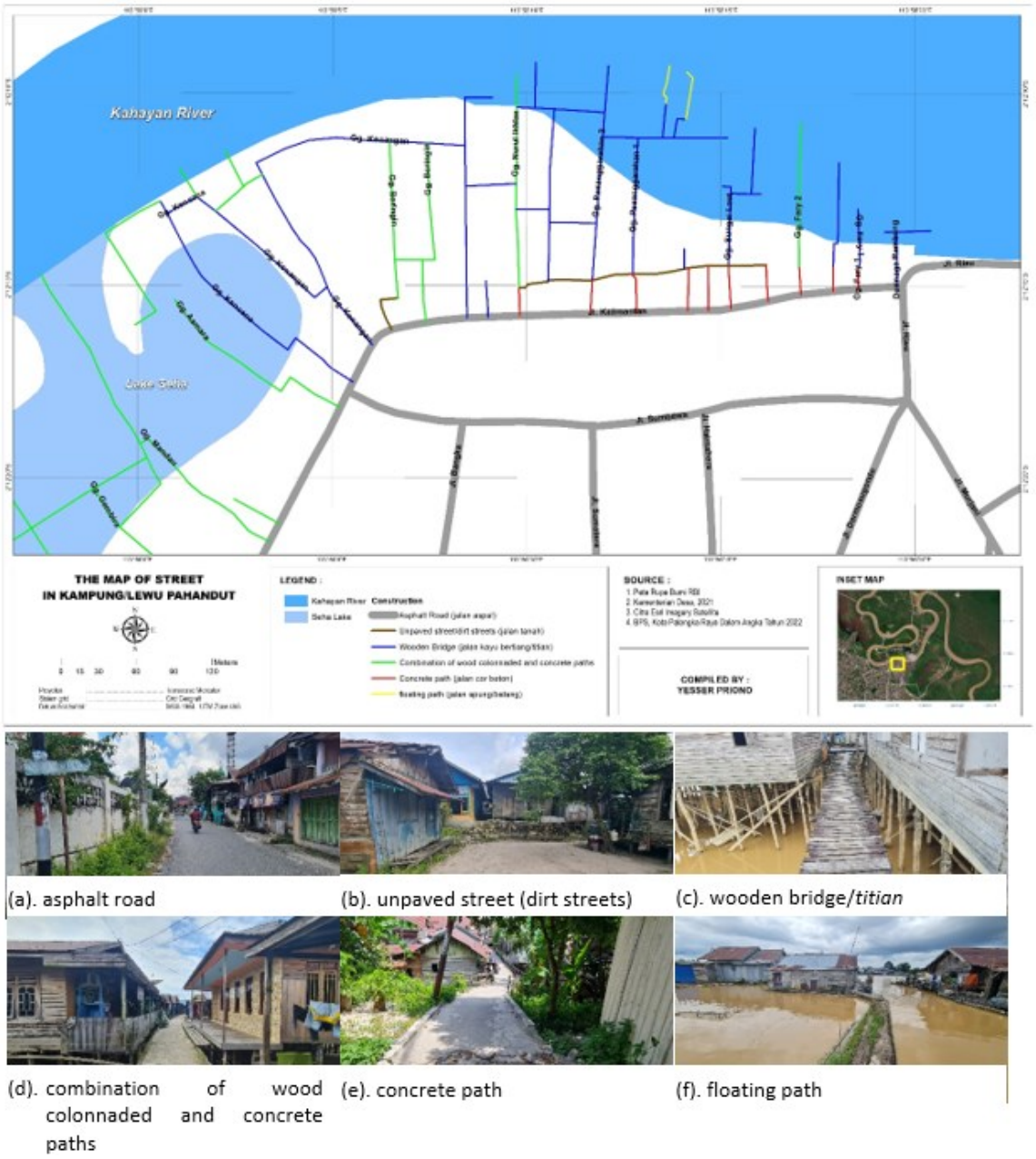


Figure 3. **Street in *Kampung* Pahandut,** *Source: Analysis & Observation Field, 2022*

***Characteristics of buildings***

According to Riwut (1979), the Dayak community selected the riverbank as their residential location refers to natural factors. The peculiarities of riverside settlements are contour patterns, topography, and the water level. The river's tides accordingly influence the condition and situation of the buildings erected at the riverfront.

The buildings in the Kahayan Riverside area have unique characteristics that express the local architecture. The typical of housing at *kampung* Pahandut includes (1) floating house/raft house *(huma lanting)*, (2) pillar house/stilt house *(rumah panggung/huma bajihi)*, and (3) permanent/concrete house *(rumah permanen/huma segah)*.

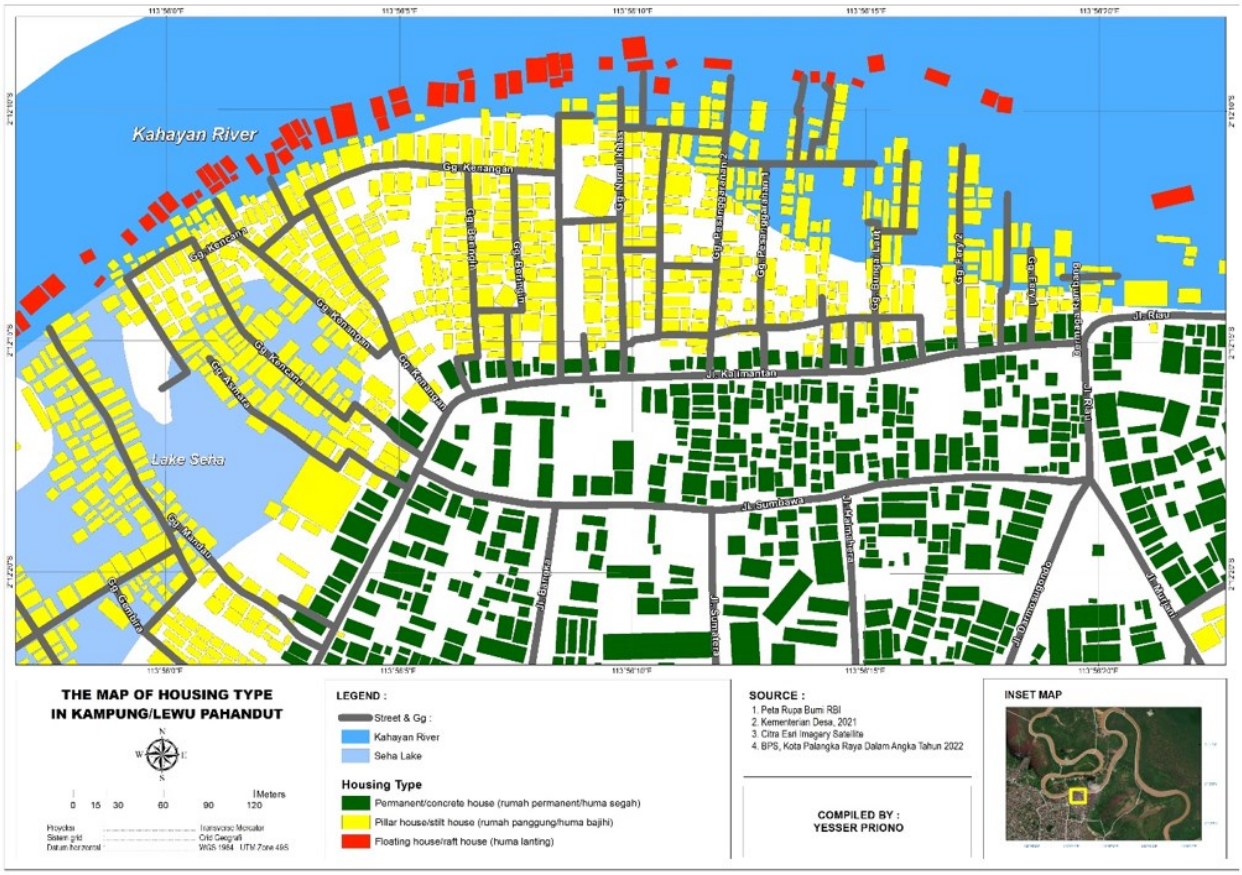
Kahayan River
Lake Seha
Gg. Kenanga
Gg. Kencana
Gg. Kenanga
Gg. Kenanga
Gg. Kenanga



**Figure 6.** Rumah bertiang/panggung/*huma bajihi* in *Kampung* Pahandut, *Source: Observation Field, 2022*

3. Permanent /concrete house *(Rumah permanent/huma segah)*
   The concrete houses (permanent houses) in the *Kampung* Pahandut area are situated in high-altitude regions. Previously, building materials used wood, and buildings tended to be built like pillar houses. Over time, it transformed into concrete buildings and was directly built on the ground.



**Figure 7.** Permanent /concrete house *(rumah permanen/huma segah)* in *Kampung* Pahandut, *Source: Observation Field, 2022*

**Landuse**

The case study area of the *kampung* Pahandut area covers 17.45 hectares of area with the following land uses: (a) housing area of 16.39 ha, (b) open space of 1.04 ha, and (c) green area (*Ruang Terbuka Hijau*) of 0.15 ha. The rest are covered by water (the river and the lake). Informal buildings with pillar wood construction dominate the settlement in kampung Pahandut. Recently, the transformation processes occurred at Kampung Pahandut following the change of the riverside environmental conditions triggered by the development of Palangka Raya city.

**Architectural Adaptation in *Kampung* Pahandut**

Following Schmidt et al. (2016) about the adaptable architecture, the spatial and architectural adaptation of Kampung Pahandut is described as follows:

*Adjustable*

Adjustable architectural adaptation occurs in the riverside area of *kampung* Pahandut, which has the attributes of change in the form of filler elements (stuff). The observations in the field found changes that formed empty spaces that the inhabitants used as cattle cages, such as ducks. The cage is arranged into a floating system to flexibly adapt to the water level during the flood and dry season. The floating system drives the residents to make the impermanent cage. The cage becomes a space-filler element that can be moved quickly.

*Refillable*

The observations on refillable factors in the riverside area of *kampung* Pahandut found changes in open spaces, dock areas, and land areas. Water that becomes a space-filler element in the neighbourhood becomes an element that displays significant changes. The water is vulnerable to the tidal condition following the changing season, making the space either change into a container of water or empty land space and vice versa. When the river receded, the space became an empty land space and was utilized as a playing field for children. In the dock area, the tidal change will influence how the people use the space for daily activities. In this area, changes in water level affect the land space and create the different order of the piers and change the circulation lines. Each change of seasons will form a different elevation, and in effect, it will change the pattern of daily activity.

*Movable*

The observations revealed changes in the transition space between the river body and the riverside area. It happens because of the tidal conditions of the river. The impact changes the infrastructure from permanent *titian* to temporary *titian*. In terms of the condition of floating buildings, they follow the movement of the water surface so that the building's structural elements can move both in vertical (up and down) and horizontal directions (right, left, front, and back). The temporary titian is made of wooden logs that become a permanent *titian* that links with the floating house. As a result, they enable to move the sites following the movement of their floating houses. This situation creates both attractive and dynamic environmental conditions.

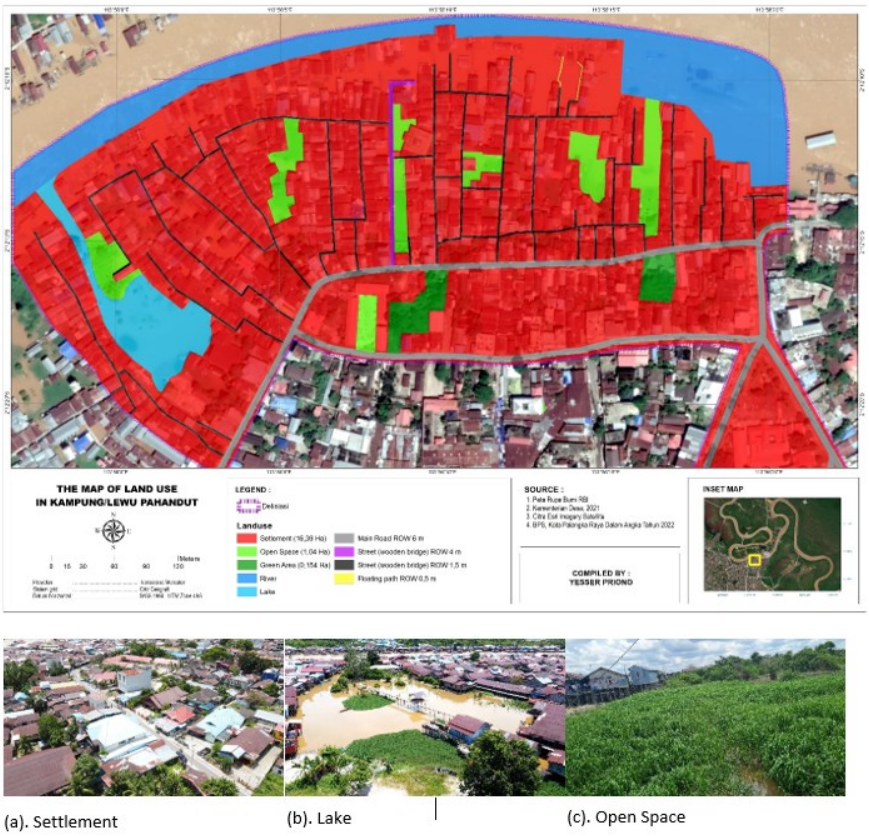


**Figure 8.** Land Use in Kampung Pahandut, *Source: Analysis & Observation Field, 2022*

To adapt to topographical and environmental conditions, houses at *kampung* Pahandut diversified following the differentiation of the ground floor structures, including: (a) houses on the ground; (b) houses with half on stilts and half on the ground; (c) houses on stilts; and (d) floating house.

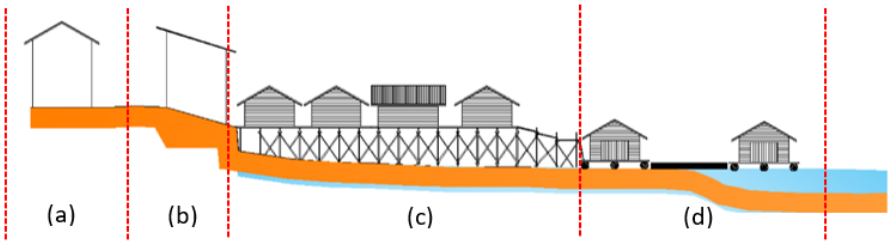


**Figure 9.** Housing situation in the dry season, *Source: Authors, 2022*

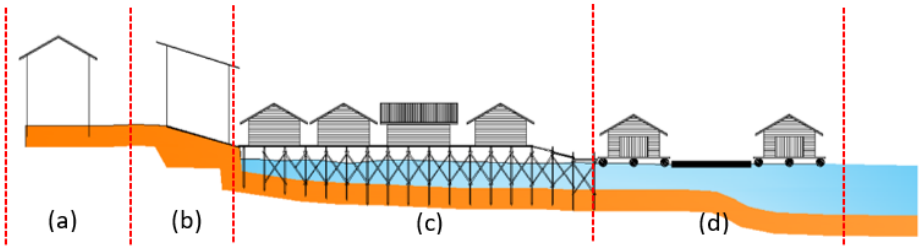


**Figure 10.** Housing typologies in flood season, *Source: Authors, 2022*

Based on environmental regulations, the *kampung* Pahandut area divides into 5 (five) classifications as follows: (1) River environment resided by floating *houses (huma lanting*). They are tied into an anchor from a wooden pole stuck into the ground; (2) The Lake environment's condition of which the environment forms spontaneously following the

city's development. Building construction in this area involves constructing pillar buildings/pillar houses *(huma bajihi)*. The height of the building poles is relatively the same, ranging from 2-3 meters; (3) Wet plain environment dominated by stilt buildings construction (pillar houses). The height of the poles on this building varies according to the topographical shape of the environment context; (4) Slope environment is a transition space between the highlands and the wetlands. The buildings are characterized by a combination of concrete materials that tread on the ground and pillar construction on the slope area; (5) Highland environment or a hilly area, wherein the water level does not exceed the land surface. There is rarely a flood in this environment due to the rising water levels. The buildings in this highland environment are varied. The buildings predominantly use wood construction, concrete construction, and a combination of wooden and concrete structures.




**Figure 11.** Classification Environmental in *Kampung* Pahandut, *Source: Authors, 2022*

## 5. Conclusions

*Kampung* Pahandut is one of the oldest villages on the banks of the Kahayan River at Palangka Raya city. The condition of the waterfront environment is constantly changing, which makes the community must adapt to environmental conditions and, in effect, triggers cultural responses. Architectural adaptations found in the riverside area of *kampung* Pahandut are adjustable, refillable, and movable. The first adaptation is adjustable. It is shown in how the inhabitants utilize the open areas in response to changes in the riverside area's environmental conditions that are affected by the tidal of the Kahayan River. The second architectural adaptation is refillable. This situation often arises in the riverside area. This adaptation occurs in the regions that accommodate different activities in high tide conditions (floods) and low tide conditions (dry). Adaptation occurs due to the spatial need for the daily activities, including spaces for the playground, the docks, and the field to grow crops, while adjusting the layout of physical elements to accommodate those functions. Refillable adaptation is shown on the pier following the changing of the tidal conditions. The water is adjusted using a flotation system and hinges on the *titian* that follows the level water level during the flood and dry conditions. Finally, movable architectural adaptation is an adaptation that occurs due to displacement or change in the location. Movable adaptations affected changes in the structure and shifted the site location from one place to another. This adaptation expresses a response to environmental changes following the water surface and temporarily occurs. This form of adaptation often intensely occurred in the floating houses/*Huma lanting* that, in effect, they can far away dislocate from their original sites following changes in water level.

Based on the physical elements of the riverside area of *kampung* Pahandut, the configuration of the road and residential patterns are influenced by several factors, including (a) the shape of the river that naturally formed, (b) the topography of the environment of the *kampung* Pahandut area, and (c) the tidal conditions of the riverside. As a result, this transformation would have some impacts, among others are the culture of the riverside community and the socioeconomic conditions of the people who live in the riverside area. The culture of settling by the river is a decisive factor in shaping the character of the riverside at *kampung* Pahandut. It reflected the community's dependence on the river. Although the city of Palangka Raya transformed into a land-based city and left behind the

riverfront area, at kampung Pahandut, the community still maintains the Kahayan River as the source of people's daily lives.

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**Conflict of Interests**
The authors declare no conflict of interest.

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# Marine Conservation and Promotion of Tourism: An Approach on Marine and Coastal Planning at Cat Island, Muscat, Oman

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**Abstract**
Oman is home to over 530 sqm of coral reefs. With the abundant coral species and reef fish, it became a popular destination for tourists. The economy has also increased because of the leading fishing industry, which serves as a point of export to nearby countries. Additionally, the capital Muscat is one of the top tourist spots due to its increasing water activities. However, in the past decade, the unforgettable cyclone Gonu destroyed the beautiful sea habitat, one of the environmental stressors for the marine ecosystem. Furthermore, the anthropogenic stressors, such as berthing, scuba diving, and overfishing, yield a decrease in natural coral reefs. Cat Island, known to be one of the diving spots in Muscat, is vulnerable to coral reef declination. This research focused on analyzing the present condition of coral reefs at Cat Island in relation to environmental and human activities. Moreover, there were studies conducted regarding the physical status of the coral reefs identifying the stressor of coral reef degradation. The researcher conducted a survey, phone and personal interviews, and distributed questionnaire forms to assess the site's character and understand the marine habitat from the primary user's perspective. Data from previous studies in the reefs of Oman and information from the government and non-government units were collected. As an outcome, it presented an imperative position towards marine and coastal planning by recommending policy enhancement and marine functional zoning in Cat Island. Additionally, it was shown that sustainable marine conservation and tourism promotion can be obtained through the aid of artificial reefs as a new habitat for the marine ecosystem. With this approach, these concepts can be used as a baseline in conducting research on another marine habitat in Muscat, Oman, which requires thorough study and future improvement.
**Keywords:** Marine and coastal planning; Marine functional zoning; Policy; Natural reefs; Artificial reef; Marine Habitat.

## 1. Introduction

Oman's coral reefs are over 530 square kilometers extended across one of Arabia's longest coastlines (Spalding et al., 2001; Burt et al., 2016). Oman reefs are home to over 100 coral species and 579 species of reef fish (Claereboudt, 2006; Grandcourt, 2012). In spite of their exceptional biogeographic setting and obvious standing to environmental and businesses, Oman's reefs are included in the less researched, accounting for less than 4% of regional reef-associated journals (Burt, 2013; Vaughan & Burt, 2015).
Cat Island as shown in figure 1 is one of the most visited areas in Muscat, Oman.




**Figure 1.** Cat Island Location.

With a maximum depth of 16m, activities such as diving, freediving, snorkeling, and fishing may be done.
As a result of environmental impact, aquatic system is greatly distressed (Halpern et al., 2008), and more than partial part of reefs are currently believed to be at great to acute risk as a consequence of these incorporated pressures (Burke et al., 2011; Burt et al. 2016).

### 1.1 Major Stressors to Oman's Marine Ecosystem

#### 1.1.1 Coral reef degradation

Coral reefs have been subjected to numerous severe stressors in latest years, which have resulted to coral cover loss and community structure shifts; however, the effects of these occurrences vary perceptually and categorically (Glynn, 1993; Bauman et al., 2010; Coles et al., 2015).
Environmental impacts on Oman's reefs signify unusual and stressful conditions that corals in the Sultanate must accept. Principal impacts include the following: 1. Recreational activities, 2. enriched water discharges from sea farms, 3. litter, 4. fishing-related damage-causing coral reef breakage; caused by entangled nets and boat anchors, 5. discharges from desalination plant, 6. oil pollution, and 7. coastal destruction (Ministry of Environmental Climate Affairs [MECA], 2010).
Ras Al-Hamra Sub Aqua Club [RAHSAC] (1998), observed that the primary cause of damage to corals is boat anchoring for leisure diving and snorkeling.

#### 1.1.2 Climate change

Climate change (CC) has enticed much public and scientific responsiveness over the last few years. Nowadays, it is generally recognized that humans' economic actions are in the lead to an essentially unrestrained surge in greenhouse gas (GHG) emission and the awareness of GHG in the earth's atmosphere.

#### 1.1.3 Boat anchoring

Actual ravage from boat anchors and their related chains is a recognized cause of damage to coral reefs (Goenaga 1991; Flynn, 2015). However, boat anchoring is rarely the subject of official study (Johnstone et al. 1998; Flynn, 2015).

#### 1.1.4 Scuba diving practice

Recreational scuba diving is a leisure and tourism activity affecting the communities, economies, and environments in various destinations, across all latitudes in both developed and developing countries (Al-Dujaili & Amen, 2018, Lucrezi et al., 2019). As coral reefs have become more accessible and facilities for visitors were improved, the quantity of people diving into this potentially fragile ecosystem has risen. Consequently, there is a widespread concern that significant reef degradation has resulted from tourism activities (Salm 1986; Ward 1990; Hawkins & Roberts, 1993).

#### 1.1.5 Fishing practice

One of the largest fish producers is Oman and an exporter of fish products (FAO, 2019).
Damage from fishing activities, including the effects of gillnets, anchors, ropes, fishing lines, and debris, were the most frequently identified and most severe effects by human impacts. Breakage is often triggered by unwanted fishing equipment, linger on the reef over time, resulting serious and long-lasting damage.
With this, it is imperative that marine and coastal planning approach should be considered in marine habitat conservation and promotion of tourism in Cat Island. Coral reef degradation is caused by natural and human stressors such as climate change, cyclone, boat anchoring, scuba diving practice, and fishing practice.
The marine and coastal planning approach will fill in the gaps missing in the study and research of natural coral reefs and make people aware of the actual scenario of marine habitat. By seeking evidence regarding the state of coral reefs, the introduction of zoning and policy will improve the island's conservation efforts to support artificial reefs as a new ground for marine habitat, thus promoting tourism.

### 1.2 Objective

The marine and coastal planning at Cat Island, Muscat, Oman, aims to adapt sustainable marine conservation and tourism approach.
The main objective is to adapt sustainable marine conservation and tourism approach. Therefore, the specific objectives of the research are as follows:
1. To determine the most relevant present condition affecting marine habitat in terms of the following:
A. Environmental condition in relation to natural coral reef
B. Human activities

b.1 Berthing practice
b.2 Scuba diving practice
b.3 Fishing practice
2. To assess the most important aspect in relation to natural and artificial coral reef to promote tourism in terms of the following:
A. Environmental policy
B. Ecotourism policy
3. To recommend the most adaptable sustainable marine conservation and tourism approach in terms of marine and coastal planning from the following strategies:
A. Policy
a.1 Marine policy
a.2 Coastal policy
B. Controlled zoning
b.1 Marine area
b.2 Coastal area
Cat Island is one of the diving locations and is a well-known tourist spot in Muscat, Oman. However, the current situation presents threats to coral reefs due to environmental conditions and physical activities.
The intention of providing Cat Island's new feature based on marine and coastal planning will be a baseline and pattern to other diving locations in Oman, that have started to deteriorate. Due to continued visits and water activities, the Daymaniyat has started to experience reef deterioration, such as coral bleaching and broken corals. With this as an example, Cat Island may survive its ongoing stressors.
Additionally, Cat Island's physical characteristics provide more opportunities in terms of ecotourism. Ecotourism is another form of sustainability that can benefit the people of Muscat, Oman.
The outcome of this study will assist the government, stakeholders, community, future researchers, and readers in promoting awareness on the importance of sustainable marine conservation by providing artificial coral reefs as a new habitat for the marine ecosystem. Awareness of the current situation will help them be socially responsible with their activities in the marine habitat. This study will be a benchmark of further investigation and future studies that may enhance the schemes regarding policy and zoning.

**1.3 Scope and Limitations**

This study focused on the general approach of marine and coastal planning by using marine functional zoning. The selected location for the study is Cat Island. The study was conducted from March 2021 up to July 2021. .
This paper synthesized the present condition of marine habitat in terms of environmental aspects related to the natural coral reef. It identified human activities such as berthing practice, scuba diving practice, and fishing activities. Also, this study provided policy and controlled zoning that are designed to boost tourism in Cat Island. Moreover, it delimited the contribution of coral reefs in promoting tourism that subscribes to environmental policy and ecotourism.
The master planning will not be part of this research; hence, this will be considered when doing the Comprehensive Land and Marine Use Planning.

**1.4 Current Physical Condition of Cat Island, Muscat, Oman**

**1.4.1 Environmental Condition in relation to the natural coral reef**

The southwest monsoon (wet season) is the most important climatical influence for the nearshore habitat and coral sites in Oman throughout the summertime from June to August (Brock & McClain, 1992, Sheppard et al., 2010; Burt et al., 2016).
**Cyclone.** The strongest tropical cyclone Gonu in 2007 was ever recorded at Arabian Sea (Fritz et al., 2010). Oman sea corals were severely affected by the cyclone, presenting significant loss of coral cover and reduction in habitat complexity (Maghsoudlou et al., 2008; Taylor, 2009; Foster et al., 2011).
**Climate change.** CC is an urgent environmental problem characterized by a global increase in the Earth's temperature due to an uncontrolled increase in greenhouse gas (GHG) emissions. It is now widely accepted that human economic activities contribute to CC (Lama & Devkota, 2009). Global warming is projected to be between 1.4 and 5.88°C by 2100 compared to 1990.
According to Mansour (2020), there is overwhelming global concern about the impacts of climate change (CC) on ecosystems and habitats of various species.
Climate change (CC) and related sea acidification will exacerbate the effects of local stressors in the coming decades.

**1.4.2 Human Activities in relation to the natural coral reef.**

Human recreational activities in the marine environment can harm coral reefs by the breakage of coral colonies and with the direct contact such as walking, touching, kicking, standing, gear contact, trampling, breakage, or overturning of coral colonies from boat anchors, changes in marine life behavior such as feeding or harassment by humans, water pollution and trash, invasive species, and debris deposited in the marine environment.

**Berthing practice**. Unfortunately, some of the best-known dive sites in Oman do not have buoys to which boats can be secured until today. This forces boats to use anchors, breaking fragile corals and disrupting the ecosystem (ESO, 2009). Hansen et al. (2018) state that recreational boating and related moorings are associated with reduced cover of aquatic vegetation constituting important habitats for juvenile fish.

In addition, Dasgupta (2019) noted that grounding and mooring dilemmas have been recorded since 1970s. Most worryingly, a reef which was damage by anchor certainly not able to recuperate, and even if it can, it could be around 50 years.

**Scuba Diving practice.** While diving tourism enjoys continued growth worldwide, there are concerns that it contributes to the degradation of coral communities biologically and aesthetically (Worachananant et al., 2008). Accordingly, the desire to escape the physical constraints of land and be enchanted by the sight of technicoloured reefs, sunken ships and otherworldly creatures is becoming increasingly popular - despite the cost and training required to explore the ocean depths (Merchant, 2012).

Coral reefs globally attracts a growing number of scuba divers, thus leading to an increasing concern on its impact to coral reefs. Pre-dive briefings are insufficient to reduce diver damage (Barker & Roberts, 2004).

The study by Worachananant et al. (2008) shows that 93% of divers had contact with the seabed during a 10-minute monitoring period, with an average of 97 contacts per hour of diving. Additionally, he stated that two-thirds of divers caused damage to corals, with an average of 19 corals broken per dive hour. There were significantly more coral breakages and fragments of live coral in high use areas than in low use areas (Hawkins et al., 2007).

**Fishing practice.** The study of Fisheries sustainability in Oman by Alhabsi and Mustapha (2011) states that overfishing is an outcome of changes in the absolute and relative abundance of many important commercial species in Omani waters.

**1.5 Contribution of coral reef in promoting tourism**

**1.5.1 Environmental policy in relation to the aquatic environment**

Oman's Marine Pollution Control Law of 1974 aims "to avert, decrease, and reduce all forms of contamination of the waters which are adjacent to the territory of the Sultanate of Oman as to preserve the ecology of the area."

Through Mansour's (2020) discovering, it is clear that gainful arrangement activities reduce regular dangers to coral cover across the Oman Sea coasts, explicitly as far as the improvement of hazard maps and spatial plans to ensure the most helpless, delicate, and touchy coral reef biological systems.

**1.5.2 Ecotourism**

Healthy corals are the foundation of the ocean food chain. Thus, making it a significant part of the economy. This contributes to livelihood and tourism.

**1.5.3 The Benefit of Using Terracotta as Artificial Reefs**

Artificial reefs are increasingly being boosted to mitigate impacts from human actions in coastal urban areas (Burt et al., 2009).

There should be additional assistance from the government or the States Craft's council to promote the Craft at National Level (Ghosh, 2014).

Lange et al. (2020) exhibited that 3D-printed earthenware counterfeit reefs appear to be the fate of coral reef protection.

Since the undertaking commencement was as yet in its beginning phase, there was restricted information concerning the venture's reasonability. Regardless of this, the analysts engaged with the program trusted that this new strategy for making fake reef tiles will support all the more successfully reestablishing corals and preserving biodiversity, contributing essentially to continuous worldwide endeavors to save corrupted coral reef frameworks in metropolitan regions.

**1.6 Case Studies**

**Reducing Use Conflicts through Marine Functional Zoning.** Reducing use conflicts through marine functional zoning by Fang & Ma (2018) focuses at Xiamen as a coastal city located at the southeast coast of Fujian Province, PR China. Marine functional zoning (MFZ), developed and implemented in the Xiamen Sea areas, has proven to be an effective management tool in minimizing multiple-use conflicts in coastal waters.

The MFZ in Xiamen was a successful showcase in moving ICM conceptual framework into concrete practice.
The MFZ is efficient in the conservation and improvement of environmental quality. Since implementing MFZ, the marine environmental quality of the sea areas remained stable, and endangered wild species, such as Chinese white dolphins and egrets, were protected (Jiang & Fang, 2015) without hampering the designated sea space for economic development.

**Coastal and marine tourism development (Case Study Persian Gulf)**

Coastal and marine tourism development by Ghasemnia et al., (2011), focuses on Iran, along the Persian Gulf islands. Marine tourism includes a set of services, such as management, training, marketing, tourism, transport, customs, insurance, and advertising.
The objectives of coastal and marine tourism are as follows: identify the uses of sea for tourism purpose; make a variety of facilities, institutions, making floats, beach and offshore industry; ecosystem-based marine tourism (ecotourism); tourism based on seafood; social development and empowerment of local communities; make water sports recreational, and design sea tourism; and recreational activities, sports, culture and science in the aquatic and coastal environment.

### 1.7 Conceptual Framework

Lack of proper policy and awareness is one of the root causes of the conflicts. It is evident since coral degradation is revealed in the physical characteristics of the reef. The proposal drew motivation and ideas from different studies on policy and zoning, which the researcher cites.
Sea use conflicts have become a considerable management challenge for sustainable utilization of resources in coastal waters worldwide. MFZ scheme was developed in order to decrease multiple-use conflicts in coastal waters and harmonize human use and nature conservation, (Fang & Ma, 2018).
Table 1 illustrates the research paradigm that intend to adapt sustainable marine conservation and tourism approach.

**Table 1.** Research Paradigm

| INPUT | PROCESS | OUTPUT |
|---|---|---|
| •Relevant present condition affecting marine habitat<br>•Important aspect of coral reef in promoting tourism<br>•Adaptable sustainable marine conservation and promotion of tourism | •Photographic survey.<br>•Survey thru Google form, interviews, & questionnaire forms.<br>•Data gathering using related literature, journals, & similar case studies.<br>•Policies/ laws of the Oman government | •Recommend the most adaptable sustainable marine conservation and promotion of tourism approach |

## 2. Material and Methods

### 2.1 Research Design

The descriptive method was used to gather data about the Cat Island's existing condition as shown in Figure 2.

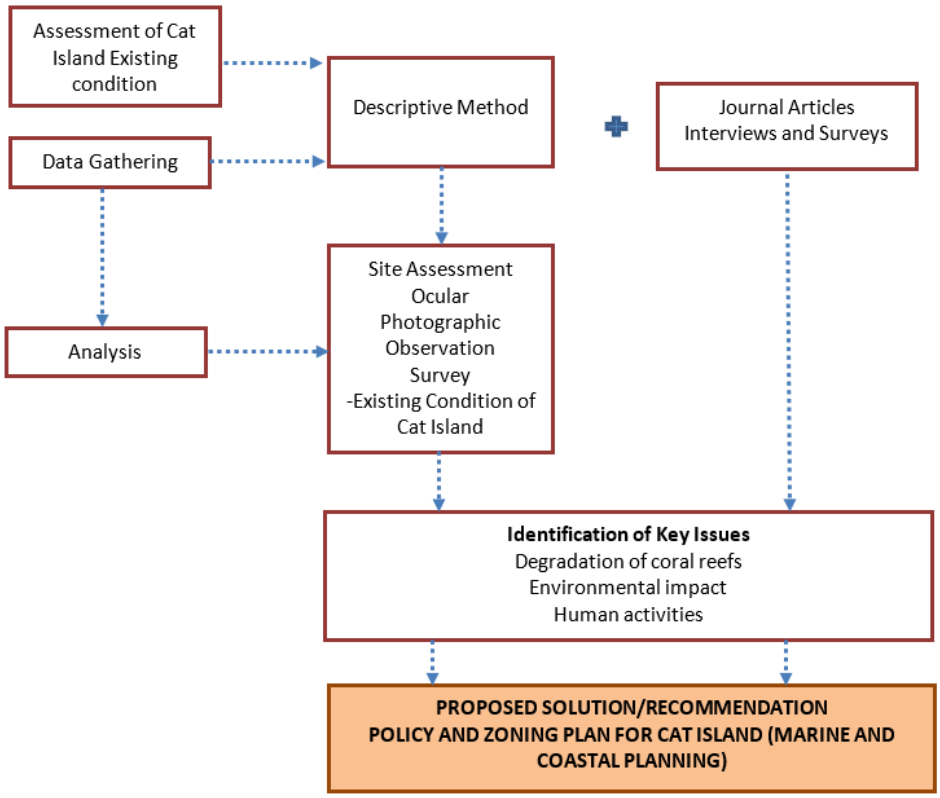


**Figure 2.** Framework of the Research Methodology

### 2.2 Demographics

The research demographics consist of 309 people working mainly for the diving centre, fishermen, divers, and tourists that visited the place for recreational diving or snorkelling as shown in Table 2.

These are the ideal group of people to answer the survey since they have the experience going underwater and have more interaction with marine life. They provided valuable insights which influence the proposed policy and zoning plan.

**Table 2.** Breakdown of respondents

| # | Origin | | Total |
|---|---|---|---|
| 1 | Respondents from Google **Survey** | Boat owner, Diving centre | 20 |
| | | Fishermen | 2 |
| 2 | | Diving Instructor | 20 |
| 3 | | Divers, Snorkelers, Students, Tourists | 263 |
| 4 | Respondents from **Interview** | Phone Interview | 2 |
| 5 | | Personal Interview | 1 |
| 6 | Respondents from **Questionnaire Form** | Digital questionnaire | 1 |
| **Overall** | | | **309** |

### 2.3 Research Instruments/Tools

The tools used in the research were surveys through Google form, interview, questionnaire form, related literature, journals, similar case studies, and photographic survey/ observation. These tools assisted in the proposed policy and zoning plan.

## 3. Results and Discussions

### 3.1 Present Environmental Condition of the Natural Coral Reef

Through the years, the effect of unexpected calamity that hit Muscat showed a declination of natural coral reef. One of the known solutions is to provide cement blocks and terracotta surrounding Cat Island. The researcher attempted to investigate through an interview with Dr. Claereboudt from Sultan Qaboos University. He responded that there

was no evidence of the terracotta study was conducted. Furthermore, there was also no record nor published research about it.

### 3.1.1 Current Condition of Cat Island through the Lens

The current condition of Cat Island is analyzed through photographic documentation of coral reefs underwater as shown in Figure 3.




**Figure 3.** Underwater photos of Cat Island with the vast marine ecosystem.

Due to the natural stressors experienced by the marine ecosystem, Figure 4 shows the effect which the coral reefs are facing in Cat Island.




**Figure 4.** Underwater photos of Cat Island with degradation of marine life due to natural stressor.

### 3.2 Present Human Activities in Cat Island

### 3.2.1 Berthing Practice

Davenport and Davenport (2006) mentioned also that as the ocean recreational activities and the linked traffic from boat increased quickly in many locations of the globe resulting to the increase of physical damage to the reef. Moreover, previous research and studies have rarely addressed the community-wide impacts from severe anchor damage (Flynn & Forrester, 2019).

With the work of RAHSAC (1998), they directed an eager venture that will secure and breed coral reefs and placement of artificial reefs (reef ball) to decrease the harm to coral due to mooring of boats for leisure scuba diving and snorkeling hobbies. The club additionally asked the setting up of extremely durable securing floats at various well-known destinations around the island.
Enumerating the involvement of mooring to coral reef deteriorate should assist to notify the design of best administration exercises for anchoring the boat near reef habitation (Flynn, 2015).
An adequately installed mooring buoy will have a minimal initial impact on the reef and can then be used almost indefinitely without further damaging the reef (ESO, 2009).
The surrounding area of Cat Island do not have available mooring buoys that boat can anchor to. Apparently, the boat owners do not have a choice but just to drop the anchor when berthing. The dropped anchors incur harm and drastically rupture the reefs.

**3.2.2 Scuba Diving practice**

Leisure diving is extensively recognized as one of the leisure industry's quickest producing businesses (Ong & Musa, 2001; Musa et al., 2006; Kirkbride-Smith et al., 2013).
Rouphael and Inglis (1997) stated that the increased participation in marine recreation and tourism has been accompanied by concern for the impacts that these activities have on coral reef environments.
To protect the aquatic resources, the Marine Conservation Department at the Ministry of Environment and Climate of Oman presented stringent scuba diving guidelines (Ministry of Environment & Climate Affairs, 2009).
Classifying the several factors that define diver manners results may aid administrators to improve better procedure on operational training, pre-dive brief, site policy, etc., to avoid or decrease the occurrence of damage reef (Rouphael and Inglis, 2001).
The majority of interactions were triggered by fluttering and touching with fins, verifying related outcomes from the study conducted at the Red Sea (Prior et al., 1995; Zakai and Chadwick-Furman, 2002).
As stated by Hannak et al. (2011), it is agreed that sensible tactics included offering environmental education courses for snorkelers and divers.
The survey shows for 263 respondents illustrates that 30 (11.4%) hit corals reefs accidentally (by fins or other foreign objects), 30 (11.4%) they touch the coral reefs accidentally (by hands), 23 (8.7%) of them take coral in the surface, and 197 (74.9%) did not do anything. This relates to the study done by Chabanet et al. (2005) and Hannak et al. (2011) that direct snorkeler or diver impacts such as trampling, fin contact, standing on corals and resuspension of sediment.
Additionally, Mcbride (2021) stated photographers contacted the reef significantly more than those divers without cameras.
The most anthropogenic concerns in recreational diving activities are acts resulting in coral breakages. These acts include trampling, touching the corals, stepping on sand, dropping anchors in coral beds, dragging dive gear, dealing damage from fin kicks, diving with a camera, and disturbing sand and sediments that clutter and cover the corals. Furthermore, Figure 5 also shows the scuba diving practices that lead to coral degradation. Accidentally or not, divers' negative behavior indicates a detrimental effect on marine life.

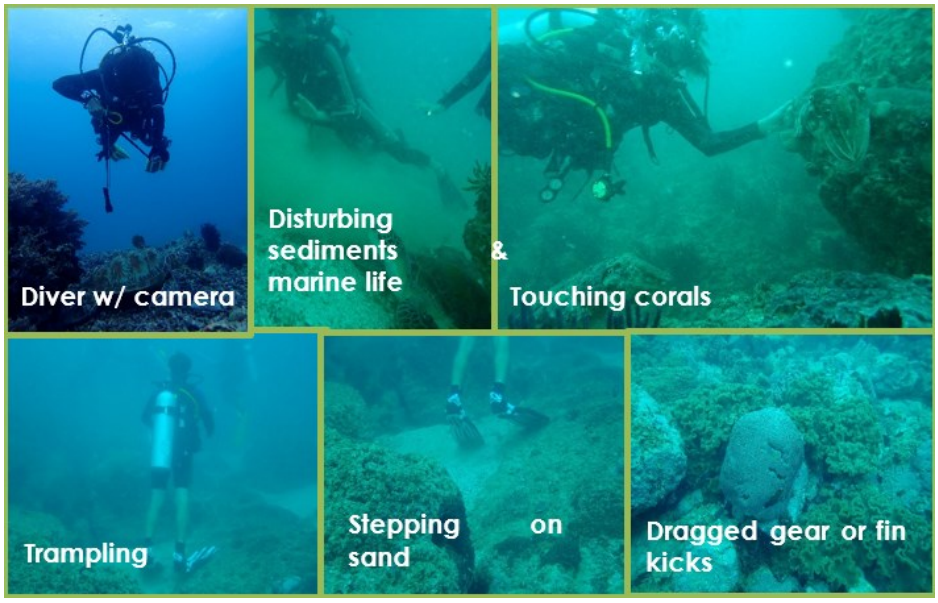


**Figure 5.** Underwater photos of Cat Island with scuba diving activities.

### 3.2.3 Fishing Activities

Overfishing is considered stressor to ecosystem (Roberts, 1995). Overfishing results to transformations in the absolute and relative richness of several important commercial species in Omani waters. Current fishery management strategies emphasis primarily on target fish populations, although may not be appropriate when fishing initiates changes in the reef ecosystem (Jennings & Polunin, 1996). Based on the observation by the researcher, the fishermen use gear such as line, net, or spearfishing in Cat Island.

Reef fishing activities are inclined to cause coral damage which may be irreversible and can impair the processes which guarantee future fish production because there is no habitat in the marine. The survey found out that out of 305 respondents, 199 (65.2%) have tried fishing with line, and 219 (71.8%) tried spearfishing. Large debris as mentioned by Ballesteros et al. (2018) such as discarded fishing gear is a huge component of litter on coral reefs. Also, corals have fragile carcasses and soft tissues that can simply become damaged when they get in contact with lost fishing equipment.

## 4. Discussions

### 4.1 Replacing Natural Coral Reefs with Artificial Reefs

It is discovered that scuba divers develop an extraordinary level of fulfilment from diving in artificial reefs (Kirkbride-Smith et al., 2013).

As a result, whether it is natural or anthropogenic activities, it is well known that coral reefs' hazards come from both physical and natural sources. Artificial reefs change the local abundance and distribution of fishes and other organisms, thus enhancing fisheries' resources and creating fishing and diving opportunities (Bohnsack, 1991).

An experiment done at Cat Island. The soft and hard corals have attached to the cement blocks. However, there were no further documentations as recalled by M. Claereboudt.

### 4.2 Environmental Policy that Relates to Contribution of Coral Reef

Conventional customs targeted at managing diver effects on reefs have accepted the idea of ecological carrying capacity (Hawkins & Roberts, 1997; Schleyer & Tomalin, 2000). Despite the good concept, Kirkbride-Smith et al. (2013) assessed that the basic resolution is insufficient by just supervising coral reefs. Diving allocations can be appropriate in delicate locations since the impact at a site is persuaded by visitor count (Barker & Roberts, 2004). The scheme of providing a limit—a “carrying capacity” of human usage—requires acceptance by the community to guarantee the protection of the natural resources (Salm et al., 2000). Currently, carrying capacity have been tried in numerous efforts to estimate popular dive sites visitors (Davis and Tisdell, 1995). However, the outcome of the evaluations varies widely among diverse locations around the globe (Dixon et al., 1993; Chadwick-Furman, 1997; Harriot et al., 1997; Hawkins et al., 1999; Schleyer and Tomalin, 2000; Zakai and Chadwick-Furman, 2002).

Presently, Oman participates to 13 key regional and international protocols and green agreements that offer values, global study, and legal for ecological protection in coastal environment and the sea (van Lavieren et al., 2011). In additional, the Sultan endorsed sufficient policies to strengthen maritime preservation with presently above 8 Royal

Decrees supported with Ministerial Decisions that relate to maritime environmental security matters (Ashrad & Sayer,2012).
This Ministerial Decision 55/2004 regulation does not permit the establishment of artificial reefs without a license.
To regulate diving activities, Oman's Ministerial Decision No. 40/2009 focuses on the specific regulations imposed in marine habitat during diving activities outside the limits of marine protected areas.
Royal Decree No. 53/81, a decree promulgating the Law of maritime fishing and protection of aquatic living resources, has been implemented. According to the summarized statement from the website of FAO (2021), this Law, applies to fishing waters, inland water, the seabed, and its subsoil.
In general, the Royal Decree No. 20/2019 provides framework law, sustainable development, fishery management, conservation and methods, protection of the environment, artisanal fisheries, promoting further research on the aquatic environment, and protecting aquatic plants transporting storage of fish.

**4.3 Environmental Policy that Relates to Coastal Area That Have Developed Coral Reefs**

Ministerial Decision No. 20/90 coastal policy was focused on setbacks. However, an extensive coastal policy that associates with the marine life such as coral reefs was not discussed.

**4.4 Contribution of The Coral Reef to Ecotourism**

Coral reefs have become an important feature for promoting international tourism (Lemay et al., 1991).
Marine tourism is related to increasing employment, increasing revenues, boosting the economy, expanding international cooperation, and improving the quality of life and livelihoods.
Based on the survey conducted, among 305 respondents, 246 (80.7%) sighted a substantial marine ecosystem in Cat Island. 240 (78.7%) noticed that there are broken and damage corals while 47 (15.4%) did not observe marine ecosystem.

**4.5 Marine and Coastal Planning**

With the advancement of modern technology, it is straightforward to propose a concept integrating land and water in the design and deliver it to a prospective client. However, the systematic approach of such presentation tends to be oblivious to the impacts during and after site construction.
According to a Naval Architect (interview with a questionnaire), experienced in his field:

> *I have worked with a company before that construct hotels on man-made islands. Just the concept of it, you would know that a portion of the reef gets destroyed. Although they try to compensate by propagating the reef somewhere else, it would never be enough to replace what has naturally existed for hundreds or thousands of years. (J. Ponce, personal interview, April 25, 2021)*

Integrated coastal zone management (ICZM) has resulted in the government developing legislation for coastal zone protection, management plans, recovery and governance, and awareness-raising programs.

**4.6 Controlled Zoning**

With the advent of maritime/marine spatial planning (MSP), marine space concepts have received renewed and much-deserved attention (Gee & Siedschlag, 2019). With the concept of zoning management to mitigate the development of sea conservation conflicts, advocates are utilizing the zoning idea to protect marine habitat. The use of controlled zoning allows the local and national authorities to regulate and control the sea use to guarantee the function and capability of the marine area to be beneficial to all stakeholders. The researcher recommends a controlled zoning scheme that can be utilized in Cat Island in order to promote a more resilient and healthier marine environment.
Since the project site is small, the sea use types used in Cat Island were classified into three categories according to the types and characteristics of sea uses and natural resources found in the site. Each of the sea areas was zoned to various uses to identify how safe and valuable it is. These are artificial reefs, artisanal fishing, and tourism. The zoning around Cat Island was divided into four major zones. The west side is for artisanal fishing and tourism; the east side is for artificial reefs (which can be developed in a later phase) and tourism; and the north and south side are for artificial reef, artisanal fishing, and tourism. The tourism area will be available for water activities such as scuba diving, freediving, and snorkeling. Artificial reef area will be protected from tourism until such time that the reefs became mature. For the artisanal fishing, the only allowed fishing activities will be fishing with line and spearfishing. Fishing with net will be controlled to avoid destroying the natural reefs. Mooring buoys will also be distributed strategically around the marine area in order to avoid anchoring to the seabed. Figure 6 and 7 shows the results of the controlled zoning.

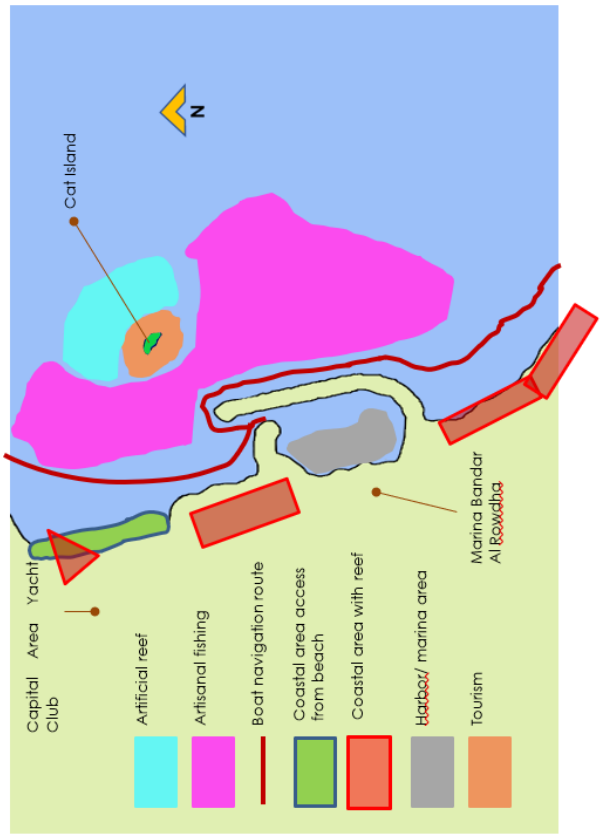


**Figure 6.** Cat Island Controlled Zoning

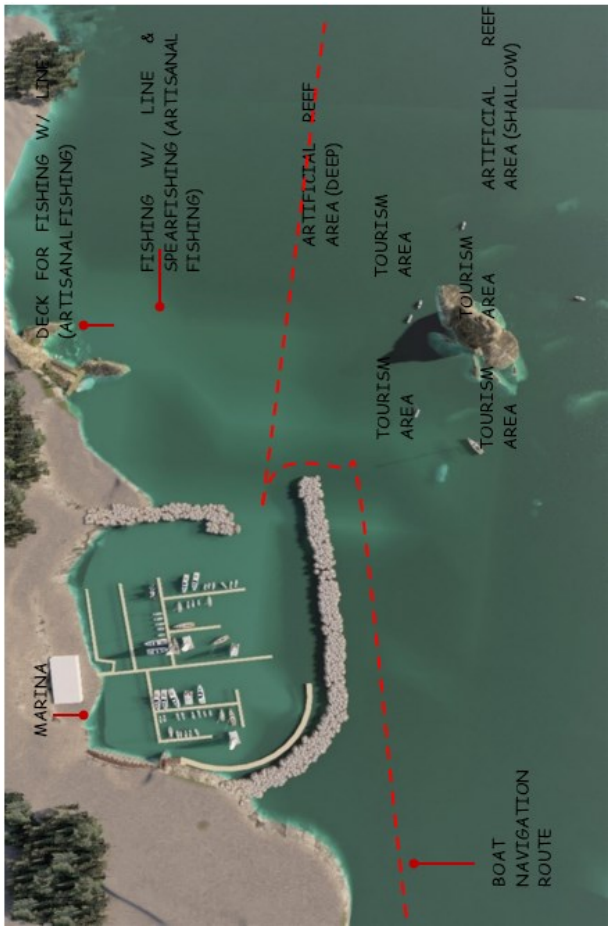


**Figure 7.** Master Site Development Plan

## 5. Conclusions

**Most relevant present condition affecting marine habitat.** Human and natural factors both affected coral reefs in Oman, causing widespread and significant degradation. Coral reefs provide several ecosystem goods and services but are susceptible to multiple environmental and anthropogenic stressors. These stressors include cyclone, climate change, berthing practice, scuba diving practice, and fishing activities. Among these, the most relevant stressor that affect marine habitat are anthropogenic activities. Management of boat anchoring, diving practice, and fishing must encourage coral reef resilience and at the same time permitting constant sustainable tourism and recreation.

**Most important aspect in relation to natural and artificial coral reef.** The most important aspect concerning the promotion of tourism through the natural and artificial reef is policymaking. Policy needs to be strictly implemented and enforce adherence to it. Current Oman administration policies are ineffectual and unsatisfactory in protecting coral reefs and other marine habitat.

**Recommended most adaptable sustainable marine conservation and promotion of tourism approach.** The Coast of Oman concentrates on tourism, urbanization, and other development activities and is subject to changes in physical progressions, causing substantial natural environment alterations. It is imperative that the government of Oman further study and consider operating comprehensive coastal zone management plans towards the protection of coral reefs. Currently Integrated coastal zone management (ICZM) has resulted in the government developing regulations for coastal zone protection, management plans, recovery and government authority, and mindfulness in raising programs. Though these policies are well written, it does not still help to aid in protecting the natural and artificial coral reefs. The reason behind this is that there is a lack of strict implementation from the government. Controlled zoning is an applicable instrument in minimizing several conflicts in the vicinity of Cat Island, which can sustain the value of the natural resource thus emphasizing sustainable marine conservation and promotion of tourism approach.

## 6. Recommendation

Natural and anthropogenic stressors surrounding marine habitat can be reduced if all the community members will be conscious of the environment and be responsible for protecting the sea.

To minimize the abuse of coral reef declination, the researcher recommends the following:

### 6.1 Policy Reformation

The legislation related to the coral reef in Oman has minimal information and guidance looking after natural reefs, especially regarding artificial coral reefs. A policy reform initiative protecting the marine habitat, whether it is natural or artificial reef, should commence.

**Berthing Practice.** In this research, there was no evidence that a law/ policy was ever passed related to berthing practice. The researcher recommends a policy on berthing on shallow water to protect the natural and artificial reefs. A preferred means of berthing is the deployment of permanent mooring buoy entrenched in the seabed. Boat anchoring should also be prohibited in the area to protect the coral reefs.

**Scuba Diving Practice.** Ministerial Decision No, 40/2009 is recommended to be revisited. With the increasing tourism in the area and all over the diving spots in the capital, a recommended Ecotourism Environment Carrying Capacity (EECC) should be implemented. In this way, there will be prevention of over-crowding tourists. The ecotourism environmental carrying capacity (EECC) refers to the adequate quantity of visitors that can be expected in a particular area, which can meet the needs of tourists, benefit the tourism industry, protect the environment, and reduce the impact of over-crowding.

**Material used on Artificial Reef.** It is recommended that a policy be formulated to provide for the production of artificial reefs made from terracotta. With this, business owners and laborers producing clay designs will be protected. Moreover, passive income will be generated for the locals. Since terracotta has earthly components, this may be used sustainably without harming the marine ecosystem.

### 6.2 Controlled Zoning

The recommended controlled zoning scheme could be adjusted according to the dominant development without sacrificing environmental veracity. This idea can also evolve a new formulation of a new zoning scheme that can be utilized in another part of Oman. Regulation and policy about sea use-controlled zoning should ensure compliance with and implementation of the formulated controlled zoning.

In the long run, the controlled zoning and policy review will have a highly significant effect to the sea use conflicts, thus warranting proper and orderly use of the sea area. Additionally, the controlled zoning and policy analysis can accommodate emerging sea uses that will promote social awareness, labor increase, and potential gross domestic product (GDP). Furthermore, promoting policy enhancement and tactically providing controlled zoning will support

a better marine environmental quality by reducing coral degradation and enhancing marine habitat by providing sustainable marine conservation while boosting its economy in tourism.

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**Conflict of Interests**
The authors declare no conflict of interest.

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# From Picturesque Landscapes to Brand-new Cities: A Survey for Understanding the Effects of Protective Structures on Visitor Impression

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**Abstract**
In order to prevent the deterioration of immovable architectural artefacts unearthed in archaeological sites, it is observed that protective structures are applied. A considerable number of applications for both temporary and permanent protective structures have significant differences in terms of design, scale and material whereas the visitor impression is not particularly taken into account. In this study protective structures are classified according to their practice in the archaeological sites and a survey-based evaluation is revealed in which visitors indicate responses for their impressions. Furthermore, it has been stated that even though there are principles for new structures provisioned by international charters and regulations, there are not only professional approaches but also visitor impressions and experiences that should be considered as design criteria. In conclusion, the research points out the importance of engagement of visitors in the design process regarding the site effect of the protective structures.
**Keywords:** Archaeological Conservation; Protective Structures; Archaeological Preservation; Architectural Remains.

## 1. Introduction

Protective structures have been applied in many archaeological sites at an increasing pace. Those structures used in archaeological sites have been criticised more after the roof construction built over the Göbeklitepe archaeological excavations in Turkey in recent years (Yılmaz et al., 2019). In Turkey, which is rich with archaeological sites, it is possible to encounter examples of protective structures in very different scales and styles (Tanaç Zeren and Uyar, 2010). When the examples are examined, it would be appropriate to say that most of the applications made, completely disturb the picturesque appearance of the archaeological sites and give the atmosphere of a city that is under construction, where even the cranes enter the perspective. Due to the construction works going on at archaeological sites, it is understandable that visitors liken archaeological sites to “Disneyland” (Kocaman, 2020). However, protective structures should have an appearance that establishes a contextual relationship with the architectural remains, articulates and harmonises with the artefacts and/or the site, rather than being a structure that overshadows the architectural remains and/or the archaeological site that attracts all attention (Krizinger, 2000). So much so that while the protective structures with their architectural features and emphasis put the archaeological artefacts in the background, unfortunately, visitors often only remember the protective structures as an image of the archaeological site (Hauselmayer, 2000; Rahman and Fatemi, 2021 ).

Protective structures are widely used in archaeological sites for many reasons (Kocaman, 2021). These structures help to protect architectural remains against sun, rain, snow and frost for a longer period of time (Dikilitaş, 2010; Ertosun, 2012). Besides protecting from climatic deterioration, a well-designed structure can also serve to create a physical appearance for archaeological remains, and provide a temporary working space underneath, or limit the access hence guarding against vandalism/theft (Wunderer, 2000; Pedeli and Pulga, 2013). Protective structures can also be used to highlight architectural remains, provide better visibility by improving site presentation and making features more accessible to the public.

There are many international regulations accepted regarding the in situ preservation of artefacts unearthed in archaeological sites (i.e. UNESCO, 1956; ICOMOS, 1990, 2008). Following the necessary protection measures applied to remains, it is recommended to carry out exhibition solutions where each visitor can best understand the value of the remains (ICOMOS, 1964; Ahunbay, 1999). In this context, although the structure applications for the protection and exhibition of immovable architectural artefacts are seen as a positive approach, the mistakes in the applications, the elementary solutions arising from the budget and the design identities of the structures cause to overshadow or even not protect the remains they are obliged to protect (Feilden, 1994). In the formation of the design identities of the protective structures, many parameters are handled by the experts of the subject and the problems faced by the remains are tried to be solved, but these solutions do not always result in the correct perception of the remains and the site by the visitors (Severson, 1999; Orbaşlı, 2008; Savrum Kortoğlu, 2013). Some of the negative aspects of protective structures are that the remains and sites fall behind compared to the protective structures, they lose their integrity, a point stands out or attracts too much attention compared with the rest of the site, and the perception of the size of the remains and the site is lost. Although these negativities are ignored in temporary protective structures compared to permanent ones,

the perception that visitors experience for that singular time period during their visit is permanent. According to a preliminary observation it can be highlighted that when examining the perception of protective structures on visitors, it does not matter whether they are temporary or permanent.
The aim of this research is to understand how the protective structures applied in the archaeological sites in Turkey are visually evaluated by the visitors and question how to ensure public participation in the design process. With this aim, 129 people from different education levels and ages responded to the survey conducted within the scope of the research. While professional approaches are given importance in the design process of protective structures applied in archaeological sites, visitor impressions are not taken into account (Figure 1). Within the scope of this study, questions are asked to the participants in order to emphasise the importance of the participation of the visitors in the design process. Visitors of various ages and occupations are reached through the questionnaire created for the study, and their experiences and impressions of protective structures are evaluated.




**Figure 1.** Design process contextualisation for protective structures (by Authors).

Several experts from different disciplines are involved in the design of protective structures in archaeological sites. Archaeologists, architects, civil engineers, conservators and landscape architects are among the main disciplines, but the contributions of the visitors and stakeholders are left out of the process. Similarly, although there are extensive studies on the design of protective structures to be applied in archaeological sites in the literature reviews, a study supporting public participation in the design process has not been found. In this research, the design criteria of protective structures are only discussed under general headings and do not constitute the main subject focus.

**1.1 Criteria for Decision Making Process**

Protective structures can be classified according to several criteria in a particular duration of usage, material, budget and scale (Pedeli and Pulga, 2013). Barker (1986) points out the differences between the temporary and permanent protective structures and their effect on the design decision. The differences between the two systems are the materials used to construct the shrouds and the system design. Temporary structures are constructed as simple metal and timber constructions based on tent-like elements or more traditional materials (Mollaert et al., 2013). Permanent structures, on the other hand, are advanced design applications that provide a controlled environment in the entire area where the archaeological remains are located, and consist of systems where wide openings are passed with very few support (Aslan, 1997; Severson, 1999; İpekoğlu and Çetin, 2013). Schmidt (1988) categories the protective structures as a)temporary protections, b)protection roofs, c)partly enclosing protective structures and d)all-side closed constructions/buildings whereas Vozikis (2005) categories based on their materials as a)metallic, b)wooden, c)concrete and/or brick, d)membrane or textile.
Due to the classification of the structures the design approaches and criteria are also changing. As stated by Vozikis (2005), the criteria affecting the design of protective structures can basically be grouped under 10 headings. Consequently, protective structures should be:

- reversible,

- low-tech, low cost and low maintenance,
- considered for microclimatic effects,
- aesthetically compatible with site, environment and landscape,
- designed by the materials that support the aesthetic impact positively and never alienate the whole impression,
- contributed to the visitor's educational experience,
- integrated informative aids for the understanding of every visitor,
- lighting,
- accessible, comfortable and safe guidance path. This classification is worth attention for dealing with the visitor parameter as well as technically regulated headings. Santoro and Santopouli (2000) highlight 5 important points for protective structures that should:
- give comfortable height for the works going on such as excavation, documentation, etc.
- have an optimised lightening
- be stable and well covering the excavated area,
- be reversible,
- be reusable. In comparison with visitor oriented classification of Vozikis (2005), Santoro and Santopouli (2000) focused mostly on the comfort of the excavation team. Besides, Tanaç Zeren and Uyar (2010) propose 5 criteria to be well-considered during the planning process of the protective structures should:
- land conditions of the archaeological site (such as ground characteristics of the region, groundwater level),
- climate conditions,
- status of archaeological remains to be protected,
- excavation site settlement area,
- economic inputs. The criteria defined by Tanaç Zeren and Uyar (2010) are mainly underlying technical requirements

for the structures.

Although protective structures have advantages such as creating a microclimate and allowing architectural finds to be exhibited where they are, they have disadvantages such as preventing artefacts from being perceived and adding a different dimension to the area (Çamurcuoğlu, 2010). If the microclimatic conditions created by the protective structures can be set up correctly (by determining the most ideal temperature, humidity and air circulation for the work), the artefacts excavated from the ground can be prevented from entering a rapid deformation process by suddenly encountering severe weather conditions.

**1.2 Prominent Examples**

The roof on Casa Grande, which was designed to protect an adobe structure built by the Hohokam American Indians between 1200-1450 AD, is a pioneering example in this context (Rael, 2008). In Arizona, the roof over the ruins of Casa Grande was built in 1903 (Rizzi, 2008) (Figure 2). The first structure, made of wood and iron materials, was replaced in 1932 with a metal roof covered over steel carriers (Figure 2). Aside from the poor protection of the existing roof due to the fact that the structure is far above the ruins, the roof visually has a very different meaning from the architectural remains.



**Figure 2.** Casa Grande in Arizona, the protective structures were applied in 1903 on the left and 1932 on the right (URL - 1, 2022).

In 1977, a Swiss architect group in Greece thought that the Acropolis should be covered with a complete dome because it was so affected by weather conditions and air pollution, and they prepared a project on this subject. In this way, original marble blocks, decorations and sculptures belonging to the Acropolis will be able to be replaced (Schmidt, 1988). The

project cannot be realised due to the budget of the project, the square metres it needs to cover, and the difficulties related to the application details (Figure 3). Although this project could not be realised, it can be considered a very important landmark as an innovative initiative. It is very clear that keeping every archaeological site as a whole under a total protective structure is not an efficient solution, besides isolating the visitors from having visual contact with the context such as the site, settlement, city and/or nature.

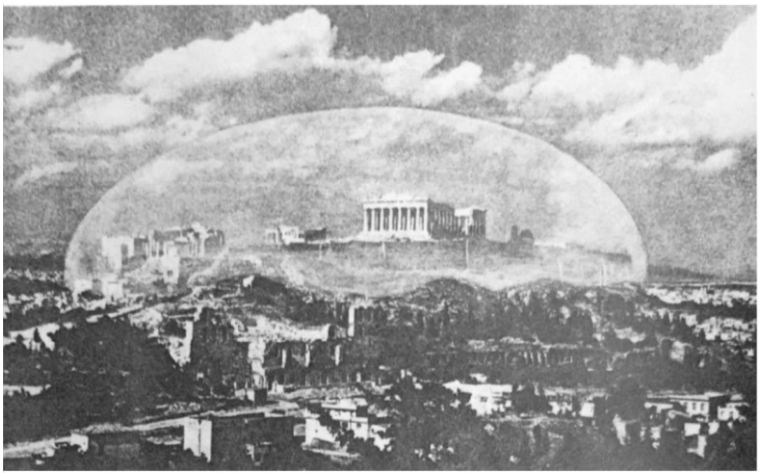

**Figure 3.** Acropolis of Athens, the project was developed in 1977 for covering the Acropolis (Schmidt, 1988).

This synthetic membrane tent, which is designed to protect the Bassae Apollo Temple from damage during the conservation works and is planned to be used temporarily until the restoration and conservation works are completed, is visually dominant in the area and prevents visitors from interacting with the original remains of the temple (Figure 4a). The temporary solution also has question marks for being considered a new permanent - temporary because of the long term restoration and conservation interventions that are still going on (Vozikis, 2005).
The structure applied to protect Göbeklitepe, where the remains date back to B.C. 1200s, was completed in 2018 and covers an area of approximately 4,000 square metres (Figure 4b) (İrepoğlu, 2019). In the first winter after the construction of the roof was completed, it was understood that the eaves of the roof were not long enough to prevent snowfall, but no expansion could be made due to its unique form. In addition to the fact that this gigantic roof is not able to protect the ruins, it is also the visual weight it brings to the site and the loss of the visitors' sense of scale.



**Figure 4.** a. Temple of Apollo Epikourios in Bassae on the left (URL - 2, 2022) and b. Göbeklitepe Excavation Site on the right (URL - 3, 2022).

In this context, many more examples can be presented according to their positive and negative characteristics, but since the research focuses on visitor impressions, examining a large number of examples is beyond the scope of this research.

**2. Material and Methods**

Surveys are an efficient tool for collecting data on ideas or concepts that are difficult to quantify, such as opinions, impressions, and attitudes. Additionally, questionnaires can also be used to gather information about behaviours that cannot be directly observed, by documenting whether participants are willing to respond. However, before creating a questionnaire, it is imperative to decide whether a survey is the best method to address the research question or topic of interest (Artino et al., 2014). In the related studies on protective structures, it has been realised that among the design

criteria, the opinions of the visitors whom the structures are in direct visual interaction with are not included. Considering that the visitors experience the site and the protective structures, the participation of the visitors in the visual impact of the final product is seen as a necessity. Due to this research focused on understanding the impression of visitors regarding the protective structures applied in archaeological sites, a survey-based evaluation as a methodology is revealed in which visitors indicate responses for their impressions. The research is also used for understanding the level of participation of the public in the case of a design process for protective structures that will be applied in archaeological sites.

**2.1 Type of the Questionnaire**

The sources for the research are examined and a measurement tool suitable for the purpose of the study could not be found. For this reason, a purpose-oriented questionnaire is developed. The questions are designed according to three different types of responses. These are:

- Closed-ended “yes/no” response options
- Closed-ended labelling response options with both numbers and verbal labels on a scale of 1 to 5 to express the level of agreement
    1: I totally disagree
    2: I disagree
    3: Neither agree nor disagree
    4: I agree
    5: I totally agree
- Open-ended short responses.

During the survey, closed-ended responses are emphasised rather than long answered long questions in order to prevent the participants from giving up on the survey. Open-ended responses are also used with a limited number of questions in which the personal approach of the participants is important.

**2.2 Target Group of the Questionnaire**

The target of the research consists of participants who visit archaeological sites. Through the questionnaire created within the scope of the study, 129 respondents who visited the archaeological sites are reached. The analyses are carried out on the impressions of these participants.

**2.3 Context of the Questionnaire**

The questionnaire consists of three parts and 10 questions. In the first part of the questionnaire, the general profiles of the participants are determined by asking questions about the age and professional knowledge of the people participating in the research. In the second part, there are questions to learn the impressions of the visitors about the protective structures applied in archaeological sites. The third and last part, it is aimed to make a more detailed assessment of the opinions of the participants by asking critical questions about the protective structures.

Attention is taken to ensure that the questions are clear and understandable. The questionnaire form is directed to the participants via online with email groups and social media accounts.

**2.4 Evaluating Technic of the Questionnaire**

The responses to the questionnaire are collected via Google Forms and they are examined in detail. The responses to the closed-ended questions are separated according to their percentages with a pie chart and made more understandable. In addition, the responses to the open-ended questions are classified according to their consistency or compatibility and presented as a pie chart according to the intensity of the answers. The responses that are singular in the answers and weak compared to the other answers are combined under the title called "other".

**3. Analysis**

In this part of the research, the results obtained from the survey are evaluated with the percentage method for each factor and the findings are analysed. In accordance with the purpose of the research, the responses to the questions collected in three sections are presented in graphics.

**3.1 Part 1 Participant Profile**

In the first set of questions, the findings related to the participant profile are analysed and the percentage distributions are presented with figures.

The age distribution of the participants is shown in Figure 5. When the findings of the research are examined, it is seen that 56% of the participants are concentrated in the 20-29 age range. This density is followed by those between the ages of 30-39 with 32%. It is seen that 2% of the respondents over the age of 50 participated in the survey.

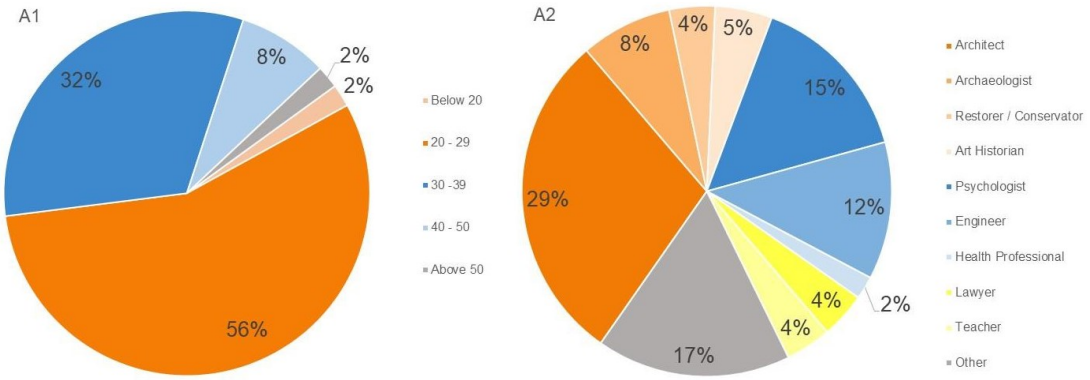


**Figure 5.** Age and profession of the participants.

The profession / branch distribution of the participants is shown in Figure 2. It is striking that most of the people participating in the survey are in the field of architecture with 29%. After architecture comes psychologists, engineers, archaeologists, art historians, restorers, teachers and lawyers. Professions with low density participating in the survey are gathered together and included in the other 17%.

### 3.2 Part 2 Focus on Protective Structures

In the second set of questions, the participants are asked about the effect of protective structures on the visuality and authenticity of the architectural remains at archaeological sites and their opinions are evaluated. The answers given to the questions are shown in the graph in Figure 6.

The question asked about the relationship between the protective structures and their visual effect on the architectural remains, is answered as “strongly agree” by 48% of the participants.

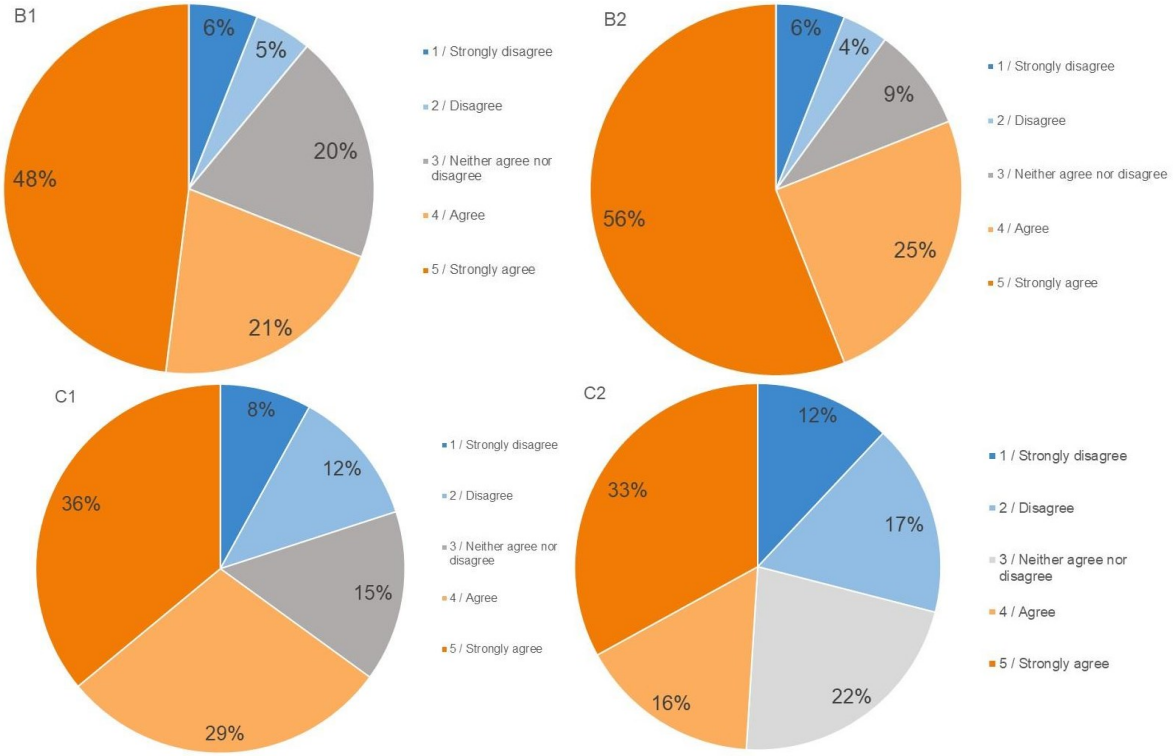


**Figure 6.** The effect of protective structures on the visuality of the monument (B1), site (B2) and the effect of protective structures on the authenticity of the monument (C1) and site (C2).

On the other hand, it is seen that 36% of the participants answer "strongly agree" to the question asked about the effect of the conservation structures on the authenticity of the architectural remains and the site. The answers given by the participants are shown in the graph, Figure 4. Looking at the answers to the questionnaire, the participants agree that the protective structures change the authenticity of the architectural remains and archaeological sites.

### 3.3 Part 3 Critiques

In the third set of questions, it is aimed to reach a more detailed visitor evaluation by asking the participants about the examples of protective structures.

The answers by the participants about the protective structures they encountered in archaeological sites as visitors are given in Figure 7. It is seen that 54% of the participants are not satisfied with the protective structures they encounter in archaeological sites.

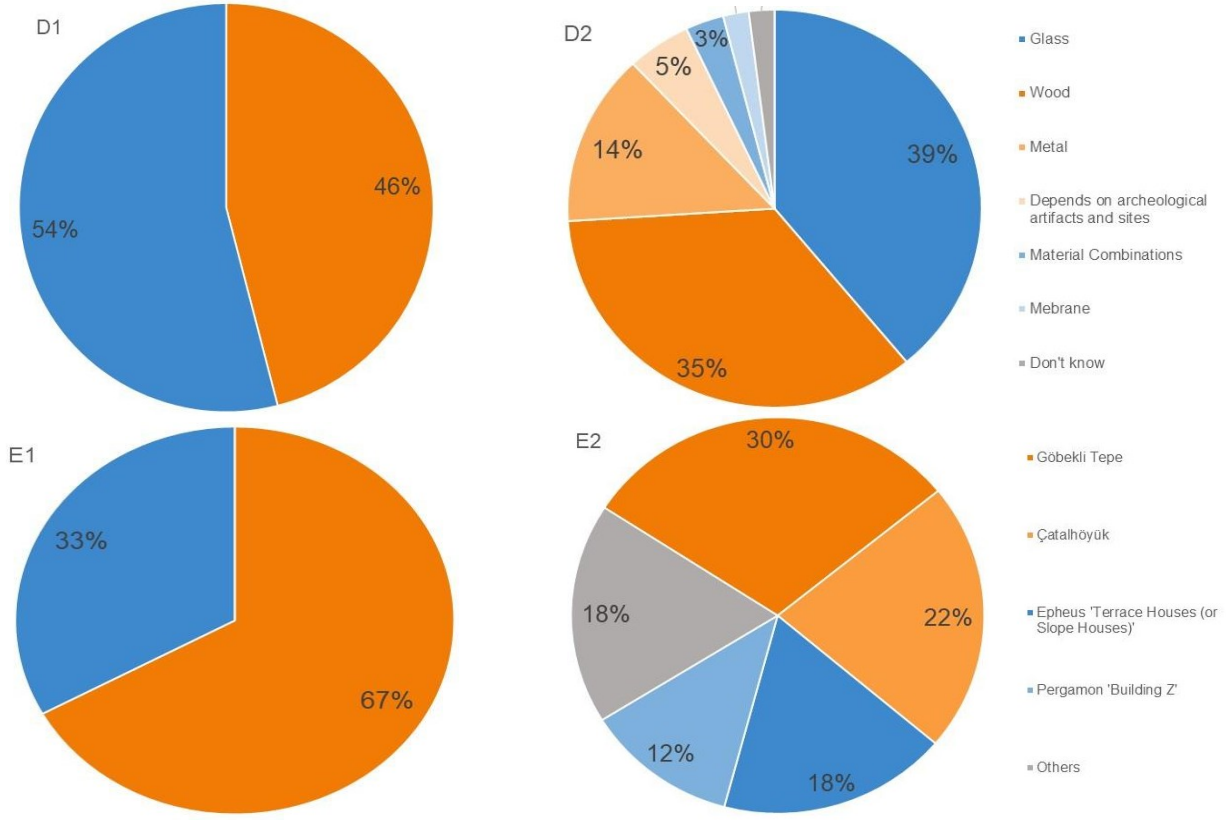


**Figure 7.** Satisfactory level of the visitor (D1), material as a preference (D2), digital apps as an alternative (E1) and successful protective structure examples (E2).

The answers they gave to the question about which materials used make the protective structures more visually interesting are shown in Figure 7. 39% of the participants prefer structures using glass, followed by 35% for timber materials.

When the participants are asked whether digital applications could create an alternative to protective structures, 67% think that they would create an alternative by saying yes. The distribution of answers given to the question is shown in Figure 7.

Participants are asked to give examples of conservation structures that they found successful. The examples given in Figure 8 can be seen. As a result of the answers given, Göbeklitepe with 30% and Çatalhöyük with 22% are seen as successful examples.

### 4. Discussion

During the answering of the questionnaire by the first participants, there was a criticism from the two participants that there was not enough explanation at the beginning of the questionnaire about what the protective structures are, and the practitioners immediately intervened at this point and information about protective structures was put in the introduction part of the questionnaire.

Regarding the results of the questionnaire, it can be assumed that the participants accepted that the protective structures visually affect the architectural remains and archaeological sites and change their authenticity. In particular, while the absolute majority of agreements have been recorded for the questions in groups B, C and E, an equal distribution in D1 and various opinions are recorded in D2 except for the two dominant answers. In B2, the question about whether the protective structures are effective in the visualisation of the archaeological site is recorded as the highest agreement (85%).

This aspect may suggest that the participants approach the visuality of the archaeological site differently from the visuality of the architectural remains and give more importance to the appearance of the site.
The satisfaction level of the participants related to the protective structures in archaeological sites that they encountered is low and 98% of the participants answered the question "What kind of material/s that are used in protective structures are more interesting for you from the visual point of view?". Thus, in the case of proposing material alternatives, participants will choose the one that they are visually satisfied with. During the design process the material alternatives can be improved by professionals and with digital applications they will be opened to the public to be voted on. Virtual reality and wearable technologies should also be considered for maximising the visitor experience.
Several protective structures also aim at interpretation and representation of the architectural remains which is possible today by using digital applications; however, the participants' response to the digital applications cannot create an alternative. Even though the negative effect of protective structures on the visuality of the archaeological sites is agreed upon by participants, Çatalhöyük and Göbeklitepe are the most given successful examples in contrast.

**5. Conclusion**

In the presented research, after a scrupulous analysis of the process ideas of the existing examples and the design criteria for protective structures, it became clear that public participation is extremely necessary for the design of protective structures. The study also questions at what stage and to what extent public participation could be integrated into the decision mechanism.
It is clear that the technical decisions should be left to professionals whereas it would be appropriate to take the opinions of the public and involve them in the process of determining the visual effects of the protective structures.
The involvement of the public in decisions about the visuality of the monuments and sites does not have a strict part in all the processes hence the feedback coming from the public should be integrated with the draft projects during the form design, material and scale selection, etc. Besides, it has been understood during the research that the participants are willing to express their opinions about the appearance of the cultural heritage, which is the right of the public.
The limit of the research is that a couple of the professions show dominance due to the circles of the people whom do the work being used in the sharing of social media and email groups.
As a result, the questionnaire recorded that integration of the public is possible for decisions taken for the visuality of the protective structures on the monuments and/or the archaeological sites; however, since the procedure has been applied only once, to understand its reliability it would be beneficial to apply the model to a higher number of participants, preferably with a satisfactory level of different background.
This research is planned to be developed in the future by testing on a model that will be used in protective structure applications which have an ongoing design.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Gamification and Storytelling for Architectural History and Cultural Heritage Awareness

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**Abstract**
Many people, even architecture students, fail to connect with the multi-layered city they live in and with its past. Most inhabitants of such "palimpsest*" cities usually live as if the current built environment has always existed throughout the history, failing to see the light that the buildings of different periods shed for their own age and their importance for us. When the reflections of the culture, which has been transmitted through generations and diversified by being fed from different sources, cannot be distinguished on various buildings, the architectural heritage of the cities can be overlooked, and might be consciously or unconsciously destroyed. Unfortunately, present architectural history or cultural heritage conservation courses do not help to adequately establish a healthy relationship between residents and the city or the cultural site that needs to be protected.
In order to fill this important gap, we have recently proposed an EU project and this paper presents the objectives, partners, methodology and prospective implementations of the project, namely "Palimpsest Cities", which aims to create an alternative, innovative, interdisciplinary curriculum of a new course supported with gamification and storytelling techniques. This course will especially be designed for architecture students, and the project also aims to test this approach by various implementations in partner universities, as well as through collaborations with local governments and professional organizations. By doing so, it aims to deliver the content of this innovative course to whole residents of the city from children to elderly, with a special emphasis on social inclusion of disadvantaged groups. Likewise, this paper and its presentation will be an important opportunity to disseminate the project before its kick-off and contribute to essential network our project is seeking for.
**Keywords:** Architectural history, cultural heritage, gamification, storytelling.

## 1. Introduction

Since I moved to Alanya in September 2021, I visited the historical buildings of the city many times with great pleasure, and many others which are trying to survive with difficulty and sadness. (Figure 1) However, I was very surprised when I learnt that most of my students at the faculty of architecture have not visited the historic sites in Alanya, although they were living in the city for several years. Okay, as I am an architectural historian, I may have been fascinated by the extraordinary architectural heritage of this city I have just moved to. But my students are studying architecture and they have been living here for years.
Is it just them? Unfortunately, this is not only the case for students of architecture, but also for the whole public. Few people in the city know the history, layers, values and stories of the places they live in. Especially the underrepresented ones; the disabled, refugees or lower-income groups; they even do not have the chance to see them. For this reason, it is not surprising that some of the buildings have been abandoned and the values of the well-off are not known except for the scenery they offer. Therefore, it is essential to *truly* become aware of the architectural heritage of our cities. If we want to achieve this, we need to change our education system first. And it is necessary to realize this with a completely new, innovative and creative teaching methodology; not by adding traditional, inefficient courses based on memorization to the existing architecture curriculum, which is even alienating students from history and architectural heritage studies (Thompson, 2017).
Moreover, the protection of our architectural and cultural heritage should start from the bottom, not from top, and the only way to protect Europe's and the whole world's historic and multi-layered cities is to make everyone embrace their cities through getting familiar with them, knowing them and above all meeting them. Therefore, we designed Palimpsest Cities project as a higher education project since most of the project team is from academia; but we particularly aim to work hard to make the outputs of the project reach every single member of the society by providing necessary adaptations to disseminate the results to anyone, not only to our architecture students.
Accordingly, this paper presents this new EU project that promise to trigger the awareness of cultural heritage starting from local scale to international scale by creating and implementing a new course equipped with innovative methodologies including gamification and storytelling, and by putting learners/people at the centre. Although the

* a manuscript or piece of writing material on which later writing has been superimposed; something reused or altered but still bearing visible traces of its earlier form. (Oxford Languages Dictionary)

project has not been funded yet, this paper aims to share the methodology of the project, disseminate it to the public before its kick-off and contribute to essential network the project is seeking for.



**Figure 1.** Monastery on the Cilvarda Point, Alanya, in a ruinous state (photo by author).

**2. Palimpsest Cities Project at a Glance**

The project entitled "Palimpsest Cities: Gamification and Storytelling for Architectural History and Cultural Heritage Awareness" was submitted on 23 March 2022 for Erasmus+ KA220 HED grants, with the project ID: 2022-1-TR01-KA220-HED-000089912. This "Cooperation partnerships in higher education" project is developed in collaboration with Mimar Sinan Fine Arts Univesity (MSGSU) from Istanbul, Turkey; Center for Education and Innovation (InnovED) from Volos, Greece; and Asociatia De-a Arhitectura (DAA) from Bucharest, Romania; under the coordination of Alanya Hamdullah Emin Paşa University (AHEP) from Antalya, Turkey.

The primary aim of the project is creating architectural history and cultural heritage awareness, especially for multilayered cities, by establishing bonds with city's past and its inhabitants through innovative, hybrid, learner-based approaches, by particularly using techniques of gamification and digital storytelling. By implementing it, we want to change the mindsets of our students as well as the whole public starting from the underrepresented groups, in an effective and sustainable way.

We will firstly design a new course called "Palimpsest Cities" on architectural history and cultural heritage conservation, by applying novel education approaches, especially by keeping in mind how learners have changed recently by putting emphasis on game-based learning (Prensky, 2001) and keep up with the "digital natives" (Prensky, 2012), with the complementing skills of the partners. Then, we will make implementations at our universities and for local groups, targeted particularly to youth and children. We will test the success of this approach with qualitative and quantitative evaluations to improve the quality of the course and provide a guide for future adaptations.

By realizing this project, we expect to have significant improvement in architectural and cultural heritage awareness, stronger bonds with the city for everyone, and better protection of our built environment. We also believe that this project and its implementations would open a new path both in architectural education and heritage conservation, with its original, interdisciplinary approach putting learners into an active role, and create strong synergies in academia, NGOs and local bodies with its inclusive character.

**3. Project Activities**

This two-year project will be composed of two phases, each lasting one year. In the first phase, the curriculum for a new course (ARCH 4XX-Palimpsest Cities) on architectural history and cultural heritage awareness for multi-layered cities will be designed. The second phase, devoted to testing the new curriculum with test lectures & local implementations and evaluation of the impact of this new approach, will took places in the second year together with all other dissemination activities.

The first phase of the project will start with the literature review, to learn about the most recent, innovative approaches of education. Then, the rest of the first year will be devoted to the design of the modules of the new course and each partner will be responsible for their leading modules and work in collaboration with other partners. Below modules will also be the sub-phases of the first year of the project:

Timeline Travel: This module will create new timelines for the multiple layers of the prototype cities, Alanya and Istanbul, on the Timeline Travel mobile app (Özgüleş, 2020). This app was designed for architectural history, as the last output of a previous Erasmus+ project entitled "Timeline Travel: An Alternative Tool for Architectural History Learning and Teaching", and the positive effect of usage of Timeline Travel in architectural history courses was previously demonstrated. (Özgüleş, et. al, 2020) Therefore, this module is anticipated to be the backbone and essential component of this new project.
Digital Storytelling: This module will be synthesised with a linear narrative approach, aiming to have students as story-tellers in order to capitalise and trigger their interest and correlation to specific points in their cities that deserve undivided attention. The elements of story-telling will be combined to result in a series of videos, which will be created and edited by students as well.
Gamification: Virtual and face-to-face workshops will be carried out among project partners to learn how to gamify a lecture or the whole course content. After these workshops, a suitable gamification method will be chosen to be applied during implementations.
City on Trial: This activity is based on the personification of the city and will use debate club method. The idea is to have the two confronting teams building arguments connected to how a city, in time, could satisfy the needs of its inhabitants.
Tunnel Book: This unique and sculptural book form will be the output of this module. The construction of a big model of the city using tunnel book technique will be carried out by students again, but during the design phase, elements and layers of this book (i.e. different periods of a city) will be determined.
Apart from these activities, one opening and one closing lecture video will be prepared as a part of the design phase of the course. These videos will be shot in historic centres of Alanya and Istanbul as the introduction and conclusion of the proposed course, which could be used by anyone wishing to adapt this course to their curriculum. Also, in line with this purpose, an online guide will be created for instructors to prepare a similar course for other multi-layered cities with user-friendly instructions to modify it to their target groups' needs.

The second phase of the project will be based on testing this new course at partner universities with test lectures towards architecture students as well as further implementations at local level adapted to other target groups. These test lectures and local implementations will be realized in such a way that feedback collected from them will be used to improve the quality of the newly designed curriculum. Therefore, the second year of the project could also be seen as testing, evaluating and improving phase of the main outputs of the project.
Therefore, in the beginning of the second year, test groups and evaluation methods to be used during tests will be determined, measurement tools for implementations will be specified and pre-test & end-test questions will be prepared, in such a way that they would allow researchers to benefit from the feedback from the end users. Then, the first test lectures will take place at architecture departments of AHEP and MSGSU, with the students who are registered to the new course ARCH4XX-Palimpsest Cities at these universities in the 2023-2024 academic year's fall semester. These courses will be dedicated to palimpsest cities Alanya and Istanbul and the test lectures will be equipped with field trips in Alanya and Istanbul, respectively.
Parallel to these test lectures, other partners, namely DAA and InnovED, will conduct implementations in Bucharest and Volos, respectively, particularly towards children and other underrepresented groups. These implementations will also form an example for adaptations of this new course to different needs and different target groups. These implementations will mainly follow the outline of the Palimpsest Cities course, but they will be composed of selected modules only, with necessary changes in accordance with the group in focus, prepared with the help of the guide to be prepared by the end of the first phase of the project.
In the spring semester of 2023-2024 academic year, the second test lectures will be conducted at AHEP and MSGSU equipped with field trips again. However, this time, the content of the courses delivered at these institutions will be slightly different, as the "Palimpsest City" in focus will be exchanged. In other words, AHEP will be testing Palimpsest Cities-Istanbul course whereas MSGSU will be testing Palimpsest Cities-Alanya course, in Alanya and in Istanbul respectively. This will give the project group the chance to make different implementations for different contents or subjects and these tests will also form a good example of adaptations of courses to different universities or departments.
Further implementations in Alanya and Istanbul with public workshops, especially in collaboration with associated partners and local groups will be an essential part of the project, and it is planned to take place in the last quarter of the project duration. Children, women, immigrants, elderly and disabled people will be given priority in local implementations and adaptations of the Palimpsest Cities course will be delivered to local people as free workshops with on-site tours. Towards the end of these implementations as well as the first implementations in Bucharest and Volos, and at the end of the first and second test lectures at AHEP and MSGSU, interviews with students, instructors

and local people participating in workshops will be conducted. As explained above, these will give the project group the essential insight and feedback to improve the quality of the outputs of the project.
Finally, in the last three months of the project, dissemination activities will be intensified to extend the reach of the project outputs. These activities will also include the development of a mobile guide demonstrating the tangible layers of a city's history incorporating the architectural heritage from different periods. This app will be similar to the Timeline Travel Mobile App (Özgüleş, 2020) and adaptable to any "Palimpsest City" on earth, with a user-friendly interface.

**4. Expected results**

During the realization of the project and at the end of the project duration, we expect to have some general and concrete results, that would contribute to one or more EU priorities and yield significant improvements in architectural and cultural heritage awareness. First of all, we are positive that this project will create stronger bonds with the city for everyone, hence better protection of our built environment. In the long term, the project will in all likelihood bring out positive impacts to ensure the protection of our built environment with the direct involvement of local people (De le Torre, 2013; Graham and Howard, 2016). More importantly, we are positive that the participants of the project, both the students and the local people, would become active protectors of their cultural heritage by gaining sense of place (Waterton, 2005; Çiftçi, 2020).
On the other hand, we expect that this project and its implementations would open a new path both in architectural education and heritage conservation, with its original, interdisciplinary approach putting learners into an active role (Vogel and Klassen, 2001). We also hope to create strong synergies in academia, NGOs and local bodies with the project's inclusive character.
As a result of the implementations throughout the project duration, including the research, design and testing phases, we hope to have following concrete results:
-At least 60 students from two partner universities will take this new course and increase their awareness of architectural and cultural heritage
-40 high school children from the other two partner cities, Bucharest and Volos, will have workshops on cultural heritage awareness about their own cities.
-20 members of the project team will not only improve their academic and pedagogic skills but also establish new networks
-A total of 1000 local people from Alanya, Istanbul, Bucharest and Volos will get architectural and cultural heritage awareness about their cities' historic past by benefitting from the cleverly adopted outputs of the project.
-A total of 100 people from underrepresented groups, especially those who cannot benefit from and identify with their multilayered city's heritage, will find the chance to truly meet with their cities
-A set of 60 pre-tests and end-tests providing data that will help us to understand how successful the project has been and whether it has achieved its objectives.
Accordingly, at the end of the project duration, we anticipate to validate this new educational approach, together with success of the course and assessment system, and the impact of the course, i.e. whether it raised cultural heritage awareness or not with the user interviews. We are planning to publish the results and outputs of the project in one or two research articles, with one or two conference presentations. All of these would definitely improve the outreach of the project and intensify its impact.

**5. Conclusions**

In conclusion, the Palimpsest Cities Project presented in this paper, would be an innovative contribution to the field, as it will create a hybrid course through augmenting alternative education methodologies and intertwining various course modules created with the most appropriate competences of the partner institutions. By putting students into a more active role, using their creativity through learning by doing approach and bridging between different disciplines and benefiting from digital tools through gamification and storytelling, this project is very innovative and ambitious, and it also aims at establishing new collaborations between higher education institutions, local bodies and creative sectors.
By creating effective methods to ensure inclusiveness through all layers of the public, by introducing new digital tools and interactive workshops, and by bringing hands-on non-formal and informal teaching methods in a formal education environment depending heavily on "learn by doing" methodology -a strong notion embedded in the nature of architectural education and very much dependent on the enhancement of the artistic creativity of the learner-, the proposed project come to the forefront. Last but not least, with its emphasis on gaming and storytelling, this project aims at transforming the teaching practice to make it more sustainable compared to conventional methods, especially given the fact that architectural history is usually described as one of the most boring subjects in schools of architecture.

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**Conflict of Interests**
The author declares no conflict of interest.

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# LEVANTEN KÜLTÜRÜNÜN 19. YÜZYIL İZMİR KENT FORMU VE DOKUSUNDA İZLERİ

'Bildiri, Başkent Üniversitesi, Fen Bilimleri Enstitüsü, Mimarlık Yüksek Lisans Programı'nda Dr. Öğr. Üyesi Çağla Caner Yüksel danışmanlığında yürütülmekte olan ''Levanten Kültürünün 19.Yüzyıl İzmir Kent Morfolojisine Etki Üzerine Bir İnceleme'' adlı yüksek lisans tezine dayandırılarak hazırlanmıştır.'

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**Özet**
19. yüzyılda İzmir Osmanlı İmparatorluğu'nun en önemli dış ticaret merkezlerinden biriydi. Türkler, Rumlar, Ermeniler, ve Levantenler gibi farklı etnik grupların beraberinde getirdiği toplumsal yapıdaki çeşitlenme, kentin kültürel ve fiziksel yapılanmasını etkilemişti. Kendi mahallelerini çevreden bağımsız olarak kuran ve kentin ticaret hacminin ekseriyetini ellerinde tutan Levantenler, kıyı şeridine deniz ticareti sebebiyle limana yakın olmak için güvenlik sebebiyleyse tehlike ve ihtiyaç halinde kendilerini kolaylıkla tahliye edebilmek için yerleşmişlerdi. Levantenler, kendilerine özgü yaşam biçimlerine cevap verebilecek mekânlarıyla İzmir'in kentsel form ve dokusunun biçimlenmesini etkilemişlerdir. Bu kapsamda bu bildiri Levantenlerin İzmir'in 19. yüzyıldaki mekânsal gelişim ve biçimlenmesindeki etkisini irdelemektedir. Bu çerçevede, 19. yüzyılda görsel temsil aracı olan fotoğraflar, kartpostallar, haritalar ve kent planlarından yararlanılan çalışmada; kent ölçeğinde, kentin kıyı şeridinde Frenk Mahallesi olarak bilinen Levantenlerin yaşam çevreleri ve mimari ölçekte, mahalle dokusunu oluşturan birimler, kente Levanten kültürle birlikte yeni tanıtılan eğlence ve konaklama yapılar gibi mimari tipleri esas alan morfolojik çözümlemeler ve değerlendirmelerle Levantenlerin 19. yüzyıl İzmir'inde izleri tartışılmaktadır.
**Anahtar Kelimeler**: Levanten; İzmir; Kent Morfolojisi; Kültür.

## 1. Giriş
İzmir kenti kuruluşundan itibaren Anadolu'nun önemli liman kentlerinden biri olmuştur. Coğrafi konumu sebebiyle dışarıdan gelebilecek saldırılara savunma kolaylığı sağlaması, doğal bir liman kenti özelliğini taşıması, körfeze akan dereleri sayesinde verimli tarım arazileri barındırması gibi özellikleri ile toplumun temel ihtiyaçlarına cevap verebilmesi şehrin önem kazanmasında rol oynamıştır. İzmir kenti, önemli bir kent olması neticesinde tarih boyunca çok sayıda topluma, kültüre ev sahipliği yapmış bununla beraberde çok sayıda savaş görmüştür. Yapılan savaşlar ve yaşanan doğal afetler sebebi ile şehir sürekli bir yıkım ve yeniden yapım süreci geçirmiştir. Tarih üzerine tarih yazılmış, kent üzerine kent yapılmıştır. Bunun sonucu olarak yıkımlar ve yeniden yapımlardan dolayı çok katmanlı, tarihi evrelere ev sahipliği yapan kentte yaşanmışlığın, anının ve tarihin izlerini sürmek zordur. 14. yüzyılda Kadifekale yamaçlarında Müslüman Türklerin, Limankale'de Hristiyanların ayrı ayrı egemenlik sürmesi ile 20. Yüzyıl başlarına kadar sahip olunacak kent kimliğinin temelleri atılmıştır. Kentte bulunan farklı etnik grupların birbirinden bağımsız hayat sürmeleri ile asimile olmamalarından dolayı bir kent içinde birbirinden ayrılan farklı kent kimlikleri gelişmiştir. Şehrin morfolojik yapısı ve kimliği o kentte bulunan sosyal grupların, kültürlerinin yansımasıdır.

### 1.1 Kent Morfolojisi
Morfolojik yaklaşım, şehir coğrafyası çalışmalarında bir akımı temsil etmiştir. Morfoloji veya fizyonomi şekil, biçim anlamına gelmektedir (Ayan, 2010). Şekil kelimesi "bir nesnenin dış çizgileri bakımından niteliği, dıştan görünüş biçimi olarak tanımlanmaktadır." (Türkçe Sözlük, 1983) Kent, zaman içinde sosyal ve ekonomik faktörler tarafından şekillendirilmiştir. Kültürler tarafından yönlendirilmiş bireysel ve küçük grup eylemlerinin toplamıdır. Kent morfolojisi şehre, yaşayan bir organizma olarak yaklaşmaktadır. Odak noktası; sosyal, dinamik ve ekonomik güçlerin beraber doğurduğu bir sonuç olan fiziksel dünyadır (Moudon, 1997). Kentler tarihleri boyunca barındırdıkları insan toplulukları tarafından inşa edilmişler, geliştirilmişler ya da geriye dönük eksi bir gelişim göstermişlerdir. Binalar, cadde ve sokaklar, bahçeler, parklar ve anıtlar gibi olgular morfolojik analizin ana elemanlarıdır. Bu olgular zaman içerisinde dönüşüme uğraması sebebiyle, yaşanılan ve yaşayan birer organizma olarak kabul edilmiştir. Aralarında sıkı ve dinamik bir ilişki bulunmaktadır (Moudon, 1997). Şehrin fiziksel yapısı, formu ve bileşenlerinin incelenmesi ve bu öğeler arasında ilişkiler kurulması kent morfolojisi olarak adlandırılmıştır (Wilkinson & Willoughby, 1962). Farklı coğrafyalarda farklı kültürler oluşturan insanlar, kültürleri ile birlikte gelişim göstermiştir.
''Kent morfolojisi, bir bilimsel araştırma alanı olarak yapı planlarının sınıflandırılması olarak tanımlayabileceğimiz bina tipolojilerinden, kentlerin bir bütün olarak biçimsel özelliklerinin anlaşılması olan kent makroformu araştırmalarına kadar kent ve kenti buluşturan fiziksel parçaların biçimsel özelliklerinin araştırılıp, kavranmasına yönelik son derece geniş bir ilgi ve çalışma alanını kapsamaktadır.'' (Ayan, 2010)

**2. Kapsam ve Yöntem**

Bu çalışmada Levanten toplumun, İzmir kent merkezindeki oluşuma ve gelişime etkisi incelenmektedir. Levantenlerin özellikle etkinliğini gösterdikleri 19. yüzyıl ve rıhtımın inşası ile hız kazanan inşa faaliyetleri ile 19. yüzyılın son çeyreğinde İzmir kent morfolojisi ele alınmıştır. Kent ölçeğinden başlanarak yapı ölçeğine inilmiştir. Sosyal, kültürel ve fiziksel anlamda farklılık oluşturan batı toplumunun kimliklerinin, kent morfolojisi üzerine etkisi incelenmiştir.

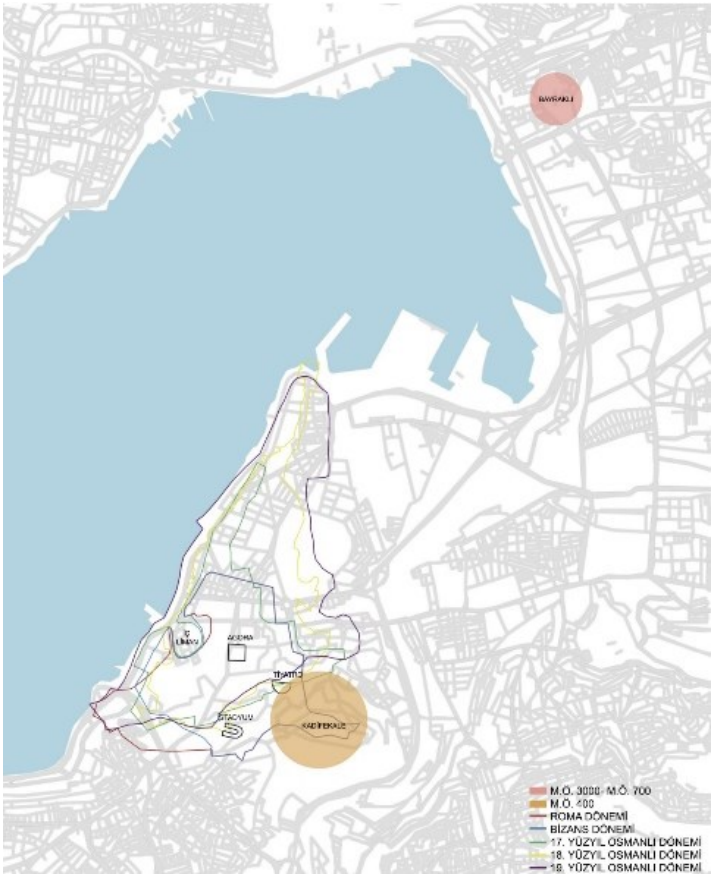
Kent morfolojisi ağırlıklı olarak Levantenlerin en etkin dönemleri olan 19. yüzyılın son yarısı üzerinden ele alınmıştır. Kent merkezi ikili bir şehir yapılanması ile karşımız çıkmaktadır. Frenk Mahallesi, kent merkezinde Levantenlerin yaşam alanıdır. Öncelikli olarak 1856, 1876 ve 1905 tarihli haritalar üzerinden ilk kentin makroformu incelenmiş ve sonra Frenk Mahallesi ve yakın çevresine odaklanılmıştır. Devamında mahalle ölçeğinden yapı ölçeğine inilmiş ve kıyı boyunca ve rıhtım üzerine inşa edilen yapılar tipo-morfolojik açıdan değerlendirilmeye çalışılmıştır.

Son döneme tarihlenen bu yapılar kent genelindeki yapı tipolojisinin olgunlaşmasını tamamlamış yapılardır. Farklı yapı tiplerinin incelenmesine olanak sağlayan rıhtım yapıları, kullanıcılarının kimliklerini büyük ölçüde yansıttığı göz önünde bulundurularak seçilmiştir. Rıhtımda bulunan farklı işlevlerdeki yapılar Levanten topluluğunun ihtiyaçlarını ve gerekliliklerini gözler önüne sermiştir. Üslup açısından incelendiğinde de Levantenlerin özü olan Avrupa'nın o dönem hakim mimari anlayışının bir yansıması ile inşa edilmiş ve kent siluetinde yerini almıştır.

Şu ana kadar İzmir kent araştırmaları kapsamında İzmir'in Cana Bilsel'in, Sibel Zandi Sayek'in özellikle kent planları üzerinden morfolojik çözümlenmesi üzerine çalışmalar vardır. Diğer taraftan Muharrem Yıldız'ın Levantenler üzerine yapılmış çalışmaları vardır. Bunlardan Salih Nari'nin sosyal tarih çalışmaları ve de Levanten köşkleri üzerine yapılan Hümeyra Birol Akkurt'a ait çalışmalarda vardır.

Bu çalışma ise kent bağlamında Levanten kültürünün kent morfolojisindeki izlerini irdelemektedir. Ve bunu kent ölçeğinden başlayarak, sırasıyla Frenk Mahallesine odaklandığı mahalle ölçeği dolayısıyla ve de bunun içinde tek yapı ölçeğine, mimari tipo morfoloji çözümlemelerini kapsayarak yapmaktadır. Kent merkezindeki bu inceleme sosyal yapının ve yaşam kültürünün, kent mekânını ve kentteki mekânları oluşturmasındaki ilişkiye yöneliktir. Bu alanda; kentin ve yapının oluşmasına sebep olan yaşama biçimi ve kültürü, mekân kullanımları, kentin oluşumu, ulaşım ağları, yapı adaları, yapılar, yapıların sosyal yaşam içindeki rolü, yapım sistemi ve malzemeleri, yapıların kent mekânları ile kurduğu ilişki, yapıların mimari elemanları ile Levantenlerin temsil biçimi olarak ortaya konmaktadır.

**3. İzmir'in Tarihçesi**




**Şekil 1.** Güncel İzmir haritası üzerinden İzmir dönemlerinin yerleşim alanları

Günümüzde İzmir olarak bildiğimiz isim, Smyrna kelimesinden türemiştir. Türkler tarafından ele geçirildikten sonra ise İzmir biçimine dönüşmüştür.
Eski İzmir'in kuruluş yeri olarak şimdiki Bayraklı'da yer alan Tepekule adındaki ören yeri gösterilmektedir. (Yılmaz & Yetkin , 2002) Bayraklı 'da yapılan kazılar sonucu elde edilen buluntular İzmir'in kuruluşunu MÖ 3000 yıllarına tarihler. (Yılmaz & Yetkin , 2002) Yapılan araştırmalar İzmir'in bir Aiol kenti olduğunu göstermektedir. Bir dönem Hitit İmparatorluğu'nun bünyesine girse de, İyonyalılar tarafından ele geçirilene kadar Aiol kenti olarak kalmıştır (Yılmaz & Yetkin , 2002).
Dönemdeki gelişmeler, İyon kentlerinin ticaret yoluyla zenginleşmesine ve gelişmesine olanak sağlamıştır. Kentin ikinci kurulduğu yer, Kadifekale yamaçlarından denize doğru uzanmaktadır (Yılmaz & Yetkin , 2002).
İzmir MÖ 3. yüzyılın başlarında Efeslilerin tavsiyesi üzerine 13. İyon kenti olarak kabul edilmiştir. Helenistik dönemdeki savaşlarda özgür kent olarak kalmayı başarmıştır. İzmir MÖ 133 yılında III. Attolos'un ölümü ve vasiyeti üzerine Roma İmparatorluğu'nun bir parçası olmuştur. (Yılmaz & Yetkin , 2002) (Canpolat, 1992)
Roma İmparatorluğu döneminde kent önemli eserler kazanmıştır. Yapılan imar çalışmaları sonucunda kentin görüntüsüne Roma mimarisi hakim olmuştur. Her türlü tahribata rağmen büyük bölümü günümüze ulaşmış devlet agorası dönemin en dikkat çekici yapılarından birisidir. Ayrıca tiyatro, stadyum, iç limanın yakınlarında olduğu düşünülen İzmir'in ticaret agorası da günümüze ulaşamayan eserlerdendir (Yılmaz & Yetkin , 2002) (Canpolat, 1992).
Bizans erken dönemden itibaren İzmir'i dini bir merkez olarak tanımıştır. İzmir dini merkez olması sebebiyle İmparator Leon, kenti Konstantinopolis dışındaki kentlerin başkenti ilan etmiştir. Her ne kadar yangın, deprem gibi doğal afetler veya savaşlar Bizans kentine zarar vermiş olsa da Bizans'ın İzmir kenti üzerinde iz bırakabilecek potansiyelde imar çalışması yürütmemiştir. (Yılmaz & Yetkin , 2002) (Daş, 2009)
11. yüzyıldan itibaren kentte yeni bir dönüşüm evresi yaşanmıştır. Bu dönemde bölgeye gelen Türkler ve Bizans arasında şehir bir kaç kez el değiştirmiştir. Buna Haçlı Seferleri de dâhil olduğundan kentin bu yüzyılda çekişmeli bir döneme sahne olduğu bilinmektedir. (Yılmaz & Yetkin , 2002) (Daş, 2009)
1071 yılına gelindiğinde Bizans'ın Selçuklu orduları tarafından aldığı yenilgi ile Anadolu toprakları ve kent için yeni bir döneme geçilmiştir. Anadolu'nun yerleşimi ve nüfus dağılımı hızlı bir şekilde değişmeye başlamıştır (Yılmaz & Yetkin , 2002) (Daş, 2009).
Çaka Bey'in İzmir'i hakimiyet altına alması ile kent önemli bir döneme girmiştir. Çaka Bey'in ölmesi ile beraber kent tekrar Bizans hâkimiyetine girmiştir. Böylece şehir uzun süre devam edecek olan yapısına kavuşmuştur. Aynı zamanda bu durum önce Aydınoğlu devamında Osmanlı döneminde, ticari faaliyetler yürütmek, sağlanan ayrıcalıklardan yararlanmak gibi benzer sebepler ile İzmir'e yerleşen Levantenlerin bu bölgeye yerleşmesinin temellerini oluşturmuştur. (Yılmaz & Yetkin , 2002) (Canpolat, 1992)
15. yüzyılın başında Timur bir sefer düzenleyerek Liman Kalesi'ni ele geçirip yıktırmıştır. Sonrasında şehri Aydınoğlu beyliğine vermiştir. 1426 yılında Osmanlılar Aydınoğlu Beyliği'ne son vererek kenti hâkimiyetleri altına almışlardır. Böylece kent yıllardır süregelen yönetimdeki belirsizliği son bulmuştur. (Yılmaz & Yetkin , 2002) (Daş, 2009)
Osmanlı Devleti kenti ele geçirdiğinde kent harap durumdadır ve Osmanlı, Ege Denizindeki hâkimiyetini tam olarak sağlayamamıştır. II. Mehmet Liman Kalesi'ni yeniden yaptırarak şehri uzun yıllar denizden gelecek saldırılara karşı savunulmasını sağlamıştır. Zamanla ticari faaliyetler sonucu artan ekonomik refah sayesinde kentte ticari altyapı üzerine bir inşaat patlaması olmuştur. Gümrük binaları ve bedesten inşa edilmiştir. Kentin su ihtiyacının giderilmesi için su kemerleri, çeşmeler planlanmış ve inşa edilmiştir. Ticari canlılık İzmir'i nüfus açısından kozmopolit bir kente dönüştürmüştür. Bu dönüşüm sonucu Levanten bir nüfus grubu oluşmuştur. Levantenler yerleştikleri Frenk Mahallesi'ni kendi batı kültürleri ile inşa etmiş ve bunu çevrelerinden ayırmıştır. Bu bölgede kendi kültürlerine ait ibadethaneler, kulüpler, lokantalar, kültür merkezleri, hastaneler inşa etmiştir. (Yılmaz & Yetkin , 2002)

## 4. Levantenler

### 4.1 Levantenler ve Levanten Kavramı

Levanten kelimesi; doğuya ilişkin, doğuda yaşayan veya doğulu manalarına gelmektedir. Fransızca Güneş'in doğması anlamına gelen "Lever" sözcüğünden türemiştir. Venedikliler ve öteki Avrupalı tüccarlar aracılığıyla, Haçlı Seferleri sonunda Sayda ve Sur gibi kentlerle ticaretin gelişmesi günlük dilde bu adın yaygınlaşmasına sebep olmuştur. (Ethem Eldem,6–8 Mart 1998 tarihinde Ege Üniversitesi'nde, İzmir'de Avrupa Öğrencileri Genel Forumu'nda yaptığı "Levantenler ya da Avrupalılar" toplantısı panel metni)
İzmir'e yerleşmiş bulunan ve kente gelişleri 14. yüzyıla kadar uzanan bir azınlık, bazen "Frenk", bazen de "Levanten" adıyla karşımıza çıkmaktadır. Beyru; bu grubu, ithal edilmiş, buraya taşınmış ırkların bir birikimi olarak görenlerin bulunduğunu, hatta Osmanlı İmparatorluğu'nda Avrupa kökenli yabancıların tümünün bu ad ile tanımlandığına dikkat çekmektedir. Avrupalı bir aileden gelmiş ve bu ülkeye yerleşmiş kişilerin tümüne "Levanten" demektedir. (Beyru, 2000)
Levantenlerin kökeni üzerinden bir Levanten kimliği tanımlamak pek kolay değildir. Bunun sebebi, Levantenlerin soyağacına bakıldığında farklı kökenlerin bulunmasıdır. Levantenler Osmanlıya Avrupa'dan gelen farklı ulusların oluşturduğu insanlardır. Levantenler Fransa, İtalya, Almanya, Avusturya, Hollanda, Avusturya-Macaristan, İngiltere vb. devletlerin insanlarından oluşan bir etnik gruptur. Bu ülkelerin insanları Osmanlıya geldiklerinde kendi aralarında evlilikler

yapmıştır. Bu durumun sonucu olarak Levantenlerin kökenleri fazlaca ulusa dayanmaktadır. Levantenlerin köken itibariyle ağırlıklı olarak Fransız ve İtalyan kökenine sahip oldukları görülmektedir. Bulundukları coğrafyada birçok kültür ile bir arada yaşamayı başaran Levantenler, kültürler arası uzlaşmayı sağlamıştır. (Yıldız, 2012)

**4.2. İzmir'de Levanten Toplumu**

Levantenler, genel olarak ülkelerinde bulamayacakları yaşam koşulları ve iş bulma nedenleriyle Doğu Akdeniz liman kentlerine gelmişlerdir. Bu gelişler daha çok koloni şeklinde olmuştur ve ticari ayrıcalıklar nedeniyle özellikle ticaretle uğraşan bu kişiler, Küçük Asya'da – Asia Minor (Anadolu'da ) önemli zenginlikler kazanmışlardır (Üsdiken, 2006).

Levantenlerin kazandıkları paraları devletten sağladıkları ticari ayrıcalıklar sayesinde sürekli arttırmak istemeleri İzmir ve İstanbul'a gelip yerleşmelerinin en önemli nedenidir. (Üsdiken, 2006)

Levantenlerin İzmir'e gelmesinin en temel sebebi ticaret hacmi istemi ve pazar arayışıdır. Özellikle 1856'da verilen mülk edinme hakkı kentin önemli miktarda göç alma sebebi olmuştur.

19. yüzyılda Osmanlı Avrupa ilişkileri yoğunlaşması sebebiyle, azınlık grup olan Levantenler toplum içinde güçlenmiş, ticari hayatta ön plana çıkmış ve sosyal yaşamda sivrilmişlerdir. (Yıldız, 2012)

Ticaret hacminin genişlemesi ve Levanten toplumun sosyo-kültürel alanda güçlenmesi ile birlikte, batılılaşma anlayışı da giderek artan bir güce sahip olmuştur. Birçok araştırmacı Levantenleri iki gruba ayırmıştır. Birincisi patron konumunda bulunan Avrupa kökenli, ekonomik güce sahip olanlardır. Diğer bir grup ise Osmanlı topraklarında doğup büyümüş, batı kültürüne hayranlık besleyen ama bu kültüre sahip olamayanlardır.

Gözlenen bir diğer durum da, özellikle 19. yüzyılın ikinci yarısında Levanten toplumun, sosyal hayatın birçok alanında olduğu gibi, spor alanında da toplumu yönlendiren, beğeni ve alışkanlıklarını topluma yayan bir tutum içinde olmasıdır. Levantenler eğitim alanına da oldukça önem vermekteydiler. Katolik dini misyonlarına bağlı olarak öğretimin eski yıllara dayandığını söylenebilmektedir. (Yorulmaz, 1988)

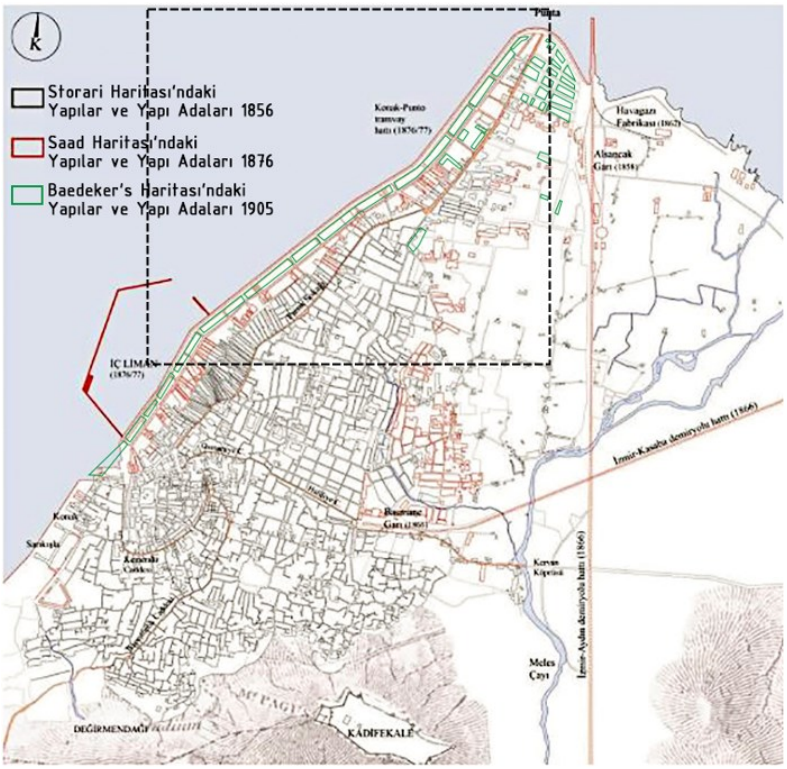
Uluslararası bir ticari limana dönüşen İzmir kenti içinde birçok etnik ve dini grubu barındırmaktadır. İzmir kentinin kozmopolit yapısının oluşumunda Osmanlıya ticaret için gelen Levanten toplumunun katkısı büyük ölçüdedir. (Akkurt, 2004)

İzmir kenti Osmanlı döneminde belirgin bir değişim geçirmiştir. Kent Pagos Dağı'ndan (Kadifekale'den) kıyıya doğru yelpaze gibi yayılmış, dağın yamacında Türk mahalleleri kurulmuştur. Kıyıya indikçe Türk mahallelerinin çeperine Yahudi ve Ermeni mahalleleri kurulmuştur. Kıyıya gelindiği zaman Levantenlerin yaşama alanları yer almıştır. Levantenlerin konutları, sosyal yaşanışının geçtiği mekânlar, okulları ibadethaneleri kısacası mahalleleri deniz kıyısına paralel olarak gelişim gösteren Frenk Caddesi çevresinde gelişim göstermiştir. (Akkurt, 2004)

İzmir Levanten Toplumun kent merkezindeki yaşam alanı bugünkü kıyı şeridi olan Alsancak bölgesidir. 1890'larda yeni rıhtımın inşası ile birlikte toplumsal hayatın merkezi de yer değiştirmiş, Frenk Sokağı'ndan (eski merkez) rıhtıma yönelmiştir. (Yorulmaz, 1988)

İzmir'deki Levantenlerin farklı yaşam alanlarını anlamak için söz konusu konut yapılarındaki mimari üsluba bakılmalıdır. Levanten toplumunun kent merkezindeki yaşama alanları ele alındığında bu alanları oluşturan kontlar iki ana grupta incelenebilir. Birincisi mimari biçimlenmede temel ortak özelliklere sahip olan, sıra ev niteliğinde konumlanmış, yoğunlukla Punta, Mektupçu ve Mithat Paşa'da saptanan konut örnekleridir. Diğeri ise tekil konumları, ölçek farklılıkları, gösterişli kitle ve cephe düzenlemeleriyle göze çarpan, genellikle rıhtımda konumlanmış diğer Levanten konut örnekleridir. Bornova, Buca gibi çevre yerleşimlerde konumlanmış Sakız tipi olarak da adlandırılan Levanten köşklerinde ise kullanıcıların sosyal statüsü, toplumsal yaşam içindeki etkisi ve gücünü ifade eden, ana vatanlarının geleneksel ve/veya popüler mimari ifadelerini, ihtişamı, çağdaşlığı temsil eden bir mimari söylem yer almaktadır. (Akkurt, 2004)

**5. Kent Morfolojisine Etki**




**Şekil 2** Storari (1856), Saad (1876) ve Baedeker's (1905) Haritaları'nın Çakıştırılması. Altlık Olarak *(Gençer, 2012)*

Kente genel anlamda bakıldığı zaman kozmopolit bir yerleşimle karşılaşmaktayız. İzmir; Türkler, Rumlar, Ermeniler, Levantenler gibi farklı etnik grupların farklı kültürlerini barındırmaktadır. Farklı kültürler, farklı anlayışlar ve farklı yaşamları getirmektedir. Kendi mahalleleri kurarak özde bağımsız yaşam çevrelerin oluşturan bu etnik gruplar, kendilerine has mekânları da ortaya koymaktadırlar.

Bizans döneminde başlayıp Osmanlının son dönemine kadar İzmir'e gelen Levantenler deniz kenarında kendi yaşam alanlarını oluşturmuşlardır. Kendi mahallerinin çevreden bağımsız olarak kuran Levantenler çoğunlukla kıyı şeritlerini seçmişlerdir. Bu durumda şehir ikiye bölünmüştür. Kadifekale civarlarından Müslüman Türkler ve deniz kıyısından Levantenler bulunmaktadır. Farklı etnik grupların birbirlerinde bağımsız kurdukları farklı mahalleler sayesinde kültür etkileşimi kısmen olsa dahi özden kopulmamıştır. Farklı kültürlerin temelini oluşturduğu kendilerine ait yaşam çevreleri ve mekânları dikkat çekmektedir.

Kentte ticari ve sosyal yaşamın odağı ağırlıklı olarak Frenk caddesinde ve çevresinde şekillenmektedir. 1876'ya kadar kentsel yaşam merkezi, toplumun ticaretinin döndüğü, hangarları ve depoları üzerinde bulundurduğu, sosyal alanlar için kafe ve barlarıda bulunan Frenk Caddesi'dir. 1876'da Rıhtım inşası ağırlıklı imar faaliyetleri ve kentsel mekânlar buraya doğru genişlemiştir.

### 5.1 1856 Storari İzmir Planı ve Frenk Caddesi

Frenk Caddesi, Rıhtım inşasına kadar kentin toplumsal merkezi olmuştur. Bir liman kenti olan İzmir'de ticaret merkezide yine Frenk caddesidir. Üzerinde bulundurduğu kafeler, barlar, dükkânlar, depolar ile bir yaşam omurgasıdır. Frenk Caddesi kıyıya paralel bir şekilde uzanmaktadır. Yaşam omurgası olan Frenk Caddesi, ulaşım ağının toplayıcısı ve birleştiricisi niteliğindedir. Önceleri ulaşım ağı, zaman içinde süregelmiş ve plansız bir şekilde oluşmuştur. Levanten kültürünün bir getirisi olan ve Avrupa şehir planlarında kullanılan, birbirini dik kesen yollar ve ızgara plan burada da görülmektedir. Zaman içinde plansız ve gerekliliklere hızlıca cevap vererek oluşan yapı adaları yol ağının bir getirisi olarak dikdörtgen formdadır. Yapı adaları oldukça uzun ve oldukça ince formdadır.

Levantenlerin batılı kültürünün bir yansıması olan bu ızgara plan önceleri kendiliğinden oluşmuştur. Sonraları kuzeye doğru gelişme ve genişleme gösteren kentte Punta'ya yerleşmeler başlamıştır. Zamanla gelişen şehrin planına baktığımız zaman öncelerde çok ince, çok uzun yapı adalarının görürken Punta'ya doğru daha planlı daha orantılı dikdörtgen yapı adaları ortaya çıkmaktadır.

### 5.2 1876 Saad İzmir Planı ve Rıhtım Projesi

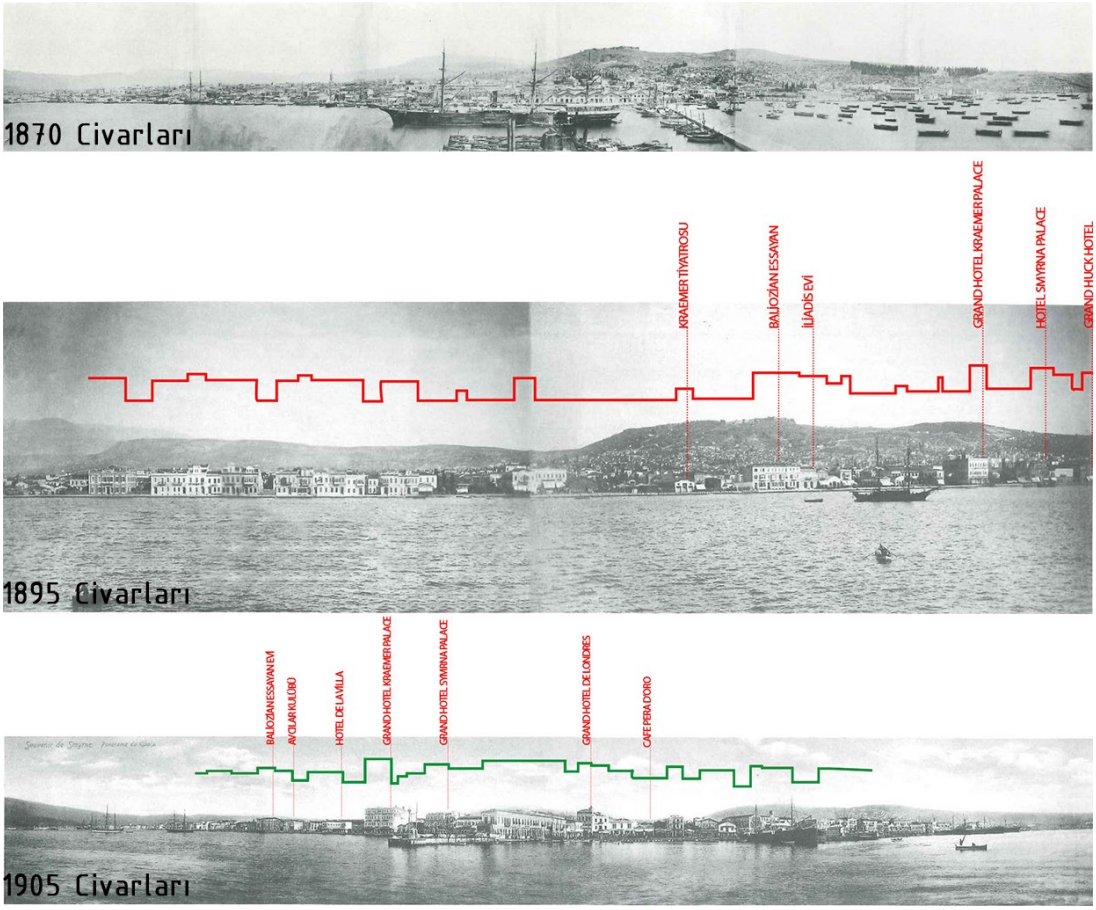
1876 tarihli Saad planında dikkat çeken rıhtımın inşası ve demir yolları ile yeni ulaşım olanaklarının kente dahil olmasıdır. Kent ticareti için yapılan bu imar çalışmaları neticesinde kentin büyüme yönü etkilenmiş yeni yerleşim alanları oluşmuştur.

Yapılan yeni imar çalışmaları doğrultusunda kent, kuzeybatı yönünde büyüme göstermiştir. Rıhtım inşaatı ile kıyı hattı daha düzgün ve doğrusal bir görünüme kavuşmuştur. Bu inşaat, yalnızca kıyı şeridine rıhtımı kazandırmamıştır. Beraberinde denizde büyük bir alan doldurulmuş ve yeni yapı parselleri oluşturmuştur.
1876 yılında tamamlanan rıhtımda ulaşım ağı planlamalar çerçevesinde oluşmuştur. Birbirine dik olarak bağlanan yollar ızgara planlıdır. Rıhtımla hareket edip sonlanan yollar Punta bölgesine doğru uzanmaktadır. Planlı yapılaşma nedeniyle yeterli genişlikte ulaşım ağları oluşmuştur.Ulaşım ağları çerçevesinde oluşan yapı adaları düzgün dikdörtgen formdadır. Eni ve boyu orantılıdır. Yapı adalarının uzun kenarı kıyıya paraleldir. Bununla beraber üzerine gelecek yapıyı sergiler niteliktedir. Saad planı üzerinden anlaşılacağı üzere Rıhtım projesi yeni bitmiştir. Rıhtım üzerindeki imar faaliyetleri yeni başlamış olup haritada görüldüğü üzere birkaç yapı yükselmiştir.

**5.3 1905 Baedeker's Haritası**

1905 tarihli Baedeker's haritası incelediğinde kent makro formunda değişiklik gözükmemektedir. Ulaşım ağı ve yapı adaları korunmuştur. 1922 büyük İzmir yangını öncesi şehir son şekline kavuşmuş durumdadır. 1876 Saad planı ve Rıhtım inşası ile karşılaştırıldığında yapı yoğunluğunda artış gözlemlenmektedir.
1876 yılında yapılan kent planına uyularak şehirde büyüme gözlemlenmektedir. Parsellerde ve ulaşım ağında bir değişiklik bulunmamaktadır. Planlanan yapı adalarına göre, kent planına uyularak ve yapı adalarına müdahale edilmeden yeni yapıların inşasıyla kentte büyüme gerçekleşmiştir. İç bölgede ise yapı adalarının kısa kenarları denize paralel olmuştur. İç bölgede kıyı şeridinden ziyade; avlulu, büyük gabarili, bütün bir yapı adasına yayılmış, okul, kilise gibi mekânlar ile de karşılaşılmaktadır. Bunun yanı sıra kısa kenarı yola paralel konumlanan bitişik nizamdaki konut örnekleri de bulunmaktadır. Punta bölgesinde ise büyük gabarili fabrika, atölye, depo yapıları gözlenmektedir.
1876 Saad haritası ile planlanmış kent bölgeleri ilk kez karşılaşmaktayız. Storari haritası ile arasındaki en büyük farklılık henüz yeni inşa edilmiş rıhtım ve denizin doldurulmasından oluşan planlı, yeni ve boş durumdaki yapı adalarıdır. 1905 Baedeker's haritası neredeyse İzmir'in 1922 büyük yangından önceki halini göstermektedir ve kent merkezi dış hatlarıyla artık gelişimini tamamlamıştır. 1876 haritası ile karşılaştırıldığında yapı adası bazında bir farklılık görülmemektedir. Tek fark boş parsellerin yerini artık yapıların almasıdır.

**5.4 Kent Silüeti**




**Şekil 3** Geç 19. yüzyıl ve erken 20. yüzyıl silüetleri. Altlık olark *(Abut, 1997)*

1870 tarihli panoramada, Rıhtım inşasından önce kıyı şeridi silueti tam olarak okunamamaktadır. İki ya da üç katlı yapılar bulunmaktadır. Oldukça uzun ve ince olan yapı adalarının ince olan kenarı gözükmektedir. Farklı derinlikler ile kıyıya uzanarak dişler oluşturmuş yapı adaları dikkat çekmektedir. Şehre gelen gemilerin referans alabilecekleri bir oluşum çok belirgin değildir. Bu sebeple kıyıda gemilerin oluşturduğu belirli bir düzen okumak zordur.
1895 tarihli panorama, rıhtımın inşasının tamamlandığını göstermektedir. Rıhtımın inşası ile birlikte yeni yapı adaları oluşmuştur. Planlanmış bu yapı adalarında kıyı şeridi boyunca yeni yapılar yükselmeye başlamıştır. Kuzeye doğru bitişik nizamda konut yapıları bulunmaktadır. Yapı adası yerleşimi doğrultusunda yapıların cephesi kıyıya denk gelmekte ve kendilerini sergilemektedirler.
(Abut, 1997) 'e göre 1905 tarihli olan panoramanın. Kent silüetine dahil olan yapılar ve bazı yapıların dört katlı oluşu dikkate alındığında panoramanın 20. yüzyılın başına ait olduğu söylenebilir. Erken 20. yüzyılda neredeyse kıyı şeridinin tamamı yeni yapılarla doldurulmuştur. Kuzeyde konut yapıları görülmektedir. Güneye inildikçe, kulüp binaları, sinemalar, kafeler, barlar, oteller görülmektedir. Bazı yapılara dördüncü katları eklenmiştir. Özellikle otel yapıları olan bu yapılar yatayda ve düşeydeki büyüklükleri ile silueti büyük ölçüde belirlemişlerdir. Kentin vitrini niteliğindeki Rıhtım 1922 yangınından önce son durumunu neredeyse almış vaziyettedir. İzmir'e gelen gemiler, belli bir bir düzen içinde kıyı boyunca konumlanmış, karadaki planlı yapılaşmaya paralel deniz üzerine yerleşmişlerdir.

**5.5 Levanten Yapıları**

Rıhtım inşası ile yeni yapı adaları oluşmuş ve 19. Yüzyılın son çeyreğinde rıhtımda inşa faaliyetleri başlamıştır. Kentin sosyal merkezinin kaydığı ve kent vitrini olarak kabul gören rıhtımda dönemin sosyal ve ticari ihtiyaçlarına karşılık veren yapılar yükselmeye başlamıştır. Özellikle ticaret hayatına yatırım yapan Levantenler, yapılarına kendi yaşam tarzlarını hem işlevsel açıdan hem de estetik değerler bakımından yansıtmıştır. İnşa ettikleri tiyatro binaları, sinema binaları gibi eğlence yapıları ile sosyal hayatlarına kendi kültürleri üzerinden katkı sağlamıştır. Sadece kendi kültürlerine değil Osmanlı tabasını da yeni sosyal aktiviteler ile tanıştırmışlardır.
Levantenlerin kente olan yatırımlarının neredeyse tamamı ticaretleri için gerekli olan yatırımlardır. Kente geliş amaçları ticaret yapmak olan ve kendilerine sağlanan çeşitli kapitülasyonlara sebebi ile de kent ticaretinde önemli bir konuma ulaşmıştır. İnşa edilen sosyal yapılarında kulüp binalarında dahi ticari çıkarlar neticesinde yatırımlarını yapmışlardır. Öyle ki kulüplerde yürüttükleri sosyal faaliyetlerin asıl amacı yeni insanlarla tanışıp yeni ticaret ağları sağlamaktır. Öyle ki sosyal kulüplere giriş için belirli şartlar istenmektedir. Kente yapılan otellerde aynı şekilde kente gelen misafirlerini yeni yatırımcılarını rahat ettirmek için ticari kaygı ile inşa edilmiştir.
Rıhtımda yapılan yapıların büyük çoğunluğu sosyal faaliyetler için inşa edilmiştir. Bu inşaatlar sonrası kentte sinema, restoran, bar, kulüp, otel binalarındaki büyük orandaki artış gözlemlenmektedir. Bu binalar arasında ki en büyük artışı otel binaları sağlamıştır. Özellikle kat sayısı bakımından diğer binalardan genellikle fazla olan otel binaları, kent siluetini gabarileri ile en çok etkileyen yapılar olmuştur. Rıhtıma inşa edilen yapıların büyük çoğunluğu arkalarında bıraktıkları yapılardan yüksek inşa edilmiş ve gerideki binaları gölgede bırakmıştır. En başından planlanan yapı adalarına uyularak düzenli bir şekilde inşa edilen bu yeni yapılar siluete bir düzen getirmiştir. Ve geride bıraktıkları yapıların düzensizliklerini gizlemiştir. Levanten yapılarının izledikleri üsluplar o dönemde Avrupa'da da yaygın olan üsluplardır. Art nouveau, barok, Rönesans ve romanesk (Neoklasik) üslupları hayatlarının, her şartta korudukları Avrupalılıklarının bir yansıması olarak kent vitrininde yerini bulmuştur.

| Yapı Adı | İşlev | Konum | Yapılış Tarihi | Üslup |
|---|---|---|---|---|
| Kraemer Tiyatrosu | Tiyatro | *Kordon (Rıhtım)<br>*Ara Parsel<br>*Kıyı Şeridi | 1880 | *Art Nouveau<br>*Taş, Demir, Cam Yapı Malzemesi<br>*Simetrik Yapı Kurgusu |
| Pathe Sineması | Sinema | *Kordon (Rıhtım)<br>*Ara Parsel<br>*Kıyı Şeridi | 1909 | *Art Nouveau<br>*Taş, Demir, Cam Yapı Malzemesi<br>*Simetrik Yapı Kurgusu |
| İzmir Tiyatrosu | Tiyatro | *Kordon (Rıhtım)<br>*Ara Parsel<br>*Kıyı Şeridi | 1886-1911 | *Art Nouveau<br>*Taş Yapı Malzemesi<br>*Simetrik Yapı Kurgusu |
| Sporting Kulüp | Kulüp ve Tiyatro | *Kordon (Rıhtım)<br>*Köşe Parsel<br>*Kıyı Şeridi | 1894-1898 | *Rönesans, Romanesk (Neoklasik)<br>*Taş Yapı Malzemesi<br>*Simetrik Yapı Kurgusu |

| | | | | |
|---|---|---|---|---|
| Avcılar Kulübü | Kulüp | *Kordon (Rıhtım)<br>*Köşe Parsel<br>*Kıyı Şeridi | 1894 | *Art Nouveau,<br>Rönesans, Barok, (Neoklasik)<br>*Taş Yapı Malzemesi<br>*Simetrik Yapı Kurgusu |
| Grand Huck Hotel | Otel | *Kordon (Rıhtım)<br>*Köşe Parsel<br>*Kıyı Şeridi | 1888 | *Rönesans, (Neoklasik)<br>*Taş Yapı Malzemesi<br>*Simetrik Yapı Kurgusu |
| Hotel Smyrna Palace | Otel | *Kordon (Rıhtım)<br>*Ara Parsel<br>*Kıyı Şeridi | 1895 Öncesi | *Rönesans,<br>Barok (Neoklasik)<br>*Taş Yapı Malzemesi<br>*Simetrik Yapı Kurgusu |
| Grand Hotel Kraemer Palace | Otel | *Kordon (Rıhtım)<br>*Ara Parsel<br>*Kıyı Şeridi | 1895 Öncesi | *Rönesans,<br>Barok (Neoklasik)<br>*Taş Yapı Malzemesi<br>*Simetrik Yapı Kurgusu |

**6.SONUÇ**

İzmir kenti kuruluşundan itibaren Anadolu'nun önemli liman kentlerinden biri olmuştur. Korunaklı limanı ve verimli tarım arazileri tarih boyunca yerleşimin tercih edilmesinde ve kentin gelişiminde rol oynamıştır. Bununla birlikte uluslararası ticaret rotalarının düğüm noktasında yer alması İzmir'in özellikle 19. yüzyılda Doğu Akdeniz'in en önemli dış ticaret limanlarından biri olarak öne çıkmasında etkili olmuştur. Farklı dillerin, dinlerin ve kültürlerin kaynaştığı bu gözde liman kenti 19. yüzyılda oldukça çeşitli bir demografik yapıya ev sahipliği yapmıştır. Müslüman Türklerin nüfusun çoğunluğunu oluşturduğu kentte, Ermeniler, Rumlar, Yahudilerle birlikte Levantenler de yaşamaktaydı.

İzmir'e en eski tarihte yerleşen Avrupalı unsurlar, diğer bir deyişle Levantenler dikkate alındığında 13. yüzyılda kentte kurulan Ceneviz ticaret kolonisinden bahsedilebilir. Cenevizliler kıyı şeridinde Liman Kalesi ve çevresine yerleşmişlerdi. 16. yüzyıldan başlayarak Fransız, İngiliz ve Hollandalı tüccarlar da, hem ticaretle ilgili limana yakınlığın avantajından yararlanarak hem de güvenlik gereği en rahat şekilde ve kısa zamanda tahliye etme olanağı sağladığı için kıyı koyunca Frenk Mahallesi'ne dönüşecek bölgede yerleştiler. 19. yüzyıl İzmir'in kent tarihinde Doğu Akdeniz'in en parlak ticaret limanlarından, kozmopolit kentlerinden birine evrildiği dönem olmuştu. Aynı zamanda bu yüzyıl İzmir Levantenlerinin tarihi dikkate alındığında, Levanten kültürün sosyal ve ekonomik alanda, kent yaşamında ve mekânında ve de kentin fiziksel yapısında izlerinin en güçlü şekilde okunabildiği dönem olmuştu. Mülkiyet hakkı edindiklerinden sonra, 19. yüzyılın özellikle sonlarında Levantenler, kentin çehresinin biçimlenmesinde büyük ölçüde etkili olmuşlardı.

Frenk Caddesi etrafında gelişen Frenk Mahallesi, Levantenlerin kent içinde yaşam alanlarına karşılık gelmekteydi. Ticaretle meşgul, Osmanlı kent kültüründen farklı daha Avrupalı bir yaşam tarzını benimseyen bu gruplar, kent dokusunda da biçimsel özellikleriyle ayrışan kendi mahallelerini kurmuşlardır. Kentin diğer mahallerinden farklılaşan, sahil hattı boyunca boylamasına uzanan, ince, uzun dikdörtgen yapı adalarından oluşan ızgara planlı Frenk Mahallesi, burada yer alan altta ticaret üstte konut karma kullanımlarıyla, yeme içme mekânları, eğlence yapıları ve kulüp binalarıyla daha dışa dönük bir kent yaşamına ve sosyal hayata ev sahipliği yapmaktaydı. 1856 Storari haritasında Frenk Caddesi boyunca gelişen bu fiziksel doku izlenebilmektedir. 1876 Saad haritası ise rıhtımın inşası ve daha oranlı dikdörtgen yapı adalarıyla birlikte Frenk Mahallesi ve çevresinde, özellikle kıyı hattında ve de kente ulaşım olanaklarının çeşitlendiği demiryollarıyla, kentin fiziksel yapısında ortaya çıkan dönüşümleri göstermektedir. Frenk Caddesi restoranları, barları, depoları ile de hem ticaret hayatının hem de sosyal hayatın merkezi konumunda olmuştu. Rıhtım inşasıyla kent yaşamının yeni odağı buraya kaymıştı. Restoranlar, barlar, tiyatrolar, sinemalar, sosyal kulüpler burada yer bulmuştu. 1905 Baedeker haritası irdelendiğinde ise, kentin vitrini niteliğinde kıyı boyunun neredeyse son görüntüsünü aldığı söylenebilir. Geç 19. yüzyıl ve erken 20. yüzyıla tarihlenen fotoğrafların da gösterdiği üzere özellikle rıhtım üzerinde oluşan yeni yapı adalarının tamamında yeni yapılar yerlerini almış ve kent silueti tamamlanmıştır. Burada inşa edilen başlıca ve örnek teşkil eden Levanten yapıları incelediğinde, mimarileri, işlevleri, malzemeleri açısından Batı etkisi dikkat çekmektedir. İşlev açısından incelendiğinde; sinema, tiyatro, bar, sosyal kulüp binaları ile Osmanlı toplum yapısının özünde bulunmayan yapılar söz konusudur. Bazı yapılar işlevleriyle de Osmanlı Türk toplumuna yeni sanat dalları tanıma imkânı sunmuştur. Yapı malzemesi genel olarak taş olan binalar, üslup açısından ele alındığında; Barok, Rönesans, Romanesk, Art Nouveau gibi üsluplar çeşitliliği ile karşılaşılmaktadır.

Denilebilir ki, Levanten kültürün izlerini İzmir kentinin form ve dokusundan başlayarak tek tek mimari birimler üzerinden değerlendirebilmek mümkündür. Kendi yaşam çevrelerini biçimlendiren Levantenler, ticaret amacıyla yerleştikleri bu liman kentinde, kentin çehresini de şekillendirecek, dönüştürecek büyük yatırımlarda bulunmuşlardır. Kordon boyunca uzanan mahallelerinin nasıl biçimlendiği doğrudan kent siluetinin biçimlenişine de yansımıştır. Kente tanıttıkları yeni yapı

tipleri ile kent yaşamını renklendirmişler, çeşitlendirmişlerdir. Sonuç olarak, kimlik yapılarını asimile olmadan koruyan Levantenler, kültürlerini kent morfolojisine direkt olarak yansıtmayı başarmışlardır. Avrupalı gezginlerin anlatılarında da yer bulduğu üzere Levanten Mahallesi adeta; Fransa, İtalya, İngiltere gibi Avrupa devletlerinin bir hülasası niteliğindedir: "İzmir, Marsilya'nın Küçük Asya kıyılarındaki bir örneği; Paris-Londra benzeri yaşam süren Avrupalı konsolos ve bankerleri olan büyük, şirin bir ticaret merkezi." (Lamartin'den naklen, Pınar, 2001, s.144).

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# Bellek Mekânı Olarak Tarihi Müze Evler Üzerine Bir İnceleme: Tokat Canikli Konağı Örneği

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**Özet**
Günümüzde müzelerin hatırlama ve anımsama kavramlarını bünyesinde barındırmasından ve toplumsal hafızayı yansıtan bellek mekânları olmasından hareketle bildiride müze evlerin bellek mekânı olarak irdelenmesi amaçlanmıştır. Müze evler, içinde yaşadığı toplumun kültürel, bilimsel, siyasal v.b katkıda bulunan önemli kişilerin yaşamış oldukları evler olduğundan, bu kişilerin anılarının yaşatılması, ortaya koydukları değerlere sahip çıkılması adına bellek görevi üstlenmektedir. Bu bildiri de tarihi ve kültürel değerleriyle Anadolu'da önemli bir yerleşim olan Tokat'ta müze ev kimliği sergileyen Canikli Konağı'na odaklanmakta ve bellek mekânı olarak çözümlemektedir. Bildiride bellek kavramının anlamları ve mekânla ilişkisi, bellek mekânları olarak müze evler tanıtılmakta, devamında bellek mekânı olarak Canikli Konağı değerlendirilmektedir. Mekânın mimari nitelikleri evin geçmiş kullanıcılarının deneyimleri ve anılarıyla ilişkili olarak tartışılmaktadır. Yararlanılan kaynaklar yapının görsel ve yazılı temsilleri ve ailenin mevcut sahipleriyle yapılan yüz yüze görüşmelerdir. Çalışmada bellek mekânı olarak Canikli Konağı kullanıcılarının belleği ve Tokat'a beraberinde getirdiği değerleri, gelecek nesillere mekânsal niteliği ve değerleriyle nasıl aktardığı ortaya koyulmaktadır.
**Key Words:** Müze Ev; Bellek Mekânları; Canikli Konağı; Tokat.

## 1. Giriş

Toplumsal etkileşimin sağlanması ve kent kimliğinin oluşmasında müzeler bellek üzerinden toplumsal değerleri kente aktarmaktadır. İsminden de anlaşıldığı üzere müze evler, içinde yaşadığı toplumun kültürel, bilimsel, siyasal v.b katkıda bulunan önemli kişilerin yaşamış oldukları müzeye dönüştürülmüş evlerdir. Burada yaşamış kişilerin kimliklerini, değerlerini yansıtan, sergilenen eserler işlevleri ile birlikte yaşam tarzı bütünlüğü içinde sunulduğunda içinde bellek, hatıra, hatırlama ve ilgili kişilerin hayatını da barındıran mekânlardır**.** Müze evler, bir taraftan kişisel tarihi deneyimleterek diğer taraftan kentin tarihini anımsatarak, toplumsal tarihi hatırlatarak ziyaretçileri direkt içeri alırlar. Bu müzeleri değerli kılan, değerleri ve geleneği olan hayatı temsil etme veya yeniden canlandırması özelliğine sahip olmalarıdır.

Walter Grasskap "En eski müze hafızadır" sözüyle bellek ve müze ilişkisini ilişkilendirmek üzere öncelikli olarak bu kavramlar üzerinde düşünülmesi gerektiğini aktarmaktadır. Birçok disiplin tarafından incelenerek ele alınan belleğin disiplinlerarası özelliği vardır. Özellikle tıp, sosyoloji, tarih gibi çeşitli disiplinlerin çalışma alanı içerisinde olan bellek mimarlık disiplininin de çalışma alanlarından biridir. Bu çalışmada, belleğin mekân ile ilişkisi incelenerek mimarlık araştırmaları kapsamında değerlendirilmektedir

Çalışmada geleneksel mimari özelliklerini büyük ölçüde koruyan müze evler bellek kavramından yola çıkarak, bellek ve mekân ilişkisi kapsamında incelenmiş bir örneklem üzerinden açıklanmaktadır. Bu bağlamda sahip olduğu değerleriyle Tokat'ın kolektif belleğinin bir parçası olan Canikli Konağı ele alınmaktadır. Canikli Konağı'nın içinde barındırdığı koleksiyonlarından ziyade etnografik özellikleri açısından "müze ev" kapsamında nasıl değerlendirildiği irdelenmektedir.

## 2. Çalışmanın Amacı, Kurgusu ve Yöntemi

Bu çalışma, Canikli Konağı örneğine odaklanarak "müze ev"lerin bir bellek mekanı olarak çözümlemesini sunmayı amaçlamaktadır. Çalışmada insanların mekân ile ilişki kurarak bu ilişkinin hafızalarında nasıl yer edindiğini anlayabilmek adına öncelikle bellek kavramının barındırdığı anlamlar esas alınmıştır. Bu bağlamda belleğin nasıl çalıştığı ile ilgili mevcut araştırmalar incelenmiştir. Çalışmada, mimarlığı ilgilendiren kavramlar ile olgular üzerinden de bir dizi bellek okuması yapılmaktadır. Bununla birlikte anıların ve bireysel deneyimlerin Tokat kenti içerisindeki bir müze ev üzerinden topluma nasıl aktarılmakta olduğunun değerlendirilmesi hedeflenmektedir. Bu bağlamda incelenen Canikli Konağı'nın toplum ve bireyler üzerindeki etki düzeyi saptanmak istenmektedir. Literatürde müze evler ile ilgili birçok çalışma vardır, fakat bellek ve müze ev ilişkisi bağlamında henüz tamamlanmış bir tez çalışması bulunmamaktadır. Tokat kentinde de bellek mekânı olarak müzeler ya da müze evler daha önce çalışma kapsamına dahil edilmediğinden, bu çalışmanın hem bellek, mimarlık ve müze evler kesişiminde yoğunlaşan mevcut çalışmalara hem de Tokat kent tarihi üzerine odaklanan mevcut literature katkı sağlayacağı düşünülmektedir.

Araştırmada çeşitli veri toplama tekniği kullanılmıştır; doküman analizi yapılarak, konu ile ilgili yazılı kaynaklar taranmıştır. Toplanan kaynaklar ışığında veriler konuya göre düzenlenerek alıntılar yapılmış ve yorumlanmıştır. Ayrıca literatürdeki kaynaklardan farklı olarak, çalışmaya yön vermesi için evin eski sahiplerinden Abdullah Canikli ile yüz yüze görüşülerek ses kaydı alınmıştır. Mekânın fotoğraflarına yerinde tespit ile ulaşılmıştır. Ele alınan mekânın mimari detayları, görüşülen kişilerin kişisel özellikleri, aile yapısı, geçmişi ve yaşadığı mekân ile ilgili hafızasında kalanları irdelemek esas alınmıştır. Araştırmada elde edilen bilgiler ışığında müze evlerin amaçları doğrultusunda müzelerin topluma kattığı değer açısından önemi vurgulanmaktadır.

**3. Bellek Kavramı**

Bellek kavramı farklı disiplinler tarafından ele alınarak, çok farklı şekillerde tanımlanmaktadır. Bellek kavramının ilk kullanımı Cicero'nın De Oratore'sinde yer alsa da, bazı kaynaklar belleğin ilk tanımının Antik Mısırlılar ve Pitograsçılar tarafından ortaya atıldığını savunmaktadır (Ganiç, 2016, s.12). Belleğin nörolojik temellerini nörologlar, belli durumdaki bireyin duygusal ve bilişsel hatırlama sürecini psikologlar, belleğin uzun süreli hayat öykülerindeki yerini psikanalistler, belleğin olgusunu filozoflar, topluluk belleğinin oluşumunu sosyologlar, insan belleğinin tarihteki güvenilirliğini tarihçiler ele almaktadır (Özak, 2008, s.9).

Yazılı kaynaklarda belleğin birçok tanımı yer almaktadır. Türk Dil Kurumu Türkçe sözlüğünde bellek "Yaşananları, öğrenilen konuları, bunların geçmişle ilişkisini bilinçli olarak zihinde saklama gücü, dağarcık, akıl, hafıza, zihin" olarak tanımlanmaktadır (URL-1). Webster Sözlüğü'nde ise "Kişinin hatırlama kapasitesi, tanıma ve hatırlaması, bilişsel anımsama, hatırlanan kişi veya unsurun imgesi ya da izlenimi" tanımı yapılmaktadır (URL-2).

Bellek çalışmaları toplumun ve bireyin unutma ve hatırlama sürecini incelemektedir. Hatırlama eylemi gerçekleşirken geçmişteki olaylarla birlikte o olayların hafızadaki temsili de canlanmaktadır. Huyssen'e göre "Geçmiş belleğin içinde yalın bir şekilde bulunmaz, anı halini alabilmesi için dile getirilmesi gerekir" (Huyssen, 1999). Bellek gerçekçi bir başlangıca götürmekle birlikte, bir temsile dayanır. Bir olayın hatırlanması ile yaşanması arasındaki fark göz ardı edilemez bir durumdur. Hatırlama eylemi deneyimlere ve geçmişe bağlı olarak gelişse de şu anda gerçekleşmektedir. Huyssen'e göre "Belleğin geçmiş ve gelecek arasındaki farkı bir yarık oluşturmaktadır". Bu fark belleği daha güçlü kılıp, belleği yeniden çağırma ve depolama sisteminden ayırmaktadır.

Sokrates duyu algısı yalnızca duyuların anlık uyarısını, bellek var olanı sonsuza kadar anımsamaktadır yorumunu yapmaktadır. Sokrates'in öğrencisi olan Platon belleği "zihnin rasyonel kısmının hakikat üstüne bilinçli bir düşünme sürecine girmesini sağlayan bir araç" şeklinde ifade etmektedir (Çağla, 2007, s.219). Bu tanım Platon'un öğrenmenin tamamı ile anımsama olduğu görüşüyle örtüşmektedir. Platon bilgiyi doğuştan gelen bilgiye dayandırarak, bilgi kuramını anımsama üzerine kurmaktadır.

John Locke deneyci görüşün kurucusu olarak insan belleğini "tabular rasa" olarak açıklamaktadır. "Tabular rasa" boş levha metaforu anlamına gelmektedir. Locke, kişinin dünyaya bilgi ve düşüncelere sahip olarak gelmediğini, zihninin boş bir levhaya benzediğini iddia etmektedir. Bu levha da zaman geçtikçe duyular ile oluşan idelerle dolmaktadır. İnsan zihni bunları tanıdıkça belleğe yerleştirip adlandırmaktadır. Locke'nin bellek anlayışı da bilgi anlayışına paraleldir. Locke'ye göre bir kişinin bir bilgiyi, düşünceyi veya olayı anımsaması onu deneyimlediğini göstermektedir (Locke, 2000).

Kant'ın bellek modeli deneyimin yorumlanmasını açıklamaktadır. Biliş kavramı dışarıdan gelen gerçeklikle birebir aynı değildir, bilinen şeyler düşünce yardımıyla üretilmektedir. Bu sebeple olayların yorumlanmasının bellekte ve zihinsel hayatta önemli rolü vardır (Kant, 1998).

Nora'ya göre bellek ise "Her zaman yaşayan gruplar tarafından üretilen yaşamın kendisidir." Nora bunun yanısıra belleğin hatırlama ve unutma eylemlerine açık olup, sürekli değişim halinde, uzun belirsizliklere elverişli yapıda, kullanımlara duyarlı olduğunu da dile getirmektedir. Bellek daima günceldir, geçmiş ve şimdiki zaman arasında bir bağdır, çoğuldur, bireyseldir, sınırsızdır. Uzamla, harelerle, nesnelerle ve somutla ilişki içerisinde olan bellek mutlak bir kavramdır (Nora, 2006, s.19).

**3.1 Bellek ve Mekân**

Belleğin hatırlamanın var olabilmesi için, mekân, duyulara hitap eden deneyimler, imge ve algılar, bireysel ve toplumsal özellikler gibi faktörlere ihtiyacı vardır. Mekân, belleği yoğuran, aktaran ve dönüşüme uğratan uyarıcıların başında yer almaktadır. Mekân bilinçli bellekte en temel bileşen olup, belleğin kilit taşını oluşturmaktadır (Özaloğlu, 2017, s.14). Bunun yanısıra, "Bellek unutma ve hatırlama sürecini devamlı olarak şekillenerek değiştiği bir olgu, mekân da bu ilişkilerin unsuru olarak ortaya çıkmaktadır (Özmen, Çetin, 2017, s.103). Mekânın sözlük anlamı incelendiğinde "Yer, bulunulan yer, ev, yurt, oturulan yer" (Büyük sözlük, tarihsiz, s. 1487), (Altınay, 2020, s.40) olarak görülmektedir.

Lefebvre mekânı "algılanan, tasarlanan ve yaşanan" üçlü moment içinde tanımlayarak, mekânın günlük yaşam ile ilgili deneyimleri içerdiğini savunmaktadır (Lefebvre, 2016, s.74), (Altınay, 2020, s.43).

Pallasma mekânı "Bedenimiz, evimiz, kimliğimiz ve belleğimizin sığınadır (Pallasma, 2018, s.78)" şeklinde tanımlamıştır. Bununla birlikte "Evimiz öz kimliğimizle birleşir; kendi beden ve varlığımızın parçasına dönüşür (Pallasma, 2018, s.86)" ifadesine yer vermiştir.

Belleğin oluşarak sürdürülmesi, somut nesneler üzerinden açıklanan süreci göstermektedir. Nesnelerin deneyimlerle ilişkisinde, birey topluluk için bir imgeye dönüşür ve bellekte saklanır. Bireyler ve topluluklar onları saran nesnelerin oluşturduğu bu nesneler var olmadan hatırlayamaz. Bireyi ve yapılı çevreyi oluşturan kişisel eşyalar ve fiziksel mekânlar, fiziksel çevrenin oluşmasına yardımcı nesnelerden oluşur. Mekânın bireyler için imgesel temsiller oluşturmasının yanısıra, nesnelerle ilişkili imgeler ile dolu bir düzen olduğu da görülmektedir. Buna bağlı olarak nesneler belleğin aracı, mekânlar ise belleğin bağlamını oluşturmaktadır. Mekânın fiziksel anlamda üretimi, bir mimarlık etkinliği olmasının yanında, mimari üretimler aracılığıyla bellek süreci için tetikleyici bir işleve de sahiptir (Ganiç, 2016, s.18).

Nora ise mekânı yaşayan toplumun somut üretimi olarak tanımlamaktadır (Nora, 2016, s.54). Nora'ya göre toplumların kimlik ve varoluşları ile oluşan özel mekânlar belleğin mayalandığı yerdir. Nora bu mekânları "hafıza mekânları" olarak adlandırmaktadır.

### 3.2 Bellek Mekânı Olarak Müze Evler

Kent kimliğinin oluşması ve toplumla etkileşim sağlanmasında müzelerin birikimli bir bellek ile toplumsal değerleri kente aktardığı görülmektedir. Müzelerin bellek aktarımları kültürel varlıkların bakım, onarım, koruma, belgeleme, arşivleme ve sergileme ile gerçekleşmektedir. Sosyokültürel belleğin ve kent kimliğinin aktarılması sergime ile birlikte, yapılan eğitimler, araştırma imkanları, yayınlar ve müzelerde yapılan etkinliklerle süreklilik kazanmaktadır, bu durum belleğin taze kalmasını kolaylaştırmaktadır (Özdemir, 2019, sç26-27). Müzeler modern çağ anlayışının geçmişi yansıttığı bellek mekânları olduğu için kent kimliğinin de topluma aktarılmasında önemli rol üstlenmektedir. Tarihsel olaylarda ön plana çıkmış, içinde bulunduğu döneme yön veren insanlar toplum tarafından önemli kabul edilmiştir. Bu nedenle bu insanların yaşadığı yerler özel bir yere sahiptir. Önemli insan vasfında olan bu kişiler içinde yaşadığı toplumun bilimsel, sanatsal, sosyal ve kültürel hayatına katkıda bulunmuşlardır. İnsanlar bu önemli kişilerin ne yediğini, nasıl giyindiğini, gündelik hayatlarında neler yaptığını öğrenmek istedikleri için onları ait evleri koruma altına almak istemişlerdir. Toplum kişilere olan saygının korunarak, anılarının yaşatılması ve değerlerine sahip çıkılması amacıyla bu evlere önem vermektedir. Evlere verilen değeri gösterebilmek ve dokunulmaz hale getirebilmek için bu evler "müze "ev" e dönüştürülmektedir. Müze evler insanların istekleri dışında, içinde yaşayan, topluma yön veren kişilerin de talebi ile dönüştürülmektedir (Uz, 2015, s.268).

Müze evlerin amacı ise tarihi önemi ve anlamı olan evlerin birimleri korunarak, özgününe uygun yorumlanıp, bu değerlerin gelecek kuşaklara aktarılmasını sağlamaktır. Sergileme ve eğitimler ile bu evlerde yaşayan insanların hayatlarından kesitler aktarılması amaçlanmaktadır.

Dünya genelinde müze evlerin artmasıyla birlikte uluslararası bir kuruluş ihtiyacı doğmuştur. 1977 yılında "Yaşayan Tarih: Tarihi Ev Müze" konferansı Cenova'da düzenlenerek, özel müzeler için ICOM komitesi kurulması talep edilmiştir. Bu sürecin devamı olarak 1998'de DEMHIST (International Committee for Historic House Museums-Uluslararası Tarihi Ev Müzeler Komitesi)" kurulmuştur.

DEMHIST tarihi müze evleri şu şekilde tanımlamaktadır: "Günümüzde halka açılmış, geçmişte mesken olan tarihsel yapıların, orijinal mobilyaları (eşyaları) ile tarihî, kültürel koleksiyonlarını gösteren, ünlü yaratıcıların ruhunu yansıtan ve güçlü bir şekilde bir topluluğun tarihsel anılarına bağlı, özel bir müze çeşididir" (URL-3).

Müze ev tanımıyla ilişkili, bu kuruluşlar dışında konuyla ilgili araştırmacılar arasında farklı yaklaşımlar ve tanımlamalar dikkat çekmektedir. Örneğin Atasoy şöyle bir tanımlama yapmaktadır: "Müze evler, mimarisi ve içinde yaşayan şahsiyet nedeniyle korunması gereken yapılardır." (Madran, 1999 s.14). Önder ise müze evleri: "Müze evler, tarihi ve mimari yönden korunması gereken konak ve evlerdir." şeklinde tanımlamaktadır (Madran, 1999 s.14).

Türkiye'de farklı illerde yöresel özellikleri ile ön plana çıkan, önemli şahıslara ait olan ve mimari süslemeleri sebebiyle korunması gereken birçok ev, konak ve köşk müze haline getirilmiştir. Bu tarihi evlerde kazılardan çıkarılan arkeolojik eserler sergisinin yanısıra, yöre halkından toplanan etnografik malzemelerin de sergisi yapılmaktadır. Bu çalışma kapsamında müze evler koleksiyon malzemesi dışında yaşanmışlığa tanıklık etmesi nedeniyle müze ev olarak tanımlanabilir.

## 4. Canikli Konağı Fiziksel Özellikleri

Tokat İli merkez Mahmut Paşa Mahallesinde yer alan yapı, 1700'lü yıllarda Ruhani Şeyhi evi olarak yapılmıştır. Oldukça bakımsız durumda olan ve konut olarak kullanılan yapı Tokat Belediyesi'nin sosyal projesi ile özgün haline dokunulmadan restore edilmeye çalışılmıştır. Konağın banisi hakkında net bir bilgi yoktur ancak Canikli adını evi son kullanan ailenin soyadından almıştır. Yapının restorasyonu yapılarak kötü onarım izlerinden ve niteliksiz ekten kurtarılmıştır. Günümüzde Kültür Evi-El Sanatları Müzesi işlevi verilmiştir.

Behzat Bulvarı Behzat Deresi karşısında yapılan konak geleneksel Türk Evi plan yapısındadır. Bahçeli, sofalı ve iki katlı olan yapı Tokat geleneksel evlerindeki plan tiplerinden iç sofalı plan tipindedir. Cephesi ahşap karkas arası kerpiç üzeri sıva ile kaplanmıştır (Özay, 2020, s.115). Konağın güney kısmı sokağa paralel olmakla birlikte üç payandalı şekilde yapılarak, kuzey bölümüne göre güneydoğu bölümünde daralma görülmektedir (Görsel 1). Konağın iki girişi olmasına rağmen asıl giriş Behzat Bulvarı tarafından çift kanatlı ahşap kapı ile sağlanmaktadır. Diğer girişe ise konağın doğusundaki avluya bakan arka cepheden ulaşılmaktadır. Arka kapıya açılan bu avluya da yapının güneyinde moloz taşla yapılmış, basık yuvarlak kemerli kapı ile ulaşılmaktadır (Sertyüz, Şahin, 2018, s.225). Ön cephedeki birinci katta testere dişi şeklinde bir çıkma bulunmakta, bu çıkma üç bölmeden oluşmaktadır. Yapılan müdahaleler ile birlikte çıkmanın ön yüzünde yer alan özgün pencereler değiştirilerek, yerine dikdörtgen formda pencereler eklenmiştir. Çıkmanın güney tarafında ise özgünlüğünü yitirmiş dikdörtgen formda pencereler yer almaktadır. Çıkmalar yatay ve dikey silmelerle vurgulanarak, ahşap çıkma konsollar ve payandalar ile desteklenmektedir. Konağın ön cephesinde saçak altında çıtalı ahşap kaplamalar vardır. Yan cephesinde bahçe girişi ve arka bahçe duvarı mevcut değildir. Yapının arka cephesinde simetrik bir düzen hakimdir. Arka bahçeye girişler arka cepheden sağlanmaktadır (Görsel 2).



**Görsel 1.** Canikli Konağı Genel Görünüş (Kavukçuoğlu, 2017, URL-4)

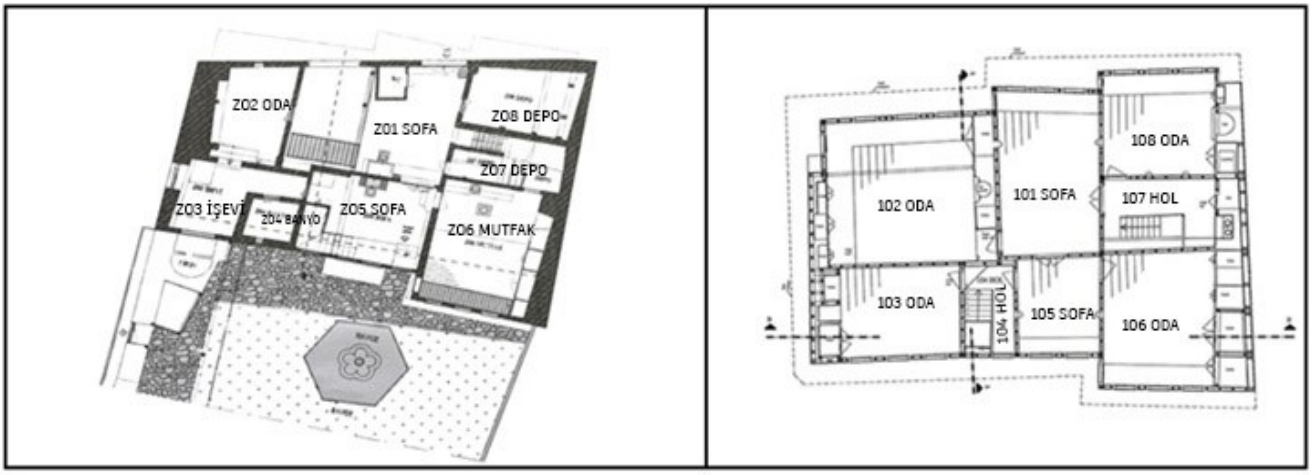


**Görsel 2.** Konağın Arka Cephesi (Kavukçuoğlu, 2017, URL-4)

Halit Çal'ın da belirttiği gibi, Tokat evleri genellikle iki kattan oluşmaktadır. Zemin kat, mutfak, ambar ve kiler gibi hizmet mekânlarından, üst kat daha çok oturma mekânlarından oluşur. Evlerin genelinde de Tokat kentinde "bölme" olarak adlandırılan "ara kat" bulunmaktadır. Bu alanlar kışın sıcaklığın korunması için basık tavanlı yapılan alanlardır ve genellikle oturma alanı olarak kullanılmaktadır (Çal, 1987, s.366). Canikli Konağı da zemin kat, ara kat ve birinci kat olmak üzere toplam üç kattan oluşmaktadır. Konağın ara kattaki odaları Halit Çal'ında belirttiği gibi basık tavanlıdır.

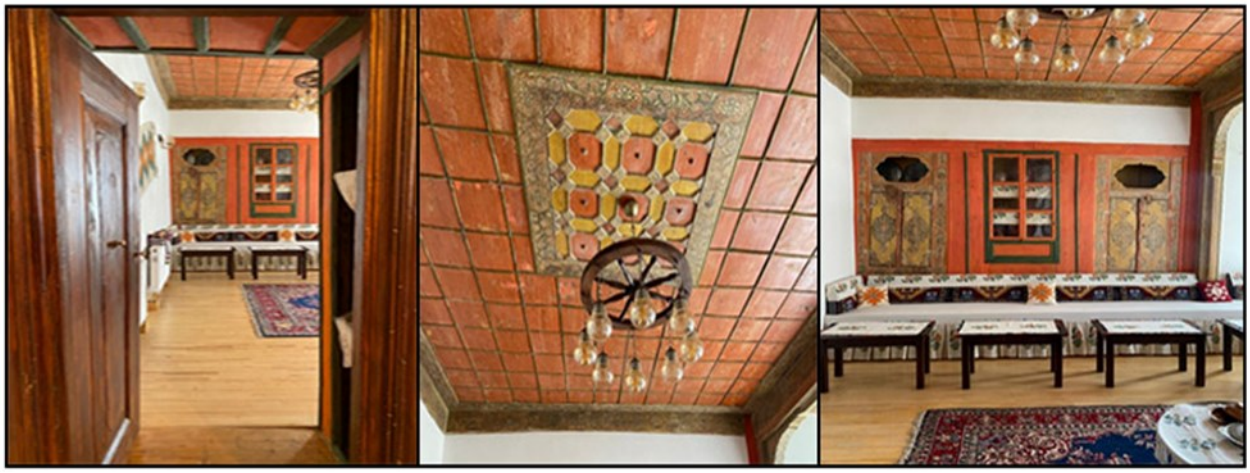
Tokat kentinde üç plan tipi vardır. Bu planlar belirlenirken evlerin yalnızca üst katları değerlendirilmektedir. Bu plan tipleri; "İki yüzlü iç sofalı", "üç taraflı odalı dış sofalı" ve "dış ve köşe sofalı" plan tipleridir. Tokat'ta genellikle iki yüzlü iç sofalı plan tipi tercih edilmektedir. Sofaya açılan ve ortada yer alan odalar bu plan tipinin esasını oluşturmaktadır (Çal, 1987, s.366). Belirtilen plan tipleri arasında Canikli Konağı, iki yüzlü iç sofalı plan tipindedir. Yapının zemin katında ön ve arka cepheden girişi olan birer adet taşlık vardır. Behzat Deresi tarafındaki ön cepheden giriş yapıldığında zemin kattaki Z01'de taşlık mekanına, arka bahçeden girişte de Z05 nolu taşlığa ulaşım sağlanmaktadır.

Taşlıkların içinde de konaktaki su ihtiyacının karşılanması için birer tane çeşme bulunmaktadır. Z01'deki taşlıkta depo ve kiler işlevinde bölümler yer almaktadır. Ara kat alanına merdiven ile ulaşılmaktadır. Z05 nolu alanda taşlığın sağında mutfak ve depo, solunda da iş evi, banyo ve orjinalliği korunarak günümüze ulaşabilmiş tuğla bacalı fırın yer almaktadır (Sertyüz, Şahin, s.226). Canikli Konağı'nın birinci katına iki ayrı merdiven ile ulaşılmaktadır. İlk merdiven zemin katta Z01 nolu taşlıktaki ara kat merdiveni ile çıkılan 107 numaralı koridordan, ikincisi de zemin katta Z05'den tek kollu merdiven ile ulaşılan 104 nolu koridordan sağlanmaktadır. Konağın içerisinde iki merdiven olması birinci katta hol ve iki adet sofa sisteminin çıkmasını sağlamıştır. Konak iç sofalı plan tipinde olduğundan kuzey ve güney cephelerine dört adet oda yerleştirilmiştir. Odalara sofadan ve sofalara bitişik olan ara hollerden geçiş yapılmaktadır (Şekil 1).




**Şekil 1.** Canikli Konağı Zemin Kat Planı, Birinci Kat Planı (Kavukçuoğlu, 2017, URL-4)

Konağın en süslü odası başodadır. Bu alan özgün kullanımda konukların ağırlandığı özel bir yaşam alanıdır. Bundan dolayı diğer odalara oranla daha nitelikli ve büyük bir alana sahiptir. Odaya alçak tavanlı bir giriş eyvanından ulaşım sağlanmaktadır. Çıtakari tekniğiyle yapılan giriş eyvanı üzerinde kalem işi bezemeler vardır. Ahşap zemin kaplamasına sahip olan odanın orta kısmında tavan süslemesi yer almaktadır. Tavan kaplaması çıtalar ile kare bölmelere ayrılmıştır. Giriş kapısı karşısında ve yanında ahşap yüklükler bulunmaktadır. Kapının sol tarafındaki ahşap yüklük ve alçı şerbetlik bozulmadan günümüze ulaşmıştır. Yüklük kapakları çıkatari tekniğinde bir bezeme ile yapılmıştır. Yüklük ve şerbetlik arasında bulunan sütunçe alçı işçiliği ve ahşap oyma ile yapılmış olup mekânın ikiye bölünmesini sağlamıştır (Görsel 3).



**Görsel 3.** Canikli Konağı Başoda İç Mekan Görselleri (Özdiri, 2022)

**4.1 Abdullah Canikli'nin Belleğinden Canikli Konağı**

Abdullah Canikli, Canikli Konağı sahiplerinin son torunlarındandır ve Tokat'ta ikamet etmektedir. Ev içinde yaşadığı anıları ve belleğinde kalanları şu şekilde anlatmaktadır;

Behzat Deresi tarafındaki çift kanatlı kapıdan girildiğinde, hayat denilen kapalı avlu şeklindeki alana çıkılmaktadır. Öncesinde ön cephede çift kanatlı kapı yanında fayton garajı bulunmaktadır. Fayton garajının içinde ise bir atın beslenmesi için ahır yer almaktadır. O dönemde faytona ve ata sahip aileler dönemin zengin aileleri arasına girmektedir. Fayton garajı yanında bir ambar ve samanlık alanı yer almaktadır. Bu alan restorasyon ile birlikte hayat denilen mekâna dahil edilmiştir. Hayat denilen kısım, aynı zamanda sofa olarak anılmaktadır. Sofada çeşmenin bulunduğu yerde çamaşırlar kül ile yıkanmaktadır. Çamaşırın yıkanacağı gün akşama kadar ev halkı bu iş ile meşgul olurlarmış. Bu tarz işler için evde yardımcı kadınlar bulunmaktadır. Bunların biri Ermeni diğeri ise Türk asıllı kadınlardır. Abdullah Canikli'nin dedesi Abdullah Efendi, öksüz büyüyen bu kadınların evlenmesine de vesile olmuştur. Kadınlar evlendikten sonra da Canikli Konağı'nda çalışmaya devam etmişlerdir.
Girişin sol tarafında mahzen adı verilen alan yer almaktadır. 1.5 metre tavan yüksekliğine sahip bu alana eğilerek giriş yapılabilmektedir. Bu alan kışlık hazırlıkların yapıldığı serin odadır. Diğer Anadolu şehirlerinde olduğu gibi Tokat'ta da peynir, pekmez, turşu, tenekelere basılan kürek denilen kavurmalar mahzende saklanmaktadır. Zemin katta yer alan bu alanda kışlık için hazırlanan yiyecekler bozulmadan 6 ay süre saklanmaktadır. Zamanında iki büyük deprem ve sel gibi afetlere maruz kalan Tokat'ta ambarlar tedbir amaçlı önceden doldurulmaktadır. Konakta da iki adet ambar yer almaktadır. Bu ambarlar toplamda 4 ton malzeme alabilecek kapasitede yapılmıştır. Evin ihtiyacı olan odun ve tuz da bu ambarlarda saklanmaktadır (Görsel 4).



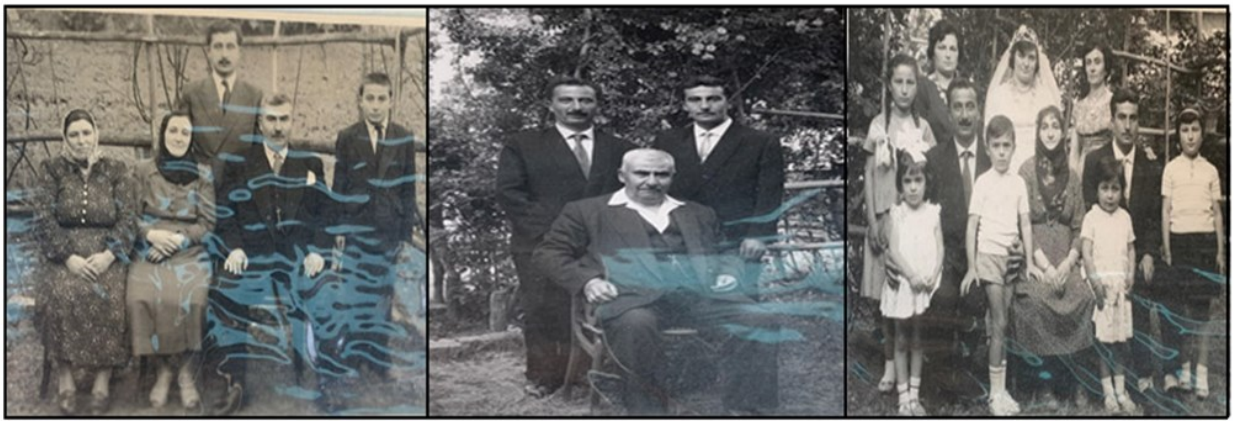
**Görsel 4.** Canikli Konağı Mahzen Girişi (Sivas Kültür Varlıklarını Koruma Bölge Kurulu Müdürlüğü)

Zemin katta iş evi görevinde bir oda bulunmaktadır. Bu alanın içerisinde ekmek fırını vardır. Fırında yöresel Tokat köy ekmeği ve tava ekmeği pişirilmektedir. Bu yöresel ekmekler ev halkına yetecek kadar yapılarak, haftalık tekrarlanmaktadır. İş evi içerinde ayrıca kebap ocağı yer alır. Bu ocağın yanında geleneksel kavurma yemeği yapılmaktadır. Bu mekânda evin kadınları haftanın belirli günleri toplanarak erişte kesip, çökelekli katmer yapmaktadır.
Yemekler aşgana (aş evi) denilen oturmalı mutfakta yenmektedir. Bu alan zemin katta yer alır, girişte harem kapısının sol tarafındaki odadır. Burada soba ve bir adet ocak bulunmaktadır. O dönemde eski ocak kullanılırken zamanla set üstü ocak kullanımına geçilmiştir. Aşgana denilen alan mutfak görevinde olup, oturma alanları sedir adı verilen yerlerden oluşmaktadır. Yemekler ise sinilerde sunulmaktadır. Anadolu şehirlerinde sık rastlanılan, Tokat şehrinde de görülen olaylardan bir tanesi, yemek yenirken ev halkı dışında mutlaka bir misafirin konuk edilmesidir. Bu durum da Anadolu insanının misafirliğini gözler önüne sermektedir. İş evinde daha sonradan yapılan bir banyo yer almaktadır. Bu mekâna hem arka sofadan hem de kilere çevrilmiş alandan geçilebilmektedir. Aşgananın kuzey duvarında sade bir gömme dolap bulunmaktadır (Görsel 5). Yapılan birkaç değişiklikten sonra mutfak tezgahının önüne su kuyusu koyulmuştur.



**Görsel 5.** Konağın Aşgana Bölümü (Mutfak) (Sivas Kültür Varlıklarını Koruma Bölge Kurulu Müdürlüğü)

Konağa diğer giriş bahçeden sağlanmaktadır. Bahçe alanı 1000m2 olup, ortasında bir süs havuzu yer almaktadır. Bahçenin bakımı için konakta yaşayan bahçivanlar vardır. Zamanında Tokat şehrinin bostanı Çağ Gölü Mahallesi olarak anılmaktadır. Kazova'da sulama yapılmadığı için o dönemde suyun en bol olduğu mahalle Çağ Gölü Mahallesi'dir. Tokat'ın sebze ve meyvesi buradan karşılanmaktadır. Canikli Konağı sahiplerinin bu mahallede bahçeleri vardır, konağın işlerine bakan bahçıvanlar bu bölgeyle de ilgilenmektedir. Konağın bahçesinde armut ağaçları, yasemin çiçekleri, zambaklar, kışlık ve yazlık güller, siyah ve mor güller yetiştirilmektedir.
Konak sahiplerinin yaz akşamlarında oturma ve toplanma mekânı genel olarak bahçede yer alan havuz başıdır. Evin hanımları arkadaş toplantılarını burada yapmakta, beyler de misafirlerini bu bahçede ağırlamaktadır. Sosyalleşmenin fazla gelişmediği Tokat kentinde, evlerin bahçeleri en gözde toplanma mekânı olduğundan burası yaşam alanı olarak kullanılmıştır (Fotoğraf Görsel 6).



**Görsel 6**. Canikli Ailesinin Konak Bahçesindeki Anıları (Canikli, 2021)

Hayat (sofa) denilen bölümden diğer alanlara geçerken bir harem kapısı ile karşılaşılmaktadır. Hayat bölümünün solunda erkek konukların kullandığı üst kata çıkan merdiven yer almaktadır. Merdivenle çıkılan yer kadınların bulunduğu harem kısmı, erkekler ise oturma odası olarak da anılan sofa bölümünde oturmaktadır.
Ara katta cumba şeklindeki oda 10 m2 lik alana sahiptir. Bu oda yaz ve kış zamanlarında Abdullah Canikli'nin amcasının ve babasının ofis olarak kullandığı mekândır (Görsel 7). Diğer odalara göre daha basık bir oda olduğundan kışın ısınması kolay olsun diye bu odayı kullanmaktadırlar. Odaya merdivenle ulaşılan sahanlıktan tek kanatlı kapı ile giriş sağlanmaktadır. Bu kapının sol tarafında gusülhane ve ahşap yüklük bulunmaktadır.



**Görsel 7.** Canikli Konağı Ara Kattaki Oda (Sivas Kültür Varlıklarını Koruma Bölge Kurulu Müdürlüğü)

Canikli Konağı'nın birinci katına ulaşım hem ara kat önündeki merdivenden hem de bahçe kapısı önündeki sofadan sağlanmaktadır. Bu merdiven ile birinci katın sofasına ulaşılmaktadır. Abdullah Canikli ve kuzenlerinin nikah merasimleri bu sofada gerçekleşmiştir. Bu mekânda şerbet törenleri ve farklı toplantılar da yapılmaktadır .
Canikli Konağı'nın birinci katında Abdullah Canikli'nin amcasının kızlarının 3 adet odası bulunmaktadır. Bu odaların her birinde birer adet banyo yer almaktadır. Banyo içlerinde duş için soba kazanları mevcuttur. Üst kattaki bu odalar mahrem alanlar olduğu için, kız çocuklarının tüm ihtiyaçları bu alanda karşılanmaya çalışılmıştır.

**5. Sonuç ve Değerlendirme**

Geçmişi ele alan, unutmayı ve hatırlamayı içeren bellek, bir diğer anlamıyla geçmişin korunmasını ve depolanmasını ifade etmektedir. Kişilerin kendi geçmişiyle ilgili anıları depoladığı kişisel hafıza mekânlarını içerdiği kadar toplumsal hafızayı da içermektedir.
Bellek tanrıçasının kızları "Musa"lar ve "Müz"lere adanan ilk mekânlar aynı zamanda ilk bellek mekânları ve müzeler olarak ifade edilmektedir "(Dönmez ve Kılınçer 2011, s.103). Zamanla gelişen ve değişen bu mekânlar milliyetçilik fikirleri ile birlikte "ulusal" bir nitelik kazanmıştır. Zaman içerisinde ulusun geçmişinin yer aldığı, yeniden kurgulandığı ve hatırlandığı mekânlar haline gelmişlerdir.
Müze evler ise, içinde bir evi veya tek bir tarihi içeren yapılar topluluğunda koruma odaklı olan bir müze türüdür. Müze evlerin yorumlanması öncelikli olarak yapının mimari özelliklerinin daha sonrada bina ile bağlantısı olan veya içinde yaşamış kişilere yöneliktir. Müze evler toplumda dönemin ileri gelen, toplumda büyük çoğunluğun takdirini kazanan insanların hayatının bir döneminde yaşadığı mekânlardır.
Çalışmada kişilerin yaşamında mekânsal çevresiyle etkileşim halinde olduğunu ve bu etkileşimlerin sonuçlarının hafızada saklayabildiğini, ayrıca yeniden anımsayabildiğini ortaya koymaktadır. Çalışmada mekân ve bellek ilişkisi çocukluk evi bağlamında ele alınarak, mekân belleğinin oluşumu incelenmiş, bellekte kalan mekân öğeleri ortaya çıkarılarak mekân öğelerinin bellek ile ilgili ilişkileri değerlendirilmiştir.
Çalışmada Huyssen, Locke, Sokrates, Kant, Nora, Lefebvre, Pallasma gibi düşünürlerin bellek konusundaki düşünceleri incelenmiştir. Bu yorumlar sonucunda hafıza mimaride zihinsel bir eylem olarak ele alınarak, hareket halinde olduğu görüşüne ulaşılmıştır. Ayrıca sadece şimdide bedenin yaşadığı duyumları değil, hem gelecekte hem de geçmişte yaşadığı duyumları olanaklı kıldığı sonucuna ulaşılmıştır. Bu bağlamda mimari deneyimlenerek yaşam boyunca belleğe kodlanmaktadır.
Canikli Konağı özgünlüğü bozulmadan günümüze gelen mimari detayları ile geçmişi yaşatan bir mekân olma özelliğine sahiptir. Restorasyondan sonra el sanatları müzesine dönüştürülen konak, mekânın deneyimleri, kullanımı, anıları ile Tokat'ın yerel kültürünü yaşatmaya ve tanıtmaya çalışmaktadır. Sahip olduğumuz değerlerin zamanla değiştiği ve yok olduğu dönemde, Canikli Konağı hafızaların güçlü kalarak geçmişin unutulmaması adına önem taşımaktadır.

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# Diyarbakır Behram Paşa Camii'nin Simetrik Tabanlı Estetik Özelliğinin İncelenmesi

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**Özet**
Mimarlığa sanatsal boyut kazandıran, mimari ürünün estetik özelliğidir. Simetri kavramı ise belirsiz bir mükemmelliği yansıtarak güzellik ve estetik unsurlarının önemli bir parçası olarak ifade edilmektedir. Ayrıca oran ve denge duygusunun karşılığı olarak da tanımlanmaktadır. Antik Çağ'da yapı ile tüm yapı öğeleri arasındaki uyum ve ölçü ilişkisi olarak tanımlanabilen simetri, günümüzde, ortadan bir eksenle ikiye bölünmüş bir bütünün, eksenin iki yanında yer alan iki eş parçasıdır. Bu bildiri ile mimarlık alanının yapı ve şehir ölçeğinde tasarımın en önemli kriterleri arasında yer alıp, estetiğin sağlanmasında önemli ölçütlerden olan simetrinin tarihi yapılar üzerinden analiz edilerek geleceğe yönelik çıkarımlar sağlanması amaçlanmıştır. Diyarbakır'daki Osmanlı Dönemi eserleri arasında yer alan, ayrıca Tuhfet-ül Mimari'nde Mimar Sinan eseri olarak geçen Behram Paşa Camii'nin estetik özellikleri, yapının mevcut rölöve çizimlerindeki simetri uygulamaları üzerinden analiz edilmiştir. Elde edilen veriler sonucunda simetri ve estetik arasındaki ilişkinin plan, cephe ve kalemişlerinde öne çıktığı, örnekler üzerinden değerlendirilmiştir. Çalışmanın sonucunda yapıda estetik ile ilişikilendirilen simetri uygulama teknikleri, geleceğe yönelik estetik değer taşıyan yapılar için de bir öneri niteliği taşımaktadır.
**Anahtar Kelimeler:** Simetri, Mimari Tasarım, Estetik, Osmanlı Dönemi.

## 1. Giriş

Estetik müdahalelerde ya da güzel bir görüntüde çoğu zaman simetri aranmaktadır. Doğada tanımlanan matematiksel bir kuram olan simetrinin mimaride estetik kurgunun sağlanmasında önemli bir parametre olması geçmişten bugüne birçok eserin cephe tasarımında, planlanmasında, işlemelerde, peyzaj tasarımlarında ve tasarımın olduğu çoğu yerde kullanılmasını sağlamıştır. Özellikle tarihi birçok eserin mimarisinde sıklıkla görülmektedir. İslam mimarisinde anıtsal yapıların tarihsel süreçteki gelişimi incelendiğinde, ağırlıklı olarak simetri ve parçalı geometri kullanımı öne çıkmaktadır. Birbirinden farklı ölçekte ve malzemelerle üretilen mekânsal elemanlar (strüktür, mekânsal elemanlar, süslemeler vs.) simetrik olarak tekrar eden formlarla ve estetik geometrik örüntülerle tasarlanmakta, mekana dekoratif katkı sunan bezemelerde çok köşeli ve çizgisel elemanlara yer verilmektedir. Bunların yanı sıra mukarnas gibi kendi içerisinde simetrik tekrarlardan oluşan formlar estetik etkileri ve tekrarlanabilir üretimlerinden dolayı kubbe, yarım kubbe, söve ve taç kapıların detaylandırılması ile birlikte
Estetik bir görüntü sağlaması tercih edilmektedir. Strüktürde, modüler ve tekil mekân algısını oluşturarak, radyal simetriyle çalışabilen kubbe ve tonozlu yapılara yaygın olarak rastlanmaktadır (Karakoç, 2019). Çalışmada incelenen Behram Paşa Camii'nin simetri uygulamaları; plan düzleminde, kalemişi desenlerinde ve cephe düzleminde analiz edilmiştir.

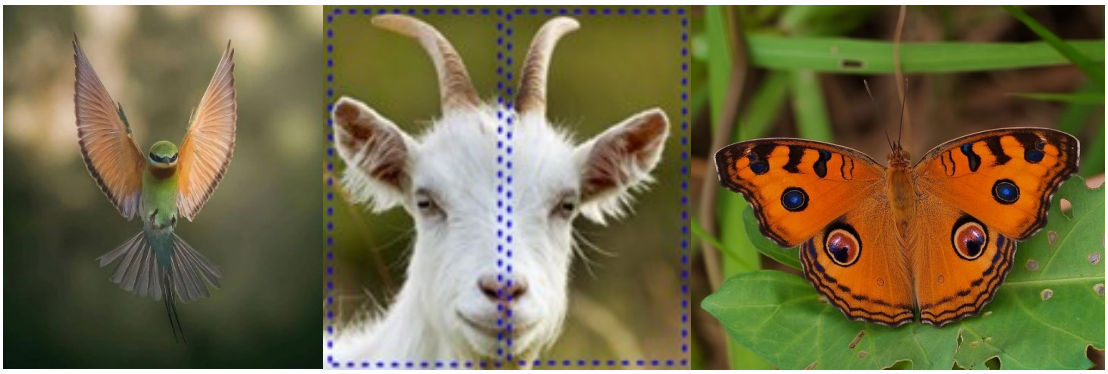
## 2. Materyal ve Metod

Çalışmaya doğadaki estetik düzenin matematiksel kuramlarından biri olan simetri kavramı ve mimaride kullanımlarını kapsayan bir literatür taraması yapılarak başlanmıştır. Simetri uygulamalarının öne çıktığı örnek plan ve projeler çalışma kapsamında incelenmiştir. Çalışma alanı olarak belirlenen Diyarbakır Osmanlı Dönemi eserlerinden biri olan Behram Paşa Camii rölöve çizimleri T.C. Vakıflar Bölge Müdürlüğü'nden temin edilerek, yapının estetik özellikleri, mevcut rölöve çizimlerindeki simetri uygulamaları ile ilişkili olarak analiz edilmiştir. Elde edilen veriler sonucunda simetri ve estetik arasındaki ilişki üzerine bir takım değerlendirmeler yapılmıştır.

## 3. Simetri ve Mimaride Kullanımı

Simetri, güzelliği ve belirsiz bir mükemmelliği yansıtan estetik unsur olarak tanımlanmasının yanı sıra bir oran ve denge duygusu olarak da ifade edilmektedir. Farklı bir tanımla kesin ve iyi tanımlanmış biçimsel sistemin kurallarına (geometri, fizik vb.) göre gösterilebilen veya ispat edilebilen bir denge ve oran kavramı veya "kendine benzeşme örneği"' olarak da ifade edilmektedir. Kısacası doğadaki canlıların biçimleriyle keşfedilen, mükemmelliğe ve düzene izafe edilen biçim olarak tanımlı geometrik ölçüye simetri denir (wikipedia.org, Erişim Tarihi: 01.12.2021, 12.40). Doğada canlıların anatomisi, çiçek yaprakları, gezegenlerin güneşin etrafında periyodik hareketlerle dönmesi gibi doğadaki varlıkların biçimlerinde, anatomisinde, aynı zamanda doğanın işleyişinde simetri, önemli bir

unsur olmaktadır. Ayrıca doğada estetik görünümleri ile dikkat çeken bal peteği veya bir kar kristal tanecik gibi bazı formların oluşumunda da simetri vardır (Şekil 1).



**Şekil 1.** Doğada simetri

Simetrinin doğadaki olumlu etkileri ile beraber; oran, denge, ritim ve estetik gibi mimarlık alanını da kapsayan temel unsurlara atki etmesi simetrinin mimaride kullanımını da gerekli kılmaktadır.
Mimarideki simetri ise eksenelliği ya da bina şeklindeki merkezliliği ifade eder. Bilateral simetri ile bir mimari eleman veya yapı içinde bir denge meydana getirirken radyal simetri, etrafındaki tekrarlı elemanlarla ayrı bir yer oluşturur. Özellikle anıtsal mimaride genellikle simetri kullanılır. Bununla birlikte, simetrik mimari elemanlar bir uzayda uyum ve düzen uyandırabilir.
Gestalt kuramında da yer alan simetri ilkesine göre; zihin nesneleri simetrik olarak ve bir merkez noktası etrafında şekillendirerek algılar. Nesneleri eşit sayıda simetrik olarak bölmek algısal olarak memnuniyet vericidir. Sonuç olarak birbirine bağlı olmayan iki simetrik parça olduğunda zihin algısal olarak uyumlu bir şekil oluşturmak için onları birleştirir. Birleşik simetrik nesne oluşturmak için grup olan nesneler simetrik nesneler arasındaki benzerliği arttırabilir.

**3.1 Behram Paşa Camii ve Özellikleri**

Behram Paşa Camii Diyarbakır şehrinin güneyinde ve Mardin Kapı civarında yer almaktadır. Dönemin on üçüncü Osmanlı valisi ve beylerbeyi olan Behram Paşa tarafından inşa edilmiştir. Cümle kapısında bulunan kitâbede, inşasına 972 (1564) yılında başlanıp 980 (1572) yılında tamamlandığı bilgisine ulaşılmıştır. Behram Paşa Camii, Mimar Sinan'ın İstanbul dışındaki önemli bir eseri ve deneme yapısı olarak değerlendirilmektedir. Ayrıca Tuhfetü'l-mi'marin'de Behram Paşa Cami'den bahsedilmektedir (islamansiklopedisi.org., 08.06.2020, 18.20.) (Şekil 2).



**Şekil 2.** Behram Paşa Camii

Mimar Sinan eseri olan Behram Paşa Cami'nin avlusuna kuzey, doğu ve batı yönlerinden açılan kapılarla giriş sağlanmaktadır. Avlunun ortasında yer alan sekizgen planlı sekiz sütun üzerine oturan bir şadırvan bulunmaktadır (Anonim 2012). Caminin, merkezinde yer alan büyük kubbesi ve kare planlı harimin kuzeyinde, 2 sıralı, yanlara da uzanan 5 kubbeli son cemaat yeri bulunmaktadır (Tuncer 1996). Camiye giriş, dilimli kemer kavsara içinde basık kemer açıklıklı büyük bir kapı ile sağlanmaktadır. Kavsaranın içi, iri mukarnaslar ve sarkıtlarla süslenmiştir. Ayrıca kapının sağında ve solunda da nişler bulunmaktadır. Kubbeye geçiş, tromplarla sağlanmıştır. Üst bölümde ise üç tarafı çeviren bir mahfil yer almaktadır. Camide; ana mihrap dışında, üç tane sağ ve üç tane sol tarafta olmak üzere

altı tane mihrap bulunmaktadır. Caminin tüm duvarları, zeminden belirli bir yüksekliğe kadar çinilerle süslenmiştir. Kubbede, kalem işi bezemeler mevcuttur (Anonim 2012).

Özellikle anıtsal mimaride sıklıkla kaşılaşılan simetri uygulamalarının camii yapıları özelinde incelendiğinde; bu yapıların planlama ve tasarım aşamalarının simetri baz alınarak uygulandığı görülmektedir. Plan ve cephelerin yanı sıra bu yapılarda sıklıkla rastlanan işlemeler ve kalem işleri de simetri tabanında şekillenmekte ve çevre peyzaj düzenlemelerinde de simetrinin tasarımda belirleyici ve önemli bir unsur olduğu görülmektedir. Sonuç itibariyle simetrinin, estetiğin öne çıktığı yapılarda önemli bir etken olarak yer aldığı görülmektedir. Bu çalışmada ise Diyarbakır için önemli bir tarihi eser olan Behram Paşa Camii'nin estetik tabanlı simetrik uygulamaları incelenerek, bir takım değerlendirmeler yapılmıştır.

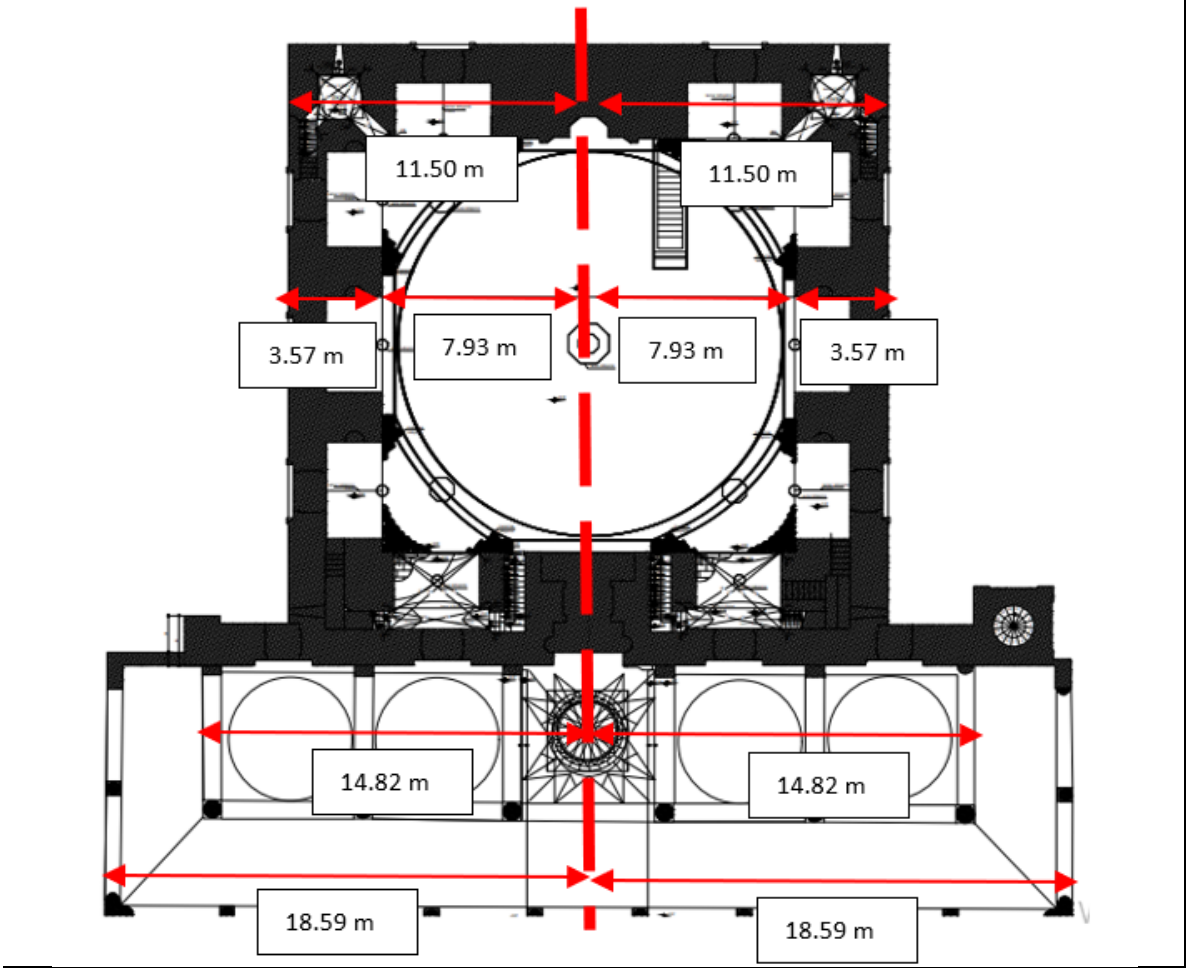
## 4. Bulgular

Özellikle cami mimarisinde ritmik bir organizasyon, düzen ve estetik arayışı doğadaki estetik düzende de sıklıkla rastlanılan simetrinin camilerin planlanmasında da kullanılmasına yönlendirmiştir. Tarihten günümüze birçok anıtsal yapıda rastlanıldığı gibi camii tipolojisinin neredeyse tamamında simetri uygulamaları dikkat çekmektedir. Simetri, bu yapıların tasarımında ve planlanmasında etkin bir rol oynayarak, yapının estetik yönünü güçlendiren bir unsur olarak kullanılmaktadır.

### 4.1 Plan Düzleminde Simetri Uygulamaları

Camii yapıları plan tasarımlarında, simetrinin etkin bir rolü vardır. Bu durum yapının formunu, işleyişini ve cepheleri önemli ölçüde etkilemektedir. Çalışma kapsamında incelenen Klasik Osmanlı Dönemi cami tipolojisine sahip Behram Paşa Camii'nin plan düzleminde yer alan simetri uygulamaları Tablo 1'de verilmiştir.

**Tablo 1.** Behram Paşa Camii plan şeması ve simetri uygulaması.

| Plan Düzleminde Simetri Uygulamaları |
|---|
|  |



Behram Paşa Camii'nin plan şeması simetri baz alınarak incelendiğinde; merkezi noktadan geçen aksın; yapıyı harim kısmında 11.5 m genişliğinde iki eşit parçaya, giriş bölümünde yer alan son cemaat yerini ise 18.59 m

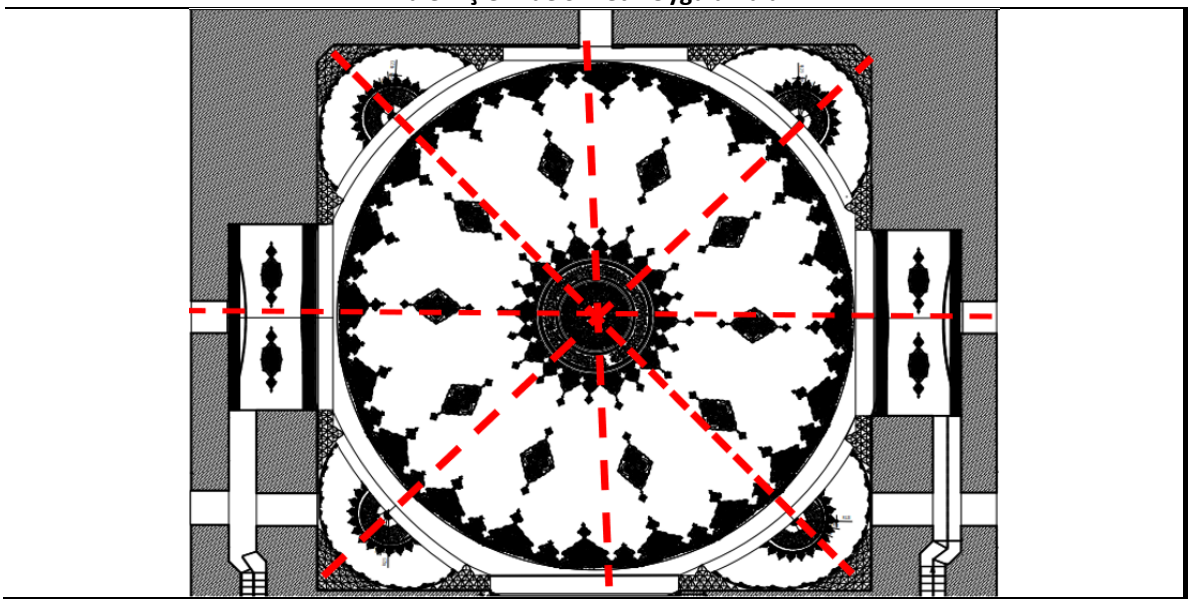
genişliğinde eşit iki parçaya böldüğü görülmüştür. Yapının planlanmasının merkezden geçen bu aksa göre simetrik bir düzenle tasarlandığı planlamanın birçok aşamasında rastlanmaktadır. Pencerelerin konumlandırılması ve ebatları, kubbelerin sayısı ve genişlikleri simetri aksına göre aynı oranda tekarlarlardan oluşmakta ve plan şemasının neredeyse tamamı bu aks üzerinden şekillenmektedir. Bu durum hem yapının fonksiyonel bir tasarım olmasına hem de estetik bir cephenin oluşumuna katkı sağlamaktadır.

**4.2 Kalemişlerinde Simetri Uygulamaları**

Simetrinin plan bazında kullanımları ile beraber yapının estetik yönünü güçlendiren desenlerde de, geometrik veya daire şeklindeki işlemelerde de simetrinin öne çıkan bir unsur olduğu görülmektedir. Bahsedilen bu şekil ve motifler bir alana işlenecekse simetri kullanımına ihtiyaç duyulmaktadır. Sonraki aşamada, simetri eksenlerini çizerek tasarımın yapılacağı birim alanı belirlenmektir. Genelde simetri eksenleri 1/4, 1/6, 1/8, gibi çift rakamların katları şeklindedir.

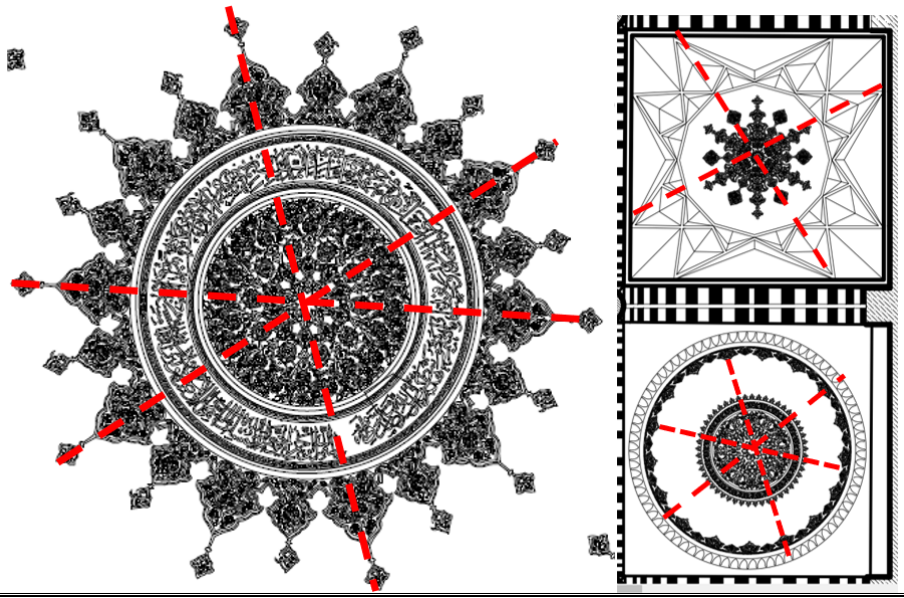
Simetri eksenlerini bulma işlemine kalem işi çalışmasında "taksimat"adı verilmektedir. Taksimat; kubbedeki pencere sayısı dikkate alınarak yapılan bir işelmdir. Pencere sayıları çoğunlukla çift rakamlardan oluşmaktadır. Caminin kubbe çevresi, kıble tarafına bakan ortadaki pencere üzerinden başlanarak ölçülür. Bu ölçümden çıkan rakam pencere sayısına bölünür ve elde edilin sayı kubbeye uygulanacak kompozisyonda bir tane birimin simetri ekseninin genişlik ölçüsünü verir. Böylelikle her pencere üzerine çizilecek simetri eksen çizgilerinin yerleri tespit edilmiş olur. Kubbenin içbükey uzunluğu karşılıklı olarak dört cepheden merkeze doğru ölçülür ve bu şekilde kubbenin merkezi belirlenir. Daha sonraki aşamada ise kubbe merkezinden pencere üstlerine kadar esnek bir mastar yardımı ile simetri eksen çizgileri çekilir. Çekilen bu çizgilerin uzunluğu ölçülür. Bu teknik bütün kubbelerde aynı şekilde tekrar ederek uygulanır (Birol, 2010: 113). Behram Paşa Camii'nin kubbelerinde ise simetri bazlı ve büyümeyi tarifleyen organik formlar analiz edilmiş ve geometrik olarak soyutlanarak elemanların mekansal ihtiyaçlarına cevap verebilecek şekilde kurgulanmıştır. Ana kubbenin kalemişleri simetri tabanında organik bir form tasarımıyla şekillenmiştir. Bu uygulamalar iç mekanda estetik bir görüntü sağlayarak, mekanın görsel yönünü güçlendirmektedir (Tablo 2).

**Tablo 2.** Behram Paşa Camii Kalemişlerinde Simetri Uygulaması.

| **Kalemişlerinde Simetri Uygulamaları** |
|---|
|  |

Doğada rastlanılan birçok bitkisel formun yapısı, radyal simetri ile farklı kolların tek merkezde bağlandığı oran ve denge unsurları üzerine kuruludur. Bu kural üzerine ortaya çıkan "filotaksi" kavramı bitkilerde spiral döngüleri meydana getirerek, parça ve bütün arasında ritmik bir hareket oluşmasına sebep olmaktadır. Bu perpektif ile incelendiğinde; genel tasarım yaklaşımı tekil bir merkezden dağılan, parçalanarak büyüyen ve farklı kollar arasında strüktürel bağlar oluşturan formları ele aldığı görülür (Karakoç 2019). Bitkisel formların radyal simetri ile geliştirildiği bu uygulamalara camii yapılarının kalem işi bezemelerinde sıklıkla rastlanmaktadır. Radyal simetri kullanılarak gelişim gösteren kalemişleri Behram Paşa Camii'nin tavan işlemelerindeki desenlerde öne çıkmaktadır (Tablo 3).

**Tablo 3.** Behram Paşa Camii Kalemişlerinde Simetri Uygulaması.

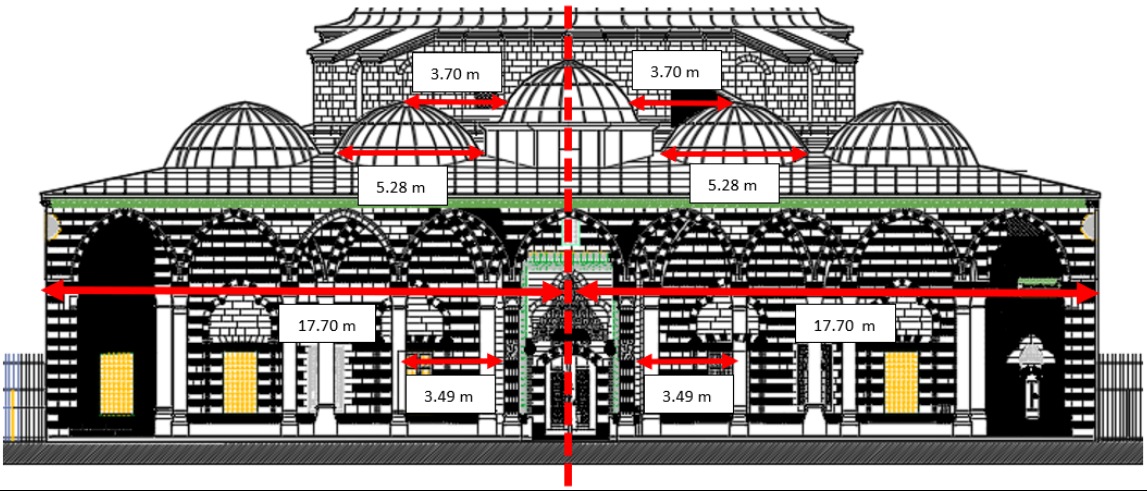
| Kalemişlerinde Simetri Uygulamaları |
|---|
|  |

Caminin merkezi kubbesi başta olmak üzere yapının diğer kubbelerinin de iç kısımlarında yer alan kalem işleri incelendiğinde; desenlerin küçük ölçekteki çizimlerinden büyük ölçekteki çizimlerine kadar simetri aksları esas alınarak bir tasarım geliştirildiği görülmektedir. Ayrıca bezemeler parça özelinde ve bütün genelinde de kendini simetrik bir biçimde tekrar etmektedir. Merkezi bir eksen etrafında dairesel bir düzenin olması kubbelerde yer alan kalemişlerinin ortak özelliğidir. Birbirine benzerliğin bir eksen üzerinde tekrarı estetik bir görüntü sağlamakta ve mekandaki görsel etkiyi güçlendirmektedir.

### 4.3 Cephe Düzleminde Simetri Uygulamaları

Cepheler yapıların estetik yüzü olmaları ile beraber kullanıcının algısı ile ilk iletişim kuran yüzeylerdir. Bu bağlamda tasarımın en önemli parçalarından biridir. Özellikle anıtsal yapılar başta olmak üzere birçok tarihi yapıda estetiğin vurgulanması ve kullanıcı üzerinde düzen algısı oluşturmaya yönelik bir eylemin parçası olan simetrinin etkin kullanımı dikkat çekmektedir. İlk olarak Behram Paşa Camii'nde yapının estetik yönü ile öne çıkan giriş (kuzey) cephesindeki, simetri uygulamaları incelenmiştir (Tablo 4).

**Tablo 4.** Behram Paşa Camii Kuzey (Giriş) cephesinde simetri uygulaması

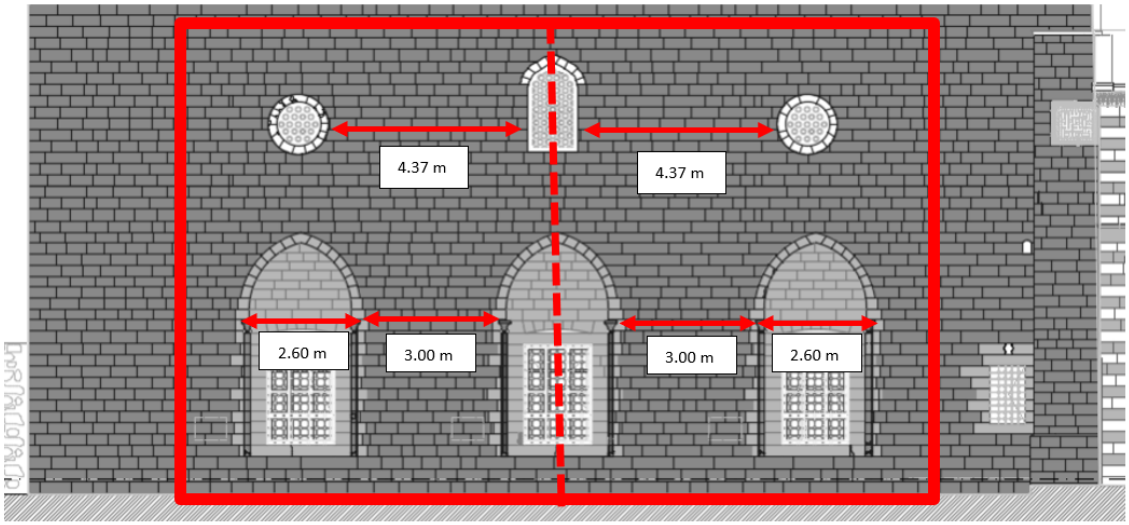
| Kuzey Cephesi Simetri Uygulamaları |
|---|
|   |

Yapının giriş cephesinin ortasından geçen aksın yapıyı simetrik olarak iki eşit parçaya böldüğü ve planlamanın simetri unsuru baz alınarak tasarlandığı görülmüştür. Aksın sağında ve solunda ikişer kubbe yer almaktadır. Kubbelerin genişlikleri 5.28 m olup aksa eşit mesafede yer almaktadır. Bu kubbelerin merkezi tepe noktalarının

ortada yer alan kubbeye mesafeleri de 3.7 m olup, eşit uzaklıktadır. Girişte yer alan revaklarda da durum benzerdir. Bu kısımda yer alan kemerler de orta noktadan geçen aksa eşit mesafede olup, 3.49 m genişliğindedir. Aksın sağında ve solunda eşit sayıda 4 kemer bulunmaktadır. Kısacası cephe elemanlarının, cephenin orta noktasından geçen aks referans alındığında eşit sayıda ve eşit mesafelerde tekrar ettiği görülmektedir. Bu durum yapıda düzenli ve ritmik bir kurgu oluşmasını sağlayarak, estetiğin öncelikli olarak arandığı giriş cephesinde belirgin bir görüntü oluşturmuştur. Yapının kuzey cephesinde olduğu gibi güney cephe kurgusunda da yine estetik ve düzen unsurlarını öne çıkaran simetri uygulamalarına rastlanmaktadır (Tablo 5).

**Tablo 5.** Behram Paşa Camii Güney cephesinde simetri uygulaması

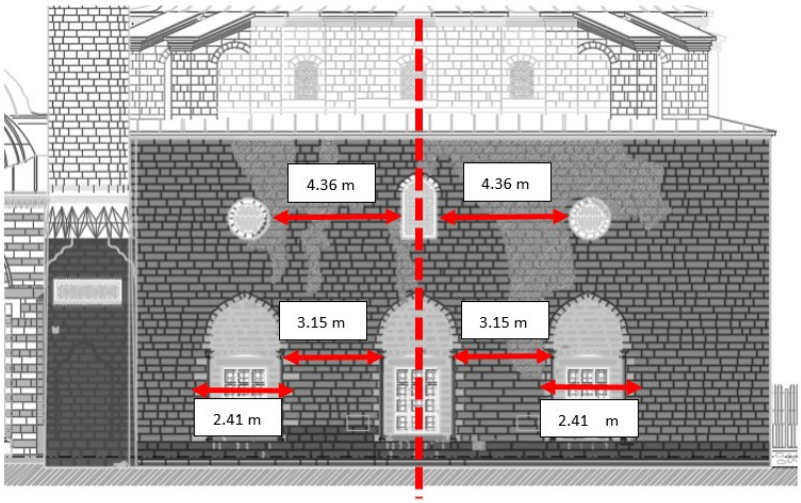
**Güney Cephesi Simetri Uygulamaları**




Yapının güney cephe kurgusu simetri tabanında incelendiğinde; cephenin ortasında yer alan pencerelerin merkezi noktasından geçen aksın diğer pencere elemanlarını iki eşit parçaya böldüğü görülmektedir. Aksın sağında ve solunda 2.6 m genişliğinde aynı pencere elemanları kullanılmış olup, aksa 3 m uzaklıkta yer almaktadırlar. Tepe pencereleri de aksa 4.37 m mesafede eşit uzaklıkta konumlandırılmıştır. Böylelikle simetri uygulamasının bu cephe tasarımında da öncelikli bir unsur olarak kullanıldığı tespit edilmiştir. Behram Paşa Camii'nin doğu cephesinde de benzer simetri uygulamaları mevcuttur. Bu uygulamalar Tablo 6'da verilmiştir.

**Tablo 6.** Behram Paşa Camii Doğu cephesinde simetri uygulaması

**Doğu Cephesi Simetri Uygulamaları**




Doğu cephesinin ortasından yer alan cephe elemanlarının merkezi noktasından geçerek iki eşit parçaya ayıran aksın, diğer pencereleri de eşit aralıklarla ayırdığı görülmektedir. Aksın sağında ve solunda 2.41 m genişliğinde aynı pencere elemanları aksa 3.15 m mesafede eşit uzaklıkta ve aynı sayıda kullanılmıştır. Benzer şekilde tepe

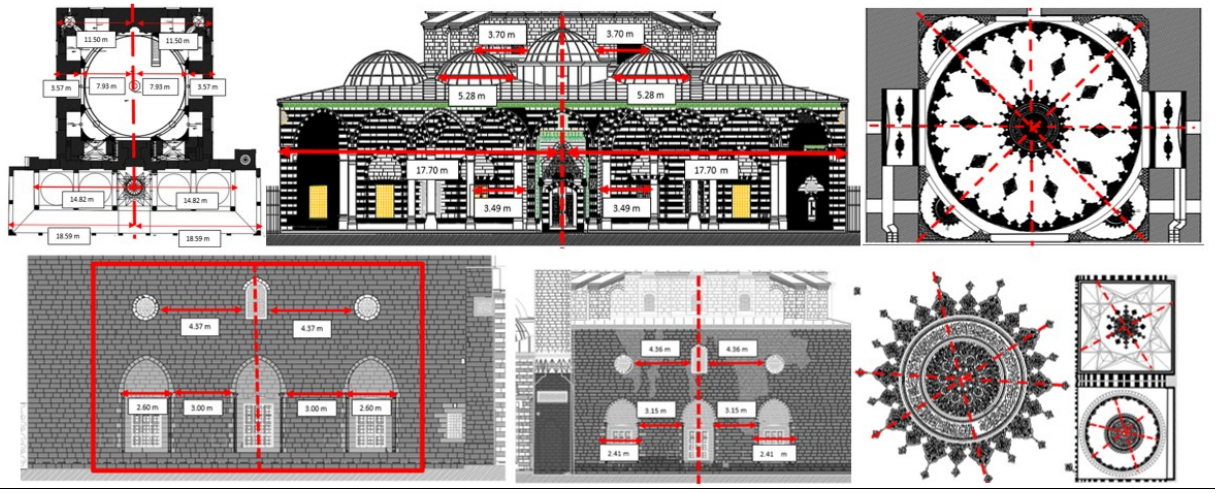
pencereleri de aksa eşit mesafede 4.36 m uzaklıkta konumlandırılmıştır. Yapının diğer cephelerinde olduğu gibi bu cephede de simetri uygulaması planlamada öne çıkan unsur olması ile beraber cephenin görsel etkisini güçlendiren faktörlerden biri olmuştur.

**5. Sonuçlar**

Tarihten günümüze yapılar estetik özellikleri ile ele alındığında; doğanın kurgusunda canlıların anatomisinde, sistemlerin ilerleyişinde görülen simetrinin mimari plan ve tasarımların tabanında önemli bir kriter olarak değerlendirildiğini ve planlamanın gidişatını belirleyen önemli bir parametre olduğu görülmektedir. Simetri önemli bir denge unsuru olması sebebiyle, kullanıcı üzerinde bir düzen algısının oluşmasına sebep olmaktadır. Düzen ve uyum kavramlarıyla ilişkili olan estetik kavramı; yapıların kullanıcı algısını olumlu yönde etkileyen ve beğenisini kazandıran etki unsuru olmaktadır. Yapı ve estetik arasındaki bağın kurulmasında simetrinin etkin bir rolü olduğunu, simetrinin doğa ve canlılar üzerindeki etkisi ve kullanım alanlarına bakarak söylemek mümkündür. Özellikle estetik arayışın öne çıktığı camii yapıları simetrinin incelikle kullanıldığı yapılar olmuştur.

Behram Paşa Camii plan, cephe ve kalemişleri çalışma kapsamında incelendiğinde; yapının en küçük ölçekteki detaylarından yapının bütününe kadar simetri yöntemi kullanılarak tasarlandığı görülmüştür. Simetri kullanımın yapıda meydana getirdiği düzen ve dengenin sonuçlarından biri olan estetik, yapının algılanırken kullanıcının beğenisini kazandırmaktadır. Literatürde yapılan çalışmalar simetrinin kullanıcı üzerinde düzen ve uyum algısı oluşturduğu yönündedir. Bu sebeple çoğu yapı tasarlanırken, simetri planlamada önemli bir faktör olarak değerlendirilmiştir. Behram Paşa Camii'nin kat planında, yapının estetik yüzü olan cephelerinin kurgusunda, yapının estetik yönünü güçlendiren kalemişlerinin çizimlerinde simetrinin esas alınarak, tasarımın planlandığı sonucuna ulaşılmıştır (Tablo 7).

**Tablo 7.** Behram Paşa Camii cephelerinde simetri uygulamaları

| **Behram Paşa Camii Simetri Uygulamaları** |
|---|
|  |

Yapılan incelemeler ile simetrinin doğada ve canlılar üzerinde oluşturmuş olduğu olumlu etkinin yapılarda da oluşturulabileceği düşünülmektedir. Günümüzde ve ilerleyen zamanlarda yapılacak yeni tasarımlarda simetri uygulamalarının görsel etkiyi güçlendireceği görülmüştür.

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# Traditional Room-Space Setup in “Mansions” of Alanya

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**Abstract**
While the plan scheme and structure are important in the traditional building, it is essential to go down to the concept of 'room' at a lower scale to understand these structures. The concept of 'tent', which is the accommodation element of the nomadic life culture, and the entire life cycle that takes place within this concept, being taken into a 'room' over time, in other words, its transformation into a set space, creates the basis of the concept of housing. Although the rooms seem to be constant, they are variable spaces where multiple actions occur: eating, drinking, cooking, washing, and sleeping. This study is based on the fact that a single nomad tent corresponds to a "room" in traditional buildings. The place of the rooms in the houses, described as mansions, which have been built in a more planned way outside the castle walls of Alanya, in the concept of traditional building and the definition of the ideal room has been examined. The traditional concept of 'room' has been evaluated overhead the rooms in Alanya mansions. For this determination, 11 mansions, which were previously restored, were selected and examined in situ and the spatial components of the rooms were determined. Then, the influence of the combination of these components in space on the space setup was examined. As a result, it was determined that the ideal room type defined for traditional houses was reached in 34 rooms studied in 11 mansions, which was largely achieved.
***Keywords:*** Alanya; Traditional building; room; space setup; tent.

# Alanya Surdışı “Konak” larında Geleneksel Oda-Mekân Kurgusu

**Özet**
Geleneksel yapılar günümüzde birçok araştırmanın konusu olmuş, ağırlıklı olarak plan tipolojisi ve belgeleme çalışmaları yapılmıştır. Geleneksel yapı bütününde plan şeması ve kurgusu önemli iken daha alt ölçekte ‘oda’ kavramına inilmesi bu yapıların anlaşılması için önemlidir. Göçebe yaşam kültürünün barınma elemanı olan ‘çadır’ kavramının ve içerisinde gerçekleşen tüm yaşam döngüsünün zamanla bir ‘oda’ içerisine alınması ve sabit bir mekâna dönüşümü konut kavramının temelini oluşturmaktadır. Odalar her ne kadar sabit gibi görünse de içerisinde yeme, içme, pişirme, yıkanma, yatma gibi çoklu eylemlerin gerçekleştiği aslında değişken mekanlardır. Bu çalışmada tek bir göçebe çadırının geleneksel yapılarda bir “oda” ya karşılık gelmesinden yola çıkılmıştır. Alanya’nın kale surları dışında daha planlı şekilde inşa edilmiş konak olarak adlandırılan konutların odalarının geleneksel yapı kavramı ve ideal oda tanımı içerisindeki yeri araştırılmıştır. Daha önce tanımlamaları yapılan geleneksel ‘Oda’ kavramının Alanya konaklarındaki odalar üzerinden değerlendirilmesi yapılmıştır. Bunun için daha önce restorasyonları yapılmış olan 11 konak seçilmiş ve bu yapılar yerinde incelenerek odaların mekânsal bileşenleri belirlenmiş ve bu bileşenlerin mekân içerisindeki dizilimlerinin mekân kurgusuna etkisi incelenmiştir. Sonuç olarak 11 konakta incelenen 34 odada geleneksel konutlar için tanımlanan ideal oda tipine ulaşılmaya çalışıldığı ve büyük ölçüde sağlandığı tespit edilmiştir.
**Anahtar Kelimeler:** Alanya; Geleneksel yapı; oda; mekân kurgusu; çadır.

## 1. Giriş

İlkçağlardan bu yana insanların barınma ihtiyacı farklı çözümleri de beraberinde getirmiştir. Kimi zaman iklim nedeniyle göç etmiş, kimi zamanda kalarak iklime, coğrafyaya uyum sağlayabileceği yapılar inşa etmiştir. En temel ihtiyaç barınmanın ardından aile yapısı içerisinde bir arada olma olgusu gelişerek daha kapalı, dışarıdan soyutlanmış mekân arayışı başlamıştır. Aileyi bir araya getirme düşüncesi sabit mekanlar fikri akla getirse de konar-göçer toplumların göçebe yaşam şekli bu durumu oldukça iyi başarmıştır. Aile üyelerinin 5-6 m² ile sınırlı bir alan içerisinde tüm günlük ihtiyaçlarını aynı yerde gerçekleştirebildiği mekanlar yaratılmış, hem de aile bir arada tutulmuştur. Dokunmuş olan bir üst örtü ile yaratılmış olan bu kapalı mekân aslında çevre etkilerine açık fakat insan ölçeğinde gerekli mahremiyeti sağlayacak kadar kapalı mekanlardır. Üst örtü olumsuz çevre koşullarını tamamen içeriye aldığından iç ortamın uygunluğunun sağlanabileceği yerlere göç edilmiş ve bu taşınabilen mekân insanların hayatı olmuştur. Isınma, pişirme, yemek yeme, yatma, oturma, depolama gibi tüm işlevlerin gerçekleştiği bir alan olan bu örtü altı olarak tanımlanan yaygın kullanımıyla “çadır” birimi değişken koşullara kolaylıkla uyum sağlayabilen bir iç yapıya sahiptir. Bu değişken iç mekân kendi içerisinde bir dizilime sahiptir. Ortada ocak, girişin sağında kiler, yatma bölümleri, yatma bölümünü hemen yanında askılık olarak kullanılan bir demir kazık, karşısında sandık alanı, girişin solunda ise eğerlerin konulduğu sehpalar (Küçükerman, 1988, s. 26). Geleneksel yapılarda “oda” kurgusunda olduğu gibi tamamen çadırı kullanan kişilerin ihtiyaçları doğrultusunda

şekillenmiş bir iç mekân kurgusu bulunmaktadır. Çadırın şekli kullanan topluluklara göre kimi zaman yuvarlakken, kimi zaman dikdörtgene yakın ama üst örtüde kullanılan örtünün doğası gereği keskin köşeli değildir. Geleneksel yapılarda odanın boyutları ve şeklini, çadır da olduğu gibi malzeme belirlemektedir. Örneğin ahşapla geçilebilecek en büyük açıklık veya elde edilebilen en uzun ağaç bu boyutları belirlemede etkilidir. Her ne kadar günümüzde hala göçebe yaşam bazı toplumlarda devam etse de yerleşik düzene zamanla geçilmiş ve doğa koşullarına göre kendisine kullanım kolaylığı sağlayacağı sabit mekanlar oluşmaya başlamıştır. Bu sabit mekanlar oluşturulurken daha önceki alışkanlıklardan vazgeçilmemiş, bir çadır bir odanın mekânsal karşılığı olacak şekilde düzenlemeye gidilmiştir. Bu odaların sayıları değişken olsa da oluşturulan ortak bir mekanla yine birliktelik kavramından vazgeçilmemiştir. Bu ortak alan etrafında kurgulanan ve çoğu zaman ortak alanın şekline göre sınıflandırılan yapılar çevresel etkiler, iklim, topoğrafya, toplumun kültürüne uygun şekilde inşa edilmişlerdir. Geleneksel konutlarda odaların dizilişi açısından bakıldığında topoğrafyaya uygun olarak şekillenen zemin kat, genellikle mutfak, ahır, depo gibi servis mekanları olarak kullanıldığından yapıların ana planı en üst katta daha rahat okunmaktadır. Üst katlardaki odalar bir ailenin ihtiyaç duyabileceği eylemleri gerçekleştirebileceği değişken bir mekandır. Odaların biçimlenmesi bu eylemler için gerekli olan mekân parçalarının bir araya gelmesiyle oluşmuştur (Küçükerman, 1973, s. 41).

Bu çalışmada Alanya'da kale surları dışında düzlük alandaki yerleşimde bulunan ve halk arasında "konak" olarak betimlenen konutların "Geleneksel Yapı" kavramı çerçevesinde "genel yaşama odaları" nın biçimsel ve mekânsal kurguları değerlendirilmiştir[1]. Genellikle odaların birbirleri ile olan ilişkileri ortak alan sofa üzerinden incelenerek bir tipolojiye ulaşılmıştır. Bu çalışma ile daha temele inilerek tipolojinin en küçük parçası olan "oda" nın kendi içerisindeki bileşenlerinin birbirleri ile olan ilişkileri ve konumları incelenmiştir[2] . Bunun için Alanya Belediyesi proje arşivinde daha önce restorasyonları yapılmış olan 11 konak seçilmiş ve bu konaklardan 34 odanın planları yerinde incelenerek oluşturulmuştur. İlk olarak Alanya konaklardaki genel yerleşim kurgusu incelenerek "oda" kavramının bu kurgu içerisindeki yeri belirlenmiştir. Daha sonra geleneksel yapılardaki ideal "oda" kavramına odaklanılmış ve özellikleri belirtilmiştir. Daha önce tanımlanan ideal oda kavramı çerçevesinde Alanya konaklarındaki "oda" tanımı yapılarak odayı oluşturan bileşenlerin ilişkileri değerlendirilmiştir.

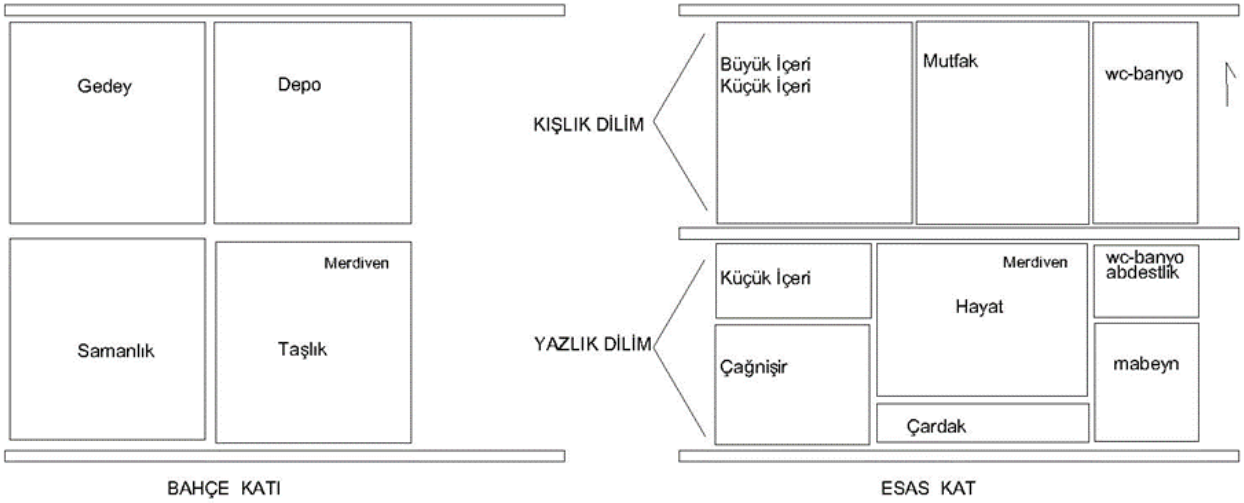
**2. Alanya Geleneksel Konutlarında Mekân Biçimlenişi**

Antalya'nın doğusunda Akdeniz kıyısında yer alan Alanya doğu Akdeniz ticaretinde önemli bir yere sahip olduğundan tarih boyunca önemini korumuştur. Alanya'da yerleşim 1860'lara kadar kalede sur duvarları içerisindeyken, kale içerisinde genişlemeye ve yeni konutların inşasına uygun yer kalmaması ve surların içinin sıkışık bir yerleşim olmaya başlamasından dolayı zamanla sur dışında düzgün konutlar inşa edilmiştir. Yeni kasaba olarak nitelendirilen bu yerleşimde konutlar sur içindeki evlere göre oldukça muntazam şekilde kagir ve düzenli olarak nispeten daha zengin kişiler için inşa edilmiştir. 1864 yılında kale surları dışında başlayan bu imar faaliyetleri sonucunda 1914 yılına kadar inşa edilen konut sayısı 720'ye ulaşmıştır (Gönüllü, 2008, S. 37).

Kale surları içerisindeki evler yoğunluk olarak Hisariçi Mahallesi ve Tophane Mahallesinde toplanmıştır. Kale yolunun üst kısmında Ehmedek ile iç kale arasında yer alan Hisariçi mahallesinde evler bahçeli küçük hacimli ve genellikle iki katlıdır. Kale yolunun alt kısmındaki Tophane mahallesinde ise evler deniz seviyesinden 260 m. yükselen dik yamaçta (yaklaşık %60 eğimli) konumlanmıştır. Eğim oldukça fazla olduğundan evler bu eğime uygun olarak yerleştirilmiştir. Evler genellikle iki katlı olup, eğim nedeniyle bazı evler üç katlıdır. Bu şekilde düzenlenen yapılarda en alt kat ahır olarak kullanılmaktadır. Yollar eğime paralel olarak yerleştirilmiş, eğime dik olan yollar ise merdivenli olarak düzenlenmiştir. Konya Vilayet Salnamesinde yolların genişliğinin iki arşını geçmediği ve bir yol düzeni olmadığından bahsedilir (Gönüllü, 2008, s. 37). Evliya Çelebi Seyahatnamesinde (1935) sur içerisindeki evlerin eğimden dolayı birbiri üstüne yapılmış toprak ve kireç örtülü olduğundan, birbirlerinin damlarını kullandıklarından bahseder. Ayrıca bütün sokakların merdiven merdiven yalçın kayalık olduğu ve halkın eşek ve katırlarla inip çıktığından bahseder (Çelebi, 1935, s. 323). Eğimden dolayı belli bir sokak dokusu oluşmadığından bazı sokaklarda tekerlekli araç trafiği bulunmamakta ve bazı sokaklar çıkmaz bir sokakla sonlanmaktadır. Araziye teraslamalar yapılarak yerleştirilen evlerin girişleri alt kattaki avludan, arkadaki yoldan veya her ikisinden de olacak şekilde düzenlenmiştir. Evlerde esas kat geleneksel Türk evlerinde olduğu gibi üst kattır (Şekil 1). Zemin kat; depolama, ahır ve servis mekanlarından oluşur. Bu mekanlar evin esas kat ile bağlantısını sağlayan merdivenlerin de bulunduğu avluya (havluya) açılırlar. Zemini taş kaplama olarak inşa edilen avlular kimi zaman evin içerisine dahil edilmeyip açık bırakılmışlardır. Bu tür evlerde giriş kapısı avluda bulunan ve yan kısımları ahşap duvar ile kaplanmış merdivenin önünde yer almaktadır (Şener, 1984, 11 Nolu ev; Hacıkura, 2000, s. 34).

[1] Farklı parametre ve olguları da içeren bir çalışma Hülya Yürekli tarafından İskilip konutları üzerinden yapılmıştır. Daha fazla bilgi için bkz. Yürekli, 1977; Yürekli 1979; Yürekli H.ve Yürekli F., 2005. 1974 yılında Yürekli yazmış olduğu Y. Lisans Tezinde Türk Evi Karakteristiklerini dış gözlem ile saptamaya yönelik çalışmalar yapmıştır.

[2] Cengiz Bektaş odaların her birinin bağımsız evler olduğunu adlarının da oda değil "ev" olduğunu, odaların hepsini eşdeğerde işlenmediğinden fakat bir ailenin tüm özel yaşamına çözüm arandığını belirtmiştir (Bektaş, 2005, s. 90).




**Şekil 1.** Kale İçi Dış Sofalı Plan Tipinde Mekânsal Öğeleri Gösteren Şematik Plan[3]

1860'lara kadar sur duvarları içerisinde olan yerleşimde Konya Vilayet Salnamesinde de belirtildiği gibi dik topoğrafyanın her gün inip çıkma zorluğu ve sıkışık yerleşim dokusu nedeniyle yerleşim sur dışındaki geniş ve düzlük alanlara taşınmış ve burada bir yeni bir konut dokusu oluşmuştur. (Gönüllü, 2008, s. 37). Kale dışında bulunan iki veya üç katlı yapılar halk arasında "konak" olarak adlandırılmaktadır. 'Konak' kelimesi göçebe hayattan gelen ve geceyi geçirmek üzere bir yerde konaklamayı ifade etmektedir. Konmak fiili yerleşik hayatın sürekliliği içinde sivil mimarinin kalıcı unsurlarını belirleyen konut ve konak gibi terimlere kaynak teşkil etmiştir (URL-1)**.** Mimari bir terim olarak barınmaya karşılık gelen konak sözlük anlamıyla büyük ve görkemli ev anlamındadır (Hasol, 1995, s. 267). TDK sözlüğünde ise büyük ve gösterişli ev olarak tanımlanmaktadır (URL-2)**.** Bu evlerin kale içindeki evlerden farkı hem düz bir topoğrafyada olmaları hem de büyük bahçelerin ortalarında konumlanmalarıdır. Kale dışında bulunan geleneksel yapılar genellikle dörtgen şeklinde ana yapı, bir ya da iki servis birimi ve bir çıkmadan oluşan iki ya da üç katlı yapılardır (Görsel 1; Şekil 2). Servis yapısı yapının bir cephesinde yapı ile aynı kat adedine sahip ve bitişik çatılı olabildiği gibi daha özenli yapılarda yapının arkasında tek katlı ve üstü teras olarak kullanıldığı da görülmektedir. Bazı örneklerde her iki servis yapısı da görülebilmektedir[4]**.** Servis yapıları genellikle tuvalet, banyo, abdestlik gibi ıslak hacimler, mutfak veya yardımcıların konaklaması için odalar düzenlenmiştir. Üç katlı yapılarda genellikle girişler cumba altından ve 1. Kattan ve ikinci bir giriş de zemin katta bahçeden sağlanırken iki katlı yapılarda ise doğrudan zemin kattan giriş sağlanmıştır. Üç katlı olup girişi güney cephedeki cumba altından değil de doğu cepheden olan bir örnek de bulunmaktadır[5]**.** Üç katlı yapılarda bahçe katı *gedey, taşlık* ve *ambar*[6] kısmından oluşur. Giriş katı ve üst kat yaşam katıdır. Kale dışındaki geleneksel yapılarda plan tipi olarak genellikle iç sofalı plan (Eldem, 1954, 93) kurgusu görülmektedir. İç sofa aynı zamanda karnıyarık plan tipi olarak da bilinmektedir ve sofada bulunan eyvanlar kimi evlerde merdivenler için kullanılmış, kimi evlerde de sofadan zeminini yükselterek ve direklikle özelleştirilerek oturma alanı olarak düzenlenmiştir. Bazı evlerde hayatta bulunan eyvan kapatılarak çağnişir olarak düzenlenmiştir. Genellikle sofanın dar kenarına merdivenler yerleştirilmiş ve tüm odaların sofaya açılması sağlanmıştır. Sofanın manzaraya yönelen kısmına çıkma yapılmış ve çıkmanın üç tarafına sabit olmayan sedir yerleştirilerek sofanın oturma alanına dönüşümü sağlanmıştır. Fakat genellikle sofada niş, ocak veya dolap bulunmamaktadır. Esas kat olan yaşam katında çağnişir ve mabeyn olarak adlandırılan odalar genellikle güneye konumlandırılmış, küçük içeri ve büyük içeri olarak adlandırılan odalar ise kuzeye yönelmiştir. Kimi yapılarda eyvan çağnişir olarak kurgulanmıştır. Bu mekanlarda bazı yapılarda yüklük, tek dolap niş ve sedirler bulunur. Bazı yüklüklerin köşelerinde "*gusülhane"* ya da "*yunmalık"* adı verilen ıslak hacim vardır. Bazı örneklerde, içeri mekânı, pabuçluk, seki altı, seki üstü gibi mekânsal ayırım için bir basamak ile bölünmüştür. Yaşam katında kuzeye yönelen odalardan biri bazı evlerde mutfak olarak düzenlenmiştir. Mutfak olarak

[3] Şener 1984, s. 11-Şekil 1 şematik olarak yeniden yorumlanarak çizilmiştir. Bundan sonraki kaynak gösterilmemiş olan tüm şekil ve görseller yazar tarafından üretilmiştir.

[4] Hasanağalar Konağı olarak bilinen günümüzde Alanya Kültür Müdürlüğü olarak kullanılan yapıda her iki servis yapısı da bulunmaktadır. Hasanağalar Konağı hakkında daha fazla bilgi için Göncü, 2012, s.128 ve Belediye arşivinde bulunan 17.08.2012 tarihli Rölöve Restorasyon ve Restitüsyon Raporları (Proje Müellifi Mimar Şükran Gülücü Ural).

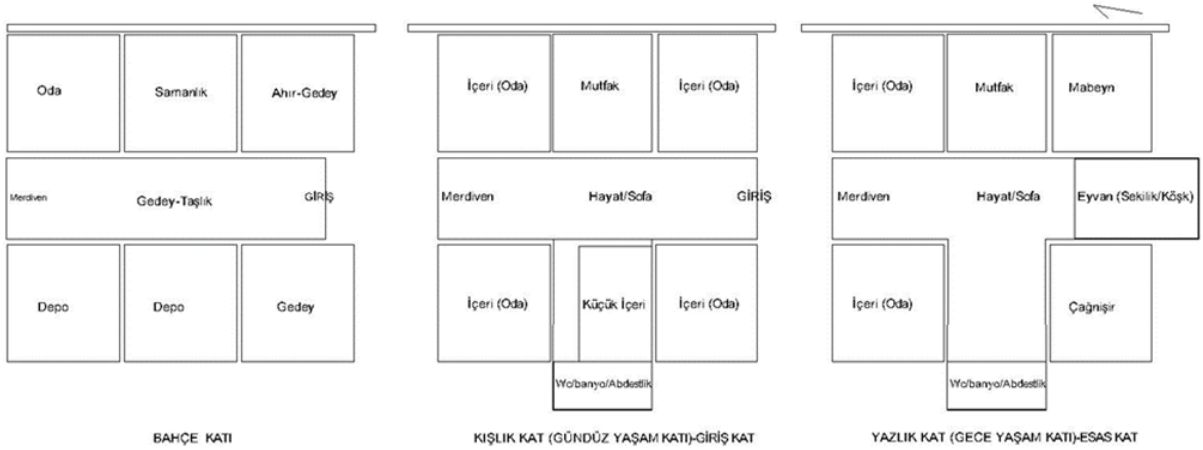
[5] Alanya Şekerhane Mah. 258 ada 191 numaralı parsel içerisindeki 3 katlı Mithat Tokuş Konağında ana giriş doğu cephededir. Konak hakkında daha fazla bilgi için Arı, 2016, s. 148.

[6] Gedey: Yapıların zemin katında bulunan ahır ve samanlık olarak kullanılan depolama alanlarıdır. Sıvasız duvarları ve sıkıştırılmış toprak zeminleri vardır. Yapının giriş kapısı beslenen hayvanın rahatça girip çıkabileceği yükseklik ve genişlikte düşünülmüştür. Örneğin deve besleniyorsa kapı genişlik ve yükseklikleri daha fazladır. (Hacıkura, 2000, EkA).

düzenlenen odada ocak olmasına dikkat edilmiştir. Bu ocak ahşap davlumbazı *(yaşmak)* olmayan tuğladan kemerli ocaktır. Daha çok pişirmeye yönelik kullanılmıştır.



**Görsel 1.** Alanya'dan örnek bir "konak"




**Şekil 2.** Kale Dışı İç Sofalı Plan Tipinde Mekânsal Öğeleri Gösteren Şematik Plan[7]

Geleneksel yapı kurgusunda olduğu gibi Alanya'da bulunan geleneksel yapılarda da iklim değişiklikleri ile ilgili bir takım yapısal düzenlemeler öngörülmüştür. Alanya evleri ile ilgili yapılmış olan çalışmalarda bu konuda iki farklı görüş bulunmaktadır. Bu görüşlerden biri evlerin kabuk yapısında mevsimsel bir ayırım olduğudur. Buna göre hayat, çağnişir, mabeyn, küçük içeri[8] ve çardak hacimlerinin bulunduğu manzara yönündeki kısmın yapının "yazlık" dilimi, büyük içeri, mutfak ve bazen de küçük içeri hacimlerinin bulunduğu kısmı "kışlık" dilimi olarak tanımlanmıştır (Şener 1976, s. 9-Şekil 1.12; Şener 1984, s. 11-Şekil 1.) (Çizim 1). Kışlık dilimin kabuk özelliklerinin dışta sıvasız içte sıvalı ve ahşap hatıllı taşıyıcı taş duvar olduğu, yazlık dilimin kabuk özelliklerinin zemin katta taşıyıcı ahşap dikmeler, birinci katta ahşap iskelet üzerine ahşap çıtalar ve bunların üzerine kıtık sıva olarak oluşmuş duvarlar, çağnişir ve mabeyn hacimleri üzerinde tavanlı, diğer hacimler üzerinde tavansız olmak üzere tek eğimli beşik veya kırma biçiminde alaturka çatı olduğu belirtilmiştir (Şener, 1976, s. 9-10). Diğer görüşte ise Alanya'nın Akdeniz iklim kuşağında yer almasından dolayı havanın genellikle sıcak ve nemli olduğu, doğrudan ve yaygın şiddetli güneş ışınımı ve ikindi yağmurları alması ve gece ile gündüz ısı farkları nedeniyle uygulanabilecek mekânsal çözümlerden bahsedilmiştir (Ceylan 1997, s. 79). Buna göre konut içi konforun sağlanması için yatay ve düşey esinti oluşması gerektiği ve gece ile gündüz yaşamında konut içi konforun sağlanmasında malzemenin önemi vurgulanmıştır. Isının yüksek olduğu gün boyunca yaşanan mekanların masif taş duvarlı kuzey cephelerde olduğu, akşam ve gece süresince yaşanılan mekanların hafif malzeme yani ahşaptan oluşan çağnişir, mabeyn, çardak gibi mekanların bulunduğu hayat kısmı olduğu belirtilmiştir (Ceylan 1997, s. 81). Alanya konaklarında ve kale içindeki konutlarda bu türden bir ayırım yapıldığı yapılardaki malzeme ve duvar kalınlıklarının farklılığından anlaşılmaktadır[9]. Yine

[7] Azakoğlu Konağı için planlar yerinde şematik olarak yeniden üretilmiştir. Proje müellifi Y. Mim. Nimet Hacukura'dır.

[8] Çağnişir: Evin en güzel manzaraya bakan en ayrıntılı ve süslü odası. Mimari eleman olarak yüklük ve sedir bulunur (Hacıkura, 2000, Ek A).
Mabeyn: Çağnişire göre daha küçük düzenlenmiş, kalabalık misafir olduğunda kadınların oturduğu genellikle güneye bakacak şekilde düzenlenmiş özenli olan diğer oda. Genellikle büyük konutlarda çağnişir ve mabeyn iki ayrı oda şeklinde görülür (Hacıkura, 2000, s. 34).
İçeri: Uyuma için düzenlenen odalardır. Büyük içeri ebeveynlerin kaldığı, küçük içeri ise çocukların kaldığı odalar olarak düzenlenmiştir. Oda içerisinde ocak, dolap, sedir gibi mimari elemanlar bulunur (Şener, 1976, s. 6).

[9] Alanya'da yaz sıcaklarında yerli halk çoğunlukla yaylalara gitmektedir. Yaylalarda yaptıkları konutlarda çardak öğesi genellikle güneye konumlandırılır. Gündüz güneşli havalarda kuzey tarafındaki odalarda gün geçirilirken, akşam bu çardaklarda yaşam devam etmektedir. Bu yaşam

geleneksel yapılarda olduğu gibi alt kat sokağa veya parsele uyumlu iken çıkmaların kullanımı ve ideal dörtgen plana yaklaşım üst katlarda sağlanmaya çalışılmıştır.

**3. Geleneksel Yapılarda Mekân-Oda Kurgusu**

Mekân, içinde insan ve objelerin var olduğu ve/veya hareket ettiği, çeşitli eylemler gerçekleştirebileceği alanlar ve hacimler veya tanımlanmış bir boşluk olarak ifade edilebilir. Bir mimari mekânın oluşabilmesi için taşıyıcı sistem, cephe sistemi, mekânın içinde yer aldığı bağlam ve dolaşım sisteminin hep birlikte var olması gerekir (Soygeniş, 2017, s. 14). İnsanlar yaşamlarını sürdürürken yaptıkları çeşitli eylemler için farklı mekanlara gereksinim duyarlar. Bazı durumlarda ise bir mekân içinde farklı eylemleri gerçekleştirebilirler, bu tip mekanlara çok işlevli mekanlar denilmektedir (Soygeniş, 2017, s. 33). Kuban (1992, s. 15), mekânın biçimsel olduğu kadar insan yaşamına ilişkin özellikleri de içermesi gerektiğinden bahseder. Ayrıca hareket ve ışıkla belirlenen sadece boşluk ya da sadece sınırlardan oluşan bir olgu değil de boşlukla onu sınırlayan öğelerin ortak oluşturdukları bir olgudan söz eder. Çok işlevli bir mekân tanımlayan geleneksel yapılarda "oda" kavramını sadece boşluk ya da sınırlardan ibaret bir mekân olarak tanımlamak yeterli değildir. Boşluğu sınır öğeleri birlikte tanımlamak gerekir. "Oda" kavramı hakkında birçok tanımlama ve görüş bulunmaktadır. Odalar günlük yaşamın geçtiği mekanlar olduğundan mekânsal organizasyon da önem kazanmıştır. Küçükerman'a (1995, s. 91) göre odaların en önemli ve etkili özellikleri bu mekanların tek başlarına, bir yapının içindeki belirli işlevleri kendi içlerinde bir tür yoğunlaştırarak karşılayabilen mekanlar olmasıdır. Odaların en önemli özelliği değişik eylemlerin gerçekleşmesi için değişik çevre parçalarının bir araya getirilmiş olmasıdır. Odalar bir yandan bir araya gelerek mekân kuruluşuna katkıda bulunurken diğer yandan da kendi başlarına çok yönlü günlük işlerin karşılanabildiği bir bütündür. Bu yüzden iç düzenleri kesin olarak belirlenmiş, sistemleştirilmiş ve hatta iç düzende kullanılan ürünler bile standartlaştırılmıştır (Küçükerman, 1995, s.92). Bu standartlaşma odalarda dörtgen bir şekilde görülürken oda içerisinde kullanılan alan alt örtüde (döşemede) ve onun yansıması olan üst örtüde (tavanda) kareye yakın bir formda görülmektedir. Bu formun oluşmasında iç düzen için kullanılan mekânsal öğelerin dizlimi etkilidir. Bektaş'a (2001) göre "oda" bir çekirdek ailenin yirmi dört saat kullanacağı yeme, içme, yatma, yıkanma gibi bütün gereksinimlerini karşılayabileceği bir mekandır. Odanın kapısı açıldığında direkt odanın içinin görünmediği ve burada yaşmak duvarı veya pahlı bir dolapla ya da kapıyı ters yönde oda içine değil de duvara doğru açarak kontrollü giriş sağlandığını belirtir. Ayrıca odanın iki bölümden oluştuğunu kapıdan sonra girilen bölümün seki altı olduğunu ve burada dolaplar (dış duvara yakın bitişik ucunda "yunmalık", bir bölümünün yüklük, yüklüğün yanında açık raflar ve kapalı dolaplar vardır) düzenlendiğini belirtmiştir. Seki altından bir basamakla asıl odaya çıkıldığından odanın kareye yakın veya dörtgen olduğundan bir duvarının ocak duvarı olduğundan bahseder (Bektaş, 2001, s. 61-62). c(Yürekli H. ve Yürekli F., 2005, s. 16.).

Oda mekanının kurulmasında yapının taşıyıcı sistemi ve dolayısıyla da malzeme önem kazanmıştır. Taşıyıcı sistem ve malzeme oda boyutlarını ve biçimini etkilerken bir taraftan da pencere-kapı gibi iç-dış ilişkileri ve iç düzen öğelerini etkilemiştir. Geleneksel yapı sisteminde "odanın kavramı- odanın iç düzen öğeleri- yapı sistemi" üçlüsünün değişik birleşmeleri sonucunda evin biçimi belirlenmiştir (Küçükerman, 1995, s. 95). Kullanılan yapı malzemesi odanın boyutlarında etkili olsa da oda içerisindeki kapı, pencere, dolap, ocak ve bunlar arasında kalan boşluk mekânı oluşturan ana öğeler olmuştur. Bu öğelerin yerleşimindeki ve ölçülendirilmesindeki "insan ölçeği"[10] boyutlandırma ve kullanımda oldukça önemlidir. Tepe pencereleri, tavan ve dolapların az kullanılan üst rafları bu ölçeğin üstündedir. Bu sınır ise yatay bir raf veya ahşap kaplama ile vurgulamış ve oda böylelikle algısal olarak yatayda ikiye bölünmüştür ve iç mekân öğeleri ile yakından ilişkilidir. Yürekli (1977, s. 3), bir odayı oluşturan bileşenleri İskilip konutları için kullandığı kavramlar olan "Orta Mekân", "Pencere Duvarı", Yüklük Duvarı" ve "Ocak Duvarı" olarak tanımlamıştır. Buna göre Orta Mekân odanın ana bileşeni olup diğer bileşenler ile çevrelenir ve tümü ile doğrudan ilişkilidir. Sedir orta mekândan kopuk değil orta mekânın bir elemanıdır. Bu ilişkiyi orta mekânın kareye yakın biçimi ve onun yansıması üst örtü tavanın burada özelleşmesi güçlendirmektedir[11] (Yürekli H. ve Yürekli F. , 2005, s. 16-19). Pencere Duvarı, yaşama odasının bir bileşenidir ve orta mekânın bir veya iki kenarında yer alır. Bu bileşen de sedirle doğrudan ilişkili olup genellikle sedirin bulunduğu kenarlardır. Pencere duvarı aynı zamanda duvarın çıkmalı ve çıkmasız olması durumlarına göre de farklı şekillenir (Yürekli, 1977, s. 3). Yüklük duvarı ise yüklük, seki altı (sofanın devamı niteliğindeki oda girişi) ve bölücü açık raf sisteminden oluşmaktadır. Sofa ile odanın arakesitindedir ve hem odanın içidir hem de sofanın bitimidir. Aynı zamanda odanın giriş kapısını da içerir (Yürekli, 1977, s. 4). Giriş kapısı sofaya göre şekillenir ve kimi zaman pahlı bir şekilde köşede yer alır. Bir korkuluk veya direklikle seki altı sekilikten ayrılarak orta mekân vurgusu güçlendirilir. Ocak duvarı orta mekânın pencere ve yüklük

şeklinin hala devam etmesi Alanya içinde bulunan konutlardaki odaların kullanılış şeklinin gece ve gündüz şeklinde olduğu yönündeki görüşü desteklemektedir.

[10] Küçükerman (1988, s. 68-69; 1995, s. 95) a göre; "kullanma alanlarının insan boyutlarının dışına çıkmaması" temel ilkesine ve böylece görülebilen bir "üst sınır" yaklaşık olarak 2.20m. den geçirilen ahşap yatay bir raf sisteminin altı kullanılabilen faydalı alan, üstü "soyut üst çevre" oluşturur. Bektaş'a göre ölçüler insan vücudundan çıkar. Tahta bir parmak kalınlığında bir karış genişliğinde iki kulaç uzunluğundadır. Keser sapı bir ayak uzunluğundadır. Kışlık kat olarak tanımlanan ara katlarda yükseklik "elim değmesin yeter" ölçüsündedir. Pencere üç karış genişlikte beş karış yüksekliktedir. Bu karış, kulaç, parmak ölçüleri yapı ustası ya da yapı sahibinin bedensel ölçeğidir (Bektaş, 2001, s. 51).

[11] Ayrıca detaylı plan şeması için bknz. Yürekli H. ve Yürekli F., 2005, Şek. (6a).

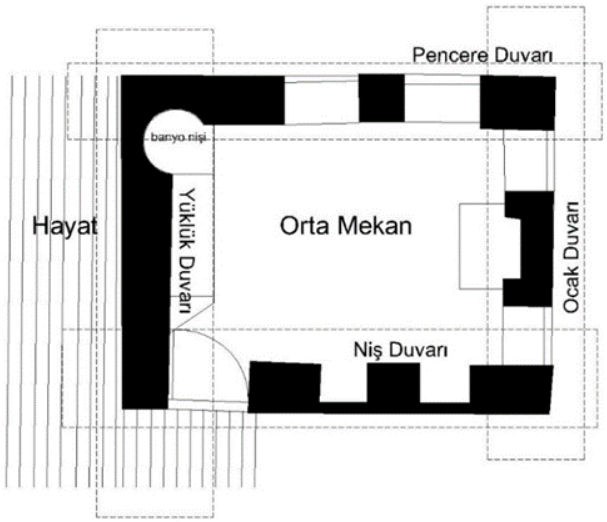
duvarlarına dik duvarlardan birinde yer alır. Ocak, yanında açık veya kapalı dolaplar bazen pencere bulunur. Tüm bu oda bileşenlerinin doğru bir dizilimle bir araya gelmesiyle geleneksel yapılarda ideal oda tipi oluşturulmuştur.

**4. Alanya "Konak" ları Yaşam 'Oda'larında Mekânsal Kurgu**

Bu çalışmada Alanya'da kale surları dışında bulunan 11 adet 'konak' olarak adlandırılan konuta ait 34 adet oda incelenmiştir (Görsel 2). Odanın bileşenleri olarak Yürekli (2005, s. 16)'nin İskilip konutları için de kullandığı kavramlar olan "Orta Mekân", "Pencere Duvarı", Yüklük Duvarı" ve "Ocak Duvarı" terimleri Alanya konaklarındaki odaların mekânsal kurgusu anlatılırken kullanılmıştır. Bu terimlerin yanı sıra incelenen örnekler doğrultusunda tanımlanan bu üç duvarın dışındaki dördüncü duvarı 'Niş Duvarı' olarak adlandırılarak bu çalışma kapsamında yeni bir tanımlama yapılmıştır (Görsel 3; Şekil 3).




**Görsel 2.** Alanya kale Surları Dışında İncelenen 11 adet konak yapısı




**Şekil 3.** 'Oda' da Mekânsal Kurgu

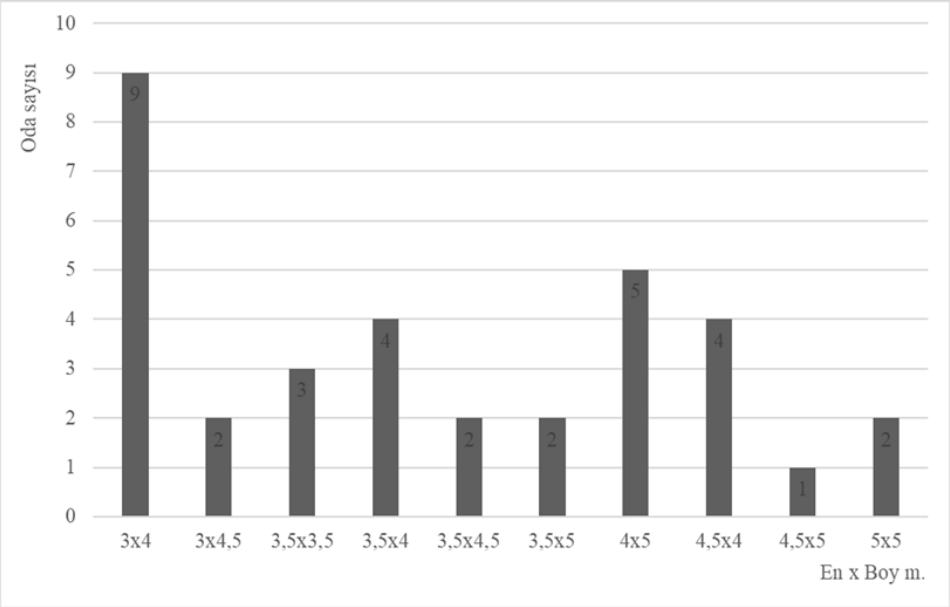



**Görsel 3.** Odada Mekânsal Öğe Örnekleri



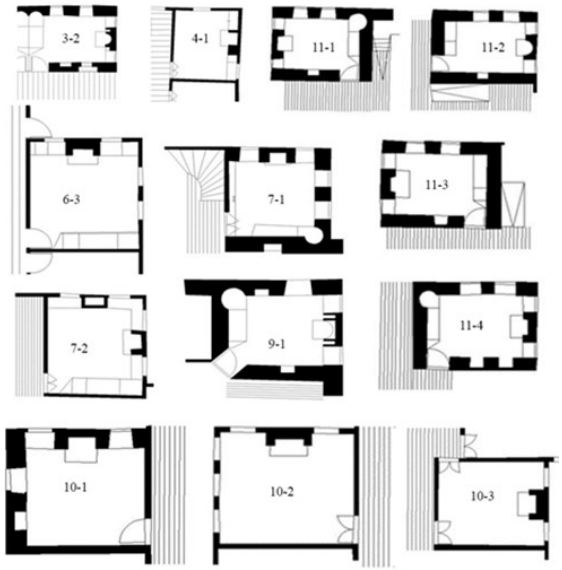
**Görsel 4.** Geleneksel Odada Orta Mekân-Pencere Duvarı-Ocak Duvarı-Yüklük Duvarı ve Niş Duvarı Öğeleri

*Orta Mekân:* Odaların biçimsel ve boyutsal karakteristiklerine bakıldığında en boy oranı 3m. ve 5 m. arasında değişiklik göstermektedir. İncelenen odaların en ve boy genişlikleri ile ilgili Grafik 1'de veriler bulunmaktadır. Bu verilere göre incelenen odalar yaklaşık kare ya da dörtgen şeklindedir. Kare olmayan odalarda ocak, dolap, sedir gibi mekânsal öğelerle kareye yakın bir orta mekân oluşturularak ideal oda formuna ulaşılmaya çalışılmıştır.

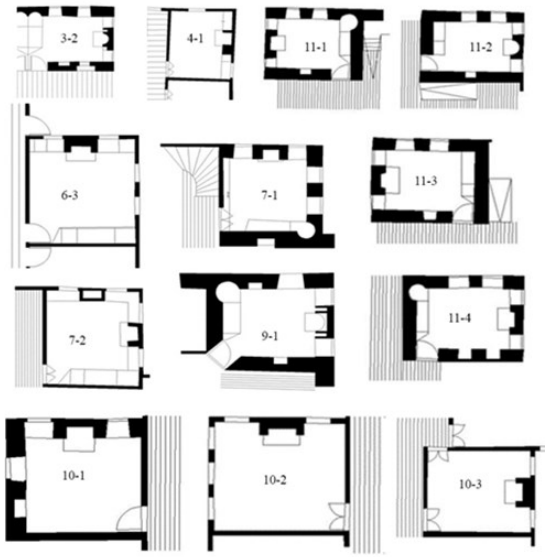



**Grafik 1.** Oda En ve Boyları (m.)

Odaların kat yükseklikleri iki katlı yapıların zemin katında en düşük 2.00 m. en yüksek 4.00 m., üst katında en düşük 3.96 m. en yüksek 4.31 m. dir. Üç katlı yapıların zemin katında en düşük 2.00 m. en yüksek 3.70 m., birinci katında en düşük 3.14 m. en yüksek 4.20 m., esas kat olarak adlandırılan üst katta en düşük 3.72 m. en yüksek 5.58 m. olarak belirlenmiştir. Orta mekânın bir elemanı olan sedir tüm evlerde ve odalarda bulunmamaktadır. Dört evde ahşap sedir elemanı bulunmakta ve bir evin odasında (Şekil 4. 6-3) bulunan ahşap sedir elemanında aynı zamanda depolama işlevi de sağlanmaktadır (Şekil 4).




**Şekil 4.** Ahşap Sedirli Odalar

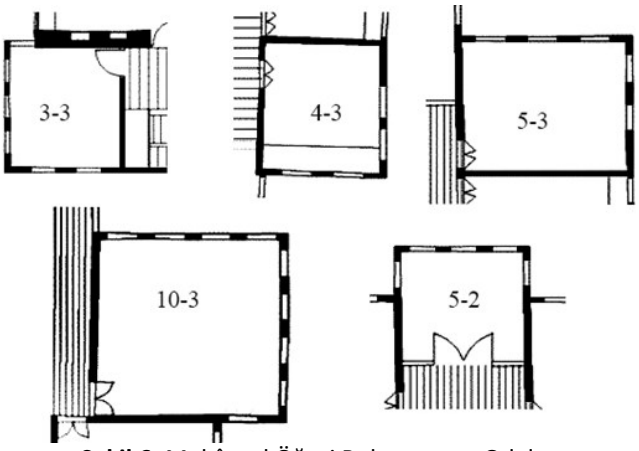



**Şekil 5.** Ortada Ocak Sağında ve Solunda pencere bulunan Odalar

Diğer konutlarda ise oturma ya yerde ya da hareketli ahşap sedirlerle sağlanmaktadır. Fakat sabit olan sedirler ahşap döşemeden, döşemenin belli bir seviyeye yükseltilmesiyle döşemenin bir parçası olarak oluştuğu için orta mekândan ayrı düşünülemez. Orta mekânda ölçek açısından görsel algıyı etkileyen önemli bir unsur da 'tabaklık', 'serender' veya

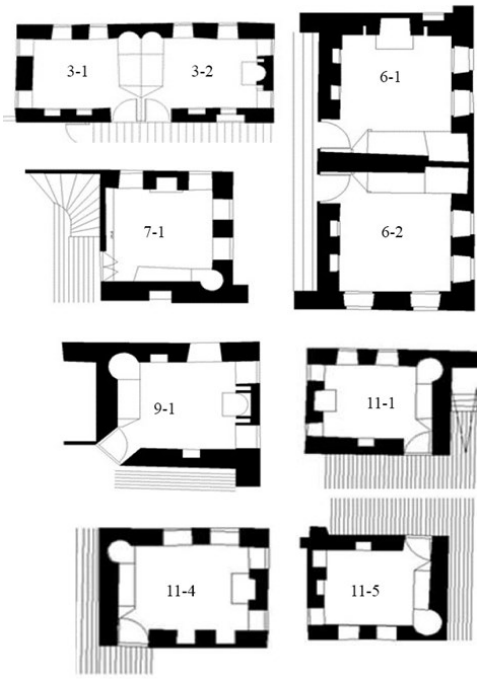
'musandra' adı verilen ocak, pencere, kapı üstü yüksekliğinden odanın duvarlarını çevreleyen raflardır. Bu raf sistemi kapı ve pencere üst sınırını belirleyen yatay ahşap öğedir. Bu yatay öğe pencere pervazı, kapı kasası, ocak üstü gibi odanın mimari öğeleri ile düşey yönde bağlantı kurarak mekânı tanımlar.

*Pencere Duvarı:* Orta mekânı çevreleyen bileşenlerden biri olan pencere duvarı, sedir olan odalarda sedirin bulunduğu kenarda bulunur. İncelenen örneklerde pencere duvarı bir duvar olabildiği gibi sıklıkla L biçiminde de görülmektedir ve genellikle bir duvarda 2 diğer duvarda 2 olmak üzere dört pencere bulunmaktadır. 13 odada ocak duvarında ocağın sağında ve solunda birer pencere bulunmaktadır (Şekil 5). Bu kurguya Alanya konaklarında sıklıkla karşılaşılmaktadır. Pencere duvarları tepe penceresi içermemektedir. Pencere genişlikleri 0.80-0.90 m. yükseklikleri ise 1.50 m. ve 2.40 m. arasında değişmektedir. Taş duvarlı ve ara katta bulunan pencerelerin yüksekliği üst kat odalardan daha azdır. İki pencere arası en az 0.30 m. en fazla ise 0.90 m. dir. Bazı odalarda pencere duvarı dışında yüklük, ocak, sedir gibi hiçbir mekânsal öğe bulunmamaktadır. İncelenen örneklerde 5 oda bu şekildedir (Şekil 6).



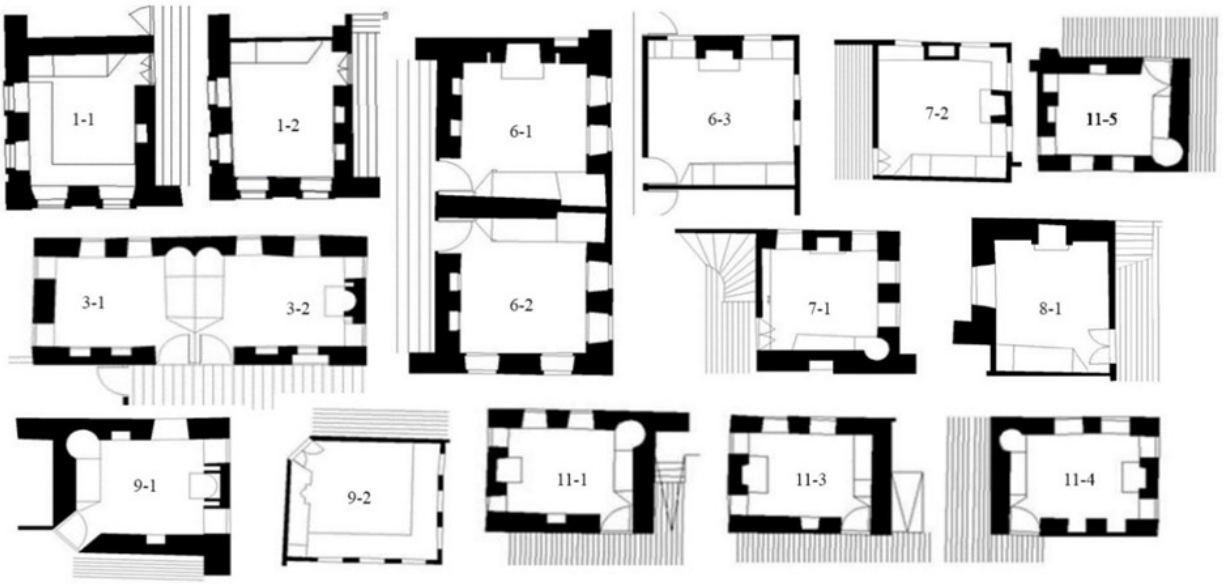

**Şekil 6.** Mekânsal Öğesi Bulunmayan Odalar

*Yüklük Duvarı:* Bileşenleri oda girişi, yüklük ve bölücü açık raf sistemidir. Pencere duvarına paralel olabildiği gibi ocak duvarına paralel örnekler de bulunmaktadır. Yüklük genişliği 0.5 m. ve 0.9 m. arasında değişmektedir. Yüklük içerisinde yunmalık veya abdestlik olarak taş duvar yuvarlak veya dörtgen şekilde daraltılarak ve zemini taş döşenerek ıslak hacim bırakılmışsa o kısımda yüklüğün genişliği 1.00 m. ile 1.35 m. arasında değişmektedir. İncelenen örneklerde 9 adet odada yüklük bu şekilde düzenlenmiştir. İki odada içerisinde ıslak hacim barındıran yüklükler sırt sırta düzenlenmiştir (Şekil 7).

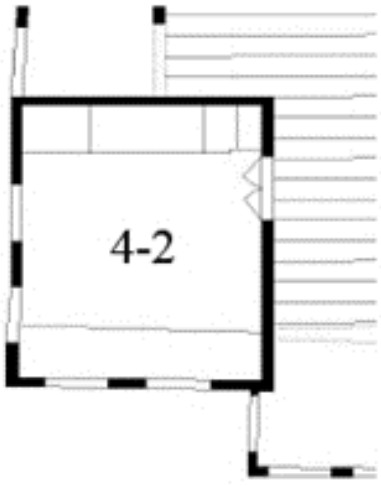



**Şekil 7.** Yüklük İçerisinde Yunmalık Bulunan Odalar

Yüklüğün kapı tarafındaki kısmında pahlı bir köşe yapılarak açık raf sistemi ile giriş kısmı kontrol altına alınmıştır. Bu tipe uyan 15 adet oda bulunması Alanya konaklarında kapı girişinde dolabın köşesinin pahlanarak girişin kontrollü biçimde sağlanması yaygın olarak kullanıldığını göstermektedir ve bu geleneksel konutlarda da yaygın olarak görülmektedir (Şekil 8). Yalnızca 4 Nolu evin 2 numaralı odasında giriş kapısı yanındaki yüklüğün genişliği kapı genişliği kadar olan kısmı kadar pahlanmak yerine daraltılmıştır (Şekil 9).



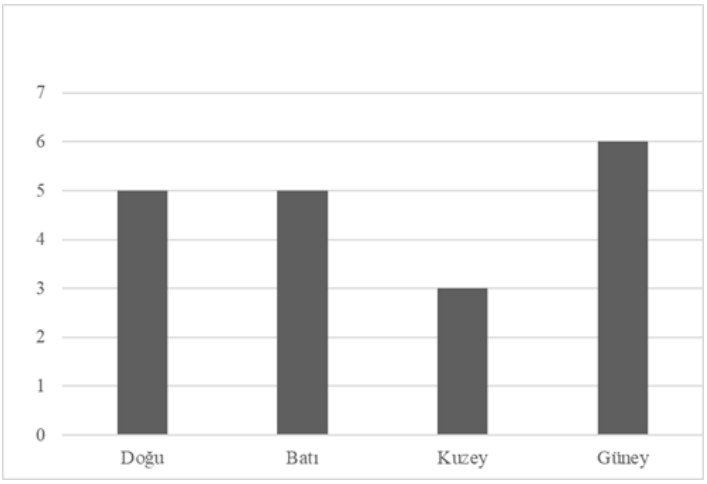

**Şekil 8.** Köşesi Pahlanmış Yüklük Bulunan Odalar




**Şekil 9.** Kenarı Daraltılmış Yüklük Bulunan Oda

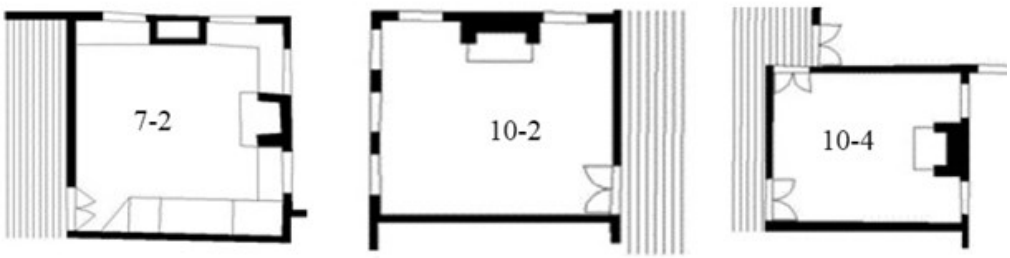
Yüklük duvarı incelenen örneklerde 5 odada doğuda, 5 odada batıda, 3 odada kuzeyde ve 6 odada ise güney tarafta konumlanmıştır (Grafik 2). Yüklüklerde geleneksel odaların insan ölçeği ile uyumu dikkat çekicidir. Yüklükler insan elinin ulaşabileceği yaklaşık olarak 2.10-2.20 m. yükseklikte kurgulanmış, bazı yüklüklerde ise bu ölçeğin üstünde kalan kısım korkulukla kapatılarak daha az kullanılan malzemelerin depolanması, Alanya özelinde ise pişirilen yufka ekmeklerin kırılmadan saklanabilmesi için kullanılmıştır. Bu nedenle *musandıra* olarak isimlendirilen bu kısma *ekmeklik*[12] adı da verilmektedir. Ayrıca yüklüklerde geleneksel konutlarda da sıkça görülen *tembel deliği, lambalık, kavukluk, fincanlık* gibi isimler verilen açık raf sistemleri de bulunmaktadır.

[12] Ekmeklik bazı konutlarda sofada merdiven yanında da bulunmaktadır.



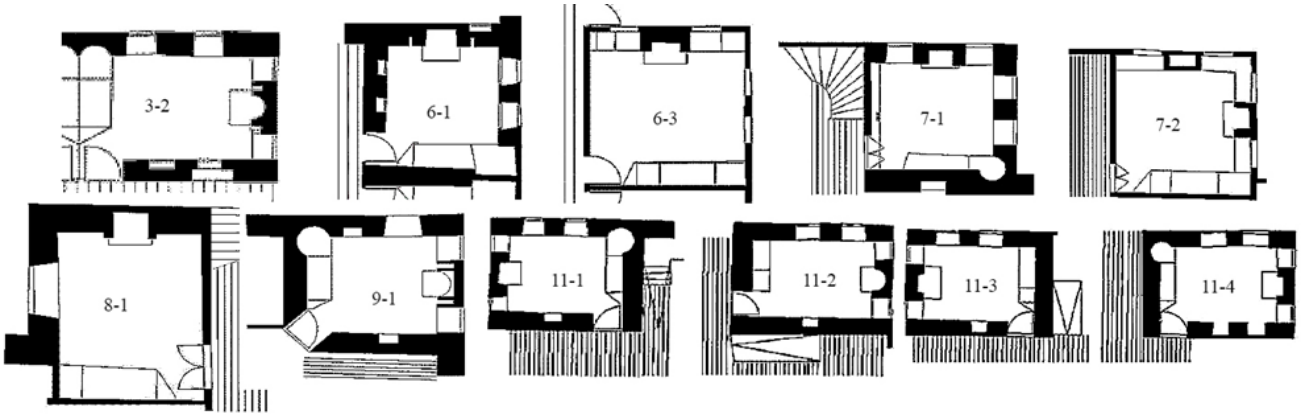

**Grafik 2.** Yüklük duvarının odalar içerisindeki yönelimi

*Ocak Duvarı:* Ocak duvarı Alanya konaklarında duvarın ortasında ocak ve sağında solunda olmak üzere pencere veya dolap nişinden oluşmaktadır (Tablo 3). Her odada ocak bulunmamaktadır. İncelenen örneklerde ocak bulunan odalarda ocaklar genellikle batı ve kuzey duvarda konumlanmışlardır (Tablo 4). Yaklaşık 0,70m. ve 0.80m. genişliğinde inşa edilmiştir. Ocak bulunan duvarlar genellikle kalınlığı 0,70 m. ve 0,90 m. arasında değişen taş duvarlardan oluşmaktadır. Yalnızca 3 odada tuğla duvarlarda ocak kurgulanmıştır ve duvar kalınlığı daha incedir (Şekil 10).



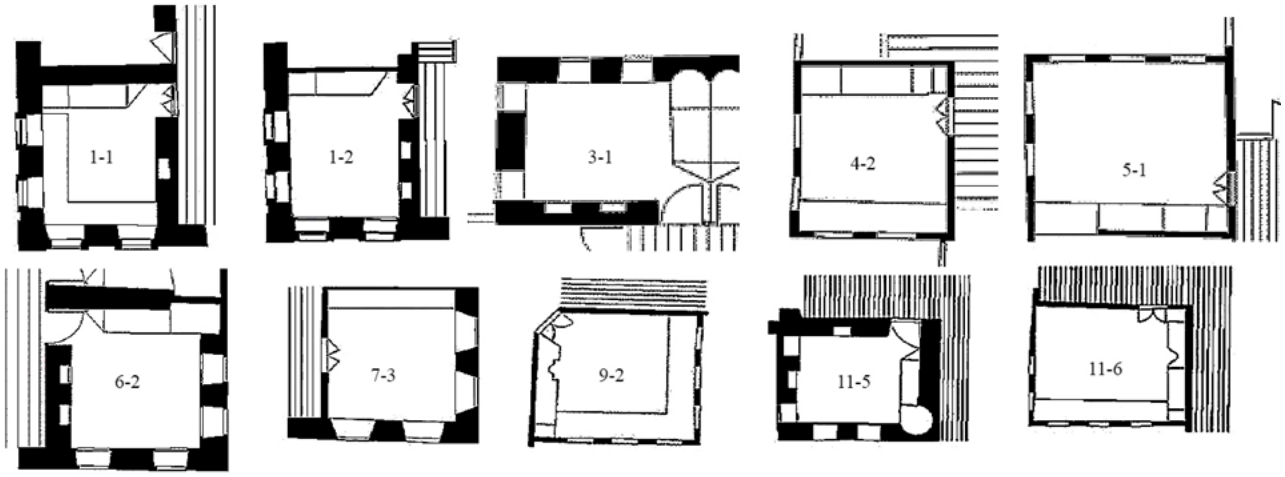

**Şekil 10.** Ocağın Bulunduğu Duvar Tuğla Duvar Olan Odalar

Odanın mekânsal kurgusunu etkileyen ocak duvarı ve yüklük duvarının birlikte olduğu oda sayısı incelenen örneklerde 11 adettir. Orta mekânın ocak ve yüklük duvarlarının karşılıklı geldiği 10 örnek bulunmakta iken, yüklük duvarına dik olan ocak duvarı yalnız 7-2 nolu odada bulunmaktadır (Şekil 11).

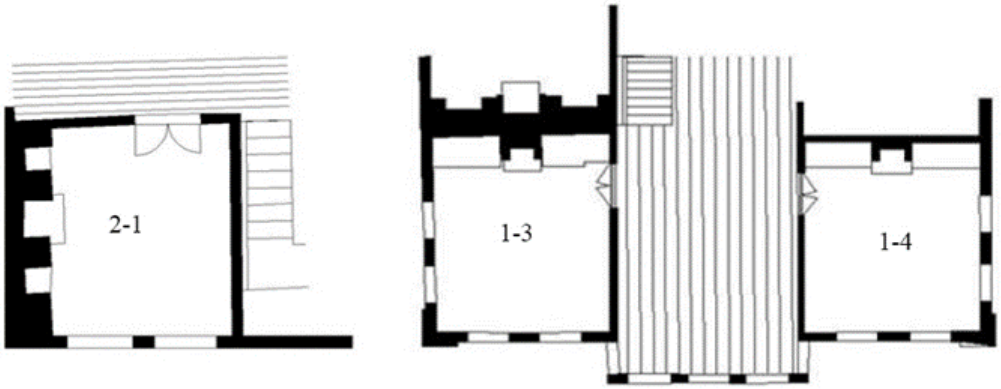



**Şekil 11.** Ocak Duvarı ve Yüklük Duvarının Birlikte Olduğu Odalar

Sadece yüklük bulunan oda sayısı 10 adettir (Şekil 10). Dört odada yüklük ve sedir elemanı aynı mekandadır (Şekil 12. 1-1, 4-2, 9-2, 11-6). 3 odada ocak duvarının iki yanında dolap nişi bulunmaktadır (Şekil 13). 13 odada ocak duvarında ocağın iki yanında pencere bulunmaktadır (Şekil 5).

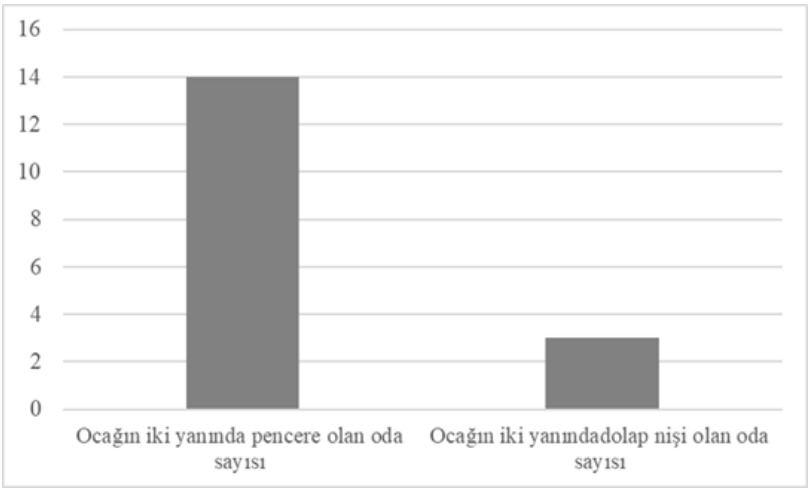



**Şekil 12.** Yalnız Yüklük Bulunan Odalar



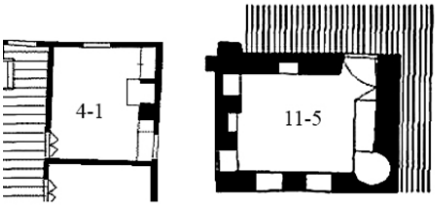

**Şekil 13.** Ortada Ocak Sağında ve Solunda Dolap Nişi Bulunan Odalar

Ocak iki yanında dolap veya pencere bulunan her iki durumda da ocak cephesi simetriktir ve simetri ekseni ocağın ortasından geçmektedir. Odalarda ocaklar farklı şekillerde görülmektedir. İlki ocak üzerinde yaşmak adı verilen ahşap davlumbaz bulunur. Odalarda bu ahşap davlumbaz iki farklı yükseklikte görülmektedir ve orta mekân kurgusu içerisinde yer alan tabaklık olarak adlandırılan yatay raf sistemi ile birlikte kurgulanmaktadır. Ocağın külahının başladığı yükseklik bu yatay öğe ile birleşir ve böylece odanın bir öğesi haline gelmesi güçlenerek bu yatay öğe düşey bir elemanla birleşir. Diğer ocak tipi ise yaşmaksız, tuğladan yapılmış kemerli ocaktır. Bu tipte tabaklık elemanı ile bir ilişki bulunmamaktadır. Ocak duvarı konutun dış duvarı olduğu konutlar olduğu gibi iç duvarlarda da yer almakta olup bu bir zorunluluk değildir.

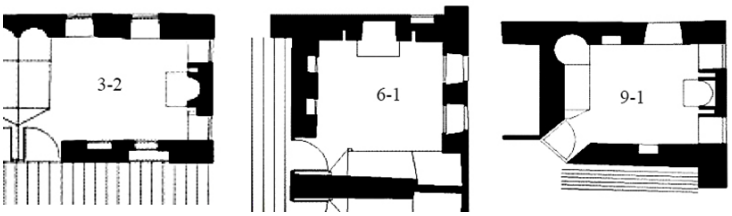



**Grafik 3.** Ocak duvarı ile pencere ve dolap ilişkisi

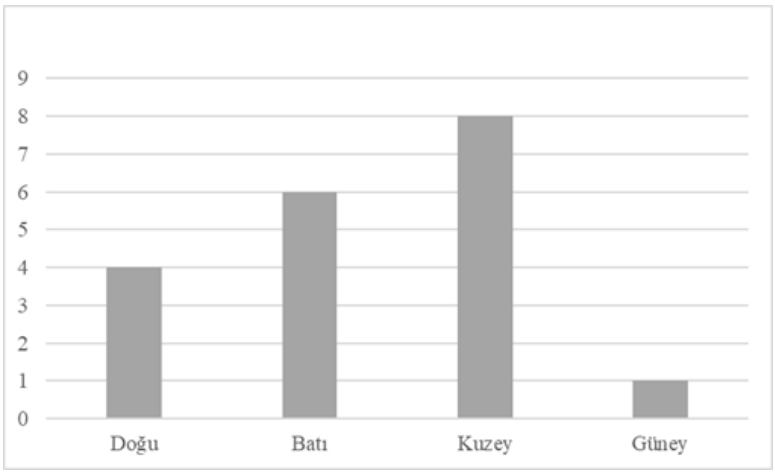
2 odada ocağın bir tarafında pencere diğer tarafında dolap nişi bulunmaktadır (Şekil 14). 3 odada ocakların üzerine küçük nişler bırakılmıştır. Bunlar *"çıralık"* veya *"kibritlik"* olarak adlandırılmaktadır (Şekil 15).




**Şekil 14.** Ocağın Bir Tarafında Pencere Diğer Tarafında Dolap Nişi Bulunan Odalar

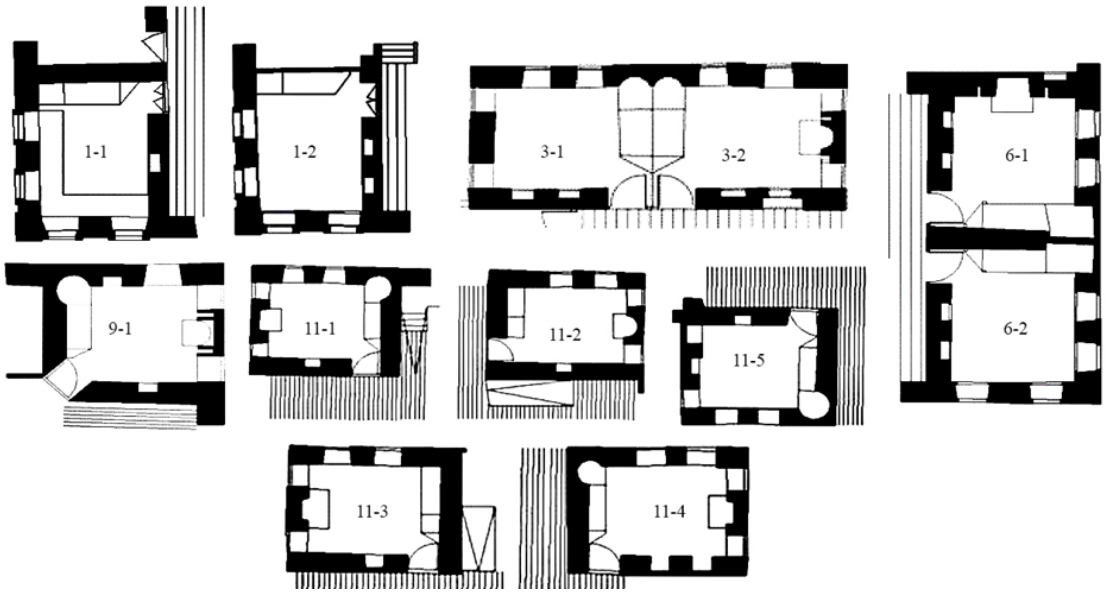



**Şekil 15.** Ocağın Üzerinde Kibritlik Bulunan Odalar




**Grafik 4.** Ocak duvarının odalar içerisindeki yönelimi

*Niş Duvarı:* Oda giriş kapısının olduğu duvarı tanımlayan ve yerden yaklaşık 0,50 m.-0,90 m. yükseklikte olup, tanımlamalarda 'tek dolap' olarak adlandırılan yaklaşık 0,80 m. x1.40m. ölçülerinde tek veya çift kapaklı ya da açık raf sistemi şeklinde dolaplardır. İncelenen örneklerde genellikle duvarda 2 adet olduğu tespit edilmiş olsa da 6 örnekte tek niş dolabı olduğu görülmüştür (Şekil 14). Genellikle pencere seviyesinde olup odanın yatay ahşap bileşeni için düşey birleştirici olabilecek yükseklikte sonlanmaktadır. İçi ahşap kaplı olabildiği gibi sadece sıvalı niş şeklinde örnekleri de bulunmaktadır. Kapı duvarında olduğu için hayat kısmının duvarını da oluşturduğundan hayat kısmına açılan nişlerde bu duvarda görülmektedir. İncelenen örneklerde 12 odada bu şekilde niş dolabı bulunmaktadır (Şekil 16). İncelenen örneklerle sayı olarak kıyaslandığında Alanya konakları sıklıkla görülmektedir.




**Şekil 16.** Niş Duvarı Bulunan Odalar

**4.Tartışma ve Sonuç**

Göçebe kültürdeki çadırlar gibi her "oda" temel ihtiyaçlar olan yeme, içme, pişirme, yatma eylemlerinin gerçekleştirildiği konutun en küçük temel birimidir. Odaların biçimlenmesi ise onu oluşturacak olan mekânsal öğelerin belli bir dizilimle bir araya gelmesiyle gerçekleşir. Her ne kadar farklı coğrafyalarda farklı yapı malzemeleri, kültürler bu biçimlenişi etkilese de bileşenler değişmez. Pencerelerin sayısı, yüksekliği değişse de pencere duvarı kavramı değişmez, yüklük özelliği değişse de yüklük duvarı kavramı değişmez, Ocak şekli ve yeri değişse de ocak duvarı kavramı değişmez, nişlerin şekli ve sayısı değişse de niş duvarı kavramı değişmez olgulardır. Orta mekân kavramını bu bileşenler ve bir araya gelişleri oluşturur ve geleneksel konutlarda orta mekân kavramı fazla değişiklik göstermez. Bir boşluğu tanımladığı gibi onu çevreleyen bu duvar bileşenleri ile yakından ilişkilidir. Alanya Konaklarında belirli kalıplara uyan ideal oda oluşturulmak istendiği için, Orta Mekân, Ocak duvarı, Yüklük ve Niş duvarı biçimlenişleri odalar arasında ve konutlar arasında benzerlikler göstermektedir. Kale içerisinde gayrı muntazam şekilde inşa edilmiş olarak tariflenen (Gönüllü, 2008, s. 37) konutların tam tersine daha özenli mekanlar ve konutlar inşa edilmiştir. Orta Mekân kurgusunda kare formunun yakalanmaya çalışılması, bunun alt örtü döşemede ve üst örtü tavan biçimlenişinde kendini göstermesi geleneksel yapılarla ortak özelliktir. Pencere duvarları biçimlenişi bazı odalarda farklılık gösterse de genellikle L biçimli duvarda her duvarda iki adet olacak şekilde düzenlenmiştir. Çağnişir, mabeyn, baş oda gibi özellikli odalarda bu sayı daha fazladır. Genel olarak tepe pencereleri konaklarda yoktur. Bu da kat yüksekliklerinin az oluşundan ve dönemsel olarak bir tipoloji olmasından kaynaklıdır[13]. Ocak duvarı genellikle batı ve kuzey yönde bulunmaktadır. Ocak sağında ve solunda birer pencere açıklığının bulunuşu birçok oda örneğinde ortaktır ve istisna örnekler dışında ocak duvarı ile yüklük duvarı karşılıklıdır. Ocak duvarı yapının dış duvarında olduğu gibi iç duvarında konumlanan oda örnekleri de bulunmaktadır. Birçok örnekte yüklük içerisinde abdestlik veya banyo nişi bulunmaktadır. Bu da geleneksel konutlarda sıklıkla görülen bir kurgudur. Yüklük köşesi odanın giriş kapısı için ve girişin kontrol altına alınabilmesi için kırılarak pahlı yapılmıştır. Yüklük duvarının oda içerisindeki konumu ve niş duvarının oda içerisindeki konumunu kapı girişi ve dolayısıyla da odanın hayat içerisindeki konumu belirlemektedir. Odadaki tüm mekânsal dizilimi etkileyen önemli bir öğe olan Küçükerman'ın (1973, s. 44) 'yatay ahşap öğe' olarak tanımladığı kapı, pencere ve dolapların üst sınırı olan Alanya konaklarında ocak yaşmağı ile de ilişkili olan 'tabaklık' 'serender' olarak adlandırılan öğedir. Tüm mekânsal elemanların üst sınırı 'insan ölçeği' paralelinde düzenlenmesine neden olur ve bu yatay düzenleyici düşeyle bu öğeler aracılığı ile ilişki kurar. Bu yatay sınırın alt kısmı odada günlük işler için kullanılır (Küçükerman, 1988, s. 71). Yani bir nevi faydalı kullanım alanı olarak tanımlanmıştır. Bu yatay sınırın üstü ise soyutlanmış üst çevredir ve daha az kullanılan öğeler için ayrılmıştır. Üst örtü yani tavan bu soyutlanmış üst çevreye dahildir fakat alt örtü yani döşeme ve bağlantılı olarak orta mekân tavanın biçimini oluşturmaktadır. Yaratılmak istenen kareye yakın form tavan için de geçerlidir. Oda diziliminde genel kurgu benzer olsa da birtakım farklılaşmalar görülmektedir. Bu farklılaşmaların kaynağı oda bileşenlerini oluşturan ocak, yüklük, sedir, nişlerin birbirilerine göre konumlarının değişmesidir. Tüm bunlar konutun genel plan şemasına, arsa durumuna, topoğrafyaya, kat sayısına, sahibinin ekonomik durumuna, odanın kat planındaki konumuna ve hayat ile olan ilişkisine bağlıdır. Birtakım farklılıklara rağmen incelenen örneklerde geleneksel konutlar için tanımlanan ideal oda tipine ulaşılmaya çalışıldığı ve ulaşılabildiği söylenebilir.

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Yazarlar çıkar çatışması beyan etmemiştir.

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[13] Bu çalışmanın ilk aşamasında 11 konak ve 34 oda incelenerek belirli sonuçlara varılmıştır. Çalışmanın devamında incelecek olan konaklarla birlikte belirli bir tipoloji çıkarılması mümkün olacaktır.

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# Change in the Urban Fabric of Historic Cities (Case Study of the Residential Environment of the Old City of Mosul)

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**Abstract**
This paper focuses on clarifying the change and state of the urban fabric in the residential environment of the old city of Mosul. This city, with a distinctive architectural character, was destroyed and lost most of its features due to the recent war, in addition to the influence of other factors. From this point, the need arose to shed light on the state of the urban fabric, especially the residential environment in the study site. The research aims to study the dimensions of the change in the urban fabric of the city. The research assumed that there were factors that affected the pattern of traditional housing schemes in the city. The research adopted an analysis system for the city's data, in addition to the survey data that was conducted there, and the comparison between the old city and the modern part of the city of Mosul.
**Keywords:** Residential Environment, The Old City of Mosul, Traditional Housing, Urban Fabric.

# التغيير في النسيج الحضري للمدن التاريخية
# (دراسة حالة البيئة السكنية للمدينة القديمة في الموصل)

**الملخص**
يركز هذا البحث على توضيح تغيير وحالة النسيج الحضري في البيئة السكنية للمدينة القديمة في الموصل. هذه المدينة ذات الطابع المعماري المميز، دمرت وخسرت اغلب معالمها بسبب الحرب الاخيرة بالاضافة الى تاثيرعوامل اخرى .انطلاقا من هذه النقطة ظهرت الحاجة الى تسليط الضوء على حالة النسيج الحضري وبالاخص البيئة السكنية في موقع الدراسة . يهدف البحث الى دراسة ابعاد التغيير الحاصل في النسيج الحضري للمدينة حيث افترض البحث وجود عوامل اثرت على نمط مخططات المساكن التقليدية في المدينة .اتخذ البحث نظام تحليلا للبيانات الخاصة بالمدينة اضافة الى بيانات الاستبيان الذي تم اجراؤه فيها والمقارنة بين المدينة القديمة والجزء الحديث من مدينة الموصل.
**الكلمات الدالة:** : البيئة السكنية، المدينة القديمة في الموصل، المساكن التقليدية، النسيج الحضري.

## 1. المقدمة
تعتبر المدن التاريخية المثال الاول في الدراسات التي تسبق اي مشروع, كونها تلائم البيئة المحيطة بها بأبسط الاساليب والمواد المحلية. وكون البيئة السكنية هي النقطة الاهم في تصميم اي مدينة فقد تعددت الدراسات حول هذا الموضوع لمعرفة الطرق الامثل للمحافظة على هويتها وحماية نسيجها من التغييرات التي تؤثر سلبا عليها.
منذ بداية الاستيطان في المنطقة اتخذت العمارة نمطا يراعي بيئتها وظروفها المناخية بالدرجة الاولى اضافة الى طبيعة المجتمع حيث ان مجتمع الموصل عرف على انه مجتمع محافظ, وهي النقاط التي راعاها نمط المسكن التقليدي في المدينة. بمرور الزمن اصبحت الاراضي تقسم باشكال هندسية متساوية نتيجة تاثر بعوامل منها الاقتصاد ومحاولة استغلال الاراضي. فاتجه البناء لاستبعاد الفناء وجعل المسكن عبارة عن كتلة واحدة تتخلها فراغات عمودية( المناور) لتوفير الاضاءة والتهوية اللازمتين.
بعد احداث داعش فقدت المدينة العديد من معالمها مثل منارة الحدباء اضافة الى الضرر الكبير في نسيجها الحضري وعلى عدة مستويات, المستوى الاجتماعي يتلخص بأن سكان المنطقة اغلبهم من اصحاب الدخل الضعيف, والمستوى الاقتصادي بضعف فرص العمل بعد ان كانت حيوية, واما ثقافيا فقد تزايدت نسبة الامية للسكان.

## 2. فرضية وهدف البحث
يفترض البحث وجود عوامل اثرت على نسيج المدينة بشكل عام وبالاخص منطقة المدينة القديمة في الموصل, هذه العوامل اثرت على الجوانب الاجتماعية والاقتصادية للمنطقة مسببة خللا في التنظيم العام لها. ومن هذه النقطة تم تثبيت هدف البحث وهو معرفة ابعاد التغيير الحاصل في النسيج الحضري للمدينة القديمة في الموصل والاسباب التي ادت الى وصولها لوضعها الحالي.

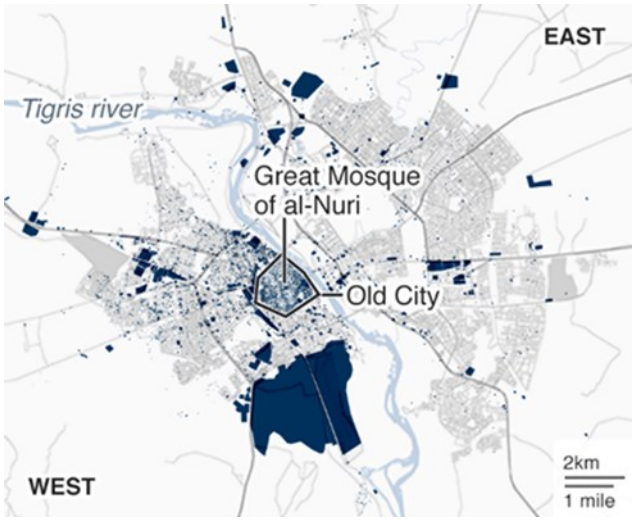
## 3. المنهجية
يعتمد البحث جمع المعلومات وتحليلها, بدا من المعلومات العامة للمدينة وصولا للمعلومات المذكورة في الابحاث السابقة(Aziz Amen, 2018 & 2020). يضاف اليها المعلومات التي تم جمعها من ورقة الاستبيان وباعتماد مبدا المقارنة حيث قام الباحث بتوزيع ورقتي استبيان, الاولى في الجانب الغربي للمدينة في المدينة القديمة في الموصل, والثانية في الجانب الشرقي من المدينة وتحديدا في منطقة الحدباء.

## 4. مدينة الموصل
هي مركز محافظة نينوى, تقع في الجزء الشمالي من العراق على طرفي نهر دجلة ( شكل1 ) وتبعُد مسافة ٤٣٠ كم إلى الشمال الغربي من مدينة بغداد عاصمة العراق. يعود تاريخ الاستيطان في هذه المنطقة الى ماقبل العصر الحجري (6000 ق.م.). تاريخ بناء المدينة غير معروف بالضبط الا ان اول ذكر لمدينة نينوى هو قبل الميلاد. اشتهرت في وقت الحضارة البابلية

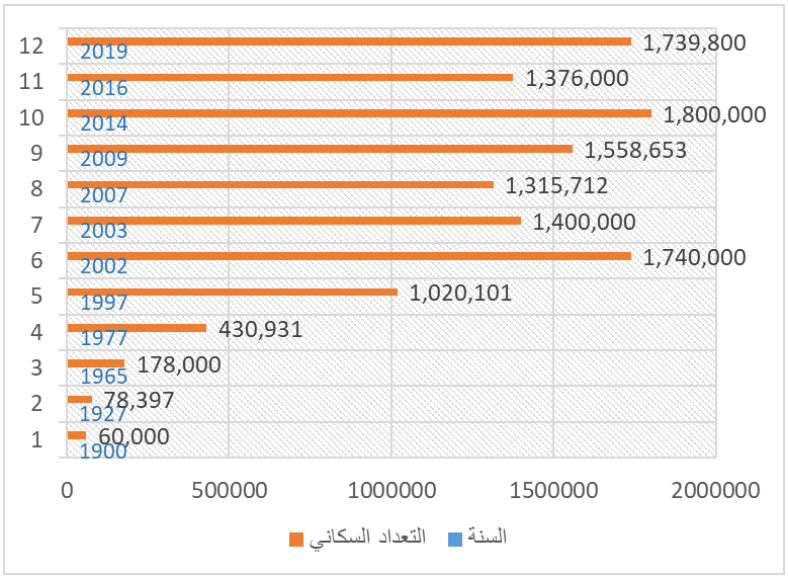
والاشـــورية. تشـــير الدراســـات ان مدينـــة الموصـــل هي مدينـــة اشـــورية حيـــث انهـــم اتخـــذوا المنطقـــة الواقعـــة عـــلى الضـــفة الشـــرقية مـــن نهـــر دجلـــة في عهـــد العاهـــل الاشـــوري تجـــلا تبلـــيزر (١٠٨٠ ق.م.) [السـلمان, 1985]. لقـد مـرت المدينـة بمراحـل عديـدة مـن التطـور منـذ يوم تأسيسها ولكنها كانت مركزا ثقافيا واجتماعيا على مر العصور.

يتمـيز منـاخ المدينـة بانـه بـه جـاف ,الريـاح السـائدة في المنطقـة هي الريـاح الشـمالية الغربيـة. تعـد محافظـة نينـوى ثـاني مدينـة في العـراق مـن حيـث التعـداد السـكاني بعـد العاصـمة بغـداد, بتعـداد سـكاني يقـدر بحـوالي ثلاثـة ونصـف مليـون نسـمة حيـث تشـكل الموصـل 57% مـن سـكان محافظـة نينـوى وحـوالي 10 % مـن سـكان العـراق (جـدول 1). عاشـت المدينـة حـالات مـن الهجـرة بسـبب الظـروف الامنيـة مثـل حـرب 2003 و 2014. مسـتوى المعيشـة في المدينـة متوسـط فمعظـم السـكان مـن الطبقـة المتوسـطة, دخـل العائلات في الجانب الايمن وهو الجانب الذي يضم المدينة القديمة يعتبر اقل من متوسط الدخل العام للمدينة.

عـلى الـرغم مـن بسـاطة المـواد المسـتخدمة في البنـاء تمـيز التصـميم المعمـاري في الموصـل عـن غـيره في المـدن العراقيـة في الـنمط العمـراني المميـز. بـني البيـت الموصـلي عـلى عـدة عوامـل منهـا مناخيـة واجتماعيـة، اثـرت هـذه العوامـل بشـكل مبـاشر عـلى شـكل المخطـط والواجهـات, شـاع اسـتخدام عنـاصر معماريـة مهمـة يـأتي في مقـدمتها الفنـاء فهـو عنصر وظـيفي أسـاسي للفعاليـات اليوميـة وللحركـة، إضـافة إلى وظيفتـه البيئيـة في تـوفير الاضـاءة والتهويـة الطبيعيـة [الـديوجي واخـرون, 2010], اضـافة الى عنـاصر اخـرى مثل الايوان والزخرفة.



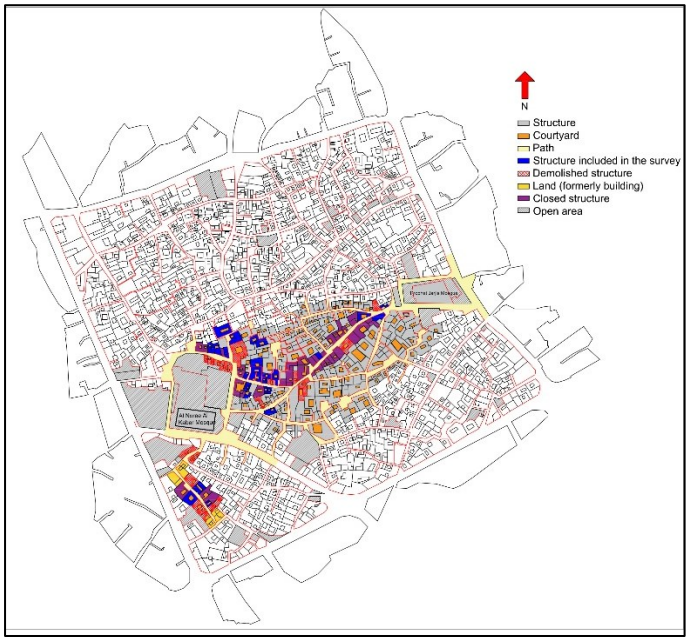

**شكل 1 :** مدينة الموصل وموقع المدينة القديمة (WEB-1,2017)




**جدول 1:** جدول التعداد السكاني لمدينة الموصل ( الباحث)

**5. منطقة الدراسة**

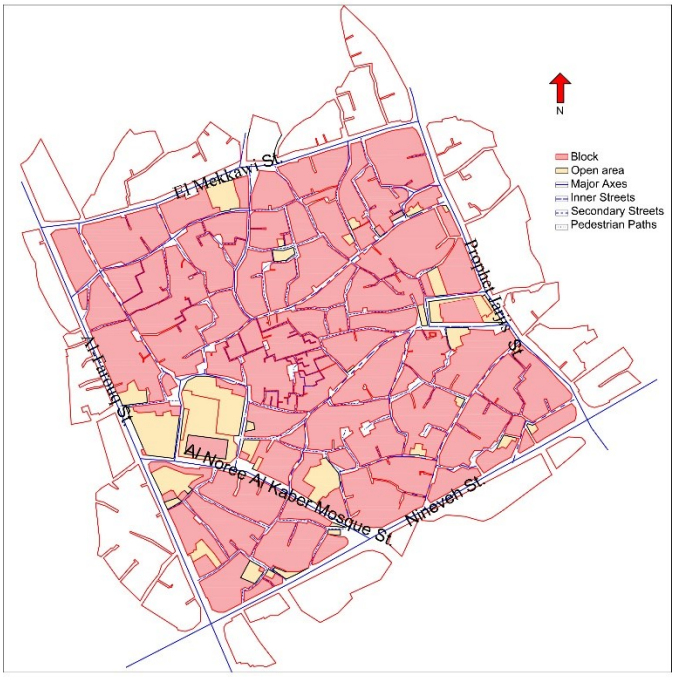
تعتمـد الدراسـة العمليـة في الاسـاس عـلى مبـدا المقارنـة بـين جـزئي المدينـة, المدينـة القديمـة (شـكل2 ) ونسـيجها العضـوي المتكتـل بينمـا يغلـب النظـام الشـبكي عـلى معظـم اجـزاء المدينـة الاخـرى. لـذلك تـم توزيـع 30 ورقـة اسـتبيان في كـل مـن المنطقتـين ولتحديـد نقاط التشابة والاختلاف فيهما من خلال النقاط التالية:




**شكل 2:** الاستبيان الخاص بالمدينة القديمة في الموصل ( الباحث)

**5.1 .الوصولية**

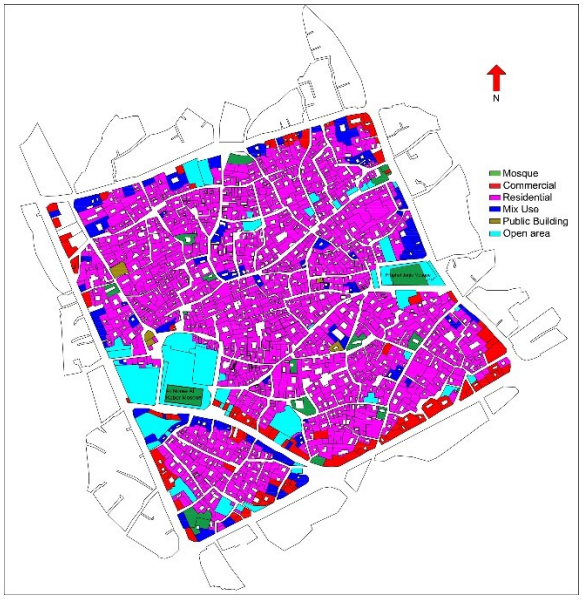
تم اختيار الزقاق بين جامع النوري الكبير وجامع النبي جرجيس في المدينة القديمة للاستبيان الاول. الموقع محاط بشارعين رئيسيين هما شارع نينوى من الجنوب وشارع الفاروق من الغرب، يحده من الشرق شارع النبي جرجيس ومن الشمال شارع المكاوي. تخلل هذه المنطقة عددا من الازقة والشوارع الضيقة والتي تصل الى عرض المتر او اقل (شكل 3). اما في المنطقة الثانية فالشوارع متعامدة بنظام شبكي وقطع الاراضي ذات اشكال منتظمة.




**شكل 3 :** مخطط الوصولية ( الباحث)

**5.2.استخدامات الارض**

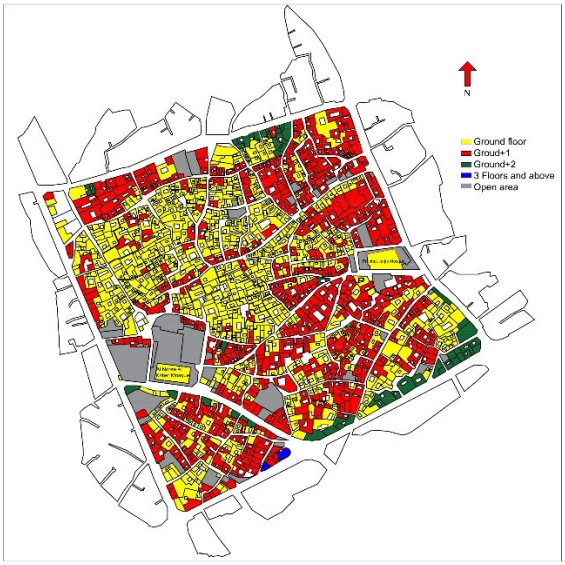
تتنوع استخدامات الأرض في الموقع بين المباني السكنية والتجارية والدينية والعامة ، لكن الاستخدام السكني يغطي الجزء الأكبر منها (شكل 4). وبحسب البيانات التي تم الحصول عليها من مشروع التجديد العمراني للمدينة القديمة في الموصل 2008 ، فإن الاستخدامات تتوزع على النحو التالي: 83٪ سكني ، 10٪ تجاري ، 3٪ استخدام مختلط ، و 2٪ مباني عامة (مشروع التجديد الحضري لمركز مدينة الموصل القديمة، 2008).




**شكل 4:** مخطط استخدامات الارض ( الباحث)

**5.3.الارتفاعات**

ارتفاع المبنى او عدد الطوابق فقد عرف البناء في المدينة القديمة بكونه ذو طابق واحد ارضي او مكون طابقين ارضي واول، واعتمد هذا الارتفاع على جميع انواع المباني. حسب الدراسة التي اجريت سنة 2008 فالبيانات كانت كالاتي: 50.9 % طابق واحد، 46.6 % طابقين، 1.9 % ثلاث طوابق و0.5 % اربع طوابق واكثر (مشروع التجديد الحضري لمركز مدينة الموصل القديمة، ٢٠٠٨). ومن الاستبيان الذي تم اجراؤه في الموقع المختار تم التوصل الى النتائج التالية: 40 % طابق ارضي، 43 % طابق ارضي+1 ، طابق ارضي+2 10 % و طابق ارضي+3 7 % (شكل 5). نمط البناء في الجزء الحديث من المدينة يسود فيه البناء ذو طابق ارضي واول ومن الاستبيان المجرى في منطقة الحدباء كانت النتائج كما يلي: 80 % ارضي+1، 10% ارضي و 10% ارضي+2 .

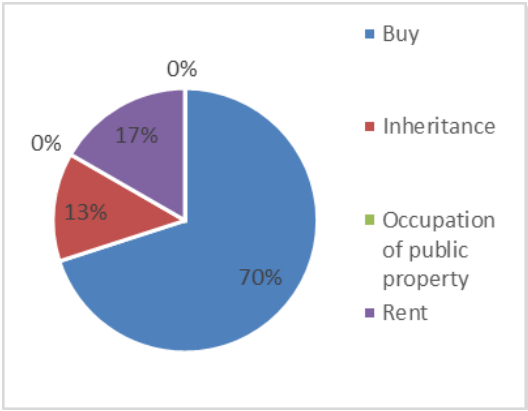



**شكل 5:** مخطط ارتفاعات المباني ( الباحث)

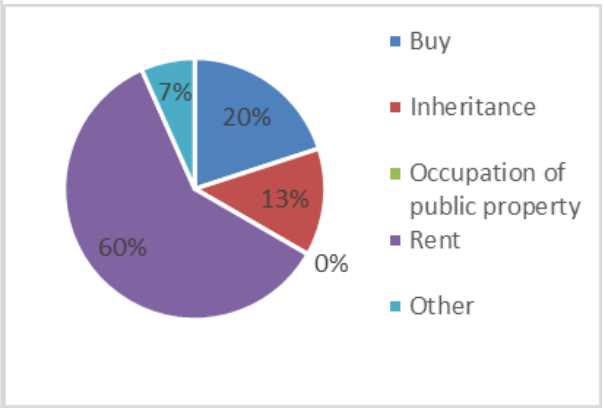
**5.4 .الخصائص الاجتماعية، هيكل العائلة والملكية:**

المجتمع الموصلي معروف بسماته الحضارية منذ القدم، انعكس هذا الامر على جوانب الحياة بشكل كبير. تسكن عوائل المدينة القديمة في منزل العائلة الكبير اي انها(extended family) . رب الاسرة هو الاب او الام وفي حالات غياب الابوين يتولى الامر الجد او الجدة. عدد الاطفال للعائلات الكبيرة ٤ على الاقل. الملكية في المدينة القديمة هي للايجار بالنسبة الاكبر وذلك لان اغلب السكان تركو المنطقة بعد الحرب بسبب الوضع الامني، وفي المرتبة الثاني الملكية الخاصة ثم الميراث ( شكل 6) .

اما بالنسبة للعائلات في الاستبيان الثاني فيغلب عليها كونها( nuclear family) ، مكونة من الاب، الام والاطفال الذين يكون متوسط عددهم 2-3 للعائلة الواحدة. رب الاسرة هو الاب. والملكية هي الملكية الخاصة بالدرجة الاولى يليها الايجار والميراث ( شكل 7 ).




**شكل 6:** نسب الملكية في المدينة القديمة (الباحث)




**شكل 7:** نسب الملكية في منطقة الحدباء (الباحث)

### 5.5 .التعليم ، الحياة الاقتصادية والمهن

سكان المدينة القديمة في الموصل لهم نصيب ليس بقليل من الامية وذلك بسبب نقص الوعي لاهمية التعليم اضافة الى فقر المستوى المعيشي الذي تسبب به كون مستوى دخل الافراد اقل بكثير متوسط الدخل العام في المدينة. فالعائلات تحتاج الى راتب اكثر من شخص واحيانا يعمل 3 افراد من نفس العائلة لتامين لقمة العيش. اغلب العاملين هم من اصحاب الاجور اليومية والمهن البسيطة كعامل البناء، الخباز او عامل في محل ملابس وغيرها. سبب ترجيح السكن في المنطقة هو قربها من المناطق التجارية ومناسبة قيم الايجار مع رواتبهم القليلة. في الاجزاء الاخرى من المدينة نلاحظ ارتفاع مستوى التعليم للافراد وزيادة في مستوى الدخل عن المدينة القديمة كما هو الحال في منطقة الاستبيان الثاني.

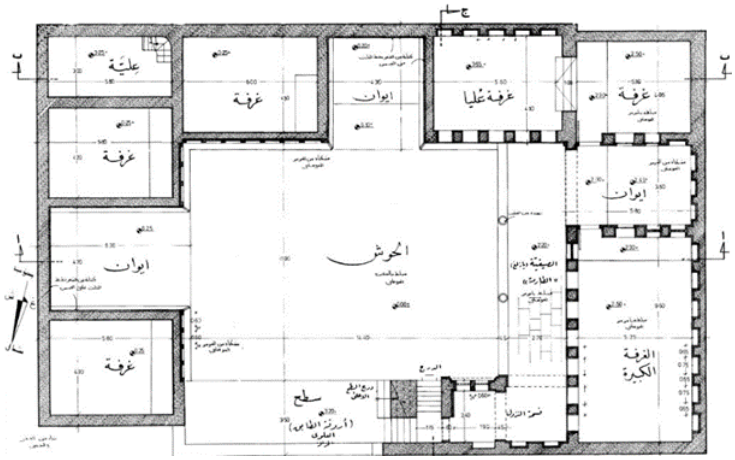
### 5.6.تحليل النسيج، المخططات والواجهات

يمكن تمييز نسيج المدينة القديمة بتقارب المباني بشكل كبير مكونة كتلة كبيرة اضافة الى شكل الازقة الضيق والمتعرج والذي يقلل من المساحة المعرضة للشمس هذه العناصر تساعد في مقاومة الظروف البيئية . تصميم المباني موجه نحو الداخل (شكل 8) والواجهات تكون قليلة الفتحات مراعاة لمبدأ الخصوصية. يتوسط المبنى فناء وسطي مفتوح تكون الفضاءات موجه عليه، هذا الفناء يستخدم لتلطيف الجو. الايوان هو فراغ يتوسط غرفتين ويكون موجه نحو الفناء. السرداب هو فضاء يقع تحت الفناء وتكون شبابيكه مطلة على الفناء. عدد الغرف في بيوت المدينة القديمة يكون2-3 غرف ويصل الى 6 غرف في المنازل ذات المساحة الكبيرة.

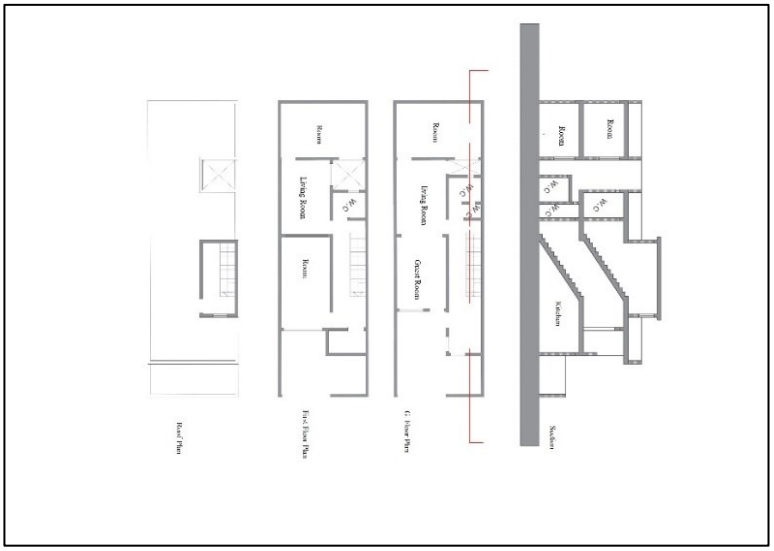
اما بالنسبة للمباني الحديثة تكون موجه نحو الخارج (شكل 9)، موقع الفناء غير مركزي وعادة مايكون صغيرا جدا يستخدم كموقف للسياره، تستعمل في الواجهات عناصر جمالية عديدة وبطرز مختلفة، عدد الغرف عادة مايكون 3-4 غرف.

### 5.7. تصنيف المباني في مدينة الموصل القديمة:

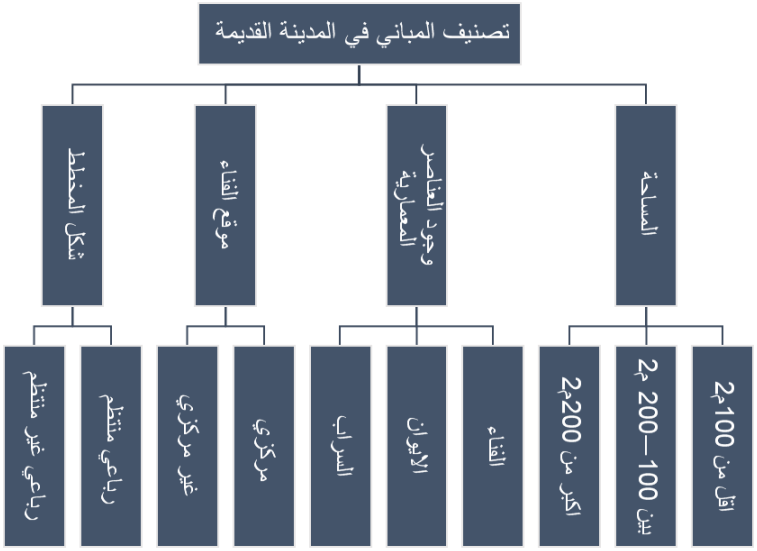
حسب الدراسة العملية التي تمت داخل منطقة الدراسة، تم التوصل الى عدد من العوامل المشتركة في نمط البناء منها: وجود العناصر المميزة للعمارة الموصلية مثل الفناء وموقعه الذي يكون مركزي في الغالب وشكل المخطط الذي يكون غير منتظم نتيجة النسيج العضوي والتقسيم العشوائي للاراضي وهذه النقطة هي ايضا السبب في اختلاف مساحات المنازل بالاضافة الى تفاصيل اخرى (شكل 10).




**شكل 8:** مخطط بيت التنجي ( مكتب الانشاءات الهندسي-الموصل, 1982)



**شكل 9:** مخطط مسكن في الاستبيان الثاني (الباحث)




**شكل 10:** تصنيف المباني في المدينة القديمة للموصل (الباحث)

**الاستنتاجات**

- في الجزء العملي من البحث تم اختيار المدينة القديمة في الموصل كونها قلب المدينة اضافة الى حاجة المنطقة الى الاعمار بسبب وضعها التي الت اليه بعد حرب داعش. هذه المنطقة كانت تعتبر من اكثر المناطق اقتضاضا بالسكان اصبحت في الوقت الحالي شبه مهجورة وذات ضرر كبير .
- يتميز نسيج مدينة الموصل بالتنوع بين النظامين الشبكي والعضوي, هذا الاختلاف نتج عن اختلاف الفترات الزمنية التي تم البناء فيها اضافة الى تاثير العوامل الاجتماعية والاقتصادية .
- مخططات المساكن في المدينة القديمة تتميزباختلاف اشكالها حسب مساحتها فهي في الغالب اشكال رباعية غير منتظمة ناتجة من تقسيم الاراضي الغير متساوي.
- نتيجة التداخل الذي حصل جراء الحرب والهجرة من والى المدينة فقد عانت المدينة القديمة من تغيير في معالمها ,حالتها وسكانها, سكان المدينة القديمة انتقلوا للعيش في احياء او مدن اخرى تاركين بيوتهم للايجار وبقيم رمزية .
- اذا ما تم تقسيم المدينة حسب مستوى الدخل نلاحظ التفاوت الملحوظ بين جهتي المدينة, الجهة الشرقية غالبيتها جيدة او متوسطة الدخل اما الجهة الغربية فهي متوسطة او قليلة الدخل .
- ظهور حالات الاعمار الهجين داخل حدود المدينة القديمة وبنمط البناء الحديث للابنية التي تهدمت كليا او جزئيا, الامر الذي يهدد نسيج المدينة وهويتها .
- الحث على مواصلة استخدام عناصر العمارة الموصلية مثل الفناء الوسطي،الايوان والزخارف فهذه العناصر فضلا عن اهميتها التصميمية توفر قيمة جمالية لايمكن الاستغناء عنها.
- محاولة النهوض بالواقع التعليمي لسكان المنطقة عن طريق نشر الوعي باهمية وضرورة التعليم واعادة اعمار المدارس في المنطقة تشكل نقطة ضرورية في هذه الخطوة .
- تشجيع الاقتصاد المحلي، فتح مشاريع جديدة لزيادة فرص العمل وتوفر الدعم اللازم لارباب العمل اساسي في رفع مستوى دخل الافراد. هذه المشاريع هي بالاساس فرصة السكان في المنطقة ورد روح التجارة فيها .

- التعريف بالهوية الثقافية والتاريخية للمنطقة ومدى اهميتها، يمكن استغلال عدد من الابنية ضمن المدينة القديمة وجعلها مركز ثقافي لوصف تاريخ وعمارة المدينة او عن طريق اقامة الندوات الثقافية المحلية والدولية .
- المساكن التقليدية هي اكثر ملائمة للظروف المناخية ومتطلبات الحياة الاجتماعية من خصوصية وعزلة لسكان المنزل, نمط البناء الحديث هو نتاج عوامل تغيير في نمط البناء والتحدد بقواعد البناء واستغلال المساحات.

**المصادر**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# BOOK OF ABSTRACTS
# ICCAUA-2022

## **SESSION D:** Habitat Studies / Infra Habitation

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# Affordable Housing for Low-Income Community in Thailand: The Challenges of the Improvement of the Quality of Life

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**Abstract**
The major problems of the urban poor are lack of land, housing insecurity and access to basic infrastructure. The increase in inadequate housing and homelessness among the urban poor are clear manifestations of their relative poverty. For decades, affordable housing has been a strategy of the Thai government to promote access to the housing of an adequate standard. The main focus of this paper is on two low-income communities which constructed new settlements on new lands. Both were supported by funding and housing loans from the Thai Community Development Organizations Institute (CODI), and I was appointed to lead the projects as a community architect. This paper aims to explore the challenges of promoting affordable housing and how people deal with these challenges. They were involved in the participatory planning, design processes and worked collaboratively with each other. Additionally, financial assistance was a vital mechanism to facilitate community building processes. The outcomes of the processes generated by the activities and solutions respect the needs of the people. Also, collective saving groups were a significant development to learn together and overcome considerable constraints.
**Keywords:** Affordable Housing, Urban Settlements, Low-Income Community, Collective Saving Group

## 1. Problems of Urban Poor and Challenges

The past decades have been seen the growth of the population of the cities in Thailand. People continue to migrate to urban areas to find job opportunities. In 2017, the Thai government described people earning no more than Baht 100,000 a year as low-income earners. Around 14 million Thais are registered as poor and need additional state welfare (Thai PBS, 2017). This includes both rural and urban areas. Also, the migration of people from rural to cities has put pressure on people living in cities and has also affected the demand for urban housing. Then, many urban poor households live in insecure housing and lands because they cannot afford the high housing price from the private sector. Breaking the cycle of urban poverty requires understanding of the elements that affect urban living, such as access to basic infrastructure and services, the cost of basic goods and the ability to participate in the political system (Parikh et al, 2020; Mitlin & Satterthwaite, 2013, Aziz Amen, 2022). Of course, the provision of appropriate infrastructure in a community settlement has an impact on the socio-economic indicators of urban residents such as health, education, income and housing (Parikh & McRobie, 2009, Amen & Nia, 2020).

Some households intrude on the state and public lands as illegal squatters. There are many problems for the urban poor who cannot afford the land and houses individually in the formal market system. This means they cannot get access to a secure dwelling. They also do not have the power to negotiate the land authority for long-term land leases. The lack of financial assistance is a crucial problem and constraint in accessing adequate and affordable housing (UN-HABITAT, 2009). The majority of housing financial mechanisms have high-interest rates. Additionally, People have few options for using low technology to reduce the cost of housing construction (UN-HABITAT, 2005). The study aims to present the challenges of two former intruder low-income communities and the challenges of improving the quality of life of communities through participatory processes. The infrastructure subsidies and housing loans were both projects received from Baan Mankong, a channel of CODI. The Baan Mankong Project is responsible for supporting the design and management process with community organisation participation (Boonyabancha, 2005; Ebrahimi et sl., 2022; Ghasemi, 2019 ). Today they both built a registered community and obtained secure land and house.

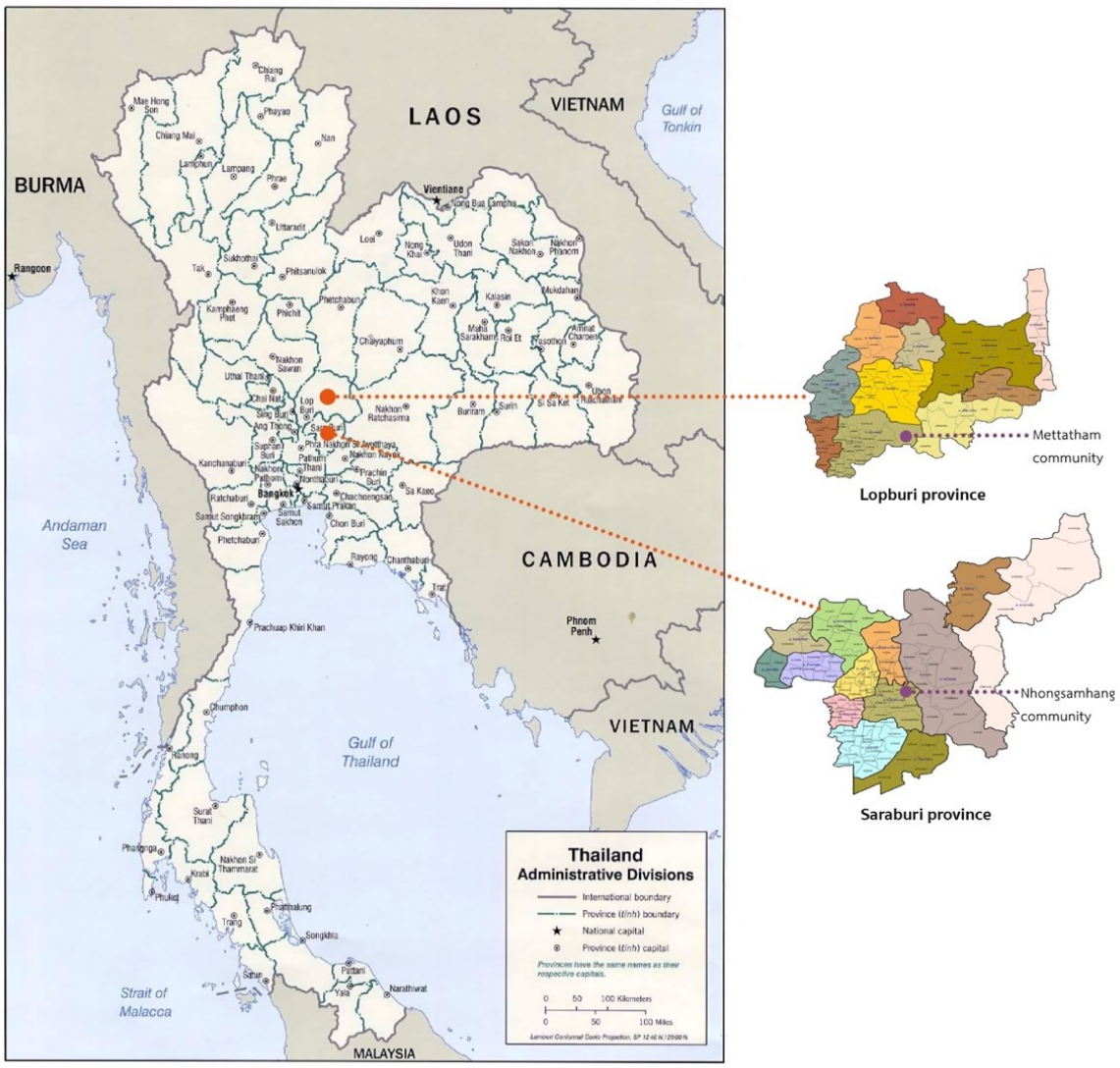



**Figure 1**. A map shows the location of Lopburi and Saraburi provinces

**2. Case studies**

Both case studies lived in insecure dwellings and poor housing conditions built by private on public land illegally. Some of them rented cheap rooms in the city in poor condition and often had insufficient infrastructure. Both communities also faced a problem with financing and affordability level.

Firstly, the Nhongsamhang community, Saraburi province, is gathered from the urban poor people who live in the Napralan district, Saraburi province. Total 121 households, most of them were renters and extended households. They were seeking secure land and housing. They negotiated to purchase the land for building a community. They also took a CODI loan for land and housing. To bring down the cost per family, they use participatory building and collective management to build the house. The average cost per household was US$ 5,900-6,700, which include US$ 757 for infrastructure subsidy. Each household makes repayments of US$ 32-37 per month for 15 years.

Secondly, the Mettatham community, Lopburi province, occupied the land of the Thai temple many years ago. A squatter community of 13 families occupied 1.12 ha of land without any documentation, which was owned by the Thai temple in Koktoom district, Lopburi province. Together, they and other urban poor negotiated the land authority; an agreement was reached to rent and share the land between the 13 families and other low-income living nearby, totalling 56 households. They took a CODI loan for housing. The average cost per household was US$ 3,600-6,700, which include US$ 757 for infrastructure subsidy. They have to repay their housing loan approximately US$ 20-37 per month for 15 years.

**3. How can they afford houses**

The affordable housing on the market is one of the major problems facing low-income households due to the continuing rising construction costs. The ability to pay for housing is usually measured by the relationship between household income and housing costs (Menshawy, Shafik & Khedr, 2016). Affordable housing refers to housing in which a household can afford the initial and other expenses of less than 30 per cent of a household's income (Maschaykh, 2015; Hulchanski, 2013). For the urban poor, the cheapest form of housing is built or assembled by individuals on a piece of land occupied without any formal title. This is the mode of housing production commonly found in the slum. However, it is an insecure dwelling with a lack of sanitary and poor construction. Although this mode is the cheapest housing, it is the most expensive regarding health and security (UN-HABITAT, 2005).

On the other hand, there is an optional housing construction involving the building process's lower cost. It is collective or collaborative housing. This approach incorporates a government programme and financial inputs. The programme brings low-income people together involved in the process to address the challenge of financing and integrate a financial mechanism to support the implementation of settlement upgrading strategies. The urban poor can be upgraded successfully when involved in the planning and design of upgrading projects (UN-HABITAT, 2009). It is also a substantial factor in creating a sense of community around the build together concept (UN-HABITAT, 2005).

**4. Structure of intervention**

In both case studies, it is necessary for the urban poor to be involved in the process. They have to participate in the beginning stage of the building process to ensure that houses suit their needs and are within income capacity. Hamdi (1991: 75) mentions that the best community participation ensures that everyone involved has a stake in the outcome (Aziz Amen & Nia, 2018). All concerned will share the responsibilities, profits, and risks of what he or she decides to do. Participatory design and planning is an approach to problem-solving and understanding the complex interweaving of environmental, social and technological forces. Sanoff (1979) proposes principles of collaborative design processes. First, the conceptual framework should provide the learning activities. Second, the conceptual framework should be provided to encourage initial participant independence. Third, the participant should be given a maximum feasible choice at all decision parts. Therefore, the step of working and implementation of both communities formulate:

- Identify the stakeholders
- Meet and explain the programme
- Set community-saving activity and collective saving group
- Find problems and possible solutions
- Negotiate land authority
- Measure the plot of land
- Design and planning workshop
- Work with local government agencies
- Propose the project to CODI
- Approve the project and get loans and funds
- Clear the land right (purchase or lease land)
- Plan for construction
- Management plan
- Coordinate local government agencies and relevant organisations
- Financial management plan
- Build houses
- Move into new houses
- Continue develop, welfare, occupation, community management, environment management.

In addition to these processes, funding from CODI comes in the form of infrastructure and housing loans. In terms of housing loans, housing cooperatives can borrow CODI loans at an interest rate of four per cent per annum. The housing cooperative will lend this fund to each family at an interest rate of six per cent per annum. Housing cooperatives will receive a profit margin of two per cent to cover loan administrative expenses, community welfare and acts as a buffer for late repayments or default (CODI, 2017). Urban poor people are the key actors in the process and manage the funding and overall management. They also undertake most of the building, making funding go much further and bringing in their own contributions (CODI, 2017). This process also promotes the bottom-up approach and people process. They take action on their own behalf to build houses and communities. Also, the democratic voting process is significant to making the consensus in community planning design. Workshops offer a

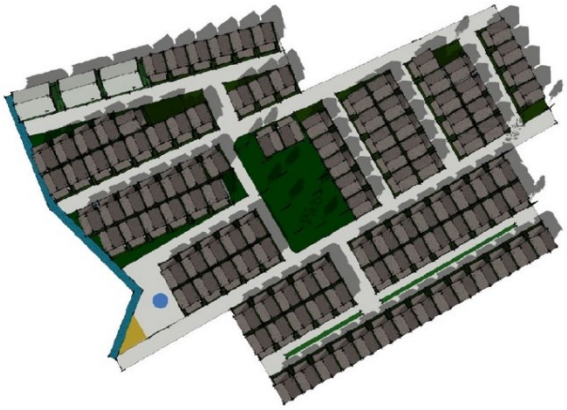
learning experience that causes them to reflect on ideas to problem-solving. However, it should bear in mind that observation of each group assists in shaping the design process.



**Figure 2**. Defining and analyzing the problems with the Nhongsamhang community



**Figure 3**. Meeting with the Mettatham community to identify problems and possible solutions



Nhongsamhang masterplan



Mettatham masterplan



Nhongsamhang community



Mettatham community

**Figure 4**. Masterplan and after building processes of both communities, people moved to new houses

## 5. Results and discussion

### 5.1 Community-saving groups and funds

Community funds and saving groups are a mechanism that strengthens the community and can reduce the risk for the individual's management. Community funds from CODI offer them small loans to households through community organisations. These collective loans are for purchasing land and building houses which are necessarily made by a group working together.

However, the challenging task is how to manage the funds effectively to ensure that all stakeholders have benefits and meet their needs. For instance, the Nhongsamhang community use loans for purchasing a plot of land and building houses for 121 units, while the Metthatham community uses loans for only building houses 56 units. Regarding infrastructure, both communities negotiate with the local government agencies to develop both electricity and water supply and construct the streets in the communities.

Saving activities connect people in the community. It is a strategy to help with repayments in which they have to demonstrate a capacity to collect money. The community-saving groups have to show a ten per cent deposit to qualify for the loan. The regulation and agreement between CODI and communities encourage them to save money within the families. This brings people to work together at both household and community levels in building activities. It also provides the confidence for a comprehensive self-development process (UN-HABITAT, 2009). However, it should bear in mind that the form of community-saving groups associated with affordable housing and the way of life of each household, mainly income and minimum wage. On the other hand, we found that many people withdrew their memberships and money from the group because they did not trust the project. Thus, building trust is important in the first stage of the meeting.

### 5.2 Ways to reduce housing costs

Housing production cost components are categorised into financial assistance, land, infrastructure, building materials, design, location and building technology. To be affordable, all of these elements require to be integrated into the process. It is obvious that financial assistance is the critical source of the cost of the building process. It is a powerful tool that brings the urban poor to work, learns, and makes decisions to implement effectively. Also, the development fund allows people to participate in the management process.

Furthermore, access to affordable land for housing is a significant constraint. There are two possible approaches for both communities: long-term land lease and land purchasing, which depend on the situation and availability of each community. The new community's location is also essential in deciding on a new location because it affects the commute to work for the villagers and going to school for children in the community. The essential features of the affordable land process are participation and collective ownership. People identify and select the location to be developed for building community. It must be related to income-generating activities. It is essential for building the community to be located as closely as possible to the income-earning opportunities.

In terms of building materials, both communities employed the collective building and materials methods that are the most affordable way of providing sustainable housing. It is saved because it is based on the cooperative substantive amount of equity. Beneficiaries engaged in it and shared and reflected the ideas. They are able to pay for the construction of the housing, and it responds to their actual needs. It responds to the actual needs of people and level of affordability. For example, buying bulk materials to save on construction costs or finding a construction company and negotiating construction prices together. Moreover, the design helps to identify the cheapest building materials and components for durability with the imperative low-cost construction solution. My role as an architect is, therefore, a factor that influences the process. It is necessary to open mind to develop a degree of trust and spend the time to build trust. I also aim to empower them to take on responsibility for decision–making, planning, and implementing their own development's ideas.

The community welfare programs are an interactive strength-building tool within groups, such as patient funds: elderly funds, and community emergency funds. A community welfare project has been developed to take care of members of the community. These welfare funds allow them to help each other so that isolated issues become a community's shared responsibility (UN-HABITAT, 2009). The consensus of poor communities is the key agreement of each welfare activity. Thus, people should participate in the decision-making stage. This approach has demonstrated sustainable development in which the people are the main action at all stages.

### 5.3 The challenges of the improvement of the quality of life

Does the process improve the quality of life? There is no single formula to achieve affordable housing. The issues of land tenure and secure housing have been resolved, and basic infrastructure is created in place. These have greatly improved the quality of life for low-income people. They can negotiate long-term leases with landlords. And safe land holdings are essential, which gives them confidence and a sense of security in their long-term residence. They

share ownership of the land and become common property, which is an efficient way to sustain their lives. In terms of repayment, they have repaid their land and housing loans in the long term with a small amount of money.
They can manage their communities based on their ideas; it generates confidence and management skills. Several types of house forms and sizes have been developed through loans to community initiatives to match each household income, including resetting on land that is close to former squatter or living areas. The advantage is that they can continue to live and work in the same area.

**5.4 The role of an architect**

An architect who works with the community or community architect may differ from other types of the architect. An architect aims not only to design a community but also to criticise, discuss, understand, and explain the phenomenon of community. The ambition is to improve the quality of life and dwelling through social and design processes as well as to recommend concrete solutions to society. We aim to understand the phenomenon of society and find the solution by presenting new perspectives and analysing the contexts, and working with the urban poor. This is, of course, a lesson for an architect to contribute to the knowledge. The features of the process enable participants to improve the stage of practice through the participatory process, which is a flexible process. It is essential to think that the participatory process shapes and changes the practice and helps to constitute architectural educational practice. This working process is an optional practice to help an architect who works with the community to achieve the goal. Importantly we found that process-based holistic thinking and the analysis of phenomena are developmental concepts and challenge the old paradigm of working and understanding the context of urban society.

**6. Conclusion**

This paper has examined how the urban poor deal with the challenges of promoting affordable housing. Both communities challenged the problems of financial assistance, building materials, design and land to produce affordable housing. A participatory approach was applied from the beginning stage to the end of the process. Participatory design and planning provide problem-solving methods, and it becomes a tool that brings people to work, learn and make decisions together, particularly in financial management and the building process.
When considering the housing process for the urban poor, clear communication is a vital consideration that makes people understand to engage in the projects. If they get unclear information, they may not trust and participate in the projects. Then, the collaboration of the local government agencies was essential, which also impacted the project's success in supporting the basic infrastructure. However, this is an optional way to achieve both case studies. The most challenging task was setting up community-saving groups because we had to build trust and connect people who come from different places to work as a team. At the end of the process, we found that secure land and financial assistance are essential considerations that the urban poor desire and enable them to build their own affordable houses. Further studies need to examine more closely the links between the spatial arrangement of the internal house and the urban poor to search for the adaptation of affordable house.

**Conflict of Interests**

The authors declare no conflict of interest.

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# Investigating the Role of Vernacular Architecture as a Sustainable and Eco-Friendly Architecture in City Branding

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**Abstract**
Regarding the tough competition among cities to strengthen tourism industry, building specific identity with distinguishing features of the city has been further emphasized. Vernacular architecture as an eco-friendly architecture with minor impacts on the natural areas, through reflecting the community culture and characteristics of the environment, has the potential to promote the citys' brand. In this research, the role of vernacular architecture in making city image has been investigated to provide in-depth knowledge in boosting city image, and the city of Masouleh in Iran has been considered as the case study. Regarding the qualitative nature of this project, in-person interview with main types of users (residents, Iranian tourists, and foreign tourists) has been used. Analyzing the results showed that key factors of vernacular architecture including natural landscape, sustainable design, unique local design, and cultural values have significant effects on city branding.
**Keywords:** Vernacular Architecture; Sustainable Design; Eco-Friendly Architecture; City Branding; Masouleh.

## 1. Introduction

The majority of places around the world are facing the effects of globalization in several aspects. In such a situation, the world's cities compete to attract tourists, businessmen, and talents to achieve their goals, and the strategic idea of branding is increasingly getting the main factor of urban growth, development, and quality of life. It seems necessary for cities to distinguish themselves by highlighting and communicating their distinctive features and create a positive image in their users' minds (Aziz Amen,2022, Amen & Nia, 2020). In fact, cities are making a hard effort to become a brand (Pilenska, 2012; Vela, 2013). Cities that are categorized as ones with quality of living, should have best sites of commerce and art, public spaces, and many other elements that play significant roles as integral parts of human beings' life. Related to this matter, vernacular architecture, which is a built environment on the basis of meeting habitants' needs via using natural potentials and local materials of the area, can be an interesting concept to be considered more thoroughly. This research focused on city of Masouleh Located in Gilan Province, Iran as a case study and investigated that how the vernacular architecture of Masouleh has potentials to affect the city branding.

## 2. Material and Methods

In this section, before discussing the effect of vernacular architecture on city branding, it is dispensable to highlight both definitions and features. Vernacular architecture is a type of architecture harmonized with local materials, local ecological environment and morphology, climatic factors, and local-based culture and traditions to develop sustainable living within the context of the surrounding environment (Mobaraki, & Oktay Vehbi, B, 2022; Tawayha et al, 2019; Philokyprou and Michael, 2021, Amen 2021). Karahan and Davardoust (2020) asserted that vernacular architecture is a functional architecture characterized by its social, ecological, traditional, and cultural features to protect the natural resources of the environment (Karahan and Davardoust, 2020; Khafizova, 2018). Since adaptation to the environment is a critical factor shaping the vernacular architectural patterns, climate change adaptation should receive sufficient attention (Nguyen et al., 2019). The term climate change adaptation refers to the process of adjusting in the actual or expected future climate of the region to improve human beings' comfort by the use of proper factors such as form, orientation, and materiality of the buildings (Ozyavuz et al., 2018; Karahan and Davardoust, 2020; Nguyen et al., 2019; Lodson, 2018). Research indicates that local people attempt to tackle the faced predicaments by a) developing their experience-based learning knowledge, b) cultivating innovative ideas, c) transmitting their collected and shared traditions, and d) focusing on their natural surroundings and constraints (Tawayha et al., 2019; Philokyprou and Michael, 2021; Karahan and Davardoust, 2020).This type of design not only has the potential to demonstrate an economical use of local building resources, but also can show the cultural values of the local communities (Ozyavuz et al., 2018; Karahan and Davardoust, 2020; Hasanpour et al., 2014; Wuisang and Jones, 2015).

Many authorities count the general image of their cities as a key item of development and focus on uniqueness, authenticity, and city branding as a significant strategy for redeveloping the cities' picture (Shamai and Ilatov, 2005). Psychological research works show that in a first glance, majority of users and visitors look at the architecture of the city when they take a tour from a city (Soltani et al., 2018). Soltani et al. (2018) defined city branding as a management process to develop the city's distinct identity with distinguishing features (Soltani et al.,2018).
Ashworth & Kavaratzis (2010) defined it as the process of applying brand strategy, marketing techniques and disciplines to the social, political, economic, and cultural growth of the cities (Ashworth & Kavaratzis, 2010). Research indicated that city branding has a crucial effect on city marketing, financial promotion, city identities, and city values; therefore, city branding should be designed and programmed as a product carefully (Kotler and Levy, 1999). City branding could be implemented in the context of city space to transform the city into a public space and cultural product (Vela, 2013). Considering such an important fact, vernacular architecture, which represents the traditional cultures of the society, local customs, values, and beliefs of the dwellers, can be an interesting concept to be addressed to search for more correlations between that type of architecture and city branding (Ju et al.,2012; Choi and Yu, 2011; Rafat and Elahi, 2011). While there are many research works on the vernacular architecture and city branding separately, reviewing the literature indicates that none of them have been focused on the analysis of the correlation between vernacular architecture and city branding directly.
This study focuses on the stairs city of Masouleh in Gilan province, Iran, where vernacular architecture can reflect the brand in the consistency of the environmental design and traditional local values. The intention of this research is to look at the unique attributes of the vernacular architecture, employing a branding lens to provide insights into how environmental features of architecture can be bolstered to develop sustainable and adaptive urban landscape in a way that promote city image.

**3. Case Study: Masouleh**

Masouleh located in Gilan province, approximately 60 kilometres southwest of Rasht and 32 kilometres west of Fuman(Kiami et al., 2016). The city is about 1,050 meters above sea level in the Alborz Mountain range, near the southern coast of the Caspian Sea (Kiami et al., 2016). Masouleh has located in a mild, humid region of Iran, its rainfall is generally about 700 millimeters, and snow is 800 millimeters per year (Kiami et al., 2016). Considering its strategic location, on the slope of a mountain, it is a stairs village, where the maximum difference height level in this city is about 100 meters (Nasehi et al., 2017; Reza, 2011; Farnian, 2016; Amini, 2019). In the unique urban pattern of Masouleh, the roofs have diverse functions such as yard, roof, and public places (Reza, 2011; Farnian, 2016; Amini, 2019). Not only does this structure provide profound and durable connectivity among the wide-ranging places of the urban, but also develops an exceptional city image in users' minds. In addition, the narrow way, as well as many stairs, has prohibited using vehicles in this traditional city (Kiami et al., 2016; Nasehi et al., 2017). The vernacular design of Masouleh looks like a design of a garden city with the co-existence of the natural environment and human-made architecture by utilizing local materials (Nasehi et al., 2017; Reza, 2011; Farnian, 2016; Amini, 2019). In order to adapt to the climatic and topographic conditions of the area, the houses include several zones such as entrance, winter room, summer room, living room, staircase, storeroom, and balcony (Kiami et al., 2016; Nasehi et al., 2017). The houses are elevated from the ground, mostly 3 levels (Farnian, 2016; Amini, 2019).



**Figure 1**.City of Masouleh (Source: Author).

The ground floor is dedicated to storerooms and the higher levels function as residential places. Having several openings to maximize the natural ventilation and get away from the humidity of the permanent rainy weather and

efficient use of the natural light for heating are other factors of such a brilliant vernacular architecture. Gray soil (as an insulation material on roofs), yellow clay, local wood, and stones are the primary construction materials that moderate the problem of excessive moisture (Farnian, 2016; Amini, 2019Kiami et al., 2016; Nasehi et al., 2017). Moreover, walkability can play as a constructive factor in enhancing social interactions among local people, visitors, and tourists (Elahi and Ardaneh, 2012).

Put simply, Masouleh is an obvious vernacular architecture in a form of stepped city by having more than 700 traditional houses and public buildings. The architectural design of Masouleh indicates its unique pattern and design based on its specific location to protect the natural resources of the environment and develop the social life of people. Research by Rossini and Nervino (2019), "City Branding and Public Space", demonstrates that unique and evolved urban public spaces have the potential to enhance the city image and the essence of the culture and tradition of the local communities and develop and manage the city brand effectively (Rossini and Nervino, 2019).

**4. Research Methodology**

As this research was categorized as a qualitative study, structured interview method was applied in the phase of data collection (Interviewees included local people, Iranian visitors, and foreign tourists. In the selection of residents, purposive sampling was applied (Robinson, 2014; Bowen, 2008). Timing and environment for interviews were scheduled effectively in a relaxed environment, without any pressure and friendly atmosphere for all interviewees. In addition, being open to every viewpoint without showing any disagreements were considered in all steps and each interview lasted about 30 minutes. Each interview had two steps. At the first step, the main topic (effect of vernacular architecture on city branding) did not discuss straight and open questions such as "Tell us more about the city image based on your perspective" and "how do you describe the effective features of the city at the first glance, when you arrived and during your visiting time?". In the next step, the main topic was asked and discussed directly. Overall, 56 interviews were carried out including 20 interviews with Masouleh dwellers (60% male and 40% female) in the range of 17- 65 years old, 20 interviews with Iranian visitors (55% male and 45% female) in the range of 24-50 years old, and 16 interviews with foreign tourists (50% male and 50% female) in the range of 20-52 years old. The recorded interviews were transcribed and a phenomenological thematic hermeneutic analysis was done by using NVivo software.

**5. Result and Data Analysis**

Classifying and coding of the collected data resulted in recognizing three main themes including a) Natural landscape of the city, b) Architectural design of the city, and c) Cultural values of the city, as important factors of vernacular architecture that affects city branding significantly. Subthemes (subgroups) were identified as follows (See Table 1).

**Table 1.** Recognized factors affecting city branding, (Developed by Author).

| Theme | Subthemes | # of interviewees who pointed out the related subject | | |
|---|---|---|---|---|
| | | Residents (n=20) | Iranian visitors (n=20) | Foreign visitors (n=16) |
| Natural landscape of the city | Location of the city | 5 out of 20 | 15 out of 20 | 16 out of 16 |
| | View of Masouleh (fronted green plains) | 6 out of 20 | 13 out of 20 | 7 out of 16 |
| Unique local design of the city | Sustainable architecture of the city | 19 out of 20 | 3 out of 20 | 11 out of 16 |
| | Stepped design and visual beauty of the city | 11 out of 20 | 20 out of 20 | 16 out of 16 |
| Cultural values of the city | Hospitality of local people | 3 out of 20 | 6 out of 20 | 16 out of 16 |
| | Traditions and customs | 20 out of 20 | 11 out of 20 | 14 out of 16 |

Theme A: Natural landscape of the city

The specific location of the Masouleh was mostly be declared by the tourists, especially foreign visitors. According to the conducted interviews, this theme encompasses two subthemes namely 1) specific location of the city (located on the slope of mountains) and 1) specific view of Masouleh to surrounding green plains. One of the interviewees mentioned the following statement:

"The reason that I would travel to Masouleh is its specific location in comparison to the other tourist hubs I have visited so far. Masouleh has a unique natural landscape. Blended city in the mountain is a lifetime memory from Masouleh for me, it's like that the mountain has embraced the city". (A Foreign tourist, interviewee # 5)

Theme B: Architectural design of the city

Analyzing the data showed that architectural design of the city includes two subthemes namely 1) sustainable architecture of the city (which was more important in residents' view) and 2) stepped design and visual beauty of the city (that influenced both of visitor groups). One of the Iranian tourists mentioned the following statement:

"Masouleh reflects the unique traditional architecture. The main image of that in my mind is a quite village where I can get away from the hustle and bustle of the capital city Tehran. If the vehicles were allowed in this city, Masoule would not be a calm and peaceful city. Thanks to local architectures because of designing narrow ways and staircases. I enjoyed such a romantic place". (An Iranian tourist, interview #18)

Theme C: Cultural values of the city

The third theme referred to the significance of Masouleh's cultural values. While the Iranian visitors mostly did not mention this theme, the foreign tourist and local people paid more attention to that. This theme includes two subthemes: a) hospitality of the indigenous people and 2) traditions and customs. One of Masoumeh's residents mentioned the following statement:

"Today, I noticed that belonging to this place, living with our values, preserving our traditional customs are the most important parts of my hometown". (One of Masouleh's residents, interviewee # 13)

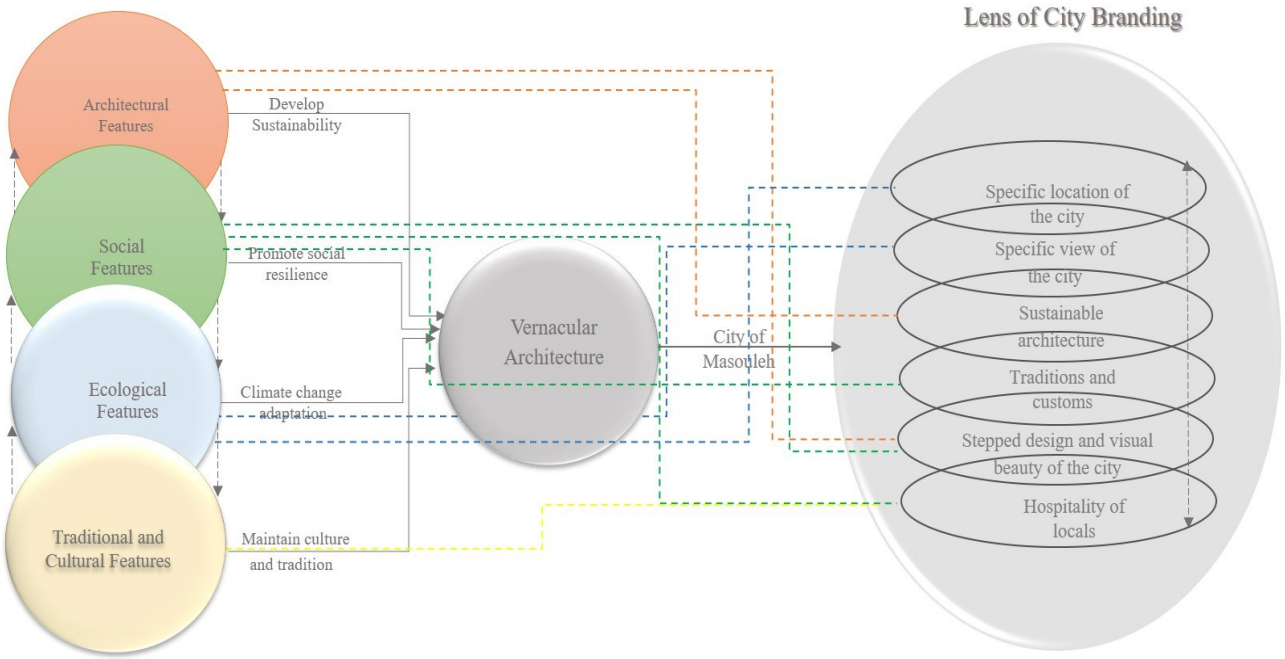


**Figure 2.** Recognized factors affecting city branding, (Developed by Author)

## 6. Discussion

Analysing the result verifies that residents considered "Traditions and Customs" as well as "Sustainable Architecture of the City" as the main factors affecting the city image and ranked the hospitality as the last effective factor. Foreign tourists fascinated by the "Hospitality of Indigenous", "Stepped Design and Visual Beauty of the City", and "the Location of the City"; they mentioned all these factors as important variables affecting the city branding. Iranians tourists mentioned "Stepped Design and Visual Beauty of the City" as the important factor affecting their city image. It seems that "Local Design of city" theme was the highest important factor that effects the city branding in Masoule and "Cultural Values of City" and "Natural Landscape of City" had the second and third priority in making city image based on interviewees' points of view.

## 7. Conclusions

The goal of this study was to investigate the effect of vernacular architecture on city branding. In the recent decade, cities are making more efforts and going through more challenges to introduce themselves effectively in a global

scale and attract more users, investments, residents, and industries. Cities should strategize their goals and follow a set of actions to build an effective and long-term positive image for users to gain a competitive merit among other urbans. In this way, preservation and utilization of vernacular architecture can be taken into account as one the practical solutions with significant effects on city branding development. In this research paper, Masouleh, which has a vernacular architecture and design, was studied and investigated. It showed that vernacular architecture as a unique and significant symbol of a city can have a significant effect on positive image development and city branding. Unique local design of place would be attractive for various groups of people, ranging from locals to visitors. The results verified not only does vernacular architecture enhance the city branding, its image and users' conception of the place, but also has a productive domino effect on other factors such as values and cultures. Considering natural landscape and cultural values and paying adequate attention to the unique local design of the buildings in cities can have a significant effect on city image development. Thus, preserving and developing the aspects of vernacular architecture to satisfy the users and make positive feeling and perceptions for them, is a vital factor in city branding development.

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# Transfer of Development Rights for Agricultural Land Protection in Izmir's Periphery: A Case Study in *Torbalı*

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**Abstract**
Turkey has been experiencing rapid urbanization and urban expansion since the 1950s. With the processes of decentralization, the city is increasingly being brought into rural areas, building pressure is increasing, agricultural production and natural resources are being destroyed, and rural areas are increasingly fitted with urban uses (shopping, tourism, leisure activities, etc.). Rural areas in close proximity to urban areas are more vulnerable to development pressures and are at risk of being abolished or abandoned. On the other hand, with the enactment of the new regulations Transfer of Development Rights is entered Turkish Planning System as a new and innovative solutions. However, there has been any available application of the TDR yet. The study's objective is to assess the TDR's effectiveness as a tool for protecting agricultural land on the periphery of Izmir's large metropolitan area. Izmir's *Torbalı* district was chosen as a case study regarding intensive agricultural activity. A bundle of techniques is used including a large survey analysis of the area. A hypothetical mathematical model was applied for assessing and transferring the market-base value for the agricultural land.
***Keywords:*** Transfer of Development Rights (TDR), TDR for agricultural land's management, TDR as a planning tool.

## 1. Introduction

In line with global Western central liberalization, globalization and capital accumulation, the mode of production has been transformed, processes that decide on the spread of cities in space have changed as a result of technical advances in the fields of deregulation and communication / information technologies in the national economies. With the processes of decentralization, the city is increasingly being brought into rural areas, building pressure is increasing, agricultural production and natural resources are being destroyed, and rural areas are increasingly fitted with urban uses (shopping, tourism, leisure activities, etc.).

New waves of migration from rural areas to cities began after the 1980s, when big cities were affected by liberal economics and globalization (Akşit, 2006). Economic transformations, technological improvements, and organizational reforms are all fueled by the world's 80% urbanization (Leaf, 2016). This is the first time in the human history that a village or peasants as a way of life is fully urban[1] (Delaney, 1999: 191). The phenomenon of total urbanization of the population on a global scale is the most basic development issue of the twenty-first century, with the rapid growth in the people living in urban areas and the continuation of rapid urbanization.

Cities are the primary spatial component of the major global transitions. Metropolitan city growth now differs from past century models focused on a single core, in which urban density decreased as distance from the center increased, therefore *designating an urban form* is higly problematic (Levent, 2018: 636 - 637). It's becoming more difficult to distinguish between the metropolitan city, the smaller city, the town, and the countryside, and traditional notions of center - periphery aren't helping (Tekeli, 2004: 74 - 75). Moreover, states favor a pro-market strategy as a result of globalization and articulation to the global economy, which introduces new emphasis on large buildings islands, large-scale public investments, and fragmentation on the city's outskirts. These changes have a huge impact on rural areas. Agriculture productivity is declining (*de-agrarianization*), agricultural-environmental assets are becoming more difficult to safeguard, and the relationship between rural and urban areas is changing dramatically due to the new communication technology and transit opportunities. As a result, rural areas in close proximity to metropolitan areas are adversely affected by this transformation, and Turkey is one of the countries that has been most impacted and has quickly abandoned its rural ties (Keyder ve Yenal, 2013: 92).

With the winds of globalization and grounded changes, traditional land use planning has been criticized for its inability to deal with global phenomena and problems seen in major cities, and it has been brought to the planning agenda as a more flexible approach that welcomes more market-based solutions. Understanding these changes in planning, as well as developing policies, strategies, and new planning methodologies, is an unavoidable obligation. Traditional land use planning is designed to find a balance between conflicting uses and activity integration in order to make them economically viable. However, by its very nature, the same planning creates irreconcilable rent discrepancies between users by designating land allocation, which results in unintended externalities such as urban land increase or decline (Micelli, 2002; Alonso, 1960). As a result, innovative alternative approaches to overcoming externalities in the planning system, which traditional land use planning has long failed to address, must be introduced.

[1] On the other hand, some say that these assessments should be handled with caution (Radoki, 2002). It is underlined that disparities in definition in nations with huge populations, such as China and India, have a significant impact on global population. For example, administrative limit adjustments in China have resulted in 40% of the population being classified as urban (Radoki 2002: 27; Öğdül, 2010).

The key difference then would be the introduction of new instruments that use market forces to accomplish governmental policies rather than the old command-and-control approach of land-use planning (Micelli, 2002: 141). The new instruments are introduced and heavily discussed in the planning to overcome the inherited weakness of the planning, such as real estate taxation, land readjustment, and the creation of new property markets, are based on flexibility without intervening normative and compulsory, rather in the form of complementary or convincing, rather than normative and compulsory (Turner et al., 1996: 188). One example of this search is the transfer of development rights (TDR).

TDR as a market-based tool is included in Turkey's legal framework, it is unclear how it would be implemented. This research[2] was carried out to solve this problem and provide direction for future efforts. This study is discusses the need and applicability of the TDR as an instrument for facilitating the problems posed by conservation activities in the agricultural areas of Izmir, *Torbalı-Muratbey District.* By using a variety of techniques, the study investigates the difficulties associated with the conservation of the agricultural land covered by the strict restrictions because of the highly economic agricultural return and the high capacity soil feature in the Turkish Planning System; it then makes a quantitative comparison of market values between agricultural areas's both economic value and rural value as a property and associated restriction of the development property rights, with the areas where the urban development rights granted to the Land Use Plan (development plan, *imar planı*). Therefore, the amount of "transferable rights" based on the market value comparison is determined taking into account the factors affecting the property's market values and standards.

A large survey analysis of the case area is conducted, which includes land-cover changes og both Izmir and Torbalı District, development plan decisions, and how they affected agricultural land protection and the growth pattern of the *Torbalı-Muratbey* region in the Izmir Metropolitan area. Finally, in-depth interviews with authorities from various government agencies and property management employees are used to analyze market conditions and assessments. The physical characteristics of the location are also documented.

## 2. Literature review

### 2.1 The Concept of Transferring Development Right as a Tool of Planning

TDR can be defined as a type of transfer and purchase of development rights from areas where urban development is restricted for specific reasons such as farmland protection or nature conservation, etc., to the areas with high development rights (Tavares, 2003; Nelson, Pruetz and Woodruff, 2013). Thus, TDR is a planning tool, management model and market-based management procedure for transferring development rights from protected areas to development areas (Hin Li and Gan, 2013: 19). It is a very useful and effective measure to facilitate the implementation of urban development policies and it promotes the development of areas designated as new growth zones (McConnell, Walls, and Kelly 2007; Aken, Eckert, Fox, and Swenson 2008). TDR enables wider and more effective protection and reduces speculative pressure to guide urban development from protected areas to development zones. It also allows for the fulfillment of the principle of "equal distribution of the development rights" i.e., *social justice* by compensating for the restricted rights of immovable property (Curtis, Pagonis, and Roach 2008; Isildak 2012). According to Pruetz (2003), TDR is an application tool which encourages the *voluntary* transfer of property rights to the areas of the communities to be protected. It is an active application tool that transfers development rights to the host area (i.e., growth area) where development is demanded in order to reduce development pressure on the areas under tight restrictions.

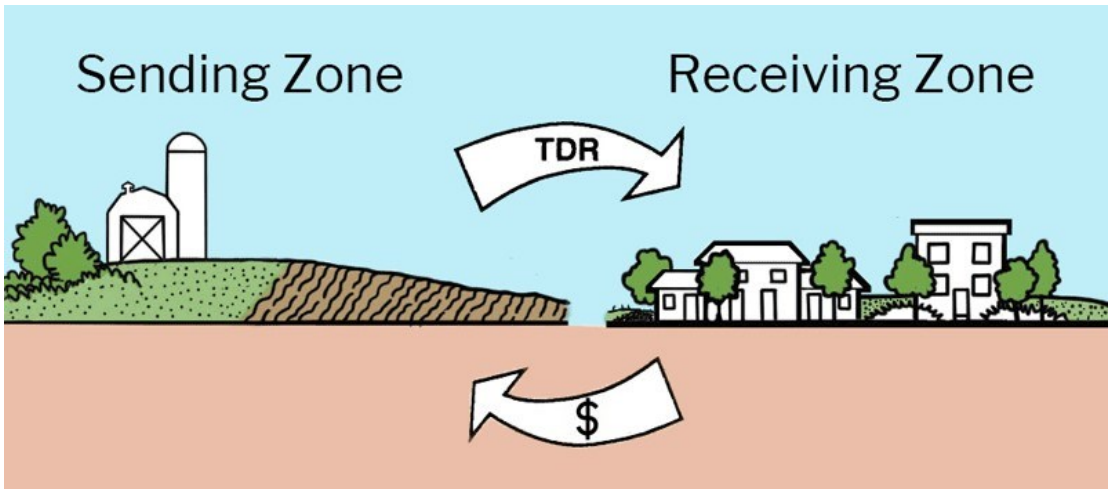



**Figure 1.** Sending and receiving areas with TDR (Chester County Planning Commision, 2022)

Additionally, it provides great convenience in situations where public resources are insufficient to meet the costs of restrictions or where the expense of protection is only imposed on the property's owner, thus ensuring the continuity and

[2] With a serious of the researches, we discussed the similar issues and TDR application for those conservation areas and TDR feasibility (**Güzle REF**).

efficiency of safeguarding by balancing gains and losses (Messer, 2007: 51). TDR programs may provide both flexibility against the strict protection rules of the nature protection areas and disaster-risk areas, farmland and heritage areas and, a systematic tool to help authorities achieve comprehensive long-term environmental and economic goals (Machemer and Kaplowitz 2002: 773). In TDR programmes, central or local authorities intending to exercise protective measures in areas or settlements that cannot be opened up to development or have lower zoning rights can do so *without any necessary payment*. When we look at the concept in terms of sustainability it ensures the protection and preservation of nature and farmland areas by guiding the stress of growth in other areas that need to be built by efficiently allocating public resources; i.e., planning and empowering people living in heritage areas.

The critical point in the TDR is that urban land is not subject to sales; only the right to urban land development can be transferred or purchased. The urban landowner may continue to use their property after selling their development rights. For example, after the development rights in a listed building or agricultural land have been sold, the landowner remains in or continues to make use of his/her building or continues to use land-based agriculture (Akcesme, 2006). Any property owner has rights that give direct sovereignty over his/her immovable property. TDR allows property owners to waive their property rights (construction, purchase or rent, use or restriction of other land use) in whole or in part and to receive payment as reciprocity for this procedure by transferring their rights to the receiving areas (Nelson et. al., 2013).

There are different opinions about the model's historical development when it first began to be applied. In 1916, first in New York, due to extensive urban planning, skyscrapers prevented the use of the sky by the surrounding properties, thereby limiting the height and prohibiting the construction of workplace manufacturing and housing units (Hanly-Forde, Homsy, Lieberknecht, and Stone 2014). In this way, property owners who have not yet reached the height limit in the adjacent parcel were allowed to sell those rights to be used in other parcels. The model emerged again in New York City, starting with the 1968 "Cultural Property Protection Act" (Yamak 2006), which permitted the transfer of the development rights of property owners not based on the lot or the adjacent plot, but throughout the city. The TDR was then intensively spread in the USA in the 1980s (Pruetz 2003). In reality, many TDRs initiatives in the United States are focused on agriculture protection or natural areas.

The TDR program has four basic components (Machemer and Kaplowitz 2002, 775). The first is the areas where the immovable is to be protected (*sending area*) and the second is the areas to be developed (*receiving area*) (Figure 2).

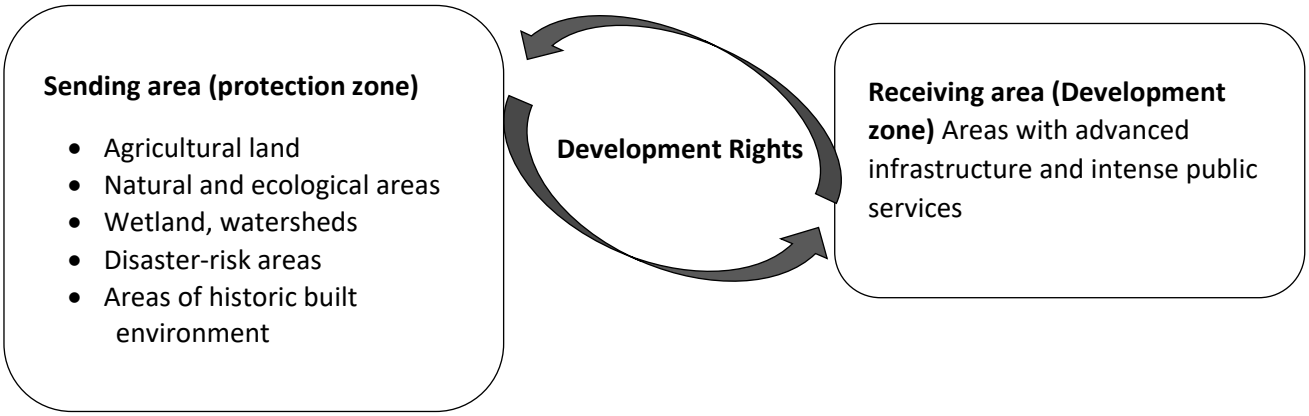



**Figure 2.** Sending and receiving area concepts (Guzle and Akpınar, 2019)

While TDR is meant to safeguard equal distribution of the development rights, it means different things to different people. Immovable property owners, for example, can profit by selling their rights and simultaneously selling or transferring their rights to another buyer on the market. Developers, on the other side, can purchase more immovable rights and profit from the plan's increased density. The planning offices, as a prominent player, reaped numerous benefits from the use of TDR. By implementing buffer zones, green belts or limiting development densities, local governments can redirect urban development to areas where they want to expand while reducing development pressure on protected areas.

TDR may be transferred in two ways under the Law, depending on the nature of the property under protection status: partially or totally. The property ownership of the immovable property (i.e. watery agricultural land and high capacity soil) is maintained in partial transfers. In this instance, however, the property owner is required to do continuation of the agricultural production for the land's protection in accordance with the protocol to be signed with the relevant administration (Guzle, 2019). The property rights of the immovable property change with all of its elements in the case of a full transfer of development rights, and the immovable property is wholly owned by the public. In this instance, the landowner receives a certificate confirming his development rights, and his ownership is transferred to the public.

Reselling a property that has been transferred to the general public is prohibited by law. In other words, a property owner who has lost his or her development rights certificate; (1) use the property, (2) benefit the production fruit, (3) possess, sell, rent, bequeath, mortgage, or just *use* his/her property (Isildak 2012, 98). Despite the fact that the Law makes no provision for the design and determination of receiving areas, the area to be transferred is first selected from the relevant municipal

boundaries, and if there is no room for a receiving area, it is expected to be used in other areas determined through joint programs with other public institutions (Guzle,2019).

**3. Brief Info About the Turkish Planning System**

Conventional land use planning and zoning are the most prevalent tools used in traditional planning to regulate urban development. The essence of the management of the urban development is the separation of conflicting functions (zoning) in design and the transportation network built between these activities (Amen & Nia, 2020). Building Permits distributed are granted or rejected based on whether they are compatible with the rules of the regions defined in the plan (Aziz Amen,2022). In this way, undesirable development is controlled and blocked, but the development is not ensured in the suitable place and form (Albrechts, 2008). The fundamental problem in traditional land-use planning is that the zones grow complex by changing after they are first created and becoming complex, and by substituting functions in response to property owners' requests. All of these issues are related to the ineffective use of land management (Talen, 2013).

In the Turkish Planning lack of integrated planning approaches since 1980s is the well-known fact; however, the idea of planning can never be rejected. Although the Turkish planning system has not been new, extended till the late Ottoman Era, however, today the planning is in deep crisis, fragmented, chaotic and far from being preparation for the future. Planning under these conditions causes anguish and frustration amongst planners in the neoliberal era (Eraydın and Tasan-Kok, 2013: 229). This may be the main reasons why market-based tools like TDR can not even offer planning professionals a place to debate. Hence, the main objective of this study is to demonstrate the potential that TDR offers as a planning tool and as an efficient way of incorporating urban growth energy into planning while preserving and contributing to urban resilience, preservation of the farmland area and environmental, i.e., better policy outcomes, in terms of efficiency and equity.

The conventional land-use planning is conducted and regulated by the Law no. 3194 i.e., Reconstruction Law[3] coming into effect in 1985 and related regulations in Turkey. The Reconstruction Law is responsible for the land-use management and also draw the spatial structure as overll shape i.e., urban macroform of the metropolitan cities in general (Ataöv and Osmay, 2007).

This model is meant to control land-use and land-use changes at local level. In the model urban growth is controlled through Urban Development Plans (*imar planı*). The planning powers were transferred to municipalities with the enactment of the Reconstruction Law and the resources transferred to the municipalities were increased. In almost all major cities, comprehensive planning and zoning have been started. The approval authority for local physical plans was transferred from central administrations to municipalities which began to make frequent use of plan changes which can be taken as a form of deregulation.

As Turkey has opened to the world order and transitioned to the global economy, the intense commodification of the housing and land market have resulted in a construction boom and never-ending construction facilities in Turkish cities. The socio-spatial configuration of the big cities including Izmir has impacted most of these developments. The rapid commodification of land resulted in speculative construction activities and a drastic rise in housing prices which gave way to the construction boom (Erol, 2019: 738) eventually resulted in the rise of the land and property prices. Many forms of deregulation with the Reconstruction Law were provided in the planning system in order to ease the massive construction activity or circumvent the bueuracratic process of planning. For example, a form of dergulation for obtaining planning powers is very common provided to various central government ministries with their sectoral priorities or special plan planning powers (Balaban 2012; Eraydın 2012). For these reasons agricultural areas in close proximity to major cities are vulnerable to conversion, placing agricultural production at threat.

Between 1960-1990 the implementations of the conventional land-use plans are of the large density increases that were not so commonly enforced that the urban fabric was developed in accordance with the "regional floor layout" plan[4]". In conjunction with the neoliberal transition, development changes in response to the rise in density should not be matched with the required increase in public services that has begun and spread through broad urban regions. Especially in 2000s the super high-rise structures has become dominant figures of the city scape and with the ease of related changes in planning legislation[5] and in planning to control of the high-rise construction has getting more and more difficult task in the Nation. Today, however, the density rises, many times followed by peculiar legal applications, in a very unregulated manner (Cavusoglu, 2016: 142).

The connection between planning system and real-estate sector before the 1980s had depended upon the purchase of the both rural and urban land in the market, but this has changed with the globalized era and there has increased substantial studies revealed the powerful real-estate institutions or companies manage and manipulate the land market in urban sphere to a varying degree to all over the world (Tiesdell and Allmendinger, 2005). Negative effect of the world-wide globalization,

[3] Law no. 3194 *İmar Kanunu.*

[4] In 1965, Law No. 634, "Condominium Legislation" (*Kat Mülkiyeti Yasası*) was enacted and accompanied by plans for "regional floor layout" (*bölge kat nizamı*), the existing building stocks in the legal and formal part of the cities were almost completely demolished and then renewed into very similar, uniform apartment blocks dotted around the city's legal-formal part. Single ownership was given for each individual housing unit (not land ownership) in one block of apartments constructed onto one urban plot so that the multi-ownership pattern was available in one urban land plot. The actors come in with these applications; land parcels ownership, developers with limited capital and households with limited income (Gunay, 2005). The large squatter areas were built out of the formal planning domain, surrounded particularly by state-owned land at the vicinity of the city's core areas.

[5] "Very high rise building", for example in the Law of 644, "The Establishment of the Law of the Ministry of Environment and Urbanization" (2011).

privatization has brought substantial impact to the planning in general. Turkish case represents both the global restructuring which took place on a planetary scale, however bears also internal characteristics. Practices in the Turkish case should not be confused with worldwide examples as applications that go beyond market or global logic were already developed. While not all groups in society opposed all these implementations and the matters were also referred to the public court very common. However, it is needlessly to say that the problems brought by globalization and its local translation and interpretation have not promoted a kind of awareness on part of governments, society and citizens of the need for innovation in social policy and land management. After a break in centralized and integrated approaches in planning a new and approach has to redevelop and revise which recovers the institutional and managerial framework of planning.

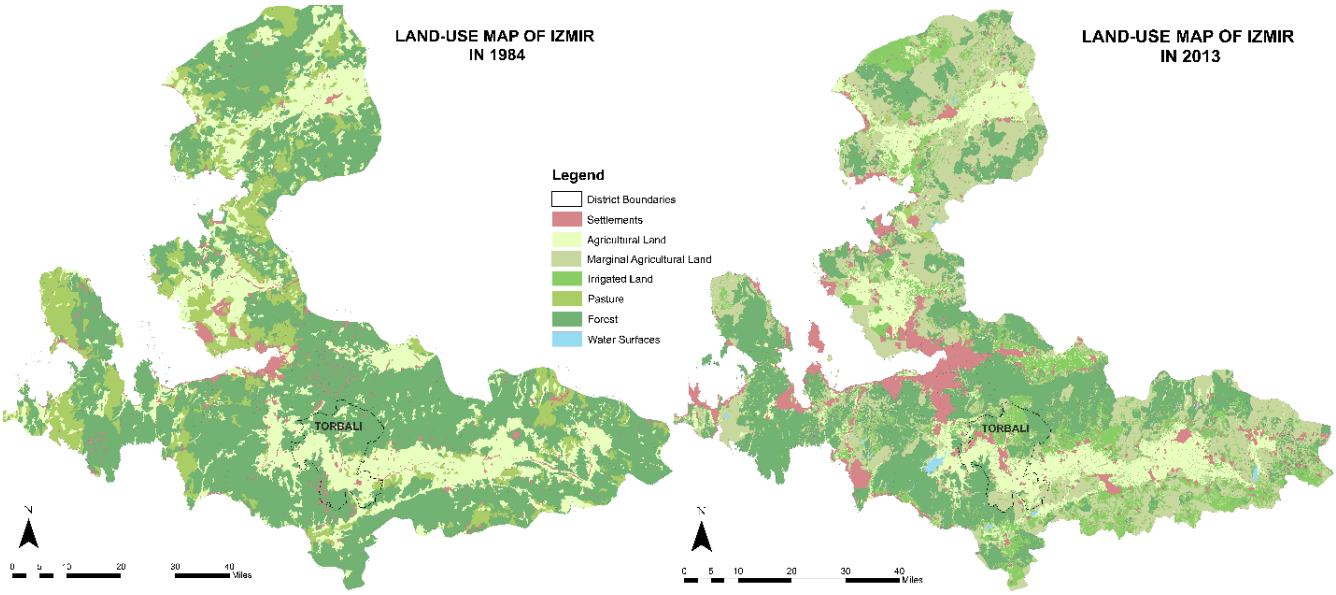



**Figure 3.** Land-use change of İzmir between 1984 and 2013 (Izmir Special Province Administration, 2013)

**4. The Conversion of the Agricultural land into urban parcels in the Turkish Planning System**

In Turkish Planning system, converting cadastral land into Urban Parcel (Land), is only possible with the implementing the Urban Development Plan which was specified in zoning bylaws. The local administrators are responsible to provide substantial number of urban parcels and areas for the population's future demand for development under the Article 18 of the Zoning Law No. 3194.

The amount of potential development land (or urban parcels) should not be less than the number of construction licenses issued the previous year. Known as the colloquial "dough rule" (*hamur kaidesi*, Article 18[6]) regulation application in the Turkish Planning system, after the required land readjustment, up to 45 percent of the land should be reserved for public use for the reciprocity of the anticipated (expected) increase in land value. The public land then is used for education, health, and green areas which necessitate those populations living in the residential areas. In this application, the assessment procedures are based solely on the size of the land parcels[7]. This can be considered as a private property public control mechanism by laws.

Another regulation related to the conversion of agricultural land into urban lots is the "Land and Land Use Law"[8]. In accord with the bylaws and related regulations, agricultural land is categorized under various statuses with regard the soil classification and agricultural potential. As per ordinances and standards, agricultural land is defined as "absolute agricultural land", "special cropland", "marginal crop land", and "planted land", depending on land classification and agricultural potential. Furthermore, "watery agricultural land" is defined as agricultural lands irrigated by necessary infrastructure by the Ministry of Agriculture and Forest. The rest of the agriculture fields (which aren't irrigated) is dependent on climatic factors like rainfall. Farmlands classified as watery land, without a doubt, are regarded to produce the highest value of crops.

Article 13 of the "Land and Land Use" Act regulates the use of agricultural lands for purposes other than agricultural production. It states that "watery agricultural land", "special product lands", and "planted agricultural land" *will not be employed for purposes other than agricultural production* (*Agricultural Lands Used for Non-Agricultural Purposes,* Article 13[9]). However, the Ordinance includes various deregulations and exceptional circumstances that allow agricultural areas to be opened up to non-agricultural activity under certain conditions. If the central and local administrators are unable to find

[6] It is a regulation on land land regulation principles to be established in accordance with Article 18 of the Zoning Law (R.G. 02.11.1985 / 18916).

[7] The other parameters such as location, conservation status, and volumetric consideration do not constitute part of the value assessment.

[8] Law No.5403, "Land and Land Use Law" (R.G. 19/7/2005-5403).

[9] Law No.5403, "Land and Land Use Law" (R.G. 31/1/2007-5403).

substitute land for the designated land uses, the Ordinance can allow agricultural property to be used for non-agricultural purposes (Table 1).

**Table 1.** Exceptional cases for the conversion of agricultural land into non-agricultural uses

| | |
|---|---|
| 1. | Strategic need for defense |
| 2. | Temporary Settlement Requirement after Natural Disaster |
| 3. | Petroleum and Natural Gas Search and Operation Activities |
| 4. | Mining activities |
| 5. | (Public interest) Road infrastructure-upper building activities |
| 6. | Energy source areas |
| 7. | Geothermal-based technological greenhouse investments. |

Although the Ordinance establishes a strict conservation status for agricultural land, it also allows for some flexibility, such as the transformation of agricultural lands into urban land with a “appropriate” view obtained from the local municipal administration and the provincial directorate of Agriculture10 in the administration of the city’s metropolitan areas to transform cadastral parcels (agricultural field, vineyard, garden, etc.) that are not directly included in the local development plan’s limit. Furthermore, illegal constructions on agricultural fields that authorities seem unable to manage or condone are indeed widespread (Figure 4).



**Figure 4.** Incompatible structures built on agricultural lands in Torbalı
(https://earth.google.com/web/search/torbal%c4%b1/)

Traditional land use planning is also known to be ineffective in the face of illegal developments spreading quickly over agricultural lands near urban limits and incapable of demonstrating the necessary control; on the contrary, authorities may have approved practices that make it difficult to protect agricultural land with Development Plan zoning decisions.

[10] Provincial directorate of the Ministry of Agriculture and Forest.

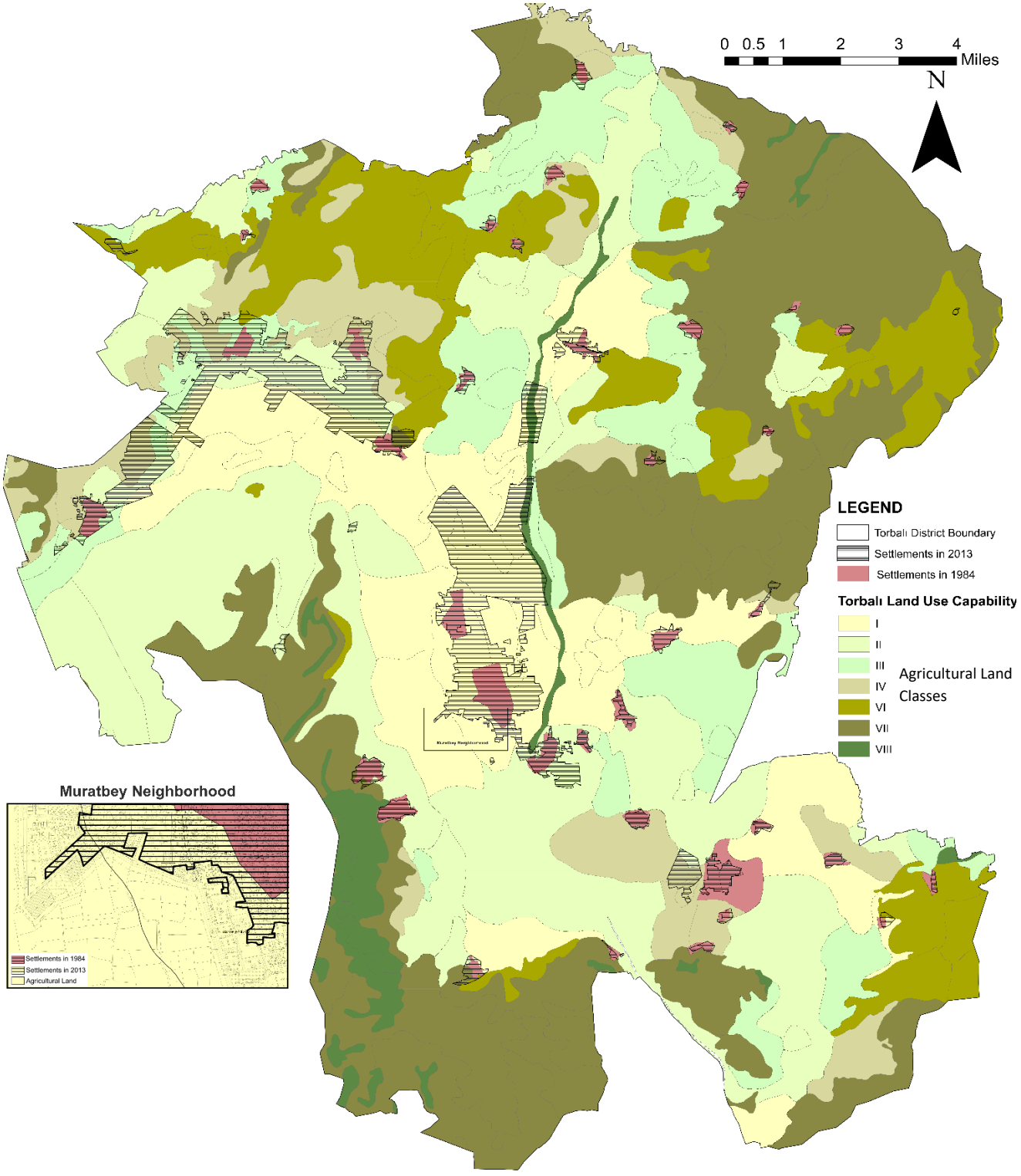



**Figure 5.** Torbalı's Agricultural Land-use Capability Map (Izmir Special Province Administration, 2013)

As a result, public lands in general and agricultural land in particular can be easily sell out private people, real estate agencies, organization, or even transfer in Turkish case. The maps and statistics of the agricultural land exchange in Izmir and Torbali show that agricultural areas have been substantially changed and covered with diverse urban purposes by years (Figure 6). Izmir's agricultural land has decreased by 15.25% since 1995 and Torbalı's agricultural land decreased by 25,57% from 1995 to 2015 (TURKSTAT, 2022).

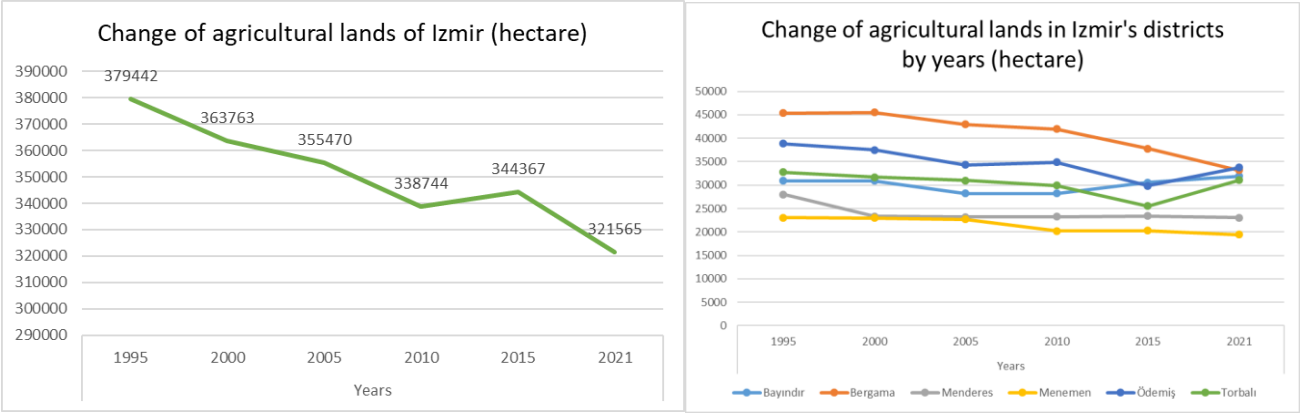



**Figure 6.** Change of agricultural lands of İzmir and some selected districts (Source: TURKSTAT, 2022)

Another major concern is the populist policy of amnesty laws and normalization of illegal developments. The most important regulation, which recently reorganized the zoning rights and caused confusion in the venue and on the legal plane, was enacted by law no. 7143[11] under the name of "zoning peace" despite being a zoning amnesty (2018). The most comprehensive of the zoning amnesty slated for Turkey's urbanization date came into force ahead of local elections on June 24, 2018. This does not contradict the nation's populist policy characteristics. With this law, amnesty has been introduced to almost all illegal structures.

Amnesty laws is not particularistic rearrangements of the development rights heavily related with the Turkish politics popular character, however, this rearrangement of the amnesty under the rubric of "peace" was the most extensive one and has been introduced to almost all illegal structures by paying a fee. To summarize, the idea that "the state forgives one day anyway" has become internalized in large parts of society, resulting in an increase in illegal construction and rendering the regulatory and control mechanisms of planning obsolete.

As a result, our findings reveal that traditional land-use planning and execution by local authorities has significant flaws and limitations when it comes to protecting rural regions and regulating urban expansion in a sustainable manner. Traditional planning methods have a number of shortcomings when it comes to managing externalities and guaranteeing social equity in development rights allocation. The need for structural rehabilitation is urgent, and it is hard to include new tools like TDR as a supplementary and corrective strategy for long-term sustainability within such a planning framework. However, as planners, we want to believe in more active and socially accepted planning with the space that history has created and the trickle-down impact of international policy applications (Amponsah et. al., 2022).

## 5. TDR Model

### 5.1. Land Value Assessment for the Agricultural Land

The concept of "**value assessment**" lies at the rationale of the transfer of the development right. Determination of the concept of "value" and strict clarification of its parameters are crucial in TDR applications. Before the transfer takes place, factors such as the market price value of the sending and receiving areas where the transfer will have departed from and completed, the size of the parcel in the region, and the number of building density should be defined precisely. The TDR program, which is explained in a clear and detailed manner, will both ensure that the model is carried out effectively and that owners can understand the transfer of development rights and use the programs (REF). Technicians and administrations have developed criteria and methods to establish land classifications capable of ensuring fair and equal treatment of property in order to appropriately categorize each property. The segmentation of conversion areas is determined from an economic standpoint as a result of their effective usage, which reflects either their actual or potential value (Micelli, 2002). The expected land rent is determined by anticipated urban trends as well as future urban planning and specific spatial projects.

Agricultural production is dependent on the availability and existence of soil as a resource. Agriculture's viability is heavily dependent on the supply of soil and the continuity of production, which can be seen of as insurance for rural landowners and communities.

The "**direct comparison valuation methodology**" is commonly used one in the land valuation in Turkey. The factors and method of the land valuation is stemmed from the "Expropriated Law" (R.G. 2942/8/11/1983). The valuation of the agricultural land is done by the principles stated in the article 11 and 15 which is named as the "Principles of Determination of Expropriation Fee[12]". The value of the land (expropriation fee) is evaluated according to the **net income** to which the land is used according to the location and conditions (11/1-f of the Law).

[11] Amnesty Law, No: **7143. The name of the Law is "Development peace" (R.G. 18.05.2018 / 30425)**

[12] (R.G. 2942/8/11/1983). "*Kamulaştırma bedelinin tespiti esasları"*

In Turkey, the "direct comparison value methodology" is widely employed. The "Confiscated Law" (R.G. 2942/8/11/1983) established the criterion and method for assessing land value. The "Principles of Determination of Confiscation Fee" are used to value agricultural land. The valuation of the land (confiscation fee) is calculated by the **net income** generated by the land, taking into account its location and characteristics (11/1-f of the Law). Although the parameters to be considered in the evaluation are specified in the law's titles, court decisions have largely shaped what they mean and how to apply them (Aslan, 2020).

In accord with the "direct comparison method" to appraise properties inside the zoning plan's allowed limit and parcels outside of it, we first calculated the net income from agricultural yields (Table 2). According to "Soil Law, No. 5403, the designated agricultural area for the assessment is a first-class watery agricultural land with absolute protection status (Fig 5). Before calculating the net income of agricultural land, the cost and productivity of the crop grown on that property must be determined. Because land that is currently being used to cultivate a profitable crop is less likely to be sold for urban expansion. The larger the profit, the more likely the farmland will be preserved. It is known that agricultural land can only withstand urban sprawl if the profit from agricultural production surpasses the benefit from urban expansion (Catalan, 2008: 180-181).

For the valuation of the agricultural land named as the" income capitalization method" commonly used in Turkish agricultural property appraisal for those areas located away from 1,5 km and more than 1,5km. First **(1)** the net income obtained from the agricultural production is calculated; and then **(2)** the price of the land with respect to the its proximity to the urban area is appraised. For this appraisal the capitalization rates of interest are employed in accord with the decisions for the stable High Court's[13] Judgment and Ordinaces. The percentages are used as the capitalization rate as follows; Four percent (4%) for wet agricultural land, five percent (5%) for dry agricultural land, and seldom six percent (6%). Capitalization interest on high-value agricultural products is low, but when the product's economic value declines, the interest rate rises.

For the calculation of net income is as follows: 1) It is common usage that the farmers of Torbalı region, there is a four-year round change for the agricultural crops to protect the soil's productivity and economic return from the production. It has to be taken into account that, once in a four year the crop type has change to protect the soil fertility. Tomato, cabbage, corn, cotton, and green peas are among the crops planted cyclically in Izmir's agricultural production system. For instance, first year it is assumed that tomato and cabbage are cultivated; the second year grain corn; the third year is cotton; and finally green pea and silage corn. This crop list is commonly used one in the Izmir's agricultural system especially for those watery agricultural field[14] (see Table 2). For the second step (2) The economic return of the product is divided by the capitalization rate to find out the net land price of the agricultural property. The formula can be seen below.

**Table 2.** Average agricultural product income and costs in Izmir ((Agricultural Directorate of Izmir, 2021)

| Crop | Total Area (da) | Yield (kg/da) | Price (TL/kg) | Product Cost (TL/kg) | Net Income (TL/da) |
|---|---|---|---|---|---|
| Zucchini (Gum) | 200 | 3,000 | 1.50 | 1.41 | 268.83 |
| Celery (Root) | 2,460 | 3,041 | 2.50 | 2.33 | 515.81 |
| **Cabbage** | **350** | **3,500** | **2.00** | **1.34** | **2312.43** |
| **Cotton** | **241,885** | **550** | **11.44** | **7.23** | **2315.26** |
| **Green Peas (Fresh)** | **6,200** | **1,300** | **3.60** | **3.01** | **759.42** |
| Pepper (Charliston) | 503 | 4,012 | 3.03 | 1.80 | 4,939.82 |
| Tomato (Paste) | 104,803 | 9,359 | 0.64 | 0.58 | 608.30 |
| **Tomato (Table)** | **14,801** | **6,371** | **2.28** | **1.12** | **7,360.25** |
| Engineer | 8,437 | 1,362 | 7.56 | 4.03 | 4,810.05 |
| Cucumber (Table) | 1,323 | 4,249 | 2.91 | 2.13 | 3,336.03 |
| Zucchini (Gum) | 200 | 3,000 | 1.50 | 1.41 | 268.83 |
| Celery (Root) | 2,460 | 3,041 | 2.50 | 2.33 | 515.81 |
| Lettuce (Aysberg) | 100 | 4,250 | 1.50 | 1.06 | 1,854.92 |
| **Corn (Grain)** | **98,771** | **1,307** | **2.49** | **1.84** | **847.95** |
| **Corn Silage Rack** | **452,129** | **6,711** | **0.47** | **0.38** | **625.72** |
| Aubergine | 905 | 3,312 | 2.01 | 1.68 | 1,090.18 |
| Leek | 7,930 | 4,015 | 1.93 | 1.82 | 442.27 |
| Onion (Dry) | 700 | 5,000 | 0.90 | 0.60 | 1,482.69 |

[13] The capitalization rates of interest in stable High Court (*Yargıtay 5. Hukuk Dairesi*) judgements are 4 percent for watery agricultural land, 5 percent for dry agricultural land, and seldom it reaches 6 percent.

[14] This information has been gathered from the interviews with Izmir's Agricultural Directorate, farmers and agricultural engineers working on the fields.

The formula was applied to all of the crops grown in the provinces of Izmir, and data from the Izmir Agricultural Directorate revealed that the tomato was the most productive crop (Table 3).

**Step 1.** The calculation of crops' net income
The formula: **(A – B) X C**

| | |
|---|---|
| A: Price | C: Yield |
| B: Product Cost | D: Capitalization rate |

To calculate the net income of tomato (table);
(2,28 – 1,12) X 6,37 = 7360.25 TL/da

**Step 2.** The calculation of the land value
The formula: **(A – B) X C / D**

To calculate the land value of tomato (table);
(2,28 – 1,12) X 6,37 / 0.04 = 184006.21 TL

**Table 3.** Calculation Method of the Net Land Price

| Annual Round Change | Crop | Yield (kg/da) | Price (TL/kg) | Product Cost (TL/kg) | Capitalization Rate | Net Income (TL/da) |
|---|---|---|---|---|---|---|
| 1st Year | Tomato (Table) | 6,371 | 2.28 | 1.12 | 0.04 | 7,360.25 |
| | Cabbage | 3,500 | 2.00 | 1.34 | 0.04 | 2,312.43 |
| 2nd Year | Corn (Grain) | 1,307 | 2.49 | 1.84 | 0.04 | 847.95 |
| 3rd Year | Cotton | 550 | 11.44 | 7.23 | 0.04 | 2,315.26 |
| 4th Year | Green Peas (Fresh) | 1,300 | 3.60 | 3.01 | 0.04 | 759.42 |
| | Corn Silage Rack | 6,711 | 0.47 | 0.38 | 0.04 | 625.72 |
| **Total Net Income (TL/da)** | | | | | | 14,221.03 |
| Annual Net Income (TL/da) | | | 14221.03 / 4 | | | 3555.26 |
| The Value of 1 Decare of Land | | | 3555.26 / 0,04 | | | 88000.00 |
| The Value of 1 Square-meter of Land | | | 88000 / 1000 | | | **88.00** |

This calculation is valid for the locational appraisal of the agricultural land. For the proximity parameter away from urban center we use four rings according to the length in meters respectively 200m (the closest first ring to the urban area), second ring 400m, third ring is the 1,5 km, and the most remote areas (Fig 7). The fourth ring the calculation is as follows. The result according to the method indicated in the Table 3 is equivalent to the value, **88.000 TL/Decare**[15] for the watery agricultural land.

### 5.2. Land Value Assessment for The Urban Land

The method was employed for the appraisal of the urban land, which is known as the "construction right in return for flat" in Turkish Planning System. For this **(1)** it is derived the substantial number of sales data of the residential unit that reflects the market price of the property[16] as stated in the title deed. The criterias for the selection of the residential units are; 1) it has to be located in the Urban Planning Area. And the second (2) it has to be close proximity to the agricultural land, and finally (3) Recently sold residential units (Table 4). Then the average selling price has obtained which was 7000 TL/$m^2$ according to the selected residential units.

After the calculation, the Development Plan's building permission has taken into account to find the land value plus the building value, which is constructed at this land. Let's explain in the sample. Suppose we have a 4-story residential building on a 333.33 $m^2$ plot of land with respect to the building code of the Torbali's Development Plan which is 0,30 building footprint ratio (BFR) and 1,20 is the floor area ratio (FAR). The ground floor size is 100 $m^2$, whereas the rest of the flats are 115$m^2$. The floors prices are not the same because of the climatic factors. The ground floor's price is the lowest and the top is the second lowest, on the contrary the mid-floors are of the the highest price. To calculate each floor's price, we use index which are 0,925 for the top floor, 0,91 for the ground floor for the normalization of the price. The ground and top floor's price are lower than the mid-floor because ground floor generally has the lowest floor space whereas the top floor has some

[15] Decare (*dönüm*) is the land measure of the 1000 m2.

[16]Sahibinden.com is a popular website in Turkey for selling real estate, automobiles, and other items. It is a website that allows users to post commercials and conduct e-commerce transactions in a variety of categories, including real estate, autos, retail products, and services.

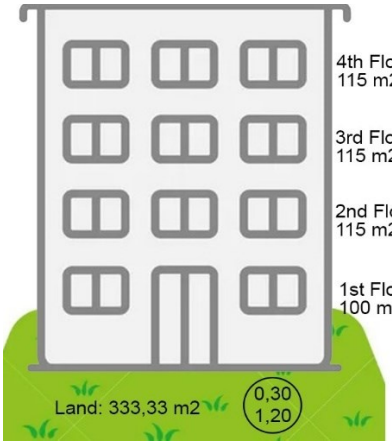
kind of climatic inconvenience stemmed from heathing, wind and escalator, etc. (Table 5). As a result, the **total value** of the sample building is **2.992.000** TL (the value of the urban land located in the Official Development Plan of Torbalı).

**Step 1.** Determining housing prices in the immediate vicinity and the average market value for a housing unit

**Table 4.** Calculation Method of the Average Price of a Housing Unit

| | Housing unit price (TL / m2) | Gross area (m2) | Price (TL) | Number of floors |
|---|---|---|---|---|
| **1** | 7500 | 100 | 750 000 | 5/5 |
| **2** | 6950 | 100 | 695 000 | 2/6 |
| **3** | 6896 | 145 | 1 000 000 | 5/6 |
| **4** | 6650 | 100 | 665 000 | 3/4 |
| **Total** | 27996 | | | |
| **Average price** | 27996 / 4 | 7000 TL/m2 | | |

**Table 5.** Calculation Method of the Average price of a Housing Unit




| | A | B | C | D |
|---|---|---|---|---|
| | **Housing unit price (TL / m2)** | **Gross area (m2)** | **Index** | **Price (TL)** |
| **1st Floor** | 7000 | 100 | 0,91 | 637 000 |
| **2nd Floor** | 7000 | 115 | 1 | 805 00 |
| **3rd Floor** | 7000 | 115 | 1 | 805 00 |
| **4th Floor** | 7000 | 115 | 0,925 | 745 000 |
| **Total Price (TL)** | | | | 2.992.000 |
| Formula to find each floors price | | | D = A X B X C | |

**Step 2.** Determining net income of the urban land by using 'construction right in return for flat' index

**Formula = ( A X B / C ) / D** = (2.992.000 X 0,45 / 1,20 ) / 333,33 = **3366 TL/m²**

A: Total price

B: 'Construction right in return for flat' coefficient (It is **45%** for Torbalı)

C: Cash payment coefficient (**1,20**)

D: Land area

**Step 3.** Converting urban land value into the cadastral land value;

3366 X 0,55 = **1850 TL/m²**

The next step (**2**) is to find out the net income which is calculated by utilizing the normalize index. The index named as "the rate of the construction right in return for flat" is generally **45 percent** in Torbalı and determined by the responsible bodies and multiple agents[17]. The developer's share in the total value (2.992.000 TL) of the property is equal to 55 percent of the property whereas the landowners' share is the 45 percent. The landowner either got the value in cash or have the residential unit with respect to the 45 percent. If the landowners would prefer actual payment in cash the coefficient **(1,20)** has to be taken into calculation for the risk the constructor for the marketing of the property and to encourach the constructor keep on the building activities. The share of the landowner is (2.992.000 X 0.45) equivalent to the 1.346.400 TL and when this value is divided by the 1,20 the net gain for the property owner is equal to the 1.122.000 TL. The unit value square meter is then 1.222.000/333.33 (the land size), which is **3366 TL/m²**. This value is the net income obtained from the urban land.

The final step (**3**) is to convert urban land into the cadastral land value for the comparision in-between urban land and agricultural land. This is crucial in the Turkish planning system for the conversion of non-urban land (agricultural land included) into the urban land "land readjustment process" is used known as the "dough rule" (*hamur kaidesi*, Article 18). This readjustment is utilized as a private property public control mechanism because after the required land readjustment,

[17] After calling various real-estate consultors and constructors we learnt that the ratio is 45 percent for the Torbalı. This ratio is 50 percent for Izmir's central areas whereas it is 45 percent for Torbalı because the district is far from the central areas and the existence of the large scale agricultural production.

up to 45 percent of the land should be reserved for public use for the reciprocity of the anticipated (expected) increase in land value. In our sample 3666 TL/m$^2$ X 0,55 is approximately equal to the **1850 TL/m$^2$.**

**In accord with the applications by the** Izmir Greater Area Municipality's Real Estate Appraisal Unit (*Emlak Yönetimi Daire Başkanlığı*) the differences between urban and non-urban (agricultural land) land values is of the **one-and-four** rate between the lands in the areas 200 m away from the approval limits of the Development plan's and the urban areas. This is equal to the (1850 / 4) = 460 TL/m$^2$. And the next ring is of 400 m far from the approval boundary and the land in this ring is **two-and-third** and the value for this ring is equal to 460 X (2/3), which is approximately **300TL** (Table 6).

**Table 6.** The estimated amount of TDR removed from the sending area

| | Features of the rings | Distance to the Boundary of the Development Plan (urban areas) | Indexes | Land value (TL/m2) | The estimated amount of TDR removed from the sending area |
|---|---|---|---|---|---|
| **Within the planned urbanized zone** | Land from the Development plan's approval boundary | - | | 1850 | - |
| **1st ring of the agricultural land** | The land with the highest expected rent (waiting for including official development plan's building rights) | 200 m | ¼ (of the urban land value) | 460 | 0.25 |
| **2nd ring of agricultural land** | The land with high expected rent (waiting for including official development plan's building rights) | 400 m | 2/3 (of the 1st ring value) | 300 | 6,2 |
| **3rd ring of the agricultural land** | Objective value increment[18] | 1.5 km | Income capitalization calculation | 110 | 16 |
| **4th ring of agricultural land** | Pure agricultural land, no pressures of the construction, further away urban area | more than 1.5 km | 4/5 of the 3rd ring value | 88 | 21 |

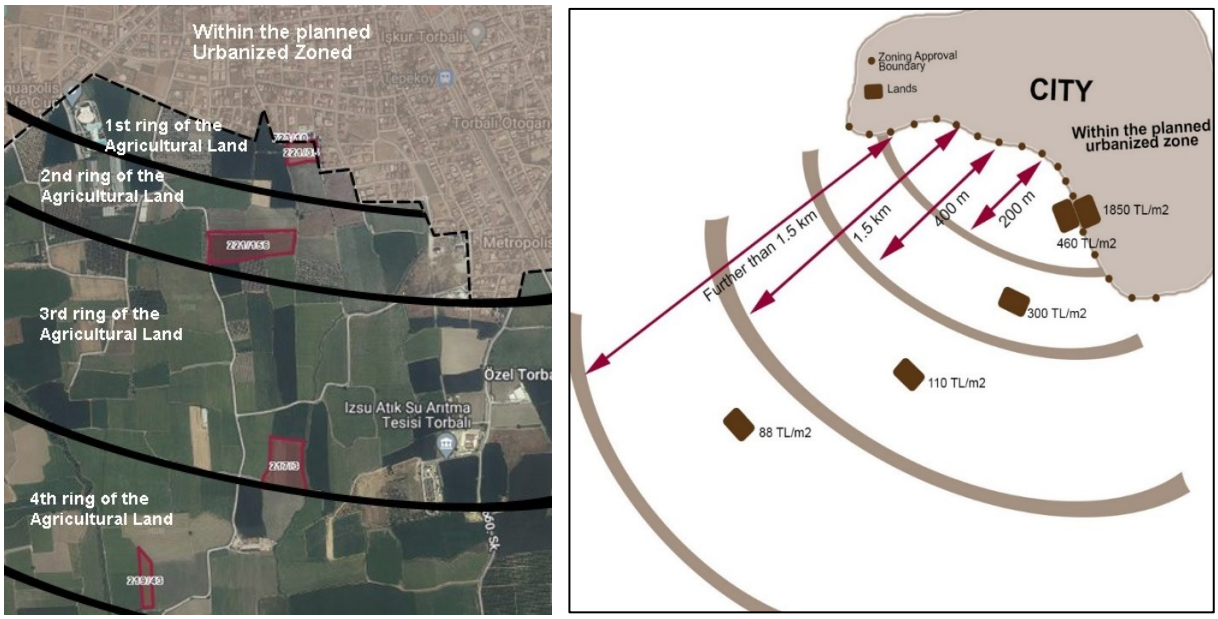



**Figure 7.** The agricultural land rings of Muratbey Neigborhood

## 6. Conclusion

TDR, as a planning tool, compensates property owners for economic losses caused by development limitations or downzoning, rather than the state paying for the confiscation of the property. The determination of how many TDRs to issue

[18] The "objective value increment" ratio is obtained from the Court's Decisions taken by the Izmir Greater Area Municipality's Real Estate Appraisal Unit. The "objective value increment" has regulated by the Confiscation Law (Law No. 2942) in article 11-f under the subheading of the "Agricultural Land Immobile Property's Value Appraisal".

to property owners in the sending areas and how many TDRs a developer needs to build an additional dwelling unit or amount of commercial space in a TDR receiving area is very crucial. The difference between conservation and conservation-free market values as the equivalent of the development right is derived from the 'density limit' or 'unused growth' to be transferred by equalizing the amount of TDRs elevated from the sending areas and then landing in the receiving area with the appropriate transfer ratio as defined in the statutory planning.

Our findings show that there is a large price difference between adjacent urban and rural land (between *Muratbey* neighborhood and adjacent agricultural land). The conversion of agricultural land for urban development would be facilitated by rising land values in the rural-urban outskirts. The first ring of the agricultural land value differential is 0,25 whereas the second ring is 6,2. Similarly, the difference between urban areas is 1/16 (3rd ring) and the most remote ring (more than 1,5 km) is 1/21. These ratios illustrate the high danger of agricultural land conversion, starting with the close proximity (1st ring) and ending with the far one (4rd ring).

Land maintenance is essential for continued rural production, and past and future environmental concerns must be addressed on a regular basis by rural landowners and rural communities to ensure agricultural production's viability. If the findings discrepancies are not addressed in the urban growth strategy in land use planning, the conservation of agricultural land and the long-term viability of food production would be threatened severly. A new approach in which the mobilization of actors using TDR as a resource and indispensable planning tool should be included in the decision-making and management process in safeguarding agricultural production and valuable soil for production, rather than difficulties or victimization due to protection.

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# Structures of Community Life in Portuguese Home-Villages: Two Case Studies

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**Abstract**
This study aims to investigate the structures of community life in Portuguese Home-Villages and the consequences of an ageing demographic population; the need to implement home structures for the elderly and on how these can contribute to a revitalization of the depopulated territories. Last datas showed a concentration of the population in the metropolitan areas and a depopulation of the inland rural areas with resident ageing population – mostly in Alentejo-Algarve border. However, this could be perceived as an opportunity rather than a problem in dealing with depopulated villages. Two case studies were selected, the Home-Village of São José de Alcalar and Monte da Palhagueira, both located in the same rural region (Algarve). The characteristics of the urban and population structures were identified, and a comparison with similar structures already existent in other countries was established.A project of intervention was elaborated, aiming to revitalize the Monte do Pessegueiro – already depopulated.
**Keywords:** Home support; Territory revitalization; Spatial Equity; independent living in old age

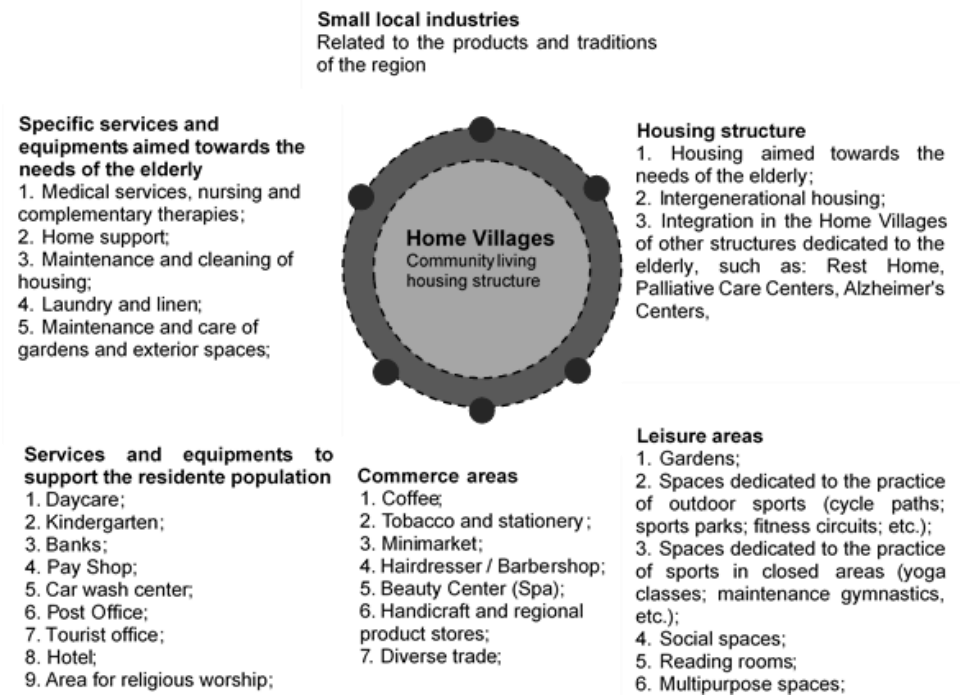
## 1. Introduction

Population aging presents itself as one of the great challenges of the 21st century for the different areas of the social, political and human sciences. In this way, and from the architectural thinking view, the issues related to housing for the elderly go beyond the concerns with the physical and psychological barriers of the housing nucleus and are transversal to the planning and planning of the territory. With the aging process in progress, it is necessary to promote mechanisms that allow the dynamism of the territory in order to avoid the depopulation of the interior.
In the international context, we find housing structures, living in a community, aimed at the elderly population - with consolidated models that are "repeated" and reinterpreted so that they adapt to the needs, characteristics and expectations of the populations they are intended for, as well as the territory in which they are located. In Portugal, these structures are not yet properly consolidated; the closest examples are the Assisted Residences and the Home Villages, where we can find three possible management models: private, public or public-private. The former ones are mostly of private development and closely linked to urban areas, while the Home Villages are more interconnected with rural areas (Karmilah and Puspitasari, 2020). The existing Home Villages do not result from the revitalization of villages or towns in the process of depopulation and, due to the characteristics of their urban form, in the reading of the territory, they lose the character of a village and are identified with the image of “equipment”.

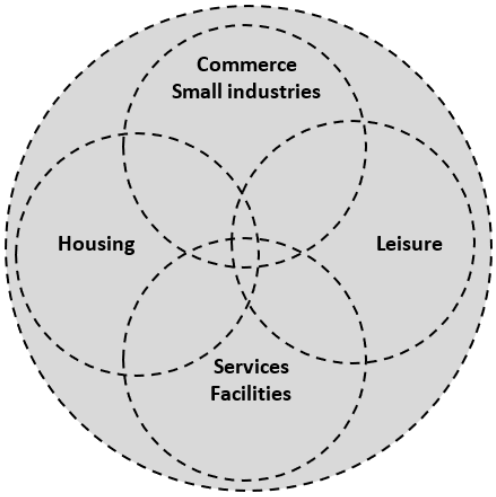
## 2. Physical and structural characteristics of the home villages (aldeias-lar) in Portugal

The concept of Home Villages presented in this investigation is based on the principles exposed by João Martins (2007) and Carminda Cavaco (2009), which can be defined as a housing structure geared towards the needs of the elderly, which values and encourages the community life, where, from the architectural point of view, this valorization should be developed through the characteristics introduced in the organization and distribution of spaces. In other words: in the way in which the distribution of buildings is structured (proximity and neighborhood relations); in housing typologies (generally single-family housing, with one or two floors, with a maximum of three bedrooms per dwelling); in the design and organization of non-built spaces (streets, gardens, vegetable gardens, patios or spaces for outdoor sports); of permanence and conviviality (interior or exterior); and in the detail introduced in the design of public and private spaces (lowered thresholds, sidewalks with the necessary width for the passage and crossing of people with reduced mobility and lowered next to the crossing zones; introduction of mobility support equipment inside and outside of buildings).
There are other factors that are fundamental for valuing community life and are related to the offer of services, the affinity relationships between the resident population, the size of the village, as well as the relationship established between the technical staff, residents and their family members.
The Home Villages seek to oppose the isolation and institutionalization of the elderly; promote its valorization and active aging. At the same time, they can contribute to the valorization and revitalization of the territory - from the physical (built-up), economic and demographic point of view - through the offer of employment that encourages the

establishment of the population, which can be established on the basis of differentiating offers, which promote the well-being of the populations (commerce, services, places of conviviality, day care, kindergarten) – Scheme 1 and 2.




**Scheme 1.** Physical and structural characteristics of the Home Villages Examples of possible structural elements to be introduced in the implementation of a Home Village, as a housing structure that promotes community life aimed towards the needs of the elderly.




**Scheme 02.** Proximity relations between the generating functions of a Home Village
Main functions established for the implementation of a Home Village as a structure that promotes community life: Housing | Services and Facilities | Commerce and Small Industries | Leisure.

These villages should integrate intergenerational housing structures and/or other facilities to support the elderly, in addition to different service spaces, commerce, leisure facilities, small local industries (related to the products and traditions of the region), in a relationship of continuity with the territory - Scheme 01.
For the characterization of these villages, ***it is necessary to understand what distinguishes the Home Villages from the different housing structures dedicated to the needs of the elderly in Portugal.*** One of the main differences lies in the valorization of community life, against the image of institutionalization and isolation, often associated with Homes for the Elderly. In Home Villages, the proximity between residents is an asset, namely through the sharing of

outdoor spaces, close to the dwellings. A feature that was fundamental during the period of isolation, caused by the world pandemic, and that allowed the enjoyment of outer space, with respect for the necessary distancing and isolation rules.

The type of housing used – single-family or single-family dwellings with a ground floor or two floors – presents itself as a potentiating factor for the implementation of community life. These housing models are also used in senior communities in Northern Europe and North America, such as senior cohousing. The proximity between services and people contributes to the improvement of their quality of life – Diagram 02.

The possibility of the Home Villages being introduced as an integral part of a process of revitalization of a certain region, could present itself as an added value, from the point of view of promoting quality housing and services, as well as economic development. and local tourist. So, ***how can Home Villages function as revitalizing structures in the interior of the national territory in the process of depopulation?***

In Revitalizing our small towns: Recent examples from Southern France, Charles Durrett (2012) presents the revitalization process implemented in the region of French Provence. In this region - recognized for its gastronomy, wine production, political and cultural influence - 67 small towns came together to identify the most critical aspects of their problems, developed solutions and acted to "save" their communities, marked by a process depopulation, with countless vacant dwellings – after the departure of the younger populations, who had no jobs in their cities – and where commerce and services closed. Cities that had more than 3,000 inhabitants now have around 900. The author identifies twelve principles, applied at the urban planning level, which he considers fundamental for the current revitalization process of this region and which present a positive demonstration of results.

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1. The existence of well-defined borders, which demarcate the limits between the city and the countryside – the urban and the rural.
2. The existence of pedestrian streets, as a privileged form of travel and interaction between residents.
3. The existence of an incentive for the development of local commerce, whose presence is reflected on the street scale.
4. The existence of small squares for regular fairs and markets, where local producers can sell their products.
5. The existence of suitable places, different from the other routes for car parking.
6. The existence of adequate vehicles at the scale of the town or city (use of public transport, of adequate dimensions, using fewer polluting fuels, namely electric vehicles).
7. The existence of a project and planning that take advantage of and value the resources available in the territory, in which new uses can be established according to the needs imposed by the revitalization process.
8. The existence of a plan that supports investment, the economy and local industry.
9. The existence of a revitalization, which is also reflected in the local economy, generates an increase in tax revenue - due to the increase in new businesses and new residents - which allows for a continuous investment in infrastructure and its maintenance.
10. The existence of cultural and architectural heritage maintenance provides a unique feeling of place.
11. The existence of schools, employment, housing and opportunities fixes younger populations, which prevents depopulation.
12. Revitalized cities are accessible to all citizens, including the elderly.

Durrett Durrett suggests the transposition of these principles to small towns in the interior of California – with similar depopulation processes – and defends their potential as elements that stimulate the revitalization of the territory, especially when associated to the implementation of communities such as cohousing or senior cohousing, which bring new residents and a new social, cultural and economic dynamic.

These principles may also be transposed and adapted to the needs and characteristics of the interior of the Portuguese territory, which is experiencing a similar process of aging and depopulation, which worsens year after year. If we add factors such as the tourist potential that Portugal offers (climate, architectural, cultural and scenic heritage), the demand by the foreign population, of retirement or pre-retirement age, of Portugal as a permanent or seasonal place of residence; the need to create housing geared towards the needs of the elderly, which simultaneously promote the integration of the elderly in the community, the diversity and intergenerationality of the territory, then we can think about the revitalization and dynamization of the territory through the

implementation of structures such as the Home Villages - which could be valued if integrated into networks with a regional (or national) dimension, as is the case in the French Provence region of Luberon.

**3. Case study: Two Home Villages in Portugal**




**Figure 1.** Location in the territory Village of São José de Alcalar e do Monte da Palhagueira (Portugal, Algarve)
Font: Service Layer Credits.Source: Esri; DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and GisUser Community

Two case studies are presented: São José de Alcalar (Mexilhoeira Grande, Portimão) and Monte da Palhagueira (Santa Bárbara de Nexe-Gorjões, Faro). The choice of these two cases is related to factors that enhance a different experience in two communities built with the same objective, where we find the following points of reference:

- Belonging to the same geographic region: the Algarve;
- They were built at the same time (São José de Alcalar started in 1989 and Monte da Palhagueira in 1990);
- They present distinct urban characteristics of insertion in the territory;
- They have different management characteristics: (São José de Alcalar – Public/private; Monte da Palhagueira – private);

**3.1 Village of São José de Alcalar**

Based on the cartographic reading of the Village of São José de Alcalar, the neighborhood and proximity relations with central support facilities were analyzed: Hospitals, Health Centers, sports facilities, beaches, Marina and Airfield – Table 1.

The village is served by good communication routes (national road and motorway), which allows easy access to central facilities and the city of Portimão, despite the proximity, it is necessary to resort to the car - in a region where the public transport network is deficient, this fact limits the mobility of residents. The village has terrestrial, mobile and internet telecommunications services.

The territory of its reference area, as in much of the Algarve, is marked by the existence of tourist villages, most of which do not obey any local memory (either in the form of occupation in the territory or in the architectural structure of the buildings). They are implanted in the territory in the form of subdivisions / urbanizations built with their own urban order, almost closed in on itself - like islands - and, mostly, with a seasonal occupation.

The reading of the São José de Alcalar microscale was established through a survey. The village extends over an area of about 1.8 hectares and 63% of the total area is unbuilt, of which 28% are for landscaped green spaces and the remaining 35% for residents' gardens, outdoor recreational facilities (amphitheater, geriatric park and squares) and vacant land. The gross construction area for housing represents 17% and the gross construction area for services represents 20% of the total gross built area in the village – Table 02.

**Table 01.** Proximity relations between the village of São José de Alcalar and the central facilities - Analysis of the macro scale of the village

| CENTRAL SUPPORT FACILITIES | DISTANCE | TIME (1) |
|---|---|---|
| Hospital of the Western Algarve | 9 km | 12 min |
| Alvor Private Hospital | 11 km | 20 min |
| Portimão Health Center | 11 km | 17 min |
| Mexilhoeira Grande Health Center | 4,5 km | 6 min |
| Portimão Sports Pavilion | 12 km | 23 min |
| Portimão Municipal Swimming Pools | 13 km | 23 min |
| Portimão Municipal Tennis Complex | 13 km | 23 min |
| Alvor Sports Complex | 11 km | 20 min |
| Penina Hotel Golf Course | 5 km | 7 min |

| | | |
|---|---|---|
| Golfe do Morgado | 11 km | 23 min |
| Palmares Golf | 15 km | 22 min |
| Portimão Marina | 14 km | 27 min |
| Beach Line (access to Praia da Rocha) | 13 km | 23 min |
| Portimão Aerodrome | 7,5 km | 11 min |

**Note:**
1. Average time to complete the route. Distance traveled by car, in accordance with the regulations and indications of the highway code

**Table 02.** General characterization of areas in the village of São José de Alcalar Village microscale analysis

| **GENERAL CHARACTERIZATION OF AREAS** | |
|---|---|
| Total land area | 18.280,00m$^2$ |
| Gross building area intended for housing* | 3.395,00m$^2$ |
| Gross building area for administration and services | 4.150,00m$^2$ |
| Total gross building area | 7.545.00m$^2$ |
| Implantation area intended for housing* | 2.142,50m$^2$ |
| Implantation area intended for administration and services | 3.395,00m$^2$ |
| Total implantation area | 5.537,50m$^2$ |
| Area for access, spaces and outdoor facilities | 7.042,50m$^2$ |
| Area for green spaces | 5.700,00m$^2$ |
| Total occupancy index | 0,3 |
| Total construction index | 0,4 |

* Permanent own housing

It offers different equipment and support services to the resident population, as well as to the neighboring community: geriatric park; general medicine consultation service, nursing service and a small ward with four rooms (for possible support to the resident population); nursery; kindergarten; leisure activities center for young people and religious celebrations. The existence of the day care center, kindergarten and leisure activities center allow the existence of an intergenerational dynamic that, however, is occasional, since children, young people and their families do not live in the village – Figure 2. Regarding the maximum accommodation capacity, in a permanent housing structure, it is 130 residents, spread over 52 dwellings that are developed in ground floor terraced apartments, consisting of 26 T1, 18 T2 and 8 T3. All dwellings have sanitary facilities adapted to the needs of individuals with reduced mobility. The open kitchen area to the common room facilitates mobility in the space. The porch, in front of the dwellings, is a place of permanence and conviviality between the residents and makes the transition between the private space and the public space – Table and Image 3.



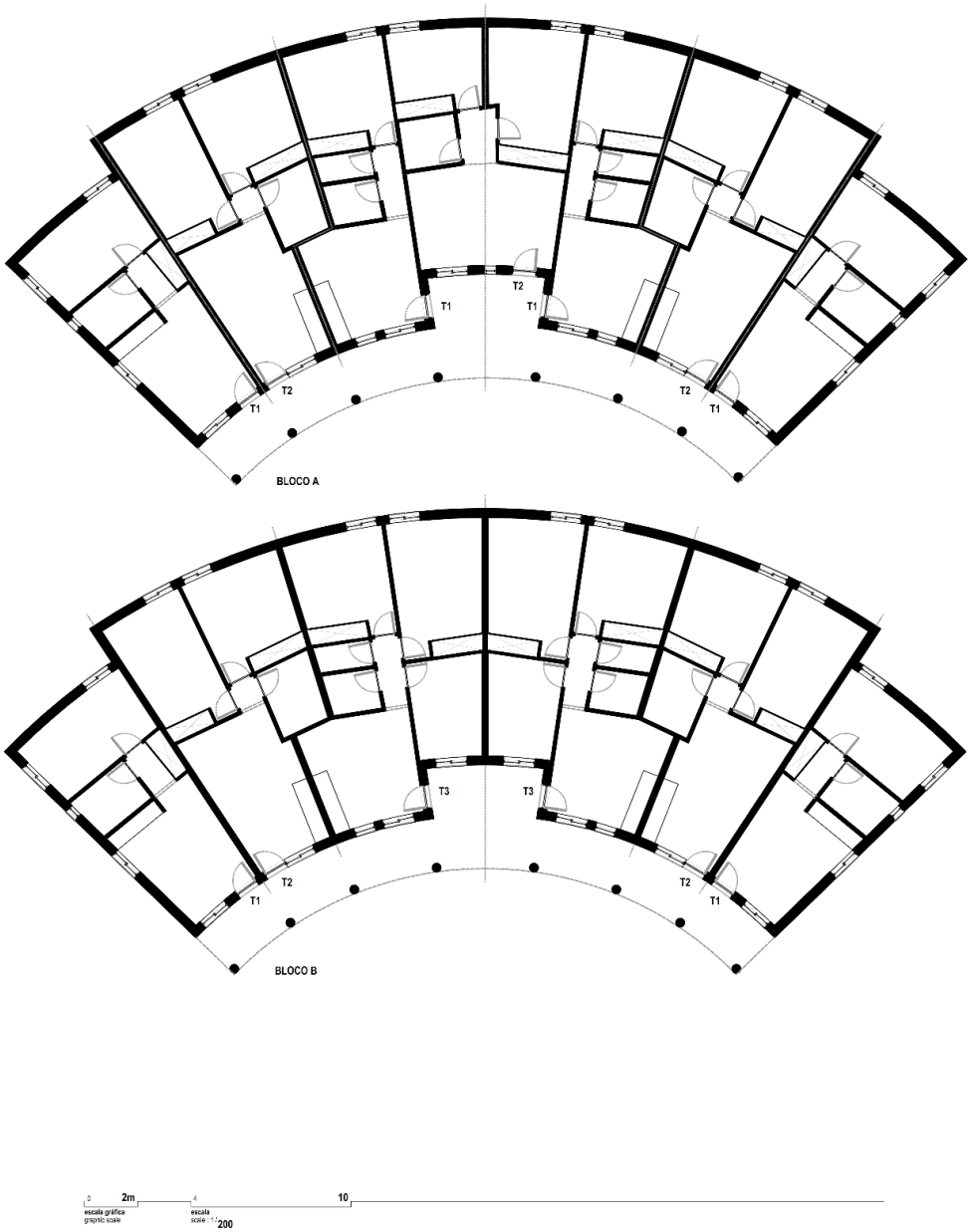

**Subtitle:**
Total land area: 18.280,00m$^2$
1. Parking / Access to the village
2. Central Building: Administrative area; chapel; multipurpose room; library; living room/tv; refectory; kitchen; barbershop; laundry/clothing; hairdresser/barbershop; doctor's office; nursing and treatment room; nursery; technical and personnel areas.
3. Outdoor Amphitheater
4. Geriatric Park
5. Building for small commercial areas: cafe, mini-market
6. Housing: T1, T2 and T3 typologies
7. Multifunctional building: day care; kindergarten; ATL; visitor reception area (dorm, sanitary facilities and living area); multipurpose room; kitchen; refectory; technical and personnel areas
8. Residents' gardens

**Figure 2.** Village of São José de Alcalar - Implementation / Topographic Survey (not geo-referenced)

**Table 03.** Relationship between the existing typologies in a permanent housing structure and the possible number of occupants in the village of São José de Alcalar Village microscale analysis

**TYPOLOGIES OF PERMANENT OWN HOUSING / RESIDENTS**

| | **HOUSING** | **OCCUPANCY** |
|---|---|---|
| T1 | 26 units | 52 |
| T2 | 18 units | 54 |
| T3 | 8 units | 24 |
| Total | 52 units | 130 |




**Subtitle:**
Block A: 4 T1 type dwellings
3 T2 type dwellings
Block B: 2 T1-type dwellings
2 T2 type dwellings
2 T3 type dwellings

**Figure 3.** Village of São José de Alcalar - Plan of a set of two blocks of housing space

### 3.2 Monte da Palhagueira

Based on the cartographic reading of Monte da Palhagueira, the neighborhood and proximity relations with Hospitals, Health Centers, Train Station, Porto and Recreation Marina were analyzed; Trucking station; Faro International Airport; universities; commercial areas; public gardens and parks; coastline; and golf courses – Table 4. The village is relatively close to the urban area of influence: the city of Faro (17km) and the town of Santa Bárbara de Nexe (4km). As in São José de Alcalar, it is necessary to use private means of transport; in this case, the village provides this service, and it is possible to arrange transport. The village is also well served by access roads (motorway and national roads) and mobile, terrestrial and internet telecommunications.

The nearest town, Santa Bárbara de Nexe, has a post office, tax office, bank agencies, insurance companies and different shops. The village's proximity to Faro International Airport is an asset, since the entire resident population is foreign, as well as a large part of the technical team and employees – Table 4.

The organization of its physical structure is marked by the church, in a circular shape, at the beginning of the village, from which the service and housing buildings arise (with a maximum of two floors in height) and through these the streets, which articulate between the built and unbuilt spaces, which contributed to the village having a reading of continuity in the territory. As in São José de Alcalar, in its reference area, there is a strong presence of tourist villages, separated by vast areas of natural and agricultural land. About 1km away, we find small villages, located along the roads.

The Monte da Palhagueira microscale reading was established through a survey. The village occupies an area of about 2.8 hectares and most of the area is unbuilt (78%), corresponds to accesses, public and private gardens, lakes, squares, bandstand area, parking lots, small golf training course, tennis court and swimming pool. It has low occupancy and construction rates and the area destined for housing corresponds to the highest percentage of built-up area – Table 05.

It has a Rest House, with 22 suite double rooms; medical services, nursing, physical therapy and occupational therapies; support and maintenance of dwellings and gardens; restaurant; café-bar with bookstore and library; open-air spaces intended for sports; Anglican Church; indoor pool with water treatment room; and, also, the regular holding of a market with regional products. The maximum occupancy capacity, in own housing, is 126 residents, spread over 33 housing units (6T1, 21T2 and 6 T3). Its construction process was gradual: the first house (1T1) was built two years after the start of construction of the Casa de Repouso, in 1992; in 1995, 3 more units were built (1Q1 and 2Q2), between 2000 and 2005, 22 houses were built and, in 2005, the construction process of the last 8 units began. Of the existing dwellings, 11 have a garage, 9 have a porch for parking and 1 have a basement.

**Table 4.** Proximity relations between Monte da Palhagueira and central facilities Macro-scale analysis of the village

| **CENTRAL SUPPORT FACILITIES** | **DISTÂNCE** | **TIME** (1) |
|---|---|---|
| Hospital of Faro | 16 km | 25 min |
| HPP - Hospital of Santa Maria de Faro | 16 km | 19 min |
| Algarve Private Hospital - Gambelas | 16 km | 19 min |
| Faro train station | 16 km | 23 min |
| Faro bus station | 16 km | 23 min |
| Faro International Airport | 16 km | 20 min |
| Faro marina and port | 16 km | 23 min |
| Faro Municipal Theater | 15 km | 21 min |
| University of Algarve - Penha Campus | 15 km | 23 min |
| University of the Algarve - Gambelas Campus | 14 km | 22 min |
| Shopping centers | 15 km | 21 min |
| Beach line | 19 km | 25 min |

Note:
1. Average time to complete the route. Distance traveled by car, in accordance with the regulations and indications of the highway code




**Subtitle:**
Total land area: 28.244.00m$^2$
1. Tennis court and support house
2. Lake and garden
3. Bandstand and playground area
4. Outdoor swimming pool (with ramped access)
   Support house (bar and barbecue)
5. Anglican Church (St. Luke's Church)
6. Restaurant
7. Cafe/Bar and Bookstore/Library
8. Rest Home
9. Pool and outdoor terrace
10. Village Square
11. Golf training course (Pitch and Put Court)

**Figure 4.** Monte da Palhagueira - Implantation / Topographic Survey (not geo-referenced)

**Table 5.** General characterization of areas of Monte da Palhagueira Village microscale analysis

**GENERAL CHARACTERIZATION OF AREAS**

| | |
|---|---|
| Total land area | 28.244.00m$^2$ |
| Gross building area intended for housing* | 4.995,50m$^2$ |
| Gross building area for administration and services | 1.975,00m$^2$ |
| Total gross building area | 6.970,50m$^2$ |
| Implantation area intended for housing* | 2.780,50m$^2$ |

| | |
|---|---|
| Implantation area intended for administration and services | 1.268,50m$^2$ |
| Total implantation area | 4.049,00m$^2$ |
| Area intended for access, spaces and outdoor facilities | 6,095,00m$^2$ |
| Area for green spaces | 18.100,00m$^2$ |
| Total occupancy index | 0,14 |
| Total construction index | 0,24 |

* Permanent own housing

**Table 6.** Relation between the existing typologies in a permanent housing structure and the possible number of occupations in Monte da Palhagueira Village microscale analysis

**TYPOLOGIES OF PERMANENT OWN HOUSING / RESIDENTS**

| | **HOUSING** | **OCCUPANCY** |
|---|---|---|
| T1 | 6 units | 12 |
| T2 | 21 units | 63 |
| T3 | 6 units | 24 |
| Total | 33 units | 99 |

### 3.3 Village of são José de Alcalar versus Monte da Palhagueira

The comparison of data established for the Home Villages of São José de Alcalar and Monte da Palhagueira, allows us to establish some considerations regarding these housing structures:

• The type of management entity may condition, from the outset, the characteristics of the resident population, the types of housing, as well as the services and equipment available; in which structures aimed at populations with greater financial availability (private) tend to offer more differentiated services and housing spaces (namely in the size and quality of housing finishes, as well as in the equipment they have; or in the services they offer: gymnasium , swimming pools, complementary supportive therapies or specialist medical care)

• The quality of the living space and outdoor spaces is one of the fundamental factors for the well-being and quality of life of the elderly. The existence of a direct relationship, without physical barriers, between the interior and exterior of the house enhances the experience of the exterior spaces and the consequent interaction with the neighbors. The analyzed Home Villages belong to a region valued for its climatic characteristics, where residents spend a large part of their day outdoors, especially in the transition space (porches and patios) between the private space of the dwelling and the common outdoor space.

• The definition, in the project phase, of the characteristics of implantation of the physical structure of the Home Villages is fundamental so that its reading is defined in continuity with the territory and in accordance with the characteristics of the region where it is inserted.

• The services available must be suitable for the resident population, as well as for neighboring populations. Thus, different interrelationships with the community can be established, in order to promote the revitalization of the territory, namely: the existence of medical services, nursing, complementary therapies, gym, restaurant, commerce, services, leisure and tourism equipment or small industries, which can attract populations to the interior of the villages.

• Proximity to urban centers - where there are large cultural, sports, educational and state facilities, among others - may or may not be preponderant, according to the characteristics of the resident population. However, easy access to hospitals or health centers is essential, especially for the emotional tranquility of residents.

### 3.4 Reflections Based on Case Study

The Home Villages in Portugal present themselves as an opportunity to respond to the need to implement housing structures geared towards the elderly and, simultaneously, to promote the revitalization of territories in the process of depopulation. Its territorial occupation model allows for a better quality of life and physical and human relationships, even in exceptional moments of a pandemic where the appreciation of the relationship with outer space was evident.

These structures respond to the question of housing needs and services aimed at the elderly, as they respect their mobility needs, as well as their specific care needs and the right to active aging, which values community life and avoids isolation and institutionalization.

Since the construction of these villages, the Portuguese demographic scenario has changed significantly, with a high increase in the aging of the population. Another significant change is the worsening of the depopulation of the interior of Portugal. These facts mark a need for a response, not only for people, but for the territory that is also

aging. In the interior, especially on the border between Alentejo and Algarve, there is a significant number of unpopulated villages, with countless vacant houses, without any commercial activity, without job offers, without young populations (who have moved to urban centers or emigrated) and with isolated elderly people, as is the case of the village of Monte do Pessegueiro, in Martim Longo, for which a synthesis of a possible intervention proposal is presented.

**4. Monte do Pessegueiro: existing situation survey**



**Figure 5 to 10.** Monte do Pessegueiro – Vacant housing (Photographs: Ana Bordalo)

Monte do Pessegueiro, in Alcoutim, marked by a long process of depopulation, meets the necessary conditions for the installation of a housing structure dedicated to the elderly.
Here, we identified 33 vacant dwellings, scattered throughout the village. In some areas we can find sets of 3 to 5 adjacent vacant dwellings, which would allow the requalification of the set of housing units in an individual or integrated way, as well as their urban structure (patios and/or streets) – Figure 11.
The dwellings are organized in a continuous street alignment, which seems to arise spontaneously and follows the natural topography of the land. It can be seen that most of the vacant dwellings are in a poor state of conservation, a fact that may indicate that with the passage of time part of the architectural heritage (singular and collective) will be lost. In the village there are 2 community ovens, also abandoned – Table 7.




**Subtitle**

**A.** Sets of three or more vacant dwellings that share common outdoor space next to the main access to housing

**Figure 11.** Monte do Pessegueiro – Parish of Martim Longo, Alcoutim - Location of vacant dwellings in the village

Most of the houses still keep their original structure and constructive characteristics: ground floor; rectangular plant; in self-supporting, exposed or whitewashed shale masonry (exterior masonry, mostly, about 50cm thick); small, with two to four interior divisions; in most cases, the only opening in the house is the entrance door - however, in some cases, we can find a small window in the room that faces the street.

The dwellings are organized in a continuous street alignment, which seems to arise spontaneously and follows the natural topography of the land. It can be seen that most of the vacant dwellings are in a poor state of conservation,

a fact that may indicate that with the passage of time part of the architectural heritage (singular and collective) will be lost. In the village there are 2 community ovens, also abandoned – Table 7.

**Table 7.** Quantitative summary of the characterization of the vacant housings conservation status in Monte do Pessegueiro

**CHARACTERIZATION OF THE VACANT HOUSINGS CONSERVATION STATUS [1]**

| | UNITS | PERCENTAGE |
|---|---|---|
| Good | 2 units | 6,0% |
| Reasonable | 8 units | 24,2% |
| Bad | 16 units | 48,5% |
| Ruin | 7 units | 21,3% |

Most keep the traditional system in exposed shale masonry, whitewashed or with a combination of the two finishes. There are, occasionally, the existence of recent changes in dwellings that do not respect the original structure, either from a constructive point of view - with the introduction of painted brick masonry or coated with ceramic materials - or even the introduction of another floor - Table 8

**Table 8.** Quantitative summary of the characterization of the vacant housings conservation status in Monte do Pessegueiro

**CHARACTERIZATION OF THE EXTERIOR WALLS CONSTRUCTION SYSTEM**

| | UNITS | PERCENTAGE |
|---|---|---|
| Exterior walls in exposed shale masonry | 8 units | 24,2% |
| Exterior walls in whitewashed shale masonry | 12 units | 36,4 % |
| Combination of exposed shale masonry with whitewashed | 12 units | 36,4% |
| Others | 1 unit | 3% |

Only one of the vacant housings no longer has the mortar tile system based on a “plumbing” structure on the roof, and most have only one water (23 dwellings, out of a total of 33 identified). In some dwellings, the roof is already significantly damaged. Another characteristic is the absence of windows, which can be seen in 28 of the 33 mentioned dwellings. In the case of openings, most keep the original wooden frame, however in some cases it is already very degraded – Table 9.

The access span, in wood with a door leaf, with or without a wicket, is normally small – with a width that varies between 75 and 80 cm and a height between 1.75 and 1.85 m. In the referenced dwellings, most keep the original door; in others it has already been replaced by a new wooden door; in five, the option was to replace it with an aluminum or iron door – Table 10.

**Table 9.** Quantitative summary of the characterization of the façade spans - windows of vacant housings in Monte do Pessegueiro

**CHARACTERIZATION OF FAÇADE VANS - WINDOWS**

| | UNITS | PERCENTAGE |
|---|---|---|
| Wooden frames (original) | 4 units | 12,1 % |
| Wooden frames (original) and other (aluminium) | 1 unit | 3,1 % |
| No windows | 28 units | 84,8% |
| Others | 0 units | 0% |

[1] For the characterization of the conservation status of vacant housings, four comparative parameters were established: GOOD – When the housing presents conditions of habitability; REASONABLE – When the housing shows some signs of degradation, but still meets the conditions for recovery with small interventions; BAD – When the housing shows strong signs of degradation and requires significant intervention; RUIN – When the housing is heavily degraded.

**Table 10.** Quantitative summary of the characterization of the access span to vacant housings in Monte do Pessegueiro

**CHARACTERIZATION OF THE ACCESS SPAN**

| | **UNITS** | **PERCENTAGE** |
|---|---|---|
| Original in wood | 25 units | 75,8 % |
| Already replaced in wood | 2 units | 6 % |
| Aluminum | 2 units | 6% |
| Iron | 3 units | 9,1% |
| No access span | 1 unit | 3,1% |

The gross construction area of the housings is a fundamental element for their rehabilitation, as well as for the entire structure. The need to provide large spaces - which promote mobility and a feeling of comfort for users and the versatility of spaces is presented as a preponderant factor for the requalification and adaptation of housing to the needs of the elderly. If we consider the values of gross area identified (in 12 dwellings it is less than 50m2 and in 15 it varies between 50 and 75m2) and taking into account that the thickness of the exterior walls is approximately 50cm, it appears that the majority have a reduced usable area; therefore, it will be necessary to consider the aggregation of two or more units to form a dwelling with the necessary and adequate dimensions and spaces – Table 11.

**Table** 28. Quantitative summary of the gross construction area (approximate values) of vacant housings in Monte do Pessegueiro

**GROSS CONSTRUCTION AREA - APPROXIMATE VALUES**

| | **UNITS** | **PERCENTAGE** |
|---|---|---|
| Less than $50m^2$ | 12 units | 36,4 % |
| Between $50m^2$ and $75m^2$ | 15 units | 45,5 % |
| Between $75m^2$ and $100m^2$ | 4 units | 12,1% |
| More than $100m^2$ | 2 units | 6 % |

Due to the formal characteristics of the housings, it will be possible to establish a direct relationship between the exterior and interior spaces. In 20 houses there is a patio (at the back; next to the main entrance common to different dwellings; or both situations), which makes it possible to generate a transition element between the street and the housing or a private outdoor space at the back. Three nuclei were identified with three or more vacant housings that share a common outdoor patio area, which may allow the creation permanence and living areas.
Most of the housings maintain the characteristics of the traditional local architecture, which allows that in a rehabilitation process, it is possible to follow the structural and constructive essence of each housing and, at the same time, give the spaces the specificities of adaptability.

### 4.1 Intervention proposal for revitalization of built heritage

Aiming the promotion of the rehabilitation of the vacant built housing heritage in Pessegueiro, its adaptability to the needs of mobility in space for the elderly (and, consequently, of all individuals) and, at the same time, to enhance the revitalization of the territory through the implementation of a housing structure for community living, in a model that is based on the structural principles of Home Villages, two possible intervention hypotheses are presented.
The proposal (schematically formalized) synthesizes the ideas and concepts exposed and transports them to a possible model of intervention in the territory. In terms of their structural organization, services, equipment and commercial spaces should take into account the current resident population, as well as the one that is intended to attract and settle (intergenerational). Thus, in addition to the local commerce and services necessary for the operation of Home Village, others should be implemented that could leverage the revitalization of the territory (such as the existence of an agrotourism or small industries related to agriculture and local crafts).
Image 12 shows the distribution of the different functional spaces in the territory. It is visible the importance that the space destined to vegetable gardens can acquire, since these are considered of extreme relevance for the population - fundamental element for the maintenance of their daily physical activity and a healthy diet (economically sustainable). Vegetable gardens are also part of the imagination of those looking to move to rural areas. The support facilities for the elderly resident population, medical and nursing services, maintenance and meal services were located in a centralized manner and adequate to the available physical space. Image 13 identifies the

proposed new constructions, as well as the constructions whose uses may be altered or requalified, to meet the proposed objectives.

Small spaces for parking should be considered, so that it is organized and allows easy access to housing, services, commerce and small industries (Image 14). The fact that the village is “torn apart” by the National Road requires greater concern in terms of pedestrian crossings, since residents on the West side (where there is a greater concentration of housing) to access medical services or the social center will have to make your crossing. With regard to the exterior floors, the urban structure is characterized by the lack of sidewalks, which should remain, as this characteristic eliminates architectural barriers, which only occur occasionally, near the entrance of some dwellings (a situation that can easily be annulled) . The streets may maintain, or recover, the characteristics of the region, with shale pavement, ensuring thatt there is no risk of falling (no variations in height and with a non-slip finish). It is proposed to introduce green spaces, with areas of permanence and conviviality between residents (Image 15).

The proposed interventions respect the elimination of physical barriers, such as steps between the different spaces (interior and exterior); placing switches at a minimum height of 90cm and a maximum of 120cm; placing electrical outlets at a minimum height of 45cm; correct dimensioning of spaces in order to allow their versatility (possible changes in furniture arrangement); allow visual contact with the outside, at the level of the seated individual (between 80 and 120 cm of minimum height from the floor); use of equipment with the correct ergonomic dimensions and usable by all individuals (such as door handles, faucets, supports, etc.); and care in the placement of equipment, in order to allow its use without additional effort (such as dishwashers, washing machines, ovens, etc.).

Hypothesis A (Image 16) presents a vacant dwelling, with a gross area of 43.00 m2, in poor condition, inserted in a building complex still inhabited, next to one of the community ovens. Due to its dimensions, it would only be used as a T0 Typology, with a small private patio. Built in exposed shale masonry, whitewashed punctually next to the access opening. It is characterized by the inexistence of windows, where a small shutter recommends a mark on the corner façade.

Hypothesis B (Image 17) presents a set of two houses, also of small dimensions (with gross areas less than 50m2, each), interconnected to allow a T1 type housing. This house can enjoy two outdoor patios: a private one (at the back) and a common one, next to the main entrance.

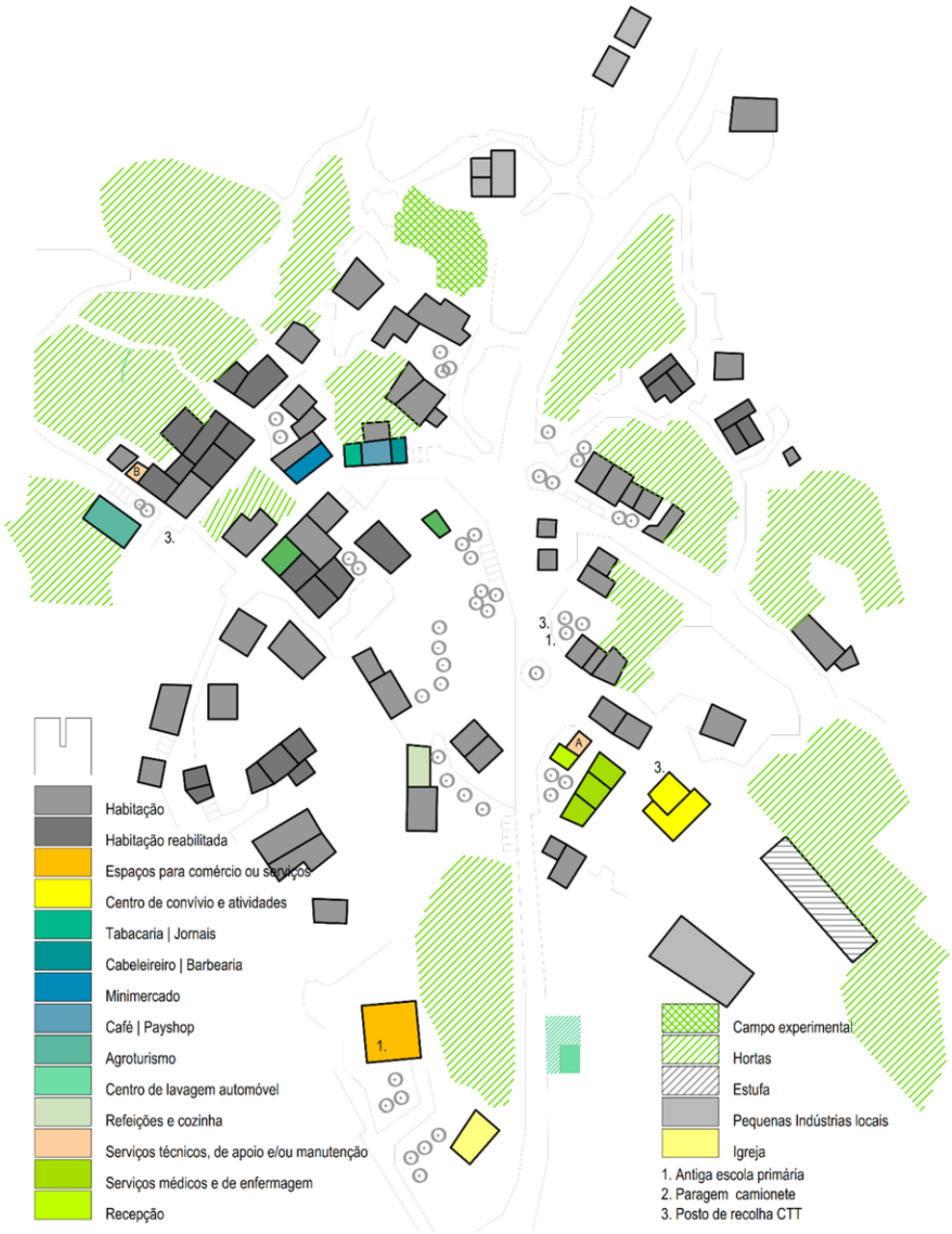



**Image 12** Monte do Pessegueiro – Parish of Martim Longo, Alcoutim - Territory intervention proposal: Urban structure

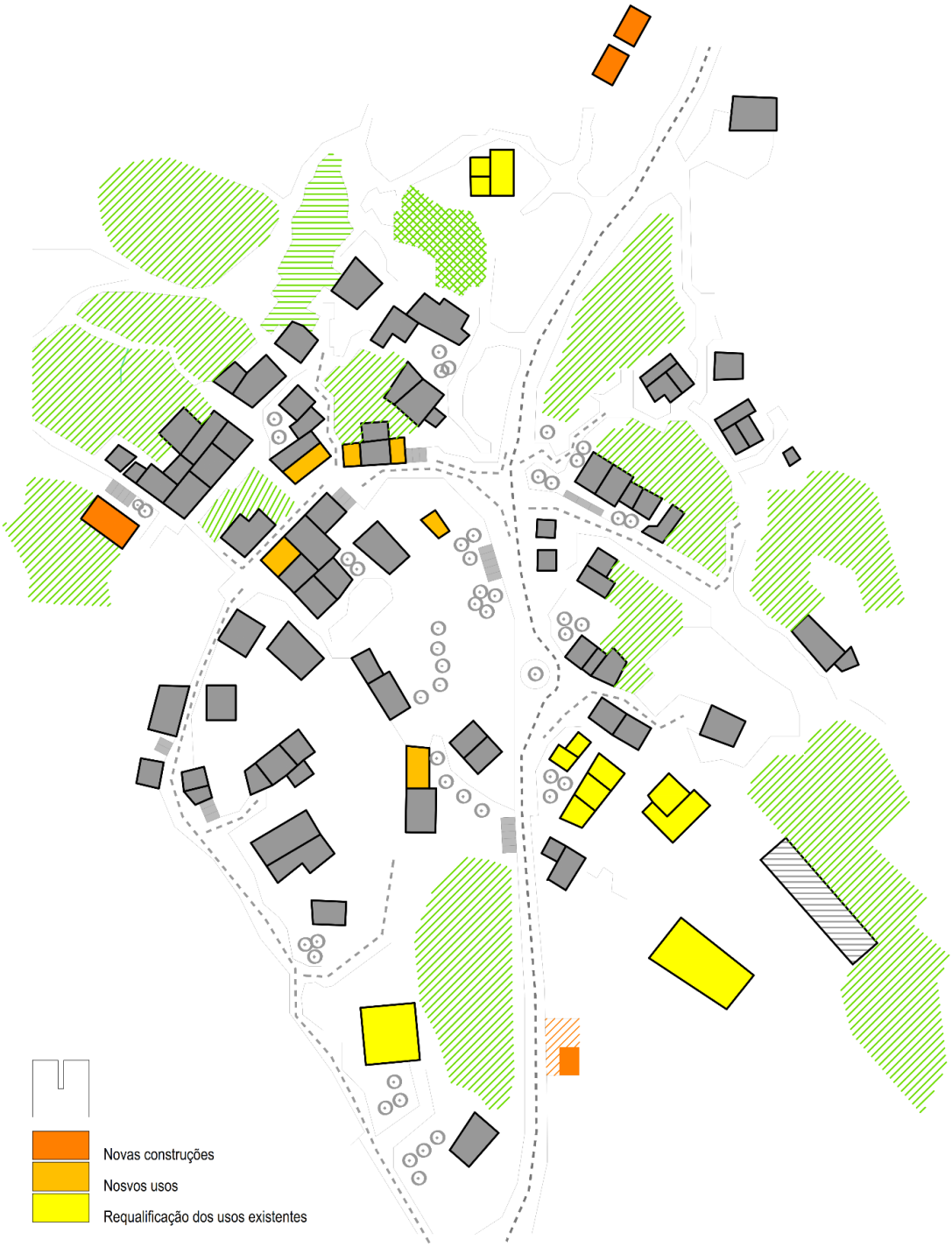



**Image 13** Monte do Pessegueiro – Parish of Martim Longo, Alcoutim - Territory intervention proposal: Urban structure - identification of new constructions, new uses and existing uses

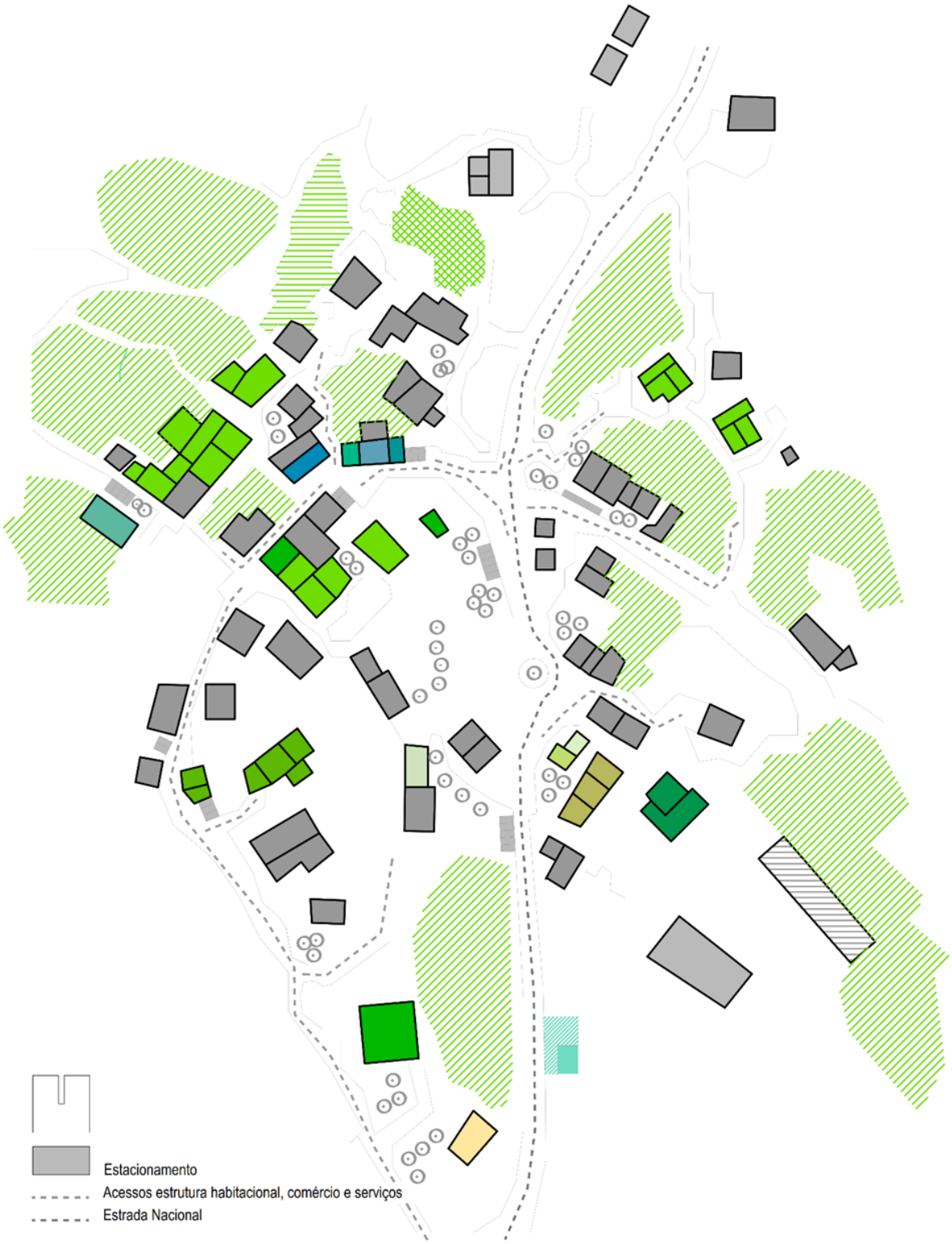



**Image 14** Monte do Pessegueiro – Parish of Martim Longo, Alcoutim - Territory intervention proposal: Road structure and parking

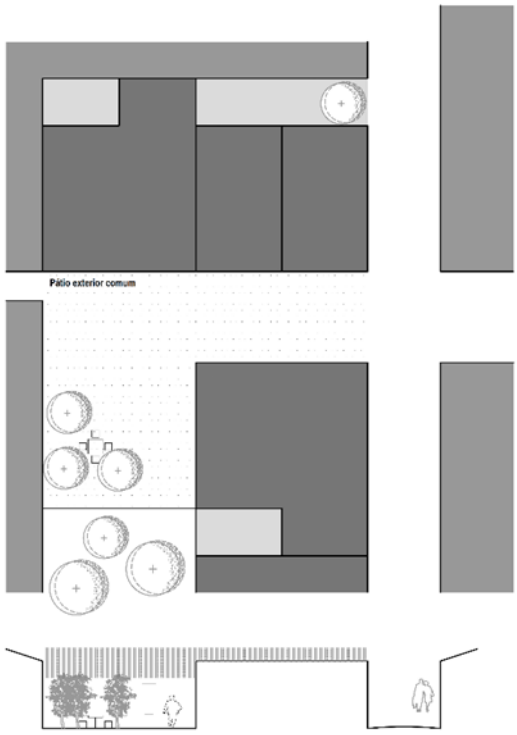



**Image 15.** Monte do Pessegueiro – Parish of Martim Longo, Alcoutim Common outdoor patio, Type proposal

**General description of the intervention proposal | hypothesis a:**
**Exterior:**
1. Regularization of the street pavement in sidewalk (to overcome the 28cm gap between the outer level and the threshold level);
Being a corner dwelling, it is possible to promote this change without causing damage to neighboring dwellings. Thus, it is possible to avoid placing an access ramp, which would always alter the façade and the urban structure;
3. Enlarge the façade spans (main and rear) - free passage span with 85cm wide and resize its height;
4. Change the structure of the façade openings: wooden and glass openings on the inner face of the wall with a wooden shutter on the outside (maintaining the characteristics of the façade but allowing more light to enter the interior).
5. Level and pave the pavement of the outdoor patio;
6. Since the patio cover is in very poor condition, it could be removed, which would allow more light to enter the interior.
**Interior:**
1. Level the floor;
2. Enlarge the interior spans - free passage span with 85cm wide;
3. Opening of a connecting span between the two dwellings, to form a T1 type dwelling;
4. Change the position of the openings between the common room and the kitchen, to allow better use of the space.
5. Change the position of the opening between the bedroom and the sanitary installation, to allow better use of the space.
**General description of the intervention proposal | hypothesis b:**
**Exterior:**
1. Regularization of the level of the exterior patio common to the dwellings - currently in shale and earth pavement - to eliminate the differences in level between the exterior and the interior.
2. Implementation of exterior arrangements that provide a welcoming environment to the common outdoor patio - create a living area for residents with rest spaces and green areas suited to the local weather conditions (shade area).
3. Enlarge the façade spans (main and rear) - free passage span with 85cm wide and resize its height;
4. Change the structure of the façade openings: wooden and glass openings on the inner face of the wall with a wooden shutter on the outside (maintaining the characteristics of the façade, but allowing more light to enter the interior).

**Interior:**
1. Level the floor;
2. Enlarge the interior spans - free passage span with 85cm wide;
3. Opening of a connection span between the two dwellings, to form a T1 Typology dwelling;
4. Change the position of the openings connecting the common room and the kitchen, to allow better use of the space.
5. Change the position of the opening between the bedroom and the sanitary installation, to allow better use of the space.

**General notes (Hypothesis A and B):**
1.Structural and constructive elements - such as shale masonry walls and roofing in mortar tile over a "pipelined" structure - must be recovered or, whenever necessary, replaced in accordance with quality standards and good construction practices.
2. Whenever the roof and its construction system are altered, the traditional system must be replaced.
3. In the sanitary installations, the possibility of introducing walking aids must be foreseen;
4. In the shower area there must be no bump on the floor.
5. All coatings, equipment and equipment used must respect the principles of *universal design*.

**Summary of proposed functional spaces and respective minimum areas**
**Reception building – 50,00m²** abc[2]
Reception; Administrative area; Management office; Sanitary instalation
**Technical, support and/or maintenance services**- **50,00m²** abc
Building A:
2 Technical offices; Meeting room; Sanitary instalation
Building B:
Personnal room; Locker room; Sanitary installation
**Living and activities center** - **250,00m²** abc
2 Activity rooms; Sanitary facilities; Playroom; Living room; Reading room
**Meals and kitchen - 120,00m²** abc
Meal room; Kitchen area; Laundry area; Sanitary facilities; Storages
**Medical and nursing services** - **250,00m²** abc
2 Medical offices; Nursing room; 1 Physiotherapy room; 1 Multipurpose room; Sanitary instalation; Geriatric bath; 2 Single rooms in suite; Storage; Support material
**Housing type t0** - **50,00m²** abc
Bedroom; Sanitary instalation
**Housing type t1** - **70,00m²** abc
Bedroom; Common room; Kitchen; Sanitary instalation
**Commercial areas**
Undifferentiated (100.00m2); Hairdresser (50.00m2); Tobacco | Newspapers (50.00m2); Coffee (90.00m2); Minimarket (100.00m2); Commerce | Services (400.00 m2)

**Notes:**
1. The indicated areas serve as a reference for the definition of spaces;
2. The spaces may work in an interconnected (not compartmentalized) way.
3. Estimated number of dwellings for the elderly: 15;
4. Estimated number of intergenerational dwellings: 25;
5. Estimated number of spaces for commerce or services: 8;
6. Estimated number of spaces for small industries: 4;
7. Estimated number of spaces for tourist accommodation facilities: 1;

[2] a.b.c. – gross building area available (approximate value)

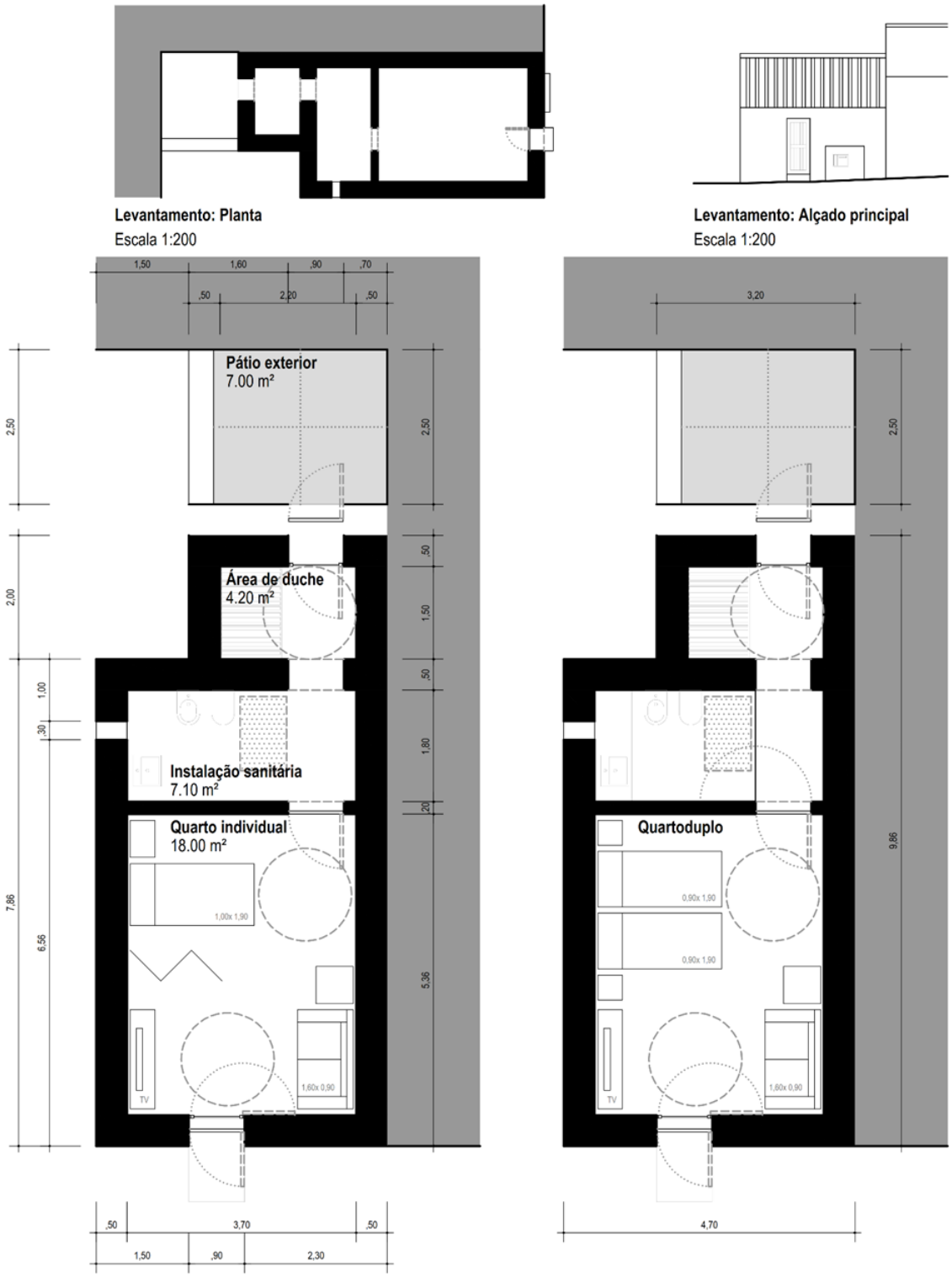
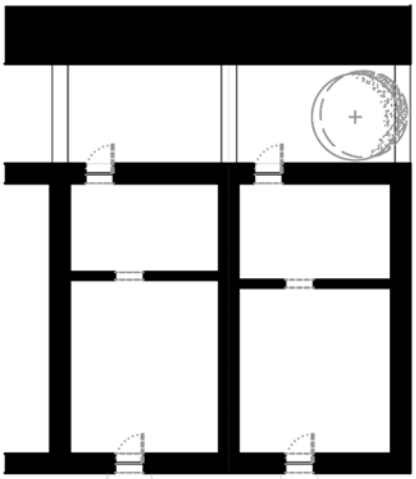
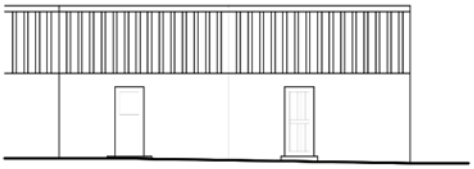


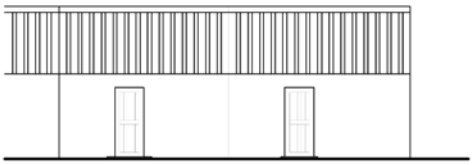

**Image 16** Monte do Pessegueiro – Parish of Martim Longo, Alcoutim | Hypothesis A - Adaptation of vacant housings to the needs of the elderly | Proposal for Typology T0: single or double room with sanitary installation and private outdoor patio



**Levantamento: Planta**
Escala 1:200



**Levantamento: Alçado principal conjunto**
Escala 1:200



**Proposta: Alçado principal conjunto**
Escala 1:200

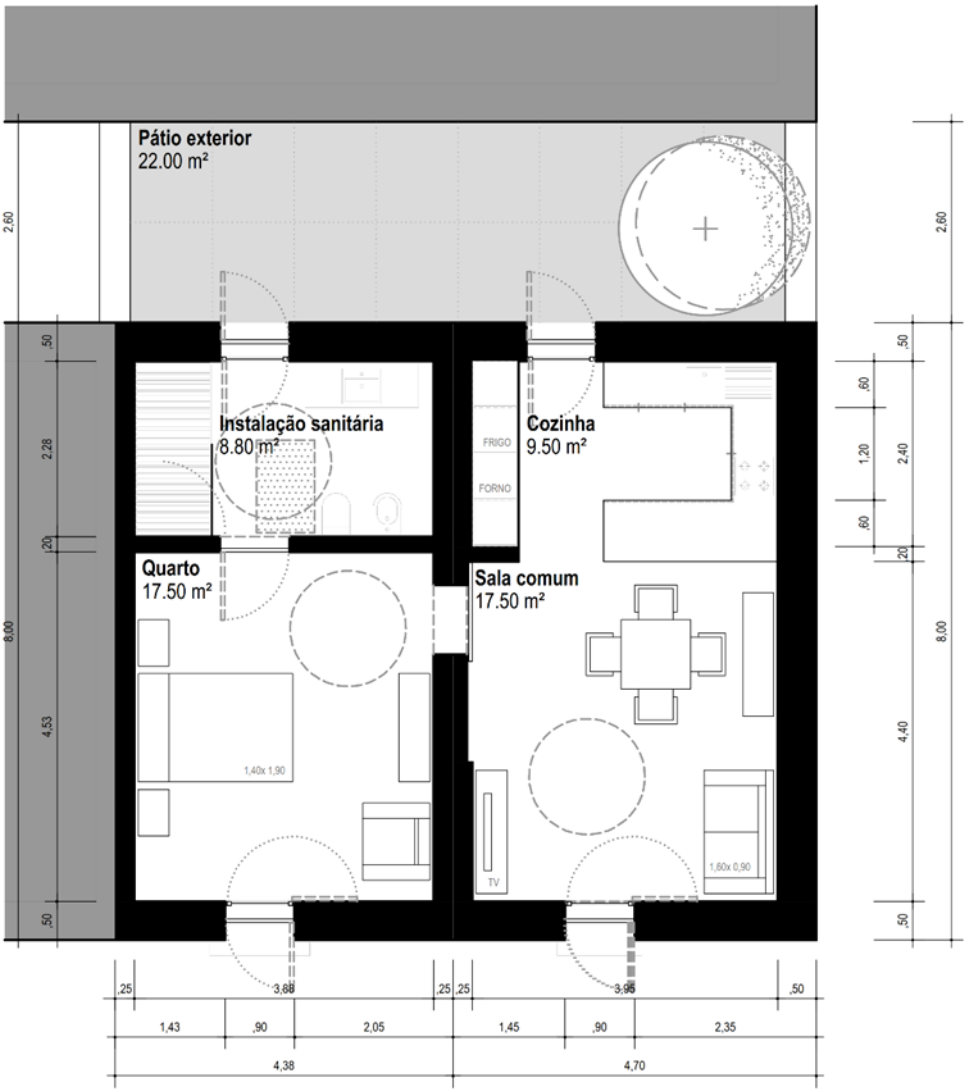



**Image 17** Monte do Pessegueiro – Parish of Martim Longo, Alcoutim | Hypothesis B - Adaptation of vacant housings to the needs of the elderly | Proposal for T1 typology: single or double bedroom, common room, kitchen, sanitary installation, a private outdoor patio (back façade) and a common outdoor patio (main façade)

**5. Conclusion**

The revitalization of a territory can only happens with people. People who can stay and develop a life project. Housing structures properly integrated with a qualified and differentiated offer of services, facilities and equipment directed to the needs of the elderly, could be the leverage element of this revitalization, they could be promoters of job offers, economic and tourist development and, thus, to contribute to the establishment of young populations – life-generating elements | urbanity, therefore revitalization.

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# Toward 2030. The Role of Resilient and Sustainable Urban Planning to Foster a Greener Decade in Coastal Areas

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**Abstract**
Nowadays, more than 600 million people lived in coastal areas, outlooks forecast that they will be more than one billion by 2030. Cities occupy less than 2% of the world lands but are responsible for 70% of CO2 emissions. Coastal areas constitute the most exposed regions facing climate change impacts. This contribution aims at stimulating a reflection over the role that sustainable and resilient urban planning can have in fostering SDGs in coastal regions. Sustainable urban planning can constitute the trigger to reduce global impacts that cities generate on environment as well as resilient urban planning can contribute to make cities more safe, efficient and equitable to cope with threats deriving from global scale. This contribution argues that the practice of urban planning should definitively embrace a holistic and multi-scale approach, moving from geography to design, from the integrated coastal zone management to the urban design.
**Keywords:** Sustainable Urban Planning; Resilient Urban Planning; Integrated Coastal Zones Management; Waterfronts Regeneration Projects; SDGs.

## 1. Introduction

Over forty per cent of the world population lives in coastal areas exercising unprecedent pressures on the coastal and marine environment (Borgese, 1999). The interaction between different human activities and the coastal territories represents the basis of the growing stresses involving terrestrial and marine ecosystems. Moreover, the consequences of climate change constantly put at risk both, the balance of environment and the sustainability of the social and economic development of settled populations. During the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, the 172 governments and 2400 NGOs involved in the summit agreed to initiate an irreversible change in the world environmental governance, which should have been based on a greater sustainability of economic development models. Agenda 21 represents the Rio conference's final document; in defining an Agenda for the XXI Century, countries agreed to launch a global energy shift from fossil fuels to a greater use of renewable energies, a better water reserves management, as well as the reduction of the impacts on public health and the environment deriving from traffic and urban transport. This key document also represents the first international engagement to adopt the Integrated Coastal Zone Management (ICZM) as method to analyse, mitigate and solve conflicts between different uses and functions in these delicate ecosystems.
In 2010, for the first time in human history, most of the world's population lived in urban areas. According to a recent statement of the World Economic Forum, in 2020 at least 56,2% of the global population lives in cities; projections forecast that this portion will reach 69% by 2050 (Komeily and Srinivasan, 2015), and up to 90% of new urban dwellers will involves Asian and African cities. According to the UN Ocean Conference (UN, 2017) more than 600 million people lived in coastal areas, representing the 7.6% of the world population. Findings of a recent UN research demonstrate that, due to the economic benefits deriving from the proximity to the sea in terms of direct accessibility to commercial networks, tourism and fishing development, as well as economic and social relations, over 40% of human settlements it's located in the coastal areas. Outlooks forecast that by 2030 more than one billion people will live in coastal areas that were less than 10 meters above sea level (Neumen *et al*., 2015; Oppenheimer et al. 2019), representing not only the 12.7% of the world population but an increase of 67% in less than ten years, compared with the 7.6% recorded in 2017. Broadening the concept of coastal zone, including lands that go beyond 10 Km from the shoreline (usually the EU limitation of the coastal areas according to EUROSTAT, 2019) we can discover that nowadays 2.4 billion of people live within 1OO Km from the coastline, representing the 30% of the world population. Moreover, an increase of the number of dwellers living in coastal areas close to 70% in less than a decade confirm that this fast-paced urbanization process mainly involves the most vulnerable portions of citizens that are moved from rural to urban areas. Nowadays the future of sustainable development is even more tied to the planning and management of coastal areas.

**2. Toward a greener decade**

Internationally, ICZM is mainly used to support the territorial analysis of highly anthropized contexts, where human activities have created and stratified conflict between natural habitat and socio-economic growth. Over the last few decades, three main approaches to ICZM have emerged. The first was consolidated thanks to the practice of American geographers, for whom the ICZM must be used as a territorial planning approach to solves conflicts between different uses and functions, with the aim to protect the environment and ecosystems (Cicin-Sain B., Knecht R. W., 1998). The second one derives from the French geographer approach, interested in applying ICZM to coordinate different regional and urban planning rules, aiming at maximizing the efficiency of the coastal areas' transformation process (Mesnard André-Hubert, 2009). Based on the precious contribution of Professor Adalberto Vallega, the former President of the International Geographic Union, a third and useful approach was elaborated. Thanks to his applied research and critical reflections, he was able to define a new way to systematize the ICZM, aiming to integrating the tools of geographic analysis with those of urban and territorial planning (Vallega A., 1999). According to this approach, an in-depth knowledge of the interactions that occur between the activity of human groups and coastal systems (terrestrial and marine), may represents the key element for planning and managing the transformation of those territories safeguarding local cultural identities (Callegari F., Vallega A. 2002). The relevance of Vallega's contribution is represented by his structured meaning of the concept of integration: of disciplines and competences; between natural contexts and human activities; among multiscale territorial and urban planning laws. In referring to the ICZM, this paper mainly adopts the approach proposed by Adalberto.

The end of the use of fossil energy sources and the shift towards renewable sources, together with the global awareness of the existential risks for humanity caused by climate change, constitute the pillars of the new green paradigm. In this context, which is the role that town planners can play to support it by contributing to invert the un-sustainable development model, fostering a more sustainable decade? More precisely, what about the role that sustainable and resilient urban planning can have to achieve SDGs in coastal zones? In answering this question, this contribution aims to reflect on coastal regions and cities deserving innovative policies and strategies to implement sustainable and resilient actions trough resilient and sustainable urban planning and design.

Towns represent some of the greatest climate change generators, contributing with CO2 and GHG emissions (Ibrahim *et al*., 2012), as well as with their increasing ecological footprint (Rees and Wackernagel, 1996) and natural lands use consumption (Randolph, 2004). At the same time, being complex systems of social, economic and ecological factors (Liu *et al*., 2007), as well as due the constant increase of the severity of extreme weather conditions' consequences (UN-DRR, 2021), cities are the most vulnerable collectors of the impacts of climate change. Despite cities occupy less than 2% of the world lands, they produce more than 70% of CO2 emissions (FAO, 2014) and 80% of the global GDP. In pursuit of sustainable socio-economic development and environment protection, urban practitioners can contribute to cope on climate change, globally and locally. Since the development of urban areas has led to an acceleration of the phenomena underlying climate change, making them more sustainable may favour a slowdown of these phenomena. The benefits will be both for the environment and for citizens.

**3. Sustainable and Resilient Urban Planning**

While the first article on urban sustainability appeared in 1968 (Cain, 1968) and the first one approaching the theme of urban resilience was published five years later (Holling, 1973), these themes are emerged as a mainstream within the academia's debate starting from the beginning of the new millennium (Mobaraki & Oktay Vehbi, 2022; Zhang and Li, 2018). Scholars have opened new fields of investigation aiming at exploring the interlinkages between the future of cities and the sustainability of the current global development model. Nevertheless, during last decade a repositioning between the two research themes occurred. If in the first decade of the 21st Century scientific production was more focused on sustainability, over the last few years an inversion has taken place, bringing the theme of resilience as a main topic (ibidem). This circumstance confirms the feeling of urgency to explore new ways to make our territories more capable to cope with climate change. Urban practitioners are like seismographs, consequently the two key terms started to be used for labelling certain urban planning approaches.

Resilient Urban Planning (RUP) refers more to the planning process aiming at enhancing the capability of self-protection of an urban system, and his ability to cope with external turbulences. Sustainable Urban Planning (SUP) is mostly referred to the planning process aiming at investigating the relationships between human activities, use of natural resources and the protection of ecosystems to define sustainable development scenarios.

Considering the role that metro areas play in worsening the conditions of unbalanced global development the role that the SUP can play in modifying the current trend becomes evident. In fact, by acting locally, SUP could contribute to reduce and manage the impacts that the fast-paced growth of cities can globally generate on environment. Furthermore, the outcomes of numerous local sustainable actions could generate positive impacts at larger scale, contributing to invert the current un-sustainable development model. Likewise, by enhancing the operativeness and continuity of urban daily life also during critical situations, the RUP can make cities more safe, efficient and equitable,

contributing to cope with global threats deriving from climate change effects. As well as for the SUP, the results of various local resilient actions can generate positive impacts also on large scale.
In achieving the 11th SDG aiming at making cities and human settlements inclusive, safe, resilient and sustainable, urban planners and cities' stakeholder are facing the challenge to integrate preservation and innovation (Mieg and Töpfer, 2013) with sustainable and resilient urban planning.

**4. Innovation and Preservation**

Along with sustainable and resilient cities, innovation and preservation are at the center of the sustainable agenda. The first one is included in the 9th SDG, while the second one constitutes the core of the 15th SDG. Historically, cities with their milieu have represented the place where technological and social innovation have been made (Braudel, 1979; Crevoisier, 1999). Innovation in urban planning is crucial and involves both aspects. Technological innovations are more tied with tangible element such as energy, communications, transports, consumption, buildings. In order to enhance efficiency and reduce consumption of urban systems, innovative solutions are often embedded in the planning process. Novel approaches or tools may involve smart and georeferenced applications; IoT and Urban Big Data; green energy resources; transport systems and urban logistics; buildings' energy efficiency and infrastructures, just to name a few. Social innovations are related to intangible elements such as governance, participation, inclusion, organization and institutions. While technological innovation is mostly referred to the large or global scale, social innovation pertains to the local level. In fact, policies innovations tents to provide governance framework to reduce or mitigate climate change impacts and effects, enhancing sustainability and resilience (UN-Habitat, 2011).
If innovations allow to move forward the present of a society, placing it into the future, more than anything else preservation aims to ensure that what has been made available to a community by those who preceded can be passed on to future generations. Depending on the difference between languages, the term preservation tents to be used to indicate concepts and practices aiming at safeguarding and transfer over the time tangible and intangible heritage. Based on different approaches, preservation can be referred to the ecosystems, resources, landscapes, built environment, cultural heritage, citizens, institutions, traditions and ancestral knowledge just to name a few. Adopting an urban planning perspective preservation must aims at safeguarding historical urban contexts, health and citizens' wellbeing, natural environment and ecosystems as well as built environments, artistic and cultural heritage, all the elements that playing a key role in forging the identity of places and cities. From an urban-resilience approach, it imply the adoption of preservation' plans and measures able to guaranteeing the continuity of strategic infrastructure operations (tangible and intangible), to enhance risks reduction related to damage or loss of real estate assets, by fostering the continuity of economic activities to protect employment and dwellers daily life.
How to move from theory to practice? This contribution argues that, to foster sustainable and resilient urban planning, especially in the vulnerable contexts of coastal zones, town planners should definitively embrace a holistic and multi-scale approach, moving from integrated coastal zone management to urban design, trough sustainable and resilient urban planning. Thanks to a simultaneous and integrated use of analysis and managing tools deriving from geography and urban planning, coastal cities can be investigated, and masterplans can be designed.
Due the deeper interrelations that exist between climate change and human activities as well as among environment protection, and urban development, coastal cities are at the fore front to define innovative policies and sustainable actions. Since coastal zones, in developing and developed countries, constitute the most critical and delicate regions of the planet, the success of new development models involving these territories can produce beneficial long-lasting impacts, safeguarding populations and natural resources in different continents.
Thanks to the adoption of the integrated coastal zones management approach, the understanding of urban phenomena in coastal areas as well as the relationships between places and human activities are more relevant. There're two main circumstances supporting this assumption.
The first one is represented by the fact that, by integrating urban planning and geographic approaches, the analyses are conducted involving different dimensional levels: macro, urban, neighbourhood and micro. The second one derives from the fact that thanks to an interdisciplinary and holistic approach the opportunities and threats for the protection of coastal ecosystems and for the socio-economic development of urban and territorial context are more perceptible and searchable.
Definitely, and thanks to SUP and RUP, plans and actions can be adopted to improve the sustainability and resilience of cities, with respect to the effects of climate change, as well as to the impacts of human activities on built environment and ecosystems. More precisely, the results of the large-scale analyses are used as a basis to outline sustainable & resilient urban plans. Those plans aim at defining the evolution and growth of towns at an intermediate scale (urban and neighbourhood). In turn, these programs, can be implemented through Urban Design. Thus, resilient and sustainable solutions can be contextualized by designers. By operating at the small-scale, urban designer are able to control details, the choice of materials consistently with the genius loci. This process is proposed here to achieve concrete and lasting solutions to the global problems. Moving from ICZM analysis to the

implementation of sustainable and resilient plans, via sustainable and resilient urban design imply an in-progress sharing of findings, visions, programs, and goals form the large scale to the small one. In order to do not lose knowledge and goals, that must be transferred from urban planners to designers, is essential to ensure coherence among documents, from the most general to the most detailed. The more those documents will be informed by resilience and sustainability, the more the movement among different scales will be smooth and consistent.
To implement sustainable and resilient (urban) plans, punctual resilient and sustainable (urban) projects are required. In fact, while masterplans represent a vision of the future, the realization of projects makes them real and present. In this context, measures constitute the pivotal element based on which urban quality can be achieved (Parfect and Power, 1997), and sustainability and resilience can concretely transform urban landscapes (Ahern, 2013). In this contribution, I argue that the scales of one to one thousand, and one to five hundred represent the size around which it is possible to design and realize resilience and sustainability of public spaces, contributing to make places more resilient and sustainable. In that sense, urban planners – that generally are architects – represent the connecting link from large to small scale. From the territorial vision of geographers to the neighborhood and street point of view of designers, urban planners are the trait d'union not only between professionals but also between practices. For this reason, town planners can play the strategic role of "transferors of knowledge". From one side, the results of geographic analyses give substance to sustainable and resilient urban plans, from the other side, the contents of those plans will have to find a coherent synthesis within the Terms of References guiding the designers toward their implementation

**5. Conclusions**

Cities play a relevant role in feeding the phenomena underpinning climate change (Gordon D. J., 2013; Taylor, 2016). At the same time, they are directly affected by the consequences of climate change. Nowadays more than six hundred million people live in coastal zones, forecast outlook that they could be more than one billion before the end of this decade. Coastal environments in both side land and ocean, represent the most exposed ecosystems. In fact, sea levels rising, extreme marine phenomena together with inland water pollution and overfishing generate dramatic impacts on settled populations. In order to save lives and protect natural environments the definition and implementation of sustainable agendas for coastal zones is urgent.
In this context, sustainable urban planning (SUP) could contribute to reduce and manage the impacts that cities generate on environment and ecosystems globally. Hence, the outcomes of numerous local sustainable actions could generate positive impacts at larger scale, contributing to invert the current un-sustainable development model.
Likewise, the result of resilient urban planning (RUP) can improve the ability of a town to recover after an external impacting event like floods, droughts, heat waves, and extreme weather phenomena and/or to safeguard citizens lives and business activities.
Ultimately, until today the role of urban planners was to understand the relationships that exist between people's life and palaces, aiming to outline plans for territories and cities development. Increasingly, and based on the growing complexity of the urban phenomena, a deeper integration of the realms of geography, town planning and urban design is urgent. In that sense, urban planners are candidate to play a central role. As a knowledge's transferors they can link the large scale of geography with the small scale of urban design. New discussion can be launched, not only for an urban governance perspective, rather than for the content of the curricula that the students at the Schools of Architecture, Planning and Design must follows. Further investigation can be conducted to propose new ways to integrate the knowledge, vision and approaches of urban planners, with those of ecologists, landscape architects, urban designers, engineering and real estate expert. Scholars interested in discussing about the role of HEI can find new inspiration to reflect on how to forge a new generation of practitioners able to work adopting a multiscale and holistic approach aiming at contributing to solve critical issues in urban coastal context.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# BOOK OF ABSTRACTS
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## **SESSION E**: Pandemic Studies

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# Post-Pandemic Urban Future: Identification of the main trends of change in Latin America, through the application of the Delphi method

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**Abstract**
The pandemic is a difficult subject to address due to its high degree of uncertainty. This condition is accentuated in Latin America, where limited information hinders any forecasting. Therefore, alternative methodologies are needed to identify the urban effects of the pandemic and its trends. This study applies the Delphi method to gather expert opinions on the influence of the global emergency, systematized in a consensus. Additionally, it employs machine learning algorithms to transform them into predictions. The sample is made up of 26 panelists from different Latin American countries, who participated in successive questionnaires until stable results were reached. The data reveal a pessimistic view of the post-pandemic, as well as a very slight consensus. Inequality is the main topic, while the factors of change are telework, e-commerce and emerging commuting habits. In summary, the research identifies the issues that are shaping the post-pandemic urban agenda.
**Keywords:** Pandemic; Urban Planning; Uncertainty; Prospective; Latin America.

## 1. Introduction

This research explores the agreements and disagreements regarding the future of Latin American cities, a prospective exercise focused on the pandemic and its local effects on urban spaces. It considers the opinion of urban planning experts residing in the region because their appraisals manifest the post-pandemic discourse. However, the intention is not to find the generality, but to value the divergent opinions. In this way, the idea of a homogeneous territory, commonly called Latin America, is questioned. Based on interviews and questionnaires, it identifies frequent themes, and then assessing the level of consensus among the participants, who come from different places. The technique chosen was the Delphi method, a procedure that combines qualitative and quantitative analyses to obtain agreements related to a common issue. Despite the age of this method, it maintains validity as a tool for trend analysis, especially when dealing with phenomena in process or lacking information to perform advanced calculations (Rosa-Jimenez, 2022). The opinion of experts in the field enriches the debate on the factors of change capable of driving future events.

Numerous are the studies that reflect on pandemic changes in the city and architecture. However, these tend to offer a partial picture of the phenomenon, focusing on case studies or specific local realities. In response, the present study broadens the horizon by convening nearly thirty specialists from six countries in the region to assess changes that taking place in Latin American cities. It should be noted that the originality of the study lies in the novelty of the phenomenon studied, which is characterized by a high degree of uncertainty because it is a phenomenon that has been constantly changing. Therefore, it is pertinent to analyse pandemic from an urban approach, since it is not only a health problem but also a trigger for new public policies related to the management of the build habitat.

Latin American specificity becomes the key topic of this research. It develops a broad analysis of the effects of the pandemic, seeking to unify the existing narratives and opinions. It identified some ideas, that tendentiously connected to the process of Latin American urbanization, understood as a variant of planetary urbanization. The potential consensus would attest to the effects of a worldwide phenomenon, academically named as a new urban question, global urbanization, post-urbanism, among other terms. In this sense, the effects derived from the pandemic would be nothing more than global effects of urbanization as a dominant historical movement. Although the Latin American context exhibits certain nuances, these would be just sequels of a larger scale process; apparently different but structurally similar. Therefore, concepts such as inequality, segregation, precariousness, etc. become inherent topics of the contemporary city regardless of geographic location.

## 2. Material and Methods

This is a prospective study of a mixed nature, focused on urban transformations in Latin America during the pandemic. It employs the Delphi method of consensus-building to assess the expert's opinions on the urban trends visible in this region of the world. Complementarily, the research uses predictive methods based on autonomous learning algorithms, which are cross-checked with the conclusions found in the first (interpretative) phase. The main objective is identifying trends of change in such an uncertain scenario as post-pandemic.

**2.1. Procedure**

It has chosen the traditional Delphi method, which differs from other variants by the application of successive rounds that end once agreement among participants. In a preliminary stage, potential participants (experts) were contacted to gather their impressions on the subject using semi-structured interviews. In this way, it built up an overview of urban concerns arising from the pandemic; this information gave rise to the final agenda. Subsequent stage, it asked participants to give their opinions using a structured questionnaire, successively until completing three rounds, the maximum recommended (George & Trujillo, 2018). It should be emphasized that from the second round onwards, it asked participants to consider the results of the previous phase both individually and as a group, as suggested in the bibliography. This was intended to generate a sense of approval in the participant throughout the process (Mahajan, 1986). Subsequently, it organized results of the third round in a segmented manner, both in isolated questions and in the general sample. It should be clarified that this information reflects the consensus of the panel based on various quantitative indicators. Finally, it should be noted that the process began around July 2021 and ended around November of the same year, approximately five calendar months. Considering the first two months for interview phase and remaining time for the successive rounds of questionnaire.

Finally, the information obtained was used for predictions based on artificial intelligence algorithms, such as Random Forest, Neural Network, Support Vector Machine (SVM) and Naive Bayes. Identifying the probabilities of a future consensus. These results were complementary, as they were compared with their analogues from interpretative phase.

**2.2. Participants**

For the panel, it contacted professionals and researchers in urban issues from different Latin American countries after searching for profiles through academic repositories. Subsequently, it communicated to candidates via e-mail to request their participation. The selection criteria were academic publications, teaching experience and professional practice in urban planning. Initially, thirty-two panellists participated in the individual interviews; it subsequently reduced this number to twenty-six and finally to twenty-five in the final round (consensus). It should be noted that it guaranteed diversity in terms of place of origin, a key factor in forming a global Latin American panorama.

It made up the final panel of experts from six different countries: Peru (21.7 %), Mexico (17.4 %), Brazil (17.4 %), Chile (17.4 %), Colombia (13 %) and Argentina (13 %). Participation was anonymous; however, it is possible to mention some general data. The panellists with a doctoral or PhD degree (74%) stand out, while the rest have a master's degree (26%). Likewise, most of them are currently teaching at the undergraduate level (78.2 %), while the remaining percentage indicate that they have suspended this activity. Finally, regarding experience in urban planning, those experts with more than ten years (78.3 %) and those with between five and ten years (8.7 %) of professional practice stand out.

**2.3. Tools**

It developed the study remotely, using various digital tools. Email was the main tool used to initiate communication with the panellists, the interviews and later helped to maintain contact during the rounds of questionnaire. Initially, it developed brief meetings through videoconferencing; while the second phase (questionnaire) it used the Google Forms application exclusively, to point out that this facilitated responses processing during the study.

Subsequently, it used data mining methods to process the information. Free software Orange Data Mining, specialized in predictive algorithms, stands out. For this purpose, it built a database from successive responses of the panellists, which were subsequently transferred to the software. It automatically executed algorithms and then compared in a confusion matrix, where it has shown the different probabilities of agreement or disagreement simultaneously.

**2.4. Questionnaire**

It resulted in final questions from the exploratory phase, semi-structured interviews. In this phase, the topics that aroused it evaluated the greatest interest in participants. It should be noted that it reduced the initial set of questions after the preparatory round, in which it examined the clarity of the sentences and the dispersion of the sample. In this way, questions whose answers were highly variable, i.e., a high deviation, were omitted. It composed the final questionnaire of fifteen statements, grouped into three thematic units: consequences of the pandemic, changes in urban regulation and trends of change. It scored affirmative statements using a Likert scale, consisting of four categories and their values: “strongly disagree” (1), “disagree” (2), “agree” (3) and “strongly agree” (4). As suggested by the literature, this strategy organizes the responses based on ordinal data susceptible to calculations of consensus (Reguant & Torrado, 2016).

### 2.5. Selection and interpretation of indicators

This study seeks to identify consensus among the participants because this condition can be quantified by various indicators. As it is flexible, the Delphi method allows the calculation to be chosen according to the nature of the questionnaire and the panel of experts. The basic indicators are the mean (AVERG), median (MED) and standard deviation (SDEV); these provide a general idea of responses translated into scores. In this first stage, mean high value translate into the predominance of categories such as “agree” (3) and “strongly agree” (4), i.e., the positivity degree in the responses. In contrast, the standard deviation represents the smallest dispersion of the sample. Both interpretations focus only on affirmation, leaving aside negative responses, also capable of building consensus. Subsequently, it used a second group of specific indicators.

In a second stage, the interquartile range (IQR), relative interquartile range (RIR) and Kendall's coefficient (K) were calculated. These indicators make it possible to identify the global consensus, considering the division into cohorts or segments. They also compare the dispersion values for each question versus the overall sample, thus providing a more detailed panorama of opinions. It should be noted that in this second group of indicators, the higher the value, the greater the agreement, whether positive or negative.

Finally, predictive algorithms such as Tree (T), Random Forest (RF), Support Vector Machine (SVM), Neural Network (NE) and Naive Bayes (NB) were used to calculate trends. These can correct their results from iterative computations until it achieved a stable model. As explained above, these were run in Orange software, which allowed comparing the performance of each prediction, to choose the most efficient model (algorithm) for the sample. It should be clarified that in this last phase, the sample was the set of responses obtained in the three successive rounds, not only from the final round. The resulting probability matrix considers the questions of the questionnaire and the incidence of the four corresponding levels of agreement (values 1, 2, 3, 4).

**Table 1.** Final questionnaire.

| Thematic | Code | Statement | Rating |
|---|---|---|---|
| **Pandemic consequences** | A.1 | Pandemic has accentuated the socio-spatial inequalities of our cities. | Likert scale, four levels |
| | A.2 | Confinement measures and other restrictions ended up polarizing the cities even more because these had a differential impact on urban space. | *Idem.* |
| | A.3 | Pandemic has prompted emergency measures focused on housing problem mitigating, in terms of deficits and overcrowding. | *Idem.* |
| | A.4 | Pandemic has prompted emergency measures focused on alleviating public space deficit in our cities. | *Idem.* |
| | A.5 | Pandemic has prompted emergency measures to face new public transport demand | *Idem.* |
| | A.6 | Pandemic has contributed to the positioning of alternative urban transport modes, such as non-motorized means of transport. | *Idem.* |
| **Changes in urban regulation** | B.1 | Pandemic has unleashed regulatory mechanisms on public spaces, which have distorted their social and collective condition. | *Idem.* |
| | B.2 | It has strengthened legislation promoting teleworking and remote education, favouring it over other modalities. | *Idem.* |
| | B.3 | Pandemic has motivated local governments to implement new strategies to guarantee the coverage of services, such as health, education, supplies, among others. | *Idem.* |
| **Trends of change** | C.1 | Pandemic will significantly transform the way we think about and manage our cities | *Idem.* |
| | C.2 | Both national and local governments will significantly reformulate their urban legislation to address the pandemic city emerging problems | *Idem.* |
| | C.3 | Diffusion of remote work and distance learning modalities can transform the form and functioning of our cities | *Idem.* |
| | C.4 | Emerging economic activities, such as e-commerce, delivery, couriers, among others, will significantly modify the functioning of our cities and will motivate new urban policies. | *Idem.* |
| | C.5 | Telework and other remote modalities will transform mobility patterns in cities in the long term, i.e., their impact will not be temporary. | *Idem.* |
| | C.6 | Return to normality, motivated by the vaccination processes, will be able to reverse the changes that our cities have undergone during the pandemic, in terms of urban form and function. | *Idem.* |

**3. Results**

As mentioned, it obtained consensus around the third-round questionnaire. The evolution of the indicators was positive only regarding standard deviation and Kendall's coefficient, while the rest of the values remained stable or even decreased. A general increase in consensus during the process is evident; however, its magnitude is not remarkable. The literature suggests that the results are significant when values equal to or greater than 0.7 in Kendall's coefficient and less than 0.1 in the relative interquartile range (Zartha-Sossa et al., 2019) are reached. The values of the study are far from these standards. Therefore, it can be concluded that the consensus obtained is mild or moderate; however, its evolution proposes a future increase.

Similarly, when it analysed questions individually. In this case, it evaluated both the degree of agreement/disagreement estimated by the cumulative score and dispersion of the responses. In the first place, the sentences where the highest and lowest values predominated stand out. On the other hand, the high variability of the responses is evident, since only five of the fifteen initial questions kept their standard deviation constant and even managed to reduce it during the process. This fact can be interpreted as an answer's stability. Only statement A.1 has a high degree of agreement from its positivity, while the remaining statements are consistent from the negation. Finally, the ideas with the best performance in both categories were: "Pandemic has accentuated the socio-spatial inequalities of our cities", "Pandemic has prompted emergency measures to face new public transport demand" and "Pandemic has prompted emergency measures focused on alleviating public space deficit in our cities". Clarifying that only the first one has a high positivity.

In case of predictions, it evaluated the degree of accuracy of the algorithms, where the performance of the Neural Network (NE) algorithm stands out above the rest. Therefore, the results are exclusive of this method. For clarity, it grouped the probabilities according to the four levels of consensus and are also separated individually by question (Figure 1). The results show a balance between agreement and disagreement in the overall sample, translated into a distribution of eight items for the first camp and seven items for the second. Likewise, opinions are mostly moderate (values 2 or 3), contrasting with the low incidence of extreme values (1 or 4). Finally, a comparison of the results of the Delphi method and these predictions reveals a great similarity. It repeated the evaluations except for two questions, A.4 and A.5, where it accentuated the degree of disagreement (Table 2).

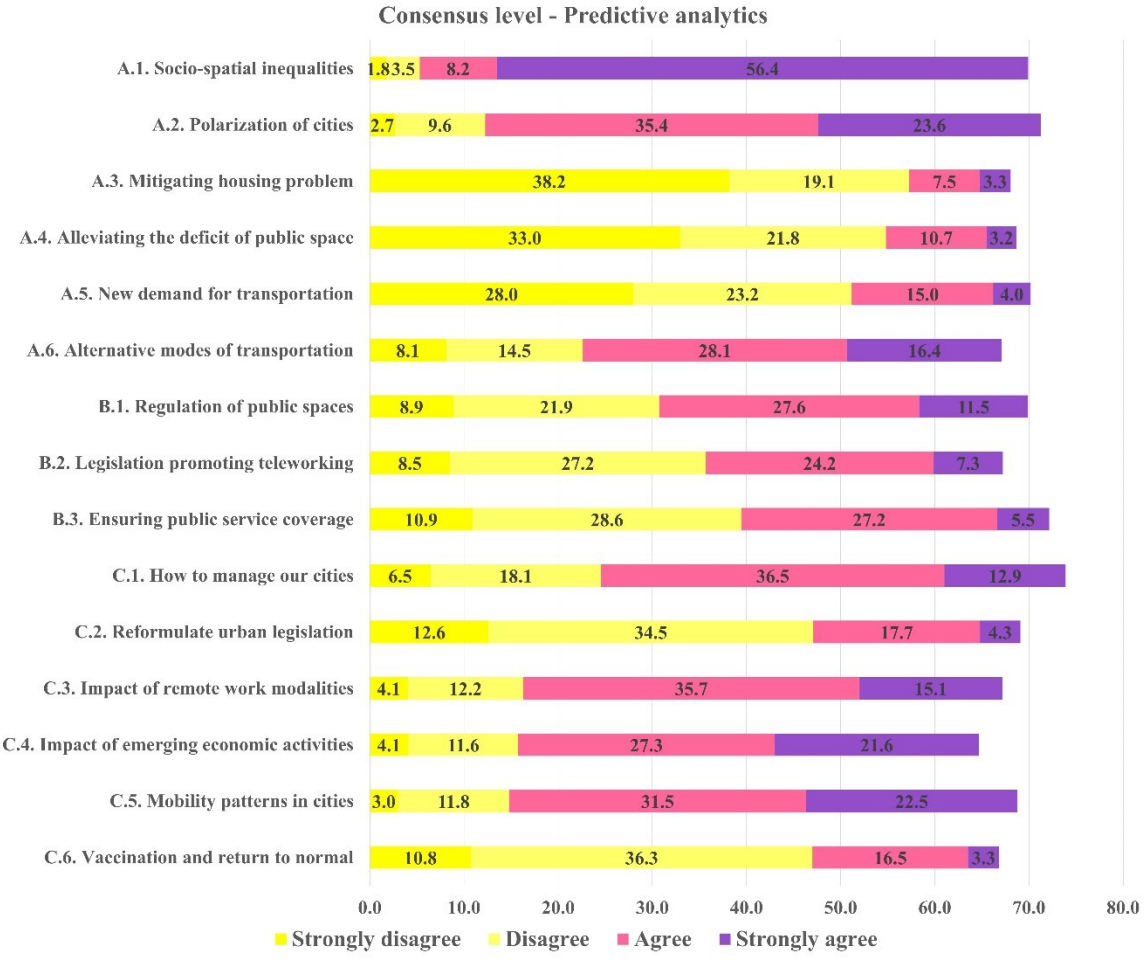

**Figure 1.** Predictive analysis based on algorithms, neural network method.

**Table 2.** Comparison of results, Delphi method versus predictions.

| Idea | DELPHI | | ALGORITHM | |
|---|---|---|---|---|
| | Median | Consensus | Value | Prediction |
| **A.1. Socio-spatial inequalities.** | 4 | Strong Agreement | 56.4 | Strong Agreement |
| **A.2. Polarization of cities.** | 3 | Agreement | 35.4 | Agreement |
| **A.3. Mitigating housing problem.** | 1 | Strong disagreement | 38.2 | Strong disagreement |
| **A.4. Alleviating the deficit of public space.** | 2 | Disagreement | 33.0 | Strong disagreement |
| **A.5. New demand for transportation.** | 2 | Disagreement | 28.0 | Strong disagreement |
| **A.6. Alternative modes of transportation.** | 3 | Disagreement | 28.1 | Disagreement |
| **B.1. Regulation of public spaces.** | 3 | Disagreement | 27.6 | Disagreement |
| **B.2. Legislation promoting teleworking.** | 2 | Disagreement | 27.2 | Disagreement |
| **B.3. Ensuring public service coverage.** | 2 | Disagreement | 28.6 | Disagreement |
| **C.1. How to manage our cities.** | 3 | Disagreement | 36.5 | Disagreement |
| **C.2. Reformulate urban legislation.** | 2 | Disagreement | 34.5 | Disagreement |
| **C.3. Impact of remote work modalities.** | 3 | Disagreement | 35.7 | Disagreement |
| **C.4. Impact of emerging economic activities.** | 3 | Disagreement | 27.3 | Disagreement |
| **C.5. Mobility patterns in cities.** | 3 | Disagreement | 31.5 | Disagreement |
| **C.6. Vaccination and return to normal.** | 2 | Disagreement | 36.3 | Disagreement |

**4. Discussions**

Results reinforce the idea of Latin America as a complex and asymmetric region, a condition that makes it difficult to build a homogeneous discourse. Examination of the urban effects of the pandemic reveals its asymmetrical impact on both territories and cities (Desai, 2020). Likewise, there are opinion divergences among experts, apparently linked to residency of the participants. The measures to contain the pandemic were local, and therefore partial and discontinuous because it depended on a specific political situation. This shifts the debate to cities governance, to the decision-making processes, which it marked in health emergency by the dilemma between the urgency and the importance of public policies.

Visions of the post-pandemic city are pessimistic. Because widespread uncertainty uncovered pre-existing dysfunctionalities or urban risk factors (Elavarasan et al., 2021); however, it has gradually diluted its renewing effect. The increase in inequality, a direct effect of the pandemic, became the dominant narrative both in Latin America and globally (Boza-Kiss et al., 2021). Perhaps the only redeemable fact of this emergency is a renewed interest in urban issues such as transportation, land use, densities, centralism, proximity, among others. This attention has been shaping a post-pandemic urban agenda that goes beyond academia to become part of public opinion. Fuelling the debate on the need for structural public policies that go beyond the conjuncture and immediacy (Parnell, 2020).

Opinions analysed emphasize the inaction of local governments because the measures applied in Latin American cities had a slight impact on pandemic progress. In other words, they did not manage to mitigate the emergency effects, nor did they address pre-existing problems such as the deficit of public spaces, public transportation coverage and access to housing. Likewise, experts' perception reveals a pessimistic outlook about regulation because there is not enough evidence to think of a significant change based on either national or local legislation. Most Latin American countries only took palliative, transitory and reversible measures; these focused on general points such as limiting displacement and supporting certain economic sectors, within the framework of a state of emergency (Ylarri, 2020). In other words, urban issues were not the core of these initiatives.

Not all conclusions are negative, there is a tendency to recognize that we are witnessing a new normality, in general terms, and a new urbanity (Soliman, 2021), in specific terms. In other words, conditions imposed by the pandemic are leading to new modes of coexistence, if it maintained, could significantly transform cities. By the results, the positive factors of change are telework, e-commerce and alternative transportation. These would be able to reconfigure people's habits and therefore the urban activities thought from the demand scope. It should be noted that this trend synthesizes into the emerging virtuality; an opportunity that should be evaluated from the pre-existing digital gap in Latin America (Batthyány & Sánchez, 2020).

Finally, it is point out mentioning the methods used both in the search for consensus (Delphi) and in trends identification (algorithms). For both approaches provide valuable information on a common theme. The problem with studying an issue as elusive as the pandemic is the lack of reliable information. Therefore, the contribution of experts from different countries contributes to build a global vision of the phenomenon. Without intention of generalizing or finding conclusive answers, but rather with intention of preliminarily identifying factors of urban change.

**5. Conclusions**

Pandemic has exposed existing urban issues while consolidating a vague idea of an alternative future. Its urban effects are not entirely clear and vary significantly from one city to another and from one country to another; therefore, it is impossible to construct a single narrative about the post-pandemic future. In Latin America, the complexity of the territory and the political contexts intervened as factors of the global emergency performance. The realities are different; however, it is possible to establish a subtle consensus on the urban transformations of the present and recent past, as well as the change trends. This is done by consulting experts in urban studies because their assessments offer an interesting interpretation that needs to be compared with reality facts.

In general terms, it demonstrated the palliative and fleeting nature of the measures taken in pandemic, whether of a practical or regulatory nature. It has missed these change opportunities, or it has gradually reversed by the emergency evolution. The new urban normality has no clear form; however, it is possible to connect it with virtuality and all its implications in the future (Neuman et al., 2021). It has shown this trend as both a threat and an opportunity, which needs to be addressed by governments to lay the foundations for a sustainable future.

In summary, the urban panorama in Latin America is not optimistic. Nevertheless, there is growing interest in specific urban issues such as transportation, housing and public space. These can mobilize diverse social actors and urban decision makers to build a shared vision of the future. The new urban agenda in pandemic (Stiftel, 2021) to make our cities fairer places; because, as explained, the most relevant problem is the increase in inequalities. Finally, to underline the need for appropriate regulatory frameworks, focused on emerging issues from a structuring vision and a conjuncture one because regulations can change cities from within.

**Conflict of Interests**

The authors declare no conflict of interest.

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# New Normal Third Places After COVID-19 Pandemic

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**Abstract**
This study examines the changes of third-place usage in the new normal era –immediately after the COVID-19 pandemic and explains the adaptation strategies of users in using the third places. This is qualitative research in which social media data is used to examine the change in third-place usage before the COVID-19 phase (normal era) and two phases during the new normal era. Mount Lavinia in Sri Lanka is considered for the empirical study. The results of the research found third-place usage in the first phase of the new normal era is lower, compared to the normal era and higher in the second-phase of the new normal era. This implies users adapting to the situation gradually, therefore, there is minimal impact to the new normal third-places. This research suggests planning attempts are necessary to enhance the resilience of third-places to face this sort of pandemic situation.
**Keywords**: Third places, COVID-19, Adaptation, pandemic, social media data.

## 1. Introduction

Third places are the spaces people use for social gathering and interaction. According to Oldenburg's Third Place concept, it is a key to build a sense of community (Oldenburg, 1989, 2001). Moreover, Third Places, including cafés, restaurants, coffee-shops, pubs, and beaches are important for bursting social city life (Coldwell, 2017) and those are public places which contain physical qualities, semantic features, and social interactions (Hajialiakbari et al. 2022). There are studies about physical third places (Oldenburg, 1999; Jalalkamali & Anjomshoa , 2019;Jeffres et al. 2009; Mehta and Bosson, 2010); virtual third places namely, online websites and social networks (Mcarthur and White, 2016; Memarovic et al. 2014) and a combination of both physical and virtual (Roger and Brignull, 2002). With the COVID-19 pandemic it highlighted the importance of paying attention to non-physical notions of public space, namely social interactions. This study deals with the changes of the social life of the third places due to COVID-19 pandemic.

Most of the time, challenging global situations like pandemics, economic depressions, and wars have directly affected our communities and changed the experience of people's day to day life (Yuniti et al., 2020). When the World Health Organization (WHO) announced COVID-19 as an International Public Health Emergency on 12th February 2020, it severely impacted the whole world both socially and economically. Self-isolation, physical distancing, and restrictions on using public spaces have been key measures to prevent the transmission of COVID-19 to protect the health of the Public (Rosés, 2020). Governments of almost all the countries have asked their people to stay at home and restrict the movements in public spaces (Sandford, 2020). A lot of people felt the loss of spending time in their familiar, vibrant, relaxed, lively and social places (Honey-Rosés et al., 2020); it can be a public park, beach, a bar or their neighbour's yard. Third places; named by Ray Oldenburg (1989) which are neither home, nor work, and the places where people choose to hang out, relax, enjoy time and discuss various kinds of topics, are also affected by the prevailing situation (Figure 1). During COVID-19 pandemic these third places were inactive since people tended to stay at home being home-quarantined. People have begun to go out in the New-Normal era, which began shortly after the COVID-19 severe transmission stage, but not as frequently. Nowadays people visit third places to reduce COVID-19 related stresses and it is observable that they are adapting to the places and to the health guidelines.

Community adaptation is a key concept of community resilience. Urban resilience is a prominent concept of global sustainable development agendas, emphasising that cities are dynamically adaptive systems. Generally, community resilience can be defined as "a comprehensive way to prepare for, mitigate and adapt to potential hazards" (Bahadur et al. 2015, Amen,2021). This study adopts the definition of "existence, development and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability and surprise" (Magis, 2010, pp. 401). Dainty and Bosher (2008, pp.357) have suggested, "a resilient built environment should be designed, located, built, operated and maintained in a way that maximises the ability of built assets, associated support systems (physical and institutional) and the people that reside or work within the built assets to withstand, recover from, and mitigate societal challenges". However, urban resilience is still defined and studied mostly related to the phenomenon of post disaster recovery and climate change, but to our knowledge limitedly discussed in relation to COIVD-19 pandemic.

This study considers COVID-19 pandemic as a significant challenge to the functions of third places and mainly discusses how community resilience acts to overcome the challenge particularly as informal bottom-up community initiatives. Considering all the aforementioned factors, the research was carried out to examine the changes of the social life of the third places (fun and recreational third places) in the new normal era after the COVID-19 pandemic and explains the adaptation initiatives of users in using the third places.




**Figure 1.** Concept of Third Places, Source: Authors

## 2. Material and Methods

The third places observed in research were categorized mainly according to their users (Table 1) as fun or recreational, service, transportation, religious, virtual, and education, but only the fun/recreational category of third places is considered in this study because such third places are optional to use, and people use them to relieve stress. Mount Lavinia, Sri Lanka is chosen as the case study area based on the selected third places category (Figure 2). Mount Lavinia is about 12 kilometres from Colombo's main CBD, which attracts a lot of people. Since Mount Lavinia has a famous beach, it attracts both local and foreign users.

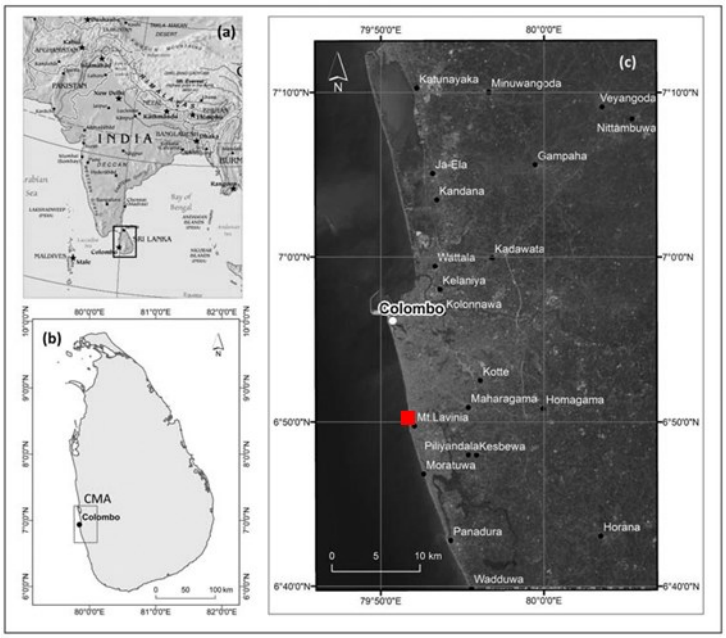


**Figure 2**: Location of Mt. Lavinia

The recent discussions on third place theory are focused on the changes which have been already done and which should be done to the characteristics of third places due to ongoing technological revolution in the world (Memarovic et al. 2014). Most recent literature study how third places have been changed over time and technology (Memarovic et al. 2014; McArthur and White, 2016; Adelfio et al., 2020). Although, some research uses Social Media data for analysing the content regarding third places (Adelfio et al., 2020; McArthur and White, 2016). When it comes to the growing trend of Social Network Services (SNS), it plays an important role in everyone's lives globally. Most of the researchers have identified and accepted social media data as a valuable resource to study specific urban

scenarios (Anselin and Williams, 2016). Location-Based Social Networks (LBSNs) are more suitable for analysing such data with reliable and informative interpretations and representations. SNSs such as Facebook, Instagram, Foursquare, Google Places, Twitter, etc. can be identified as examples.
This is deductive research, therefore, other than Social Media data, field observations also were conducted. Social Media data collection is chosen since its novelty and needed to apply it for Sri Lankan context. The changes of the third place usage was measured based on attractiveness and few criteria-based indicators were defined namely, Behavioural, Relational, Sensorial Atmosphere and Health (Rahmani and Messaoudene, 2019) (Table 2).

**Table 1.** Third Places identified in previous case studies categorized according to uses**.** Source: Authors

| Fun/ Recreational | Service | Transport | Religious | Virtual | Education | Other |
|---|---|---|---|---|---|---|
| • **Cafes/ Restaurants**<br>• **Coffee shops**<br>• **Beaches**<br>• **Pubs** | • Beauty parlors<br>• Banks<br>• Gas stations<br>• Libraries<br>• Supermarkets<br>• Hotels<br>• Cinema halls | • Bus stations<br>• Railway stations<br>• Main streets<br>• pavements | • Churches | • Online platforms | • Schools<br>• University<br>• Colleges | • Town meetings<br>• Club organization<br>• Senior centers<br>• Neighbour's yard |

**Table 2.** Indicators of measuring third place attractiveness**.** Source: Authors

| Concept | Definition | Indicators | Values |
|---|---|---|---|
| Behavioural Aspects | This measures the positive and negative civic behavior of the posts. | • Type of Social Activity – engagement of using the place | Name of the activity |
| Relational Aspects | To find out what kind of attractiveness to that place based on the type of relationship of people on the posts | • Romantic/ family outing<br>• Friends and Colleagues<br>• Communication with strangers<br>• Solo outing | Intimate Relationship<br>Personal Relationship<br>Public Relationship<br>Attachment and faithfulness |
| Sensorial Atmosphere | This measures the visual atmosphere of the place | • Crowd | Visual atmosphere – Positive/negative |
| Health Aspects | This measures the safety and healthy environment of the place for its attractiveness | • Wearing masks<br>• One-meter distance among people<br>• Number of people | Yes/No<br>Yes/No<br>Number |

The primary data source of this research is social media data, particularly from Facebook and Instagram. These are the most popular free social media platforms that allow users to publicly share photographs. Previous research indicates that leveraging social media data for information sources has a high potential. Data collection was done manually to obtain the results due to Instagram API (Application Program Interface) restrictions and Facebook's high security (Hu et al. 2014). Both applications were used to retrieve only publicly available data.
Firstly, a list of selected third places categories was prepared by searching the selected type of third places from Google Map. There are 38 locations on the list. The geotagged photographs to those areas were extracted using the location through Facebook and Instagram. Nonetheless, not all the locations had tagged images, thus photos were restricted to areas where social media data was available.
Following the collection of data from social media, a database was created with the posts and required information. Then a data sheet with the identified indications was created, and each post was subjected to content analysis by using the indicators developed under the criteria as codes. The ethical issues in social media data usage are

acknowledged and the collected data are used only for research purpose and not for any commercial purpose. All data are analysed at an aggregate level without drawing attention to individual users (Chew & Eysenbach, 2010). By covering the faces, the people in the images are de-identified.

Mainly three phases were taken for the analysis: 1st Phase | May - August 2019 (This period was used to examine the pre-COVID situation to determine the changes); 2nd Phase | May – August 2020 (This period is called the New Normal Era Phase 1, as it was the first stage of the New Normal Era following the severe pandemic outbreak); 3rd Phase | October 2021 –January 2022 (This period is called New Normal Era Phase 2 as it was necessary to study the most recent changes that occurred in the third places and to compare the first phase of the new normal era).

Photo categorisation was the main analysis method. The categorisation was done based on the location of third place, the time which the photo was taken and the indicators of measuring attractiveness. Thereby, it facilitated the categorical frequency analysis.

**Table 3**. Categorical frequency analysis, Source: Authors

| Aspects | Categories | |
|---|---|---|
| Behavioural | | |
| | 0 % - 25% | |
| | 25% - 50% | |
| | 50% - 75% | |
| | 75% -100% | |
| | | |
| Relational | Poor | |
| | Average | |
| | Good | |
| | Excellent | |
| | | |
| Sensorial | Yes | |
| | No | |
| | | |
| Health | Low | |
| | Medium | |
| | High | |

**3. Results**

Initially photos were categorized into three phases, 1st (before COVID-19), 2nd (New-normal era phase 1 and 3rd (New-normal era phase 2). According to the categorical frequency analysis, the number of postings found in the 1st phase (643) is higher than the 2nd phase (368), but that it has grown to a level higher than the 1st phase in the 3rd phase (846). It indicates that third-place usage was somewhat reduced in the first phase of the New Normal Era, but gradually increased in the second phase. The frequency of visits declined in the second phase due to strict health guidelines, but in the third phase, people adapted to some of the health guidelines and community resilience increased as use of third places is a good opportunity for pandemic-related stress releasement. This finding is in line with Dizdaroglu's discussion (2022), who states urban spaces received renewed attention and number of visits has been increase after the pandemic.

The photo categorization was then carried out in accordance with the four criteria identified during the literature review (Table 3). Despite the fact that 38 fun or recreational third places were identified in the case study area, only 14 were available on social media for dataset and was considered those available places only. According to the overall analysis, the attractiveness of each sample location was similar in the first and third phases but dropped significantly in the second phase. It is worthwhile to discuss the results for each aspect.

**4. Discussion**

**4.1 Behavioural Aspect**

The collected images were subjected to content analysis in order to identify the activities that individuals engage in and in third places. Most of the activities are for recreational purposes, such as bathing, celebrating, cooking, dating, eating, drinking, playing, relaxing, and occasionally working.

The majority of the images depict one or more types of activities where it is possible to distinguish between the three phases. Mainly, type of the activity and the number of activities were counted from each photograph. Then

according to the count of the activities it was classified under few categories (Table 3). According to the findings, the majority of the locations show a wide variety of social activities during the first phase. Results identified that, mostly dining, drinking and gatherings can be identified common activities in all places (Figure 3). Bathing and playing can be seen frequently at beachside locations such as Mount Lavinia Beach, Buba Beach restaurant, and Sugar Beach. What is highlighted mainly is the percentage of the people who used these places for gathering is relatively high (53%) compared to other activities. However, during the second phase, the activities are mainly limited to dining, drinking, relaxing, dating, and small family gatherings. Further, in the 2nd Phase most people have posted photos while they are dining or drinking. But in 2019 people have used the places to freely capture themselves while in 2020 people tend to capture while they are dining with limited movements through a particular space.

**Table 4:** Overall Summary of the Categorical frequency analysis, Source: Authors

| Location | Phases | Place Attractiveness | | | |
|---|---|---|---|---|---|
| | | Behavioral | Relational | Sensorial | Health |
| Arthurs Pizzeria | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Boat House Café | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Buba Beach Restaurant | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Casserole | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Jo Jo's Place | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| KFC | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Lions | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Loon Tao | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Mt Lavinia Beach | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Pizza Hut | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Reef House Café | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| Sugar Beach | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| The Shore by O | 1st | | | | |
| | 2nd | | | | |
| | 3rd | | | | |
| | 1st | | | | |

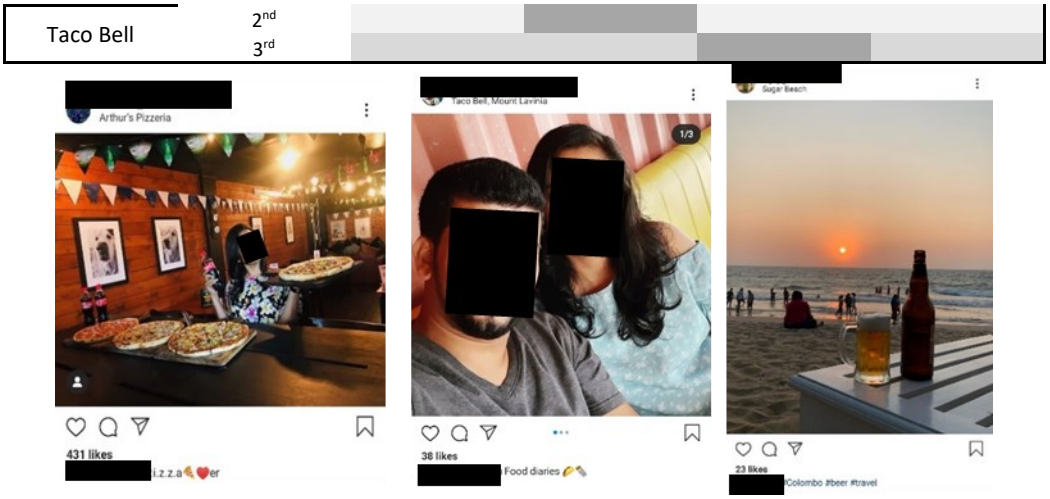


**Figure 3.** Type of social activities




**Figure 4.** A photograph from 2nd Phase

Additionally, captions of the photographs clearly show that people were desperately looking forward to visiting these third places during the 2nd phase even though the health risk was there. It can be identified that people were attracted to the third places in the 2nd phase mostly because of the isolation and self-quarantine that they experienced, wherein 2019, they were just going out as much as they felt like doing so. According to Oldenburg (1996), third places serve as gathering spots when emergencies or disasters occur. Further Oldenburg (1996) states, socialisation is a need after a disaster and it confirmed as people mentioned *'we were waiting calmly almost three months for a gathering like this'* (Figure 4.). When comparing 3rd phase and 2nd phase, it clearly shows that the people were becoming normal and adapting to the situation as a relatively high number of social activities can be seen in that era. Specifically, social gatherings have been significantly increased (54.5%).

### 4.2. Relational Aspect

The type of relationships was evaluated during the three phases based on the Relational Aspect to observe how they changed over time. There were four main indicators identified: romantic and family outings, friends and colleagues, communication with strangers, and solo outings. According to the percentage of the relationship type, solo outings have poor relational aspects, whereas communication with strangers has average relational aspects. Outing wriends and colleagues indicate a good relationship, whereas romantic and family trips indicate an excellent relationship (Table 3.). People have become more attached to their families and loved ones as a result of spreading the virus. In the second phase, more people visited these locations with their families and loved ones than with their friends, indicating a strong attachment to the location. The most prevalent aspect is that most places have a good relationship in the first phase, but it has changed to an excellent relationship in the second phase. According to research, having access to these places improves one's own quality of life and builds community bonds (Volpe, 2021).

People tend to trust their family and visit these venues with them because they are unable to go out with others besides their families due to health constraints and COVID 19 precautions. As Volpe further states, third places are not usually places where people will engage in serious conversation, but there is always the possibility of finding someone to talk to, or at least recognizing a similarity. Some of the places in the second phase have a poor relationship because they went looking for someone to talk to but were limited by health limitations. However, in the third phase, good relationships with friends and colleagues are spreading throughout the places as thousands of largely homebound people throughout the world have realized that dealing with the same people every day becomes monotonous quickly (Figure 5).




**Figure 5**. Outing with friends and colleagues

**4.3. Sensorial Aspect**




**Figure 6.** Visual atmosphere in 2nd phase vs 3rd phase.

The Visual Atmosphere indication was analyzed in Sensorial Aspect by assessing if the backgrounds of the photos were crowded. The photos were analysed using both positive(yes) and negative(no) aspects. According to (Table 3) the majority of the third places were more congested in the first phase than the second phase. In other words, COVID-19 has influenced the fact that places in the new normal are less congested than in the first phase.

There is strong evidence that physical distancing has played a significant role in containing the first wave of the COVID-19 outbreak in China (Chen et al., 2020; Kraemer et al., 2020), and the latest evidence likewise indicates their effectiveness in several European countries (Flaxman et al., 2020). Yet, in the New Normal Era, people still avoid the crowdedness of the place. Anyhow during the 3rd Phase, it can be identified the negative environment that was

identified during the 2nd Phase drastically changed in the 3rd Phase as majority of the places show positive visual atmosphere. (Figure 6)

**4.4 Health Aspect**

According to the health aspect, number of people in the photographs were analyzed. As per the number of persons indicator, 85% of the posted photographs in the 2nd Phase contain fewer than five people in one photograph. When compared to the first phase (65%), the number of people who visited these places jointly has decreased. According to the results, the number of solo trips to these places is also increased by 11% in the 2nd Phase. At the same time photographs that are included more than 10 people are also decreased by 6%. When comparing to first phase each phase was analyzed (Table 3). According to (Table 4), most of the places were more populated during the 1st Phase than in the 2nd Phase, but in the 3rd Phase it has become normalised in coming back to normal. Apart from those other aspects like wearing masks; during the 2nd Phase, according to the photograph analysis, only 13% of the people could be seen wearing or holding masks (Figure 3). Since most of the people have come to these places for dining, it cannot be identified whether they have worn masks. And some photographs show even the staff of the place are wearing masks. (Figure:4) And some places have used safety precautions like covering the cashier area (Figure:7)
According to one –meter distance indicator, no photograph was found that maintained a one-meter distance within them.
Novel Coronavirus, COVID 19 outbreak which is a global crisis unlike any in the 75-year history affects all the segments of the social and physical lives of people around the world (United Nations, 2020). It is obvious from the health aspects that safety requirements were never applied in social gathering locations prior to this incident. However, even though the threat is still evident in the third places, people gradually increased their visits with medium and large crowds in the 3rd phase.



**Figure 7.** Staff using safety covers at the cashier and wearing masks when serving.

**5. Conclusions**

This study shows the changes of third-place usage in the new normal era –immediately after the COVID-19 pandemic. The study methodology is new to Sri Lanka as the researchers have mainly used social media data. It was found that third place usage immediately after COVID-19 situation was significantly reduced compared to the normal situation but after about a year the community adapted to the health guidelines and new environments and was attracted to the third places as it was before COVID-19. There is a discourse on the impact of pandemic to urban public places including third places (Askarizad et al., 2021; Askarizad and Safari, 2020), but this research highlights that the impact is significant during and immediately after the pandemic, but it is gradually reducing due to community resilience. In general, the previous studies tend to highlight that pandemic may have a negative consequence on the third-place function (Handarkho et al. 2021). This study confirms that in the new normal era people indicated a strong desire for social interactions in third places. Thus, it can be concluded that due to the nature of adaptation of the human beings, they overcome the health guidelines related constraints.
Further this research calls the scholars to interpret the COVID-19 related socio-environmental changes in the light of community resilience concept, as this concept is mostly discussed in relation to the phenomenon of post disaster recovery and climate change. While communities adapt to the fixed-physical third place environment, planners and designers' attention is necessary to maintain the flexibilities of their designed spaces to encourage community resilience.
Moreover, the limitations should be acknowledged as social media data are used as the main data source. Only a specific category of third place users have been subjected to the study as all those who come to third places may not be posting photos to social media. Most social media users are younger generations therefore elders and children may not well represented. Moreover, when comparing three phases, it would be ideal to consider May to

August 2022 as 3rd phase as activity patterns can be different in some months of the year. However, it is possible to conduct similar research in different contexts and different time periods to confirm community resilience in post-pandemic situations by following the same qualitative methodology or by following a mixed-methods approach.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# The Impact of the Covid-19 Pandemic Crisis on BIM Architectural Practice in France

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**Abstract:**
The pandemic crisis of covid-19 has affected the world of industry and construction worldwide. In France, the government has made lockdown and telecommuting mandatory for some areas for months. In recent years, the BIM (building information model) is increasingly adopted in construction, research has shown that in France, agencies that use BIM software and regularly exchange their digital BIM models with their partners are a minority, and that France is not a leader in this field. In this research we will answer the question of how the Covid-19 pandemic crisis has impacted BIM architectural practice in France, based on questionnaires sent to architectural design offices, we will demonstrate the new collaborative tools used and their contributions to the adoption of BIM in agencies.
**Keywords:** BIM; covid-19; architectural practice; collaboration; France.

## 1. Introduction

In December 2019, a COVID-19 pulmonary epidemic emerged in Wuhan, the World Health Organization qualified it on March 11, 2020 as a global pandemic (Ranney et al., 2020). More than 85 countries were infected in a short time (Woertz, 2020).
The spread of the virus has resulted in a large number of deaths and has strongly impacted the medical sector. (Choudhury et al., 2020) To deal with the spread of the COVID-19 virus, several countries have imposed strict restrictions, the introduction of a total or partial quarantine (self-isolation of the population, shutdown of all non-vital businesses) and the cessation of transportation.
This research will concern the construction industry in France. The pandemic has affected all industries and sectors as many restrictions have been imposed in all countries. The construction sector has been strongly impacted. (Al Amri & Marey-Perez, 2020) According to a study by Price Waterhouse Coopers[1] (2020), there are three main concerns caused by COVID-19 for engineering and construction. The concerns are financial, international recession, and influence on the workforce. Architectural organizations in all countries have proposed strategies for adapting to the Coronavirus on the construction site for architects, builders, contractors.
In France, the government has set up recommendations and sanitary measures such as hygienic "barrier gestures" and physical distancing. Restrictions of travel to the strict necessities (food shopping, care and work when telecommuting is not possible), outings near the home (individual sports activity, dog hygiene), the closure of borders in the Schengen area as well as the penalization of violations related to these new rules, The interdiction of movement in several forms (national containment, partial) depending on the number of cases in the regions on three occasions:
from March 17 to May 11, 2020 not included, that is 1 month and 25 days;
from October 30 to December 15, 2020 (1 month and 15 days);
from April 3 to May 3, 2021, i.e. 28 days.
The confinement has pushed a large part of the agencies to move to telecommuting and exchange information in digital format. In some countries such as the United Kingdom, agencies and architectural offices are working in BIM Building Information Modeling unlike France where BIM is still in its infancy (Hochscheid, 2021).
The Building Information Modeling (BIM) is a method of construction of a digital model offering the possibility of assembling, in the same model, multiple information specific to the various trades participating in the project. The information shared on the model (properties, geometries, access rights, text documents, etc.) allows different actors to work together on the same medium (Aurélie de Boissieu, 2013) (Kocatürk & Medjdoub, 2011).
This method could have facilitated the work of actors during the containment. But according to the survey of (Hochscheid & Halin, 2020) in France 12% of agencies use a BIM software and regularly exchange their digital models BIM with their partners, 30% of agencies do not work at all with BIM practices but theyuse a modeling software "BIM" without carrying out exchanges BIM with its partners, and 58% of agencies do not work at all with BIM practices.

## 2. Material and Methods

[1] PricewaterhouseCoopers. (2020). COVID-19: What it means for engineering and construction: PwC. Retrieved May 27, 2020, from PwC website: https://www.pwc.com/us/en/library/covid-19/coronavirus-impacts-engineering-construction.html

Government restrictions and sanitary measures have impacted the economy of several countries, such as Oman where (Al Amri & Marey-Perez, 2020) construction has been considered the mainstay of the country's economy and tourism.
In France, the recommendations of covid-19 have influenced and changed architectural practices from the design stage in the agency to the construction site.
Al-Ashmori et al (Al-Ashmori et al., 2020) show that agencies working with BIM have the advantage of reducing the complexities and difficulties of managing a project (He et al., 2017). BIM improves the communication process, provides a collaborative platform and supports interoperability between different business areas (Alreshidi et al., 2017), (Ghaffarianhoseini et al., 2017), (Miettinen & Paavola, 2014), (Oraee et al., 2017). Furthermore, BIM can increase performance and improve productivity throughout the project life cycle if successfully implemented (Migilinskas et al., 2013) (Nick & Gary, 2020), (Haron et al., 2015), (Azhar, 2011).
We have established this research because the French government since a few years has started to take interest in BIM. It had set as a goal a BIM plan in place and implemented by early 2022. With teleworking many sectors have gone digital. The purpose of our research is to answer the following question: “how the pandemic crisis of Covid-19 has impacted the architectural practice of BIM in France and the use of digital in the field of architecture?”.
To do this in this paper our work will be divided into two phases:
Phase 1: Government decisions in relation to the construction sector: We will start with a literature review and collection of information on government decisions towards the construction sector.
Phase 2: Case study. Based on Elodie Hochsheild's(Hochscheid & Halin, 2020) research on the BIM practice of agencies, we have drawn up a questionnaire and sent it to architectural agencies in order to make a comparison before and after COVID-19 and to follow the evolution of BIM practices in the agencies.

**3. Results**

Phase 1: Government decisions in relation to the construction sector during the project review in France

**From a practical point of view**

In France, in Tableau 1, the Order of Architects declared on March 16, in relation to the health situation, recommendations for all actors in the construction sector during the different phases of the project, in our research we will take into consideration only the first phase of design and project study (*Coronavirus*, 2020a) (*Coronavirus*, 2020b)

**Tableau 1:** The French government's recommendations to architectural agencies.

| Recommendations for consideration | Parties concerned |
|---|---|
| The implementation of teleworking by equipping computer workstations with adapted software, and informing their clients of the probable impossibility of meeting their contractual deadlines in the study phase. | architects and their partners in project management |
| The College invites caution and recommends not accepting a continuation of activity if the sanitary conditions cannot be met.<br>In the case of a site visit, if the barrier measures are applicable and the sanitary conditions are met, it is possible to go there.<br>As concerns dialogue with the project owner, the government's instructions aim to limit contact as much as possible, so it is preferable to favour telephone or video-conference contact. | architects |
| The time limit for the instruction of authorisations under instruction on 12 March can be suspended until 24 May 2020. From 24 May onwards, the classic instruction period would resume. This does not mean resuming the procedure with a full deadline, but continuing the appraisal initially started.<br>For authorisations filed between 12 March and 23 May 2020, the starting point of the appraisal period will be postponed to 24 May 2020.<br>In practice, the purpose of this order is not to systematically suspend the investigation of building permit applications but only to adapt the rules to allow the investigating departments that do not have the human or material resources to postpone it to 24 May 2020.<br>This means that applications for planning permission that should and/or must be examined between 12 March 2020 and 24 May 2020 can be examined.<br>Local authorities that have already taken the step of dematerialising planning permission (compulsory from 1 January 2022) are organising themselves to continue examining applications. | urban planning department and project management |

**From an economic point of view**

The deadline for payment of professional fees, which was set for 31 March 2020, has been extended to 31 May 2020.

The URSSAF (Union for the recovery of social security contributions and family allowances) and business tax service networks have taken exceptional measures (Coronavirus, 2020b).
As regards URSSAF:
For companies: possibility of postponing the payment date for employee and employer contributions scheduled for 15 March 2020 by up to three months.
For self-employed workers: the monthly due date of 20 March will not be deducted, and they may request payment deadlines, an adjustment of the contribution schedule or the partial or total coverage of their contributions, or the allocation of exceptional aid.
With regard to corporate taxes:
For companies: possibility of requesting the postponement without penalty of the payment of their next direct tax instalments.
For self-employed workers: possibility of modulating the rate and instalments of the withholding tax.
All these points have been demanded by the president of the order of architects who has issued a request to the Minister of the Economy and the Minister of Culture in order to alert them to the consequences of the ordinance extending the deadlines for the instruction of town planning authorisations as well as to the inadequacy of the calculation of support measures for architectural agencies(*Instruction des permis et aides aux entreprises*, 2020).
In (*Résultats de l'enquête "Comment va votre agence ?*, 2021), there have been many surveys on the impact of Covid-19 on architectural agencies from an economic and architectural practice point of view, and the Ordre des Architectes in its survey "How is your agency doing?" asks about the financial situation of agencies and the state of their cash flow.
The information website for construction professionals Batiactu has also carried out a survey on ACTIVITY, INNOVATION AND PROFESSIONAL PRACTICES.

**Phase 2: Case study**

Since March 14, 2022 the French government has removed most of the restrictions and sanitary measures (vaccination pass, mask in public places), after which we decided to start our survey within architectural offices and agencies. Our survey focuses on the impact and evolution of BIM practice and the changes in architectural practice in offices and agencies due to COVID-19 pandemic. In this article we will analyse the responses of 4 architectural practices in France.
We have taken two sizes of agencies, 2 small agencies with 1 to 5 employees and 2 medium sized agencies with 6 to 11 employees.

*The impact of the COVID-19 pandemic on the economic side of the agencies*

For the small agencies: one agency laid off staff because of the pandemic and did not hire at the same time, and the other only hired.
For medium-sized agencies: one agency laid off and hired staff and the other neither hired nor laid off during the pandemic.

**Tableau 2:** The impact of the COVID 19 pandemic on the economic aspects of institutions related to staff layoffs and employment

| Agency size | Small agency | | Average agency | |
|---|---|---|---|---|
| Dismissal | yes | no | yes | no |
| Recruitment | no | yes | yes | no |

*Teleworking in architectural offices*

The French government had announced a confinement 3 times for a total duration of more than 3 months, according to the survey we have one agency out of two which did not telework for several reasons (unavailability of equipment, non-respect of the recommendations...). The agencies that have teleworked confirm that they have done so for a period of between 1 and 3 months.

**Tableau 3:** Teleworking in architectural offices

| Agency size | Small agency | | Average agency | |
|---|---|---|---|---|
| Teleworking | yes | no | yes | no |
| Duration of telework | From 1 to 3 months | 0 | From 1 to 3 months | 0 |

*Collaborative work in an architectural practice*

In order to measure the level of BIM and collaborative working, we asked about the workflow within the agency.
One agency confirmed that they work collaboratively on the same project and that everyone does their own part of the work.
In three agencies the stakeholders work individually, each stakeholder works on their own project from start to finish.

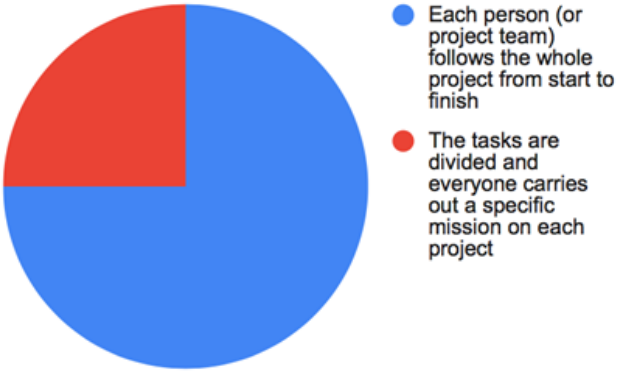


**Figure 1:** Division of tasks within the same project within the agency.

*Integration of new technologies*

In three agencies the managers have a supportive attitude to change, including one agency that has implemented a BIM system. However, in one agency the managers are indifferent.

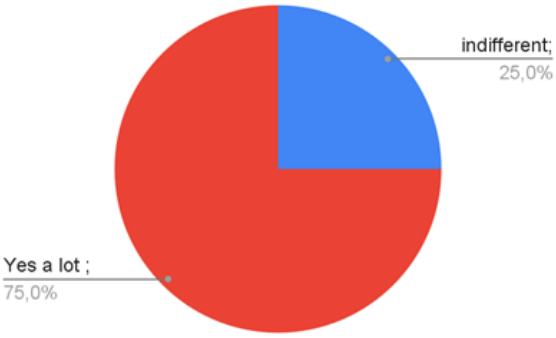


**Figure 2:** The use and integration of new technologies within the company by managers**.**

*Methods of exchange within the agency*

100% of the agencies questioned confirmed the use of a common physical server, although 50% of the agencies still exchange information by email and 25% use USB keys to transfer files.

*Level of digital implementation in agencies*

According to the agencies surveyed in Figure 3, digital practices in agencies have not changed after the pandemic and the level of application is the same before and after COVID-19.

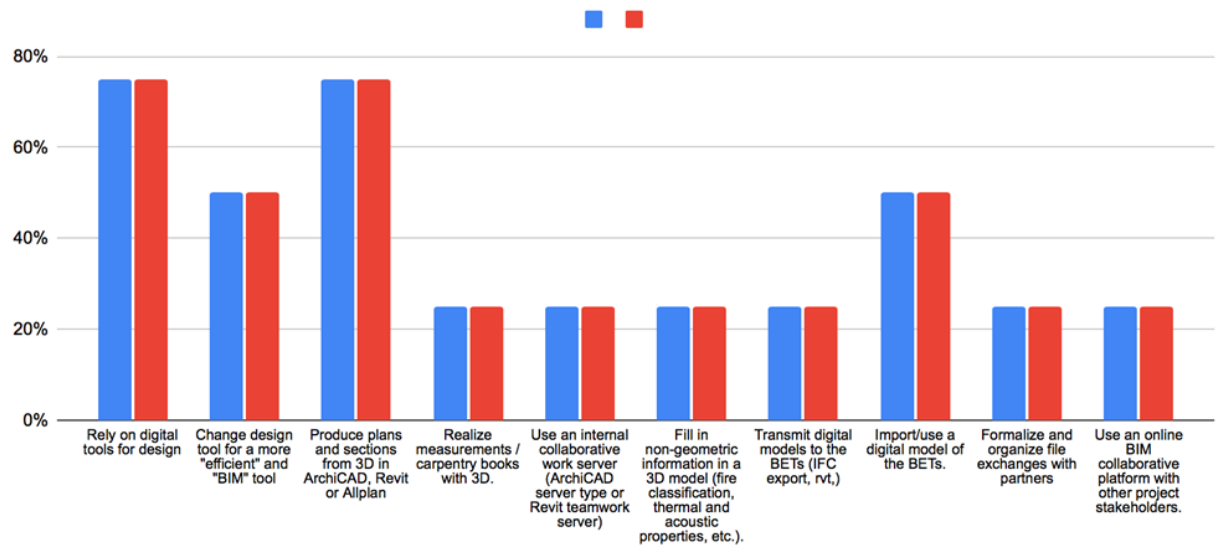


**Figure 3:** The level of digital integration and BIM practices in agencies before and after covid-19.

## 4. Discussion

This research has not been done for a long time, we will continue to generate more responses and send the questionnaire on other platforms to get more responses, then we will make a comparative analysis with previous surveys that were conducted before the COVID-19 to be able to reach conclusions.

## 5. Conclusion

From the analysis of the results we can deduce that despite the pandemic and the situation in which the agencies found for more than 3 months.Only 30% of the agencies are confident about digitalization. More than half of the agencies are not thinking of using BIM in the near future.

One of the main causes is that BIM replaces the architect.

Our proposal to answer this problem is to make seminars / webinars to inform and sensitize agencies and reassure architects on the issue of BIM

This research was prepared for the conference and is not yet complete because a very important number of agencies have not yet responded to the survey.

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# Delineating The Impact on Design Parameters Due to Covid-19

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**Abstract**
The lockdown imposed due to Covid-19 has caused economic and social challenges around the world. It has adversely impacted the real estate and construction sector. The ongoing pandemic has created a need to reassess the building design strategies to mitigate the threat of the virus. The novelty of the research lies in ranking the design parameters with regards to the pandemic, to provide better design solutions for all stakeholders. This research aims to identify, assess and rank the impact due to Covid-19 on different design parameters in architecture. An analysis of the identified parameters has been carried out by surveying architects and occupants. Recommendations have been made to provide better design solutions for the pandemic age.
**Keywords:** Architecture; Design Parameters; Covid-19; Pandemic.

## 1. Introduction

The Covid-19 or novel coronavirus has changed the world as we know it. The virus which had emerged in Wuhan City, Hubei Provence by the end of 2019, was declared as a cause for international concern and a global pandemic on March 11, 2020.

India reported its first case of Covid-19 on January 30, 2020 (Vasantha Raju Na, 2020). The country has been in a continuous series of lockdowns and restrictions since March 24, 2020. This disease has led to home quarantine in many countries creating psychological and social challenges as a result of long-term stay at home (MahsaZarrabi, 2021). An economic and social crises has followed in its aftermath. This economic recession has had varying impacts across different sectors. The real estate and construction sectors have witnessed the brunt of this fallout as seen in the empty offices and vacant construction sites.

Architecture and urbanism as academic disciplines and professions that influence, in many different ways, individuals, communities, and societies, can support the fight against the pandemic by conducting research to comprehend the socio-spatial implications of COVID-19; identifying new conceptions related to emerging lifestyles which stem from the new spatial environments that integrate working and living patterns; and ultimately developing design responses towards creating healthy environments that successfully accommodate the infected populations while addressing the associated social and psychological ramifications (J.Foss, 2020). To effectively reduce the spread of the virus, it is crucial to highlight the effectiveness of building design strategies in mitigating threats to occupants (Naglaa A. Megahed, 2021).

The design parameters for architecture change continuously according to the time and situation. As early as 30-15 BC, Marcus Vitruvius Pollio had laid down the principles of architecture in his handbook 'De architectura.' He had written the essential parameters of architecture as *firmitas, utilitas*, and *venustas* (i.e., structural stability, function and space arrangement, and aesthetics).The weightage or dynamics of these parameters keep changing with time. In his essay titled "The New World" published in 1926, Hannes Meyer has pointed out that "Each age demands its own form." We are presently living in the Covid-age. This has created a need to assess the weightage of design parameters in architecture with regards to the pandemic. The importance of this is that identifying architect and occupant priorities can provide better design solutions for all stakeholders.

## 2. Aim

The aim of this research is to identify, assess and rank the impact due to Covid-19 on different design parameters in architecture.

## 3. Objectives and Methodology

Objectives of this research are-

- To identify & categorize the qualitative design parameters in architecture through literature study.
- To understand the possible effect of Covid-19 on the identified design parameters.
- To assess and rank the impact due to Covid-19 on the design parameters by RII derived from user survey.

The Relative importance index is calculated by using the Eq. 1; where W - ranges from 1 to 5 - denotes weighting given to each statement by the respondents, A signifies higher response integer (i.e. 5 in this case), and N denotes total number of respondents.

$$RII = \sum W/(A*N) \quad (1)$$

**4. Defining the Design Parameters**

Design parameters – a corpus of variables - decompose the complexity of the human and social needs, environmental requirements, utilities and technological requirements to create a fundamental basis of design, on which the building architecture can evolve to its full potential. Since the building architecture and environment are inextricably correlated to each other, changes of any sort can bring enormous impact on the role of the parameters in design. In this section, a total of 60 different qualitative design parameters have been identified which have been broadly assorted into 5 categories as described below and the impact of the Covid-19 on each category has been discussed in Table 1, Table 2, Table 3, Table 4 and Table 5 –

- Site surrounding parameters (SS),
- Site parameters (S),
- Building parameters (B),
- Human and socio-economic parameters (HS)
- Smart building system (SBS)

**Table 1.** Site surrounding parameters (SS)

| Parameters | Description |
|---|---|
| Location | Geographic location not only determines its connectivity with the urban centres but also reveals the vulnerability to the Covid-19 infection. (Balbontin, 2020) |
| Neighbourhood context | If the immediate surroundings of the site encounter any containment zone, social contact should be avoided in all respect. (NDMA) |
| Accessibility to the site | Width of the road should be such so that it reinforces efficient circulation by allowing emergency access, social distancing, and access to amenities. |
| Access to amenities/essentials | Proximity to the food and nutrition security, clean water, reliable waste management, health services, transportation, technology, etc. is essential for sustainable living. |
| Access to public health infrastructure | Availability of sufficient and well-equipped public health infrastructure within the accessible limit of any neighbourhood plays an important role in fighting pandemic. As per National Health Policy minimum 2 beds are required per 1000 population (National Public Health, 2017). |
| Access to public open space | The accessibility to the public open space such as parks, green spaces etc. helps improving mental state, reducing stress level and thereby facilitating the balance between social life and work life. Moreover the public open spaces has to adaptable and multi-functional in nature in order to use them in emergency situation. (UN-Habitat, 2020) |
| Population density | Relation between population density and mortality rates demonstrates, people living in a densely populated areas are more susceptible to infection. (Bhadra, Mukherjee, & Sarkar, 2021) |
| Urban network | Connected to an adaptive transportation network as well as digital network is crucial to cope with the pandemic situation (Bogdan-Martin, 2020) (Network lessons: improving connectivity for the post-Covid economy, 2021). |
| Urban water cycle | Water pollution caused by drugs and untreated waste water can elevate extent of infection. In-situ and tertiary (with chlorination, UV irradiation etc.) waste water treatment can restrict the contamination. Moreover, to ensure good quality of water WHO guidelines need to be implemented at different water collection, distribution and consumption point. (Bhowmick, et al., 2020) |
| Waste management | A proper in-situ treatment of solid-waste and proper implementation of guidelines prescribed by WHO are very essential in thwarting the contamination. (Bhowmick, et al., 2020) |

**Table 2.** Site parameters (S)

| Parameters | Description |
|---|---|
| Zoning and size | Zoning at site level defines the accessibility to the site, required setbacks from the boundary, connectivity within the site, separation of different functional areas, building height, size and location which helps in reducing the probability of contamination. |
| Natural physical features | The coexistence of different natural site features like existing greenery, site topography, water body etc. create microclimate, introduce diversity and also function as a private gathering space during the period of lockdown. |
| Manmade features | Diversified elements like pathways, seating areas, feature wall, fountain, statues, building materials, landscaping etc. act as mood accelerator during the pandemic period while reducing the need of gathering in a city level public space. |
| Open space | The mandatory open space of a particular site depends on the exiting bye-laws of a particular location. However, the larger open spaces of a site act as private outdoor areas as well as buffer zones that shield the building and its occupants from the surrounding infection. |
| Circulation | Separation of vehicular and pedestrian movements (like the movement of ambulance transporting Covid-19 patients etc.) of the containment areas, from the neighbouring areas is the key to confine the level of infection to a limited areas. |
| Utilities at site level | Uninterrupted on-site services like gas, internet, electricity, telephone, security, water supply and sewage, facilitate the quarantined period. In this context, on-site treatment of the sewage and waste water of infected person is crucial to restrict the contamination. |
| Sensory | Visual connection with the surrounding, noise reduction, coexistence of flora etc. have a direct correlation with the improved mental health especially during the phases of lockdown. |

**Table 3.** Building parameters (B)

| Parameters | Description |
|---|---|
| Personal vision and style of the architect | Architect's vision and style integrate diverse parameters into the design which enables a space adaptable, flexible and aesthetically pleasing. |
| Orientation | Positioning a space according to the prevailing wind direction and sun path can improve energy efficiency, thereby facilitating money saving. |
| Climate | Designing a building considering different climatological factors like wind direction, sun path, rainfall, temperatures, snowfall etc. makes it climate responsive, sustainable and efficient; it reduces the need of artificial lighting, heating and cooling systems which results in cost saving and limits magnitude of infection. |
| Occupancy pattern | As the human behaviour, active and inactive hours etc. varies at different types of occupancies, it's very important to isolate different occupancies (mainly the public areas) to the reduce risk (Barbosa, Mateus, & Bragança, 2016). |
| Form | Different building forms (like circular, square, plane roof, pitch roof, tall building, clusters short building etc.) not only add diversity into our built environment but also its meticulous use enables a designer to achieve the optimum level of energy efficiency which reinforce the reduction of cost for Operational Energy. |
| Function | Segregation of private and semi-private space from the public space; allocation of proper quarantine zone neutralizes the potential risks to a great extent. |
| Durability | Durability of the structural and non-structural elements, building services and mechanical equipment plays an important role in preventing the infection during pandemic and post-pandemic by reducing the frequency of required maintenance. |

| | |
|---|---|
| Aesthetics | An aesthetic environment can improve the mental health of people by making them happy and thereby it improves psychic balance, reduces negative emotions and improves work efficiency. |
| Circulation | Unobstructed and automated circulation reduces the spread of infection. |
| Space size | The functionality, flexibility and adaptability of a space largely depend on its size. In a large space, its congruent elements can be rearranged as per the need in a far easier way than that in a small space. For example, the growing trend in Work From Home has resulted in the conversion of most of the office space into the co-working space. |
| Spatial layout | The arrangement of furniture, feature wall and other interior elements should facilitate the separation of private space from public space and quarantined space to ensure safety of the occupants. |
| Spatial flexibility/adaptability | A flexible & adaptable space allows multiple functions as per the present & future requirements. The decrease in capacity of food court of a mall to enhance social distancing, use of a screen wall to separate working space from the rest of the areas, conversion of large colleges into the quarantine centre etc. exhibit the usefulness of adaptable spaces. |
| Building level zoning | Zoning within the building helps in controlling the mobility of the residents/ visitors. It helps in efficient monitoring, decontamination and containment. |
| Private outdoor / balcony / terrace | During the lockdown, the balcony/ terrace has served as a space for family congregation. It has also turned into a flexible space for activities ranging from meditation to office work. The balcony/terrace has provided access to fresh air and sunlight. |
| Material specification | Covid-19 has resulted in the escalation of prices of several materials, and the imposed restrictions within different regions have caused a disruption in procurement. The demand of refractory materials has also witnessed a setback. |
| Height (building, floor) | The height restrictions for buildings were altered in many cities due to Covid-19. For example, the Chinese government placed a ban on 500 meter or taller buildings. In Mumbai, India however, the HC set aside an Airport Authority of India rule to cap building height providing relief to developers. |
| Vision & perspective / view / Visual connection | Psychologists have recommended spaces that are visually connected to nature for mental well-being after the pandemic. White rooms with large windows instil a sense of connectivity to the outdoors and give a sense of safety. |
| Acoustic/noise control | Common mental health disorders like anxiety, stroke and depression are linked to noise pollution. The lockdown has resulted in a decline in noise pollution across multiple cities. |
| Day lighting | A study has correlated the exposure to sunlight to increased Covid-19 recovery rates, due to increased production of vitamin D. (Asyary & Veruswati, 2020) |
| Artificial lighting/illumination | Artificial light from electric fixtures as well as blue light emitted from electronic devices are directly linked to physical and mental well-being. The level of illumination and exposure period impact the productivity and sleep cycles. |
| Ventilation (natural & artificial) | A study found that bringing ventilation to recommended levels had the same mitigating effect as a vaccination coverage of 50-60%. (Smieszek T, 2020) |
| Indoor air quality | Studies have found that better indoor air quality decreases the risk of coronavirus. Air pollution has also been linked to respiratory diseases and poor health outcomes due to Covid-19. (COVID-19: How Passive House = Passive Health, n.d.) |
| Heating system | Cold dry air is found to facilitate the spread of Covid-19. Statnews reported that turning on the heat dries the tissues lining the airways, impairing the mucus filtering of Covid-19. |
| Air conditioning | Air-Conditioning systems are responsible for air filtering, temperature and humidity control. The recirculation of air from air-conditioners increases the risk of Covid-19 transmission. High-efficiency particulate air (HEPA) filters have been recommended to remove airborne contaminants, especially in hospital buildings. |

| | |
|---|---|
| Water quality | Polluted water leads to the spread of bacterial, viral and parasitic diseases. Safe drinking water eliminates toxins from the body, while building immunity. Immunity has proven to be a key-factor in warding off Covid-19. |
| Waste generation & management | The focus has shifted to dealing with bio-medical waste generated from PPE equipment. Due to the lockdown, the commercial and food waste has reduced. The disposal and management of waste is important, because waste can become a health hazard if not handled properly. |
| Telecom and data system | The Covid-19 pandemic has underscored the necessity of digital connectivity to maintain a connection between community in order to reduce the negative socio-economic impact due to lockdown |
| Fire detection, alarm system & protection | Even in the time of the pandemic, the fire safety guidelines need to be in reviewed and updated to plan an evacuation in the event of fire, and ensure continued safety of life and property. |
| Safety and security system | As per the new norms and safety standards, thermal scanners are being used for checking temperature and face detection systems have been upgraded for mask recognition. |
| Maintenance | New maintenance processes have been developed to inhibit the spread of Covid-19 and provide user support. Cleanliness and hygiene standards have become more robust. |
| Environmental friendliness | Covid-19 has exposed the flaws in the built environment. The pandemic has also necessitated the need to increase building resilience, lower energy requirements and explore sustainable building design. |

**Table 4.** Human and socio-economic parameters (HS)

| Parameters | Description |
|---|---|
| Comfort | The health of an individual is directly linked to comfort. Building design plays a key role in providing both general comfort (aesthetic, recreational) and thermal comfort (through temperature, humidity and air-flow). |
| Working efficiency | The efficiency of work has been deeply impacted due to Covid-19. Working from home has hampered the productivity due to lack of access to office resources for some people. In other cases, the efficiency has improved from the time saved in commuting. |
| Privacy | The need for privacy for all individuals has been highlighted while working from home, doing chores or attending classes. It became more important when public places were shut, with no place to escape. |
| Mental health | Covid-19 has greatly impacted mental health by creating an atmosphere of fear, worry and stress. The building design could improve mental health by creating the feeling of safety and comfort, while also boosting productivity and reducing stress. |
| Social & cultural quality | Proximity to neighbours and family members with controlled zones for interaction decreases the chances of isolation and loneliness, while boosting mental health and improving the quality of life. |
| Social distancing | The Covid-19 outbreak has redefined the design of spaces keeping social distancing (1 m separation) in mind and avoiding close contact to promote a safe environment. |
| Cost factor (rent, maintenance, utility) | Due to the economic slowdown, the real estate market has suffered a major slump. There has been a rental crises for the landlords, and tenants have found it difficult to pay for utilities, maintenance and service charges. |

**Table 5.** Smart building system (SBS)

| Parameters | Description |
|---|---|
| Intelligent skin & interactive façade | A controlled building environment can result in cost saving and improved building performance. A well designed façade controls ventilation, sunlight and air-filtration and improves thermal performance. |

| | |
|---|---|
| Building Automation System | The building automation system has developed during Covid-19 depending upon varying occupancies and requirements. This system has also allowed the building owners to analyse and audit the energy consumption data. |
| Passive design | Passive designing is a cost effective measure that utilizes the natural energy sources like sunlight and wind. This in turn creates healthy indoor spaces that inhibit the transmission of pathogens. |
| Renewable resources | There has been a radical shift in the power sector during the lockdown as several grid operators have turned to renewable energy, as an economic way to meet electricity demands. |
| Life cycle costing | The cost of running and maintaining a facility has become a critical outlook for the building stakeholders, as the pandemic has had a long-term economic impact. |

**5. Assessing and Ranking the Design Parameters**

To assess the impact due to Covid-19 on the design parameters a survey has been conducted between 72 experienced professionals of architecture where they have been asked to rate different parameters on a scale of 1 to 5. The collated data have been analyzed to evaluate RII by using Eq. 1; the Table 6 describes the calculated weighted average (∑W/ N) and RII of each design parameters. Depending upon the derived RII all the design parameters have been ranked and arranged in descending order as shown in Table 7. It has been observed that few parameters – like public health infrastructure, Indoor air quality and social distancing (each scored 0.908); location and accessibility to the site (each scored 0.776) etc. - have scored same RII value which accentuate equal importance of the parameters and therefore they have been assigned same rank.

**Table 6.** Weighted average and RII of different design parameters based on data collated through survey.

| Design parameters | Weighted average (∑W/ N) | RII |
|---|---|---|
| Location | 3.88 | 0.776 |
| Neighbourhood context | 3.69 | 0.738 |
| Accessibility to the site | 3.88 | 0.776 |
| Access to amenities/essentials | 4.35 | 0.87 |
| Access to public health infrastructure | 4.54 | 0.908 |
| Access to public open space | 3.51 | 0.702 |
| Population density | 3.89 | 0.778 |
| Urban network | 3.58 | 0.716 |
| Urban water cycle | 3.96 | 0.792 |
| Waste management | 4.21 | 0.842 |
| Zoning and size | 3.54 | 0.708 |
| Natural physical features | 3.47 | 0.694 |
| Manmade features | 2.89 | 0.578 |
| Open space | 3.86 | 0.772 |
| Circulation | 4.04 | 0.808 |
| Utilities at site level | 4.22 | 0.844 |
| Sensory (visual, audible and tactile aspects of the site) | 3.83 | 0.766 |
| Personal vision and style of the architect | 3.07 | 0.614 |
| Orientation | 3.5 | 0.7 |
| Climate | 4 | 0.8 |
| Occupancy pattern | 3.75 | 0.75 |
| Form | 2.89 | 0.578 |
| Function | 3.94 | 0.788 |
| Durability | 3.76 | 0.752 |
| Aesthetics | 3.08 | 0.616 |

| | | |
|---|---|---|
| Circulation | 3.97 | 0.794 |
| Space size | 4.24 | 0.848 |
| Spatial layout | 4.17 | 0.834 |
| Spatial flexibility/adaptability | 4.18 | 0.836 |
| Building level zoning | 3.93 | 0.786 |
| Private outdoor/balcony/terrace | 4.13 | 0.826 |
| Material specification | 3.46 | 0.692 |
| Height (of building and floor) | 3.21 | 0.642 |
| Vision & perspective/view/visual connection | 3.47 | 0.694 |
| Acoustic/noise control | 3.57 | 0.714 |
| Day lighting | 4.11 | 0.822 |
| Artificial lighting/illumination | 3.56 | 0.712 |
| Ventilation (natural & artificial) | 4.47 | 0.894 |
| Indoor air quality | 4.54 | 0.908 |
| Heating system | 3.49 | 0.698 |
| Air conditioning | 3.61 | 0.722 |
| Water quality | 4.31 | 0.862 |
| Waste generation & management | 4.29 | 0.858 |
| Telecom and data system | 3.97 | 0.794 |
| Fire detection, alarm system & protection | 3.81 | 0.762 |
| Safety and security system | 3.94 | 0.788 |
| Maintenance | 4.13 | 0.826 |
| Environmental friendliness | 4.07 | 0.814 |
| Comfort | 4.29 | 0.858 |
| Working efficiency | 4.32 | 0.864 |
| Privacy | 4.24 | 0.848 |
| Mental health | 4.65 | 0.93 |
| Social & cultural quality | 3.86 | 0.772 |
| Social distancing | 4.54 | 0.908 |
| Cost factor (rent, maintenance, utility) | 4.19 | 0.838 |
| Intelligent skin & interactive façade | 3.06 | 0.612 |
| Building Automation System | 3.44 | 0.688 |
| Passive design | 3.33 | 0.666 |
| Renewable resources | 4.06 | 0.812 |
| Life cycle costing | 3.94 | 0.788 |

**Table 7.** Assigned rank to different design parameters based on RII.

| Sl. No. | Design parameters | Category | RII | Rank |
|---|---|---|---|---|
| 1 | Mental health | HS | 0.93 | 1 |
| 2 | Access to public health infrastructure | SS | 0.908 | 2 |
| 3 | Indoor air quality | B | 0.908 | 2 |
| 4 | Social distancing | HS | 0.908 | 2 |
| 5 | Ventilation (natural & artificial) | B | 0.894 | 3 |
| 6 | Access to amenities/essentials | SS | 0.87 | 4 |
| 7 | Working efficiency | HS | 0.864 | 5 |
| 8 | Water quality | B | 0.862 | 6 |
| 9 | Waste generation & management | B | 0.858 | 7 |

| | | | | |
|---|---|---|---|---|
| 10 | Comfort | HS | 0.858 | 7 |
| 11 | Space size | B | 0.848 | 8 |
| 12 | Privacy | HS | 0.848 | 8 |
| 13 | Utilities at site level | S | 0.844 | 9 |
| 14 | Waste management | SS | 0.842 | 10 |
| 15 | Cost factor (rent, maintenance, utility) | HS | 0.838 | 11 |
| 16 | Spatial flexibility/adaptability | B | 0.836 | 12 |
| 17 | Spatial layout | B | 0.834 | 13 |
| 18 | Private outdoor/balcony/terrace | B | 0.826 | 14 |
| 19 | Maintenance | B | 0.826 | 14 |
| 20 | Day lighting | B | 0.822 | 15 |
| 21 | Environmental friendliness | B | 0.814 | 16 |
| 22 | Renewable resources | SBS | 0.812 | 17 |
| 23 | Circulation | S | 0.808 | 18 |
| 24 | Climate | B | 0.8 | 19 |
| 25 | Circulation | B | 0.794 | 20 |
| 26 | Telecom and data system | B | 0.794 | 20 |
| 27 | Urban water cycle | SS | 0.792 | 21 |
| 28 | Function | B | 0.788 | 22 |
| 29 | Safety and security system | B | 0.788 | 22 |
| 30 | Life cycle costing | SBS | 0.788 | 22 |
| 31 | Building level zoning | B | 0.786 | 23 |
| 32 | Population density | SS | 0.778 | 24 |
| 33 | Location | SS | 0.776 | 25 |
| 34 | Accessibility to the site | SS | 0.776 | 25 |
| 35 | Open space | S | 0.772 | 26 |
| 36 | Social & cultural quality | HS | 0.772 | 26 |
| 37 | Sensory (visual, audible and tactile aspects of the site) | S | 0.766 | 27 |
| 38 | Fire detection, alarm system & protection | B | 0.762 | 28 |
| 39 | Durability | B | 0.752 | 29 |
| 40 | Occupancy pattern | B | 0.75 | 30 |
| 41 | Neighbourhood context | SS | 0.738 | 31 |
| 42 | Air conditioning | B | 0.722 | 32 |
| 43 | Urban network | SS | 0.716 | 33 |
| 44 | Acoustic/noise control | B | 0.714 | 34 |
| 45 | Artificial lighting/illumination | B | 0.712 | 35 |
| 46 | Zoning and size | S | 0.708 | 36 |
| 47 | Access to public open space | SS | 0.702 | 37 |
| 48 | Orientation | B | 0.7 | 38 |
| 49 | Heating system | B | 0.698 | 39 |
| 50 | Natural physical features | S | 0.694 | 40 |
| 51 | Vision & perspective/view/visual connection | B | 0.694 | 40 |
| 52 | Material specification | B | 0.692 | 41 |
| 53 | Building Automation System | SBS | 0.688 | 42 |
| 54 | Passive design | SBS | 0.666 | 43 |
| 55 | Height (of building and floor) | B | 0.642 | 44 |

| | | | | |
|---|---|---|---|---|
| 56 | Aesthetics | B | 0.616 | 45 |
| 57 | Personal vision and style of the architect | B | 0.614 | 46 |
| 58 | Intelligent skin & interactive facade | SBS | 0.612 | 47 |
| 59 | Manmade features | S | 0.578 | 48 |
| 60 | Form | B | 0.578 | 48 |

The 'Figure 1' depicts that the average RII (0.773) of all design parameters divides the data set into 2 parts – the first part consists of parameters from 1 to 36 and the second part consists of the parameters from 37 to 60 (Refer Table 7) – where the cumulative RII of the first part (29.862) is 1.8 times than that of the second part (16.514). So, during the design development process, more deliberation on the constituent parameters of the first part is a prerequisite towards the user responsive design in post-pandemic period.

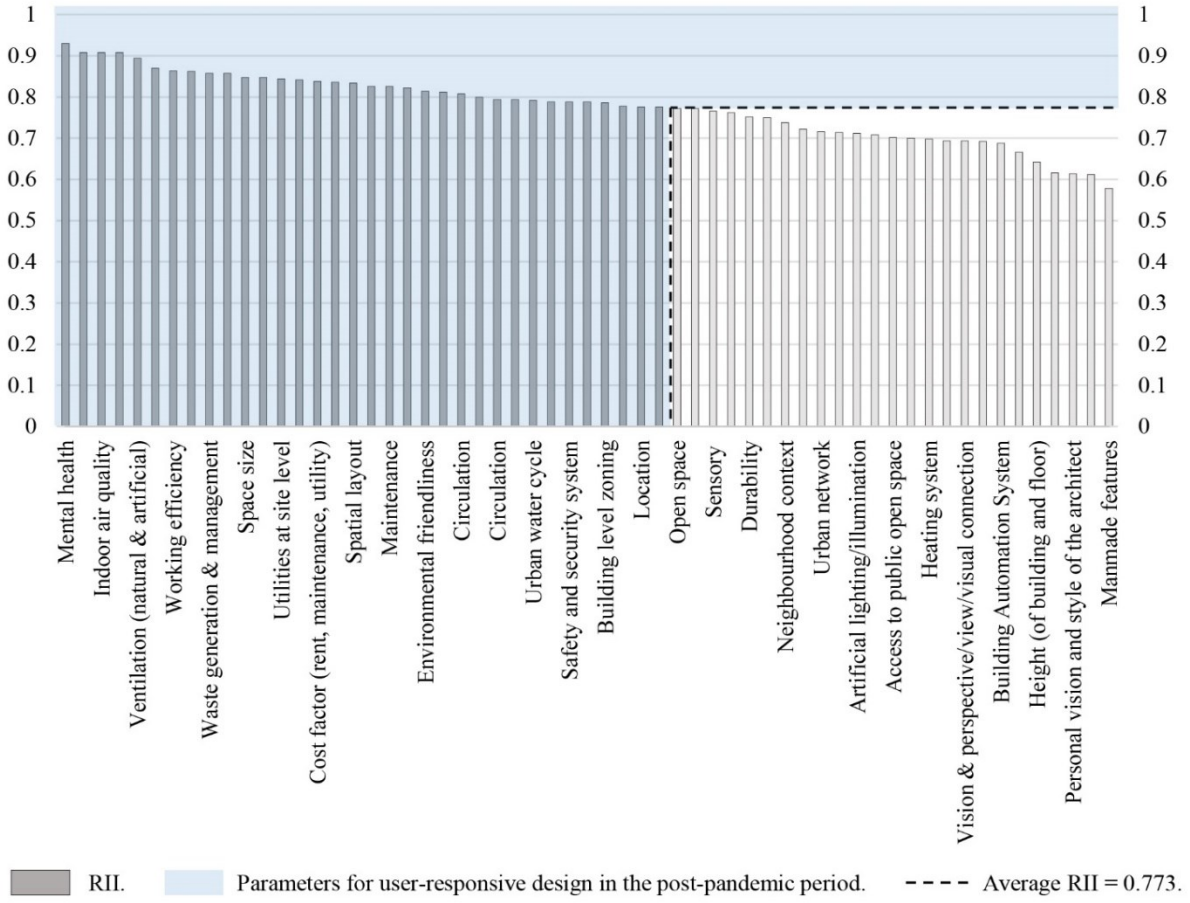


**Figure 1.** Correlation between average RII and the design parameters.

Further if we compare the 5 categories – site surrounding parameters (SS), site parameters (S), building parameters (B), Human and socio-economic factor (HS), and smart building system (SBS) – based on their average RII (Refer 'Figure 2'), it has been observed that the 4th category (HS) has scored higher than the other categories, accentuating the need to shift towards human-centric architecture.

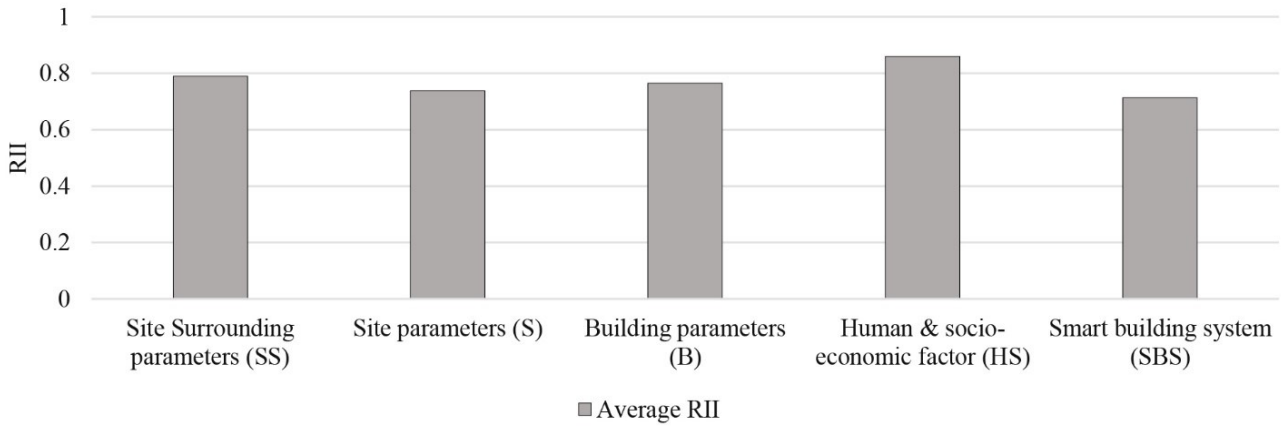


**Figure 2.** Comparison between Average RII of the categories

**6. Conclusion**

This paper has listed down the design parameters relevant today, and grouped them into five broad categories- i) Site surroundings ii) Site parameters iii) Building factors iv) Human and socio-economic factor v) Smart building system. Based on the survey of 72 experienced professionals of architecture, it has been found that mental health has emerged as the paramount factor to be considered while designing for the present times. Covid-19 and the ensuing lockdown has amplified the effect of the physical environment on the mental health of individuals. The World Health Organization had reported a 13% rise in mental health problems in the last decade. The long lasting pandemic has aggravated the illness. By focusing on well-being, architecture can help improve the mental health of the residents. Access to natural light, fresh air, controlling temperature and noise levels in the built-environment can enhance well-being. These factors have a high ranking in the survey as well.

Covid-19 is a virus affecting the respiratory system without a known medical cure. Therefore in the event of emergency, 'access to health infrastructure' like hospital and dispensaries has ranked second in the survey. This should be considered in the planning and zoning of the built-environment. Indoor air-quality has been ranked third in the survey conducted for this paper. In a recent study reported by the World Green Building Council, it was suggested that enhancing indoor air quality could be as effective in reducing aerosol transmission of viruses as vaccinating 50-60% of the population. Social distancing has ranked fourth in the survey indicating that it should be considered while designing the spatial layout. The imposed lockdowns due to the virus have hindered the workflow of several people. Therefore, working efficiency has been given a high weightage in the designing of spaces. Basic services like water quality and waste management have ranked high as well. Based on Table 7 the average value of RII is 0.773 and the close clustering of the RII values is indicative of the relevance of the selected parameters.

Overall out of the five broad categories in which the architectural parameters were grouped, 'Human and socio-economic factors' have emerged to be prominent. This indicates a shift towards human-centric design after the onset and spread of Covid-19. The perception and response of the residents towards the built-environment need to be considered in architectural planning. Further, the social and economic implications need to be factored in at the design stage to ensure sustainability.

Based on the results of this study, the next actions recommended are:

- Architects need to research about the impact of building design on the mental health of the occupants. Design guidelines need to be drafted accordingly, that focuses on well-being.
- Health-care infrastructure needs to be upgraded based on the present and forecasted pandemic requirements. The zoning in Master Plans should include easy access to hospitals and health-care facilities for all citizens.
- Covid-19 protocols like social distancing are to be reflected in architecture, to cater to the pandemic lifestyle of the residents.
- The building design needs to adapt to the new work from home culture. Buildings should be made to facilitate remote working and improve efficiency.
- This study has used an analytical-descriptive framework to identify the impact of Covid-19 on design parameters. A quantitative assessment system can be developed further to establish an empirical link.

**7. Future Scope**

The Covid-19 virus variants are mutating rapidly, and it is difficult to assess the impact of each new strain or wave. The design parameters will continue to evolve alongside the pandemic. A continuous study is required to monitor

the shift in parameters to keep up with the present and make way for the future pandemic stage. The following are a few areas for future research:

- How are the design parameters across different building typologies (residential, commercial, educational etc.) being impacted?
- How should the design of the existing buildings be modified to increase functionality in a pandemic ridden world?
- What are the building, site and urban level transformations in the Covid-19 context?
- What are the architectural measures that can be taken to deal with dual disaster?

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**Conflict of Interests**
The authors declare no conflict of interest.

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# Challenges of Architectural Education Post Covid-19 Pandemic: Analytical Study of the Potentials and Problems Associated with Distant Learning

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**Abstract**
Architectural education is considered the cornerstone in the establishment of cities, through the contributions of today's architecture students who would be future architects providing built additions in cities. Accordingly, it is of extreme importance to regard how architecture students are founded from an ideological and practical point of view, which has been widely studied in regard to pedagogy realms. Thus, this paper aims to analyse the consequences of the spread of the Covid-19 pandemic on distant learning strategies applied to architectural programs. The paper aims to find answers to whether distant learning policies have affected the capabilities of graduates, and can e-learning provide solutions for future architectural education. The methodology adopted is a qualitative, analytical method, discussing the pros and cons of distant learning experiences during the past two years, on stakeholders of the educational process at Cairo University, Architecture Program. The research concludes with the potentials for future enhancement of e-learning experiences.

**Keywords:** Architectural Education; Distant learning; Blended Strategies; Quality of Life, Quality of Education, Potentials in Future Education.

**تحديات التعليم المعماري في عصر الوباء العالمي كوفيد-19**
**دراسة تحليلية للإ مكانات و المشكلات الناتجة عن نظام التعليم المعماري عن بعد**

**الملخص**
يمثل التعليم المعماري حجر الأساس الذي يتيح للمدن فرص أفضل مرتبطة بجودة الحياة و التقدم و الإزدهار من خلال تطوير البيئة المشيدة مما يؤثر بشكل واضح و سريع في المجتمعات، سواء كبيئة عمرانية مشيدة و أيضا كتأثير مباشر يمتد الي سلوك و أنماط الاستخدام في المجتمعات المختلفة. و ذلك من خلال ما يقدمه طالب العمارة اليوم و المهندس المعماري المستقبلي من إسهامات في المدن و البلدان المختلفة. لذلك، فبناء طالب العمارة فكريا و أيدلوجيا و تقنيا لا يقل أهمية بأي حال من الأحوال من الاهتمام بدراسة المشاريع المعمارية. من هذا المنطلق، فمن الضروري التفكيرو التحليل لتبعات الوضع العالمي الراهن من تفشي وباء كوفيد-19، لثاني عام على التوالي، و ما يترتب على هذا الوضع العالمي من تأثير على التعليم المعماري في الجامعات العربية. فهل يؤثر التعليم عن بعد علي قدرات خريج طالب الهندسة المعمارية على المدي البعيد بالسلب أم بالإيجاب؟ و هل يمثل التعليم المدمج حل طويل المدى للمشاكل المستقبلية فيما بعد عصر الكورونا؟ اعتمد البحث علي منهجية إستقرائية لمناهج التعليم المستحدث مع تحليل كيفي لمساويء ومميزات التجربة خلال العامين السابقين و كيف أثرت علي شركاء العملية التعليمية من أساتذة و طلاب و خريجين مع مراعاة القاء الضوء على وسائل الحفاظ علي جودة التعليم و ذلك لضمان كفاءة الخريج حتي في الظروف الاستثنائية على مواجهة سوق العمل .من خلال دراسة تحليلية لبرنامج قسم الهندسة المعمارية بكلية الهندسة جامعة القاهرة، يهدف هذا البحث الي دراسة الوضع الراهن بالبرنامج، و تحليل المميزات والتحديات، بالإضافة إلي تحليل وجهات نظر متباينة لممثلي الطلاب و الاساتذة و الخريجيين لنظام التعليم المعماري المدمج، و ذلك في إطار فهم ما توصلت إليه التجربة حتي الوقت الراهن و إمكانيات التطوير للوصول إلي أفضل ما يمكن من فرص يمليه علينا الواقع في الظروف الراهنة.

## 1- مقدمة و مراجعة أدبية لنظريات وأنماط التعليم المعماري عن بعد و مدي مواءماته للظروف الطارئة الناتجة عن جائحة كورونا

تأثر التعليم المعماري بتفشي جائحة كوفيد-19 في مارس 2020،و انعكس هذا على الأدبيات الناقدة للتعليم المعماري المستجد، خاصة في البلدان العربية، التي لم تتوقع الإحتياج إلي الإنتقال الرقمي بهذه الصورة المفاجأة في الإطار الزمني الذي شهدناه. وبالتالي، فمن الضروري مراجعة ما تم الوصول إليه من قبل المعلمين و المنظرين في هذا الوقت المحوري الذي يشهد تحولا كبيرا يؤثر على العملية التعليمية بصورة واضحة .نجد (شونج 2021 - Cheong et al 2021)يؤكد أن بالرغم من أن العملية التعليمية للهندسة المعمارية شديدة الإتصال بمبدأ التعلم عبر التطبيق العملي، الإ أن كوفيد-19 قام بتحدي التعليم النمطي خاصة في إستديوهات التصميم، و أجبر الجميع علي تخطي ما هو مألوف، إلي درجة أنه قارن التحول الديناميكي الذي حدث بظهور فكرة المرسم (الأتليرAtelier) في مدرسة الفنون الجميلة ، في القرن التاسع عشر. وبالرغم من أن التعليم عن بعد ليس بالأمر المستحدث، فقد تم استخدام التعلم المدمج بالفعل في تخصصات مختلفة، إلا أن تطبيق هذا على المعمار ليس بالأمر السهل، كما أشار (شون Schon 1985 - 1985)فأن القيمة التربوية للإستوديو تكمن في قدرته على فتح نافذة لمهنة الهندسة المعمارية، فالتحدي ليس فقط في توصيل المعلومات عن بعد، و لكن كيفية تأهيل معماري المستقبل للتحديات الحقيقية في سوق العمل.

في ظل الإحتياج إلي التحول الرقمي السريع، تراوحت التطبيقات الأكترونية المختلفة للاستوديوهات المندمجة من **إستخدام** Zoom **و** Padlet **و** Google Clouds ... إلخ. و أيضا حدث تغير في أدوار الطلاب،فأصبحوا هم الأكثر مسؤولية عن التعلم الخاص بهم بينما يكون دور المعلمين في الغالب هو تصميم وتوجيه عملية التعلم. و في استطلاعات الأراء المختلفة، أبدي الطلاب في الجامعات الغربية تفضيلهم للتعليم المدمج، و ليس الرقمي بالشمولية، على الرغم من أنهم لا يزالون يفضلون التدريس وجهًا لوجه و ذلك لأنه أكثر فاعلية ومألوفًا أكثر، و سيتطرق البحث تفصيلا اخرا لتفضيلات الطلاب لاحقا**.**

و استنادا إلي دور التعليم المعماري في تهيئة الطالب الي سوق العمل، وضح**(**ميلوفانوفيتش2020 Milovanovic et al**)** أن هناك تغييرات في الممارسة المعمارية، تستدعي بالتبعية آراء جديدة حول العمارة و تصميم مناهج جديدة تهدف إلي الأرتقاء بقدرة المعماريين المستقبليين وتوسيع كفاءاتهم ومسؤولياتهم المهنية ، وكذلك تحسين مهاراتهم الفنية والتكنولوجية والإجتماعية والإنسانية والفنية لتصميم مبانى متوائمة للسياقات الإجتماعية والبيئية. بالتالي(Aziz Amen, 2018) ، فالمناهج الجديدة في التعليم تهدف إلي تهيئة المعماري بمرونة تقنية و معرفية تساعده على مواجهة التغيرات السريعة في سوق العمل. و من أحد أهم المنهجيات التي تساعد على خلق هذه المرونة و التكيف مع المتغيرات هي الاعتماد علي التشجيع علي البحث عن طريق نهج التصميم لتطويرالتساؤلات النقدية من خلال أعمال التصميم. و ذلك من خلال المحور الأول و هو وضع أولويات جديدة ووجهات نظر بحثية للتعلم التجريبي لهندسة الطوارئ المختلفة و ليست مقصورة على الجائحة الراهنة، ثم المحور الثاني لتطوير نموذج التعلم القائم على إكتساب الخبرات عن طريق تحويل التعليم النمطي إلي ورش عمل في مجال العمارة، بحيث يتمكن الطلاب من إكتساب الخبرات من الزملاء و المتخصصين من الأقسام المختلفة و مناقشة ما توصل إليه الطالب مع نقاد خارجيين بالإضافة إلي أساتذته **.**

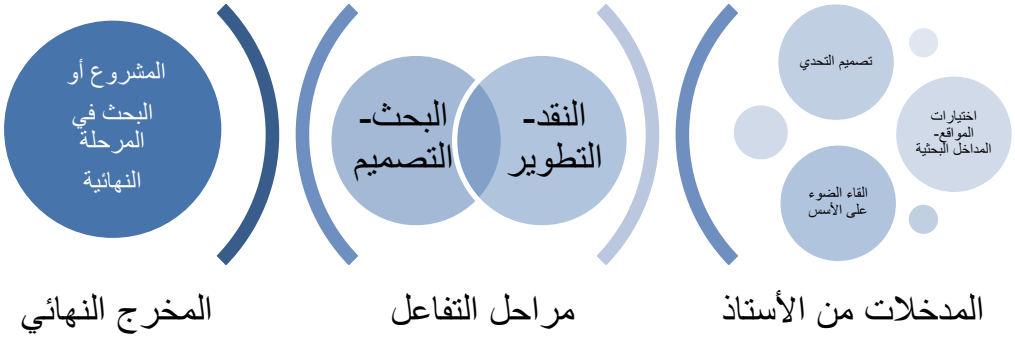
و تهدف هذه المحاولات للإستفادة من الظروف الراهنة تطوير التجربة الخاصة بالتعليم المعماري عن بعد، و التي بالفعل كانت قائمة على أنطقة أضيق، و ذلك كما يشير(إيرانمنش 2021) Iranmanesh et al ، أن الأستديو المعماري الرقمي بالفعل كان حيز التطبيق من أكثر من عقدين من الزمان، و لكن بشكل محدود و ذلك لمشاكل تقنية أو إمكانات مادية. و لكن لم تعد هناك جدوى من التساؤل حول إمكانية إجراء استوديوهات التصميم الإفتراضية وتحول التركيز بدلا من ذلك إلى أساليب التنفيذ والاستفادة من التطبيقات الرقمية الناشئة. بالعلاوة على ذلك ، طلاب اليوم هم أولئك الذين ولدوا وترعرعوا بوسائل الاتصال الرقمية ، هم المتحدثون الأصليون للغة وسائل التواصل الاجتماعي والفضاء الرقمي. لذلك، قد تكون مشاركتهم الأولية مع التحول الرقمي المفاجيء أكثر فائدة من سابقيهم فهم علي القدرة على التطبيق إلى أقصى الإمكانات. بناء على ذلك، فمن الضروري التوصل إلي عملية تعليمية ضمنية تشجع طلاب الهندسة المعمارية على تعلم التواصل و التعاون مع بعضهم البعض، وبالتالي بناء المهارات الأساسية لدخول سوق العمل. و لكن يجب الأخذ في الاعتبار أن هناك تفاوت في قدرة الطلاب على التواصل الرقمي، فالطلاب في الأعوام المتقدمة اكثر قدرة من الطلاب في السنوات الأولي من حيث استخدام الوسائل المختلفة و طرق العرض الرقمية التي تتيح لهم عرض أفكارهم بصورة واضحة و أحترافية. في حين أن السنوات الأولي تحتاج الي تدرج في إيصال المعلومات و محاكاة المعلم، مما يستلزم التفاعل القائم على التفاعل وجها لوجه لاكتساب الخبرات. فنخلص إلي ضرورة تفصيل الإحتياجات الخاصة لكل مرحلة تعليمية من خلال التدرج في التفاعل المباشر أو الإعتماد علي الإستديو الرقمي و ذلك بالتفاعل المكثف في السنين الأصغر و مع بدايات المشروعات المعطاة، ثم إعطاء الفرص مع التقدم في المراحل و السنوات التعليمية للإعتماد بشكل أكبر على الإستديو الإفتراضي لما له من مميزات سيتم الإشارة إليها في ما هو قادم من أجزاء الدراسة**.**

بالتطرق إلي المشكلات المشابهة للتعلم المعماري عن بعد في السياق العربي، نجد ألو-كانغكوم (Allu-Kangkum 2021**)** تستعرض التحديات التقنية المرتبطة بذلك. فعلي سبيل المثال، تكمن التحديات في البلدان الأفريقية و العربية في؛ عدم المساواة في الوصول إلى الإنترنت ، والصدمة الثقافية من التفاعل عن بعد ، وإستراتيجيات التعلم البديلة غير المخطط لها، وتقاعس الجهات المعنية عن إيجاد منصات مناسبة وتفاعلية. بالإضافة إلي نقص إمدادات الكهرباء الكافية ، وعدم القدرة على تشغيل بعض التطبيقات عبر الإنترنت ، وعدم القدرة على تحمل تكاليف أدوات التعلم عبر الإنترنت ، وعدم وجود بدائل لعرض النماذج ثلاثية الأبعاد بصورة مادية ، وعدم قدرة أقسام الهندسة المعمارية على توفير أدوات تعليمية مناسبة عبر الإنترنت. فهذه بعض نماذج للمشكلات التي تعيق الوصول الي أفضل النتائج من الوضع الراهن الذي فرض علينا، بالرغم من وجود الاليات المناسبة سواء على مستوى الطلاب او علي مستوى التخطيط للعملية التعليمية عن بعد**.**

و يتبقي التساؤل الذي يطرحه ديشموخ (2021) ( Deshmukh 2021)، "هل سيقتل كوفيد-19 الحرم الجامعي؟" و ذلك في إشارة إلي أن العملية التعليمية ليست فقط توصيل المعلومة أو النقد، بل أن هناك عوامل مادية و نفسية و روحية معتمدة علي التعلم من خلال التفاعل داخل قاعة المحاضرة و إستديوهات الرسم و التأثير و التأثر المتبادل بين الطلاب و الاساتذة، من الصعب أو المستحيل محاكاته في التواصل الأفتراضي في الوقت الراهن من خلال الأدوات المتاحة حاليا. و يتفق ايضا فارما (2021) (Varma et al 2021)، مع هذا الرأي، مشيرا إلي تزايد المخاوف من الإعتماد الرقمي الخالص من عدم الشمولية، وعدم المساواة ، وعدم القدرة على تحمل التكاليف و قيمة التعليم عبر الإنترنت، مشيرا إلي أن التجربة أثناء العامين السابقين هي نموذج إنتقالي طارىء (Transitional Emergency Model) يحتاج إلي موائمة أكبر لدمج مميزات التحول الرقمي مع مميزات الإستديو التقليدي و ذلك لإيجاد حلول أفضل لمستقبل التعليم المعماري.

## 2- عناصر التحليل و التقييم المستنتجة من الأطار النظري

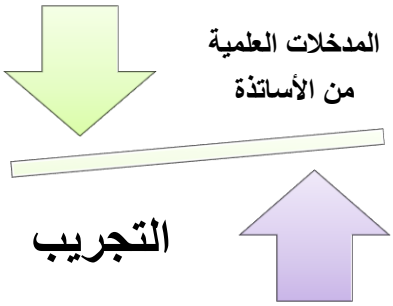
مما سبق، يمكن إستخلاص أن عملية التعلم عن بعد بذات قدر التعقيد المماثل لعملية التعليم المعماري برمته، و ذلك لتضافر الأسس والتحديات الواجب على الأساتذة و الطلاب التفاعل و التكامل معها لبلوغ أقصي درجات الإفادة و التحصيل العلمي المؤهل لسوق العمل. فالشكل الموضح أدناه (شكل1) يشير إلي المراحل الخاصة بتدرج العملية التعليمية في أقسام العمارة، و تعتبر هذه المراحل هي الهيكل التنظيمي لأغلب المقررات المعمارية التي تستند الي مخرجات تعليمية بها محاكاة لما يتم تنفيذه في أرض الواقع. و لذلك تستند الدراسة التحليلية علي إلقاء الضوء لهذه المراحل كعناصر تحليل لدراسة الحالة ببرنامج العمارة، كلية الهندسة، جامعة القاهرة. و تعتمد الدراسة التحليلية على المنهج الكيفي في التحليل، و ذلك بتحليل العملية التعليمية عن بعد على مدار العامين السابقين اثناء جائحة كوفيد-19، لإلقاء الضوء على المميزات و العيوب إعتمادا على منهج إستقرائي للعملية التعليمية و تطورها، و أيضا من خلال مقابلات ممنهجة للطلاب بالأعوام المختلفة و الخريجين الذين شهدوا الجائحة و الأساتذة القائمين على التعليم في ذلك الوقت. و ذلك لتحليل مميزات و عيوب و تطور العملية التعليمية، من خلال عناصر التحليل و هي المدخلات، طرق التطوير و المخرجات التعليمية النهائية.




**شكل1**: عناصر التحليل المستهدفة في الدراسة المحلية-الباحث 2022

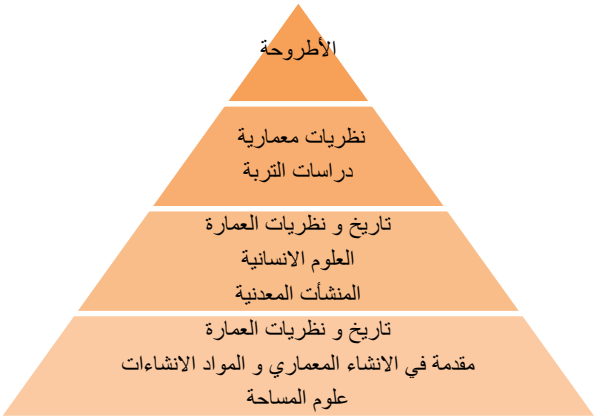
**3- دراسة الحالة المحلية: تأثير الوباء العالمي كوفيد-19 على مسار التعليم المعماري بقسم العمارة، كلية الهندسة، جامعة القاهرة**

يعد قسم الهندسة المعمارية بكلية الهندسة جامعة القاهرة من أعرق أقسام العمارة المحلية و التي تهتم بشكل خاص على تهيئة الخريج لسوق العمل المحلي و العالمي بحد سواء. و ينعكس هذا على الترتيب العالمي للقسم المدرج في تصنيف QS من ضمن أفضل 150 قسم للعمارة على مستوي العالم، و الأول على مستوي جمهورية مصر العربية. هذا بالأضافة الي حصول القسم على الاعتماد المحلي و العالمي من اتحاد العالمي للمعماريين ( UIA). يأتي هذا في سياق حرص القسم و أساتذته على خلق بيئة تعليمية تعتمد على تدرج العلوم الهندسية و الانسانية خلال الأربع سنوات المختصة بالبرنامج، و محاكاة بيئة العمل العملية في الوسائل التعليمية من مؤتمرات و ورش عمل و زيارات ميدانية و استديوهات تصميمية علي مدار السنوات المختلفة. بالتالي، فكان التحدي الأكبر للبرنامج هو إتاحة نفس مستوى جودة العملية التعليمية أثناء الإنتقال إلي التعلم عن بعد، جراء الوضع الإستثنائي المفاجيء الذي فرض بسبب جائحة كوفيد-19. فسياسة التعليم المعماري المتميز لا تقتصر على تلقي المعلومات فقط من قبل الطالب، بالأهم و الأكثر فاعلية هو إتاحة المجال للتجريب و التعلم من خلال الفعل و التطبيقات المختلفة (شكل 2).




**شكل2:** منهجية العملية التعليمية الجامعية -الباحث 2022

و بما أن المحتوي العلمي كما ذكر سابقا قائم علي التوازن ما بين المحتوى النظري في العلوم الإنسانية و العلوم المرتبطة بالتخصص والجزء التطبيقي الخاص بالتصميم و التنفيذ للمباني المختلفة، فنجد أن القاعدة النظرية تكون أعرض في السنوات الأولي من البرنامج و تقل تدريجيا لحين الوصول الي الفصل الدراسي الأخير و الذي يتوج رحلة طالب العمارة التعليمية بمشروع التخرج و الأطروحة النظرية كخلاصة لكافة العلوم الهندسية و الانسانية المدرجة بالقسم. و كما هو موضح في الشكل ادناه (شكل 3)، في العام الأول من البرنامج يدرس الطالب أسس التصميم و النظريات المعمارية، و نظريات الانشاء المعماري، تاريخ العمارة، صفات المواد و الحسابات الانشائية بالإضافة إلي إستديوهات التصميم المعماري و مقدمة للرسومات التنفيذية لمباني من طابق واحد و تتدرج تعقيدات المباني في الصل الدراسي الثاني. و يظهر في العام الثاني من برنامج الهندسة المعمارية المواد النظرية المعتمدة على التاريخ و النظريات الحداثية للعمارة و تطور العمران، و العلوم الانسانية، المنشئات الحديدية، مع تطبيقات عملية أكثر من خلال ورش العمل و الإستديوهات الخاصة بالتدريب البصري و التصميم المعماري و الرسومات التنفيذية و التصميم البيئي. في العام الثالث، تنحصر المقررات النظرية علي دراسات النظريات المعمارية المعاصرة و دراسة التربة، و بعض المواد الإختيارية في التخصص (دراسات بيئية-تصميم عمراني- تصميم داخلي- تكنولوجيا البناء)، مع وجود تركيز أعمق علي استديوهات التصميم المعماري لمباني عامة و معقدة، و إستديوهات التصميم و التخطيط العمراني، والتصميمات التنفيذية. و في العام النهائي، تتوج الأطروحة النظرية و المشروع النهائي للتخرج جميع العلوم التي تمت دراستها في الأعوام السابقة، لتنتهي رحلة التعلم بمحاكاة شبيهة لما يواجهه الطالب من دمج للخبرات و العلوم المختلفة في سوق العمل.



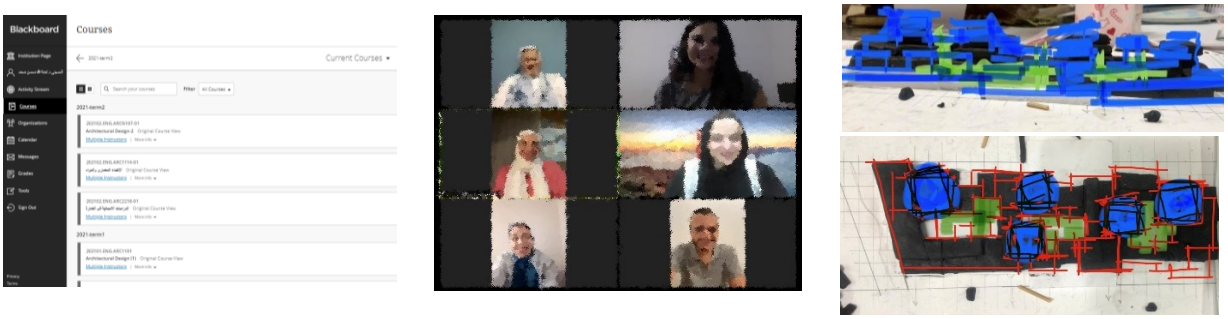

**شكل3:** تدرج العلوم النظرية أثناء سنوات برنامج الهندسة المعمارية بجامعة القاهرة-الباحث 2022

و في ظل التحول المفاجيء للتعلم عن بعد الذي شهده العالم في مارس 2020، كانت التحديات الأكبر من نصيب المقررات ذات الطابع العملي و الاستديوهات المختلفة. و بالرغم من كون السنوات الأولي اكثر تعرضا للمقررات النظرية إلا أن الاعتماد المباشر على التفاعل ما بين الأساتذة و الطلاب كان عائقا في البداية، عندما طور الأساتذة من قدراتهم علي التفاعل عن بعد وأيضا تأقلم الطلاب علي الوضع المستحدث. و ساعد على هذا بساطة المشاكل التصميمية المعمارية في السنوات الأولي وإعتمادها بشكل نسبي على مدخلات علمية اكبر من الأساتذة بالمقارنة للسنوات المتقدمة(شكل4). و لم تمثل المقررات النظرية تحديا مثل الإستديوهات و ذلك لإعتمادها على المناقشات الحية التي تم إستعواضها بالمقابلات الرقمية. و لكن التحدي الكبر للمقررات النظرية هو صعوبة الإعتماد على زيارات ميدانية، كما كان الحال قبل تفشي الوباء، لكن تم دعوة زائرين من الخبراء على تطبيقات ال Video Conferencingمما ساهم الي حد كبير على خلق نوع من أنواع التفاعل العلمي بشكل جديد للطلاب و الأساتذة.



**شكل 4 .** بعض جوانب الحياة الأكاديمية التفاعلية قبل الجائحة للأستديوهات و المقررات النظرية و الزيارات الميدانية-الباحث 2022

أدي الإغلاق الكامل للمنشاءات التعليمية إلي تحول كل وسائل التفاعل لتكون عبر الشاشات. و كان التحدي الحقيقي ليس في إستخدام التطبيقات في وقت صغير للغاية (اسبوع واحد علي اكثر تقدير)، لكن عدم فقدان الشغف أثناء التعلم عن بعد للطلاب بالإضافة إلي عدم إختزال التعليم التفاعلي الذي يميز برنامج العمارة لأسلوب تعليم معتمد علي التلقين.
فالمنصات التعليمية المختلفة (Blackboard-Google Classroom) ساعدت إلي حد كبير على تنظيم المحتوى العلمي الأسبوعي و تنظيم المتطلبات و المهام الأسبوعية،....إلخ، بينما استخدم الأساتذة اللقاءات المجمعة عبر تطبيقات المقابلات الرقمية (Zoom-Google Meet..etc) لمحاكاة روح الاستديو التصميمي النمطي، و ذلك لضمان مناقشة الطلاب في المهام و بالتالي تحجيم السرقات العلمية، بالإضافة إلي تحفيز الطلاب و نقل الخبرات التي من الصعب إنتقالها من خلال عملية الإرسال و الإستقبال الرقمية البحتة. و بالرغم من عدم توافر إتصال مباشر بين الطالب و الأستاذ، إلا أن إستخدام تطبيقات الرسم المعماري الرقمية (Digital Annotations)ساعدت علي إنتقال الأفكار و التوجيهات للتطوير بصورة ملائمة لطبيعة التعلم عن بعد(شكل **5**).

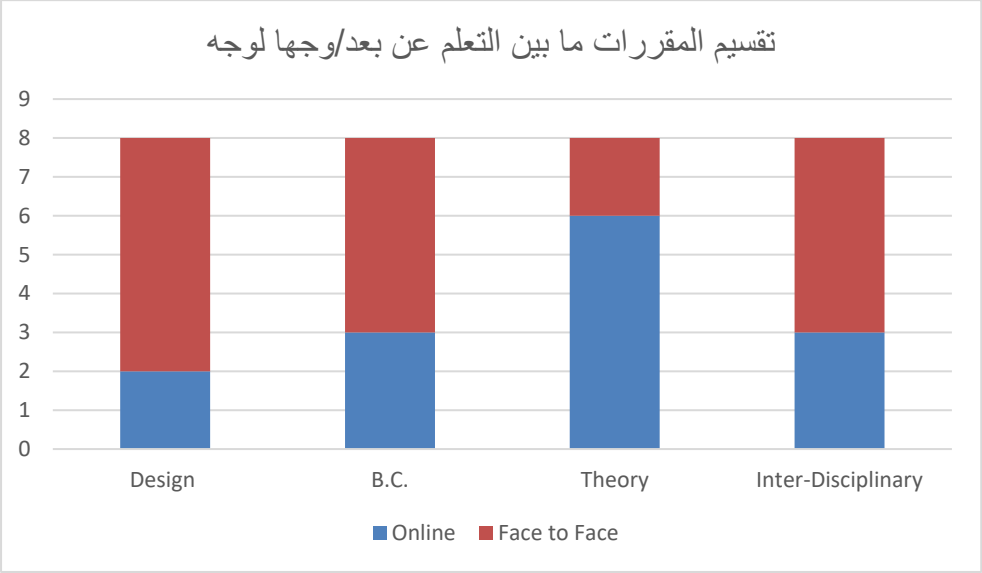



**شكل 5 .** بعض جوانب التحول الرقمي في التعلم عن بعد خلال 2021/2020-الباحث 2022

**4- دراسة الحالة المحلية: مقارنة الأداء التعليمي ما بين العام الأول و الثاني للتعليم عن بعد**

شهد برنامج الهندسة المعمارية بجامعة القاهرة عامين متواليين من التحول من التعليم النمطي وجها لوجه إلي التعلم عن بعد جراء الحاجة إلي الإغلاق الكامل بسبب زيادة المصابين بفيروس كوفيد-19. بالطبع، كما هو الحال مع العديد من البرامج التعليمية، جاء الإغلاق الأول مفاجيء و غير مخطط

كرد فعلي للوضع الصحي العالمي. و أصطحب هذا العديد من التخبط وعدم القدرة على إتقان العديد من الوسائل التكنولوجية المساعدة، خاصة في المقررات التي تعتمد علي التفاعل المباشر ما بين الأساتذة والطلاب. فيما شهد العام التاني من التعلم عن بعد على قدرة بشكل كبير على إتمام العملية التعليمية عن بعد بصورة أنجح، مع الاعتماد علي التعليم المدمج ما بين التحول الرقمي عن بعد بالإضافة الي لقاء الطلاب في المقررات و الإستديوهات التي تتطلب ذلك (شكل 6)، مع الأخذ في الإعتبار الإلتزام بالإجراءات الإحترازية من جهة و من جهة أخري تنسيق البرنامج ككل بحيث لا تتعدي نسبة الحضور بالبرنامج عن 60 بالمئة من إجمالي الوقت المخصص للحضور للجامعة. و تم التنسيق الرأسي و الأفقي بحيث تتكامل المقررات النظرية و العملية في تكييف نسب الحضور/التعلم عن بعد، مع الأخذ في الإعتبار كثافة اللقاءات في أوقات قلة انتشار الفيروس في المجتمع بصفة عامة. بالإضافة إلي هذا، تم تكيفة المقررات العملية في السنوات الأولي بحيث تستوعب الحاجة إلي التفاعل المباشر بين الطلاب و الأساتذة و ذلك لكسر الحاجز النفسي و الإندماج مع روح القسم العلمي المختلفة عن أي طبيعة علمية أخرى تعرضوا لها في سابق دراستهم (شكل7).




**شكل6 :** نموذج لتقسيم خطة التعليم ما بين الأونلاين و المقابلات بالجامعة بين المقررات المختلفة في العام الثاني من الجائحة – الباحث2022



**شكل7**: التحول الي التعليم المدمج في العام الثاني من الجائحة 2021 بناء علي طبيعة المقررات و السنين الدراسية-الباحثة 2021

و فيما يلي مقارنة للمميزات و العيوب و الأنماط التعليمية ما بين العامين الأول و الثاني لتجربة التعلم عن بعد ببرنامج الهندسة المعمارية- جامعة القاهرة (جدول 1).

**جدول 1.**مقارنة ما بين العام الأول و الثاني للتعليم عن بعد ببرنامج الهندسة المعمارية -الباحث 2022

| | **العام الأول- النصف الثاني من الفصل الدراسي الثاني لربيع 2020** | **العام الثاني- العام الدراسي 2020-2021 كاملا** |
|---|---|---|
| *المشكلات* | • مفاجأة التحول الرقمي بسبب الوباء العالمي<br>• عدم وضوح الرؤية<br>• صعوبة تعلم و تنسيق المحتوي العلمي ليكون صالح للتفاعل عن بعد<br>• استبدال الامتحانات بالأبحاث الفردية و بالتالي عدم ضمان النزاهة العلمية الكاملة في بعض المقررات<br>• صعوبة التنبأ بخطة طويلة الأمد بسبب سرعة تغيير القرارات | • زيادة عدد الساعات للمحاضرات والمناقشات عن الوقت المحدد مما يضع الجميع تحت ضغط عصبي ونفسي |
| *الفرص* | • التعلم و التأقلم مع البرامج و الأدوات الحديثة في وقت محدود وتحت ضغط الوضع الطاريء<br>• ضرورة تقليص بعض المقررات و بالتالي التنقيح الاجباري للجوانب الغير مفيدة من المقررات | • التخطيط و التعلم من التجربة السابقة<br>• القدرة على استيعاب مزايا و عيوب التعليم عن بعد وبالتالي وضع جداول تتماشي مع طبيعة كل مقرر<br>• المرونة المكتسبة للتغييرمن جانب الطلاب و الأساتذة<br>• تطوير المقررارت و أعطاء أولوية التعليم وجها لوجه للمقررات العملية - التصميم - اكتساب مهارات الرسم<br>• القدرة على اتمام الاختبارات في الكلية مع اعطاء السماح للطلاب بدخول الامتحان اكثر من مرة في حالة الاصابة |

**5- مناقشة: تحليل لمميزات و عيوب تجربة التعليم المعماري عن بعد في ظل الوباء العالمي**

في إطار إستخلاص الدروس المستفادة من تجربة التعليم عن بعد، إستند البحث علي إستطلاع أراء شركاء العملية التعليمية من أساتذة و طلاب و خريجيين (الذين عاصروا التحول الي التعليم عن بعد خلال الفصل الأخيرمن دراستهم قبل التخرج مباشرة) و ذلك لتحليل، مستندا إلي المقابلات المنظمة، أهم الأوجه الممكن تطويرها لإكتساب المزيد من الثقة في الخطوات اللاحقة من تطوير العملية التعليمية، و التي بلا شك ستعتمد علي إدماج التعليم عن بعد في بعض المقررات لما له من مزايا سنطرق اليها في الخلاصة. و تتلخص نتائج المقابلات في الجدول التالي (جدول 2).

**جدول 2.**نتائج استطلاع رأي شركاء العملية التعليمية ببرنامج الهندسة المعمارية -الباحث 2022

| ***الأساتذة*** | ***الخريجين*** | ***طلاب السنوات المختلفة*** |
|---|---|---|
| • يجب أن يكون هناك تفاعل بقدر أكبر خلال العملية التعليمية لتفادي التلقين و العمل علي رفع كفاءة الخريج، خاصة في المقررات العملية.<br>• يساعد التواصل عن بعد في بعض الحالات وخاصة عند الأصابة، ويتيح مرونة أكثر في مقابلات الطلاب الأضافية أو الساعات المكتبية.<br>• لا تمثل البنية التحتية للفراغات بالجامعة عائق بسبب اتساع المساحات والقدرة على تفعيل التباعد الاجتماعي الي حد بعيد.<br>• صعوبة وضع خطط طويلة الأمد، لكن من الممكن في العام الثاني التنبوأ بالمستجدات.<br>• التطوير المستمر للمقررات لمواءمة الطبيعة الرقمية المستحدثة.<br>• المساويء تتمثل في الحاجة الي عدد أكبر من الساعات للتواصل الفردي عن بعد مع الطلاب خاصة مع ضعف شبكات الانترنت. | • المميزات تكمن في توفير الوقت و التنقلات وبالتالي القدرة علي العمل لساعات طويلة من المنزل مما أتاح تعلم مهارات جديدة وخوض تحديات مختلفة.<br>• عدم التأثر في مشروع التخرج حيث أن الأغلاق كان في المراحل المتقدمة من تطور المشروع.<br>• وجود ضغط عصبي شديد ناتج من المكوث بالمنزل لساعات ممتدة، بالاضافة الي القلق الاجتماعي المتأثر بالأغلاق.<br>• فقدان أجواء التخرج و التفاعل مع الزملاء.<br>• المساويء تشمل الضغط العصبي المفاجيء من التحول الي التعلم عن بعد مع عدم وضوح الرؤية.<br>• القلق من التأثر بالركود بسبب الوباء، لكن مع ذلك لم يتأثر الطلاب المتميزون بسبب أكتمال البورتفوليو. | • عدم التزام بعض الاساتذة بالوقت المخصص للمقررات فبناء عليه يؤثر بالسلب علي المقررات الأخرى.<br>• صعوبة التأقلم في السنوات الأولية مع التحول الرقمي بسبب عدم أتقان طرق التواصل الأكاديمية الحديثة.<br>• الحاجة الي تفاعل أكبر مع الأساتذة لنقل الخبرات لعدم وضوح بعض التفاصيل العملية من خلال التعليم عن بعد.<br>• افتقاد روح الجامعة بالأضافة الي الضغط و التوتر العصبي.<br>• الاحتياج الي المعامل لضعف الحاسوبات الخاصة في بعض الحالات.<br>• يزداد التأقلم و التفاعل الأيجابي عن بعد في السنوات المتقدمة من البرنامج. |

**6- الخلاصة و الدروس المستفادة من التجربة المحلية و التجارب العالمية المشابهة**

تناول البحث رؤية تحليلية للتجربة المستحدثة للتعليم عن بعد في مجال العمارة، و التي فرضتها الجائحة العالمية، في ربيع العام 2020. بالرغم من أن التعلم عن بعد كان بالفعل قيد التطبيق في مجالات تعليمية متعددة، إلا أنه لم يفعل في مجال العمارة بالقدر الكافي إلا بسبب الإغلاق الكامل الذي فرض، مما أجبر الجميع على سرعة تعلم الأدوات و التطبيقات و الاستراتيجيات التعليم عن بعد لإستمرارية العملية التعليمية بالرغم من الظروف الضاغطة و ضيق الوقت .

إعتمد البحث علي منهجية استقرائية لمناهج التعليم المستحدث مع تحليل كيفي لمساويء و مميزات التجربة خلال العامين السابقين و كيف أثرت علي شركاء العملية التعليمية من اساتذة و طلاب و خريجين مع مراعاة القاء الضوء على وسائل الحفاظ علي جودة التعليم و ذلك لضمان كفاءة الخريج حتي في الظروف الإستثنائية على مواجهة سوق العمل. و يخلص البحث إلي ضرورة الإستفادة من التجربة التي فرضت في ظروف إستثنائية لتكون نواة لتطوير و تحديث المنظومة التعليمية الجامعية مما يهيء فرص أفضل يكتسبها طالب العمارة و تهيئه لمنافسة أكبر في سوق العمل .

من الدروس المستفادة التي يخلص لها البحث، العمل على رفع الروح المعنوية للطلاب من خلال التفاعل الإيجابي عن بعد أو وجها لوجه، تعويض المحتوى العملي الغير معطي بمواد تعويضية أومحتوي تطبيقي من خلال زيارة المحاكاة الإلكترونية، المعارض المتاحة من خلال صفحات التصفح، دعوة زائرين من أنحاء العالم لإلقاء المحاضرات عن بعد باستخدام المنصات الالكترونية، تنظيم و حضور ورش عمل في مجالات التخصص عبر التفاعل الرقمي، و رفع كفاءة الطالب مع وجود تشجيع على التفاعل من خلال برامج المحاكاة المتعددة.

**شكر وتقدير**

نتقدم بالشكر و التقدير للأساتذة و الطلاب و الخريجين من قسم الهندسة المعمارية، كلية الهندسة، جامعة القاهرة، لما قدموه من دعم و معلومات و اراء أثرت نتائج البحث.

**تضارب المصالح**

يقر الكاتب بتنافي وجود أي تضارب في المصالح.

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# BOOK OF ABSTRACTS
# ICCAUA-2022

## **SESSION F:** Civil Engineering

**Session Chairs:**

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# Behavior of Reinforced Concrete Frames on Flexible Foundations Subjected to Both Horizontal and Vertical Ground Motions

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**Abstract**
This paper investigates the behaviour of combined horizontal and vertical accelerations on the seismic response of reinforced concrete resting on shallow foundations. Five and nine-storey buildings are considered to represent low- and medium- rise buildings. The building was assumed to be founded on shallow foundation with soil class corresponding to soft soil deposits, the soil of foundation was modelled by an equivalent massless spring coupled with a gap. The accelergrams used in this investigation in the nonlinear range are the horizontal and vertical components of the New Hall earthquake. Although most building codes postulate that SSI generally decreases the force demand of buildings, and increases the deformation demand, it was found that the inclusion of the vertical ground motion with SSI, the horizontal displacement are decreased compared to the case with only the horizontal component.
**Keywords:** Horizontal and Vertical Accelerations; Shallow Foundation; Spring Couple; Gap; Nonlinear.

## 1. Introduction

Most of the seismic codes around the world tend to neglect the effect of vertical ground motion in the design of reinforced concrete buildings due to following reasons: it was believed that the intensity of vertical component is too weak compared to the horizontal component, the wave length of vertically propagation motions is shorter than that of the S-wave, and that structures are very rigid in the vertical direction compared to horizontal direction.
However, shear failure of concrete columns was one of the major causes of damage, as observed in recent destructive earthquakes such as the Loma Prieta (1989) and Northridge earthquakes (1994) in California and the Hyogo-ken Nanbu earthquake (1995) in Kobe, Japan. Significant damage to RC structures has been attributed to the reduction of shear strength caused by vertical ground motion effects. Many studies reported data showing that the effect of vertical ground motion can be important in some cases, Antoniou (1997) and Ghobarah and Elnashai (2003), Javed A et al (1997), Shakib H et al (2003), Collier and Elnashai (2001), Mwafy and Elnashai (2006).
Modern building codes for example NBC 105, IS 1893, UBC 97 and many other codes worldwide assume the vertical component of the ground motion to be ½ to 2\3of the horizontal component. However, the soil-structure interaction (SSI) effects were neglected. This is due to the difficulties involved in making simple but reliable dynamic models and also due to prohibitive cost associated with such analyses, and SSI involves structural and geotechnical engineering, traditional design practice has seen engineers in these two fields working independent of each other. Shallow isolated footings can be modeled using: the uncoupled approach (uncoupled translation and rotational springs); Winkler approach (distribution vertical and horizontal springs); plasticity-type macroelement formulation using foundation action bounding/yield surface; and continuum approach such as finite element or boundary element methods. The continuum approach is the most rigorous, but is computationally intensive and time consuming. The uncoupled approach can model the load-deformation behavior, but cannot predict settlement.
The macro-element approach is able to satisfactorily predict the complete foundation response because it accounts for nonlinear behavior and coupling between the responses in all directions. The Winkler model represents a trade-off between the uncoupled and macro-element model. It can simulate progressive mobilization of plastic capacity and the resulting settlement. Housne GW (1993) used the Winkler approach to evaluate the structural response accounting for foundation uplift; and Psycharis and Jennings (1984) and song and lee (1993) used it to examine the effects of rocking and uplift. More recently, Filiatrault *et al* (1992). Chaallal and Ghlamallah (1996), Anderson (2003) and Chen and Lai (2003) used the Winkler approach to examine the effect of both uplift and yield on structures.
These studies demonstrated the ability of the Winkler approach to provide reasonable prediction of the rocking response of various structures. This paper examines the effect of vertical ground motion on the nonlinear seismic behavior of reinforced concrete building with soil flexibly. A simple two-dimensional (2D) model was used to idealize the structures and the supporting soil. The nonlinear structural analysis program SAP2000 was chosen for this work.

## 2. Description of Building Models

The structures used in this study, are five and a nine story buildings, the dimension in plan are 3m x 6m and the height is 3 m. The structures were designed according to the Algerian cod RPA (2003) and are located in high seismicity region with a peak ground acceleration of 0.32g. The dimensions of the beam and columns for the three structures are shown in Figure 1 and the reinforcement details are shown in Figure 2.

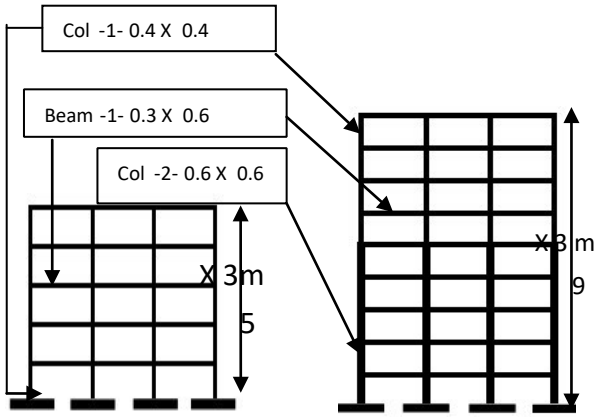


**Figure 1.** Structural models.

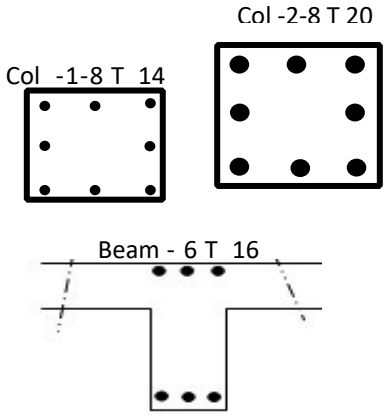


**Figure 2.** Reinforcement details.

**3. Foundation System**

The rigid footing and the soil beneath the footing in the zone of influence, considered as a" Gap element", were modeled by a NL Link element in order to model the pounding occurring between the soil and the footing. The nonlinear force–deformation relation for the Gap element is given by

$$f = \begin{cases} k(d+\delta) & if \;\; d+\delta < 0 \\ 0 & otherwise \end{cases} \quad (1)$$

Where k is the spring constant (or contact stiffness), d denotes deflection of the Gap element, and d is the initial gap separation ($\delta \geq 0$). Note that d < 0 for opening mode and do 0 for closing mode of the gap.

The vertical and horizontal elastic stiff nesses of the foundations are calculated using the frequency-independent formulas given by FEMA 356(1996) document. Allotey and El Naggar (2003) recommend using an effective shear modulus of 0.8 of the elastic shear modulus of the soil in calculating the vertical stiffness of the foundation. Therefore, the elastic shear modulus, $G_0$, of the soil was calculated from its shear wave velocity and mass density, then an effective shear modulus, G=0.8 $G_0$, was used in calculating the vertical and horizontal stiff nesses of the footing.

**4. Definition of Performance Levels**

The design objective in current building codes address life safety, control damage in minor and moderate earthquakes, and prevent collapse in a major earthquake. FEMA 356 gives deformation capacities for the inelastic components corresponding to the three target performance levels for structural components as shown in Figure 3, namely: immediate occupancy (IO), life safety (LS) and collapse prevention (CP)

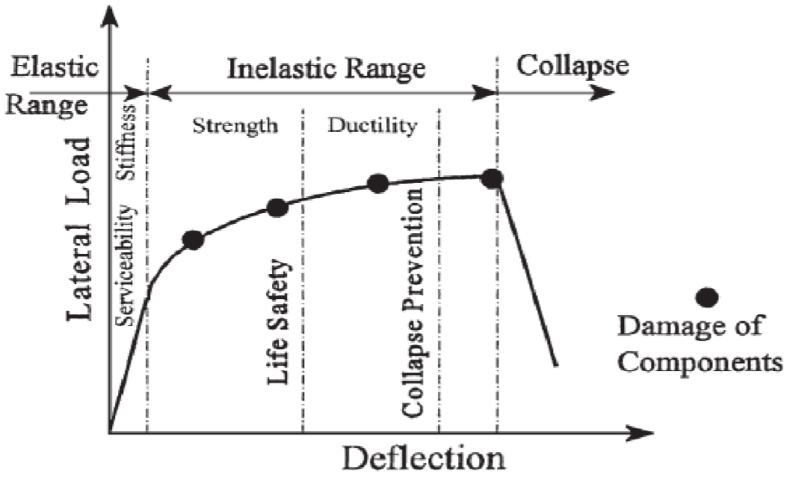


**Figure 3.** Typical performance curve for the structure.

The calculation of the flexural deflection of an RC member can be carried out by two different main methods. The first uses the finite element approach but needs a huge amount of computational effort, even for the fiber-model-based analysis. When the number of fibers in the cross section and the number of segments, along the member length, are not low, and a hysteretic analysis for a cyclic loading with a variable axial load is needed, the amount of required memory and computation are not comparable with other methods based on the assumption of a plastic hinge (Figure 4). It is evident that in the finite element method, the method of displacement approximation plays a significant role in the accuracy of the results.

In practical use, most often, the default properties provided in FEMA-356 (1996) and ATC-40 (1996) documents are preferred, due to convenience and simplicity. These default Properties can be implemented in well-known linear and nonlinear static and dynamic analysis programs such as DRAIN-2DX (1993), DRAIN-3DX (1994), PERFORM-2D, and SAP200. Some programs (i.e., SAP2000) have already implemented these default nonlinear properties. The use of this implementation is very common among the structural engineering profession and researchers. Mehmet Inel and Hayri Baytan Ozmen (2006) investigated the effect of plastic hinge properties in nonlinear analysis of reinforced concrete buildings, these analyses indicated that it is possible use this option (default-hinge) but cautiously, because the misuse of defaulthinge properties may result in relatively high displacement capacities.

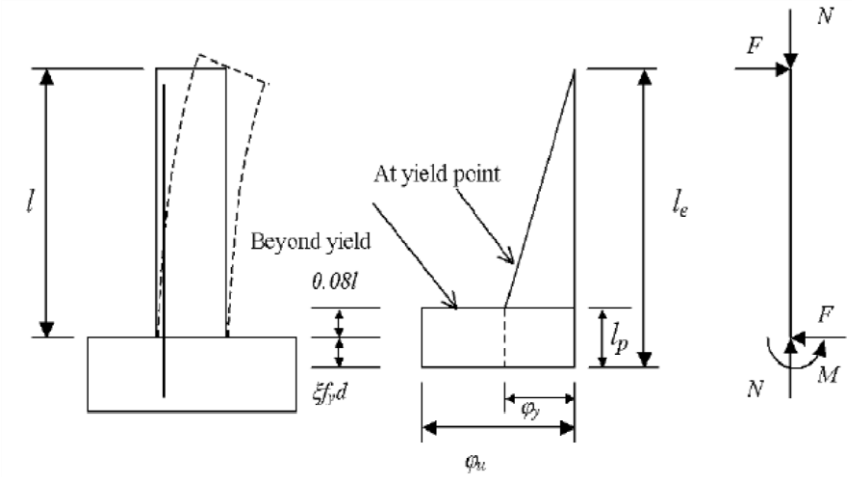


**Figure 4.** Typical plastic hinge method (Pristley and Park)

The column plastic hinge can be modeled in SAP2000 as a lumped plasticity model, using the Interaction $PM_2M_3$ Hinge. The applicability and limitations of the Interaction $PM_2M_3$ Hinge are similar to those of uncoupled hinge, except for its consideration of coupled behavior of the column in both orthogonal bending directions. The configuration of the column cross section must be taken into account in a separate moment-curvature analysis and interaction diagram, carried out to determine the nominal capacity $M_{ne}$, plastic capacity $M_p$, and ultimate capacity Mu of the column, as well as the rotations (θ) or curvatures (ϕ) related to those values, in discrete bending directions of the column. Whereas hinge based on bending moments were assigned to beam. Figure 6 shows the

load-deformation curve of the hinges. The hinge properties and modeling parameters A, B, C, D, and E were specified according to FEAM 356 (2003).

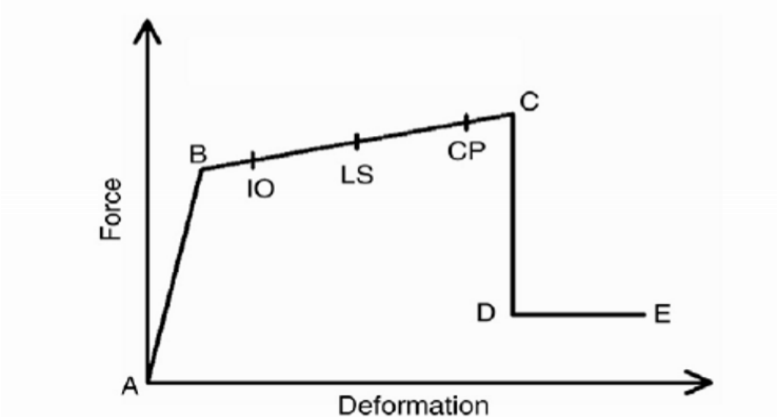


**Figure 5.** Force–deformation relationship of a typical plastic hinge.

The following points should be noted:
Point A is always the origin.

- Point B represents yielding. No deformation occurs in the hinge up to point B, regardless of the deformation value specified for point B. The displacement (rotation) at point B will be subtracted from the de formations at points C, D, and E. Only the plastic deformation be yond point B will be exhibited by the hinge.
- Point C represents the ultimate capacity for analysis.
- Point D represents a residual strength analysis.
- Point E represents total failure.

**5. Earthquake Ground Motion**

The accelerograms used in this investigation are the horizontal and vertical components of the New Hall earthquake record, figure 3. These records are believed to be representative of strong earthquake. Studies by Clough and Benuska (1966) indicate that structural response depends primarily on the peak acceleration impulse in the ground motion and that continuing motions of smaller amplitude have only a small effect on the maximum response. Therefore, the duration of the earthquake used in this analysis was primarily limited to the first fifteen seconds of the earthquake. The peak ground acceleration of the horizontal component is 0.578 g and that of the vertical one is 0.537g.

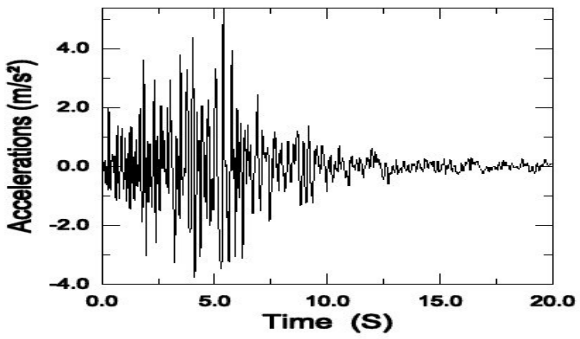


**Figure 6.** Earthquake records
New hall accelerogram (north-south component)

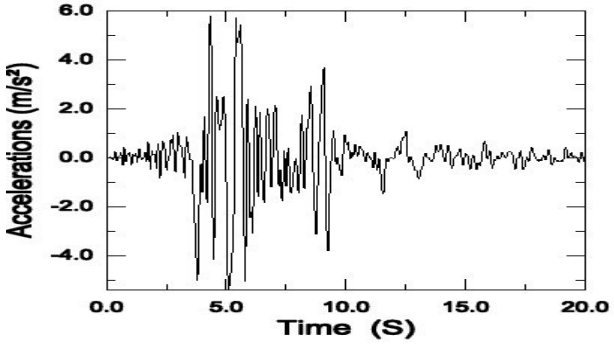


**Figure 7.** Earthquake records
New Hall accelerogram ( vertical component)

Acceleration response spectra of linearly elastic system with 0.05 damping subjected to the records are shown in figure 8. Comparison of the spectra shows clearly that the peak vertical acceleration falls in the small period range.

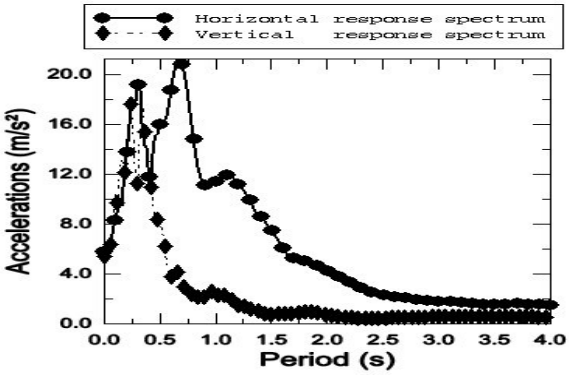


**Figure 8.** Acceleration response spectra of the records used.

**6. Nonlinear Dynamic - Analysis Time History Analysis (THA)**

In transient dynamic analysis, the following system of dynamic equilibrium equations is solved at each time t, Eq. 1.

$$[M]\{\ddot{u}(t)\} + [C]\{\dot{u}(t)\} + (f_{\text{int}}(\{u\},\{\dot{u}\},\{\varepsilon\},\{\sigma\},t,\dots\dots)) = \{f_{\text{ext}}(t)\}$$

where $[M]$ and $[C]$ are the mass and damping matrices respectively, and $\{f_{\text{ext}}(t)\}$ is the vector of external forcing functions. The vectors $\ddot{u}(t)$, $\dot{u}(t)$ and $u(t)$ are the resulting accelerations velocities and displacements, respectively. The vector $f_{\text{int}}(\{u\}$is the internal set of forces opposing the displacements and is usually dependant on the displacements, velocities, and field of strains $\{\varepsilon\}$and stresses$\{\sigma\}$.

In this study, a Rayleigh type damping is adopted. It is based on a linear combination of the mass matrix $[M]$ and the linear elastic stiffness matrix or the tangent stiffness $[k]$ as follows, Eq. 2:

$$\alpha[M] + \beta[K]$$

where the coefficients $\alpha$ et $\beta$ are determined to provide for two selected damping rations for two specific modes of vibration, ie the first two modes. The direct integration of the above equations is required. One of the most widely used methods is the HilbertHughes-Taylor method [15]. This method has superior numerical dissipation characteristics over the widely used Newmark method. For large number of degrees of freedom, the numerical damping feature is essential to suppress undesirable higher modes.

**7. Results and Discussions**

**7.1 Shear Forces**

Figures 9 and 10 shows the envelope of storey shear demand of five and nine storey structures respectively. They indicate that the SSI with the horizontal excitation only results in a decrease of 16% in the base shear compared to the fixed based, but the analyses with SSI plus a combination of horizontal and vertical motions, the shear demand is decreased by 15% compared to the case of horizontal ground motion without and with SSI.

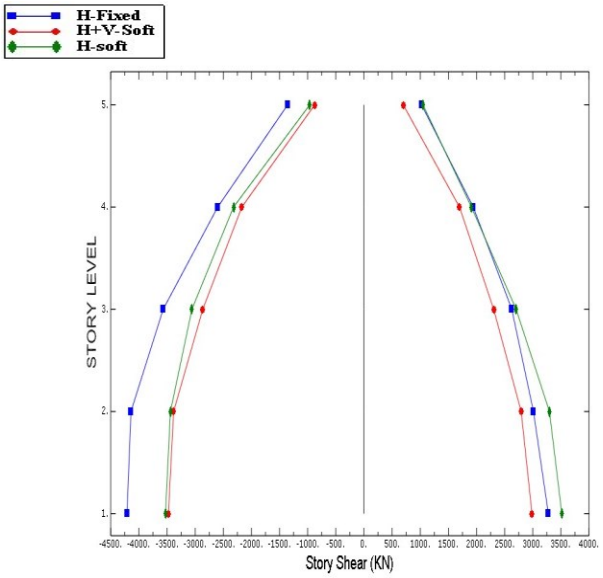


**Figure 9.** Five storey base shear.

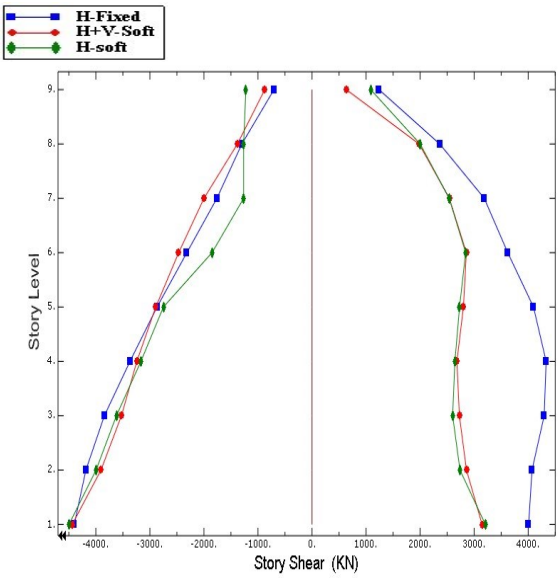


**Figure 10**. Nine storey base shear.

### 7.2 Moment Demand

Figures 11 and 12 show the envelope of storey moment demand in interior and exterior columlns of the five storey building increased by 3% in analyses SSI plus the horizontal ground motion compared to the fixed case. However, for analyses involving SSI and both ground motions, the moment demand is decreased by 15% compared to analyses considering SSI and horizontal ground motion.

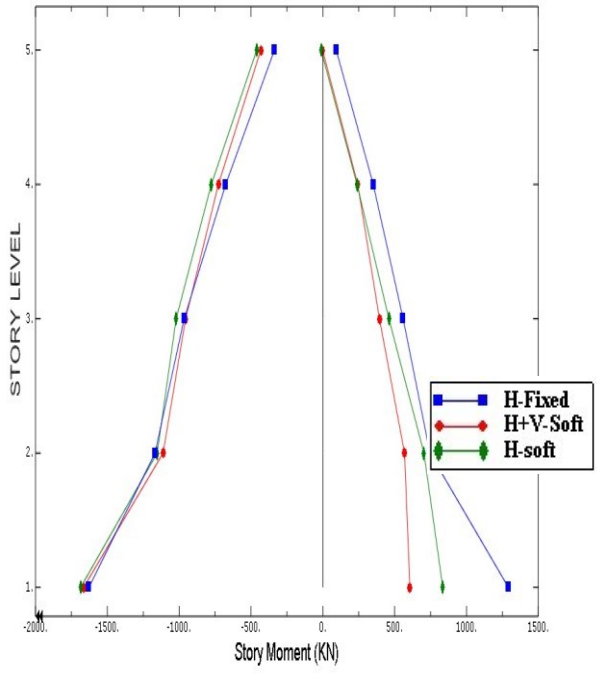


**Figure 11**. Five storey structure moment‟s exterior column

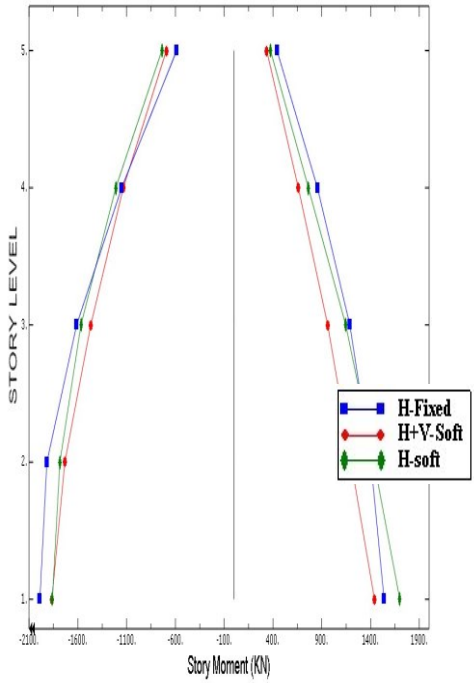


**Figure 12**. Five storey structure moments interior column.

Figs. 13 and Figure 14 compare the moment demand in the interior and exterior columns of the nine storey structure. The moment demand for analyses with SSI and horizontal ground motion component is increased by 28% compared

to the fixed case. But for analyses with SSI and a combination of the horizontal and vertical ground motions, the moment demand is increased by 2% in compression compared to the case of the flexible footing under footing under horizont al ground motion.

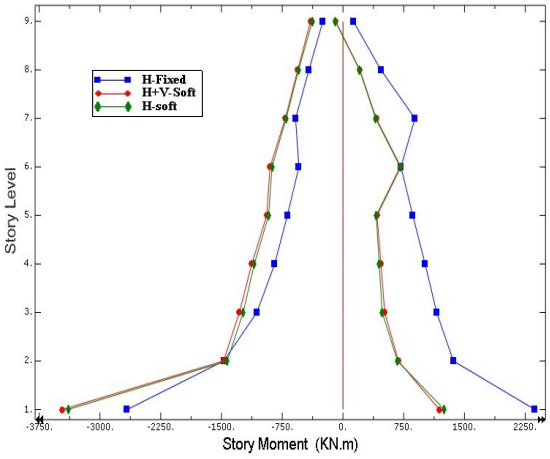


**Figure 13.** Nine storey structure moments exterior column

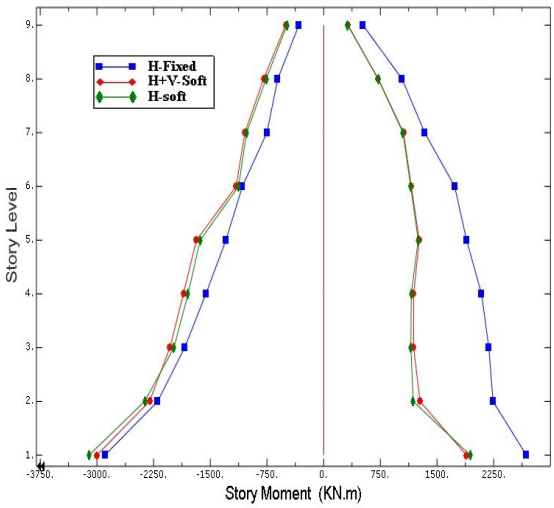


**Figure 14.** Nine storey structure moments interior column

### 7.3 Displacement

Generally, the displacements for analyses with SSI are increased compared to analyses fixed for the nine storey structure irrespective of the number of ground motions (refer Figures 15 to 16). For the five storey building, the displacements are increased compared to the fixed case when SSI and a combination of horizontal and vertical ground motions are considered.

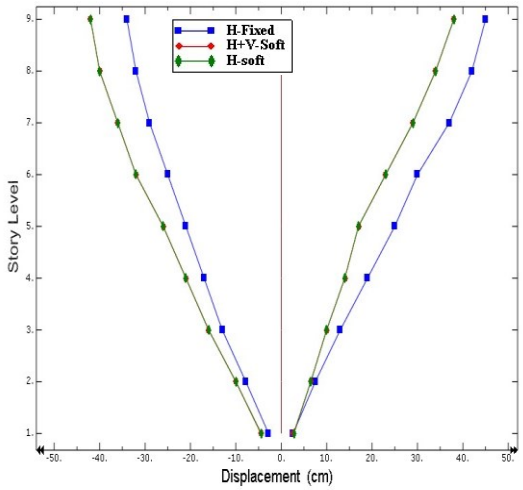


**Figure 15.** Horizontal Displacement of Nine Storey Structure

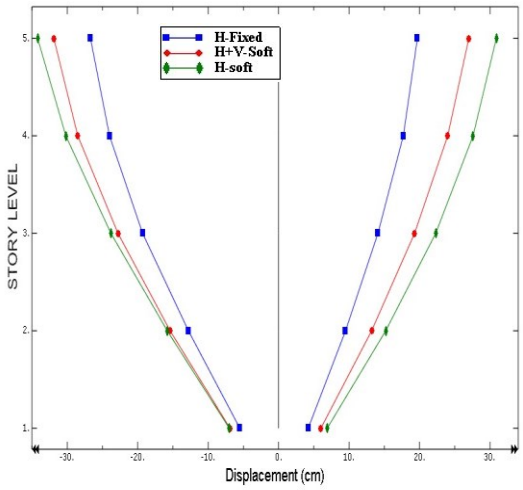


Figure 16. Horizontal Displacement of Five Storey Structure

### 8. Formation of Plastic Hinges and Accumulated Plastic Deformation:

The locations of plastic hinges formed in the 5 storey structures under New Hall earthquake are shown in Figure 17. First, it should be noted that all hinges were in the elastic domain before 4 s. Afterwards, there were some plastic deformations in the beams and the columns. SSI and a combination of horizontal and vertical ground motions can alter considerably the plastic hinges patterns compared to the fixed case. For instance, for both structures, the hinges at the base of the columns yielded at event E under SSI and both excitations.

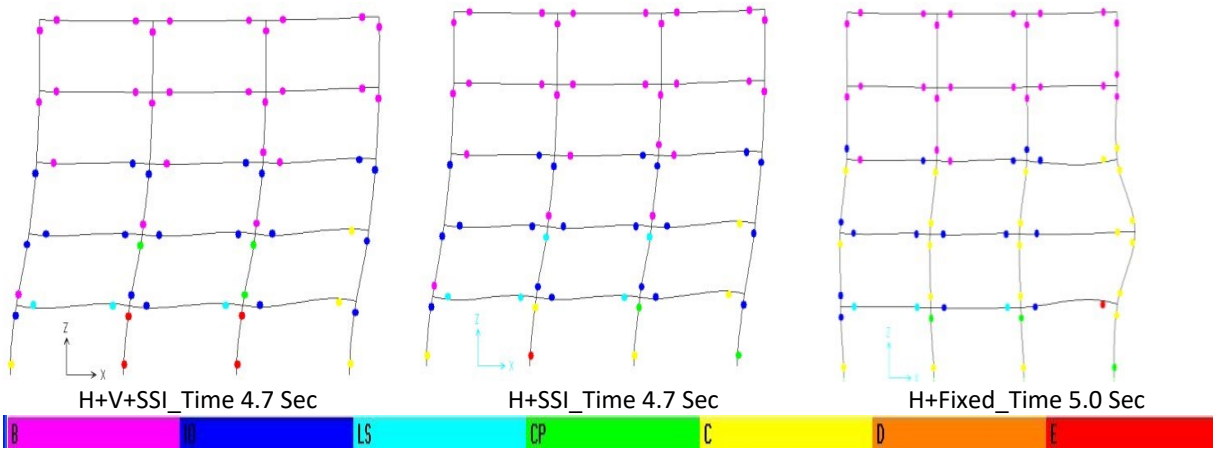


**Figure17.** Location of plastic hinges caused by New Hall earthquake

**9. Conclusions**

The results show that the SSI effects increases the base shear and moment demand on buildings founded on soft soil. This is contrary to the common assumption that SSI effect on seismic forces is always favorable, postulated by almost all the design codes. It is clearly demonstrated that the base shear and moment demand on short-period buildings could increase by up to 25% of the fixed base buildings values.

The deformations of the structural components of the buildings have also been affected by the SSI. The deformations of buildings with flexible bases have shown a considerable increase that ranged from 23% compared to the fixed base case for buildings founded on soil flexible. This would in turn increase the lateral deflection of the whole building. Thus, SSI can have a detrimental effect on the performance of buildings.

The effect of vertical acceleration are more pronounced in low and medium building, The SSI increased the displacements compared to the fixed case, this increase is absorbed by the energy dissipated in the structure which results in decreased in the forces, Under combined vertical and horizontal ground plus SSI, the displacement are decreased compared to the case of only horizontal component plus SSI resulting in an increased forces.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Seismic Vulnerability of Interaction Soil-Pile-pier Bridges Under Mainshock-Aftershock Sequences Using the Fragility Methodology

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**Abstract**
Pile foundations strongly influence the performance of supported structures and bridges during a earthquake, only mainshock actions are considered without incorporating the effect of mainshock-aftershock (MA) sequences. This study primarily investigates the seismic fragility of mainshock-aftershock (MA) sequences damaged of bridge with consideration the effect of interaction soil-pile-structure, type of soil and masse effect. Analytical fragility curves are developed for the bridge components based on the outputs of an Incremental Dynamic Analysis (IDA) using 19 synthetic ground motion records. The results indicate that these parameters are significantly influenced on lateral capacity, ductility and seismic fragility on the ISPS. The increasing in the axial load exhibit high probabilities of exceeding the damage state.
**Keywords:** Seismic; Interaction Soil-Pile-Structure; Incremental Dynamic Analysis; Fragility Curves; Bridge.

## 1. Introduction

Some structures are stable during the main shock, with potential for collapse or severe damage from aftershocks. A well-known example of such devastating aftershocks is the 1997 Marche Umbria earthquake in central Italy, which del Preti et al. I have detailed the damage. [1] As evidence for other cases of the 1999 Kocaeli earthquake in Turkey (Mw 7.4) which was rotated by the USGS [2] Severe aftershock damage after the main shock at about 1 month. Theoretically, the inelastic behavior of the structure under the previous main shock results in deformations and residual plastic stiffness. In most studies on the effects of main shocks only ignoring seismic aftershocks, there has been little research on the effects of post-traumatic stress on structures. Bridges are considered one of the most important strategic structures that are characterized by the high costs of their construction. Whereas Ehsan Al-Omranian (2018) study finds fragility curves of RC deviated bridges exposed to major tremors and seismic aftershocks and fragility assessment is performed using cloud analysis method subject to a wide range of recorded sequences.You Dong (2015) also evaluated the probabilistic seismic performance of exposed highway bridges For main- shocks and aftershocks Seismic ground motion intensities, microphone sensitivity analysis for bridges, and assessment of results in the 2021 Seismic Structures Analysis Framework by Mohammad Mehdi Tourve Nejad Design four SSMF models with 4-20 stories numerically in OpenSees and subject to dynamic analysis (IDA) These aims Analyzes to observe the state of structural collapse under aftershock events that were preceded by different levels of major shocks.) from the collapse state in the presence of successive shocks that are then evaluated. ] Seismic behavior of bridge structures (PSSI). et al. 2016); Specifically, their superstructures have been modeled as structural components simplified into linear, nonlinear, static or dynamic components (Moehle 2003). Ghazi et al (2018) and Rocky et al. (2020) investigated the interaction between the soil-stack-substrate (ISPS) system and the soil-to-soil interaction system.
(ISP) under lateral loads. The nonlinear static analysis takes into account the lateral load amplitude of the ISPS and the ISP under lateral loading using easy analysis, with the parametric study.
The linear steel ratio, pile length and soil type on the lateral response of the piles were studied with Nisreen Qaitavi on the amplitude curves for each variable to illustrate the fragility curves.
After comparing the embrittlement curves for these parameters; Wahid Choucair (2021) worked on developing a comprehensive and accurate analytical model for the seismic assessment of bridges, by studying the effects of soil-soil interaction (SPSI)
This research study aims to identify the structural and soil parameters (types of the sand, pile diameter, longitudinal steel ratio, and axial force level) that have the most and least sensitive effects on the seismic fragility of bridges. This is achieved by Transportation Infrastructure Geotechnology considering the effect of the interaction of the soil-pile-structure (ISPS) system. To reach this objective, a soil-pile-structure finite element (FE) model and a pushover analysis are used to determine the curve of capacity of the ISPS, define the damage condition criteria, and finally generate the fragility curves.

## 2. Numerical Tool and Modeling Strategies

The numerical analyses developed and described in this paper with different nonlinear modeling strategies were studied using the computer program SeismoStruct v7 (SeismoSoft and 2015). The program includes models for the representation of the behavior of spatial frames and soil under static and/or dynamic loading, considering both material and geometric nonlinearities. With this software, seven types of analyses can be performed, namely: dynamic and static timehistory analysis, conventional and adaptive pushover, incremental dynamic analysis, modal analysis, and static analysis (possibly nonlinear) under quasi-permanent loading.

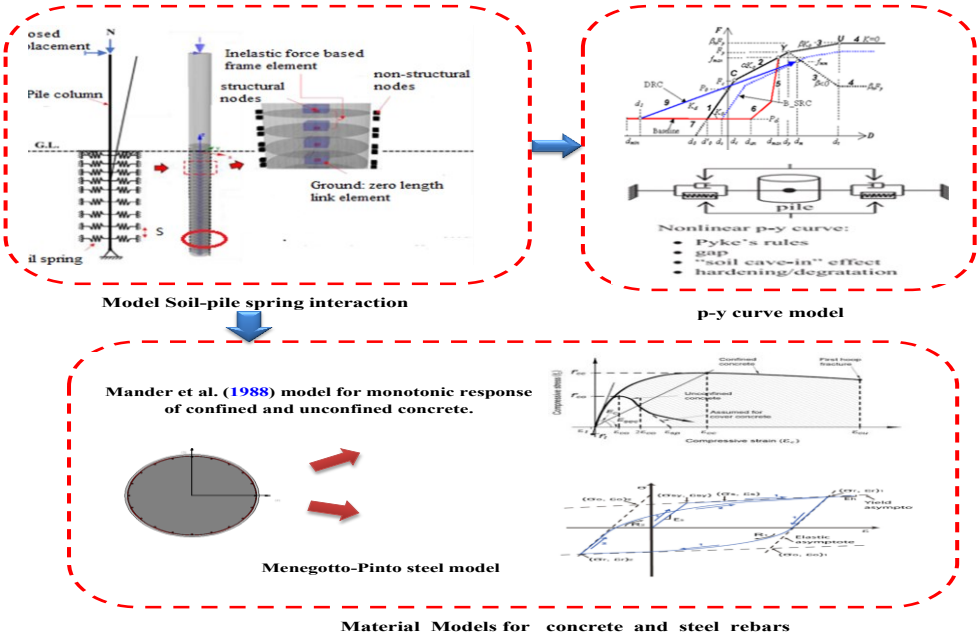


**Figure 1.** Structure of the Study (Developed by Author).

## 3. Results and Discussions

### 3.1 Incremental Dynamic Analysis

The IDA results the ISPS system in (loose) soils were obtained respectively under the influence of mass (150 tons, 350 tons) in the figures2.3. IDA curves were presented for only the three extreme cases, ie, mainshock only (MS), aftershock only (AS) and main shock -aftershock (MS-As). ISPS mean IDA curves are compared.

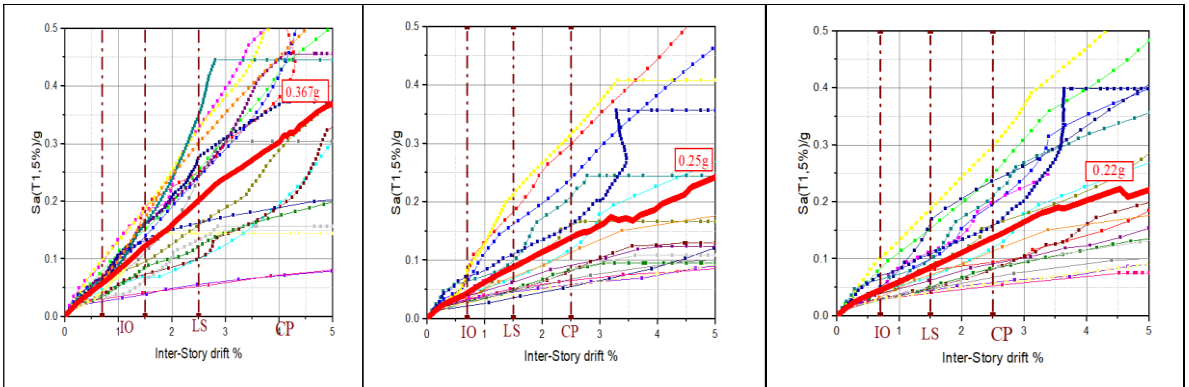


**Figure 2.** IDA results for ISPS system under the influence of mass (150t): (a) the aftershock-only (AS); (b) the mainshock-only (MS); (c) the mainshock-after shock (MS-AS).

Comparing the response of the ISPS system under the influence of mass (150 tons) subjected to the main shock only PGAs =0.25g, while the ISPS system under the mainshock- aftershock PGAs=0.22g has a lower capacity of 12%

Comparing the response of the ISPS system under the influence of mass (350 tons) subjected to the main shock only PGAs=0.111g, while the ISPS system under the mainshock- aftershock PGAs=0.09g has a lower capacity of 18%.

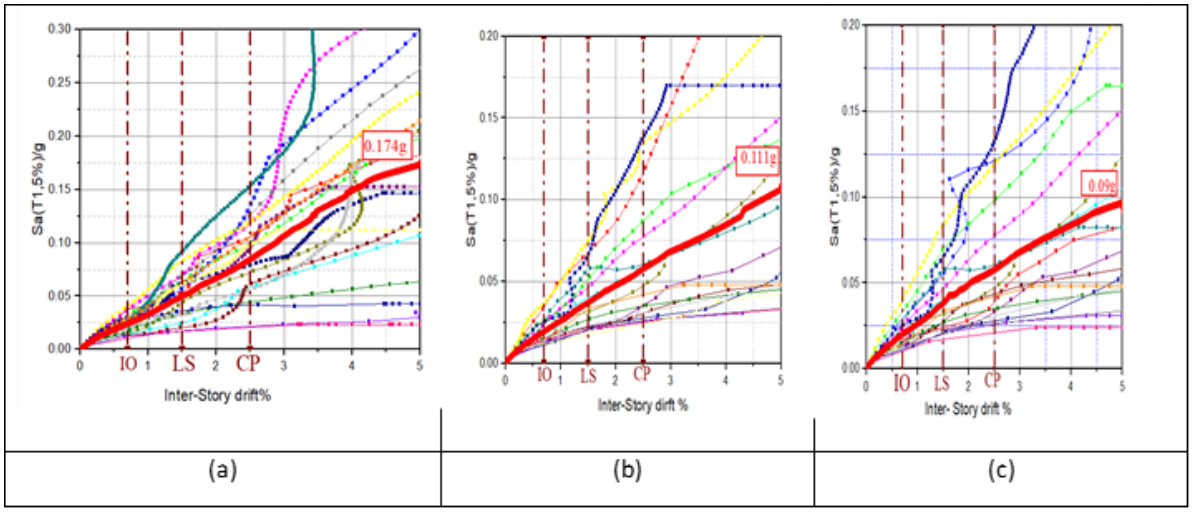


**Figure 3.** IDA results for ISPS system under the influence of mass (350t): (a) the aftershock-only (AS); (b) the mainshock-only (MS); (c) the mainshock-after shock (MS-AS).

### 3.2 Fragility Curves

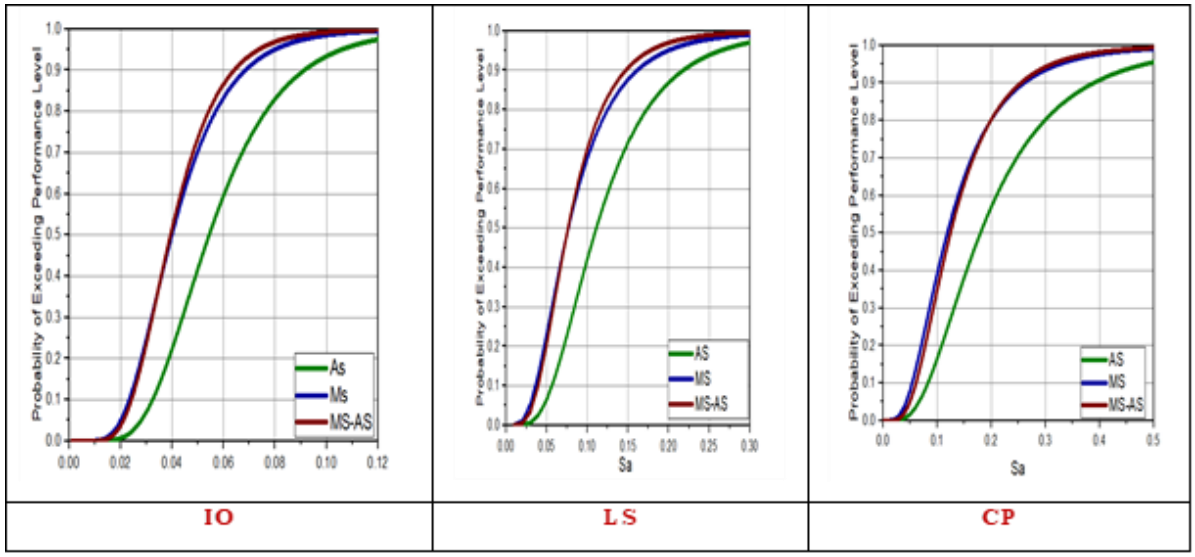


**Figure 4.** Fragility curves for ISPS system under the influence of mass( 150t ):(AS;MS and AS-MS )

The decrease of the value of that the probability of exceedance for each damage state is increased and is affected by different damage states. for ISPS in (loose) soils were obtained respectively under the influence of mass (150 tons) under the influence of main shock-aftershock more vulnerable than under the influence of main shockunder the influence of main shok only and aftershock onlyThe values of Sa (15%) of probability of damage of the ISPS system with for different damage states (IO, LS, CP).

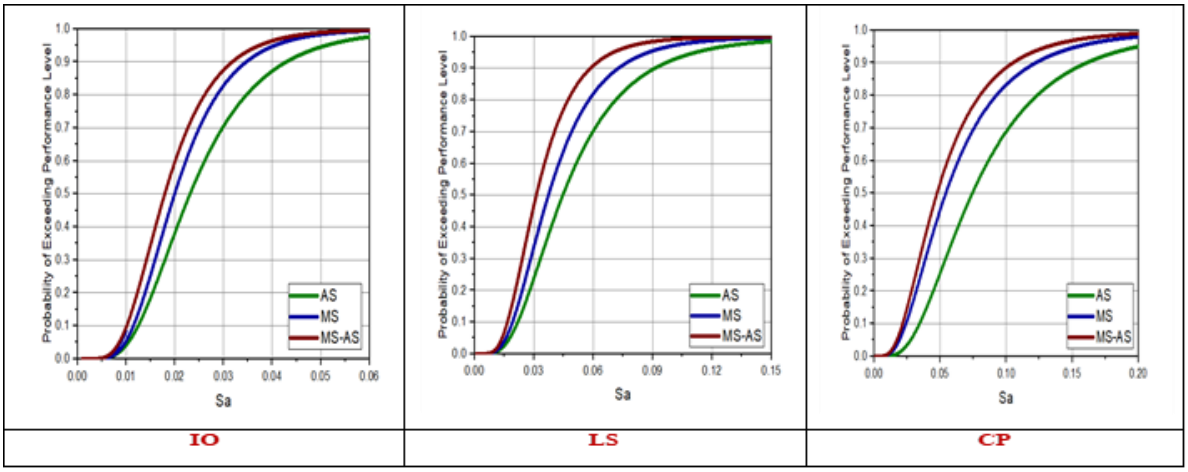


**Figure 5.** Fragility curves for ISPS system under the influence of mass (150t): (AS; MS and AS-MS)

The decrease of the value of that the probability of exceedance for each damage state is increased and is affected by different damage states. for ISPS in (loose) soils were obtained respectively under the influence of mass (350 t) under the influence of main shock-aftershock more vulnerable than under the influence of main shock under the influence of main shok only and aftershock only The values of Sa (30%) of probability of damage of the ISPS system with for different damage states (IO, LS, CP).

**4. Conclusions**

this study, the ISPS system in (loose) soils were investigated under earthquake loading capacity, were investigated under earthquake loading. the incremental dynamic analyses were carried for the three ISPS system (mainshock only (MS), aftershock only (AS) and main shock -aftershock (MS-As) for developed the fragility curves were compared, and the important

findings inferred from the study are enumerated as follows:

* The axial load influence the lateral capacity in ISPS system more IDA results (4,5)

*Mainshock–aftershock seismic sequences lead to an increase in the accumulated damage of theISPS system. Strong aftershocks will cause greater damage demands to the undamaged ISPS system than to the mainshock-damaged ISPS system.

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# Impact Of Underground Cavity on A Strip Footing at The Edge of a Cohesionless Slope and Subjected to Eccentric Load

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**Abstract**
Owing to the comeback of small-scale models, this paper presents results of an experimental study based on the effect of underground circular voids on strip footing placed on the edge of a cohesionless slope and subjected to eccentric loads. The bearing capacity-settlement relationship of footing on the slope and impact of diverse variables are expressed using dimensionless parameters such as the top vertical distance of the void from the base of footing, horizontal space linking the void-footing centre, and load eccentricity. The results verified that the stability of strip footing is influenced by the underground void, as well as the critical depth between the soil and top layer of the void. The critical horizontal distancebetween the void and the centre were also affected by the underground void. Furthermore, the results also verified that the influence of the void appeared insignificant when it was positioned at a depth or eccentricity equal to twice the width of footing.
**Keywords:** Strip footing; Eccentric load; Slope; Underground void; Bearing capacity.

## 1. Introduction

The existence of an underground void on a foundation can cause serious engineering problems that destabilize it and expose its superstructure to severe damage, which could be very expensive and hazardous. The presence of underground voids negatively affects the ultimate bearing capacity of superficial foundations. Underground cavities that cross the subsoil can be generally categorized into two: artificial and natural. Artificial or man-made cavities result from urban installation, tunnelling, mining, and old conduits, including water and gas networks. Natural cavities are shaped by the dissolution of sedimentary rocks owing to the circulation of water (karst and natural gypsum), which forms cavities of widely varying sizes. In engineering practice, the existence of voids in the ground compromises the bearing capacity and structural integrity of foundations. These cavities indicate a very significant potential risk of collapse, especially in urban sectors where the stakes are high. Frequently, footings are positioned on a soil with voids that are either hidden before building or shaped after it. Extensive analytical and model studies have been carried out to investigate the behaviour of such soil. Several researchers have dealt with the impact of voids on the ultimate bearing capacity of foundations. Researchers such as(Atkinson & Potts, 1977; Badie & Wang, 1984; Baus & Wang, 1983; Wang & Badie, 1985) pioneered studies on voids and the load-carrying capacity of footing stability. They demonstrated how the presence of voids affects a certain critical region under the footing. The size of the critical region depends on numerous factors, such as: footing shape, soil property, void size, and void shape. Wang & Hsieh (1987) investigated the collapsed load of strip foundation on circular voids via the limit analysis theory, in which he reviewed several failure mechanisms. In 'Natural and artificial cavities as ground engineering hazards', Culshaw & Waltham (1987) briefly presented the different types of cavities, outlining the mode of creation and history of natural and artificial cavities, respectively. They proposed an outline process for tracing cavities and decreasing the risk of omission during site explorations. Then, via numerical analysis, Kiyosumi et al. (2007) determined that the failure zone emerged mainly from the adjacent footing-void and did not usually expand to other cavities. Additionally, this failure was less significant in soils without voids. A computational method was developed to approximately determine the yielding pressure of strip footing over numerous holes. Addressing the impact of voids on foundation stability, another research by A. Khalil & A. Khattab (2009) adopted a non-linear finite elements analysis method. The study verified that a significant zone exists under the footing 'radial shear and failure plane zone'. If a void is placed inside this zone, then the result will be critical. Settlement rate was observed for voids positioned in this zone below the foundation.

The experimental observation of Kiyosumi et al. (2011) demonstrated three sorts of failure modes for a single void, according to the void's size and position. Upper-bound calculations were presented to interpret the observed changes in bearing capacity. Mohamed (2012) carried out a numerical study based on the Plaxis software. The results obtained from this study confirmed that the stresses under the strip footing were augmented by 40% when the rock was encountered under the middle of the footing at a depth D of 0.5 m. Additionally, the stresses under the footing were altered when the buried rock was positioned away from the middle footing to the instability of

the footing. Hussein (2014) presented results of finite element analysis for the stability of strip footing over circular continuous voids on sand. An equation was derived to define the relationship between the bearing capacity ratio and influencing feature. This equation provides a database for the design of continuous footing with an underground void at its centre. Lee et al. (2014) presented design charts estimating the undrained bearing capacity aspects as part of dimensionless factors connected to the vertical and horizontal cavity space from the footing, cavity size, and spacing between the two cavities, which contribute to soil rigidity and inconsistency. The ultimate bearing capacity is controlled by three different failures modes.

To explore the effect of inclination load on the bearing capacity of shallow continuous foundations situated on undrained clay soil with single and dual continuous cavities, small strain finite element analyses were performed by Lee et al. (2015). Additionally, they studied the influence of the position, form, and number of continuous voids. The results obtained are illustrated as normalized failure envelopes in the horizontal and vertical loading planes. Lavasan et al. (2016) numerically examined the bearing capacity and failure mechanism of a shallow strip foundation built above twin voids. The results obtained can be used to sketch the pattern of a footing on a cavity while the obtained failure mechanisms can be selected to improve analytical solutions. Moreover, it was inferred that a significant depth of the cavities and a critical space between them appear where the ultimate bearing capacity of the footing disappears. To study the impact of voids on the behaviour of strip footing under oblique load, Al-Jazaairry & Toma-Sabbagh (2017) applied the finite element analysis. They studied several footing cases, and in each case, an important depth appeared under which the existence of voids exposed the footing presented to minimum damage. When cavities were set up on this depth, the bearing capacity of the foundation varied according to the influence of many factors (position, size of the cavity, footing depth). The results obtained can be applied to create a shallow foundation laid on cavitied soil while the attained failure mechanisms can be utilized to develop numerical explanations to this sort of challenges. Zhou et al. (2018) examined the bearing capacity and failure mechanism of a perpendicular laden strip foundation on cohesive soil with square voids. The results indicate that the undrained bearing capacity with voids reacts to soil characteristics. The failure mechanism is linked to multiple soil properties, position of single voids, and straight space between two voids. Zhao et al. (2018) via the upper bound method carried out a study on the stability analysis of asymmetrical cavities. The results show that the stability numbers are augmented with an increase in the friction angle, but reduce with an increase in the horizontal distance and descriptor diameter values, with considerable asymmetrical failure mechanisms. The results also indicate that the major failure type for the soil near the cavity is the local shear failure. A clear bottom bulge fact is detected in the void at its small inner. Based on their results, Piro et al. (2018) noticed that a novel equivalent wave parameter was accurately defined to take into consideration the existence of the underground level and cavities in seismic soil-foundation-structure interactions. Then they suggested relationships between the most significant parameters controlling the interaction phenomena. Xiao et al. (2018a) examined the effects of voids on the bearing capacity of strip footing under the plane-strain state, where a reduction factor was delineated. The obtained results are illustrated in different design charts, and the critical failure mechanisms are represented. Xiao et al. (2018b) used finite element limit analysis to study the undrained bearing capacity of strip footing on voids in two-layered clays. Design charts and equations are presented to estimate the undrained bearing capacity factor Ns. The effect of the parameters on Ns has also been inspected, including the undrained shear stress ratio of the soil, thickness of the top layer, location, size, width, height, and spacing of the voids. Zhang et al. (2019) investigated the collapsed roof of deep circular voids in jointed rock masses via numerical analysis. The results are sketched in dimensionless stability diagrams and are compared with transformational findings conducted using the algorithm of an analytical upper bound solution. Then, based on the frictional Mohr-Coulomb model, and in accordance with the non-associated flow rule, Lee & Kim (2019) researched on the collapse of strip rigid foundations positioned on sandy soil with both single and dual continuous voids. The obtained results agree positively with existing theoretical and numerical solutions.

Throughout a series of laboratory-scale load tests, Jayamohan et al. (2019) investigated the impact of a subsoil cavity on the load-settlement behaviour of a strip foundation. The results show that the effect of cavities is significant when they reach a critical depth and eccentricity, after which the reinforced foundation bed develops the load-settlement behaviour of a soil with voids. Additionally, the existing subsoil cavities can lead to stress concentrations that trigger failure. Saadi et al. (2020) led an experimental inquiry on the impact of interference on the bearing capacity of dual adjoining foundations on a granular cavitied soil. The results revealed the influence of cavities and the interference of dual footings on the bearing capacity factor, as well as the efficiency factor. Then, the effects of the cavities vanished when the distance footings/cavities were greater than three.

The overall purpose of this study is to probe the impact of underground circular voids on the bearing-capacity behaviour of a shallow continuous footing located on the edge of a cohesionless slope (b/B=0) such as b is distance between foundation and the edge of a slope. To realise this objective, a strip pattern footing was experimented. Furthermore, a practical range of parameters were studied, such as the vertical distance of the top of void from

the bottom of footing (H/B), horizontal distance between cavities-footing centre (L/B), and various vertical load eccentricities (e/B).

**2. Experimental Apparatus**

The experimental pattern tests were carried out in a tank with a dimension of 1.60 × 0.60 × 0.60 m. Figure 1 presents an illustration of the tank, which is made from steel with an entirely transparent plexiglass plate as the front part, and propped up with eight wheels rolling on straight steel support girders. The purpose of the rollers is to pull the box from under the loading mechanism in order to empty it and re-fill the soil into it.

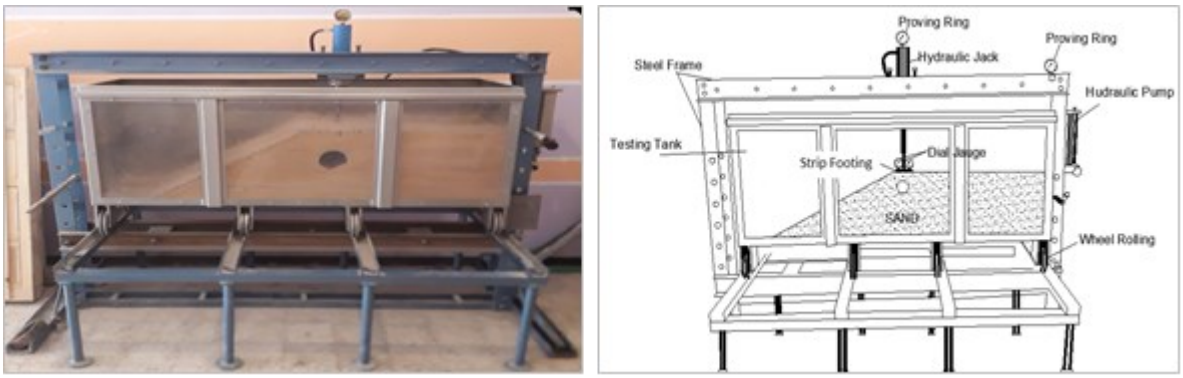


**Figure 1.** Experimental apparatus.

These girders were strongly setup on horizontal steel pillars. The Plexiglass allowed the observation of the slope. It ensured the visibility of the sample throughout preparation. It also allowed the observation of sand particles' deformation throughout the testing. However, because the impact of sand pressure and the applied load could compromise the strength of the Plexiglass, it was strengthened with two steel columns. The tank box was solid enough to support the plane strain conditions by reducing the out of plane displacement. To guarantee its solidity and prevent deformation, a thick steel plate was used to manufacture the tank. The interior parts of the tank are coated and well-polished to reduce friction with the sand as much as possible. Based on the research conducted by Ueno et al. (1998), the boundary effects were taken into account, as shown in Figure 2.

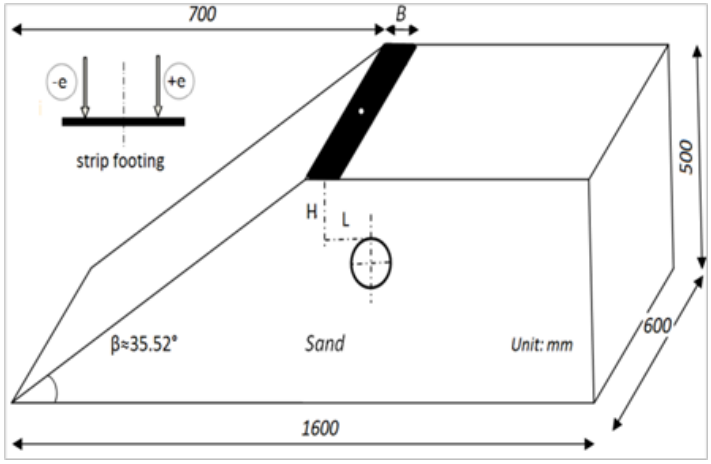


**Figure 2.** Geometry of the problem.

**2.1 Footing**

To implement the designed strip footing pattern, a thick steel plate consisting of a range of holes was utilized. Several holes were created on both sides (left and right) at a 10-mm distance from the centre hole of the footing to be used as foundation loading points, with the dimensions of 598 mm long, 100 mm wide (B), and 20 mm thick. Both ends of the testing footing were optimally lustred and lubricated to diminish frictional contact with the rigid box borders. Then, to ensure rugosity, a layer of sand paper was fixed to the footing base. To maintain plane strain conditions, the footing length and tank width were approximately the same values. Then, ball bearing was employed to allow an easy loading to the footing.

**2.2 Soil Proprieties**

This research is based on an intermediate to coarse sand that was cleaned, dried and filtered according to sand particles size'. It was collected from the south-east region of Algeria. Particles' size distribution was established following dry sieving technique and the findings are presented in Figure 3. A particular gravity of 2.65 was determined by picnometer test. The maximum and the minimum dry densities of the sand were measured and the corresponding values of the minimum and the maximum void ratio were calculated. To assess the friction angle, a series of direct shear tests at a relative sand density of 60% were performed. The residual friction angle of the compacted sand was about 37°, which matches to densified sand. Additional parameters of the tested sand are illustrated in Table 1.

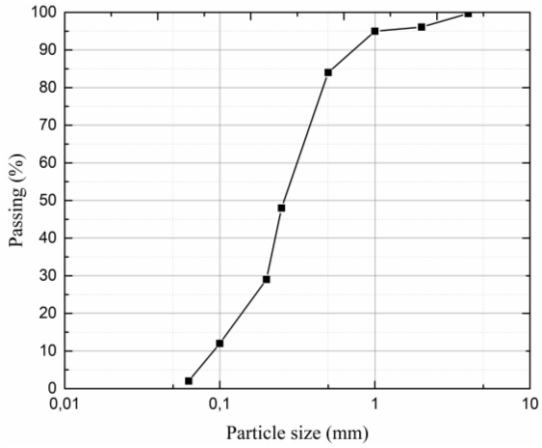


**Figure 3.** Grain size distribution curve of sand.

**Table 1.** Material properties of the sand use

| *Property* | *Value* |
|---|---|
| ● Specific gravity $G_s$ | 2.65 |
| ● Uniformity coefficient $C_u$ | 3.19 |
| ● Coefficient of curvature $C_c$ | 1.40 |
| ● Maximum dry unit weight $\gamma_{d(max)}$, kN/m$^3$ | 17.12 |
| ● Minimum dry unit weight $\gamma_{d(min)}$, kN/m$^3$ | 14.62 |
| ● Peak friction angle $\phi^0$ | 37 |

**2.3 Cavity Proprieties**

The purpose of using PVC in this work is to ensure the presence of cavity void, the thickness of PVC used is 02 mm, the exterior diameter is 110 mm and the length is 558 mm. In the design of the test model, the parameters of the PVC tube are shown in Table 2.

**Table 2.** Properties of the PVC used

| *Parameters* | *Value* |
|---|---|
| ● Density (kN/m$^3$) | 13.5-14.6 |
| ● Tensile strength (MPa) | 45 |
| ● Elongation % | 80 |
| ● Elastic modulus (MPa) | 3000 |

**3. Testing Process**

A total of 140 load bearing experimental tests were conducted on the strip footing pattern situated in close proximity to the crest slope. To improve the validity of the experiment, every single test was carried out thrice using parameters such as vertical distance between the void and footing (H/B), load eccentricity (e/B), and the horizontal distance void-footing centre (L/B). Then, based on the process presented by El Sawwaf (2004), the experimental slope sand angle was equal to 35.52°. After that, via a manual rammer, the used sand was densified in each layer- 50 mm thick up to 500 mm height, at a relative density according to the designed testing program, the desired relative density was achieved after carrying out several preliminary experiments using different compacted energies and layers thick. During the compaction process, a void was positioned in our soil sample via a circular PVC with a diameter of 100 mm and length of 598 mm. The PVC was set down in the required position and

sand compaction continued until the final bed was achieved. Tests were carried out for diverse locations of voids and varied parameters, as presented in Table 3. The sand sample was formed in line with the slope shape and framed on the plexiglass side. The formed surfaces were first levelled, then the model footing was positioned on sand, with a predetermined alignment, such that the load could be vertically transferred to the footing. To preserve typical conditions throughout the testing programme, the tank was poured out and refilled for each test.

**Table 3.** Model tests program.

| *Strip footing (mm)* | *H/B* | *L/B* | *Eccentricitiese (mm)* |
|---|---|---|---|
| 100x598 | 0.5 | 0,1,2,3 | -30, -20, -10, 0, 10, 20, 30 |
| | 1 | 0,1,2,3 | -30, -20, -10, 0, 10, 20, 30 |
| | 1.5 | 0,1,2,3 | -30, -20, -10, 0, 10, 20, 30 |
| | 2 | 0,1,2,3 | -30, -20, -10, 0, 10, 20, 30 |
| | 3 | 0,1,2,3 | -30, -20, -10, 0, 10, 20, 30 |

**4. Results and Discussion**

A total of 140 tests were conducted on the bearing capacity of stiff continuous footing situated on the slope of a soil with various void positions, a range of eccentric vertical loading ratios (e/B = 0, ± 0.1, ± 0.2, and ± 0.3), and constant footing space from slope crest (b/B = 0). The void positions moved horizontally (L/B) from the footing centre with alternating values between 0 and 3B, and also vertically from the soil surface (H/B) with alternating values between 0.5B and 3B, as presented in Table 1. A no-void reference test was also carried out.

To assess the validity and reliability of the small-scale laboratory test results, the bearing capacity was achieved by dividing the limit load on the area of footing. Ueno et al. (1998) tangent intersection method was used to set the bearing capacity results.

**4.1 Effect of Eccentricity**

The influence of eccentric loading on bearing capacity is illustrated by the load-eccentricity curves (Figure 4) for different void locations and normalized slope/footing distances (b/B= 0).

It was established through the experimental results that the bearing capacity was considerably influenced by void presence and load eccentricities, here, the load diminished with an increase in the eccentricity ratio (±e/B). A significant increase in the bearing capacity value appeared when e/B = +0.1. Although this peculiarity can be explained in terms of load divergence from the crest's slope and the void centreline, at e/B = +0.2 and e/B = +0.3, a reversal of the footing was observed, which occurred and gradually reduced the bearing capacity value.

Furthermore, the ultimate bearing capacity for a negative eccentric load is inferior to a positive one.

This signifies that the failure region under a positive eccentric loading is greater than that under a negative one. The gradual displacements shifted to the slope leaning, and a non-symmetrical failure mechanism was observed.

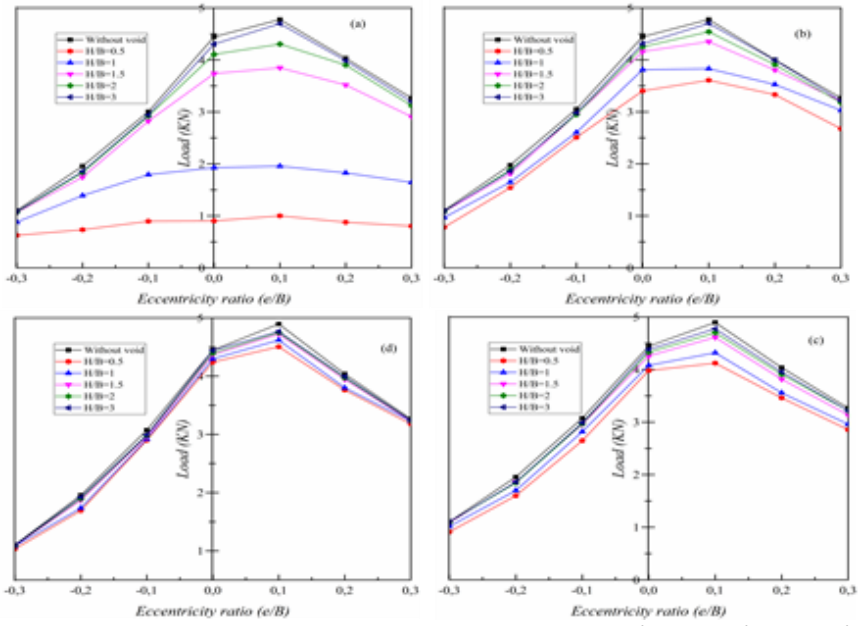


**Figure 4.** Load with variable eccentricities for void horizontal distance. a) L/B=0, b) L/B=1, c) L/B=2 and d) L/B=3

In contrast with the footing location, the passive region was imperfect, thus triggering a diminution in the bearing capacity.

### 4.2 The Effect of Void's Depth

Figure 5 shows the effect of embedment depth, from the foundation base to the void's crown, on the bearing pressure ratio of a strip foundation positioned on the edge of a sandy soil at different load eccentricities.

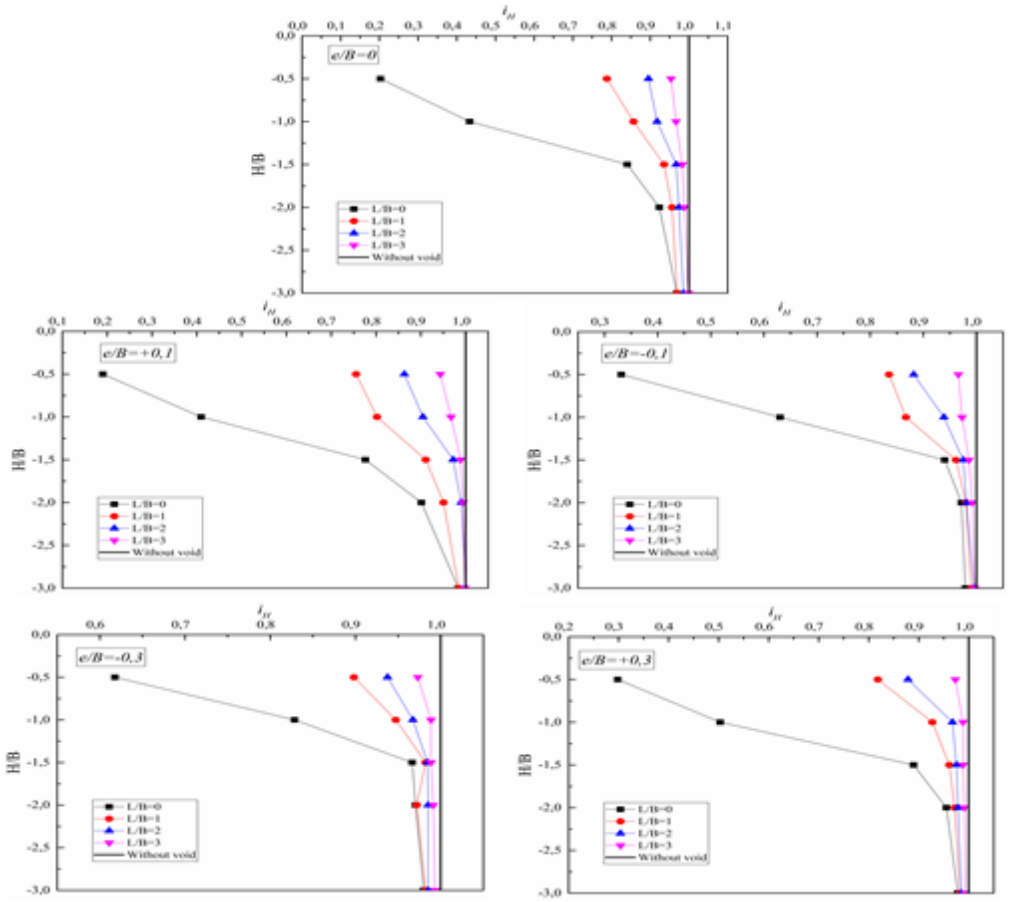


**Figure 5.** Effect of depth void with bearing capacity ratio.

The obtained results were analysed in terms of a dimensionless parameter called bearing capacity ratio: iH = qv/qnv, where qv represents the bearing capacity of the strip footing on the ground with a void while qnv defines the ultimate bearing capacity for the same footing placed on the sand without void.

A significant instability between the soil and the nearby voids had been observed when the void distance H/B and L/B were equal to 0.5 and 0, respectively. Consequently, the soil collapsed with an 80% reduction in the bearing capacity value. This occurred because the small distance between the footing and void, including the soil mass underneath the footing was thin. Therefore, a low total shearing resistance was mobilized.

Then, an increase in the negative load eccentricity (direction of the slope) reduced the void embedding effect as we suspected. Moreover, the H/B effect was less influential for negative eccentricity than for positive eccentricity, this can be explained, that for negative eccentricity, the loading point moves away from the centre of the void and thus leads to an increase in bearing capacity. Furthermore, in the cases at H/B=1 and H/B=1.5, notably, we observed the same impact for negative and positive load eccentricities but with less significant intensities.

As illustrated in Figure 5, irrespective of the eccentricity of the load and distance of the void from the centreline of the foundation, the bearing capacity ratio of the footing increases as the depth of the void's crown augments from a footing bottom, which reaches a maximum value at H/B = 2. This specific depth is called 'critical depth' and it was also determined by (Badie & Wang, 1984). Beyond this depth, the influence of the void on the bearing pressure ratio appeared to be the same as that of a footing without a void. Additionally, the values converged to the reference case. This behaviour occurs owing to the voids distant from the shear zone. Therefore, the failure mechanism formed was similar to that of the no-void. Finally, it was determined that when L/B = 3, the H/B effect is negligible.

### 4.3 The Effect of Void Horizontal Distance from Foundation Centreline

To probe the effect of the horizontal distance, several curves were plotted, as shown in Figures. 6 (a), (b), (c), (d). The results show that at L/B=2 and L/B=3, the effect of the void on the bearing capacity of a foundation under eccentric loads is annulled, and the behaviour of the footing is similar to that of a no-void foundation.

In figure 6, it was set up such that for H/B = 0.5 and H/B = 1, the influence of the eccentricities on the bearing capacity was nearly negligible as the void moved closer to the base of the footing. For the other void depths, it can be observed that the curves converge towards the case without a void.

According to the test results presented in Figure 6, curves were designed at various void horizontal distances shifting from 0 to 3 B. Irrespective of the eccentricity of the applied load (e/B = -0.3, -0.2, -0.1, 0.0, +0.1, +0.2, +0.3), the void moves far away from the centreline footing, thus indicating a decrease in its influence. Moreover, its impact becomes insignificant when the void divergence equals twice the width of the footing. Beyond H/B = 2, the foundation behaves like a foundation without a void, as shown in Figure 6(d).

A careful examination reveals that in the case of e/B = -0.3 and e/B= -0.2, the effect of the slope controls the behaviour of the foundation, whereas the effect of the horizontal distance is insignificant. Furthermore, owing to load eccentricity, the footing started to lose contact with the soil.

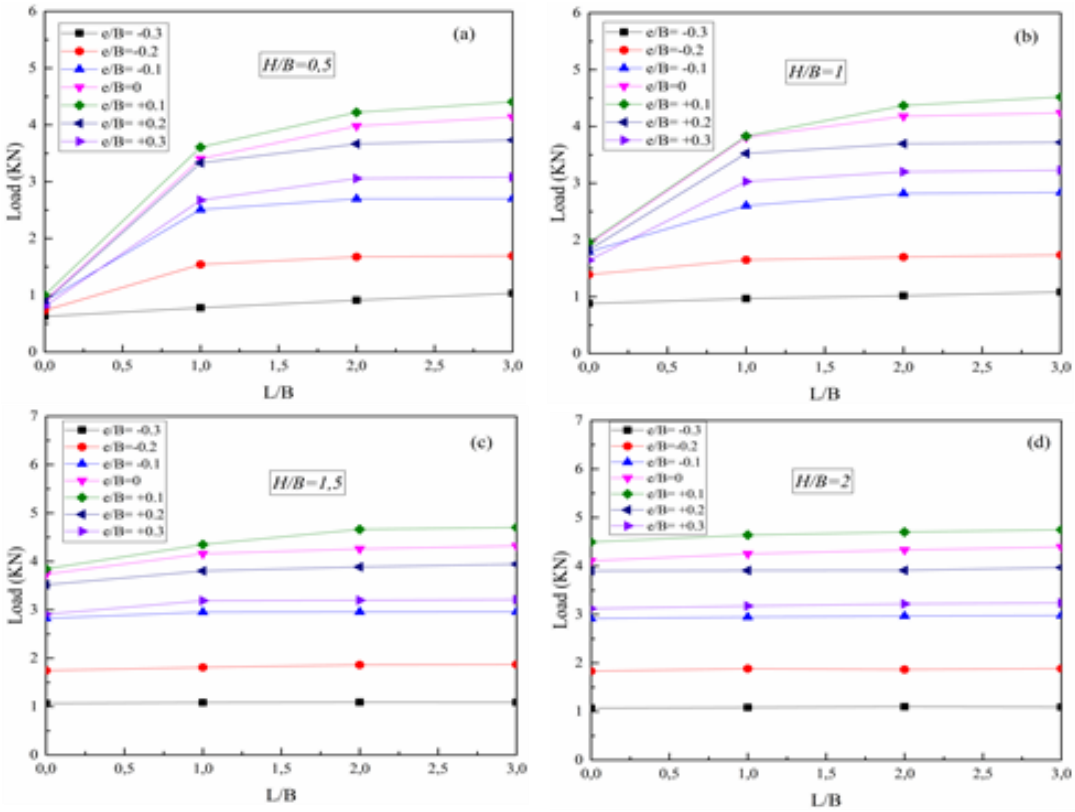


**Figure 6.** Effect of load with horizontal distance from foundation centreline. a) H/B=0.5; b) H/B=1; c) H/B=1.5 and d) H/B=2.

### 5. Conclusions

In this study, various performed laboratory tests were conducted to determine the impact of underground circular voids on the bearing-capacity behaviour of a shallow continuous footing located on the edge of a cohesionless slope (b/B=0). Based on the obtained results, the following findings and conclusions were made:

- -The results prove that the bearing capacity is considerably influenced by the location of the void and load eccentricity.
- -The ultimate bearing capacity for a positive eccentric load is greater than that of a negative one owing to the slope presence and underlying void.
- -Because the soil mass underneath the footing is thin, the short distance between the footing and void leads to soil collapse along with a significant decrease in bearing capacity, thus mobilizing a low total shearing resistance is mobilized.
- -The negative load eccentricity (direction of the slope) reduces the effect of void inclusion, whereas the effect of H/B is less significant on the negative eccentricity than on positive eccentricity.

- -Irrespective of the eccentricity of the load and distance of the void from the centreline of the foundation, the bearing capacity of the footing increases as the depth of the void's crown augments till it reaches a maximum value at H/B = 2. Beyond this depth, the influence of the void on the bearing pressure appears to be the same as that of a footing without a void.
- -In the case where the horizontal distance of the void from the foundation centreline equals three times the footing width, the effect of the void's depth is negligible.
- -The impact of eccentricities on the bearing capacity is nearly negligible when the void moves closer to the base of the footing.
- -The influence of the void is insignificant when the void is placed at a depth equivalent to 2 times the width of the footing.
- -Regardless of the eccentricity of the applied load, the influence of the void gradually reduces as the void moves far away from the footing centreline, and its impact becomes more negligible when void divergence equals twice the width of the footing.

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**Conflict of Interests**
We have no conflicts of interest to disclose

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# The Influence of Road Traffic on Heavy Metal Contamination of Road Dust and Roadside Soil along A Major RN3 Highway Through a Rural Area in Northeastern Algeria

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**Abstract**
This study examines the assessment of heavy metal contamination of pavement-side soils. In our case we studied the section of National Highway 3 (RN3). In the environment of sampling sites there is no industry or dangerous activity on the environment, the heavy metals addressed in this study are (Pb, Cu, Cr, Fe, Ni, Zn), their origin being road traffic. Results indicated that concentrations in road dust were higher than in soil. The distribution of heavy metal concentrations in dust is Fe>Pb>Zn>Cu>Cr>Ni, and the distribution in the ground is Fe>Pb>Cu>Zn>Cr>Ni in the direction of Biskra and in the opposite direction and decreases everything away from the road, while the distribution in the central solid ground is Fe> Cu>Cr>Cr>Zn>Ni. Climatic conditions such as wind, rainfall, temperature, humidity and the nature of the terrain were also significantly related to their enrichment in these roadside soils.
**Keywords:** Pollution; contamination; heavy metals; traffic; road; dust; environment; wind; pavement.

## 1. Introduction

Heavy metal soil pollution in rural areas near major highways is a major issue in roads with varied loads of traffic in rural areas. Traffic in major Algerian roads in rural areas is one of the sources of roadside soil pollution, especially with regard to heavy metal concentrations and their impact on the immediate environment of the road, for this purpose, it is necessary to identify, assess and quantify the concentrations of heavy metals in road dust and in the adjacent soil arable layer. Traffic and industrial emissions are considered important factors in metal pollution in road dust Duong et Lee [7]; Guney, M. et al. [39]; Thorpe, A., & Harrison, R. M. [40]; Wei, B., & Yang, L. [42]; Yuen, J. Q. et al. [36]. With the phasing out of leaded gasoline in developed countries and the implementation of other control measures, traffic-related metal emissions had significantly decreased Cheng, H., & Hu, Y. [42]; Preciado, H. et al. [43]. Whereas traffic-related emissions dominate metal pollution in road dust Thorpe, A., & Harrison, R. M. [40]; Wei, B., & Yang, L. [41]; Yuen, J. Q. et al. [36]. This can contribute to the enrichment of the Cr, Cu, Fe, Ni, Pb and Zn elements Apeagyei, E. et al. [44]; Duong et Lee, [7]; Gietl, J. K. et al. [45]; Gunawardana, C. et al. [46]; Thorpe, A., & Harrison, R. M. [40] ;(36) Yuen, J. Q. et al. [40]. Nevertheless, the chemical, resulting from the mixture of heavy metals linked to road traffic, varies considerably from study to study Gietl, J. K. et al. [45]; (46) Gunawardana, C. et al. [46]; Thorpe, A., & Harrison, R. M. [40], probably due to the difference in metal concentration in brake pads and tire materials, as well as the difference in road traffic volume density (Apeagyei, E. et al. [44]; Duong et Lee,[7]; Thorpe, A., & Harrison, R. M. [40]. Several studies have indicated that the contamination of soil and several types of roadside vegetation species by significant concentrations of heavy metals is due to the volume of road traffic Ho, Y. B., & Tai, K. M. [20]; Li, F. R., Kang,et al[3]; Banu Doganlar, et al. [22]; Sert, E. B., Turkmen, M., & Cetin, M. [21]; Chunjuan Bi et al [7]; Khan, A. B., & Kathi, S. [14]. In addition, the results could be used appropriately to monitor the aerial deposition of these roadside metals. Pagotto, C et al. [5] assessed the impact of certain physical infrastructure parameters (safety slides, pavement type, pavement slope) on the extent of heavy metal contamination, as well as the composition of the material near the emission source (road dust). According to Fakayode and Olu-Owolabi [30]; roads are known as the second most common source of urban pollution. Other studies have focused on the contamination of dust from roads and roadside soils in urban areas by heavy metals, Imperato, M. et al [15]; Yongming, H., et al. [17]; Shi, G., et al. [11]; Karim, Z., et al. [13]; Maeaba, W., et al. [26]; Xiao, Q., Zong, Y., Malik, Z., & Lu, S. [29]. They showed that levels of heavy metal concentration such as Pb, Cd, Cu, Cr, Ni, Zn, Fe and Co far exceeded the limits set for clean soils and their source came mainly from industrial derivatives, combined with traffic sources. Studies have examined the influence of industial activities and waste incinération on the accumulation and extent of heavy metal pollution in the complex system of surface soils and road dust; Chang, S.H et al [2]; Shi, G et al [12]; Chunjuan Bi et al [47]; They showed that

the concentrations of these métals in road dust were generally higher than those in soils. Various pulications have examined the spatial distribution of heavy metals in dust and surface soils next to roads and their orogins.Kamani, H., et al.. [10]; Dragović, S. et al [16]; Ahmed, F., & Ishiga, H. [18]; Al-Khashman O. A. [19]; (Sollitto, D. et al [6]; Khan, A. B., & Kathi, S. [14]; Liu, E., et al. [4]; Zhang, H et al [1]; Alsbou, E. M. E., & Al-Khashman, O. A. [9]; They showed that the increase in anthropogenic trace metal elements in the surface environment can most likely be attributed to urbanization, rapid industrialization and increased vehicle emissions into the atmosphere. They revealed that the distribution of heavy metals in soil samples is affected by wind direction. They concluded that concentrations of these metals in soils are higher on the surface but decrease in low-lying areas and that the highest level of metals was found in eastern parts of roads due to prevailing wind. Also, levels of contamination of these metals decrease as one moves away from the side of the road. Authors have revealed that automobile traffic is the main source of pollution from road dust and adjacent soils with a contribution of more than 50%. In addition, unregulated incineration and hazardous waste dumps along the road were responsible for these contaminations. Pan, H., Lu, X., & Lei, K. [8] ; Khan, M. N., et al. [23]. Heavy metal contamination on human health was the concern of other researchers such as Wu, F., et al. [24]; Al-Shidi, H. K., et al. [27]; Hong, N. et al. [28]. They found that the health risks associated with heavy metal accumulation were higher in densely populated areas, high-traffic areas and industrial areas. They also showed that tire wear and exhausting diesel engines have a higher potential threat to human health as they generate high amounts of high-grade heavy metals. and revealed that gasoline and diesel emissions contributed significantly to the presence of Cr and Ni during braking, and tire wear generated large quantities of Cu and Zn. Men, C., Liu, et al [26], in order to assess the risks of environmental contamination by heavy metals, they concluded that the environmental risks specific to each source and the critical sources of heavy metals have changed with the changes in seasons, suggesting that different strategies should be adopted according to the seasons.

The objectives of this study were to: (1) Determine the concentrations of heavy metals in road dust; (2) Identify the sources of different heavy metals in soils and road dust; (3) Exploring the extent of heavy metal pollution in neighbouring soils; (4) Propose a protective easement on either side of the road.

## 2. Material and Methods

### 2.1 Study area

The study area is an agricultural area far from all industrial activities, located in the commune of Oued-echaaba wilaya of Batna in north-east Algeria, on a section of the national road three called (RN03), linking the Algerian north to the extreme south of Algeria, from the wilaya of Skikda to the wilaya of Tamanrasset with a traffic of 29521 vehicles per day. the section in question is a duplication of 7m of width on either side, the stretch of road is built in embankment with full central land of 5.5m width, the type of pavement is a classic pavement, the remediation of the road is provided by earth ditches in triangular shape on both sides of the roadway, with a depth of 1.5m, a width to the mirror. The city has a semi-arid climate with hot summers, cold winters and annual rainfall of around 346 mm, humidity is 53% and the maximum wind speed is 4.3m/s.

### 2.2 Samples and sampling

Soil sampling is done using a stainless transplant (cleaned after each sample with distilled water) at the level of 36 points arranged on either side of the roadway and 3 points in the TPC see Figure 1. These samples resulted in the preparation of 15 composite and homogeneous soil samples. All samples were placed in airtight polyethylene bags, labelled and brought back to the laboratory. Prior to the analysis, all samples were put to the oven at 105oC for 24 hours for drying, crushed with porcelain mortar, then sifted to 2mm and finally ground in a type disc grinder (DM200). Road dust samples were collected about three weeks after a thunderstorm, and the weather was sunny during sampling, clean plastic brushes and brushes were used to collect road dust samples Ashbaugh, L. et al. [32]; Banerjee, A. D. [33]; six points were taken on the pavement's bearing layer on an area of 7 m2 on both sides of the roadway. A sampling was taken at the roundabout. During the preparation, small pebbles, cigarette butts, hair and other plant debris were removed. The samples were carefully mixed to obtain compound samples. The samples were placed in airtight self-sealing polyethylene bags labelled and brought back to the laboratory for drying at 105oC, and then sifted into a sieve with a mesh of 0.5mm. Soil and road dust samples were kept at 4oC until they were analyzed.

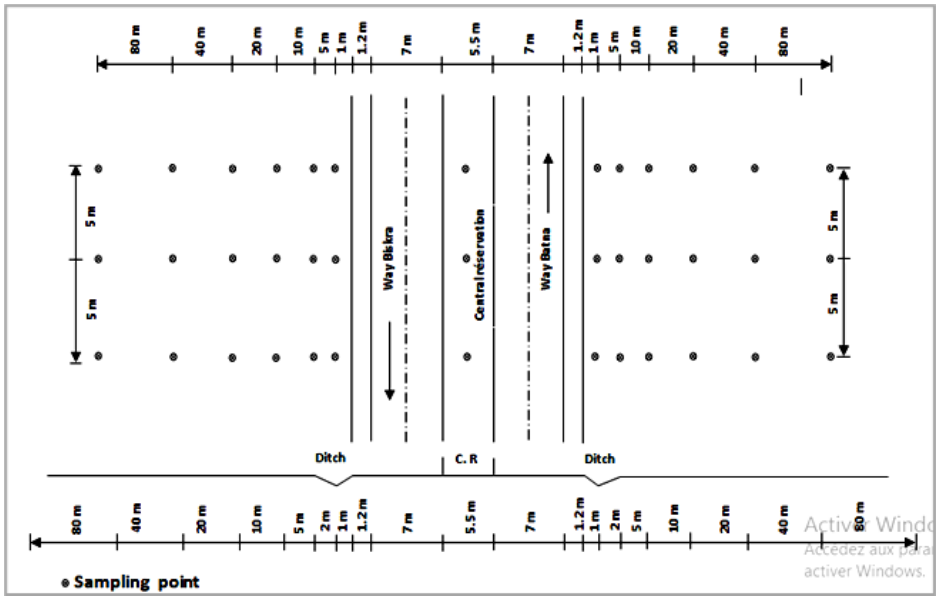


**Figure 1.** Location of sampling points.

### 2.3 Granulometric analysis

The granulometric analysis of the samples was carried out using a laser granulometer (Partica LA-960 HORIBA Laser Scattering Particle Size Distribution Analyzer). The results show a rather coarse nature for soil samples than for road dust.

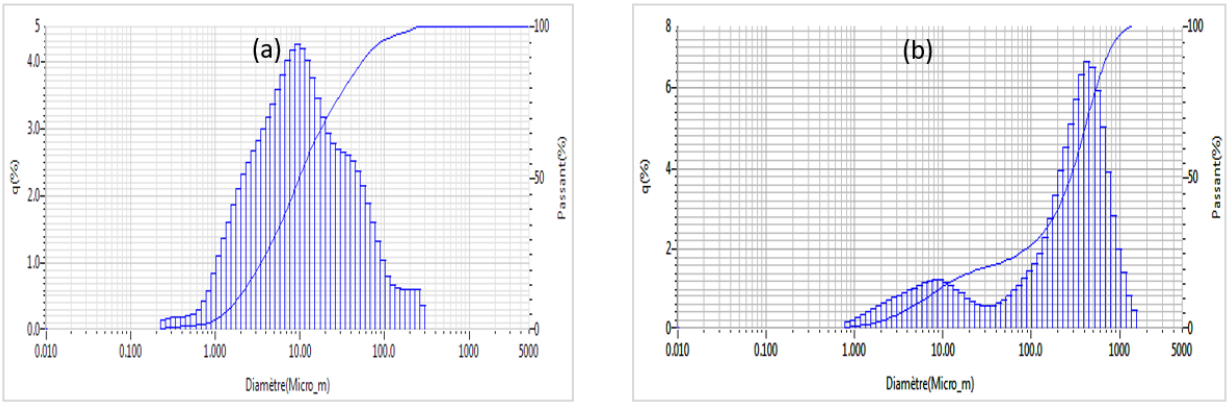


**Figure 2.** Granulometric curves (a) soil; (b) road dust.

### 2.4 Preparing Lozenges

The pellets are obtained by compressing the powder using a manual press. A boric acid binder can be added to give the lozenge a good mechanical solidity. The samples are then ready to be analyzed, the lozenge to a circular shape of 25mm in diameter, 5mm thick, and a weighte equal to 8g of powder. Samples zer analyzed by a wave lenght dispersion x fluorescence spectrometer (WDXRF) (ZSX Primus IV regaku fluorescence spectrometer).

## 3. Estimated Intensity of Contamination

The intensity of soils contamination by heavy metals was assessed from two indices : the enrichment factor (EF) and the geo-accumulation index (Igeo), theire principle is based in the comparison of measured values against reference values.

### 3.1 Enrichment FACTOR

The Enrichment factor is a parameter that allows us to see whether the concentration of heavy metals obtained in soils are anthropogenic or natural in origin. Maeaba, W et al 2020(26); if EF close to 1 indicates a natural source while EF > 10 suggests an anthropogenic source. According to Yen, J.Q et al (2012) (36) the Enrichment factor (EF) is defined by:

$$\mathbf{EF} = \frac{\left(\frac{\mathbf{C_i}}{\mathbf{Fe}}\right)_{\mathbf{Sample}}}{\left(\frac{\mathbf{C_i}}{\mathbf{Fe}}\right)_{\mathbf{Background}}}$$

Or:

$\left(\frac{C_i}{Fe}\right)_{Sample}$ and $\left(\frac{C_i}{Fe}\right)_{Background}$ are the ratios of metal concentration (i), standardizer (Fe) in sample, metal concentration(i) and standardizer (Fe) in the background material, respectively. In this research, the (Fe) has been used as a standardizer because it has low variability in occurrence and is a main component of thr Earth's crust Khademi, H et al [37]; Guo, G, Zhang, D. [25]; Maeaba, W et al [26]; and soils 80m from the roadway were used as reference materials, Yen, J.Q et al [36] and Pagotto, C et al [5]. The level of metal pollution can be categorized into five categories Sutherland, R. A.

EF < 2 Deficiency to minimal enrichment;
2 < EF < 5 Moderate enrichment;
5 < EF < 20 Significant enrichment;
20 < EF < 40 Very high enrichment;
EF > 40 Extremely high enrichment;

**3.2 Geo-Accumulation Index (Igeo)**

Guo, G., Zhang, D. [25]; Hakanson, L. [31]. To quantify the degree of metal contamination of dust and road side soils, the geo-accumulation index (Igeo) Duong, T. T., Lee, B. K. [7] was calculated on the basis of:

$$\mathbf{Igéo} = \mathbf{log2}\frac{\mathbf{C_i}}{\mathbf{1.5B_n}}$$

Or:

Igeo: Geo-accumulation index;
log2: basic logarithm 2;
i: item considered;
C: concentration measured in the sample;
B: geochemical background;
1.5: is a factor used because of possible variations in background data due to lithological variations Gope, M. et al. [34]; Guo, G., Zhang, D. [25].

In addition, Gasser, T., Muller, H. G. [35] defined a scale of values with six classes based on the intensity of pollution. As shown below:

Igeo < 0uns contaminated.
0 < Igeo < 1untaminated to moderately contaminated.
1 < Igeo < 2moderately contaminated.
2 < Igeo < 3moderately to highly contaminated.
3 < Igeo < 4highly contaminated.
4 < Igeo < 5 heavily contaminated.
Igeo > 5 extremely contaminated.

**3.3 Statistical Analysis**

The results were analyzed statistically using SPSS ver 20 software to determine the different correlations that exist between the metals (Fe, Zn, Ni, Cu, Cr, Pb) studied, Pearson correlation matrixes were established for a confidence interval of 95 and the level of significance was set at P< 0.05.

**4. Results and Discussions**

In this study, the results show that heavy metals concentrations in road dust are higher than those found in soils, and that heavy metals in soils decrease in soils by moving away from the road axis Tables 1, 2 and 3. The distribution of heavy metals in road dust is in the order of Pb >Zn > Cu. > Cr > Ni, while in the soils (Batna to Biskra and Biskra to Batna direction) is the order of Pb > Cu > Zn > Cr > Ni. In the central solid earth, the distribution is in the order of Cu > Cr > Pb > Zn >Ni. The high levels of lead in the dust are due to the overuse of leaded gasoline in third world countries, notably Algeria. In addition, the concentrations of (Cu, Zn, Cr, Ni) are due to the use of spare parts, braking system pads (discs and brake pads) and the abrasion of tires whose counter-manner is very marked in the markets. For iron, there is a high surface and roadside content. Presumably there is a road-related contribution that is more or less masked by the high concentrations of this element in natural soils. It has also

been observed that the transport of dust through the various channels (hydraulic, wind, dry fallout) directly affects the quality and degree of soil pollution as shown in the Figures 2, 3 and 4.

**Table 1.** Concentration of heavy metals in the soil (Direction Batna to Biskra).

| *Elements* | *Cr* | *Fe* | *Zn* | *Ni* | *Pb* | *Cu* |
|---|---|---|---|---|---|---|
| TPC | 197.74 | 38958.42 | 110.87 | 99.81 | 171.74 | 197.96 |
| 1 m | 145.74 | 37699.44 | 210.49 | 90.38 | 262.72 | 234.23 |
| 5 m | 84.74 | 46722.13 | 122.92 | 82.52 | 208.88 | 77.37 |
| 10 m | 92.99 | 53926.29 | N.D | 17.02 | 91.91 | 28.71 |
| 20 m | 97.11 | 54555.78 | 51.53 | 12.95 | 41.78 | 12.17 |
| 40 m | 99.27 | 48820.43 | 47.3 | 18.16 | 29.15 | 6.35 |
| 80 m | 71.74 | 52597.37 | 43.04 | 8.59 | 9.75 | 2.09 |
| V max | 197.74 | 53926.29 | 210.49 | 99.81 | 262.72 | 234.23 |
| V min | 71.74 | 37699.44 | 43.03 | 8.59 | 9.75 | 2.09 |
| V med | 112.75 | 47611.4 | 97.69 | 47.06 | 116.56 | 79.84 |
| Gap-type | 43,96 | 6932,24 | 69,97 | 41,43 | 98,47 | 96,99 |

**Table 2.** Concentration of heavy metals in the soil (Direction Biskra to Batna).

| *Elements* | *Cr* | *Fe* | *Zn* | *Ni* | *Pb* | *Cu* |
|---|---|---|---|---|---|---|
| 1 m | 154.48 | 41896.04 | 164.7 | 99.81 | 253.44 | 237.39 |
| 5 m | 93.16 | 51758.05 | 118.1 | 98.23 | 248.79 | 78.32 |
| 10 m | 92.11 | 54206.06 | 66.86 | 69.24 | 160.6 | 31.51 |
| 20 m | 91.58 | 52177.72 | 59.63 | 19.16 | 90.05 | 18.48 |
| 40 m | 86.99 | 52107.76 | 40.23 | 16.23 | 72.41 | 9.09 |
| 80 m | N.D | 54415.89 | 48.07 | N.D | 11.42 | 4.84 |
| V max | 154.48 | 54415.89 | 164.7 | 99.81 | 253.44 | 237.39 |
| V min | 86.99 | 41896.04 | 48.07 | 16.23 | 11.42 | 4.84 |
| V med | 103.66 | 51093.5 | 82.931 | 60.53 | 139.45 | 63.27 |
| Gap-type | 32,91 | 4646,84 | 48,51 | 42,67 | 98,71 | 89,340 |

**Table 3.** Concentration of heavy metals in road dust (D, G, A).

| *Elements* | *Cr* | *Fe* | *Zn* | *Ni* | *Pb* | *Cu* |
|---|---|---|---|---|---|---|
| dust D | 215.53 | 34062.39 | 316.54 | 103.74 | 368.65 | 276.82 |
| Dust G | 214.16 | 26928.17 | 156.67 | 101.38 | 380.62 | 269.72 |
| dust R | 212.11 | 25319.48 | 261.91 | 99.81 | 309.13 | 272.88 |
| V max | 215.53 | 34062.39 | 316.54 | 103.74 | 380.62 | 276.82 |
| V min | 212.11 | 25319.48 | 156.67 | 99.81 | 309.13 | 269.72 |
| V med | 213.93 | 28770.0 | 245.04 | 101.64 | 352.8 | 273.14 |
| Gap- | 1,72 | 4653,38 | 81,26 | 1,98 | 38,28 | 3,55 |

Note:
D: in the direction Batna to Biskra.G: in the direction Biskra to Batna.A: in the roundabout.

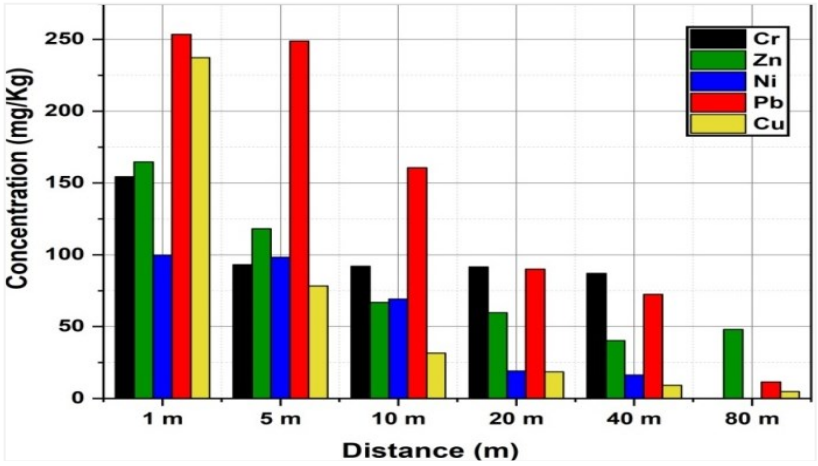


**Figure 3.** Concentration of heavy metals in the soil (direction Batna to Biskra).

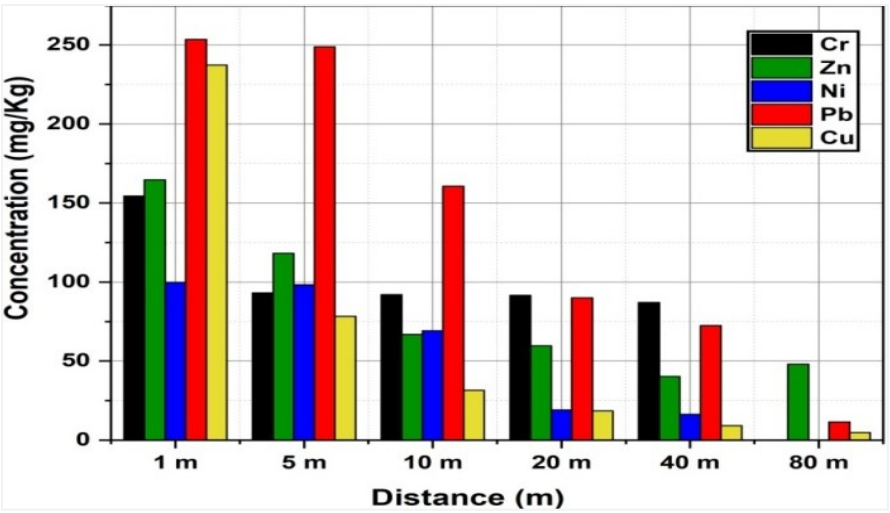


**Figure 4.** Concentration of heavy metals in the soil (direction Biskra to Batna).

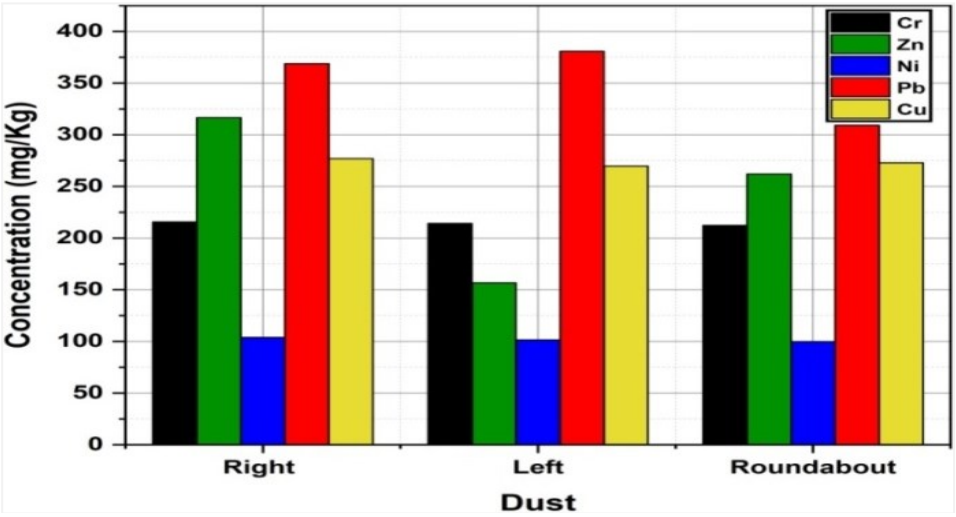


**Figure 5.** Concentration of heavy metals in road dust (D, G, A).

**4.1 Enrichment Factor (EF)**

These results suggest that for road dust: Cu is extremely enriched; Pb has very high enrichment and Zn, Ni and Cr have moderate to significant enrichment, while for soils (in both directions Batna-Biskra, Biskra-Batna and in the TPC): the Pb has a very high enrichment for distances (1m.5m) and significant to moderate for distances (10m, 20m, 40m) and minimum at 80m; for the Enrichment Cu and extremely high in (TPC, 1m, 5m) and significant to moderate to (10m, 20m, 40m) and minimal at 80m; for the neither enrichment and significant in (TPC, 1m, 5m, 10m) and moderate from ( 20m, 40m) and minimal to 80m. All elements have an FE that ranges from (moderate to strong) to (extremely contaminated), reflecting the high anthropogenic load of these metals in the study area. However, differences can be attributed to the different approaches used in methods of calculating enrichment factors.

**Table 4.** Enrichment Factor Values (EF) in the soil (direction to Biskra).

| *Distance* | *FE (Pb)* | *FE (Cr)* | *FE (Zn)* | *FE (Ni)* | *FE (Cu)* | *FE (Fe)* |
|---|---|---|---|---|---|---|
| TPC | 17.62 | 2.76 | 2.57 | 11.62 | 94.91 | 0.74 |
| 1 m | 26.95 | 2.03 | 4.89 | 10.53 | 112.30 | 0.72 |
| 5 m | 21.43 | 1.19 | 2.86 | 9.61 | 37.09 | 0.89 |
| 10 m | 9.43 | 1.29 | N.D | 1.98 | 13.76 | 1.02 |
| 20 m | 4.3 | 1.35 | 1.19 | 1.51 | 5.83 | 1.04 |
| 40 m | 2.99 | 1.38 | 1.1 | 2.11 | 3.04 | 0.93 |
| 80 m | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 5.** Enrichment Factor Values (EF) in the soil (direction to Batna).

| *Distance* | *FE (Pb)* | *FE (Cr)* | *FE (Zn)* | *FE (Ni)* | *FE (Cu)* | *FE (Fer)* |
|---|---|---|---|---|---|---|
| 1 m | 22.2 | 2.93 | 3.43 | 14.23 | 49.11 | 0.77 |
| 5 m | 21.79 | 1.77 | 2.46 | 14.00 | 16.20 | 0.95 |
| 10 m | 14.07 | 1.75 | 1.39 | 9.87 | 6.52 | 0.99 |
| 20 m | 7.9 | 1.74 | 1.24 | 2.73 | 3.82 | 0.96 |
| 40 m | 6.34 | 1.65 | 0.83 | 2.313 | 1.88 | 0.96 |
| 80 m | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 6.** Enrichment Factor Values (EF) in Road Dust.

| *Elements* | *FE (Pb)* | *FE (Cr)* | *FE (Zn)* | *FE (Ni)* | *FE (Cu)* | *FE (Fe)* |
|---|---|---|---|---|---|---|
| Dust D | 37.82 | 4.09 | 7.36 | 14.79 | 132.72 | 0.62 |
| Dust G | 39.05 | 4.06 | 3.64 | 14.45 | 129.31 | 0.49 |
| Dust R | 31.71 | 4.02 | 6.08 | 14.23 | 130.83 | 0.46 |

Note:
D: in the direction Batna to Biskra; G: in the direction Biskra towards Batna.

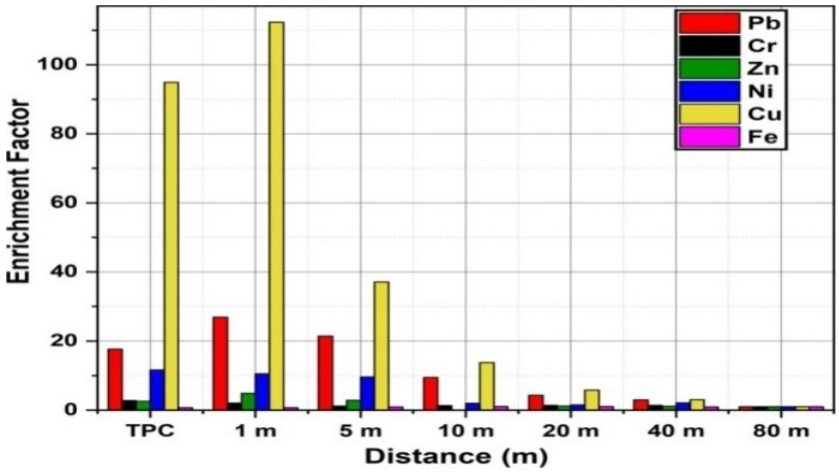


**Figure 6.** Enrichment factors (EF) in the soil (Direction to Biskra).

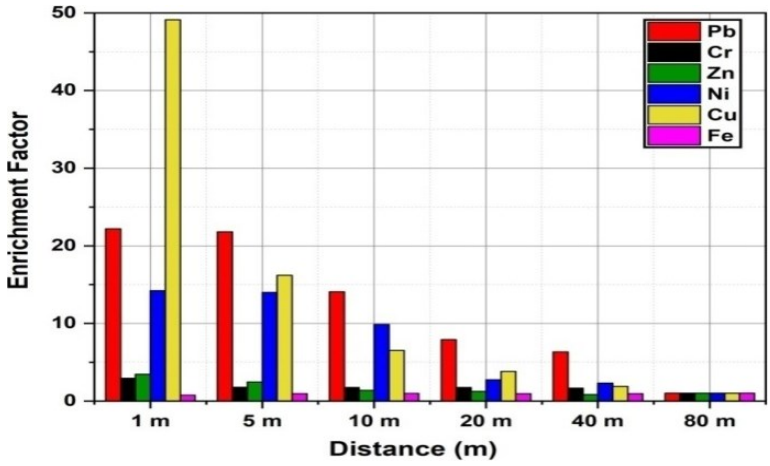


**Figure 7.** Enrichment factors (EF) in the soil (Direction to Batna).

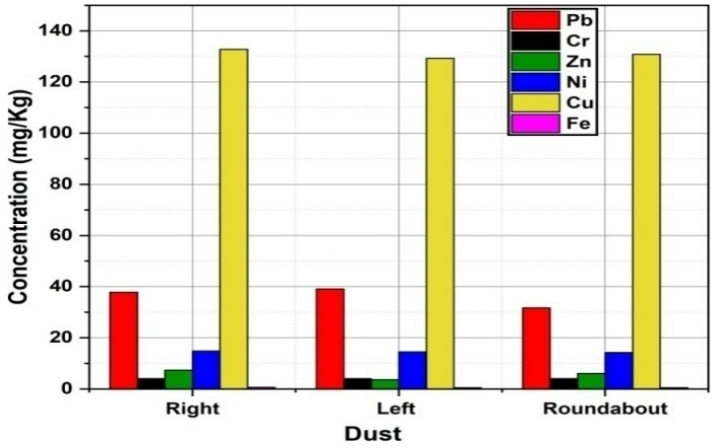


**Figure 8.** Enrichment factors (EF) in road dust.

**4.2 Geo-Accumulation Index (Igeo)**

The values of the calculated geo-accumulation indices (Igeo) are presented in the tables 9; 10; and 11 The results of the index (Igeo) in road dust show different levels of contamination depending on the element:

For Pb and Cu, Igeo ranges from (high to extremely contaminated) to (extremely contaminated); for Cr and Zn, Igeo varies between (moderately contaminated) to (moderately contaminated to highly contaminated), and for Ni Igéo is highly contaminated. The results of the index (Igeo) in soils (Batna-Biskra direction, Biskra-Batna, TPC) indicate different levels of contamination, depending on the element and distance: For Pb and Cu, Igeo in (TPC, 1m, 5m) varies between (highly contaminated) to (highly contaminated) and for distances of 10m, 20m, 40m to (moderately to highly contaminated) and at 80m the Igeo varies between (untaminated) to (not to moderately contaminated). For Cr and Zn, Igéo varies from (untaminated) to (not moderately contaminated) to (moderately contaminated) in all points. For the Ni, the Igeo for (TPC, 1m, 5m, 10m) varies between (moderately to highly contaminated) to (highly contaminated) and for distances (20m, 40m, 80m) varies from (untaminated) to (not to moderately contaminated).

**Table 7.** Values of geo-accumulation indices (Igeo) in the soil (Direction to Biskra).

| *Distance* | *FE (Pb)* | *FE (Cr)* | *FE (Zn)* | *FE (Ni)* | *FE (Cu)* | *FE (Fe)* |
|---|---|---|---|---|---|---|
| TPC | 17.62 | 2.76 | 2.57 | 11.62 | 94.91 | 0.74 |
| 1 m | 26.95 | 2.03 | 4.89 | 10.53 | 112.30 | 0.72 |
| 5 m | 21.43 | 1.19 | 2.86 | 9.61 | 37.09 | 0.89 |
| 10 m | 9.43 | 1.29 | N.D | 1.98 | 13.76 | 1.02 |
| 20 m | 4.3 | 1.35 | 1.19 | 1.51 | 5.83 | 1.04 |
| 40 m | 2.99 | 1.38 | 1.1 | 2.11 | 3.04 | 0.93 |
| 80 m | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 8.** Values of geo-accumulation indices (Igeo) in the soil (Direction to Batna).

| *Distance* | *FE (Pb)* | *FE (Cr)* | *FE (Zn)* | *FE (Ni)* | *FE (Cu)* | *FE (Fer)* |
|---|---|---|---|---|---|---|
| 1 m | 22.2 | 2.93 | 3.43 | 14.23 | 49.11 | 0.77 |
| 5 m | 21.79 | 1.77 | 2.46 | 14.00 | 16.20 | 0.95 |
| 10 m | 14.07 | 1.75 | 1.39 | 9.87 | 6.52 | 0.99 |
| 20 m | 7.9 | 1.74 | 1.24 | 2.73 | 3.82 | 0.96 |
| 40 m | 6.34 | 1.65 | 0.83 | 2.313 | 1.88 | 0.96 |
| 80 m | 1 | 1 | 1 | 1 | 1 | 1 |

**Table 9.** Values of geo-accumulation indices (Igeo) in Road Dust.

| *Elements* | *FE (Pb)* | *FE (Cr)* | *FE (Zn)* | *FE (Ni)* | *FE (Cu)* | *FE (Fe)* |
|---|---|---|---|---|---|---|
| Dust D | 37.82 | 4.09 | 7.36 | 14.79 | 132.72 | 0.62 |
| Dust G | 39.05 | 4.06 | 3.64 | 14.45 | 129.31 | 0.49 |
| Dust R | 31.71 | 4.02 | 6.08 | 14.23 | 130.83 | 0.46 |

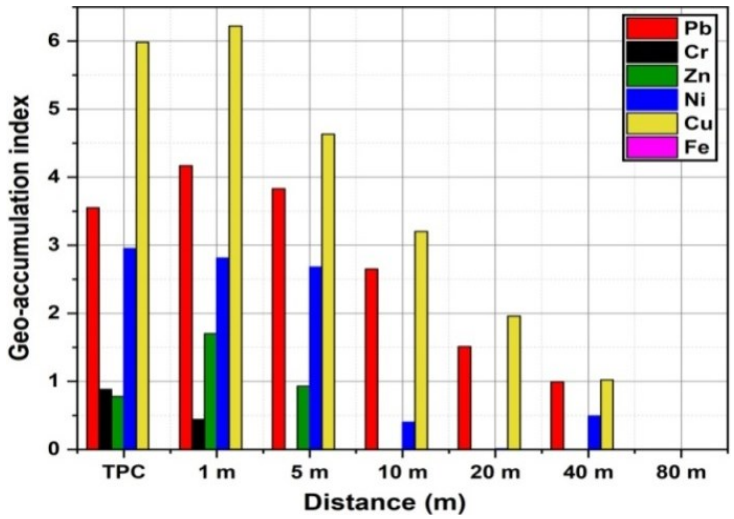


**Figure 9.** Geo-accumulation indices (Igeo) in the soil (Direction to Biskra).

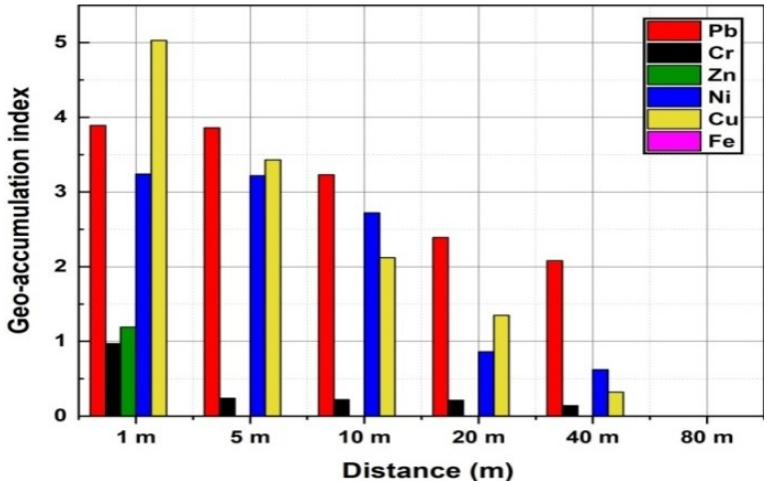


**Figure 10.** Geo-accumulation indices (Igeo) in the soil (Direction to Biskra).

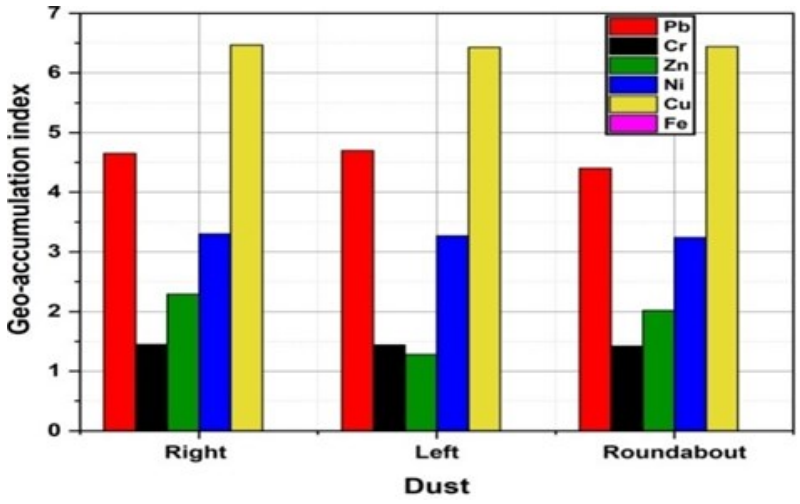


**Figure 11.** Geo-accumulation indices (Igeo) in in road dust.

**4.3 Correlations Between Heavy Metals**

Tables 10, 11 show Pearson's correlation matrixes between the heavy metals studied in soil samples. Analysis of these matrixes shows very significant and positive correlations ($P < 0.05$) between Ni/Pb, Pb/Ni and Ni/Cu, Cu/Ni; and negative correlations between Fe/Ni, Ni/Fe and Fe/Cu, Cu/Fe, and significant and positive correlations between Zn/Ni, Ni/Zn, Zn/Pb, Pb/Zn, Zn/Cu, Cu/Zn Cu/Pb, Pb/Cu, Cu/Cr/Cu, and negative between Cr/Fe, Fe/Cr,

Fe/Zn, Zn/Fe Pb/Fe, in the ground (Batna to Biskra) and in the opposite direction (Biskra to Batna) very significant correlations were observed between Zn/Cu, Cu/Zn, Ni/Pb, Pb/Ni and negative between Cr/Fe, Fe/Cr Fe/Cu, Cu/Fe and positive significant correlations between Cu/Zn, Zn/Cu, Cr/Cu, Cu/Cr, Zn/Ni, Ni/Zn, Zn/Pb, Pb/Zn and negative between Zn/Fe and Fe/Zn. The high correlations noted suggest that these parameters are governed by the same mechanism. On the other hand, the positive and significant correlations between different heavy metals reflect a common source, while the significant and negative correlations between the heavy metals studied indicate different sources.

**Table 10.** Correlation matrix (Pearson) of the soil (Direction Batna to Biskra).

| *Corrélation de Pearson* | *Cr* | *Fe* | *Zn* | *Ni* | *Pb* | *Cu* |
|---|---|---|---|---|---|---|
| Cr | 1 | -0,816* | 0,526 | 0,733 | 0,544 | 0,839* |
| Fe | -0,816* | 1 | -0,868* | -0,912** | -0,811* | -0,947** |
| Zn | 0,526 | -0,868* | 1 | 0,836* | 0,862* | 0,859* |
| Ni | 0,733 | -0,912** | 0,836* | 1 | 0,917** | 0,904** |
| Pb | 0,544 | -0,811* | 0,862* | 0,917** | 1 | 0,871* |
| Cu | 0,839* | -0,947** | 0,859* | 0,904** | 0,871* | 1 |

**Table 11.** Correlation matrix (Pearson) of the soil (Direction Biskra to Batna).

| *Corrélation de Pearson* | *Cr* | *Fe* | *Zn* | *Ni* | *Pb* | *Cu* |
|---|---|---|---|---|---|---|
| Cr | 1 | -0,928** | 0,845* | 0,714 | 0,778 | 0,917* |
| Fe | -0,928** | 1 | -0,855* | -0,582 | -0,635 | -0,958** |
| Zn | 0,845* | -0,855* | 1 | 0,881* | 0,890* | 0,954** |
| Ni | 0,714 | -0,582 | 0,881* | 1 | 0,981** | 0,761 |
| Pb | 0,778 | -0,635 | 0,890* | 0,981** | 1 | 0,774 |
| Cu | 0,917* | -0,958** | 0,954** | 0,761 | 0,774 | 1 |

## 5. Conclusion

The objective of this study is to assess the level of heavy metal contamination of roadside soils exposed to road traffic on a major road (national road three RN03) located in the commune of Oued-Echaaba, wilaya de Batna. The results obtained show that all the heavy metals detected (Fe, Zn, Ni, Cu, Cr, Pb) have a close link with road traffic. All of these elements had some higher levels than the reference values. The general sequence of metal element levels in these soils is: Fe > Zn > Cr > Cu > Ni > Pb. High concentrations of heavy metals were found in soils near the road at distances of 1 to 5m and in central solid earth (TPC). These concentrations decrease exponentially as they move away from the highway. Although all elements have achieved moderate to extremely enriched enrichment for road dust, and minimal enrichment in soils at 80m distance, to extremely high in soils (TPC, 1m, 5m), the RESULTs of FE are confirmed by the results of Igeo whose contamination is varied between uncontaminated at a distance of 80m, to highly contaminated in (TPC, 1m, 5m). Contamination of these soils is, on the one hand, a risk of poisoning through the food chain for the populations that use them for their crops and on the other hand, a risk for contamination of groundwater. Thus, an easement must be taken care of whose concern to avoid such contamination.

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**Conflicts of Interest**

The authors declare no conflict of interest.

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# The Effect of Using Iron Slag as a Replacement for Fine Aggregates for Green Concrete Mixes

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**Abstract**
Green concrete is defined as a concrete which uses waste material as at least one of its components, or its production process does not lead to environmental destruction. The goal of sustainability is to maintain balance among economy, environment, and society, and to ensure that today's needs are met without compromising the needs of future generations. This research studies the possibilities of using iron slag as total or partial replacement of fine aggregates to make green concrete. Compressive, tensile and flexural strength tests were conducted in by adding iron slag as replacement of sand in green concrete mixes in various percentages (10%, 20%, 40%, 60% , 80% ,100 at 7, 28 and 56 days. The results showed that the optimum percentage of Iron slag replacement is 60%.
**Keywords:** Green Concrete; Sustainability; Iron Slag; Flexural Strength; Compressive Strength.

## 1. Introduction

Recycling or reuse of industrial by-products and wastes is economically and/or ecologically very important. The use of different waste materials shows prospective application in construction industry as an alternative to conventional materials. Blast furnace slag is a non-metallic material consisting of silicates and aluminosilicates of calcium and magnesium together with other compounds of sulphur, iron, manganese and other trace elements. Air-cooled slag, which is allowed to solidify slowly in ladles or pits, is by far the most abundant and is a rock-like material which is almost wholly crystalline. Many researchers concluded that using iron slag as a replacement for fine aggregates for green concrete mixes could be effective. It was observed an increase in strength than normal concrete at all curing periods of 3 days, 7 days, 14 days, 28 days and 56 days was observed.

It is well known that the extraction of Steel from iron ore by quenching and smelting process results in 35 to 40% of slag as a by-product which is cost effective and eco-friendly (Karanji D. (2018)).

**Nataraj et al,** (2015) replaced river sand by slag sand at various replacements of 0%, 25%, 50%, 75% and 100% in the production of mortar of 1:3 proportions for various water cement ratio of 0.4%, 0.5% and 0.6%.

They found that the higher strength than control concrete is achieved at 70% of replacement of river sand by slag sand beyond which a reduction in strength is observed.

**Rafat Siddique, et.al**, (2016) The environment problems are very common in India due to generation of industrial by-products. Due to industrialization enormous by-products are produced and to utilize these by-products is the main challenge faced in India. Iron slag is one of the industrial by-product from the iron and steel making industries. In this paper, the compressive strength of the iron slag concrete was studied. The results confirm that the use of iron slag overcome the pollution problems in the environment. The results shows that the iron slag added to the concrete had greater strength than the plain concrete.

**Ramesh et al.** (2013) in this investigation entitled use of furnace slag (FS) and welding slag (WS) as a replacement of fine aggregates in concrete. The aim of this study is to examine the behaviour of the WSA in HPC. For mixtures containing WS, the 7 d compressive strength of concrete cubes increased from 10 to 15% and 28 d compressive strength increased from 5 to 15%. It was concluded that 5% of WS and 10% FS replacement with fine aggregates is effective for practical purpose.

## 2. Material

Various materials were used in the present experimental program; natural fine aggregates (NFA), coarse aggregates, cement, crushed bricks (CB), and crushed recycled concrete.

***Cement:*** ASTM Type I normal Portland cement was used with a specific gravity of 3.16 and a specific surface area (Blaine fineness) of 374 $m^2$/kg.

***Natural Fine Aggregates:*** Natural siliceous river sand (NS) with a fineness modulus of 2.7, a saturated surface dry specific gravity of 2.6 and absorption of 2.0 percent.

***Coarse Aggregates:*** Crushed dolomite (CD) with specific gravity of 2.7 and absorption of 1.8% was incorporated in the concrete mixtures.

***Iron Slag:*** The iron slag is a waste/by-product which remains after iron ore smelting process. When the blast furnace is operating at a temperature more than 15000C, the molten slag is obtained from the bottom of the furnace, which is later cooled by a jet of water and quenched. As the ore materials are heated above 15000C, at this temperature the slag constituents become inert. So, there will be no reactive silica or alkali in the granular iron slag. The Fineness of Slag is 3.83, density is 1595(kg/m3), water absorption % is 0.95, and Specific gravity is 2.66. Table 1 shows the chemical composition of Iron Slag and Table 2 shows its physical properties.

**Table 1:** Chemical Composition of Iron Slag

| Particulars | Proportions |
|---|---|
| SiO2 | 28.23% |
| $Al_2O_3$ | 3.25% |
| $Fe_2O_3$ | 62.45% |
| MnO | 1.13% |
| MgO | 1.83% |
| $P_2O_5$ | 1.45% |
| $SO_3$ | 0.89% |

**Table 2:** Physical Properties of Iron Slag

| Particulars | Proportions |
|---|---|
| Fineness | 3.83 |
| Density (Kg/$m^3$) | 1595 |
| Water absorption % | 0.95% |
| Specific Gravity | 2.66 |



**Figure 1.** Patches of iron slag for mixing

The physical properties tests of the aggregates were conducted according to ASTM standards and their results are shown in Table 1.

**Table 3:** Physical properties of aggregates

| Properties | | Volume Weight ($t/m^3$) | Specific Gravity | Void Ratio % | % Absorption | Fineness modulus |
|---|---|---|---|---|---|---|
| **Fine aggregate** | **NS** | 1.73 | 2.6 | 33.46 | 2 | 2.7 |
| **Coarse aggregate** | **CD** | 1.6 | 2.7 | 40.6 | 1.8 | 6.2 |

***Water:*** ordinary tap water was used in the present research.

## 3. Methods

### 3.1 Mix Design and Preparation

The mix design was done in accordance with ACI standards using the absolute volume method. The W/C ratio was kept constant at 0.45 for all mixes. Seven concrete mixes were used in the current research The replacement ratios of 0% (control mix) ,10%, 20%, and 40%, 60%, 80 %, and 100% by weight of either fine aggregate were used. Table 4 shows the details of the mix for each of the seven mixes.

**Table 4:** Composition of the concrete mixes / $M^3$

| Mix Designation | NS Kg/$M^3$ | CD Kg/$M^3$ | Cement Kg/$M^3$ | W/C Ratio | Water Kg/$M^3$ | Iron Slag Kg/M3 |
|---|---|---|---|---|---|---|
| ($M_c$) | 624 | 1248 | 400 | 0.45 | 180 | 0 |
| M (10% ) | 561.5 | 1248 | 400 | 0.45 | 180 | 62.5 |
| M (20%) | 499 | 1248 | 400 | 0.45 | 180 | 125 |
| M(40% ) | 374 | 1248 | 400 | 0.45 | 180 | 250 |
| M (60%) | 249 | 1248 | 400 | 0.45 | 180 | 375 |
| M (80%) | 124 | 1248 | 400 | 0.45 | 180 | 500 |
| M (100%) | 0 | 1248 | 400 | 0.45 | 180 | 624 |

### 3.2 Experimental Program

Th experimental program of the present research consisted of testing Eight concrete mixes with different percentages of replacement materials namely: 0% (control mix), 10%, 50%, and 100%. A total of 168 specimens were cast and tested for compressive, splitting tensile as well as, flexural strength.

### 3.3 Test Specimens

Cubes of dimensions 100 mm were used to determine the compressive strength, cylinders of dimensions 100 x 200 mm were used to determine indirect tensile strength (splitting test), and beams of dimensions 100x100 x500 mm were used to determine the flexural strength. The concrete mechanical properties were determined at 7, 28, ad 56 days after cast of the test specimens. Figure 1. Shows the test specimen during casting.

The specimens were de-molded 24 hours after the casting, and then were cured in water for 7, 28 or 56 days till the time of testing. Three samples were cast for every single test parameter and the average of obtained test results has been recorded. A total of 147 test specimens were casted and tested in the present research. Figure 1. Shows the test specimen during casting.



**Figure 2.** Shapes of test molds: cubes, cylinders, and beams.

## 4. Results and Discussion

### 4.1 Compressive Strength Tests Results

The standard cubic specimens were tested at the ages of 7-day and 28-day, three replicates of each specimen configuration were tested to obtain more reliable results based on the average of three results.

For the cubes where fine aggregate is replaced with a percentage of iron slag, the results of compressive strength of concrete cubes after 7, 28 and 56 days summarized in Table 11 and Figure 36.

**Table 5.** Results of compressive strength of concrete cubes after 7 days and 28 days

| Iron Slag % | 7 Days | 28 Days | 56 Days |
|---|---|---|---|
| | Average Compressive Strength (N/mm²) | Average Compressive Strength (N/mm²) | Average Compressive Strength (N/mm²) |
| 0 | 31 | 25 | 42 |
| 10% | 20.5 | 20 | 23.50 |
| 20% | 27 | 22.50 | 33 |
| 40% | 13.50 | 18 | 29.50 |
| 60% | 21 | 30.50 | 38 |
| 80% | 19 | 16.50 | 37 |
| 100% | 8.50 | 23.50 | 30 |

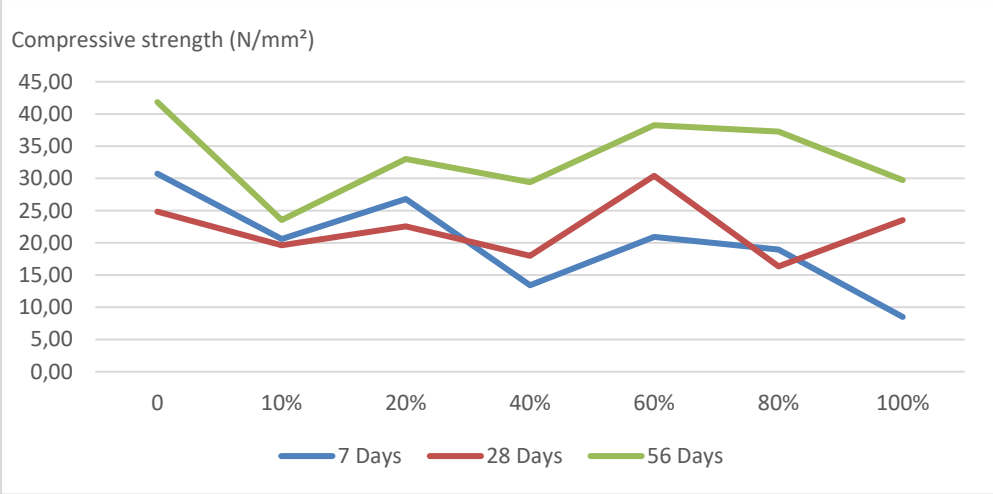


**Figure 3.**1 Results of compressive strength of concrete cubes after 7, 28 and 56 days.

It is observed that when fine aggregate is replaced by 20% with iron slag, the compressive strength at 7 days is found to be the highest on average. However, it is evident that overall highest strength is at 56 days with 60% of fine aggregate replaced with iron slag.

**4.2 Splitting tensile strength test results**

The splitting tension test was carried out on cylindrical specimens to get a bit of information about the effect of iron slag on the tensile strength of concrete in order to check whether it will improve its resistance to tension forces or not. The results of splitting tensile strength of concrete cylinders after 7 ,28 and 56 days summarized in Table 12 and Figure 37.

**Table 6.** Results of splitting tensile strength of concrete cylinders after 7, 28 and 56 days.

| Iron Slag % | 7 Days | 28 Days | 56 Days |
|---|---|---|---|
| | Average Splitting Tensile Strength (N/mm²) | Average Splitting Tensile Strength (N/mm²) | Average Splitting Tensile Strength (N/mm²) |
| **0** | | 30 | 39 |
| **10%** | 23.5 | 20 | 38 |
| **20%** | 20 | 26.50 | 30 |
| **40%** | 19 | 29 | 31 |
| **60%** | 19 | 25.50 | 40.50 |
| **80%** | 14 | 32 | 33 |
| **100%** | 15 | 41.50 | 33 |

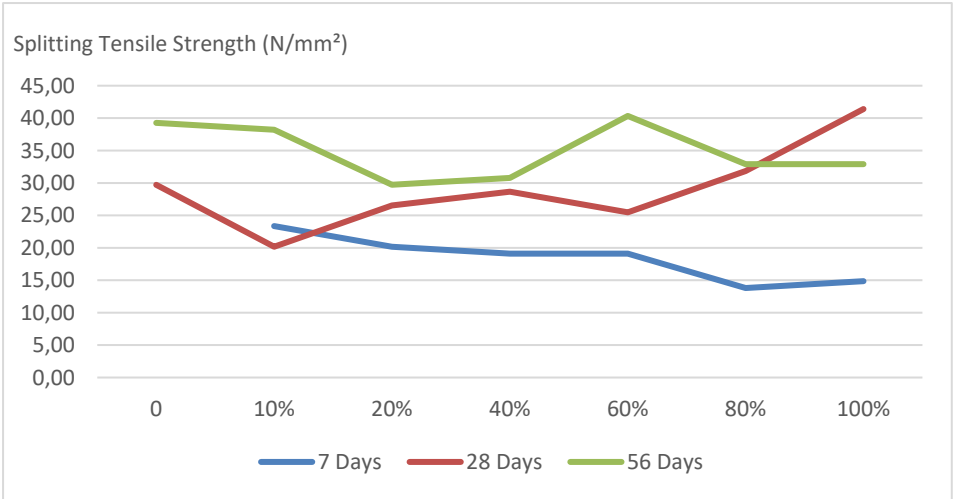


**Figure 4.** Results of splitting tensile strength of concrete cylinders after 7, 28 and 56 days

It was observed that when fine aggregate is replaced by 60% iron slag, the tensile splitting strength at 56 days is found to be the greatest and that any further replacement would, on average, reduce the tensile splitting strength at both 7 and 28 days.

### 4.3 Flexural strength test results

For the flexure test, the specimens used were prisms with dimensions of 100*100*500 mm in accordance with the code specifications. Table 13 shows the results obtained from flexure test. While figure 38 shows a comparison for the average values of flexural strength of specimens with different percentages of brick-fine aggregate replacements.

**Table 7.** Results of flexural strength of concrete Prisms after 28 and 56 days

| Iron Slag % | 28 Days | | 56 Days | |
|---|---|---|---|---|
| | Average load (KN) | Flexural Strength (N/mm²) | Average load (KN) | Flexural Strength (N/mm²) |
| **0%** | 17 | 13 | 20 | 15 |
| **10%** | 14 | 11 | 17 | 12.5 |
| **20%** | 16 | 12 | 18 | 13.5 |
| **40%** | 15 | 11.5 | 15.5 | 11.5 |
| **60%** | 17.5 | 13 | 19 | 14 |
| **80%** | 20 | 15 | 22 | 16.5 |
| **100%** | 19.5 | 14.5 | 19 | 14.5 |

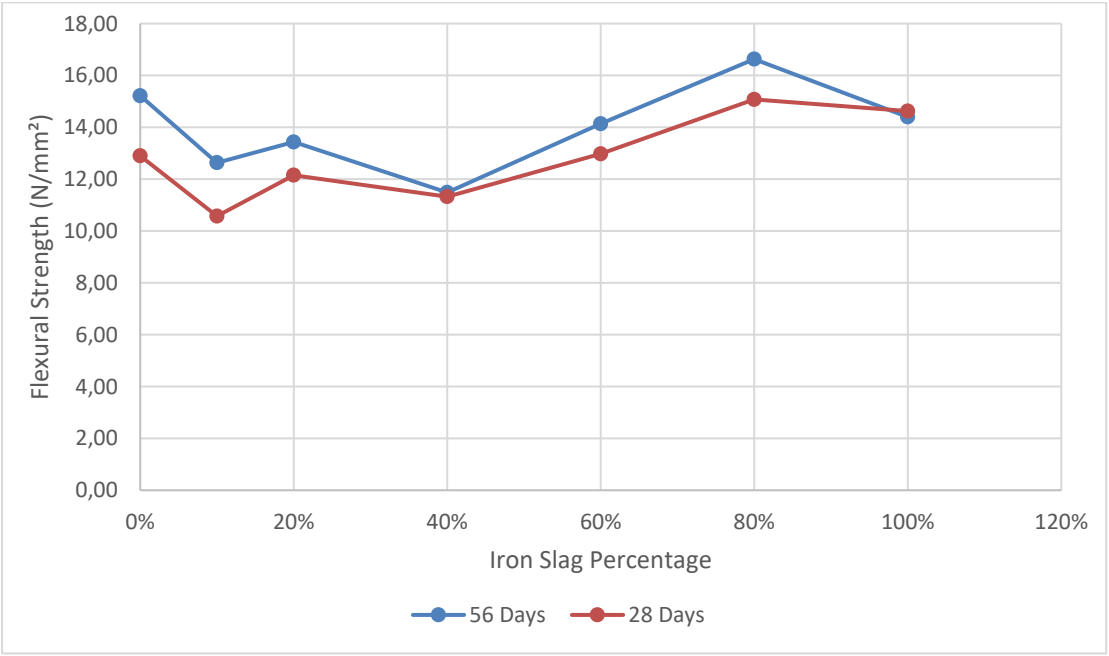


**Figure 5.** Results of flexural strength of concrete Prisms after 28 and 56 days.

### 5. Conclusions

The possibility of using wastes such as iron slag as a partial replacement for fine aggregates in green concrete mixes was investigated. The research consisted of testing concrete mixes with different iron slag percentages as partial replacement of fine aggregates. The replacement ratios used were 10%, 20%, 40%, 60%, 80% and 100%. The specimens were tested into three different types of tests, compression test, split tension test and flexure test. Based on the results of the current research the following conclusions could be drawn:

- Wastes such as iron slag can be used as a partial replacement of fine and coarse aggregates in concrete as there was an overall improvement in compressive, tensile and flexural strengths.

- There is an optimum percentage of replacement that gives the highest effect when substituting fine aggregate with iron slag which was found to be 60 % in concrete.
- At this optimum ratio (60% replacement ratio of fine aggregate with iron slag) the percentage increase in compressive strength was 23% and the percentage increase in indirect tensile strength was 28%.

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**Conflict of Interests**
The author declares no conflict of interest.

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# The Effect of Latex on The Characteristics of Asphalt Concrete Wearing Course

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**Abstract**
The Laston has a high degree of flexibility, located above the surface layer, this layer is susceptible to damage due to high temperatures, more. Asphalt as a pavement if spread will experience hardening, so that additional materials are added to make it flexible. The AC-WC mixture uses 60/70 penetration asphalt with the addition of latex. The purpose of knowing the characteristics of the marshall AC-WC mixture at the optimum asphalt content. The addition of latex 3%, 5%, 9% of the total volume of asphalt. The process is through heating asphalt and then adding latex, the proportion of aggregate is based on the ideal mixture gradation. Samples were made on hot mixture by Marshall test method. The results showed that the selected AC-WC mixture with a latex variation of 3% of the total, all asphalt properties were met. Stability 3201.1, Flow 2.4, MQ 1679,339kg, VIM 5% VMA 17.799%, VFA 74.426%.
**Keywords:** Latex Addtives, Asphalt, Marshall test.

## 1. Introduction

The flexible pavement the more used in Indonesia is asphalt concrete (laston). Laston has a high degree of flexibility so that it is located on the surface layer. This coating is susceptible to damage due to high temperatures and heavy traffic loads. The problem of AC-WC pavement as a flexible pavement layer, where asphalt works as an aggregate binder. The use of asphalt on AC-WC flexible pavement is very sensitive, if there is too much asphalt content there will be bleeding damage and if the asphalt content is too little then AC-WC flexible pavement will experience cracking damage.

Several cases that occur in road construction often experience damage before the service period ends. One of the efforts that can be done to improve service is to improve the quality of asphalt as a binder by using added materials. One of these additives is latex.

Latex (liquid natural rubber) is a natural resource that is widely produced in Indonesia, because Indonesia is the largest rubber producer in the world, so it is easy to obtain..

Therefore, research was conducted by comparing conventional asphalt and asphalt with the addition of latex as a mixture of asphalt using the Marshall test method. Determination of latex content with a standard reference content of latex mixture to asphalt, which is a minimum of 2% and a maximum of 7 to determine whether a value below or above the standard can be used. The addition of latex additives in this study with variations in latex content of 3%, 5% and 9% of the total asphalt mixture. The purpose of this study was to determine the optimum percentage of conventional asphalt that will be used as a reference for asphalt mixtures with latex using a penetration asphalt content of 60/70 and to determine the effect of adding Latex on Asphalt Concrete – Field Wear (AC-WC) mixture with Marshall test components, namely Stability, Stream, VIM, VMA, VFA.

Highway pavement is a part of the highway that is paved with a certain layer of the construction, which has a certain thickness, strength, stiffness, and stability in order to be able to safely transmit the basic traffic load on it to the ground. The pavement layer is located between the subgrade layer and the wheels of the working vehicle providing services to transportation facilities and during this period it is hoped that no significant damage will occur. (Hardiyatmo H., 2017)

Asphalt is a material which at room temperature is solid to slightly dense and is thermoplastic. The amount of asphalt in the pavement mixture ranges from 4% - 10% by weight of the mixture or 10-15% by volume. (((Nisumanti,S et al.,2020); (syahputra et al., 2020); (Carlina et al., 2019)))

Aggregate is a support which is the main component of the road pavement structure, which contains 90% - 95% percentage of aggregate by weight, or 75% - 85% of aggregate by volume. Thus the quality of the road pavement is also determined by the nature of the aggregate and the results of mixing the aggregate with other materials. (Setiawan et al., 2017)

Latex is a newly tapped sap with a dry rubber content (KKK) of about 30%. This garden latex is generally very attractive. Processing garden latex into concentrated latex requires high costs. Concentrated latex is a processed natural latex product which is concentrated by centrifugation or boiling from dry rubber content (KKK) 28% - 30%

to dry rubber content (KKK) 60%. Usually, concentrated latex is used for the manufacture of thin and high-quality rubber materials.(Suaryana et al., 2019)

Marshall test is a mandatory test for asphalt concrete, to find out and know the properties of concrete as we expect. From the marshall test, it will be known what percentage of asphalt content is needed for the planned rock gradation, which will produce the optimal compressive strength (called marshall expressed in Kg) of the embedded asphalt concrete cylinder (test object). for one hour at 60°C (Soehartono, 2014; Intari et al., 2019; Zhang et al, 2019).

Marshall testing is a volumetric analysis and flows analysis, the properties of the asphalt mixture can be seen from the marshall test criteria, including: (Nisumanti., S et al., 2020)

Stability is the ability of the asphalt mixture to withstand deformation due to workloads without undergoing permanent deformation such as groove waves. (Karami, 2017)

The flow values are the respective values indicated by the dial needle (in mm) when performing the Marshall test.

Marshall Quotient (MQ) is the result of a comparison between the currents used as an indicator of the potential flexibility of the train.

The voids filled with asphalt (VFB) is the volume between the aggregate particles filled with asphalt in the solid mixture, expressed in (%) to the total volume of the mixture.

The voids between mineral aggregates (VMA) are the empty spaces between the aggregate particles on the pavement, including air voids and the effective volume of asphalt (excluding the volume of asphalt that absorbs the aggregate).

The voids in the mixture (Va) or VIM in the asphalt pavement mixture consist of air spaces between the asphalt-covered aggregate particles. (Mochtar et al, 2019).

## 2. Material and Methods

### 2.1. Research Site

The research was conducted at the Laboratory of the Provincial Public Works Office of Bina Marga, South Sumatra Province.

### 2.2. Material

The materials used in this research are asphalt with pen 60/70 from PT. Bintang Selatan Agung, coarse aggregate in the form of split stone ½ and screen 1/1, fine aggregate from Lubuk Linggau South Sumatra, Latex From Kifazu Furniture Palembang, Filler from Semen Baturaja. The material Shows in figure 1.




**Figure 1**.Materials

**2.3. Design Mix Formulas**

The calculation of the design asphalt content in the Asphalt Concrete – Wearing Course using the Bina Marga method, then the design asphalt content is obtained, then the estimated asphalt content value is calculated to be used in determining the optimum asphalt content.

**2.4. Research Procedures**

The methodology of research is show in Figure 2

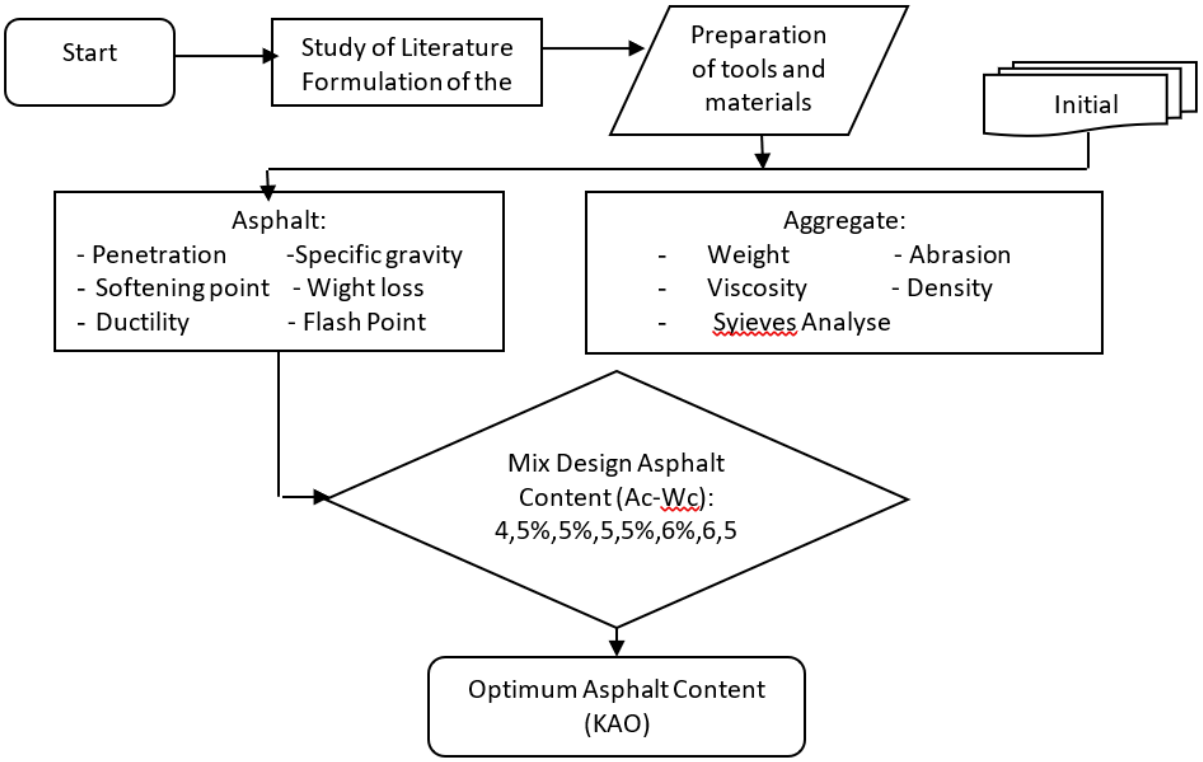


**Figure 2**. Research Procedures

Testing the physical properties of the material based on the specifications is then made a mixed design for each test object and Marshall testing is carried out in the following stages ((Direktorat Jenderal Bina Marga, 2015; Kementerian PU., 2020))

a. Aggregate test
   Sieve analysis of fine and coarse aggregates (SNI, 1968), Los Angeles machines are used to test for abrasion of aggregates, scales are used to test the specific gravity of aggregates, ovens are used to remove moisture in aggregates and pycnometers are used to determine specific gravity of aggregates and asphalt.(SNI 4804;2441;6893;2417;1969)
b. Asphalt test
   Asphalt testing is carried out to determine whether it is feasible or not when mixing.
   Penetration Testing, Flash Point and Burn Point Testing Softening point testing, ductility testing, Asphalt specific gravity testing. (SNI 2433;2439);(AASHTO T 245, 2015)
c. Make samples
   The making samples are used for conventional asphalt with asphalt content of 4.5%, 5.0%, 5.5%, 6.0%, and 6.5% to be used as a reference in latex mixtures. While the latex mixture with variations of 3%, 5%, and 9% with the optimum asphalt content (KAO) is 6%.
d. Marshall test
   Marshall test results obtained Marshall characteristic values, namely Stability, Flow, Void in Mix (VIM), Void in Mineral Aggregate (VMA), and Void Filled Asphalt (VFA). Marshall test shown in Figure 3



**Figure 3**. Testing Stage

## 3. Results and Discussion

### 3.1 Aggregate Characteristic Test

This test includes coarse aggregate, fine aggregate and filler whose results meet the characteristics of the specifications shown in the table. 1

**Table 1**. Results of Aggregate Characteristics

| Characteristic | requirement | coarse aggregate | | SNI | fine aggregate | | SNI | Filler | SNI |
|---|---|---|---|---|---|---|---|---|---|
| | | Split | Screen | | Dust | Sand | | | |
| Bulk Density | | 2,45 | 2,53 | 1969:2008) | 2,51 | 2,51 | 1970:2008 | | |
| SSD Density | | 2,58 | 2,57 | | 2,60 | 2,58 | | | |
| Specific gravity | Min 2,5 | 2,41 | 2,65 | | 2,70 | 2,69 | | | |
| Absorption % | Maks 3% | 1,44 | 1,9 | | 2,71 | 2,64 | | | |
| Abrasion Los Angeles | Maks 40% | 21,08 | - | 2417:2008 | - | - | | | |
| Aggregate adhesiveness to bitumen | Maks 95% | 95 | 95 | 2439:2011 | - | - | | | |
| Syieve analys No. 200 | | | | | | | | 100 | 1969: 2008 |
| Free from organic ingredients | | | | | | | | 3,15 | |

Table 1 shows that coarse aggregate, and fine aggregate can be used for mixed material for the test specimens because they meet the requirements of the 2010 revision of the 3rd Highways specification.

### 3.2. Characteristics of Conventional Asphalt

The asphalt used for the mixture of test objects is asphalt penetration 60/70. The results of testing the characteristics of conventional asphalt can be seen in table 2

**Table 2.** Asphalt Characteristics

| Asphalt Characteristics | Standard Test | requirement | Result |
|---|---|---|---|
| Specific gravity ($25^{\circ}C$) | SNI 2441-2011 | Min 1 | 1,032 |
| Penetration ($25^{\circ}C$, 100gr, 5 second) | SNI 06-2456-1991 | 60 - 70 | 66 |
| Softening point | SNI 2434-2011 | Min $48^{\circ}$C | $50^{\circ}$C |
| Flash point | SNI 2433-2011 | Min $232^{\circ}$C | $310^{\circ}$C |
| Burn point | SNI 2433-2011 | - | $315^{\circ}$C |
| Ductility at $25^{\circ}C$ | SNI 2432-2011 | ≥100 | 120 |

From table 3. Shows that the asphalt specific gravity, penetration, softening point, flash point, and burning point tests can be used as aggregate binders because they meet the requirements of the Revision 3 2010 Highway specification.

### 3.3. Mixed Composition with Envelope Gradient

The results of the calculation of the mixture composition using the envelope gradation method based on the Revision 3 Toll specification can be seen in Figure 4.

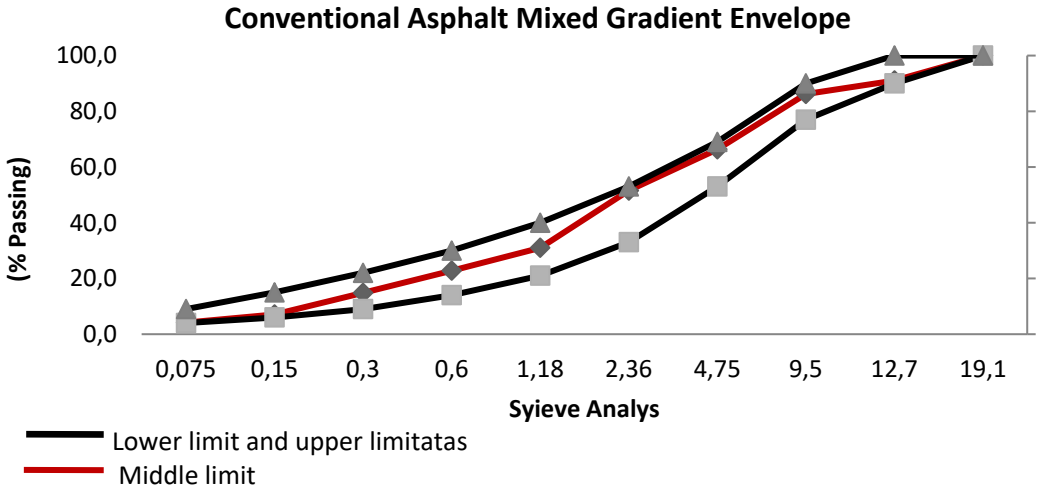


**Figure 4**. Gradition Mixed AC – WC

Figure 4 shows that the results of the mixture composition can be used for the manufacture of conventional asphalt specimens because the median gradation value of the mixture does not exceed or is not less than the lower and upper limits that have been set.

### 3.4. Conventional Marshall Test

Marshall test results obtained Stability, Flow, VIM, VMA, VFA, Density and Marshall Quotient (MQ) values. Marshall test results to determine the asphalt content of KAO. The KAO value is used in testing the characteristics of the AC-WC mixture with shown in table 3

**Table 3**. Conventional Marshall test Results

| Asphalt content | Density | VIM | VMA | VFA | Stability | Flow | Marshall |
|---|---|---|---|---|---|---|---|
| 4,5% | 2,276 | 6,645 | 16,561 | 59,927 | 1076,5 | 2,70 | 398,818 |
| 5,0% | 2,280 | 5,800 | 16,840 | 66,224 | 1127,2 | 2,86 | 394,426 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5,5% | 2,284 | 4,987 | 17,145 | 71,014 | 1166,5 | 3,05 | 382,852 |
| 6,0 % | 2,288 | 4,145 | 17,439 | 76,304 | 1341,6 | 3,19 | 421,269 |
| 6,5% | 2,282 | 3,729 | 18,093 | 79,482 | 1242,2 | 3,28 | 379,034 |

The results of the absolute density marshall test with the determination of the Optimum Asphalt Content are carried out with a bar chart, the Optimum Asphalt Content Value (KAO) is obtained from various types of variations in the planning of making test objects as shown in Figure 5.

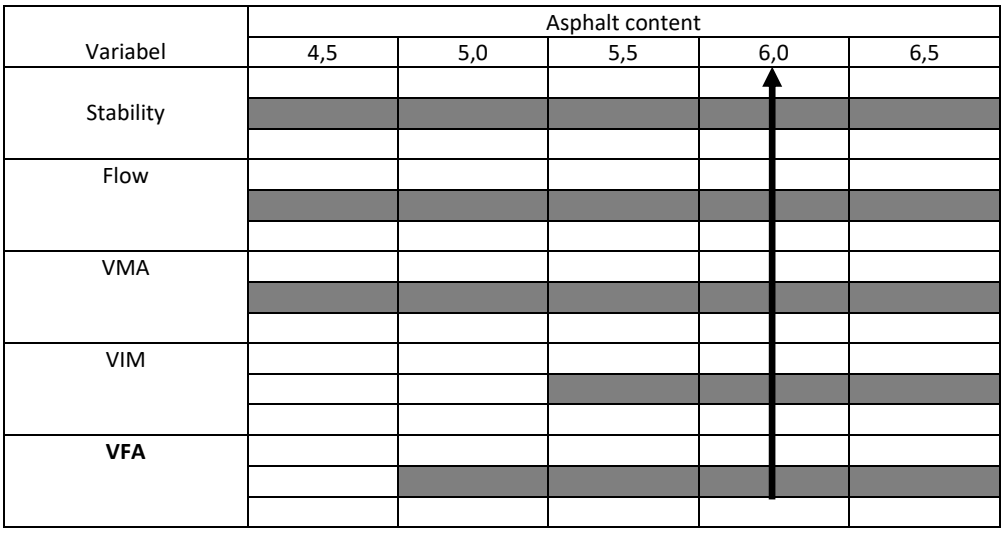


**Figure 5**. The optimum asphalt content value (K.A.O)

From figure 5. Shows the marshall parameters that meet the specifications are depicted in a bar graph to determine the optimum asphalt content limit.
The asphalt content value that meets the requirements of Laston AC-WC is located at the upper limit of 6.00%, the lower limit of 6.5% so that the optimum asphalt content value (K.A.O) of 6% is obtained which is used for asphalt AC-WC mixture

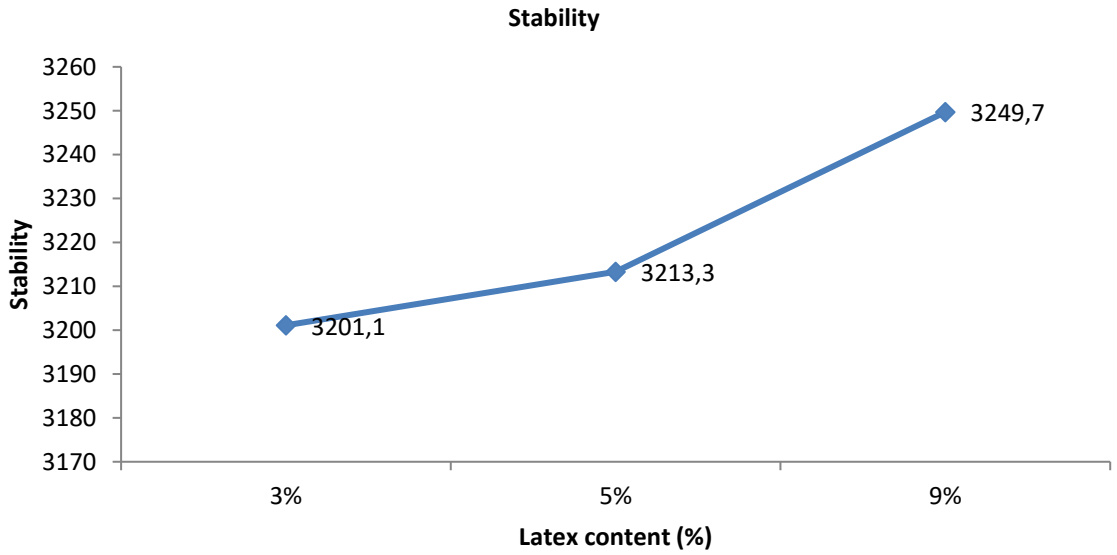


**Figure 6.** Stability Value

From Figure 6. The stability value of the test object for 3 variations of latex content meets the requirements according to the provisions, namely a minimum stability value of 900 kg.

The result of the highest stability value was 3249.7 on the test object with 9% latex content and the lowest value was 3201.1 with 3% latex content. This shows that the greater the latex content, the greater the Marshall stability value so that it can withstand excessive loads compared to conventional asphalt.

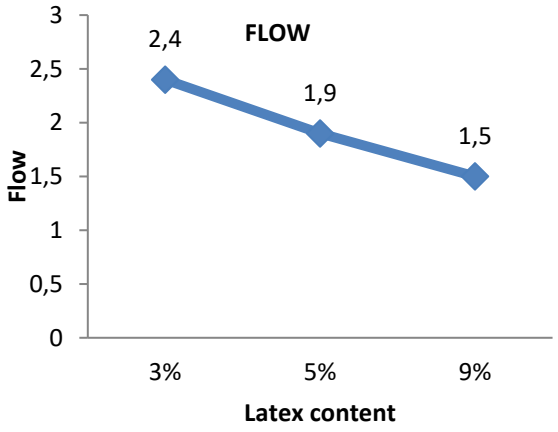


**Figure 7.** Flow value

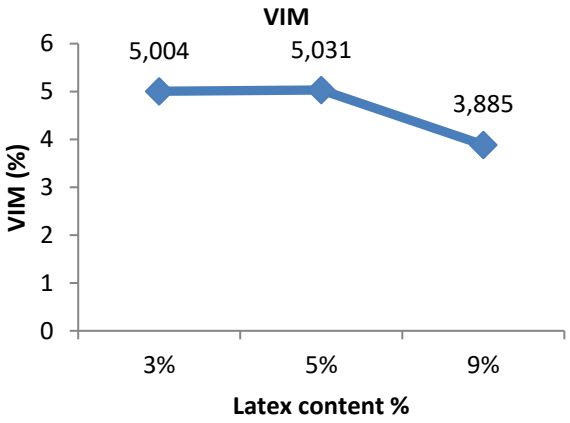


**Figure 8.** VIM value

As can be seen in Figure 7. The addition of latex to the asphalt will reduce the flow value.The addition of latex causes the mixture to tend to be harder than asphalt without latex.Latex 5% and 9% do not meet the specified specifications, namely min 2% and max 4%.3% latex content meets specifications

Figure 8. Shows the Void in mix (VIM) value with 5% latex content greater than the specified standardLatex levels of 3% and 9% have met the requirements, namely 3-5%.the best mixture is the content of 9% with a value of 3.8885.

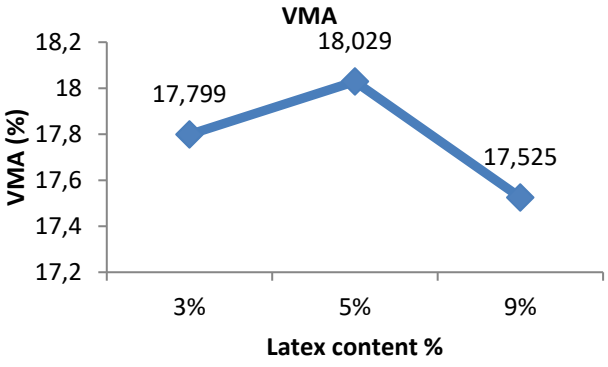


**Figure 9.** VMA value

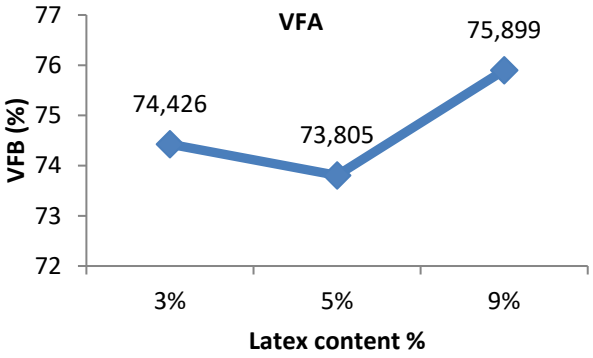


**Figure 10.** VFA value

Figure 9. Describes Voids in mineral aggregate (VMA) value the latex content of 3%, 5% and 9% was able to cover the aggregate well because the VMA value was not too small.The level of 5% has increased so that the aggregate blanket is not too good because it will make the mixture too soft.A good mixture to use is the content of 3% and 5%.

From figure 10. Show the highest Void filled with asphalt (VFA) value was found within the 9% latexs content with a VFA value of 75.899 and the lowest VFA value was 5% with a VFA value 0f 73,805.

This shows that the highest Void of asphalt content (VFA) value is found in latex content of 9% with a VFA value of 75,899 this is because the asphalt blanket value for aggregate is too small which will cause the asphalt to become soft. . While the lowest VFA value is 5% with a VFA value of 0f 73,805, the decrease occurs because the asphalt blanket is too large for the previous VMA value. The VFA value for each latex content was able to fill the cavity well because it had fulfilled the requirements, namely 65%.

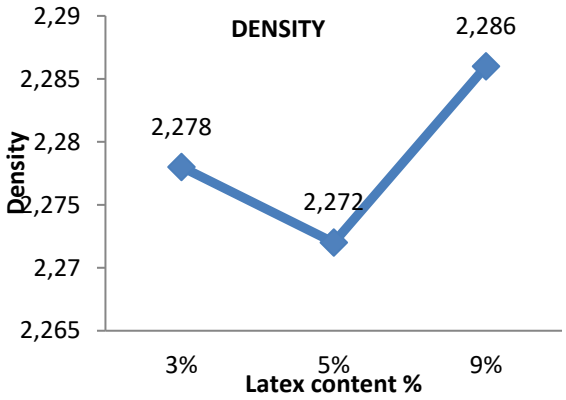


**Figure 11.** Density value

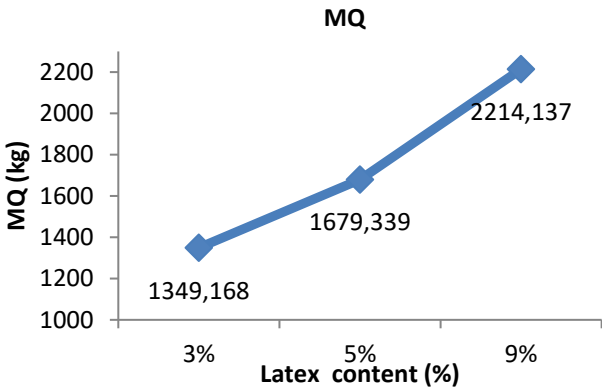


**Figure 12.** Marshall Quotient Value

From figure 11. shows the density value of each latex content that meets the specified requirements, namely at least 2%. The highest density value lies at 9% this is due to the high VFA value. While the latex content is low at 5%, the decrease is due to too much asphalt filling the cavities. The greater the density value, the greater the load-bearing ability.

Figure 12. it can be seen that the Marshall Quotient value for all sample with different variations in asphalt content, the results meet the requirements according to the provisions, namely the MQ ≥250.

The result of the highest MQ was found in the 5% latex content at 2214,137, whereas the lowest MQ was the 3% asphalt content at 1349,168.

The latex content of the MQ value will increase due to the high binding capacity of latex. The Marshall quotient value of each latex mixture is far above the specified conditions, Mixtures tend to be stiff, but can be used because they are able to withstand excessive loads.

## 4. Conclusions

Based on the analysis obtained the design asphalt content (Pb), the value of Optimum Asphalt Content (KAO) for conventional asphalt is 6% of the 5 variations of the test object. Marshall test analysis results from several variations obtained a mixture of latex asphalt with a content of 3% because the strength and flexibility of the mixture is better than conventional asphalt with Marshall parameter values namely stability 3101.1 kg/mm (Requirements > 800 kg/mm), Flow 2 ,4 mm (requirement > 2.0 – 4.0 mm), VIM 5.0% (requirement > 3.0 – 5.0%), VMA 17.799% (requirement > 15%), VFA 74.426% (requirement > 65%) and meet General Specifications Highway.

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# Behavior of Reinforced Concrete Frames on Flexible Foundations Subjected to Both Horizontal and Vertical Ground Motions

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**Abstract**
This paper investigates the behavior of combined horizontal and vertical accelerations on the seismic response of reinforced concrete resting on shallow foundations. Five and nine-storey buildings are considered to represent low- and medium- rise buildings. The building was assumed to be founded on shallow foundation with soil class corresponding to soft soil deposits, The soil of foundation was modeled by an equivalent massless spring coupled with a gap. The accelergrams used in this investigation in the nonlinear range are the horizontal and vertical components of the New Hall earthquake. Although most building codes postulate that SSI generally decreases the force demand of buildings, and increases the deformation demand, it was found that the inclusion of the vertical ground motion with SSI, the horizontal displacement are decreased compared to the case with only the horizontal component.
**Keywords:** horizontal and vertical accelerations, Shallow foundation, spring couple, Gap, nonlinear.

## 1. Introduction

Most of the seismic codes around the world tend to neglect the effect of vertical ground motion in the design of reinforced concrete buildings due to following reasons: it was believed that the intensity of vertical component is too weak compared to the horizontal component, the wave length of vertically propagation motions is shorter than that of the S-wave, and that structures are very rigid in the vertical direction compared to horizontal direction.
However, shear failure of concrete columns was one of the major causes of damage, as observed in recent destructive earthquakes such as the Loma Prieta (1989) and Northridge earthquakes (1994) in California and the Hyogo-ken Nanbu earthquake (1995) in Kobe, Japan. Significant damage to RC structures has been attributed to the reduction of shear strength caused by vertical ground motion effects. Many studies reported data showing that the effect of vertical ground motion can be important in some cases, Antoniou (1997) and Ghobarah and Elnashai (2003), Javed A et al (1997), Shakib H et al (2003), Collier and Elnashai (2001), Mwafy and Elnashai (2006).
Modern building codes for example NBC 105, IS 1893, UBC 97 and many other codes worldwide assume the vertical component of the ground motion to be ½ to 2\3of the horizontal component. However, the soil-structure interaction (SSI) effects were neglected. This is due to the difficulties involved in making simple but reliable dynamic models and also due to prohibitive cost associated with such analyses, and SSI involves structural and geotechnical engineering, traditional design practice has seen engineers in these two fields working independent of each other. Shallow isolated footings can be modeled using: the uncoupled approach (uncoupled translation and rotational springs); Winkler approach (distribution vertical and horizontal springs); plasticity-type macroelement formulation using foundation action bounding/yield surface; and continuum approach such as finite element or boundary element methods. The continuum approach is the most rigorous, but is computationally intensive and time consuming. The uncoupled approach can model the load-deformation behavior, but cannot predict settlement.
The macro-element approach is able to satisfactorily predict the complete foundation response because it accounts for nonlinear behavior and coupling between the responses in all directions. The Winkler model represents a trade-off between the uncoupled and macro-element model. It can simulate progressive mobilization of plastic capacity and the resulting settlement. Housne GW (1993) used the Winkler approach to evaluate the structural response accounting for foundation uplift; and Psycharis and Jennings (1984) and song and lee (1993) used it to examine the effects of rocking and uplift. More recently, Filiatrault *et al* (1992). Chaallal and Ghlamallah (1996), Anderson (2003) and Chen and Lai (2003) used the Winkler approach to examine the effect of both uplift and yield on structures.
These studies demonstrated the ability of the Winkler approach to provide reasonable prediction of the rocking response of various structures. This paper examines the effect of vertical ground motion on the nonlinear seismic behavior of reinforced concrete building with soil flexibly. A simple two-dimensional (2D) model was used to idealize the structures and the supporting soil. The nonlinear structural analysis program SAP2000 was chosen for this work.

## 2. Description of Building Models

The structures used in this study, are five and nine story buildings, the dimension in plan are 3m x 6m and the height is 3 m. The structures were designed according to the Algerian cod RPA (2003) and are located in high seismicity region with a peak ground acceleration of 0.32g. The dimensions of the beam and columns for the three structures are shown in Figure 1 and the reinforcement details are shown in Figure 2.

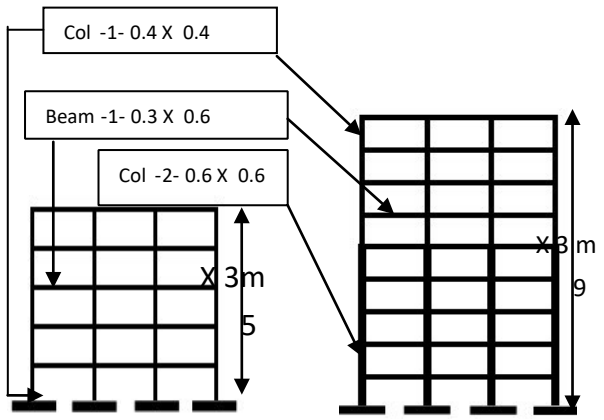


**Figure 1.** Structural models.

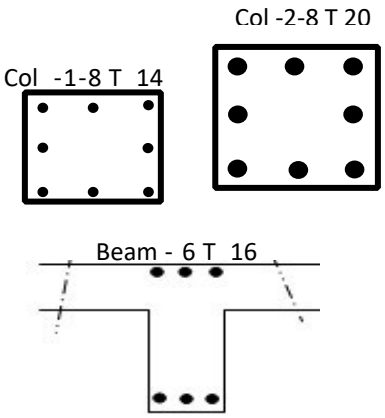


**Figure 2.** Reinforcement details.

## 3. Foundation System

The rigid footing and the soil beneath the footing in the zone of influence, considered as a ”Gap element”, were modeled by a NL Link element in order to model the pounding occurring between the soil and the footing. The nonlinear force–deformation relation for the Gap element is given by

$$f = \begin{cases} k(d+\delta) & if \;\; d+\delta < 0 \\ 0 & otherwise \end{cases} \quad (1)$$

Where k is the spring constant (or contact stiffness), d denotes deflection of the Gap element, and d is the initial gap separation ($\delta \geq 0$). Note that d < 0 for opening mode and do 0 for closing mode of the gap.

The vertical and horizontal elastic stiff nesses of the foundations are calculated using the frequency-independent formulas given by FEMA 356(1996) document. Allotey and El Naggar (2003) recommend using an effective shear modulus of 0.8 of the elastic shear modulus of the soil in calculating the vertical stiffness of the foundation. Therefore, the elastic shear modulus, $G_0$, of the soil was calculated from its shear wave velocity and mass density, then an effective shear modulus, G=0.8 $G_0$, was used in calculating the vertical and horizontal stiff nesses of the footing.

## 4. Definition of Performance Levels

The design objective in current building codes address life safety, control damage in minor and moderate earthquakes, and prevent collapse in a major earthquake. FEMA 356 gives deformation capacities for the inelastic components corresponding to the three target performance levels for structural components as shown in Figure 3, namely: immediate occupancy (IO), life safety (LS) and collapse prevention (CP)

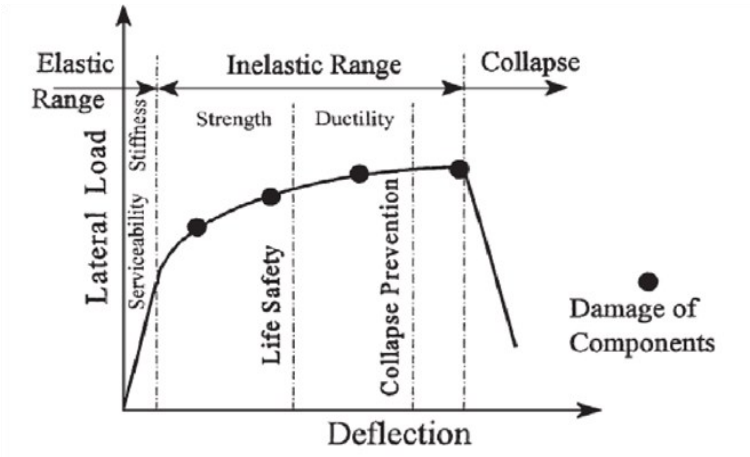


**Figure 3.** Typical performance curve for the structure.

The calculation of the flexural deflection of an RC member can be carried out by two different main methods. The first uses the finite element approach but needs a huge amount of computational effort, even for the fiber-model-based analysis. When the number of fibers in the cross section and the number of segments, along the member length, are not low, and a hysteretic analysis for a cyclic loading with a variable axial load is needed, the amount of required memory and computation are not comparable with other methods based on the assumption of a plastic hinge (Figure 4). It is evident that in the finite element method, the method of displacement approximation plays a significant role in the accuracy of the results.

In practical use, most often, the default properties provided in FEMA-356 (1996) and ATC-40 (1996) documents are preferred, due to convenience and simplicity. These default Properties can be implemented in well-known linear and nonlinear static and dynamic analysis programs such as DRAIN-2DX (1993), DRAIN-3DX (1994), PERFORM-2D, and SAP200. Some programs (i.e. SAP2000) have already implemented these default nonlinear properties. The use of this implementation is very common among the structural engineering profession and researchers. Mehmet Inel and Hayri Baytan Ozmen (2006) investigated the effect of plastic hinge properties in nonlinear analysis of reinforced concrete buildings, these analyses indicated that it is possible use this option (default-hinge) but cautiously, because the misuse of defaulthinge properties may result in relatively high displacement capacities.

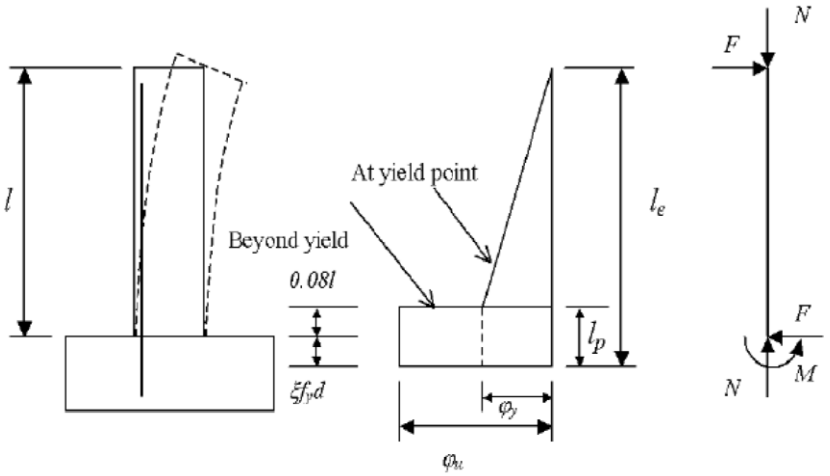


**Figure 4.** Typical plastic hinge method (Pristley and Park)

The column plastic hinge can be modeled in SAP2000 as a lumped plasticity model, using the Interaction $PM_2M_3$ Hinge. The applicability and limitations of the Interaction $PM_2M_3$ Hinge are similar to those of uncoupled hinge, except for its consideration of coupled behavior of the column in both orthogonal bending directions. The configuration of the column cross section must be taken into account in a separate moment-curvature analysis and interaction diagram, carried out to determine the nominal capacity $M_{ne}$, plastic capacity $M_p$, and ultimate capacity Mu of the column, as well as the rotations (θ) or curvatures (ϕ) related to those values, in discrete bending directions of the column. Whereas hinge based on bending moments were assigned to beam. Figure 6 shows the load-deformation curve of the hinges. The hinge properties and modeling parameters A, B, C, D, and E were specified according to FEAM 356 (2003).

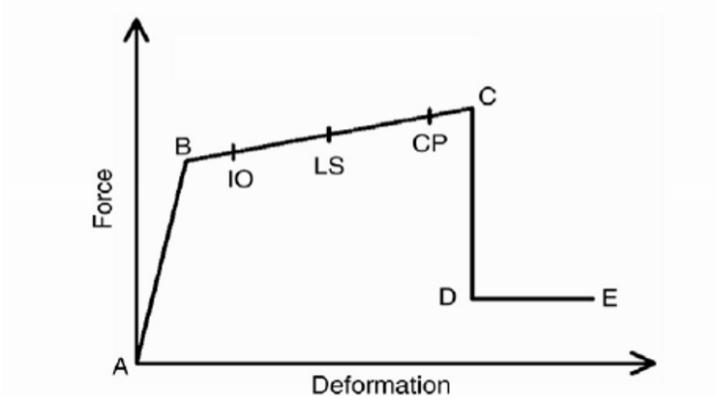


**Figure 5.** Force–deformation relationship of a typical plastic hinge.

The following points should be noted:
Point A is always the origin.

- Point B represents yielding. No deformation occurs in the hinge up to point B, regardless of the deformation value specified for point B. The displacement (rotation) at point B will be subtracted from the de formations at points C, D, and E. Only the plastic deformation be yond point B will be exhibited by the hinge.
- Point C represents the ultimate capacity for analysis.
- Point D represents a residual strength analysis.
- Point E represents total failure.

**5. Earthquake Ground Motion**

The accelerograms used in this investigation are the horizontal and vertical components of the New Hall earthquake record, figure 3. These records are believed to be representative of strong earthquake. Studies by Clough and Benuska (1966) indicate that structural response depends primarily on the peak acceleration impulse in the ground motion and that continuing motions of smaller amplitude have only a small effect on the maximum response. Therefore the duration of the earthquake used in this analysis was primarily limited to the first fifteen seconds of the earthquake. The peak ground acceleration of the horizontal component is 0.578 g and that of the vertical one is 0.537g.

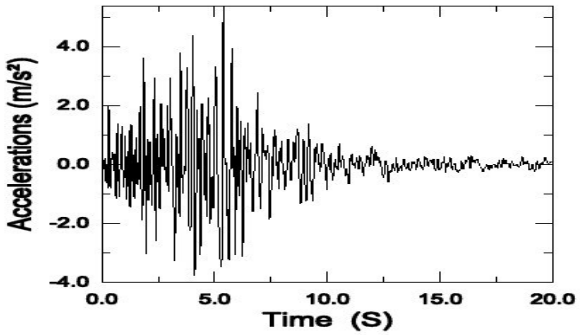


**Figure 6.** Earthquake records New hall accelerogram (north-south component)

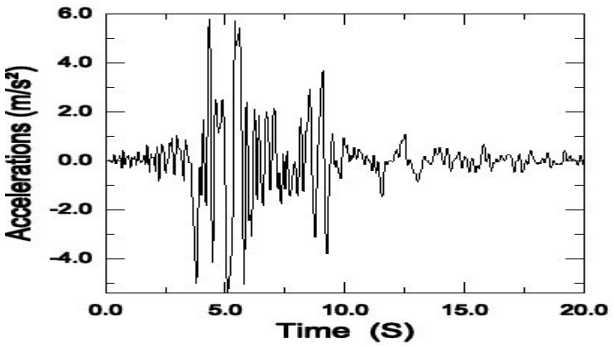


**Figure 7.** Earthquake records New Hall accelerogram (vertical component)

Acceleration response spectra of linearly elastic system with 0.05 damping subjected to the records are shown in figure 8. Comparison of the spectra shows clearly that the peak vertical acceleration falls in the small period range.

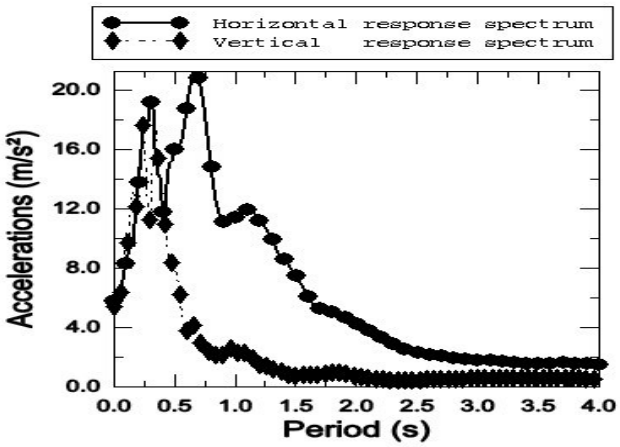


**Figure 8.** Acceleration response spectra of the records used.

**6. Nonlinear Dynamic - Analysis Time History Analysis (THA)**

In transient dynamic analysis, the following system of dynamic equilibrium equations is solved at each time t, Eq. 1.

$$[M]\{\ddot{u}(t)\} + [C]\{\dot{u}(t)\} + (f_{\text{int}}(\{u\},\{\dot{u}\},\{\varepsilon\},\{\sigma\},t,\dots\dots)) = \{f_{\text{ext}}(t)\}$$

where $[M]$ and $[C]$ are the mass and damping matrices respectively, and $\{f_{\text{ext}}(t)\}$ is the vector of external forcing functions. The vectors $\ddot{u}(t)$, $\dot{u}(t)$ and $u(t)$ are the resulting accelerations velocities and displacements, respectively. The vector $f_{\text{int}}(\{u\}$is the internal set of forces opposing the displacements and is usually dependant on the displacements, velocities, and field of strains $\{\varepsilon\}$and stresses$\{\sigma\}$.

In this study, a Rayleigh type damping is adopted. It is based on a linear combination of the mass matrix $[M]$ and the linear elastic stiffness matrix or the tangent stiffness $[k]$ as follows, Eq. 2:

$$\alpha[M] + \beta[K]$$

where the coefficients $\alpha$ et $\beta$ are determined to provide for two selected damping rations for two specific modes of vibration, ie the first two modes. The direct integration of the above equations is required. One of the most widely used methods is the HilbertHughes-Taylor method [15]. This method has superior numerical dissipation characteristics over the widely used Newmark method. For large number of degrees of freedom, the numerical damping feature is essential to suppress undesirable higher modes.

**7. Results and Discussions:**

**7.1 Shear Forces**

Figures 9 and 10 shows the envelope of storey shear demand of five and nine storey structures respectively. They indicate that the SSI with the horizontal excitation only results in a decrease of 16% in the base shear compared to the fixed based, but the analyses with SSI plus a combination of horizontal and vertical motions, the shear demand is decreased by 15% compared to the case of horizontal ground motion without and with SSI.

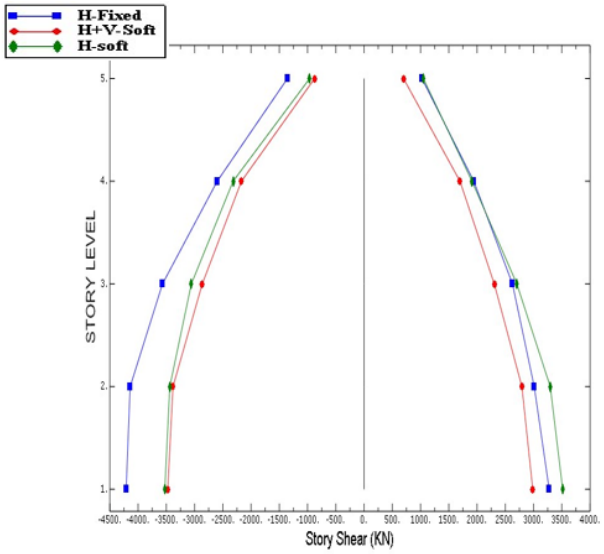


**Figure 9.** Five storey base shear.

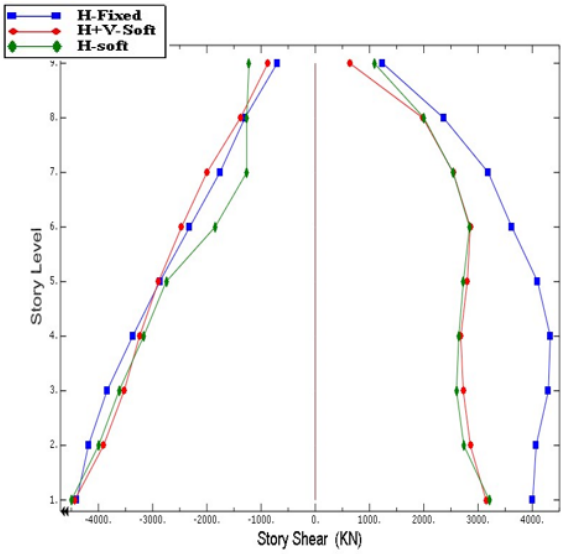


**Figure 10.** Nine storey base shear.

### 7.2 Moment Demand

Figures 11 and 12 show the envelope of storey moment demand in interior and exterior columlns of the five storey building increased by 3% in analyses SSI plus the horizontal ground motion compared to the fixed case. However, for analyses involving SSI and both ground motions, the moment demand is decreased by 15% compared to analyses considering SSI and horizontal ground motion.

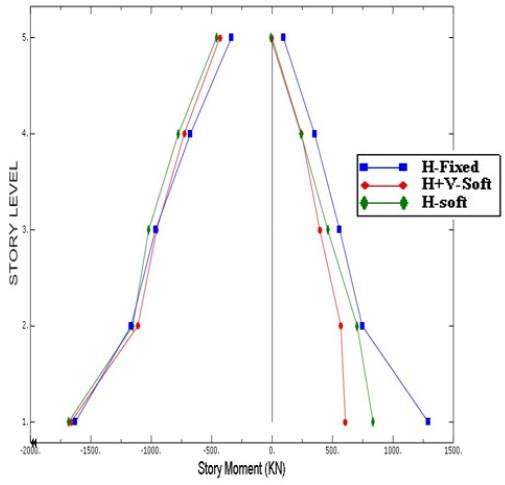


**Figure 11.** Five storey structure moment‟s exterior column

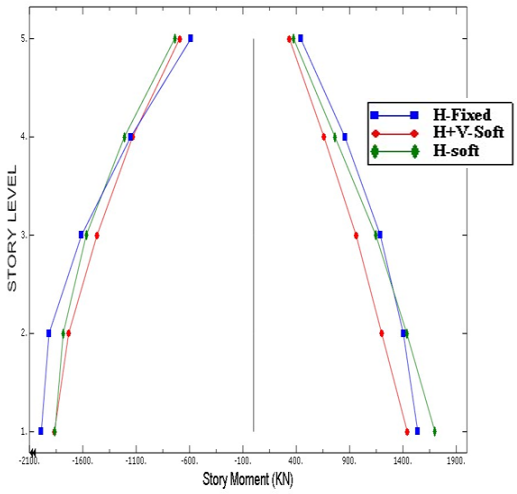


**Figure 12.** Five storey structure moments interior column.

Figs. 13 and Figure 14 compare the moment demand in the interior and exterior columns of the nine storey structure. The moment demand for analyses with SSI and horizontal ground motion component is increased by 28% compared to the fixed case. But for analyses with SSI and a combination of the horizontal and vertical ground motions, the moment demand is increased by 2% in compression compared to the case of the flexible footing under horizontal ground motion.

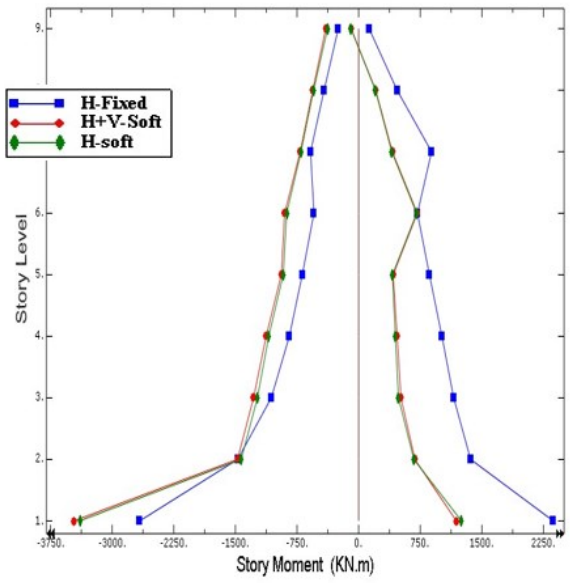


**Figure 13**. Nine storey structure moments exterior column

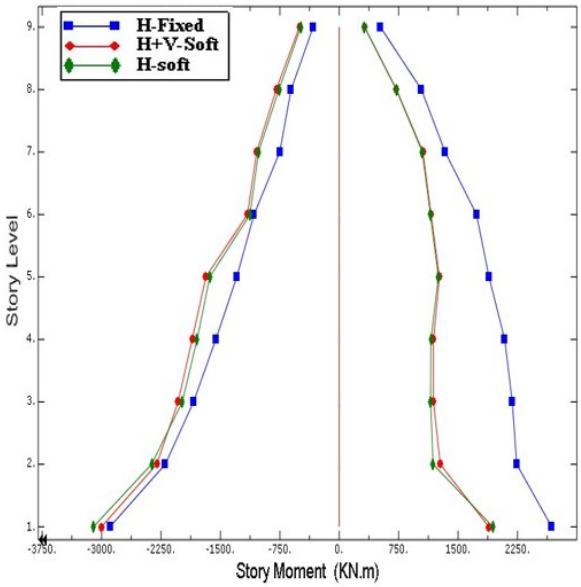


**Figure 14.** Nine storey structure moments interior column

**7.3 Displacement**

Generally, the displacements for analyses with SSI are increased compared to analyses fixed for the nine storey structure irrespective of the number of ground motions (refer Figures 15 to 16). For the five storey building, the displacements are increased compared to the fixed case when SSI and a combination of horizontal and vertical ground motions are considered.

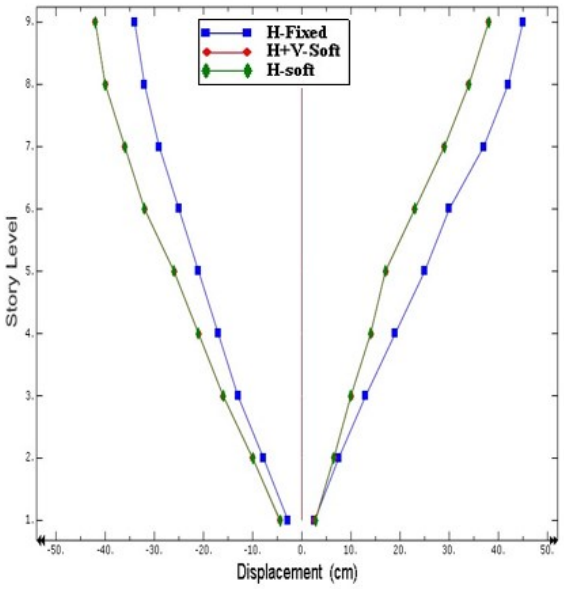


**Figure 15.** Horizontal Displacement of Nine Storey Structure

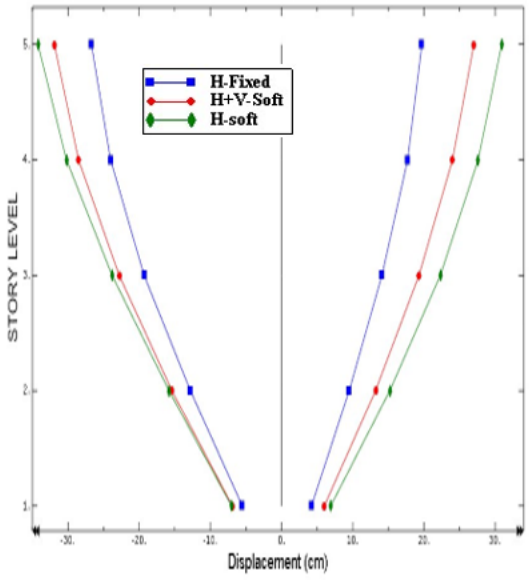


**Figure 16.** Horizontal Displacement of Five Storey Structure

**8. Formation of Plastic Hinges and Accumulated Plastic Deformation:**

The locations of plastic hinges formed in the 5 storey structures under New Hall earthquake are shown in Figure 17. First, it should be noted that all hinges were in the elastic domain before 4 s. Afterwards, there were some plastic deformations in the beams and the columns. SSI and a combination of horizontal and vertical ground motions can alter considerably the plastic hinges patterns compared to the fixed case. For instance, for both structures, the hinges at the base of the columns yielded at event E under SSI and both excitations.

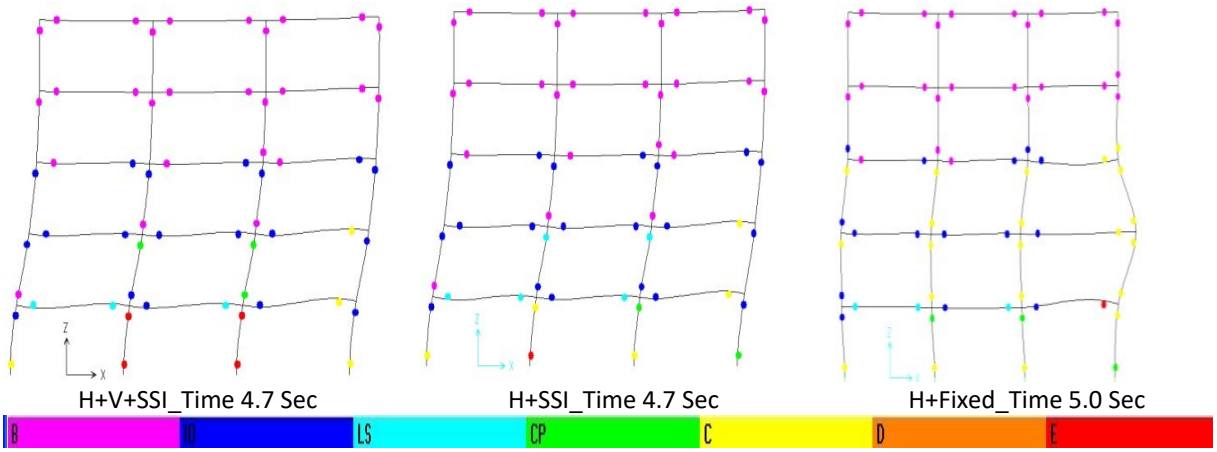


**Figure17.** Location of plastic hinges caused by New Hall earthquake

**9. Conclusions**

The results show that the SSI effects increases the base shear and moment demand on buildings founded on soft soil. This is contrary to the common assumption that SSI effect on seismic forces is always favorable, postulated by almost all the design codes. It is clearly demonstrated that the base shear and moment demand on short-period buildings could increase by up to 25% of the fixed base buildings values.

The deformations of the structural components of the buildings have also been affected by the SSI. The deformations of buildings with flexible bases have shown a considerable increase that ranged from 23% compared to the fixed base case for buildings founded on soil flexible. This would in turn increase the lateral deflection of the whole building. Thus, SSI can have a detrimental effect on the performance of buildings.

The effect of vertical acceleration is more pronounced in low and medium building, The SSI increased the displacements compared to the fixed case, this increase is absorbed by the energy dissipated in the structure which results in decreased in the forces, under combined vertical and horizontal ground plus SSI, the displacement is decreased compared to the case of only horizontal component plus SSI resulting in an increased force.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Watershed Segmentation Region-Based Criteria Applied to Thermographic Imagery Within the Water-Space

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**Abstract**
This case study researches a non-invasive forensic approach in order to identify anomalies related to the production and presence of antagonistic components operating in the maritime sector. In accordance with the internal and external consistency that regulates the port development plans, the cyber threat has recently obtained its own acknowledgment within the Port Facility Security Plans (PFSPs), as sealed in principle by the EU Directive 2005/65, becoming key to the Operators of Essential Services (OES). The study is focused on the spectral emissivity of non-contact, active, and Non-Destructive Techniques (NDT), ground and aerial, to be implemented in conjunction with histogram equalizations, transform waveforms, and segmentation image analysis following object detection by template matching. The hyper-parameterization overcomes the environmental limits that easily occur in likely electronic warfare scenarios. According to an emerging bibliography on the subject of modern strategic-military conception for Port Security Authorities (PSAs), a cyber-physical system (CPS) is strictly addressed to the emissivity of the physical theory of semi-conductors in the matter of smart-grid. Due to Electronic Data interchange (EDi), which mostly consists of volatile and unidentifiable stress agents in the digital environment, the malicious drivers are often under-recognized, i.e. non-IP based networking, that requires an urgent response in order to prevent alteration of the Internet of Things (IoT) supply-chain devices, by downgrading their performances or taking possession of their maneuverability. To entrust controllability, unmanned solutions can deliver immediate enforcement with the addition of infrared cameras, to detect electronic agents that cast suspicion and predict breaches across the latest Building Information Model (BIM) levels, all at a safe distance. In defense of water-space, harbor infrastructure pitfalls have demonstrated the upcoming necessity of adopting simultaneous strategies, jointly with private stakeholders and the Departments of Transport (DfT), that corresponds to the critical domain and require adaptation of usage according to international codes of behavior of safety. Sea-surface domain has been gradually analyzed and addressed as a physical area of interest due to its unique phenomena. The research proposes: (1) a set of multi-scalar parametric evaluations, (2) an in-depth theory dissertation, (3) a versatile open-source strategy, and (4) a risk-management implementation concerning maritime cyber security. Due to the limits of research, the author has included a list of references that are susceptible to adaptation to the engaged novel open-source solutions, within the cited optimizations for the Green Build System of the Build Information Model (BIM) techniques. Moreover, because of Unmanned and Infrared systems cost, the work-study implements a licensed aerial dataset for research and a thermal ground camera possessed by the author. Port Authorities are critical non-flying zones whose maneuverability is not granted unless specific designations. The licensed dataset reconciles this missing opportunity, by including specific urban issues and infrastructures.
**Keywords:** Maritime Cyber Security; Port Authority; Water Space; Digital Forensics; Incident Response; Electronic Warfare.

## 1. Introduction

As highlighted by the UNCTAD 2021 [1], the Investment Policy Framework for Sustainable Development (IPFSD) developed in 2015 has drawn a link between a set of Core Principles for Investment Policymaking (CPIP), balancing new design criteria for investment planning, threats, and policies.
The Covid19-sars agent outbreak has defined challenging key-guidance of the UNCTAD 2015 framework by which the weakness of a new model of digital economic diplomacy has urged dedicated strategies with budget allocations in the matter of Sustainable Development Goals (SDG) that are locally commuted into multi-stakeholder entities.
To accelerate this informatic transaction towards national bodies capable of stable intermediary roles across international platforms, an SDG financing space was defined in defense of targeted specific coordination of research groups that met the challenge favored by start-ups and Universities, adhering to international standards and consensus-strengthening of foreign investors through scalable ventures such as microfinance backed up with aftercare services.

[1] UNCTAD/DIAE/PCB/2021/1 «Investing in the Sustainable Development Goals: the Role of Diplomats». eISBN: 978-92-1-604005-5

This multipurpose of globalized virtual trade and manufacturing supply chain has confirmed the main strategic role to the Port Authorities. Due to their presence in worrisome landscapes, their economic model [2] [3] has been gradually modeled following the Community advocacies [4] which demanded their own water space and landcover usage in favor of local citizenships [5] that are issued by numerous researchers belonging to the urban studies, these hybrid scenarios surfaced as a well distinguishable paradigm threatened by volatile antagonists that are difficult to be detected. In terms of urban heat islands [6]. the industrial waterfront controllability is often undermined by the dark occlusions scattered by operative infrastructures [7] [8] such as fences, a stack of containers, cranes, bridges, mobile platforms, and canals.

The study surveys the benefits achieved from digital functional imaging applied to hyperspectral thermography in support of surveillance of undeveloped and transborder zonings [9], called into question to penetrate informatic attacks towards the cyber-physical fences [10]of maritime infrastructures.

Consequently, anti-drone countermeasures deploy tailored radio frequencies by implementing these reflections and interference to un-stabilize antagonist drones and neutralize the payload of jammer devices [11].

The purpose of this permeability can rely on a temporary breach of information so that sacrificing a drone might be a convenient choice in a moment by which the consumer electronic market ensures mass devices. Due to their dual purpose, military and civil, Port Authorities forwarded levels of readiness in terms of interoperability by granting access to heavy vehicles, equipment, perishable goods, and personnel. Internal and external Port analysis consistencies are now cyber-dependent through cyber security assessments (CSA) [12].

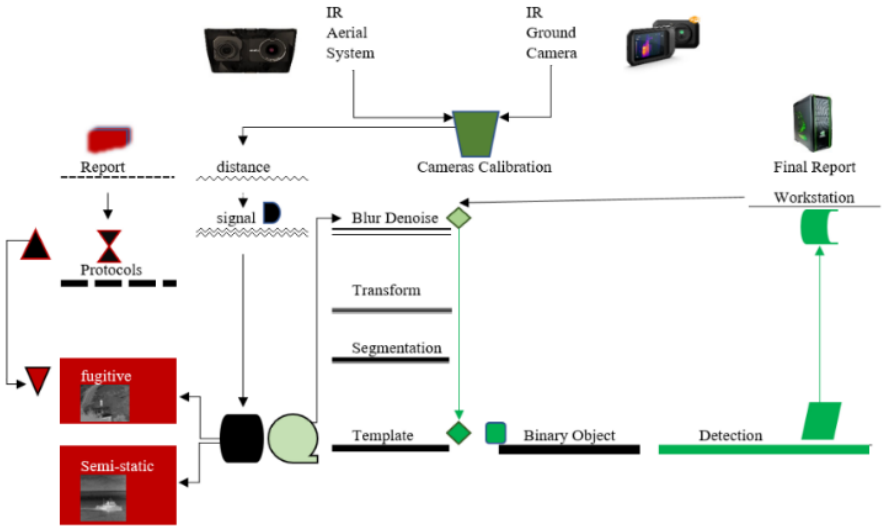


**Figure 1.** Structure of the Study (Developed by Authors).

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**2. Emissivity Discussion Within the Water-Space**

As initially stated, the scope of the research is merely investigated for surveillance purposes with an analog *modus operandi* that adheres to search and rescue (SaR) operations [13]. As consequence, infrared applications [14] [15] are carried out in severe and unpredictable environmental conditions [16].

The atmosphere itself is in fact not entirely transparent to IR and behaves like a body being characterized by relative humidity, in the matter of aerosol, temperature, view, and air mass. This synergy of factors occurs whereby attenuation might perform otherwise within specific atmospheric frames (SW – short wave, 3 – 5 μm; LW – longwave, 8-14 μm). Thermal cameras are commercialized referring to these bands, and their manufacturers have developed atmospheric corrections to overcome these difficulties of assessment. Thermography is classified under two categories: passive and active thermography. Surveillance thermal cameras in the majority operate according to the first class [17]. To summarize, the three radiation power modalities are:

**Table 1:** Radiations.

| Radiation from the object | Reflected radiation | Atmosphere radiation |
|---|---|---|
| $\varepsilon \cdot \tau \cdot W_{obj}$ | $(1 - \varepsilon)\, \tau \cdot W_{refl}$ | $(1 - \tau)\, \tau \cdot \mathrm{W}_{\mathrm{atm}}$ |
| ε = emittence of the body | $(1 - \varepsilon)$ = reflectance of the body | $(1 - \tau)$ = emittance of the atmosphere |
| τ = transmittance of the atmhere | $T_{\mathrm{refl}}$ = ambience emission | $\mathrm{T}_{\mathrm{atm}}$ = temperature of the atmosphere |
| $T_{obj}$ = body temperature | | |

The spectrum is restricted to optically opaque materials with metals and organic material that are easy to be detected because they present a full opacity; in industrial scenarios, this aspect is well known even though there are semi-translucent materials to infrared heat, i.e. sapphire glass [18]. The imagery of fossil energy is commonly associated with the landscape of harbors so that the impact of private and public petroleum stakeholders [19] has been modeled over the last 150 years, a shaped citizen concept that strengthens corporate brand [20].

The waterspace, in conjunction with the petroleumscape, is indeed a complex scenario [21] [22] to detect antagonists so that special budgets are deployed in order to install a special weather station [23] on the docks.

A specific research abstract, “Ship Infrared Detection/Vulnerability” has been well discussed over the years because of its mention in the introduction of physical phenomena occurring to detect anomalies for cargos and other objects

[13] Ren, Peng, Qinglin Meng, Yufeng Zhang, Lihua Zhao, Xu Yuan, e Xiaoheng Feng. «An Unmanned Airship Thermal Infrared Remote Sensing System for Low-Altitude and High Spatial Resolution Monitoring of Urban Thermal Environments: Integration and an Experiment». Remote Sensing 7, n. 10 (27 ottobre 2015): 14259–75. https://doi.org/10.3390/rs71014259.

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[15] Vollmer, Michael, e Klaus-Peter Möllmann. «Infrared Thermal Imaging: Fundamentals, Research and Applications». Weinheim, Germany: Wiley-VCH Verlag GmbH & Co. KGaA, 2017. https://doi.org/10.1002/9783527693306

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[17] Yin, Jiale, Lei Liu, He Li, e Qiankun Liu. «The Infrared Moving Object Detection and Security Detection Related Algorithms Based on W4 and Frame Difference». Infrared Physics & Technology 77 (luglio 2016): 302–15. https://doi.org/10.1016/j.infrared.2016.06.004.

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[23] A.N. de Jong Ship Infrared detection/vulnerability. SPIE Vol. 2020 Infrared Technology XIX (1993)! 219 TNO Physics and Electronics Laboratory.

beyond sea surfaces [24] [25] [26] [27]: solar heating, sunlight at the sea surface (SSS), molar absorptivity, internal heating sources, wind cooling, caused by convective heat transfer, cold sky cooling, determined by apparent sky temperature, sea surface reflection of cold sky/cloud background, sunglint at the sea surface, selective radiation from exhaust gases, sea clutter pattern, spectral response curve of sensor, spatial resolution of sensor, range and aspect angle (azimuth and elevation).
Among these, SSS and cold sky/cloud background are the most critical to handle, by downgrading the emissivity of leaks, gas, and men in the water. The adoption of a simplified atmospheric model by manufacturers [28] [29] [30] has optimized the rapidity of the bundle adjustment even though the air-water at sea-surface domain requires specific physical models that evolved the accuracy against the interferences for the volumetric and through-plane temperature here absorbs and reduce the blur and distance with the target, reinforce the image focus, and pixel resolution.
Aqueous boundary layers of air [24] (J.Kunz and B. Jähne, 2018) account for heat transfer in a matter of minutes and meters. Passive thermography (PT) and active thermography (AT) are both addressable to surveillance- Radiative and evaporative cooling of the water surface. AT relies on the excitation of signals which amplify the spectral firm of water by confirming temperature amplitude and phase shift.

**Table 2:** Machinery temperatures of exercise and thresholds of emergency.

| Class | Operability | Temperature |
|---|---|---|
| Severity 0 | Regular exercise | Inferior to 210.0 °C |
| Severity 1 | Attention | 210.0 °C < temp < 220.0 °C |
| Severity 2 | Risk | > 220.0 °C |

The exchange of air masses and gases across the air-water layers is mainly generated by the wind blowing over the sea surface. These layers vary in terms of thickness that weights particularly for the speed of exchange (transfer velocity) and near-surface turbulence. In the air, the heat boundary layers and the mass hold a similar thickness as the viscous boundary layer; such an AT technique uses as a proxy tracer for these masses through a heat flux. The advantage is clearly visible in its response. In water, the mass boundary layer is much thinner (10–350 μm) than the viscous boundary layer, (because in water molecular diffusion for mass (D) is a thousand times slower than for momentum (v), i.e., the Schmidt number $Sc = v/D \approx 1{,}000$.
The transfer velocity k expresses the exchange rates in quantitative terms. It's obtained in form of the ratio between the mass flux density jc and the concentration difference Δc, occurring between air and water.
According to a 2004 statement by loyd's Register, "In the near future, mechanical machinery onboard vessels will also benefit from thermal imaging, especially as a pre-docking strategy to identify and target equipment and systems which need attention as well as to eliminate necessary work". Due to its non-invasive survey method of process monitoring, IR technique has migrated into other scopes. The industry of cargos is commonly associated with the maritime trade and energy-dependent on the logistics of petroleum linked to the versatility of airborne systems, has been recently extended to oil spill detection [31] [32] [33] whose spectrum is detected through IR radiometer or IR/ultraviolet (UV) equipment which benefit of the conjunction with remote sensing hardware like Side Looking

[24] Kunz, Jakob, e Bernd Jähne. «Investigating Small-Scale Air–Sea Exchange Processes via Thermography». Frontiers in Mechanical Engineering 4 (26 marzo 2018): 4. https://doi.org/10.3389/fmech.2018.00004
[25] Garbe, Christoph S., Anna Rutgersson, Jacqueline Boutin, Gerrit de Leeuw, Bruno Delille, Christopher W. Fairall, Nicolas Gruber, et al. «Transfer Across the Air-Sea Interface». In Ocean-Atmosphere Interactions of Gases and Particles, a cura di Peter S. Liss e Martin T. Johnson, 55–112. Springer Earth System Sciences. Berlin, Heidelberg: Springer Berlin Heidelberg, 2014. https://doi.org/10.1007/978-3- 642-25643-1_2.
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[28] Flir® infrared camera help to ensure safety at sea. (Echo Class and River Class ships). 1558693_EN.pdf https://www.flirmedia.com/MMC/THG/Brochures/1558693/1558693_EN.pdf
[29] Flir® Mariner Operator's Manual. Thermovision® Mariner. User's Guide.
[30] Flir® Radiometric Temperature Measurements
[31] Goerlandt, Floris, e Jakub Montewka. «A Framework for Risk Analysis of Maritime Transportation Systems: A Case Study for Oil Spill from Tankers in a Ship–Ship Collision». Safety Science 76 (luglio 2015): 42–66. https://doi.org/10.1016/j.ssci.2015.02.009.
[32] Szyliowicz, Joseph S. «Safeguarding Critical Transportation Infrastructure: The US Case». Transport Policy 28 (luglio 2013): 69–74. https://doi.org/10.1016/j.tranpol.2012.09.008.
[33] Senarak, Chalermpong. «Port Cybersecurity and Threat: A Structural Model for Prevention and Policy Development». The Asian Journal of Shipping and Logistics 37, n. 1 (marzo 2021): 20–36. https://doi.org/10.1016/j.ajsl.2020.05.001.

Airborne Radar (SLAR), Imaging Airborne Laser Fluorosensor (IALFS), Microwave Radiometer (MWR) and photo cameras.

Along with IR applications, Sea-borne systems complete this group and have been designed to rise coating protection against the influences of mechanical forces, anti-reflection, and marine water. Besides, the applicability of the International Convention for the Safety of Life at Sea (SOLAS) special measures to guarantee maritime security and require temporary certifications as life-saving appliances [34] [35] [36] [37] : Electrical installations and general stability, fire protection detection and extinction, personnel arrangements, radiocommunications, and special consideration of strategic assets, i.e. pharmaceuticals and nuclear ships. The adherence to its mandatory protocols started between 17 June 1960 and 26 May 1965 as issued by the International Maritime Organization (IMO). Conditions of endured conditions, provide deterrence for breaches. Cargos are the primary trade vector so specific literature has been developed on their electrical and propulsion systems [38], by enlisting severe criteria of maneuverability [39] [40].

**2.1 Cyber Threats and The Harbourscape**

According to Directive 2016/1148 (NIS Directive), bodies of ports are identified in the form of "any specified area of land and water, with boundaries defined by the Member State MS in which the port is situated, containing works and equipment designed to facilitate commercial maritime transport operations" [41] that involve operations of the AECO sector [42] [43] [44] [45]. Building Information Model (BIM) [46] has been enhanced until Level 2 by operating in a Common Data Environment (CDE) [6] and included augmented intelligent analysis of real-time data and information gathered to promptly optimize decisions [32]. These Information and Communication Technology (ICT) applications, in the first stage, consented to a file-based coherence of a project who followed an Object model-based exchange (Level 3).

This informatic matter is often targeted by hackers; we might comprehend that BIM is not merely confined to the AECO industry, but extended to daily Contemporary operations and Maintenance (O&M). Smart-grids are continuously visited by security specialists and practitioners who interact with high sensitive proxies, i.e. Bluetooth and 5G, that are interdependently confronted onto URL nodes [6] Research related to this dichotomy [47], has reviewed the cyberthreat-awareness concerning asset information models (AIM) for large infrastructure asset managers complaint within public and private sectors in (ThaiCERT) Thailand Computer Emergency Response Teams from 2011 to 2019. This reporting has underlined the impairment to utilities and core infrastructures with a detailed case record of underestimated informatic deficiencies, i.e. website defacement and cookies data by which scrap data are assemblable. Likelihood has been validated through the years as a comparative pre-assessment of the risk-mitigation

[34] Birkel, Hendrik Sebastian, e Evi Hartmann. «Impact of IoT Challenges and Risks for SCM». Supply Chain Management: An International Journal 24, n. 1 (14 gennaio 2019): 39–61. https://doi.org/10.1108/SCM-03-2018-0142.

[35] International Chamber of Shipping et al. «The Guidelines on Cyber-Security Onboard Ships». (2020)

[36] Kohnke, Anne, Dan Shoemaker, e Kenneth Sigler. «The complete guide to cybersecurity risks and controls. Internal audit and IT audit». Boca Raton: CRC Press, Taylor & Francis Group, 2016.

[37] H. Boyes, R. Isbell and A. Luck. «Code of Practice. Cyber Security for Ports and Port Systems». Institution of Engineering and Technology, London. 2016

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[39] Shapiro, Lauren R., Marie-Helen Maras, Lucia Velotti, Susan Pickman, Hung-Lung Wei, e Robert Till. «Trojan Horse Risks in the Maritime Transportation Systems Sector». Journal of Transportation Security 11, n. 3–4 (dicembre 2018): 65–83. https://doi.org/10.1007/s12198- 018-0191-3.

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[41] Langen, Peter W. de. «Towards a better port industry: port development, management and policy». London; New York, NY: Routledge, Taylor & Francis Group, 2020.

[42] Boyson, Sandor. «Cyber Supply Chain Risk Management: Revolutionizing the Strategic Control of Critical IT Systems». Technovation 34, n. 7 (luglio 2014): 342–53. https://doi.org/10.1016/j.technovation.2014.02.001.

[43] Macaulay, Tyson, Bryan Singer, e an O'Reilly Media Company Safari. «Cybersecurity for Industrial Control Systems». Taylor & Francis Group. 2016. https://learning.oreilly.com/library/view/-/9781439801987/?ar

[44] «Augmented Human International Conference, Albrecht Schmidt, Andreas Bulling, Christian Holz, Association for Computing Machinery», SIGCHI (Group : U.S.), e ACM Digital Library. Augmented Human'13: 4th International Conference: March 7-8, 2013, Stuggart, Germany, 2013. https://doi.org/10.1145/2459236.

[45] Kohnke, Anne, Kenneth Sigler, e Dan Shoemaker. «Implementing cybersecurity: a guide to the National Institute of Standards and 24 Technology Risk Management Framework. Internal audit and IT audit». Boca Raton, FL: CRC Press, 2017.

[46] Natephra, Worawan, Ali Motamedi, Nobuyoshi Yabuki, e Tomohiro Fukuda. «Integrating 4D Thermal Information with BIM for Building Envelope Thermal Performance Analysis and Thermal Comfort Evaluation in Naturally Ventilated Environments». Building and Environment 124 (novembre 2017):194–208. https://doi.org/10.1016/j.buildenv.2017.08.004.

[47] Senarak, Chalermpong. «Port Cybersecurity and Threat: A Structural Model for Prevention and Policy Development». The Asian Journal of Shipping and Logistics 37, n. 1 (marzo 2021): 20–36. https://doi.org/10.1016/j.ajsl.2020.05.001.

[48] [49] [50], and well supported by customer questionnaires in a cost-effective manner: Electronic Chart Display and Information System (ECDIS), has been lately officialized within the International Safety Management (ISM) Code safety management system by 1 January 2021. The assignment of the reports to all crew [51], regarding incident handling, influences training, i.e. sea-piracy, and improves the awareness program [52] [53] in favor of sea-air-ground personnel (ENISA).

**3 Unmanned Aerial Vehicles (UAV) Systems in Rescue or Surveillance Missions**

Intelligence Surveillance Reconnaissance (ISR) has primarily endured its challenges on stationary ground targets to photograph each target with time-saving human resources. The digital environment can be compared with Digital Elevation Model (DEM) and Digital Terrain Elevation Data (DTED) for military purposes [54]. In order to entrust its accuracy, photogrammetric models superimposed with Lidar Detection And Ranging (LIDAR) and Synthetic Aperture Radar (SAR) datasets, have validated accuracy in conditions of critical visibility.

UAV is able to provide a multipurpose payload and according to this scope, in compliance with IR tracking conversion into an electrical signal is performed in the form of raster images in which pixels are commuted into temperature amounts.

Because of sudden intervention, qualitative measurement is preferred rather than quantitative. Sudden movements are a common issue that depends on flight factors, indeed we face an uncontrollable environmental change that compromises automatic object detection [55] [56].

False-positive [57] [58] [59] are moreover promoted by high update temporal information by which one preferred an independent ad-hoc adjustment to confirm the duality of this hybrid approach. For gas detection infrared spectroscopy was developed to identify toxic gases by IR spectroscopy: the vast majority of TICs and CWAs adhere to bands in the MID-IR for their absorption. CWAs (Chemical Warfare Agents) [60] [61] and Toxic Industrial Chemicals (TICs) are a national interest, crossing both military and civilian defenses.

Ideally, the detectors (i.e. surface acoustic wave, flame photometry, Raman spectroscopy, and ionizations) are forced to operate under severe hazards. Due to the finest state of the art of electronic engineering, IR-based detectors are complex to maintain and put into practice for size and weight. Photoacoustic-based IR sensors are in particular affected by many false positives caused by vibrations or do not behave respond to CWA vapors at IDLH levels. Counter-drone defense is another argument that recently emerged and it's addressed to neutralize jamming attacks and smuggling purposes. IoT devices [3] can hence integrate independent anti-drone solutions to facilitate the counter-response of personnel.

[48] Haywood, Russ. «Railways, urban development and town planning in Britain: 1948-2008. Transport and mobility series». Farnham, England ; Burlington, VT: Ashgate, 2009

[49] M. Hershman «Urban Ports and Harbor Management. Responding to Change along U.S. Waterfronts». Routledge Library Editions: Urban Studies. 2017. https://www.taylorfrancis.com/books/e/9781315099873.

[50] Kolokotronis, Nicholas, e Stavros Shiaeles, a c. di. «Cyber-security threats, actors, and dynamic mitigation». Boca Raton: CRC Press, 2021.

[51] Patterson, Wayne, e Cynthia E. Winston-Proctor. «Behavioral cybersecurity. Fundamental principles and applications of personality psychology». First edition. Boca Raton: CRC Press, 2021.

[52] Dunn Cavelty, Myriam. «Cyber-Security and Threat Politics: US Efforts to Secure the Information Age».

[53] Svilicic, Boris, Miho Kristić, Srđan Žuškin, e David Brčić. «Paperless Ship Navigation: Cyber Security Weaknesses». Journal of Transportation Security 13, n. 3–4 (dicembre 2020): 203–14. https://doi.org/10.1007/s12198-020-00222-2.

[54] Kitzen, Martijn, e Christina van Kuijck. «All Deterrence Is Local: The Utility and Application of Localised Deterrence in Counterinsurgency». In NL ARMS Netherlands Annual Review of Military Studies 2020, a cura di Frans Osinga e Tim Sweijs, 287–310. NL ARMS. The Hague: T.M.C. Asser Press, 2021. https://doi.org/10.1007/978-94-6265-419-8_15.

[55] Stecz, Wojciech, e Krzysztof Gromada. «Determining UAV Flight Trajectory for Target Recognition Using EO/IR and SAR». Sensors 20, n. 19 (8 ottobre 2020): 5712. https://doi.org/10.3390/s20195712. Taguchi

[56] T. Mahnken, T.Sharp, G. Kim . «Deterrence by Detection: a key role for unmanned aircraft systems in great power competition». Center for Strategic and Budgetary Assessments (CSBA). 2020

[57] Gaszczak, Anna, Toby P. Breckon, e Jiwan Han. «Real-time people and vehicle detection from UAV imagery». a cura di Juha Röning, David P. Casasent, e Ernest L. Hall, 78780B. San Francisco Airport, California, USA, 2011. https://doi.org/10.1117/12.876663

[58] H.Wu, W.Li, W.Li, G. Liu. «A Real-time Robust Approach for Tracking UAVs in Infrared Videos". SigPro Lab, School of Information and Communication Engineering, Xi'an Jiaotong University Xianning West Road 28, 710049, Xi'an, P.R. China.

[59] Ashraf, Muhammad Waseem, Waqas Sultani, e Mubarak Shah. «Dogfight: Detecting Drones from Drones Videos». arXiv:2103.17242 [cs], 9 aprile 2021. http://arxiv.org/abs/2103.17242.

[60] Campbell, Matthew B., e Edwin J. Heilweil. «Noninvasive detection of weapons of mass destruction using terahertz radiation». a cura di R. Jennifer Hwu e Dwight L. Woolard, 38. Orlando, FL, 2003. https://doi.org/10.1117/12.504297.

[61] Fischer, Bernd M., Hanspeter Helm, e Peter Uhd Jepsen. «Chemical Recognition With Broadband THz Spectroscopy». Proceedings of the IEEE 95, n. 8 (agosto 2007): 1592–1604. https://doi.org/10.1109/JPROC.2007.898904.

### 3.1 CLAHE

The Contrast Limited Adaptive Histogram Equalization (CLAHE) is a computer image processing technique used to highlight the contrast in images. It diverges from ordinary histogram equalization in that matter the adaptive method computes several histograms, which are used to redistribute the lightness values of the image.
It is therefore indicated to enhance the local contrast and sharpen the definitions of edges in each region of an image. AHE has a tendency to over-amplify noise in relatively homogeneous regions of an image.

### 3.2 FAST FOURIER TRANSFORM

A Fast Fourier Transform (FFT) has been performed due to the capability that this algorithm offers to convert digital images from their original domain into the inverse frequency domain. It's based on O(NlogN) algorithm for estimating the signal's duration.

### 3.3 Segmentation

Watershed image processing is metaphorically related to a geological watershed by which drainage lines are divided. The thresholding method is a simple but effective method to segment an image [62] by which a gray-scale image is commuted into a binary image [63].
The function watershed is able to fill the gaps of ideal catchment basins and watershed lines for any grayscale image. Histogram-based methods are very efficient when compared to other image segmentation methods because they typically require: that the peaks and valleys in the histogram are used to locate the clusters in the image. It requires only one pass through the pixels.

## 4 Results

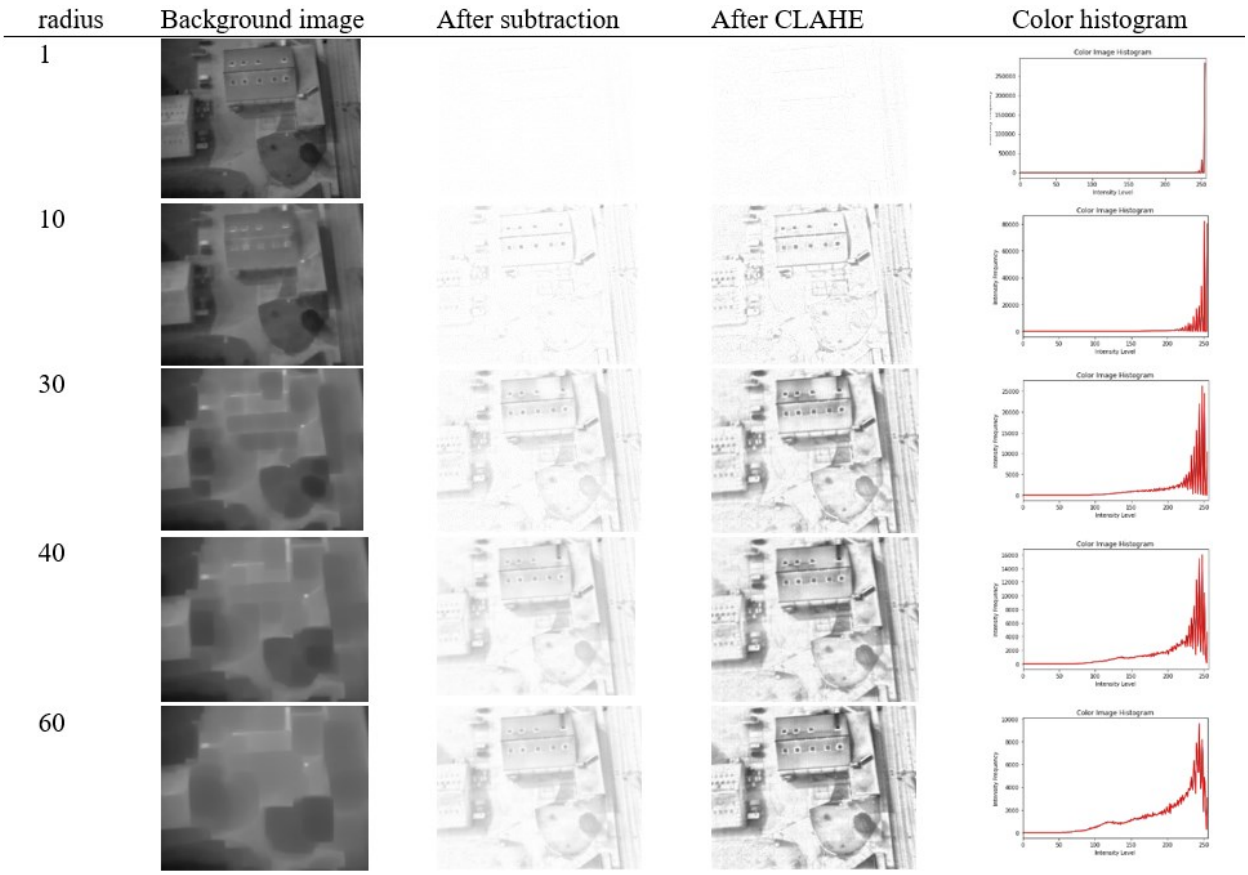


**Figure 2.** CLAHE hyperparameterization.

[62] Barnett R., Stratulat Alisa, Andrew M., Carl Zeiss Microscopy, Advanced Segmentation for Industrial Materials using Machine Learning, USA 2018
[63] Taguchi et al. Template Matching Processing Device and Template Matching Processing Program. United States Patent 8,971,627 B2 (2015)

This raw-image group [64] [65]has been encountered by the log-normalization function which adjusted the intensity contrast of the image dynamically. In the second instance, a correlation was measured in the splitting of the degree to which was subdivided into two variables agree, to better comprehend the general behavior. The two variables are the corresponding pixel values in two images, template, and source.
CLAHE limits the amplification by clipping the histogram at a predefined value (clip limit) as the threshold value; tile grid size, instead, defines the number of tiles in row and column.
The hyper-parameterization was gradually enhanced to control the visual process. By contrast and efficiency, the scope was directed to ver-amplify noise in relatively similar regions of the frame, in order to expand the available image quality for detection, in accordance with the limitations of available transmission bandwidth.
The radius became stable at 3600 and therefore preferred for a low-computing factor. Additionally, two ROIs were reported: a stack of parking slots, understandable for the recent utilization of hoods, and a roof, by which the heating footprint was gradually confirmed.

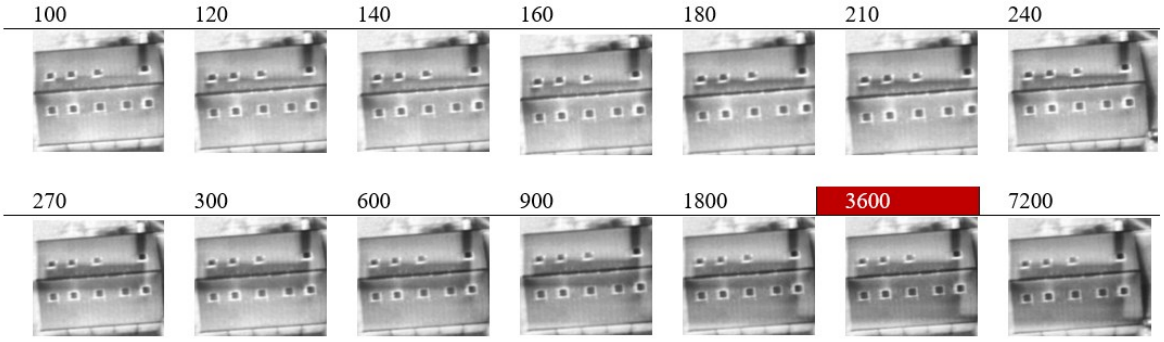


**Figure 3.** A second insight for the second ROI. Thermal traces of the roof.

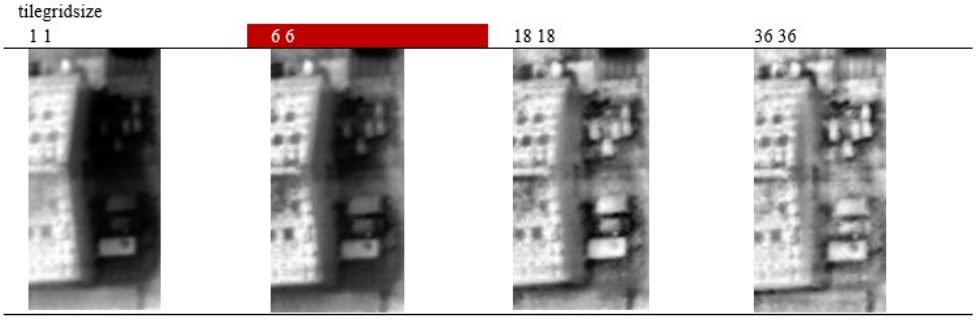


**Figure 4.** The preferring setting was finally picked up to 6 - 6.

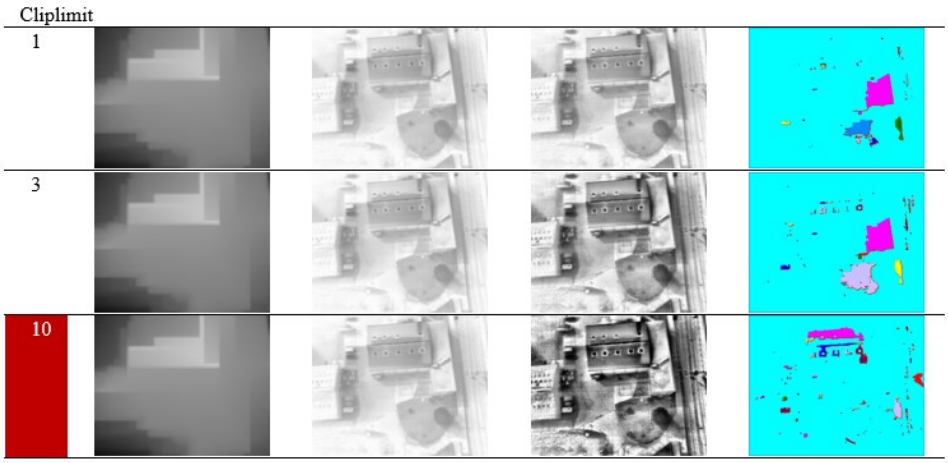


**Figure 5.** The second parameter was limited to 10 with regard of a first Watershed segmentation preview.

[64] SenseFly® Duet T® Camera Collection; Flir® Duo & Duo R® User Guide (2017)
[65] Flir® C5 User's manual Cx series (2020)

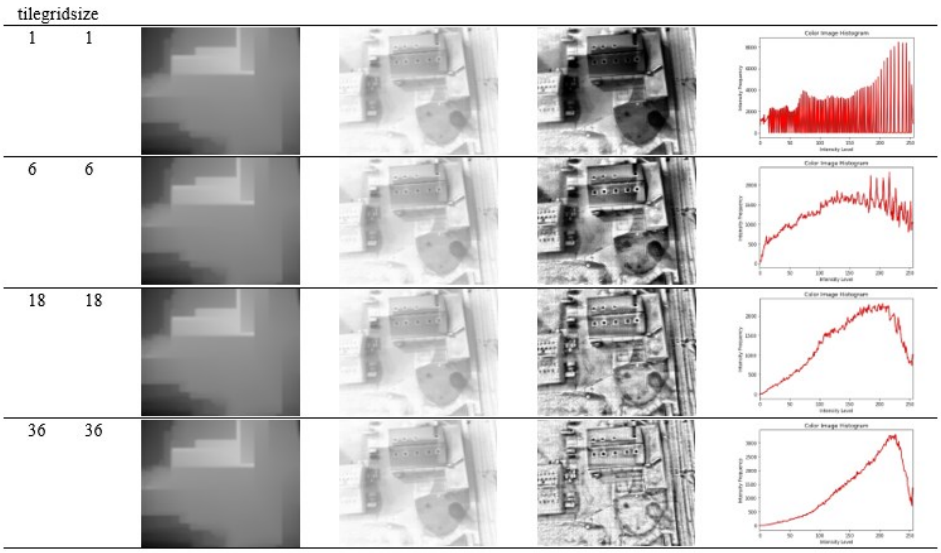


**Figure 6.** The tilegridsize block-based processing, amplified and finished to apply histogram equalization to each of the occlusions.

**5 Watershed segmentation**

The results of the watershed over-segmentation of FFT allowed for enhancing even tiny and apparently insignificant infrared differences. Removing minima traces is considered too shallow, due to the impossibility of operating with military measuring devices that better accomplish an ideal environment.

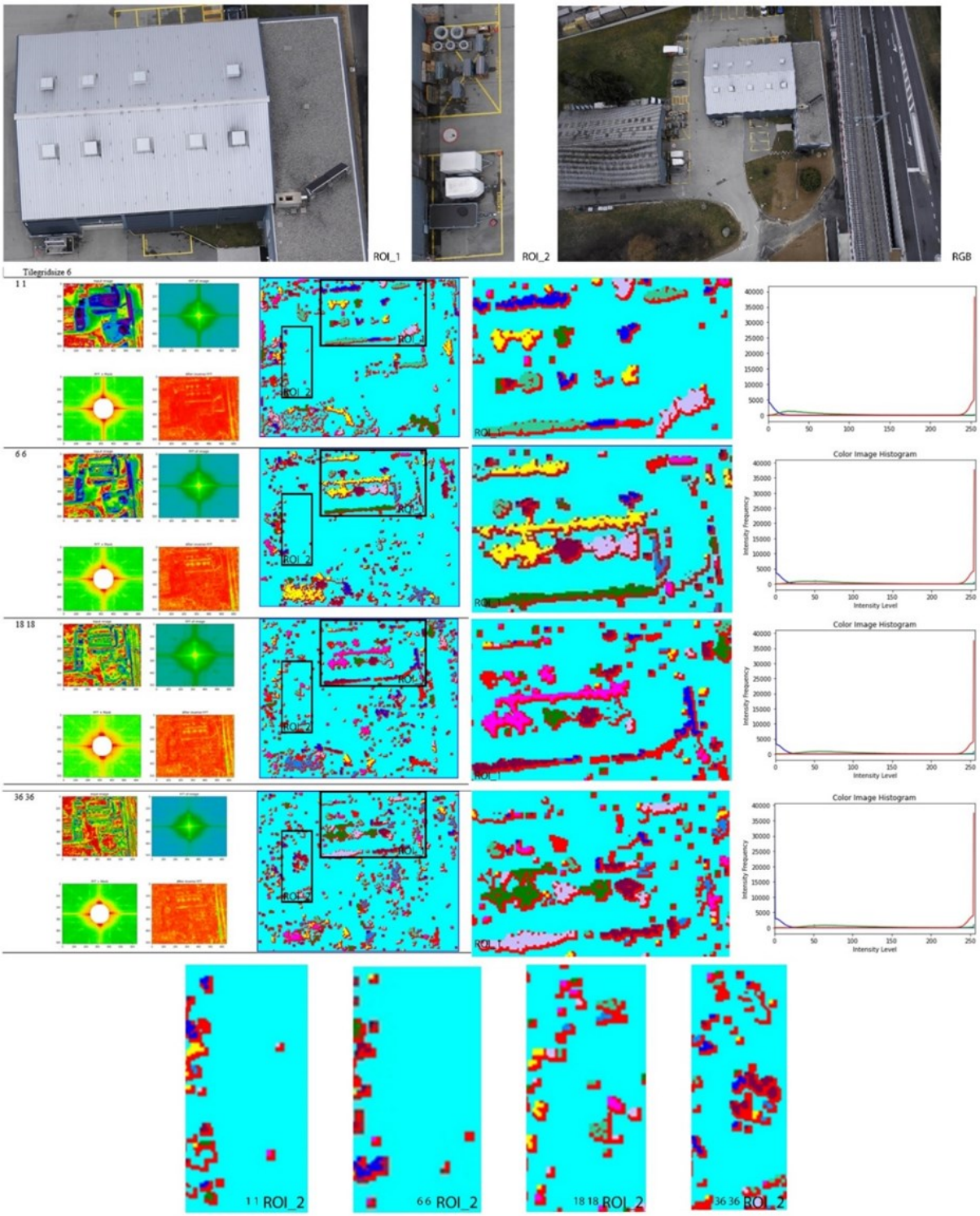


**Figure 7.** Results of final Watershed segmentation. The RGB histograms vary at the increment of tiles.

Regarding the unmanned dataset, the ROI_2 36-36 frame benefitted from the hyper-parameterization with the vehicle thermal traces on the environment [66] (depending on sunlight to vehicle heat transfer) and recent utilization

[66] Libra, Martin, Milan Daneček, Jan Lešetický, Vladislav Poulek, Jan Sedláček, e Václav Beránek. «Monitoring of Defects of a Photovoltaic Power Plant Using a Drone». Energies 12, n. 5 (27 febbraio 2019): 795. https://doi.org/10.3390/en12050795.

characteristics [67] (heated or cold engine). This railway infrastructure, [68] [69] [70] [71] [72] [73] [74] [75] is in fact specified in the literature review by which we assist in an upgrade of awareness spectral signatures obtained with the "heat islands" roof emissivity and pieces of machinery, parked in a stack.

Regarding the ground thermal survey, instead, the segmentation has, with the need for extended enhancement, augmented the silhouettes of the ships, in the condition of cast sunlight day and night light. In particular, some qualitative signs have been reported: three persons on board (Fig.8a), the heterogeneity of cliff composition (Fig.9a), and structural deficiencies of the hulf (Fig.10a). In compromised light conditions, it was necessary for a hyper-parameterization of radius and tiles, to better detect the objects cast in the obscurity of the cliff.

The personnel on board was not easily identifiable at distance, except for the face. The emissions were on the contrary clear at the stern/bow rather than the human factor.

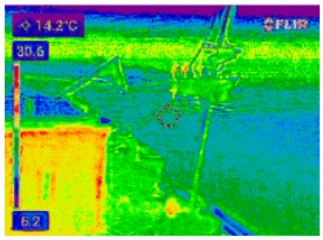

Figure 8a: Small vessel.

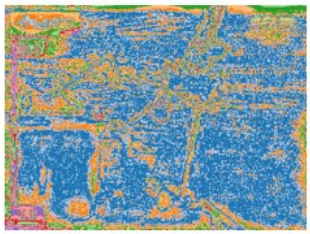

Figure 8b: FFT (ropes and edges).

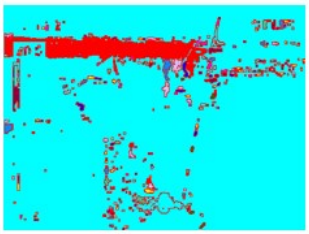

Figure 8c: Watershed (three figures).

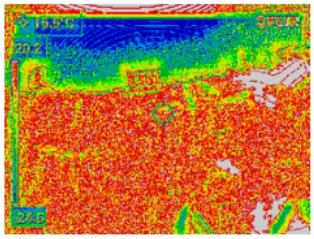

Figure 9a: Castle and rock cliff.

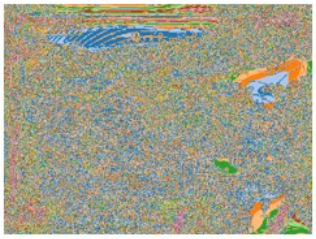

Figure 9b: FTT (rock formations).

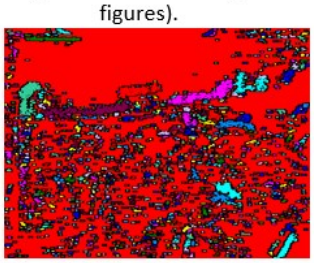

Figure 9c: Watershed (rocks and castle).

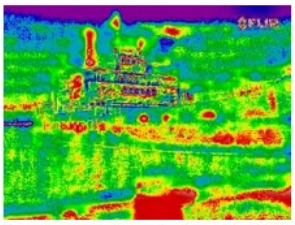

Figure 10a: Ro-Ro refuelling in harbour.

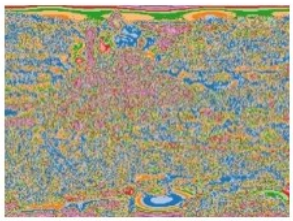

Figure 10b: FFT (berth, hulf, chimnery).

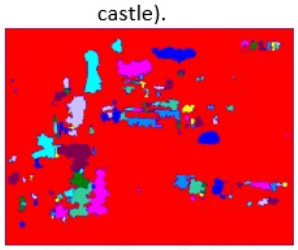

Figure 10c: – Watershed (reflected heat island).

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**Conflict of Interests**
The authors declare no conflict of interest.

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# Analysis of Technical Indicators for Leak Performance in District Metered Areas with Active Leak Control

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**Abstract**
Active leak control method is applied to detect and prevent unreported leaks in distribution systems. These leaks are determined and repaired by applying this method. However, during the application of this method, the field works are carried out in the field and cost is incurred. For this reason, it is necessary to analyze the benefits obtained after applying this method. This benefit is basically the amount of leakage prevented by the application of this method. In this study, active leakage control was applied in isolated measurement zones in drinking water distribution systems and the gains were analyzed according to technical performance indicators. In this context, the province of Malatya was chosen as the application area of the central distribution system. In the application area, active leakage control has been applied in 4 isolated measurement zones. The total volume of leakage prevented at the beginning and end of the study was determined. Then, technical performance indicators were calculated for each isolated measurement zone. These indicators are basically leakage amount per unit network length, leakage amount per unit service connection. Thus, the benefits obtained in the considered time period were analyzed according to the physical properties of the system. With the help of these indicators, it provides an opportunity to evaluate whether the active leakage control implemented improves the leakage performance of the system or not. It is thought that the outputs obtained from this study will make important contributions especially for practitioners.
**Keywords:** Urban water management, leakage, isolated zone, performance indicator.

# Aktif Kaçak Kontrolü Uygulanan İzole Ölçüm Bölgelerinde Sızıntı Performansı için Teknik Göstergelerin Analizi

**Özet**
Dağıtım sistemlerinde meydana gelen ve yüzeye çıkmayan sızıntıların belirlenmesi ve önlenmesi için aktif kaçak kontrolü yöntemi uygulanmaktadır. Bu yöntemin uygulanması ile sızıntılar belirlenerek onarılmaktadır. Ancak bu yöntemin uygulanması sırasında sahada çalışmalar yapılmakta ve maliyet oluşmaktadır. Bu nedenle bu yöntemin uygulandıktan sonra elde edilen faydaların analiz edilmesi gerekir. Bu fayda temel olarak bu yöntemin uygulanması ile önlenen sızıntı miktarıdır. Bu çalışmada içme suyu dağıtım sistemlerinde izole ölçüm bölgelerinde aktif kaçak kontrolünün uygulanmış ve elde edilen kazanımlar teknik performans göstergelerine göre analiz edilmiştir. Bu kapsamda Malatya ili merkez dağıtım sistemi uygulama alanı olarak seçilmiştir. Uygulama alanında 4 adet izole ölçüm bölgesinde aktif kaçak kontrolü uygulanmıştır. Çalışmanın başlangıç ve sonu itibariyle önlenen toplam sızıntı hacmi belirlenmiştir. Daha sonra her bir izole ölçüm bölgesi için teknik performans göstergeleri hesaplanmıştır. Bu göstergeler temel olarak, birim şebeke uzunluğu başına sızıntı miktarı, birim servis bağlantı başına sızıntı miktarı, şeklindedir. Böylece göz önüne alınan zaman aralığında elde edilen faydalar sistemin fiziksel özelliklerine göre analiz edilmiştir. Bu göstergeler yardımıyla uygulanan aktif kaçak kontrolünün sistemin sızıntı performansının iyileştirip iyileştirmediği kapsamında değerlendirme imkanı sunmaktadır. Bu çalışmadan elde edilen çıktıların özellikle uygulayıcılar için önemli katkılar sunacağı düşünülmektedir.
**Anahtar Kelimeler:** Kentsel su yönetimi, sızıntı, izole bölge, performans göstergesi.

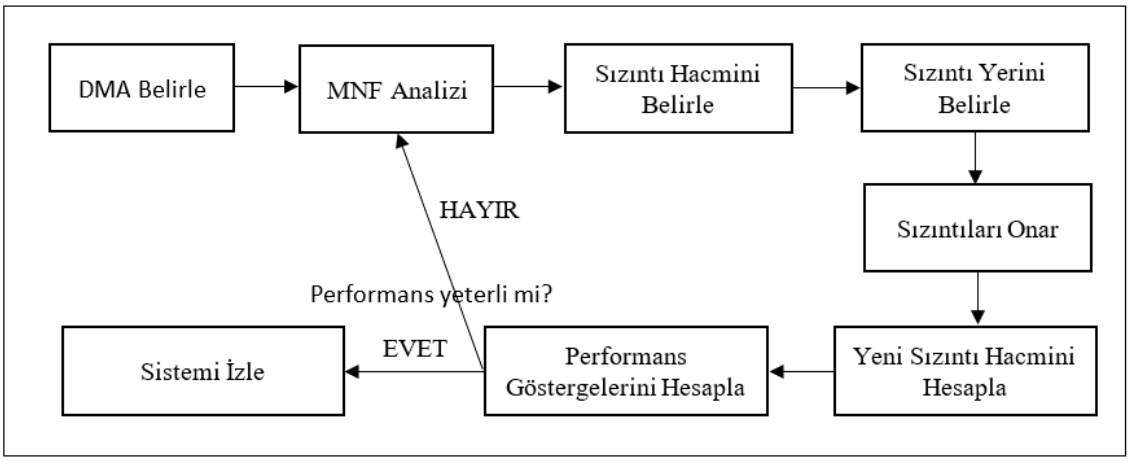
## 1. Giriş

Içme suyu dağıtım sistemlerinde meydana gelen arızalar, işletme koşullarının bozulmasına, maliyetlerin artmasına ve hizmet kalitesinin düşmesine neden olmaktadır. Bu nedenle arızaların azaltılmasına bağlı olarak finansal, çevresel, işletme ve personel verimlilik sağlamak mümkün olacaktır. Dağıtım sistemlerinde sisteme verilen ancak ücreti alınamayan su, gelir getirmeyen su (GGS) olarak ifade edilir (Pearson, 2019). GGS temel olarak, şebekedeki sızıntılar, idari kayıplar ve yasal faturalandırılmamış kullanımlar (itfaiye, yangın hidrant kullanımı, ibadethane) gibi bileşenlerden oluşmaktadır (Farley vd., 2008). Sızıntılar, genel olarak dağıtım sisteminde ana hatlarda, servis bağlantılarında ve vanalarda gözlenmektedir. Bu sızıntılar belli bir kısmı yüzeye çıkarken (rapor edilen arızalar) önemli bir kısmı ise yüzeye çıkmamaktadır (rapor edilmeyen arızalar) (Boztaş vd., 2019). Bu sızıntıların azaltılması, önlenmesi ve yönetilmesi için, basınç kontrol yönetim sistemi (Creaco ve Walski, 2017; Muhammetoglu vd., 2018; Özdemir vd., 2021), aktif sızıntı kontrolü (Cabral vd., 2019; Lipiwattanakarn vd., 2019; Durmuşçelebi vd., 2021), arıza oranının azaltılması, arıza yönetimi, şebeke yenileme ve boru

malzemesi yönetimi (Marchionni vd., 2016; Agathokleous ve Christodoulou, 2017), SCADA sistemi ile hidrolik bileşenlerin izlenmesi ve analizi (Güngör vd., 2019) gibi temel yöntemler uygulanmaktadır. Bu yöntemler uygulanarak sızıntıların izlenmesi, tespit edilmesi, kontrol edilmesi ve yönetilmesi mümkün olmakla birlikte, yöntemlerin gereksinimleri, kısıtları, ilk kurulum ve işletme-bakım maliyetleri önemli seviyelere ulaşmaktadır (Yılmaz, 2021). Bu nedenle, sistemin işletme bileşenlerini dikkate alınması, su kayıp bileşenleri için ekonomik analizlerin yapılması ve fayda-maliyet analiz modelinin tanımlanması, etkin ve sürdürülebilir su kayıp yönetimi açısından oldukça önemlidir (Ezbakhe ve Foguet 2019; Jensen ve Nair 2019; Lopez vd., 2019; Yılmaz vd., 2021). Zamenian vd. (2017), şebekede oluşan arızaların, önemli sosyal, ekonomik ve çevresel etkilerinin olduğunu ve özellikle pompa ile beslenen sistemlerde enerji tüketimi ciddi oranda arttırdığını vurgulamıştır. Bu nedenle, boruların mevcut durumun değerlendirilmesi, arıza oranı tahmini yapılarak yenileme yapılacak bölgelerin önceliklendirilmesi için stratejik varlık yönetimi planlarının oluşturulması gerektiğini belirtmiştir.
Lipiwattanakarn vd. (2019), sızıntılarla mücadelenin ve arızaların onarılmasının enerji ve sistem işletme maliyeti üzerindeki etkilerini araştırmıştır. Uygulama alanında izole bölgede sızıntıların onarılmasından sonra izole bölge giriş debisinin % 9 azaldığını buna bağlı olarak sistem giriş enerjisinde % 8 azalma tespit edildiği, aktif kaçak kontrolü uygulanmasıyla sistem verimliliğinin iyileştiği vurgulanmıştır. Creaco vd. (2019), gerçek zamanlı kontrol ve otomasyon sistemleri ile su dağıtım sistemlerinin ve bileşenlerinin (sistem basıncı, depo seviye, pompa çalışma süresi ve enerji optimizasyonu, basınç kontrol vanaları vb.) izlenmesi ve kontrol edilmesinde önemli faydalar sağladığını vurgulamıştır. Güngör vd. (2019), yaptıkları çalışmada pilot bölgeler için uygulanan basınç yönetimi stratejisi ile sisteme daha az su verilerek önemli tasarruflar sağlanabileceğini göstermişlerdir. Ayrıca SCADA, abone yönetim sistemleri ve ölçülebilir alt bölgeler ile daha etkili bir su yönetim strateji ortaya konulabileceğini savunmuşlardır. Diğer taraftan, su kayıp önleme yöntemlerinin etkinliğinin test edilmesi ve verimliliğin izlenmesi için en uygun performans analizinin yapılması gerekir (Lambert vd., 1999; Liemberger vd., 2006). Performans değişiminin analiz edilmesinde uygulanabilir ve karşılaştırılabilir göstergeler kullanılarak çalışmanın başlangıcı ve sonundaki performanslarının analiz edilmesi gerekmektedir. Sızıntı yönetimi performansının izlenmesinde, sistem giriş hacminin yüzdesi, şebeke uzunluğu ve servis bağlantı sayısını esas alan göstergeler kullanılmaktadır. Fontana vd. (2018) sızıntıların önlenmesi ve azaltılması amacıyla gerçek zamanlı basınç kontrol sistemini önermiştir. Saha uygulama sonucunda gerçek zamanlı basınç kontrolünün minimum gece debisinin azaltılması, basınç dalgalanmalarının en aza indirilmesi ve basıncın düzenlenmesi kapsamında önemli kazanımların elde edildiğini vurgulamıştır. Moslehi vd. (2020) sıklıkla kullanılan kayıp azaltma yöntemlerinden biri olan basınç yönetiminin ekonomik faydalarını araştırmıştır. Çalışmada sabit çıkışlı basınç kırıcı, debi duyarlı ve zaman ayarlı basınç kırıcı vanalar (PRVs) karşılaştırılmış ve debi duyarlı PRVs ile sistemin yönetilmesinde en iyi sonuçların elde edildiği ortaya konulmuştur. Dağıtım sistemlerinde meydana gelen ve yüzeye çıkmayan sızıntıların belirlenmesi ve önlenmesi için aktif kaçak kontrolü yöntemi uygulanmaktadır. Bu yöntemin uygulanması ile sızıntılar belirlenerek onarılmaktadır. Ancak bu yöntemin uygulanması sırasında sahada çalışmalar yapılmakta ve maliyet oluşmaktadır. Bu nedenle bu yöntemin uygulandıktan sonra elde edilen faydaların analiz edilmesi gerekir. Bu fayda temel olarak bu yöntemin uygulanması ile önlenen sızıntı miktarıdır. Bu çalışmada içme suyu dağıtım sistemlerinde izole ölçüm bölgelerinde aktif kaçak kontrolünün uygulanmış ve elde edilen kazanımlar teknik performans göstergelerine göre analiz edilmiştir. Bu kapsamda Malatya ili merkez dağıtım sistemi uygulama alanı olarak seçilmiştir. Uygulama alanında 4 adet izole ölçüm bölgesinde aktif kaçak kontrolü uygulanmıştır.

## 2. Materyal ve Metot

Izole ölçüm bölgesi (DMA), su kayıplarının azaltılması ve yönetilmesinde kullanılan, izolasyon vanalarıyla diğer şebeke elemanlarından ayrılan ve genelde 1 veya 2 girişe sahip alt bölgeler olarak tanımlanabilir (Pearson, 2019). Dağıtım sistemlerinde aktif sızıntı kontrolünün uygulanabilmesi ve beklenen faydaların elde edilmesi için DMA planlamak en temel adım olarak gösterilebilir (Morrison, Tooms ve Rogers, 2007; Farley vd., 2008; Mutikanga, Sharma ve Vairavamoorthy, 2013). DMA planlanan ve sahada uygulanan dağıtım sistemlerinde minimum gece debisi (MNF) analizi yapılmakta, potansiyel önlenebilir sızıntı belirlenmekte ve akustik yöntemlerle sızıntı yerleri tespit edilmektedir. Bu süreçlerin uygulanması ile özellikle yüzeye çıkmayan arızaların daha etkin yönetilmesi mümkün olmaktadır. Bu çalışmada DMA planlanmış ve sahada uygulanmış dağıtım sistemlerinde performansın izlenmesi ve analiz edilmesi amaçlanmıştır. Bu amaçla literatürde sızıntıların izlenmesi ve değişimin analiz edilmesi kapsamında önerilen çeşitli performans göstergeleri belirlenmiştir. Süreç göstergeleri olarak da ifade edilen bu göstergeler kullanılarak yöntemin uygulandığı ilk durumdaki koşullara ve yöntemin uygulanmasından sonra oluşan koşullara göre analiz gerçekleştirilmektedir. Bu çalışmada izlenen metodoloji Şekil 1'de verilmiştir.




**Şekil 1.** Sızıntı Yönetimi ve Performans Analizi için İzlenen Yol

Minimum gece debisi (MNF) analizinde önemli olan hususlardan biri, gece tüketimlerinin en doğru şekilde tespit edilebilmesidir. Bilindiği üzere bir dağıtım sisteminde su tüketimi gece saatlerinde (özellikle 02:00-04:00 arası) minimum seviyeye inmekte ve bu saatlerde sisteme fazla su girişi gözlenirse sızıntı veya kaçak kullanım ihtimali göz önüne alınmalıdır. Bu kapsamda öncelikle denklem (1) kullanılarak belirsiz sızıntılar hesaplanmaktadır. Daha sonra gece saatlerinde abone profiline bağlı olarak denklem (2) kullanılarak gece yasal tüketimler hesaplanmaktadır (Lambert vd., 1999).

$$Q_{sızıntı} = (C_1 * L_m + C_2 * N_c) * (0.028 * P - 0.347) \quad (1)$$

$$Q_{tüketim} = 500 + N_{konut} * 1.7 + N_{tic} * 8) \quad (2)$$

Bu denklemlerde, Lm; şebeke uzunluğu (km), $N_c$; Servis bağlantı sayısı, P; gece debisi saatlerinde ortalama basıncı (m), C1 ve C2 sırasıyla boru ve özel bağlantı sızıntısı katsayısı, $N_{konut}$, konut abone sayısı, $N_{tic}$, ticari abone sayısını ifade etmektedir. Bölgede bu bileşenler hesaplandıktan sonra, MNF anındaki giriş debisinden gece yasal tüketimler ve belirsiz sızıntılar çıkarılarak potansiyel önlenebilir sızıntı hesaplanmaktadır.

Performans analizinin yapılması, sistem için önemli olan bileşenlerin düzenli izlenmesi, zayıf yönlerin belirlenmesi ve iyileştirilmesi için en uygun yöntemin belirlenmesi, sistem işletme maliyetinin düşürülmesi ve abone memnuniyetinin arttırılması açısından oldukça önemlidir. Ancak bu değerlendirmelerin ve analizlerin yapılabilmesi için sistem performansının en uygun, uygulanabilir, kıyaslanabilir, anlaşılır ve verisi ölçülebilir göstergelerle izlenmesi gerekir. Performans göstergeleri sisteminin Su İdarelerine uygulanması ile beklenen faydalar şunlardır;

- İdarenin performansının ana bileşenlerde analiz edilmesi, izlenmesi ve kıyaslanması,
- Karar vericiler için kurumun eksik ve güçlü yanlarının ortaya konulması,
- Dağıtım sisteminin hizmet kalitesinin arttırılması ve GGS oranının en aza indirilmesi,
- Su ve enerji tüketimi, personel, ekipman, mali açıdan sistemin veriminin arttırılması,
- Performansın iyileştirilmesi için yatırım planlamalarının/düzenlemelerin yapılması,
- Yapılan yatırımların/alınan kararların etkilerinin izlenmesi ve strateji geliştirilmesi

Bu kapsamda bir dağıtım sisteminde GGS ve alt bileşenlerini çeşitli parametrelere göre değerlendiren göstergeleri hesaplamaktadır;

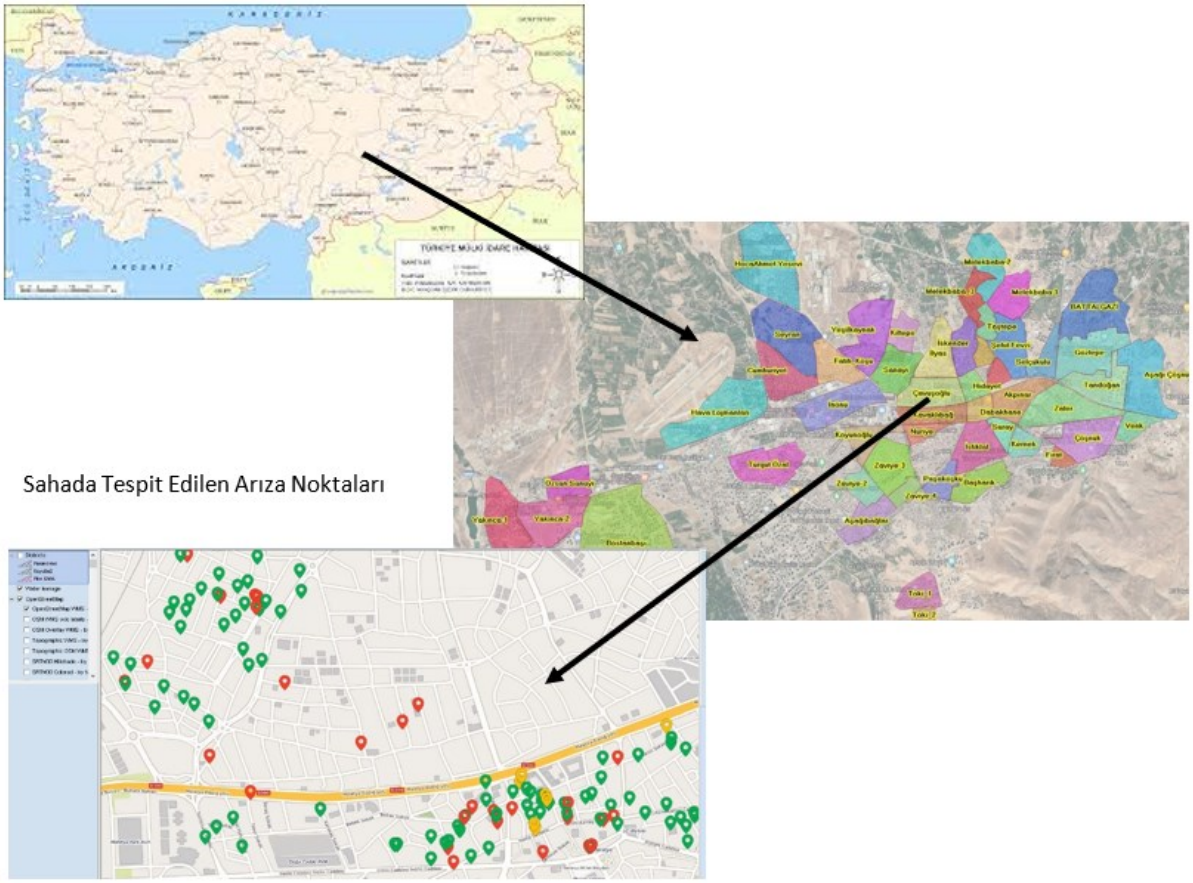
- Hacimsel ve SIV % si olarak GGS performansı
- Birim Servis Bağlantı sayısına göre Performans Göstergeleri
- Birim ana hat uzunluğuna göre Performans Göstergeleri
- Fiziki Kayıp Göstergeleri

**Tablo 1.** Fiziki Kayıplar İçin Süreç Göstergeleri

| Parametreler | Birim | Açıklama |
|---|---|---|
| Fiziki Kayıp Oranı | % | (Fiziki Kayıp Hacmi / Sistem Giriş Hacmi)*100 |
| Birim Servis Bağlantı Başına Fiziki Kayıp Hacmi | litre / bağlantı /gün | (Fiziki Kayıp Hacmi / Servis Bağlantı Sayısı / Gün) |
| Birim Hat Uzunluğu Başına Fiziki Kayıp Hacmi | litre /km/gün | (Fiziki Kayıp Hacmi / / Şebeke Ana Hat Uzunluğu (km) / Gün) |

| | | |
|---|---|---|
| Birim Basınç Altında Servis Bağlantı Başına Fiziki Kayıp Hacmi | litre / bağlantı /gün/basınç(m) | (Fiziki Kayıp Hacmi / Servis Bağlantı Sayısı / Basınç (m)/ Gün) |
| Birim Basınç Altında Hat Uzunluğu (km) Başına Fiziki Kayıp Hacmi | litre /km /gün/basınç(m) | (Fiziki Kayıp Hacmi / Şebeke Ana Hat Uzunluğu (km) / Basınç (m)/ / Gün) |

Çalışma kapsamında bu analizlerin gerçekleştirilmesi için Malatya ili merkez dağıtım sisteminde pilot izole bölgelere ait veriler kullanılmıştır (Şekil 2). Bu veriler Malatya Su ve Kanalizasyon İdaresi (MASKİ) Genel Müdürlüğü İçme Suyu Daire Başkanlığının sahada yaptığı çalışmalardan elde edilmiştir (Tablo 2) (MASKİ, 2022).




**Şekil 2.** Çalışma Alanı ve Arıza Bölgeleri

**Tablo 2.** Pilot İzole Bölgelere ait Karakteristik Bilgiler (MASKİ, 2021)

| Parametreler | DMA 1 | DMA 2 | DMA 3 |
|---|---|---|---|
| Şebeke Uzunluğu (km) | 6.09 | 14.076 | 14.733 |
| Servis Bağlantı Sayısı (adet) | 401 | 682 | 522 |
| Abone Sayısı (adet) | 2161 | 1581 | 3397 |
| Ortalama Basınç (m) | 55 | 48 | 51 |
| Çalışma Başlangıcı Ölçülen MNF | 29 | 44 | 39 |
| Çalışma Başlangıcı Hesaplanan Gece Yasal Tüketim (l/s) | 4.10 | 2.0 | 3.89 |
| Çalışma Başlangıcı Hesaplanan Toplam Sızıntı (l/s) | 24.9 | 42 | 35.11 |
| Çalışma Sonunda Ölçülen MNF | 17 | 36 | 24 |
| Çalışma Sonunda Hesaplanan Gece Yasal Tüketim (l/s) | 4.10 | 2.0 | 3.89 |
| Çalışma Sonunda Hesaplanan Toplam Sızıntı (l/s) | 12.9 | 34 | 20.11 |

**3. Bulgular**

Su kayıp yönetiminde en önemli hususlardan birtanesi de performans izleme süreçlerinin sağlıklı bir şekilde yapılmasıdır. Su kayıplarının azaltılması için yapılacak saha çalışmalarının performanslarının ve elde edilen kazançların tespit edilmesi amacıyla performans göstergeleri hesaplamaları yapılmaktadır. Bu kapsamda Malatya ili merkez dağıtım sisteminde 3 adet izole ölçüm bölgesi (DMA) pilot bölge olarak belirlenmiştir (Tablo 2).

Bu kapsamda her bölge için çalışma öncesi ve sonrası olmak üzere; toplam sızıntı hacimleri, fiziki kayıp oranları, birim servis bağlantı başına fiziki kayıp hacimleri, birim hat uzunluğu başına fiziki kayıp hacimleri, birim basınç altında servis bağlantı başına fiziki kayıp hacimleri ve birim basınç altında hat uzunluğu (km) başına fiziki kayıp hacimleri hesaplanmıştır (Tablo 3). Söz konusu hesaplamalarda öncelikli olarak izole bölgelerin genel karakteristik özellikleri (uzunluk, abone sayısı, bağlantı sayısı ve basınç); abone yönetim sistemleri, çoğrafi bilgi sistemleri ve SCADA sistemi yardımıyla tespit edilmiştir. Her bir izole bölge için giriş debilerinin de ölçülmesiyle beraber detayları daha önce verilmiş yöntemler yardımıyla minimum gece debileri hesaplanmıştır. Yapılan hesaplamalar ile her bir bölge için ayrıca gece yasal tüketimler ve tahmini sızıntı miktarları da tespit edilmiştir.

**Tablo 3.** Fiziki Kayıplar için Süreç Göstergeleri

| Parametreler | Birim | DMA1 | DMA2 | DMA3 |
|---|---|---|---|---|
| Çalışma Başlangıcı Toplam Sızıntı Hacmi | $m^3$/gün | 2151.36 | 3628.80 | 3033.50 |
| Fiziki Kayıp Oranı | % | 85.86% | 95.45% | 90.03% |
| Birim Servis Bağlantı Başına Fiziki Kayıp Hacmi | litre / bağlantı /gün | 5364.99 | 5320.82 | 5811.31 |
| Birim Hat Uzunluğu Başına Fiziki Kayıp Hacmi | litre /km/gün | 353261.08 | 257800.51 | 205898.59 |
| Birim Basınç Altında Servis Bağlantı Başına Fiziki Kayıp Hacmi | litre / bağlantı /gün/basınç(m) | 97.55 | 110.85 | 113.95 |
| Birim Basınç Altında Hat Uzunluğu (km) Başına Fiziki Kayıp Hacmi | litre /km /gün/basınç(m) | 6422.93 | 5370.84 | 4037.23 |
| Çalışma Sonunda Performans Göstergeleri | | | | |
| Fiziki Kayıp Oranı | % | 75.88% | 94.44% | 83.79% |
| Çalışma Sonunda Toplam Sızıntı Hacmi | $m^3$/gün | 1114.56 | 2937.6 | 1737.504 |
| Birim Servis Bağlantı Başına Fiziki Kayıp Hacmi | litre / bağlantı /gün | 2779.45 | 4307.33 | 3328.55 |
| Birim Hat Uzunluğu Başına Fiziki Kayıp Hacmi | litre /km/gün | 183014.78 | 208695.65 | 117932.80 |
| Birim Basınç Altında Servis Bağlantı Başına Fiziki Kayıp Hacmi | litre / bağlantı /gün/basınç(m) | 50.54 | 89.74 | 65.27 |
| Birim Basınç Altında Hat Uzunluğu (km) Başına Fiziki Kayıp Hacmi | litre /km /gün/basınç(m) | 3327.54 | 4347.83 | 2312.41 |

Çalışma yapılan izole bölgeler incelendiğinde fiziki kayıp oranlarının çok yüksek olduğu (sırasıyla %85, %95 ve %90) görülmektedir. Günlük toplam sızıntı hacimleri de incelendiğinde görülecektir ki söz konusu bölgeler de içme suyu sızıntı yönetiminin hayata geçirilmesi elzemdir. Bu bölgelerin mevcut şartlarda teknik ve ekonomik olarak işletilmesi İdare için mümkün görülmemektedir. Bu nedenle izole bölgelerde çeşitli arıza tespit yöntemleri ile (aktif kaçak kontrolü, sızıntı dinleme metodu vs.) arızalar tespit edilmiş ve onarımları gerçekleştirilmiştir. Çalışma sonrası giriş debileri tekrardan ölçülmüş ve bu kapsamda tahmini sızıntı miktarları yeniden hesaplanmıştır (Tablo 2 ve Tablo 3).

Yapılan çalışma sonucunda ilk performans değerlendirmesi fiziki kayıp oranları üzerinden yapılabilir. Ancak bilinmelidir ki sadece giriş hacminin değişmesine bağlı olarak değişen bu gösterge, performans izlemede tek başına yeterli bir etkiye sahip değildir ve tek başına kullanılması doğru bir performans izleme için yeterli olmayacaktır. Bölgeler incelendiğinde toplam sızıntı hacimlerinde ciddi oranlarda bir azalış gözlemlenmesine rağmen fiziki kayıp oranlarındaki azalış miktarları aynı oranda olmamıştır. Öyleki yapılan sızıntı azaltma çalışmalarından sonra DMA 1 için toplam sızıntı hacmi yaklaşık olarak %48 azaltılmış olmasına rağmen fiziki kayıp oranlarında sadece %10'luk bir azalma olduğu görülmektedir. Benzer yaklaşımlar diğer DMA bölgeleri içinde geçerlidir. Bu nedenle de performans izlemede fiziki kayıp oranı göstergesinin tek başına yeterli olmayacağı görülmektedir.

Bir diğer performans izleme parametresi olarak birim servis bağlantı başına fiziki kayıp hacmi ve birim hat uzunluğu başına fiziki kayıp hacmi kullanılmıştır. Buradaki temel gaye sızıntıların birimini boyutsuzlaştırarak farklı çalışma bölgelerinin durumlarının birbirleriyle ve kendi içerisinde kıyasının yapılmasına imkan sunulmasıdır. Bu kapsamda yapılan hesaplamalar sonucunda ilk durumda (sızıntı azaltma çalışması öncesi) birim servis bağlantı başına fiziki kayıp oranları sırasıyla 5364.99, 5320.82 ve 5811.31 litre/bağlantı/gün olarak hesaplanmıştır. Bu bölgeler birbirleriyle kıyaslandığında

benzer performanslarda oldukları görülmüştür. Yapılan kayıp azaltma çalışmaları sonrasında ise bu değerler yeniden hesaplanmıştır. Yapılan hesaplamalarda DMA bölgeleri için yeni değerler sırasıyla 2779.45, 4307.33 ve 3328.55 litre/bağlantı/gün şeklinde olmuştur. Yine birim hat uzunluğu başına fiziki kayıp hacimleri de ilk olarak 353261.08, 257800.51 ve 205898.59 litre /km/gün şeklinde hesaplanmış ardından yapılan çalışmalar ile birlikte 183014.78, 208695.65 ve 117932.80 litre /km/gün'e düşürülmüştür. İlgili performanslar incelendiğinde fiziki kayıp oranlarından farklı olarak değişimlerin fiziki kayıp hacimlerindeki değişimle orantılı oranda olduğu görülmektedir. Bu kapsamda DMA 1 için yaklaşık %50'e varan bir iyileştirme oranından söz edilebilmektedir.

Performans değerlendirmede kullanılan bir diğer temel unsurda birim basınç altında servis bağlantı başına veya şebeke uzunluğu başına fiziki kayıp hacminin yorumlanmasıdır. Kayıp hacimlerinin basınçla doğrudan etkili olduğu bilindiğinden (Lambert ve Lalonde, 2005) basınç biriminin de boyutsuzlaştırılması bölgelerdeki kayıp performanslarının birbirleriyle kıyaslanmasında önemli bir avantaj sunmaktadır. Bu kapsamda kayıp azaltma çalışmaları öncesinde bölgeler incelendiğinde birim basınç altında servis bağlantı başına fiziki kayıp hacimleri sırasıyla 97.55, 110.85 ve 113.95 litre/bağlantı/gün/basınç(m) şeklinde hesaplanmıştır. Söz konusu veriler ile birim servis bağlantı başına fiziki kayıp hacimleri kıyaslandığında görülecektir ki; birim servis bağlantı başına fiziki kayıp hacmi DMA1 bölgesinde DMA2 bölgesine göre daha fazla olmasına rağmen (DMA1:5364.99 ve DMA2: 5320.82), kıyaslamaya basınç faktörü dahil olduğında DMA2 bölgesinin daha kötü bir performansa (DMA1: 97.55 ve DMA2:110.85) sahiptir. Bu nedenle iki farklı bölgenin birbirleriyle kıyaslaması yapılacaksa basınç faktörüde dikkate alınmalıdır.

**4.Tartışma ve Sonuç**

Su kayıp yönetiminde en önemli hususlardan birtanesi de performans izleme süreçlerinin sağlıklı bir şekilde yapılmasıdır. Bu çalışmada içme suyu dağıtım sistemlerinde izole ölçüm bölgelerinde aktif kaçak kontrolünün uygulanmış ve elde edilen kazanımlar teknik performans göstergelerine göre analiz edilmiştir. Bu kapsamda Malatya ili merkez dağıtım sistemi uygulama alanı olarak seçilmiştir. Uygulama alanında 4 adet izole ölçüm bölgesinde aktif kaçak kontrolü uygulanmıştır. Çalışmanın başlangıç ve sonu itibariyle önlenen toplam sızıntı hacmi belirlenmiştir. Daha sonra her bir izole ölçüm bölgesi için teknik performans göstergeleri hesaplanmıştır. Bu kapsamda her bölge için çalışma öncesi ve sonrası olmak üzere; toplam sızıntı hacimleri, fiziki kayıp oranları, birim servis bağlantı başına fiziki kayıp hacimleri, birim hat uzunluğu başına fiziki kayıp hacimleri, birim basınç altında servis bağlantı başına fiziki kayıp hacimleri ve birim basınç altında hat uzunluğu (km) başına fiziki kayıp hacimleri hesaplanmıştır. Bu kapsamda fiziki kayıp oranları göstergesi değerlendirilmiştir. Giriş hacminin değişmesine bağlı olarak değişen bu gösterge, performans izlemede tek başına yeterli bir etkiye sahip değildir ve tek başına kullanılması doğru bir performans izleme için yeterli olmayacaktır. Bölgeler incelendiğinde toplam sızıntı hacimlerinde ciddi oranlarda bir azalış gözlemlenmesine rağmen fiziki kayıp oranlarındaki azalış miktarları aynı oranda olmamıştır. Öyleki yapılan sızıntı azaltma çalışmalarından sonra DMA 1 için toplam sızıntı hacmi yaklaşık olarak %48 azaltılmış olmasına rağmen fiziki kayıp oranlarında sadece %10'luk bir azalma olduğu görülmektedir. Benzer yaklaşımlar diğer DMA bölgeleri içinde geçerlidir. Bu nedenle de performans izlemede fiziki kayıp oranı göstergesinin tek başına yeterli olmayacağı görülmektedir. Benzer şekilde birim servis bağlantı başına fiziki kayıp hacmi ve birim hat uzunluğu başına fiziki kayıp hacmi göstergeleri kullanılmıştır. Buradaki temel gaye sızıntıların birimini boyutsuzlaştırarak farklı çalışma bölgelerinin durumlarının birbirleriyle ve kendi içerisinde kıyasının yapılmasına imkan sunulmasıdır. İlgili performanslar incelendiğinde fiziki kayıp oranlarından farklı olarak değişimlerin fiziki kayıp hacimlerindeki değişimle orantılı oranda olduğu görülmektedir. Bu kapsamda DMA 1 için yaklaşık %50'e varan bir iyileştirme oranından söz edilebilmektedir. Ayrıca performans değerlendirmede kullanılan bir diğer temel unsurda birim basınç altında servis bağlantı başına veya şebeke uzunluğu başına fiziki kayıp hacminin yorumlanmasıdır. Kayıp hacimlerinin basınçla doğrudan etkili olduğu bilindiğinden (Lambert ve Lalonde, 2005) basınç biriminin de boyutsuzlaştırılması bölgelerdeki kayıp performanslarının birbirleriyle kıyaslanmasında önemli bir avantaj sunmaktadır. Sonuç olarak sızıntıların yönetilmesinde önemli faydalar sağlayan aktif kaçak kontrolü yaklaşımının sahada oluşturduğu maliyetlerin de göz önüne alınması gerektiği ve yapılan çalışmalar sonucunda performanslarının da düzenli bir şekilde incelenmesi gerekliliği ortaya çıkmaktadır. Buna göre elde edilecek sonuçlarda bölgeler için ayrı ayrı performans kriterleri belirlenmeli ve yapılacak çalışmalarda öncelikler bu kıstasa göre yapılmalıdır. Bu çalışmadan elde edilen sonuçların özellikle sahada uygulayıcı ve karar vericiler için önemli bilgiler sunduğu düşünülmektedir.

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# Analysis of Cost and Benefit of Leakage Management in Isolated Metering Areas: Field Practices for Pilot Areas

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**Abstract**
Operating cost in urban water management is the most important component that should be reduced for administrations. The most basic way to reduce this is to minimize faults (reported failures) and leaks (unreported failures). The increase in the number of failures increases the volume of leakage, the frequency of maintenance and repair, and therefore the operating cost. For this reason, leaks that do not come to the surface especially need to be managed with the right methods. This study, it is aimed to analyze the cost of the methods applied in the management of non-surface leaks in distribution systems according to field data and to calculate the benefit resulting from the application of these methods. For this purpose, the Malatya water distribution system was chosen as the application area. In the application area, the costs of the inspections (crew, working hours and equipment) made by acoustic methods in the pilot isolated areas and the benefits of the detected leaks were analyzed in detail. Thus, the economic efficiency of the applied method and process is determined and monitored. It is understood that the studies will be inefficient if the costs of detecting faults that do not come to the surface are higher than the benefits to be obtained, especially in regions where the loss rate is low. In such areas, it is necessary to monitor flow and pressure changes, maintain the current situation and implement site inspections depending on the increase in leakage rate. It is thought that the outputs obtained from this study will contribute to technical personnel and decision-makers.
**Keywords:** Water management, leakage, cost, benefit analysis.

# İzole Ölçüm Bölgelerinde Sızıntı Yönetiminin Ekonomik Maliyetinin ve Faydasının Analizi: Pilot Bölgeler İçin Saha Uygulamaları

**Özet**
Kentsel su yönetiminde işletme maliyeti idareler için azaltılması gereken en önemli bileşendir. Bunu azaltmanın en temel yolu ise arızların (yüzeye çıkan) ve sızıntıların (yüzeye çıkmayan) en aza indirilmesidir. Arıza sayısının artması, sızıntı hacmini, bakım onarım sıklığını ve dolayısıyla da işletme maliyetini arttırmaktadır. Bu nedenle özellikle yüzeye çıkmayan sızıntıların doğru yöntemlerle yönetilmesi gerekir. Bu çalışmada dağıtım sistemlerinde yüzeye çıkmayan sızıntıların yönetilmesinde uygulanan yöntemlerin maliyetinin saha verilerine göre analizi ve bu yöntemlerin uygulanması ile ortaya çıkan faydanın hesaplanması amaçlanmıştır. Bu amaçla Malatya içmesuyu dağıtım sistemi uygulama alanı olarak seçilmiştir. Uygulama alanında pilot izole bölgelerde akustik yöntemlerle yapılan denetimlerin (ekip, çalışma saati ve ekipman) maliyetleri ve tespit edilen sızıntıların faydaları detaylı bir şekilde analiz edilmiştir. Böylece uygulana yöntemin ve sürecin ekonomik verimliliği belirlenmekte ve izlenmektedir. Özellikle kayıp oranının düşük olduğu bölgelerde yüzeye çıkmayan arızaların tespit maliyetlerinin elde edilecek faydalardan fazla olması durumunda yapılan çalışmaların verimsiz olacağı anlaşılmaktadır. Bu tür bölgelerde debi ve basınç değişimlerinin izlenmesi, mevcut durumun korunması ve sızıntı oranındaki artışa bağlı olarak saha denetimlerinin uygulanması gerekir. Bu çalışmadan elde edilen çıktıların teknik personeller ve karar vericiler için katkı sunacağı düşünülmektedir.
**Anahtar Kelimeler:** Kentsel su .yönetimi, sızıntı, maliyet, fayda analizi.

## 1. Giriş

Kentsel su yönetiminde, arıza oranının artması, şebeke ile elemanlarının yaşlanması ve faydalı ömürlerinin azalması, nüfus artışına bağlı olarak su talebinin fazla olması, mevcut sistemin kapasitesinin ihtiyacı karşılayamaması ve yeni yatırımların zorunlu hale gelmesi, sızıntı miktarının fazla olması ve önlenememesine bağlı olarak yeni kaynak arayışı ve enerji tüketiminin artması maliyetleri arttırmakta ve idareler için önemli ölçüde yükler getirmektedir. Ayrıca, birçok idarede gelir getirmeyen suyun önemli bir kısmını oluşturan fiziki kayıpların önlenmesi, azaltılması, kontrol edilmesi ve izlenmesi için uygulanan yöntemlerin ilk kurulum ve işletme-bakım maliyetleri de önemli seviyelere ulaşmaktadır. Bu nedenle, sistemin işletme bileşenlerini dikkate alınması, su kayıp bileşenleri için ekonomik analizlerin yapılması ve fayda-maliyet analiz

modelinin tanımlanması, etkin ve sürdürülebilir su kayıp yönetimi açısından oldukça önemlidir (Mutikanga vd., 2013; Ezbakhe ve Foguet 2019; Jensen ve Nair 2019; Lopez vd., 2019). Di Nardo vd. (2017), dağıtım sisteminin izole bölge oluşturmak için planlanması ve tasarlanmasının oldukça karmaşık yapıya sahip olduğu, hidrolik, ekonomik ve topolojik açıdan sistemin detaylı bir şekilde analiz edilmesi gerektiğini vurgulamıştır. Berardi vd. (2016), şebeke yönteminin ve su kayıplarının azaltılmasında aktif kaçak kontrolü çalışmalarının uygulanması ile sızıntı ve arızalardan dolayı çevreye verilebilecek olası zararların ve sızıntıdan kaynaklı su kaybının azaltılması, işletme maliyetinin düşürülmesi ile önemli faydaların elde edileceğini belirtmiştir.

Haider vd. (2019), yaptıkları çalışmada Suudi Arabistan'da yapılan çalışmaları incelemiş ve genel olarak su kayıplarının azaltılması amacıyla uygulanan temel yöntemlerin (aktif kaçak kontrolü, basınç yönetimi ve boru-malzeme yönetimi) ekonomik analizlerini yapmışlardır. Yapılan analizler sonucunda aktif kaçak yöntemi ile altyapı kaçak indeksi (ILI) seviyesinin 20'den 7.28'e kadar düşürülebileceği ve diğer yöntemlerinde uygulanması ile ekonomik olarak %43'lük bir kaybın sisteme kazandırılabileceğini tespit etmişlerdir. Ayrıca yapılan çalışmada su satış fiyatlarının artırılması ile aktif kaçak kontrolü ile elde edilebilecek faydanın artırılabileceği de önerilmiştir. Al-Washali vd. (2020), su kaybının sıfıra indirilmesinin teknik ve ekonomik olarak mümkün olmadığını, su kayıp bileşenlerinin doğru bir şekilde analiz edilerek kayıp azaltma politikası oluşturulması gerektiğini savunmuşlardır. Literatürde kabul görmüş yöntemler için yapılan analizlerde farklı yöntemler için aynı bölgelerde birbirinden farklı sonuçlar alındığını ve bu nedenle yapılacak çalışmalarda en az 2 yöntemin kullanılarak birbiriyle kıyaslamasının yapılması gerektiğini savunmuşlardır.

Samir vd. (2017), basınç yönetiminin su kayıp azaltma yöntemleri içerisindeki en iyi uygulamalardan biri olduğunu ortaya koymuştur. Yaptıkları çalışmada basınç kırıcı vanalar kullanılarak oluşturulan izole bölgelerde kayıp oranlarının %37'e kadar azaltılabildiği görülmüştür. Bu nedenle su yönetiminde ilk olarak basınç yönetimi uygulamasının ekonomik faydalarının ve maliyetlerinin analiz edilmesi tavsiye edilmiştir. Fontana vd. (2018), sızıntıların önlenmesi ve azaltılması amacıyla gerçek zamanlı basınç kontrol sistemini önermiş ve saha deneyleri sonucunda gerçek zamanlı basınç kontrolünün minimum gece debisinin azaltılmasında, basınç dalgalanmalarının en aza indirilmesinde ve basıncın düzenlenmesinde önemli kazanımların elde edildiğini vurgulamıştır. Yılmaz vd. (2021) dağıtım sistemlerinde meydana gelen sızıntıların yönetilmesinde aktif sızıntı kontrolü ve basınç yönetimi gibi temel yöntemler önemli fayda sağladığını ifade etmiştir. Bununla birlikte bu yöntemlerin uygulanması sırasında ekipman, personel, saha çalışması ve veri transferi ve izlenmesi kapsamında önemli maliyetlerin oluştuğu da vurgulanmıştır. Bu nedenle bu yöntemler uygulanmadan önce ortaya çıkacak maliyetler ve potansiyel faydalar analiz edilmelidir.

Bu çalışmada dağıtım sistemlerinde yüzeye çıkmayan sızıntıların yönetilmesinde uygulanan yöntemlerin maliyetinin saha verilerine göre analizi ve bu yöntemlerin uygulanması ile ortaya çıkan faydanın hesaplanması amaçlanmıştır. Bu amaçla Malatya içmesuyu dağıtım sistemi uygulama alanı olarak seçilmiştir. Uygulama alanında pilot izole bölgelerde akustik yöntemlerle yapılan denetimlerin (ekip, çalışma saati ve ekipman) maliyetleri ve tespit edilen sızıntıların faydaları detaylı bir şekilde analiz edilmiştir.

## 2. Materyal ve Yöntem

Dağıtım sistemlerinde, sızıntıların önemli bir kısmını oluşturan rapor edilmeyen sızıntıların farkına varılması, yerinin tespit edilmesi ve onarılması faaliyetlerini içeren aktif kaçak kontrolü stratejisi, fiziki kayıp hacminin azaltılmasında önemli rol oynamaktadır (Lambert ve Lalonde, 2005). Ancak aktif kaçak kontrolü yaklaşımında beklenen faydaların elde edilmesinde, izole bölgelerin oluşturulması ve sınırların tanımlanması oldukça önemlidir. Rapor edilmeyen sızıntıların farkına varılması ve yerinin tespit edilmesi sürelerinin uzamasına bağlı olarak önlenebilir sızıntı hacmi artmaktadır. İzole bir bölgede, minimum gece debisinin izlenmesi ile farkına varılan önlenebilir sızıntı hacminin azaltılması için, yer mikrofonu, bölgesel kaydedici, bölgesel korelatör gibi cihaz ve ekipmanlarla sızıntı yerinin tespit edilmesi çalışmaları yürütülmektedir.

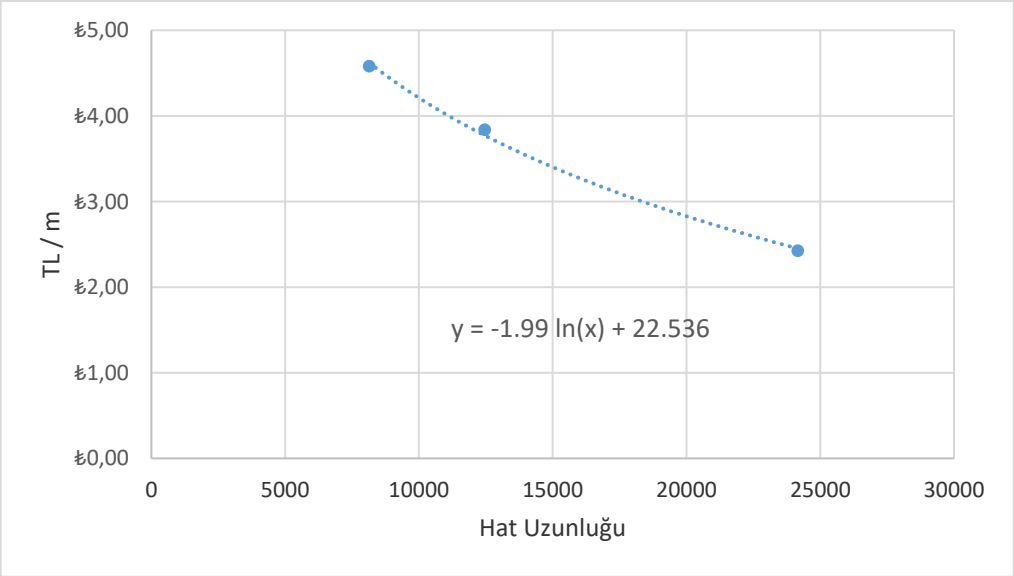
Aktif kaçak kontrolü yönteminde, yöntemin fayda-maliyet analizinin ortaya konulması çok güçtür. Şebekelerin farklı fiziksel ve çevresel özelliklere sahip olmasına, akustik ekipmanları kullanan ve sızıntı yeri tespiti yapan ekiplerin saha tecrübesine ve cihazların ve malzemelerin kalitesine bağlı olarak yöntemin etkin faydaları bölgeden bölgeye değişim göstermektedir. Bu kapsamda literatür çalışmaları ve saha tecrübeleri referans alınarak birim su kaybının azaltılması için bileşenler ve maliyetleri hesaplanmıştır (Tablo 1) (Yılmaz, 2021).

**Tablo 1.** Aktif Kaçak Kontrolü Fayda-Maliyet İçin Değişken Tanımlanması

| Değişken | Birimi | Değeri | Açıklama |
|---|---|---|---|
| Toplam Hat Uzunluğu | m | | Hesap yapılan şebekenin gerçek verisi girilmelidir. |
| Abone Sayısı | adet | | Hesap yapılan şebekenin gerçek verisi girilmelidir. |
| Şebeke Arızası / Toplam Arıza Oranı | % | 38% | (Nicolini vd., 2014; Aydoğdu ve Firat, 2015; Boztaş vd., 2018) |

| | | | |
|---|---|---|---|
| Abone Arızası / Toplam Arıza Oranı | % | 62% | Otomatik Hesaplanacaktır. |
| Şebeke Arızası Onarım Maliyeti | TL/ad | ₺1,850.00 | Gerçek saha verisine göre hesaplandı |
| Abone Arızası Onarım Maliyeti | TL/ad | ₺1,350.00 | Gerçek saha verisine göre hesaplandı |
| Ortalama Şebeke Basıncı | mss | | Hesap yapılan şebekenin gerçek verisi girilmelidir. |
| Çalışma Süresi | Gün | 180 | Taranan Bölgenin Döngü Süresi (ortalama 6 Ay) |
| Birim Su Maliyeti | TL/m³ | | İlgili kurumdaki birim su maliyeti |

Aktif kaçak kontrol yöntemi sonucunda bir birim (litre) su tasarrufu sağlamak (sızıntıyı önlemek) için ortaya çıkan maliyetlerin hesaplanabilmesi için öncelikle Tabloda tanımlanan verilerin elde edilmesi gerekmektedir. Aktif kaçak kontrolü faaliyetleri için uygulanan fayda-maliyet analizinde bir diğer aşama, sahada şebeke tarama ve dinleme birim maliyetlerinin çıkarılmasıdır. Yöntemin uygulanması aşamasında çeşitli ekipman, işçilik, malzeme ve bakım giderleri ortaya çıkmaktadır. MASKİ bünyesinde daha önce farklı uzunluklardaki şebekelerde yapılan aktif kaçak kontrolü çalışmaları referans alınarak birim maliyet tablosu ve buna bağlı olarak denklem edilmiştir (Şekil 1).




**Şekil 1.** Şebeke Sızıntı Dinleme ve İzleme Faaliyetleri için Referans Maliyetler

Şekil incelendiğinde akustik ekipmanlarla denetim yapılan şebeke uzunluğu artıkça sızıntı denetim ve izleme birim maliyetlerinin azaldığı görülmektedir. Bunun temel nedeni, aktif kaçak kontrolü için gerekli olan ekipmanların ilk yatırım maliyetlerinin artan metrajla daha geniş alanlarda kullanılması olarak gösterilebilir.

Aktif kaçak kontrolü yönteminde bir diğer önemli parametre ise arama kalitesi (denetim yapılan şebeke hattında tespit edilen ve onarılan arıza oranı) gösterilebilir. Bu parametre üzerinde genellikle tarama yapan ekiplerin tecrübesi oldukça önemli olup bu parametre için ortaya konulan performans doğrultusunda sistemin verimi değişmektedir. Literatürde yapılan çalışmalar ve farklı İdarelerde yapılan saha çalışmalar/tecrübeleri doğrultusunda hesaplanmış 65 m basınç seviyesinde arama kalitesi parametreleri belirlenmiştir (Yılmaz, 2021). Buna göre sistemin tamamının bir tur olarak taranması/denetlenmesi sonucunda ilk seferde toplam mevcut arızalarının %40'ını, yine şebekenin tamamının ikinci bir kez daha taranmasının ardından başlangıçtaki arıza oranının %25'inin tespit edilebildiği görülmektedir. Sistemde, 5 kez aynı bölgenin taranması ve arızaların giderilmesiyle sistem içinde bulunan arızaların %95'nin onarılabildiği öngörülmektedir. Hesaplanan tüm değişkenlere ait maliyetlerin ardından birim maliyet hesabı yapılması amacıyla öncelikle her bir tarama döngüsü için toplam maliyet (tarama ve arıza onarım dahil) ve toplam fayda (tespit edilip onarılan arızalar karşılığında kazanılan su miktarı) hesaplanmalıdır (Tablo 2) (Yılmaz, 2021).

**Tablo 2.** Fayda Maliyet Analizleri

| | 1. Dinleme | 2. Dinleme | 3. Dinleme | 4. Dinleme | 5. Dinleme | 6. Dinleme |
|---|---|---|---|---|---|---|
| Toplam Harcanan (a) | A1 | A2 | A3 | A4 | A5 | A6 |
| Kurtarılan Su Miktarı (b) | B1 | B2 | B3 | B4 | B5 | B6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Birim Maliyet ($m^3$/TL) (c) | C=A1/B1 | C=A2/B2 | C=A3/B3 | C=A4/B4 | C=A5/B5 | C=A6/B6 |

Yapılan hesaplamalar birim kaçak kontrolü için harcanan tutarın, birim su üretim maliyetinden yüksek olduğu noktaya kadar devam ettirilir. Böylelikle aktif kaçak kontrolü sonucunda ekonomik olarak kurtarılabilecek su miktarı bulunmuş olacaktır.

**3. Bulgular**

Su kayıplarıyla mücadelenin temel yöntemlerinden biri olan aktif kaçak kontrolü yönteminin ekonomik sınırlarının belirlenmesi ve ILI göstergesi üstündeki muhtemel değişimlerinin analizinin yapılması için Malatya ili merkez dağıtım sisteminde 4 adet izole ölçüm bölgesi (DMA) pilot bölge olarak belirlenmiştir.

**Tablo 3.** Çalışma Alanı Verileri

| Parametre | | Birim | DMA1 | DMA2 | DMA3 | DMA4 |
|---|---|---|---|---|---|---|
| Şebeke Uzunluğu | | m | 15620 | 3160 | 4400 | 3550 |
| Abone Sayısı | | adet | 4208 | 1208 | 2550 | 1250 |
| Abone Bağlantı Sayısı | | adet | 526 | 300 | 150 | 610 |
| Ortalama Abone Uzunluğu | | m | 7.83 | 8 | 5 | 5 |
| Tahakkuk Miktarı | | l/s | 3.82 | 6.44 | 9.65 | 8.10 |
| Su Üretim Maliyeti | | TL/$m^3$ | 2.32 | 2.32 | 2.45 | 2.45 |
| Ortalama Basınç | | m | 51 | 52 | 45 | 54 |
| Ortalama Giriş Debisi | | l/s | 13.52 | 10.23 | 12.35 | 11.28 |
| Gelir Getirmeyen Su Miktarı | | l/s | 9.7 | 3.8 | 2.70 | 3.18 |
| Gelir Getirmeyen Su Oranı | | % | 71.75 | 37.10 | 21.91 | 28.0 |
| Fiziksel Kayıp Miktarı (CARL) | | l/s | 7.76 | 3.04 | 1.13 | 1.17 |
| İdari Kayıp Miktarı | | l/s | 1.94 | 0.76 | 1.57 | 2.02 |
| | UARL | l/s | 0.48 | 0.21 | 0.11 | 0.33 |
| | ILI | - | 16.33 | 14.14 | 10.10 | 3.53 |

Bu kapsamda her bölge için, GGS hacmi ve oranı, yıllık kaçınılmaz kayıp hacmi, yıllık fiziki kayıp hacmi ve altyapı sızıntı indeksi hesaplanmıştır. Su üretim maliyetlerinin tespit edilmesinde; genel işletme giderleri ile su kaynak durumu dikkate alınmıştır. DMA 1 ve DMA2 bölgeleri besleyen ana kaptajdan cazibeli şekilde beslenmekte olup söz konusu bölgeler için su üretim maliyetleri eş kabul edilmiştir (Yılmaz, 2021). Benzer şekilde DMA3 ve DMA4 bölgelerini besleyen kaynaklar aynı olduğu için su üretim maliyetleri bu bölgelerde aynı alınmıştır. Seçilen pilot bölgelerin karakteristiklerinin farklı olmasına dikkate edilmiş ve daha doğru değerlendirme ve kıyaslama imkanı sunulmuştur. Tablo 4'te verilen parametreler kullanılarak her bir izole bölgede aktif kaçak kontrolünün uygulanmasına bağlı olarak elde edilecek faydalı debiler hesaplanmıştır (Yılmaz, 2021).

**Tablo 4.** Aktif Kaçak Kontrolü Faydalı Hacminin Hesabı

| Parametre | Birim | DMA1 | DMA2 | DMA3 | DMA4 |
|---|---|---|---|---|---|
| Aktif Kaçak Kontrolü Faydalı Debisi | l/s | **4.64** | **1.8** | **0.00** | **0.00** |
| CARL | l/s | 3.12 | 1.24 | 1.13 | 1.17 |
| ILI | - | 6.56 | 5.75 | 10.10 | 3.53 |
| ILI | - | B | B | C | B |
| GGS Oranı | % | 37.42 | 19.50 | 21.91 | 28.0 |

Bu hesapların gerçekleştirilmesi için öncelikli olarak her bir bölge için IWA standart su dengesi tablosu oluşturulmuştur. DMA1 bölgesi karakteristiği incelendiğinde sistem şebeke uzunluğunun ve abone sayısının oldukça fazla olduğu görülmektedir. Ayrıca şebeke fiziksel ve işletme parametrelerini dikkate alan ILI göstergesi de hesaplanmış ve sınıflandırılmaları yapılmıştır. DMA1 için, GGS oranı % 71.75 iken ILI göstergesi ise 16.33 (D sınıfı) şeklindedir. DMA2 için GGS oranı % 37.10 iken ILI göstergesi ise 14.14 (D sınıfı) şeklindedir. Söz konusu bölgelerde şebeke mevcut durum özelliklerine göre detayları *"önceki* bölümde verilen esaslara göre aktif kaçak kontrolü faydalı debileri hesaplanmıştır. Hesaplanan bu faydalı debiler, bölgelerde ekonomik olarak aktif kaçak kontrolü yöntemiyle sisteme kazandırılabilecek maksimum su miktarını temsil etmektedir.

Hesaplanan ALC faydalı debileri incelendiğinde; DMA1 bölgesinde akrif kaçak kontrolü yönteminin ideal bir su kayıp önleme yöntemi olduğu görülmektedir. Birim uzunluğa düşen abone sayısının nispeten yüksek, su üretim maliyetinin şebeke ortalamasında olduğu düşünüldüğünde, bu bölgede aktif kaçak kontrolü yöntemiyle ciddi kazanımlar elde edileceği beklenmektedir. Hesaplanan faydalı debilerin sisteme kazandırılmasıyla oluşacak yeni kayıp miktarları ve ILI değerleri hesaplandığında bu iki bölgenin B sınıfına yükseltilebileceği hesaplanmıştır. DMA2 incelendiğinde ise su kayıp oranı (%37.15) ve ILI değerlerine göre ( C Sınıfı) iyi sayılabilecek şebekeler olmasına rağmen birim uzunluğa düşen kayıp miktarının fazla olması nedeniyle ALC yöntemi uygulamanın ekonomik faydalı sonuçlar ortaya koyabileceği görülmüştür. Diğer taraftan, DMA3 ve DMA4 bölgelerinde aktif sızıntı kontrolü uygulamasının ekonomik olmayacağı hesaplanmıştır. Bu tarz bölgelerde birim suyun sisteme geri kazandırılması için harcanması gereken maliyet, kazanç ile elde edilen suyun maliyetinden fazla olduğundan bölgede aktif bir kayıp azaltma stratejisi uygun olmayacaktır. DMA3 bölgesindeki GGS oranının (%21.91) ve fiziki kayıp oranının (%9.17) düşük olması bu kayıp stratejisinin hem sebebi hem de sonucu olarak yorumlanabilir. Benzer şekilde DMA4 bölgesindeki GGS oranının (%28) ve fiziki kayıp oranının (%10) düşük olması bu kayıp stratejisinin hem sebebi hem de sonucu olarak yorumlanabilir. Su kayıplarıyla mücadelede aktif kaçak kontrolü önemli bir yer tutmaktadır. Saha ekiplerince ses dinlemeleri sonucunda arızaların tespiti, onarımı ve yapılan işlemlerin izlenmesi ile sisteme ciddi miktarlarda su kazandırılabilmektedir. Bir diğer yandan gerek dinleme ekipmanlarının maliyetleri gerekse arızaların tespitinden sonra onarımları İdareler için ciddi maliyetler doğurmaktadır. İçmesuyu sistemlerinin performansında çok önemli bir yeri olan ILI parametresi de tek başına bölgede ALC uygulamasının ekonomik olup olmayacağını belirtmekte yetersiz kalmaktadır. Bu nedenle ALC çalışmalarında öncelikli olarak yöntemin ekonomik olup olmayacağı hesaplanmalıdır.

**4. Sonuçlar**

Bu çalışmada dağıtım sistemlerinde yüzeye çıkmayan sızıntıların yönetilmesinde uygulanan yöntemlerin maliyetinin saha verilerine göre analizi ve bu yöntemlerin uygulanması ile ortaya çıkan faydanın hesaplanması amaçlanmıştır. Bu amaçla Malatya içmesuyu dağıtım sistemi uygulama alanı olarak seçilmiştir. Uygulama alanında pilot izole bölgelerde akustik yöntemlerle yapılan denetimlerin (ekip, çalışma saati ve ekipman) maliyetleri ve tespit edilen sızıntıların faydaları detaylı bir şekilde analiz edilmiştir. Bu kapsamda Yılmaz (2021) tarafından yapılan çalışmadaki maliyet yapısı göz önüne alınmıştır. Pilot DMA bölgelerinde yapılan analizlerde aktif kaçak kontrolünün uygulanmasına bağlı olarak ortaya çıkan maliyetler hesaplanmıştır. Benzer şekilde bu bölgelerde aktif kaçak kontrolünün uygulanması durumunda elde edilecek faydalar da analiz edilmiştir. Hesaplanan ALC faydalı debileri incelendiğinde; DMA1 bölgesinde aktif kaçak kontrolü yönteminin ideal bir su kayıp önleme yöntemi olduğu görülmüştür. Bu bölgede aktif kaçak kontrolü yöntemiyle ciddi kazanımlar elde edileceği beklenmektedir. Hesaplanan faydalı debilerin sisteme kazandırılmasıyla oluşacak yeni kayıp miktarları ve ILI değerleri hesaplandığında bu iki bölgenin B sınıfına yükseltilebileceği hesaplanmıştır. DMA2 incelendiğinde ise su kayıp oranı (%37.15) ve ILI değerlerine göre (C Sınıfı) iyi sayılabilecek şebekeler olmasına rağmen birim uzunluğa düşen kayıp miktarının fazla olması nedeniyle ALC yöntemi uygulamanın ekonomik faydalı sonuçlar ortaya koyabileceği görülmüştür. Diğer taraftan, DMA3 ve DMA4 bölgelerinde aktif sızıntı kontrolü uygulamasının ekonomik olmayacağı hesaplanmıştır. Bu tarz bölgelerde birim suyun sisteme geri kazandırılması için harcanması gereken maliyet, kazanç ile elde edilen suyun maliyetinden fazla olduğundan bölgede aktif bir kayıp azaltma stratejisi uygun olmayacaktır. DMA3 bölgesindeki GGS oranının (%21.91) ve fiziki kayıp oranının (%9.17) düşük olması bu kayıp stratejisinin hem sebebi hem de sonucu olarak yorumlanabilir. Benzer şekilde DMA4 bölgesindeki GGS oranının (%28) ve fiziki kayıp oranının (%10) düşük olması bu kayıp stratejisinin hem sebebi hem de sonucu olarak yorumlanabilir. Sonuç olarak sızıntıların yönetilmesinde önemli faydalar sağlayan aktif kaçak kontrolü yaklaşımının sahada oluşturduğu maliyetlerin de göz önüne alınması gerektiği ortaya çıkmaktadır. Buna göre elde edilecek faydalar analiz edilerek yöntemin ekonomik olarak verimli olup olmadığı değerlendirilmelidir. Bu çalışmadan elde edilen sonuçların özellikle sahada uygulayıcı ve karar vericiler için önemli bilgiler sunduğu düşünülmektedir.

**Teşekkür**

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# Dynamic Analysis and Water Demand Model with EPANET in Drinking Water Distribution Systems

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**Abstract**
Providing long-term water management in distribution systems is very important for sustainable network management. The basic principle in urban water management is to deliver the desired amount and quality water to the subscribers on time. In order to achieve this, the amount of water demanded in the network should be accurately defined. In demand flow, the amount of demand according to network characteristics, leakage rates, population or number of subscribers, authorized unbilled demand flow in the region should be determined accurately. On the other hand, dynamic modeling has a very important place in network hydraulic analysis. It is very important to define fire flow rates especially in areas where critical structures (historical artifacts, wooden structures, chemical facilities) are located in the region. In the event of a fire in the region, the flow rate required for fire intervention must be provided and sufficient pressure must be created. In order to achieve this, a model in which all components are taken into consideration should be developed in the region. Therefore, in this study, it is aimed to create and analyze the demand flow and dynamic model in a distribution system with EPANET. For this purpose, an application was carried out for the pilot isolated region in Malatya central distribution system. During the establishment of the model, necessary data, modeling stages and results obtained were detailed. In the dynamic model, demand flow rates and pressures were monitored for different time periods by making fire analysis.
**Keywords:** Water Management; Dynamic Model; Water Demand; Hydraulic Analysis.

# İçme Suyu Dağıtım Sistemlerinde EPANET ile Dinamik Analiz ve Su Talep Modeli

**Özet:**
Içmesuyu dağıtım sistemlerinde sürdürülebilir şebeke yönetimi için uzun dönemli planlama yapılması oldukça önemlidir. Kentsel su yönetiminde en temel prensip yeterli miktarda ve kaliteli suyun zamanında abonelere iletilmesidir. Bunu sağlamak için şebeke ve bileşenleri detaylı analiz edilmeli ve talep debisi doğru bir şekilde tanımlanmalıdır. Su talep modelinde, şebeke özellikleri, abone tüketim davranışları, sızıntı oranları, nüfus, abone sayısı, yasal faturalandırılmamış kullanıcılar doğru bir şekilde tanımlanmalı ve analiz edilmelidir. Diğer taraftan dinamik modelleme şebekenin hidrolik davranışını ortaya koymak adına önemli bir yere sahiptir. Bölgede özellikle kritik yapıların (tarihi eserler, ahşap yapılar, kimyasal tesisler) bulunduğu alanlarda yangın debilerinin belirlenmesi oldukça önemlidir. Bölgede yangın çıkması durumunda yangına müdahale için gerekli debi sağlanmalı ve yeterli basınç oluşturulmalıdır. Bunun için bölgede tüm bileşenlerin dikkate alındığı bir model geliştirilmelidir. Bu nedenle bu çalışmada EPANET ile bir dağıtım sisteminde talep akışı ve dinamik modelin oluşturulması ve analizi amaçlanmıştır. Bu amaçla Malatya merkezi dağıtım sisteminde pilot izole bölge için bir uygulama yapılmıştır. Modelin oluşturulması sırasında gerekli veriler, modelleme aşamaları ve elde edilen sonuçlar detaylandırılmıştır. Dinamik modelde yangın analizleri yapılarak farklı zaman periyotları için talep debileri ve basınçları izlenmiştir.
**Anahtar Kelimeler:** Kentsel Su; Yönetimi; Dinamik Modelleme; Su Talebi; Hidrolik Analiz.

## 1. Giriş

Artan dünya nüfusu ve kentselleşme süreci beraberinde, su talebini artırmaktadır. Bu durum su temini ve dağıtımından sorumlu kurumların, su temin ve dağıtım problemine daha detaylı çözümler üretmesini zorunlu kılmaktadır. “Su Yönetimi” ve önemli alt başlıklarından biri olan “Hidrolik Modelleme” konusu üzerindeki ilgi her geçen gün artmaktadır. “Hidrolik Modelleme” sürecinde tüketim taleplerinin doğru tahmin edilmesi ve sahadaki gerçek durumun modele gerçekçi bir şekilde tanımlanması gerekmektedir. Kentsel su talebini tahmin etmek ve yönetmek, kentsel alanlarda insan ve doğal sistemler arasında var olan sıkı ilişki nedeniyle karmaşıktır. Bu ilişki, mikro ölçekli (bireysel, hane veya parsel düzeyinde) ve makro ölçekli (bölgesel) süreçler ve modeller arasındaki çoklu etkileşimlerden kaynaklanmaktadır. Örneğin, karmaşık sistemlerde, bireyler arasındaki yerel etkileşimler uzay ve zaman üzerinde birikerek, sırasıyla bireysel seçimleri etkilemek veya kısıtlamak için geri besleme sağlayan orta ölçekli ve makro ölçekli değişkenler üretir [Liu vd, 2007; Irwin vd, 2009].
Su dağıtım sistemlerinin planlanması ve işletilmesinde en önemli faktör tüketici talebinin karşılanmasıdır. Bu, kullanıcılara sürekli olarak makul basınçta yeterli hacimlerde kaliteli su sağlamak ve böylece güvenilir su dağıtımı sağlamak anlamına

gelir (Brentan vd., 2017). Tüketim modeli oluşturulurken; tüketimleri boru uzunluğu ve tüketim yoğunluğuna bağlı kesafet katsayıları kullanarak dağıtmak hidrolik tasarım süreçlerinde başvurulan bir uygulamadır. Yaygın kullanımı olan açık kaynaklı EPANET-2 programında, Uzatılmış Dönem Simülasyonu (EPS) sürecinde orijinal formülasyonunda su talebi, ağ düğümlerinde toplu çekimler olarak temsil edilir. Ancak, tek kenar (boru) seviyesinde enerji dengesi gözetilmediğinden, bu yaklaşım hidrolik yük dağılımında önemli hatalara neden olabilir. Bu dezavantajın üstesinden gelmek için (Menapace vd., 2018) çalışmalarında su talebinin borular boyunca eşit olarak dağıldığı yeni bir EPANET-2 uygulaması önermişlerdir. Tüketim modeli oluşturma uygulamalarına, sadece hidrolik tasarım yaparken değil; nüfus artışı, yeni imar alanlarının eklenmesi, su dağıtım şebekesinde zamanla artan fiziki kayıplar gibi sebeplerden tasarım sınırlanın dışına çıkmış olan halihazırda işletilmekte olan içme suyu dağıtım şebekelerinde de yönetim sürecinde başvurulmaktadır. (Arunkumar vd., 2011) çalışmalarında kentsel altyapının en önemli bileşenlerinden biri olan su temini ve dağıtım şebekelerinin etkin bir şekilde planlanması, geliştirilmesi ve işletilmesi amacıyla EPANET 2.0 yazılımı kullanılarak kamusal su temini yapan Belediyelerde su talep analizini incelemiştir. Nüfus artışından yetersiz mevcut tesislere kadar bir dizi faktörün metropole su temininde sık sık yaşanan kıtlıktan sorumlu olduğu düşünülmektedir. Çalışmada, Belediye bünyesinde hizmet verilmeyen alanlar ile Belediye tarafından yetersiz hizmet verilen alanlar tanımlanmış, EPANET 2.0 hidrolik model yazılımı kullanılarak tüketim modeli oluşturulmuş ve yetersiz hizmet verilen alanlar ile hizmet verilmeyen alanlara ait su talepleri hesaplanmıştır. Tüketim modeli oluşturulurken, su dağıtım şebekesinden çekilen su talebinin zamansal değişimleri de dikkate alınmalıdır. Hidrolik modelleme sürecinde izole alt ölçüm bölgelerinde (DMA), farklı abonelere göre günlük ve saatlik su tüketim profilleri ve su tüketim oranları büyük farklılıklar göstermektedir. Su tüketiminin zamansal ve mekansal varyasyonları ve DMA'nın değişken topografik seviyeleri, hidrolik modellemede düğümsel su talebini tahsis etmek için dikkate alınması gereken parametrelerdendir (Kara vd.,2016). Ayrıca, su idareleri tarafından işletilmekte olan mevcut içme suyu dağıtım sistemlerinde hidrolik modelleme uygulamaları yaparken, su dağıtım sistemindeki sızıntı miktarlarının tespit edilip tüketim modelinde dağıtılması da, hidrolik modelleme sürecinde alınacak olan sonuçların saha koşullarını temsil edebilme kapasitesini artıracaktır. Su dağıtım şebekesi hidroliğini çözebilme kapasitesinin büyük ölçüde ilgili simülasyon modellerinde talep temsiline bağlıdır. Şebekeden farklı su çıkış türleri olarak; insan tabanlı, hacim tabanlı, kontrolsüz orifis tabanlı ve sızıntı tabanlı talepler de dahil olmak üzere, gelişmiş su dağıtım şebekesi simülasyon modellerindeki taleplerin kapsamlı bir görünümünü sunulmalıdır (Guistolisi vd., 2012).

Tüketim talebini ve karakteristiklerini tahmin edebilmek için, hidrolik modelleme sürecine başlamadan önce "Tüketim Modeli"nin oluşturulması gerekir. Bu çalışmada, tüketim modelini gerçekçi bir şekilde tahmin edebilmek için, su idarelerinin teknik kapasiteleri göz önünde bulundurularak uygulanabilir bir yöntem önerilmiştir. Bu amaçla Malatya içmesuyu dağıtım sistemi uygulama alanı olarak seçilmiştir. Uygulama alanında pilot izole bölgede su tüketim modelinin saha verilerine göre belirlenmesi ve yaşanan sorunların tartışılması amaçlanmıştır.

## 2. Tüketim Modeli: Teorik Altyapı

Hidrolik hesaplamalarda girdi parametrelerinden olan tüketim verisi, doğası gereği hesaplamalarda tahmin edilmesi en zor olan parametredir. Hesaplamalar yapılırken kullanılan diğer girdi parametreleri (boru karakteristik özellikleri, topografya, su kaynağı, vb.) çok az hata payı ile hidrolik probleme dahil edilebilmektedir. Fakat, tasarlanan sistemin işletmeye alındıktan sonra ne kadar tüketim yapılacağı, tüketimin nasıl bir dağılıma sahip olacağı, şebekedeki kayıp-kaçak oranlarının nasıl gerçekleşeceği, su tüketiminin hangi dönemlerde ne kadar artacağı gibi sorular belirli kabuller yapılarak hesaplanmaktadır. Bu sebepten hidrolik hesaplamaların en başında tüketimin miktarının ve daha önemlisi tüketim dağılımının iyi hesaplanması gerekmektedir.

Hidrolik hesaplamaları tasarım ve modelleme olarak iki başlık altında inceleyecek olursak, tüketim modelinin oluşturulma yöntemleri de iki durum için daha farklı yaklaşımlar gerektirir. Hidrolik tasarım yaparken, mevcut bir hidrolik sistem olmadığından dolayı, tüketimler belirli kabullere dayalı öngörüler üzerinden yapılır. Hidrolik modelleme ise, halihazırda çalışmakta olan bir hidrolik sistem üzerinden yapıldığı için, tüketim modelinin oluşturulması, saha ölçümleri ile elde edilen verilerin çeşitli yöntemlerle analizine dayalıdır.

*Hidrolik Tasarımda Tüketim Modeli*

Hidrolik tasarımda, tüketim modeli oluşturulurken, güncel nüfus verisi başlangıç verisidir. Buradan planlanan servis ömrü (genellikle 35 yıl) göz önünde bulundurularak nüfus projeksiyonları yapılır. Sonrasında belirli kabullere dayanan kişi başı tüketim değerleri, sanayi tüketimleri, özel tüketimler, su kayıp-kaçak oranları, vb. kullanılarak tasarım debileri belirlenir. Ayrıca pik tüketim zamanı debileri belirlenir. Son aşamada ise, hesaplanan tasarım debisi, proje alanındaki imar planları, nüfus yoğunlukları göz önünde bulundurularak içme suyu şebekesi üzerinden dağıtılır.

*Hidrolik Modellemede Tüketim Modeli*

Hidrolik modelleme sürecinde, sahada halihazırda bulunan hidrolik sistemden su talep eden ve tüketim gerçekleştirilen kullanıcılar mevcuttur. Sahada mevcut bulunan ölçüm cihazlarından (tüketici sayaçları, debimetreler,…) elde edilen veriler kullanılarak, sahadaki gerçek durum hidrolik sisteme tanımlanabilir. Veriler analiz edilirken doğru bir yaklaşım ile hidrolik model tüketim modelindeki hata payının, hidrolik tasarım tüketim modeline göre çok daha küçük değerlere çekilmesi mümkündür.

**3. Hidrolik Model Tüketim Modelinin Oluşturulması**

Bir hidrolik sistem; borular, düğüm noktaları, akış kontrol vanaları, basınç kırıcı ve düzenleyici vanalar, pompalar, depo, rezervuar gibi hidrolik elemanlardan oluşur. Her hidrolik sistemde bu elemanların tamamı veya bir kısmı bulunur. Bahsi geçen hidrolik elemanlar arasından su kaynağı, borular ve düğüm noktaları bir hidrolik sistemin temel elemanlarıdır. Her hidrolik sistemde bu 3 eleman mutlaka bulunmalıdır. Burada düğüm noktaları, sistemden ihtiyaç debisinin çekildiği noktalardır. Su kaynağı sisteme ihtiyaç debisi sunan hidrolik elemandır. Borular ise su kaynağı ile düğüm noktaları arasında su iletimini sağlarlar.Toplam tüketim miktarının düğüm noktalarına nasıl dağıtılacağı sorusunun cevabı hidrolik model tüketim modeli oluşturmaktır. Bunun için hesaplanan toplam tüketim miktarının içme suyu dağıtım sistemi üzerinde; miktarsal, mekânsal ve zamansal dağıtımlarının belirlenmesi gerekmektedir.

*a. Miktar Dağıtımı*

Bir DMA bölgesinde giriş debimetreleri; bölgeye ait ölçülen legal tüketimleri ölçtüğü gibi bölgedeki ölçülmeyen legal kullanımları, illegal kullanımları ve hidrolik sistemin çeşitli bölümlerinde meydana gelen fiziki kayıplara ait debileri de ölçmektedir. İllegal kullanımlar ile ölçülmeyen legal kullanımları tespit etmek çok kapsamlı çalışmalar gerektirmektedir. Eğer bölgedeki illegal tüketimlerin fazla olduğu düşünülüyorsa, öncelikle bu alanda çalışmalar yapılarak daha sonra hidrolik model ve tüketim modeli çalışmaları yapılabilir. Açıklanan sebeplerden dolayı hidrolik sistemde, DMA bölgesine giren debi her zaman sayaçlardan elde edilen tüketim debi miktarından daha fazladır.

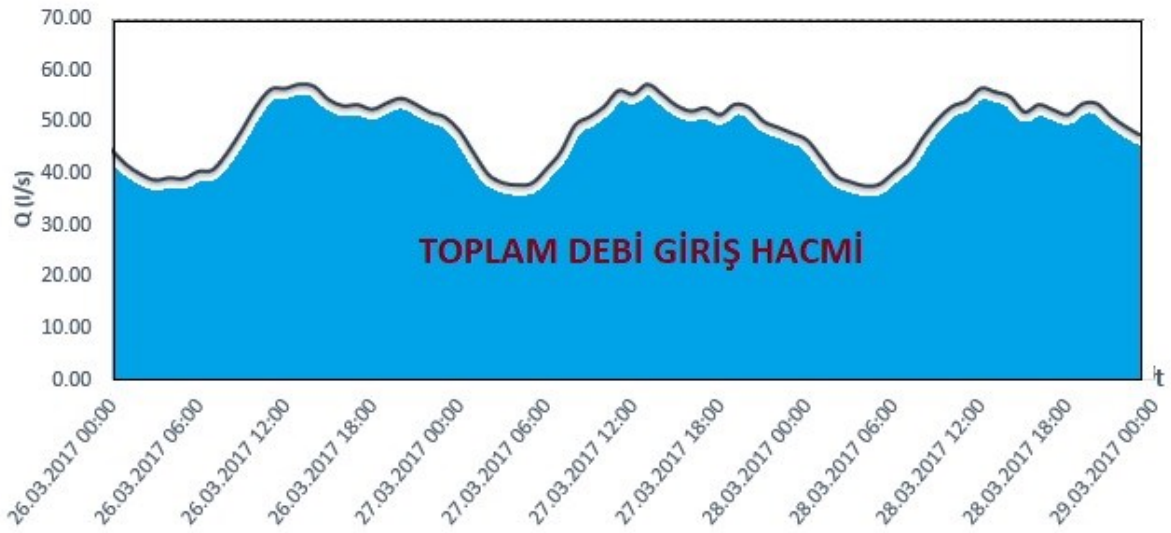
Eğer bunun aksi bir durum varsa;

- Ölçüm cihazlarının kalibrasyonlarının yapılıp yapılmadığı
- Sıfır basınç testi kontrolü yapılarak bölgenin izole olup olmadığı
- DMA sınırları ve ilgili birimden temin edilen sayaç okuma verilerine ait sınırların örtüşüp örtüşmediği
- kontrolleri yapılmalıdır.

Hidrolik Model Tüketim Modeli oluştururken, öncelikle fiziki kayıplara ait debi miktarının, toplam giriş debi miktarından ayıklanması ve sayaç okuma verilerinin kalibre edilmesi gerekir.

*Giriş hacminin belirlenmesi*

Hidrolik Modele altlık olacak Tüketim Modeli oluşturulurken öncelikle sınırları belli olan DMA bölgesine giren su hacminin belirlenmesi gereklidir. İzole edilmiş ve debileri izlenen bir DMA bölgesinde, belirli bir zaman dilimi içerisinde debimetrelerden alınan giriş debisi grafiğinin altında kalan alan, söz konusu zaman dilimi içerisinde o bölgeye verilen toplam su hacmini (Vgiriş) verir (Şekil 1).




**Şekil 1**. Debimetre Verisi ve Toplam Su Giriş Hacmi

*Minimum Gece Debisi Yöntemi ile Tüketim Hacminin Belirlenmesi*

Debimetre ölçümleri ile hesaplanan toplam giriş hacmi, çalışma bölgesine ait, legal ve illegal tüketimler ile, su dağıtım sisteminin çeşitli elemanları üzerinde meydana gelen fiziki su kayıplarının toplamıdır. Hidrolik modelleme yaparken, tüketimlere ait olan su debisi ile, fiziki kayıplara ait debinin birbirinden ayrılması, saha koşullarını daha gerçekçi simüle etme yolunu açacaktır. Çünkü tüketimler, çalışma alanı üzerinde nüfus yoğunluğu yüksek olan veya özel (ticari, endüstriyel,…) tüketimlerin olduğu bölgelerde yoğunlaşmaktadır. Fiziki kayıplar ise, üzerinde hiç tüketim olmayan borularda bile gerçekleşebilmektedir. Bundan dolayı, bu iki bileşen bu aşamada birbirlerinden ayrılmalıdır. Aksi durumda,

tüketim modeli üzerinde, sahada tüketimin yoğun olduğu yerlere fiziki kayıplar da aynı oranda yoğun olarak tanımlanmış olacaktır.

Tüketim hacmi (Vtüketim) ile sızıntı hacminin (Vsızıntı) belirlenmesi için minimum gece debisi analizi hızlı ve gerçeğe yakın sonuçlar veren iyi bir yöntemdir (Şekil 2). Tüketim hacmi, minimum gece debisi analizinde belirli kabullere dayalı olarak hesaplanan gece tüketimi ile gün içerisinde anlık kullanım durumuna göre değişen anlık tüketimlerin toplamından oluşmaktadır.

Bunun yanında, her içme suyu dağıtım sisteminde meydana gelen önlenemez kayıplar (arka plan sızıntıları) da minimum gece debisinin bir bileşenidir. Çeşitli arka plan sızıntı tahmin yöntemleri kullanılarak elde edilen sonuçlar arasındaki fark ihmal edilecek kadar önemsiz olmasına rağmen, MNF'nin legal gece tüketiminden önemli ölçüde etkilenebileceği vurgulanmıştır (Lee vd., 2005). Bu açıdan, arka plan sızıntıları dikkate alınması sonuçları daha tutarlı hale getirecek olsa da bu aşamada gece tüketiminin doğru tahmin edilmesinin en kritik nokta olduğu düşünülmektedir.




**Şekil 2**. Minimum Gece Debisi Analizi

Tüketim hacmi, şu şekilde hesaplanabilir;

$$V_{tüketim} = V_{giriş} - V_{sızıntı} \quad (2.2.1)$$

*Vtüketim → Bölgedeki legal ve illegal kullanımların toplam hacmi*

*Vgiriş → Debimetre verileri ile elde edilen bölgeye toplam giriş yapan toplam su hacmi*

*Vsızıntı → Minimum Gece Debisi yöntemi ile belirlenen sızıntı hacmi*

*Sayaç Okuma Verileri*

Sonraki aşamada, izole edilmiş DMA bölgesinde kayıtlı olan abonelere ait sayaç okuma verileri, ilgili birimler üzerinden temin edilmelidir (Şekil 3 ). Kullanıcılara ait tahakkuk miktarlarının toplamı hesaplanır (Vtahakkuk). Burada dikkat edilmesi gereken husus, debilerin izlendiği dönem ile, tahakkuk oluşturulan dönemlerin aynı olmasıdır. Sayaç okumalarına ait dönemler düzenli değilse, öncelikle bu konuda bir çalışma yapılmalıdır. Sayaç okuma dönemlerinin, debi izleme verileri ile eşleştirilmesi mümkün olamıyorsa günlük ortalama tüketim verileri hesaplanarak bir yaklaşım yapılabilir. Fakat bunun bir yaklaşım olduğu ve mutlaka buradan da bir hata oranının hidrolik model sonuçlarına dahil olacağı göz önünde bulundurulmalıdır.

| FAALIYET_TURU | ILCE | MAHALLE | SOKAK | KAPI_NO | BINA | DAIRE_NO | TOPLAM_TUKETIM | TOPLAM_TAHAKKUK | GUN_FARKI |
|---|---|---|---|---|---|---|---|---|---|
| | BATTALGAZİ | AKPINAR | ŞEHİT MEHMET ÖZBEK | 12 A | | 2 | 64 | 520.76 | 64 |
| TİCARİ ISYERİ | BATTALGAZİ | AKPINAR | SARIOĞLU | 9 A | | | 7 | 59.06 | 93 |
| TİCARİ ISYERİ | BATTALGAZİ | AKPINAR | SARIOĞLU | 8 G | | 0 | 2 | 17.38 | 30 |
| TİCARİ ISYERİ | BATTALGAZİ | AKPINAR | ŞEHİT MEHMET ÖZBEK | 12 B | | UN SA | 2 | 18.56 | 62 |
| TİCARİ ISYERİ | BATTALGAZİ | AKPINAR | TURFANDA | 19 | . | 0 | 61 | 495.28 | 31 |
| TİCARİ ISYERİ | BATTALGAZİ | AKPINAR | ASLANTEPE | 34 | . | | 20 | 164.36 | 46 |
| MESKEN | BATTALGAZİ | AKPINAR | SARIOĞLU | 5 | . | 3 | 23 | 71.34 | 62 |
| MESKEN BİNALARI | BATTALGAZİ | AKPINAR | TURFANDA | 5 A | . | 3 | 19 | 59.38 | 59 |
| MESKEN BİNALARI | BATTALGAZİ | AKPINAR | AZİZLER | 20 B | . | 0 | 8 | 25.34 | 30 |
| MESKEN BİNALARI | BATTALGAZİ | AKPINAR | AZİZLER | 4 A | . | Z | 16 | 50.36 | 62 |
| MESKEN BİNALARI | BATTALGAZİ | AKPINAR | SARIOĞLU | 5 | . | 1 | 15 | 47.34 | 62 |
| MESKEN BİNALARI | BATTALGAZİ | AKPINAR | SARIOĞLU | 1 | . | | 18 | 56.16 | 93 |
| TİCARİ ISYERİ | BATTALGAZİ | AKPINAR | TURFANDA | 16 A | . | 1 | 11 | 91.46 | 62 |
| LOJMAN | BATTALGAZİ | AKPINAR | ŞEHİT MEHMET ÖZBEK | 7 A | . | 1 | 93 | 407.59 | 546 |
| MESKEN BİNALARI | BATTALGAZİ | AKPINAR | AZİZLER | 20 | . | 2 | 10 | 32.32 | 62 |

**Şekil 3**. Abone Sayaç Okuma Verileri

*Sayaç Okuma Verilerinin Kalibrasyonu*

İzole bir DMA bölgesinin tüketim verileri incelendiği zaman, çoğunlukla bölgede tahakkuk edilen su miktarı, bölgeye verilen su miktarından çok daha azdır. Önceki bölümde anlatılan minimum gece debisi yöntemi ile fiziki kayıplar dolayısıyla sistemde kaybolan sızıntı hacmi düşüldükten sonra bile bu durum çok değişmez.

Bu çalışmada çalışılan DMA bölgesi; Malatya ilinde çok eski yerleşimlerin olduğu karmaşık mimari yapıya sahip eski işhanları ve ticari binaların olduğu şehrin ticari merkezi konumunda olan bir bölgedir. Müşteri hizmetleri biriminden alınan bilgiler, bölgedeki sayaçların okuma sürecinin çok zorlu olduğu ve sayaçların bir kısmına ulaşılamadığı bilgisi alınmıştır. Bu nedenle bölgedeki sayaç okuma verilerinin güvenilirlik kalitesi düşük olarak belirlenmiştir. Bundan dolayı sayaç okuma verilerinin kalibre edilerek tüketim modeline dahil edilmesi iyi bir yaklaşım olacaktır. Eğer tahakkuk miktarı (Vtahakkuk), tüketim miktarından (Vtüketim) fazla ise, öncelikle hesaplamalar gözden geçirilmeli, sonuç alınamazsa debimetre verileri ile sayaç okuma verilerinin doğruluğu sorgulanmalıdır.

Sayaç okuma verilerini kalibre etmek için;

$$k = \frac{V_{tüketim}}{V_{tahakkuk}} \qquad (2.4.1)$$

$$q_{ik} = q_i * k \qquad (2.4.2)$$

*Vtüketim → Bölgedeki legal ve illegal kullanımların toplam hacmi*

*Vtahakkuk → Bölgede tahakkuk edilen toplam su hacmi*

*k → Kalibrasyon katsayısı*

*qi → "i" no'lu abonenin tahakkuk miktarı*

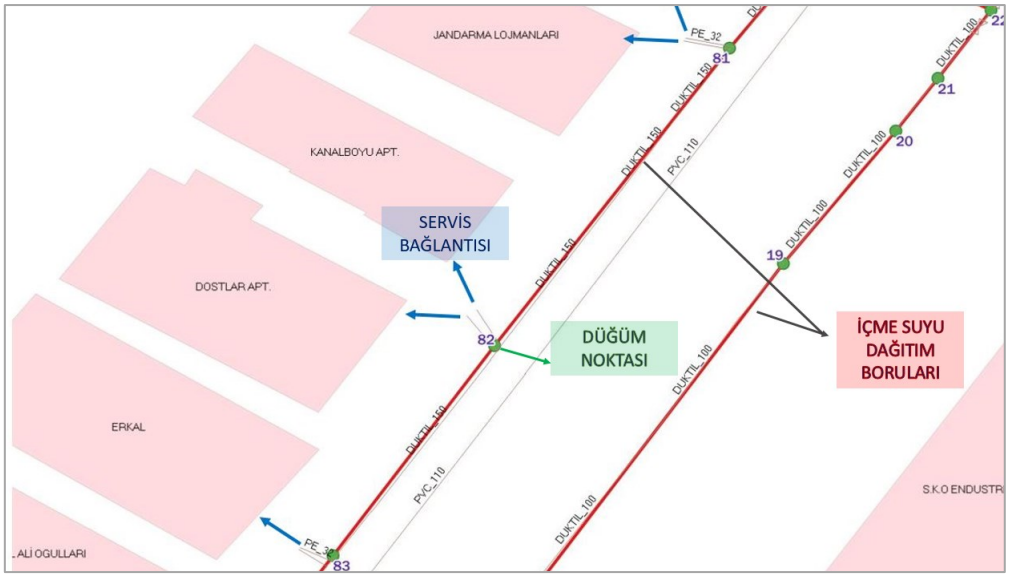
*qik → "i" no'lu abonenin kalibre edilmiş tahakkuk miktarı*

*b. Mekansal Dağıtım*

İzole bir DMA bölgesinde, mevcut şebekenin hidrolik modeli oluşturulurken, bölgeye giren su miktarı, giriş borularına takılacak debimetre cihazları ile takip edilebilmektedir. Bu şekilde debimetreler vasıtasıyla elde edilen giriş debisi verisinin, oluşturulan şebeke hidrolik modeli üzerindeki düğüm noktalarına dağıtılması gerekmektedir. Toplam debiyi düğüm nokta sayısına bölerek, toplam debi düğüm noktalarına eşit şekilde dağıtım yapılacak olursa, simülasyon sonuçları sahadaki gerçek durumu yansıtmaktan uzak olacaktır. Bu şekilde, oluşturulmuş olan şebeke geometrisinin durumuna göre düğüm noktalarının sık olduğu bölümler yoğun su talebi yapan bölümler olurken, düğüm noktalarının seyrek atıldığı bölümler daha az su talebi yapan bölümler olacaktır. Çoğunlukla sahadaki gerçek durum bundan farklıdır.

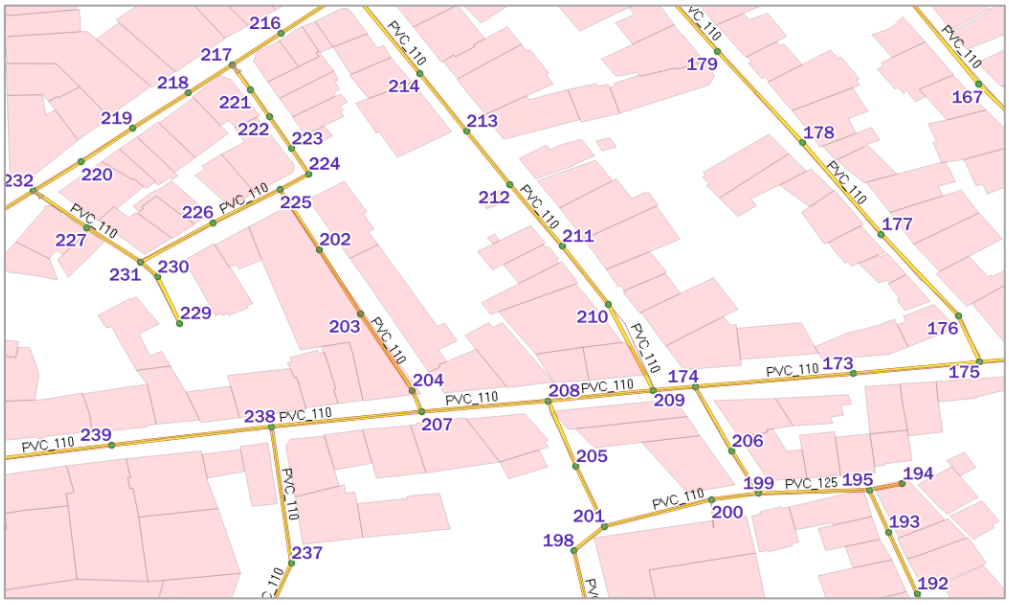
Bir diğer seçenek, hidrolik tasarımda olduğu gibi toplam debinin boru uzunluğu boyunca kesafet katsayıları dikkate alınarak dağıtılmasıdır. Bu şekilde yapılan debi dağıtımının simülasyon sonucunda doğru sonuçlar verebilmesi, öngörülen kesafet katsayılarının ne kadar gerçekçi seçildikleri ile doğru orantılıdır. Toplam giriş debisinin düğüm noktalarına eşit dağıtılmasına göre daha iyi sonuçlar elde edilmesine rağmen, gerçek saha sonuçlarının bu şekilde yakalanması yine de pek mümkün olmamaktadır.

Hidrolik modelleme yaparken, sonuçların saha koşullarına en iyi şekilde yaklaştırabilmek ancak sahadaki gerçek durumun modelde yansıtılabilmesi ile mümkün olabilmektedir. Gerçek bir içme suyu dağıtım şebekesinde, su talebi çoğunlukla en yakın borudan sağlanan servis bağlantıları sayesinde karşılanır. Eğer servis bağlantılarının konumu sayısal veri olarak mevcut ise, o servis bağlantısından su kullanımı sağlayan kullanıcıların hesaplanan tüketimlerini, içme suyu şebekesinden servis bağlantısı yapılan noktaya hidrolik model üzerinden tanımlanacak düğüm noktalarına atamak, sahadaki durumu en gerçekçi şekilde modelleme yöntemi olacaktır (Şekil 4 ).




**Şekil 4.** İçme Suyu Dağıtım Şebekesi ve Servis Bağlantıları

Sayısal şebeke ve servis bağlantısı verileri üzerinden her servis bağlantısına bir düğüm noktası tanımlamak hidrolik modeli gerçek saha koşullarına en çok yaklaştıran yöntem olsa da, çoğu su idaresinin elinde, özellikle önceki yıllarda yapılmış servis bağlantılarına ait sayısal veri mevcut değildir. Ayrıca her binanın veya bağımsız birimin önüne düğüm noktası tanımlamak, modelleme sürecinde zaman kayıplarına sebep olabilmektedir (Şekil 5 ).




**Şekil 5**. Hidrolik Model Üzerinde Binaların ve Düğüm Noktalarının Dağılımı

Gerek hidrolik tasarım yaparken gerekse de hidrolik modelleme yaparken düğüm noktaları; borunun yön değiştirdiği noktalar, branşman noktaları, boru çapının değiştiği noktalar gibi yerlere tanımlanır. Bunun yanında, arazi koşulları ve boru uzunlukları göz önünde bulundurularak fazladan düğüm noktaları tanımlanır. Çok fazla düğüm noktası tanımlamak, hesaplamalardaki hassasiyeti artırırken, sürecin zorluk derecesini artırmaktadır. Çok az düğüm noktası tanımlamak, süreci kolaylaştırırken, hesaplamalardaki hassasiyet azalacaktır. Bu açıdan hidrolik modelleme yapılırken, bu iki unsur göz önünde bulundurularak ideal bir düğüm noktası sayısı üzerinden hesaplamalar yapılmalıdır.

*Mekansal Dağıtım ve Yöntem Önerisi*

Mekansal dağıtım yaparken, dağıtımın yapılabilirliği için zorluk seviyesini çok artırmadan aynı zamanda da sahadaki gerçek durum hidrolik modele aktarılırken doğruluk seviyesinden uzaklaşmadan pratik bir çözüm aşağıdaki gibi önerilmiştir. Mekansal dağıtım, tüketici noktalarının bölgeye ait halihazır haritalar üzerinden coğrafi bilgi sistemleri yardımıyla belirlenen bina şekillerinin ağırlık merkezine tekabül ettiği varsayımı ile yapılabilir (MASKİ Su Temini ve Rehabilitasyonu

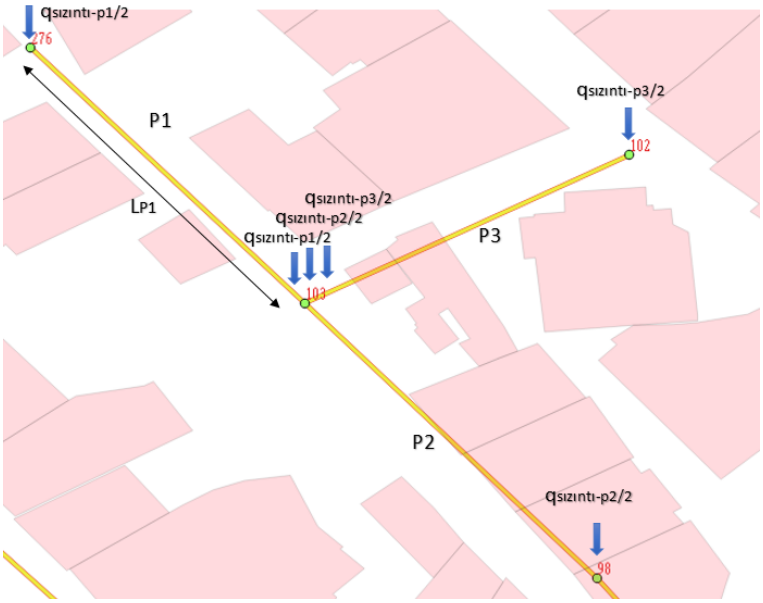
Projesi, 2016). Uygulama şu şekilde ilerler; her tüketici noktasının su ihtiyacı belirlendiğinde, bu ihtiyacın modelin uygun düğümüne atanması gerekmektedir. Uygulanan strateji aşağıdaki gibidir:

- Coğrafi Bilgi Sistemleri kullanılarak, belirlenen tüketici noktasının en yakın boruya bu boruya dik olan hayali bir kol yardımıyla (Şekil 6) atanır.




**Şekil 6:** Su ihtiyacının (tüketim debisi) dağıtılması (MASKİ Su Temini ve Rehabilitasyon Projesi, 2016)

- Her boru ile ilgili tüketiciler daha sonra borunun en yakın düğümüne atanır. Bu prosedür sonucunda aşağıda verilen kritere göre, her düğüm bir kullanıcı listesi ve bu nedenle de bir toplam su ihtiyacı ile karakterize edilmektedir;
- Minimum gece debisi yöntemi ile belirlenmiş olan sızıntı hacmi boru uzunlukları ile orantılı olacak şekilde borulara dağıtılır ve her boruya tanımlanan sızıntı debisi o boruya ait düğüm noktaları arasında paylaştırılır. Daha sonra her bir düğüm noktasına, bağlı olduğu borulardan gelen sızıntı debisi eklenir (Şekil 7 ).



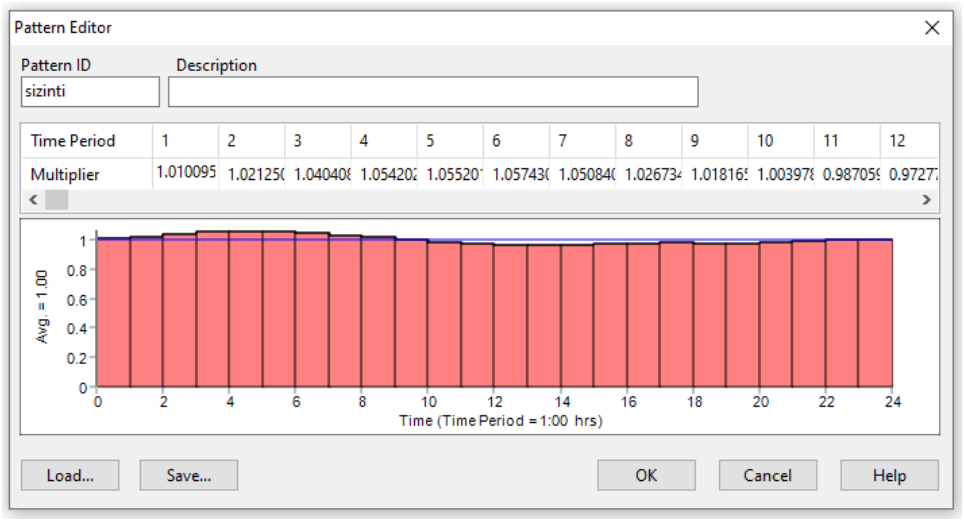

**Şekil 7**. Sızıntı Debisinin Düğüm Noktalarına Dağıtılması

$$V_{sızıntı} = \Sigma Q_{sızıntı-Pi}$$
$$V_{tüketim} = \Sigma Q_{düğüm-noktası}$$
$$Q_{düğüm-noktası} = \Sigma q_{tüketici} + \Sigma q_{sızıntı}$$

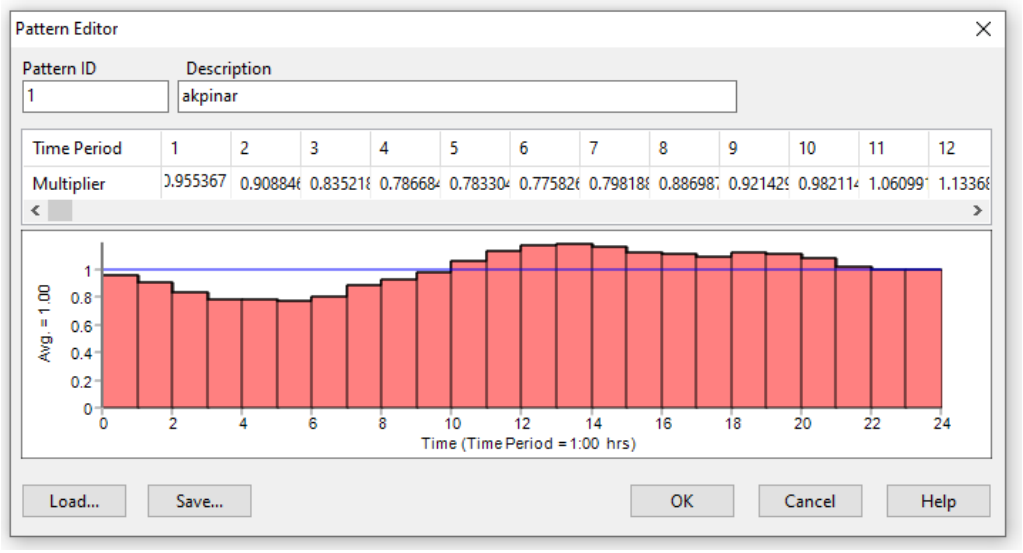
*$Q_{sızıntı-Pi}$ : Pi borusuna ait sızıntı debisi, $V_{sızıntı}$ : Minimum Gece Debisi yöntemi ile belirlenen sızıntı hacmi, $V_{tüketim}$: Bölgedeki legal ve illegal kullanımların toplam hacmi, $Q_{düğüm-noktası}$ : Modelin bir düğümünde toplam ortalama ihtiyaç, $q_{tüketici}$ : Tek bir tüketicinin su ihtiyacı, $q_{sızıntı}$ : Düğüm noktasına bağlı boru üzerinden tanımlanan sızıntı debisi.*

*c. Zamansal Dağıtım*

Hidrolik çözümler, ortalama debiler kullanılarak anlık çözüm olarak yapılabileceği gibi, debideki dalgalanmalar dikkate alınarak uzatılmış zaman dönemleri için de yapılabilir. Hidrolik modelleme yapılırken ise, hidrolik çözümün uzatılmış zaman dönemi için yapılması gerekmektedir. Bir DMA bölgesine giren debiyi ölçen debimetrelerden alınan giriş debisi hacmi, farklı zamansal karakteristikleri olan sızıntı debisi ve tüketim debisinin toplamından oluşur. Tüketim debisinin zamansal karakteristiği; DMA bölgesinin sosyo-ekonomik, ticari, turizm, kültürel,… durumlarına bağlı olarak büyük dalgalanmalar gösterirken, sızıntı debisi basınç değişimlerine bağlı olarak daha küçük dalgalanmalar gösterir. Debinin zamansal dağıtımı için saatlik dilimler kullanılabilir. Bu çalışma bir günlük (24 saat) bir dönem için yapılabileceği gibi, hafta boyunca değişen tüketim karakteristiğine sahip bölgeler için 7 günlük (168 saat) bir tüketim deseni oluşturulması faydalı olacaktır. Bu çalışmada; zamansal dağıtım sürecinde saatlik debi değişimlerini hidrolik modele tanımlamak için tüketim debisini ve sızıntı debisini temsil eden ayrı iki adet zamansal tüketim desenleri oluşturulmuştur (Şekil 8,9). Debimetrelerden elde edilen veriler minimum gece debisi yöntemi ile sızıntı ve tüketimler olarak ayrılmış ve saatlik debi verileri ortalama debilere bölünerek her saat dilimi için katsayılar belirlenmiştir.




**Şekil** 8. Sızıntı Debisine ait Zamansal Tüketim Deseni (EPANET)




**Şekil 9.** Tüketim Debisine ait Zamansal Tüketim Deseni (EPANET)

**4. Sonuçlar**

"Tüketim Modeli" oluşturulması; "Su Yönetimi" konusunda yapılacak en önemli işlerden olan "Hidrolik Modelleme" aşamasına altlık oluşturacak ve modelin saha koşullarını gerçekçi bir şekilde simüle etmesine yarayacak önemli bir aşamadır. Bu çalışmada; Malatya Su ve Kanalizasyon İdaresi Genel Müdürlüğü tarafından işletilmekte olan Malatya İli İçme Suyu Dağıtım Sistemi üzerinde tesis edilmiş olan bir DMA bölgesine ait hidrolik modelleme çalışmaları sürecinde, şebekeden çekilen talep debisinin hidrolik çözüme saha koşullarını en yakın şekilde temsil etmesini sağlamak amacıyla yapılan tüketim modeli oluşturma süreci aşamaları anlatılmıştır. DMA bölgesinde şebekeden çekilen su miktarlarını tespit edebilmek amacıyla miktarsal dağılım süreci tamamlanmıştır. Yanı sıra, müşteri hizmetleri biriminden bölgedeki sayaçlara ait okuma verileri alınmıştır. Bu çalışmada çalışılan DMA bölgesi özelinde, çok eski yerleşimlerin olduğu karmaşık mimari yapıya sahip eski işhanları ve ticari binaların olduğu bir bölge olduğundan, sayaç okuma verilerinin güvenilirlik kalitesi düşük olarak belirlenmiştir. Bu sebeple, minimum gece debisi yöntemi kullanılarak sızıntı hacmi belirlenmeye çalışılmıştır. Sayaç okuma verileri ise mekansal dağıtım sürecine altlık olarak kullanılmak amacıyla kalibre edilmiştir. Mekansal dağıtım sürecinde, coğrafi bilgi sistemleri kullanılarak tüketim debisi kendilerine en yakın borulara ve ordan da en yakın düğüm noktasına tanımlanmıştır. Sızıntı debisinin ise boru uzunlukları ile orantılı olarak dağıldığı varsayılmıştır. Talep debisindeki zamansal dalgalanmaları tahmin edebilmek amacıyla, bölgeye giren su debisini ölçen debimetreler kullanılarak bölgeye ait zamansal tüketim deseni oluşturulmuştur.

Hidrolik Modelleme ve kalibrasyon süreçleri için tüketim modeli oluşturma çalışmaları yaparken, hesaplamaların sezgisel süreci göz önünde bulundurularak, sahadaki gerçek durumunun bire bir simüle edilemeyeceği ancak gerçeğe yakınlaşabileceği unutulmamalıdır. Şebeke üzerinde sahada gerçekleşen su talep debisi çekim karakteristiklerini temsil etmek amaçlı yapılan tüketim modeli uygulamalarında, idarelerin teknik kapasiteleri ile su şebekesinin fiziki durumları göz önünde bulundurularak farklı analiz yöntemleri belirlenebilir. Bu süreçte sahadaki koşulları en gerçekçi şekilde temsil

edilecek bir model teşkil edilmesi amaçlanmalıdır. Su temini ve dağıtımından sorumlu olan kurumların, su yönetimi konusuna eğilirken, bu çalışmada önerilen tüketim modeli çalışmalarını yapmalarının, ilgili kurumlara hidrolik model dışında farklı alanlarda da fayda sağlayacağı düşünülmektedir. Özellikle müşteri hizmetleri alanında, tahakkuk verilerinin tüketim modeli için önemli bir parametre olması dolayısıyla, illegal kullanım ve bölgesel sayaç okumalarında farkında olunmayan hataların da meydana çıkmasını sağlayarak bir oto-kontrol mekanizmasının gelişmesine dönük faydalar sağlayacaktır.

**Teşekkür**

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# CONFERENCE PROCEEDINGS

## BOOK OF FULL PAPERS
## ICCAUA 2022

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Alanya HEP University, Alanya, Turkey
Editors: José Manuel Pagés Madrigal and Mojdeh Nikoofam
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# Introduction

The *5th International Conference on Contemporary Affairs in Architecture and Urbanism* is organized by Alanya HEP University with the collaboration of the German University in Cairo and the Journal of Contemporary Urban Affairs. ICCAUA 2022's mission is to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of the contemporary concerns, methods and approaches to architecture and urbanism. It also provides the premier interdisciplinary forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, concerns, practical challenges encountered and the solutions adopted in the field of Architecture and Urbanism.

Accordingly, the conference brings together all the theories, manifestos and methodologies on contemporary architecture and urban spaces to raise the understanding for the future of architectural and urban planning. Overall, the conference aimed to establish a bridge between theory and practice in the built environment. Thus, it reports on the latest research findings and innovative approaches, methodologies for creating, assessing, and understanding contemporary built environments.

A broad outline of the conference's scope includes peer-reviewed original research articles, case and technical reports, reviews and analyses, papers, and short communications. This conference proceeding is the combination of scholars, practitioners, professionals, researchers and policymakers with a common interest in the field of architecture and urban design from different disciplines, such as Art, Architecture, Landscape, Urban planning and Urban Design. The scopes of this conference include:

**Architecture and Technology**
Environmental Sustainability
Smart Buildings
Sustainable Design
Green Architecture and Urban Planning
Climate and building
New Technologies
Climate Change Adaptation
**Sustainability and Urban Design**
Landscape Architecture and Urbanism
Sustainable Urban Development
Urban ecology
Housing and Urban Environments
Urban Aesthetics
New Urbanism
Urban Transport planning, management, and strategies
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Regeneration and Urban Renewal
Urban Sprawl
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**Keynote Speakers**
Professor Dr. Ahmed Faggal, department of architecture, Faculty of Engineering, Ain shams University (ASU), Cairo, Egypt
Professor Dr. Jianfa Shen, Department of Geography and Resource Management, The Chinese University of Hong Kong, Hong Kong, China
Professor Dr. Sahar Attia, Department of Architecture, Faculty of Engineering, Cairo University, Egypt
Professor Dr. Yasser Mahgoub Faculty of Architecture, Galala University, Egypt
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## Keynote Speakers' Self-Biography



**Professor Dr. Jianfa Shen, Department of Geography and Resource Management, The Chinese University of Hong Kong, Hong Kong, China**

Prof. Jianfa SHEN is Professor of the Department of Geography and Resource Management, and Director of Research Centre for Urban and Regional Development of Hong Kong Institute of Asia-Pacific Studies at The Chinese University of Hong Kong. His research interests focus on urbanization, migration, urban and regional development, urban governance and urban competitiveness. He has undertaken substantial research in these areas contributing to theoretical and methodological advancements, as well as empirical analysis and applications including the development of a dual-track urbanisation framework and the causes of changing migration patterns in China. He is one of the top two percent of the world's scientists according to the list released by Stanford University in December 2020. He received RGC Senior Research Fellowship 2020/2021. He serves in the Editorial Boards of The China Review, Population, Space and Place, Applied Spatial Analysis and Policy, Asian Population Studies, Asian Geographer and Geographical Research. He has published 197 papers and 28 books including "Urbanization, Regional Development and Governance in China" (2018, Routledge) and "Development and Planning in Seven Major Coastal Cities in Southern and Eastern China " (2017, Springer).



**Professor Dr. Jean-Francois Lejeune, University of Miami, USA**

Jean-François Lejeune is Professor at the U-SoA, where he teaches architectural design, urban design, and history theory. From June 2009 to December 2014 he was the Director of Graduate Studies. He taught at the Oregon School of Design (1985-87) and was Visiting Professor at the Universidade do Rio Grande du Sul (Brazil), the Università La Sapienza Roma, and the Universidad de Alcalá in Alcalá de Henares in Spain. In 2007 he was an Affiliated Fellow at the American Academy in Rome. Born in Belgium, he graduated from the University of Liège (Belgium) with the Diploma of Engineer-Architect. He is now a Ph.D. candidate and researcher at TU Delft, Netherlands, where he is completing his dissertation on Reciprocal Influences: Rural Utopia, Metropolis and Modernity in Franco's Spain.

Lejeune's research has also focused on Latin America and Miami and he is a founding member and secretary of DoCOMOMO-US/Florida. He curated in Brussels the exhibition Cruelty and Utopia: Cities and Landscapes of Latin America whose catalogue won the Julius Posener CICA Award for Best Architecture Catalogue in 2005. Other exhibitions include Cuban Architects at Home and in Exile: the Modernist Generation (2016-17, with Victor Deupi), The Florida Home: Modern Living in Miami, 1945-65 (Miami-Tallahassee, 2004-5, with Allan Shulman), Interama: Miami and the Pan-American Dream (Miami, 2008, with Allan Shulman). He is currently at work on two monographs: Loos and Schinkel: The Metropolis between the Individual and the Collective (Routledge) and The Modern Village: Rural Utopia and Modernity in Franco's Spain (DOM, Berlin).



**Professor Dr. Ahmed Faggal, department of architecture, Faculty of Engineering , Ain shams University (ASU), Cairo, Egypt.**

Professor Ahmed Faggal is a professor in the Architectural Department, Faculty of Engineering, Ain shams University (ASU), Cairo, Egypt, a visited Professor in The German University in Cairo (GUC) & The Britsh University in Egypt (BUE) and recently he is the Dean of Canadian International College – (CIC). Professor Ahmed Faggal had his PH. D in Architecture Eng. "2002" Ain Shams University, and his M.Sc Degree in Architecture Eng. "1998" Ain Shams University, Bachelor of Engineering "Sept. 87, - June 91" Ain Shams University, Faculty of Engineering. He teaches building technology, environmental control systems, and thermal comfort courses at both the undergraduate and postgraduate levels. He has supervised thesis in M.Sc. Degree & PH. D for more than 19 years. He has published papers in the area of environmental control and thermal comfort in buildings.



**Professor Dr. Yasser Mahgoub Faculty of Architecture, Galala University**

Dr. Yasser Mahgoub is an architect, academic and scholar. Currently, Program Director, Faculty of Architecture, Galala University. Received his Doctorate in Architecture degree from The University of Michigan in 1990. Held several academic positions at Ain Shams University (Egypt), United Arab Emirates University, Kuwait University, Qatar University, Dar Al Hekma University (Saudi Arabia) and Galala University (Egypt). Practised as a professional architect and consultant.. Teaches design studios, research methods, environment and behaviour, creativity and innovation, professional practice, graduation/senior projects and graduate courses. His research interests include social and cultural aspects of architecture, sustainable architecture, architectural education and the impact of globalization on architecture. Published several refereed research papers in internationally refereed journals and book chapters. Attended and presented papers in several international and regional conferences. Served as a scientific referee for many scientific conferences and journals. Was a member of the Agha Khan for Architecture Award reviewers for the 2010 cycle and currently country nominator.



**Dr. Joseph Adeniran ADEDEJI,Federal University of Technology, Akure, Nigeria**

Dr. Joseph Adeniran Adedeji has his core research interest in landscape hermeneutics. He joins the Rachel Carson Center from The Federal University of Technology, Akure (FUTA), Nigeria where he is a senior lecturer in the Department of Architecture. He obtained Bachelor (Hons.) and Master of Technology degrees in Architecture from Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, and Doctor of Philosophy degree in Architecture from FUTA. He lectured briefly at Osun State College of Technology, Esa-Oke (2004-2007), and LAUTECH (2007-2011) before his appointment in FUTA in 2011. A full member of the Nigerian Institute of Architects (NIA) and chartered by the Architects' Registration Council of Nigeria (ARCON), he has over two decades of practical experience. His teaching, research works, and publications are situated at the intersection of spatial considerations for the comfortable use of urban open spaces, environment and behaviour, cultural morphology of cityscapes, and more intensely, landscape hermeneutics of the urban grain in an African context. Specifically, he has a passion for researching the socio-cultural aspects of ecosystem services and biocultural identity of the Yoruba nation of south-west Nigeria. His most recent project titled Bioculturalism of Yorubas: Intersection of mythology and nature for wellbeing at Osun Sacred Grove UNESCO Site, Osogbo, Nigeria is part of a bigger picture of the project Urban realities and urban nature: Facilitating processes of wellbeing and belonging within urban biocultural environments (Earthscan, forthcoming). He is a reviewer with several academic journals, including Emerald's Management of Environmental Quality and Health Environment Research & Design, Urban Design International, Journal of Conservation Planning of the University of Florida (including an editorial board membership from 2014 to 2017), and Elsevier's Social Science and Humanities Open, among others. He is an

external examiner and Ph.D thesis assessor. He has published widely and presented research at learned conferences in Nigeria and abroad. These include IFLA (International Federation of Landscape Architects) World Congress 2012 and 2016, and the 2nd International Workshop on Civil Engineering and Architecture, among many others. He is a research methodologist with emphasis on the mixed-method paradigm, which he teaches at a postgraduate level. His Survey research designs incorporate data dummying: The what and how of a strategy for studying environment security is a wealth of resources on research methods praxis.



**Professor Dr. Sahar Attia, Department of Architecture, Faculty of Engineering, Cairo University, Egypt**
Dr. Sahar Attia, is an Emeritus Professor of urban design at the Faculty of Engineering, Cairo University. She has been the Head of the Department of Architecture in the same institution from 2013-2017. She has 40 years of experience practising and teaching urban planning, urban design, and architecture. She is currently a member of the Supreme Council of Urban Development in Egypt, a member of the Stakeholders Advisory Group Enterprise (SAGE) UN-Habitat, She is also the co-chair of the University Network Initiative -UN-Habitat (UNI), and a board member in Ecocity Builders, a non-profit public benefit corporation in SF California-USA.

She is the Co-Editor of: "Dynamics And Resilience Of Informal Areas: International Perspectives" (2016), "New Cities and Community Extensions in Egypt and the Middle East" (2018), "Cultural Sustainable Tourism" (2019), and "Ecocities Now" (2020), all four published by Springer. In January 2021, she has been appointed a member of the Egyptian Parliament, and a member of the Science & technology working group in the International Parliamentary Union (IPU).



**Dr. Laura P. Spinadel, BUSarchitektur & BOA GmbH, Competence Center URBAN MENUS for Smart Urban Development, Austria**
Laura P. Spinadel (1958 Buenos Aires, Argentina) is an Argentine-Austrian architect, urban planner, writer, educator and principal of the companies BUSarchitektur and BOA office for advanced randomness in Vienna. She is particularly reknown for her works Compact City and Campus WU, both considered pioneers of the holistic architecture ideology. She is Doctor Honoris Causa at the Civic Parliament of the Humanity, Transacademy Universal Institute of Nations. Currently, she is working on URBAN MENUS**, an Interactive Society Future Planning Serious Game to create our cities in 3D using an impact-oriented consensual approach.
** Granting Promotion XL Innovation AWS Austrian economy services of the Creative Industries (2017) & Impact Innovation funding Austrian Research Promotion Agency FFG (2020) & aws technology internationalization 2021-2022 support for URBAN MENUS India market study for a Smart Area Development solution.
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**Professor Dr. Carlo ALBERINI, Mohammed VI Polytechnic University, Morocco.**
fter his master's in Architecture at the School of Architecture – University of Genoa (in 1998), with a thesis on *Teaching of Urban Planning in the European Schools of Architecture,* he began his research and teaching activities. In 2005, he got his PhD in Urban Planning at the School of Engineering – University of Genoa, with a thesis on *Ports planning, urban governance and waterfronts regeneration projects.*
Since he graduated, he has been Researcher and Adjunct Professor at the School of Architecture in Genoa for several years, taking courses on *Town Planning* and *Town Planning History*. Adjunct Professor at the Schools of Architecture in Florence, where he taught courses on *Urban Planning*, *Urban Management*, *Infrastructures and Urban Development*. He also taught at the Master' on *Waterfront regeneration projects in Mediterranean cities*. Its areas of research investigation covered the topics of *urban analysis* and *urban regeneration projects management*, with specific focus on the quality of public space and the impact on real estate value; internationally he has been involved in research projects funded by the EU, in the fields of *urban mobility*, *cities-infrastructures design & management*, *infrastructure & environment*.
Since august 2018 he's a Professor and Researcher at the School of Architecture Planning and Design - Mohammed VI Polytechnic University (Morocco), where he has held courses in the Master on "*Resilient, Sustainable and Smart Buildings & Cities*" as well as for the bachelor's degree in Architecture. In the Master RSSBC he's in charge for teaching the modules related to: *Analysis of urban contexts in African cities*; *Funding resilient and sustainable buildings & cities*; *Introduction to real estate finance for sustainable and resilient urban transformation projects*. On the bachelor's in architecture, he's in charge for the *Design Studio #1, Design Studio #2, Introduction to Environment Ecology and Sustainability*. At the EMINES – School of Industrial Management (UM6P) he in charge for teaching the module *Finance and Urbanization*. He's author of three monographies on infrastructure development and urban development process, waterfront regeneration project and port planning, urban planning & real estate finance. He's also correspondent for the International Architecture Review AREA. Recently he presented the paper "*How to teach Urban Big Data for tomorrow' town planners"* at the 2022 International Conference of the Association of Collegiate School of Planning. He is Co-Coordinator of the research project: "*Urban structure and COVID19 spread. Defining and monitoring Urban Health & Hygiene Performance Index*" as well as Coordinator of a 3-year research project "*Dakhla Region 2030 Action Plan. Fostering SDGs trough integrated coastal zones management and sustainable urban planning*". As a professional, during last 20 years, he has gained an extensive experience in hospitals and healthcare infrastructures programming & design, as well as in regeneration's projects of public and private large real estate assets.

## Preface by the Local Organizing Committee Chair

On behalf of the organizing committee of the 5th International Conference of Contemporary Affairs in Architecture and Urbanism at Alanya HEP University, I am honoured and delighted to welcome you to this annual conference. As you may know, the main reason that we have decided to hold our conference online was due to the pandemic that has changed completely the lifestyle of people. But according to the statistics, it seems that we are now in the normalization process. So, it is now a time for a big rethink on how to plan a post covid cities. In this regard, the main aim of this conference is to seek how we can design a better world together considering post covid era. In this regard, recent findings on post-pandemic studies will be discussed at this conference. Accordingly, all the articles have been selected and classified in such a way to enrich the possibility of this importance. Therefore, as a manifesto for the recent problem, I believe that the post-pandemic cities will bring lots of ideas to design a better world together.

Overall, referring to the essence of this conference, I would say that this event has been organized to provide and share the latest manifestos, methodologies, and developments, to raise the understanding of the future of architecture and urban planning. Bringing together leading academic scholars to exchange and share their research results is also the main concern of this conference.

We have launched this annual conference about five years ago. During organizing ICCAUA2022 based on our global advertisement, we received 261 papers from 48 countries and after doing all the review and registration process, 170 high-quality manuscripts from 43 different countries have been accepted for publication in the proceedings of the conference. So looking at the statistics we can see that the conference has reached its aims of providing a global platform to discuss contemporary affairs in architecture and urbanism. Gathering 322 highly cited scholars from 42 countries is a dream of each organizer to transfer the objectives of the conference. I hope the participants of this conference will be able to transfer recent findings presented in this conference to their own colleagues and students. Urbanization and sustainable urban development, Planning the Post-Covid Cities, Energy and Climatic Design, Sustainability and Urban Design, Design philosophy and Education, Architecture and Technology, Habitat Studies and Heritage and Cultural Landscapes are the hottest topics which will be discussed at this conference.

Our technical program for this conference is rich and varied with 7 Keynote Speeches and 7 invited talks and 170 Technical papers which have been splinted between 3 parallel sessions to be discourse during these two days.

As the conference chair of the ICCAUA2022, I know that the success of the conference depends ultimately on the many people who have worked with us in planning and organizing the program. In particular, I thank the Rector of Alanya Hamdullah Emin Paşa University, professor Prof. Dr. Ebru Gülbuğ EROL, Professor Dr. Erol R. SAYIN and Asst. Prof. Dr. Muzaffer ÖZGÜLEŞ who respectively are the Dean of the faculty of architecture and Head of the department of architecture at Alanya HEP University. I thank them for all their advice, support and partnership. I have also thank all the organizing committee members specifically Prof. Dr. José Manuel Pagés Madrigal, Dr Seda H. Bostancı, Dr. Mennat-Allah El-husseiny, Dr. Rokhsaneh Rahbarianyaz and Professor Dr. Islam Hamdy Elghonaimy and Prof. Dr. José Manuel Pagés Madrigal who support us as conference co-chairs and all the reviewers of the Journal of Contemporary Urban Affairs for their detailed and timely reviewing of the papers.

My acknowledgement also goes to:

Professor Dr. Ahmed Faggal, department of architecture, Faculty of Engineering, Ain shams University (ASU), Cairo, Egypt

Professor Dr. Jianfa Shen, Department of Geography and Resource Management, The Chinese University of Hong Kong, Hong Kong, China

Professor Dr. Sahar Attia, Department of Architecture, Faculty of Engineering, Cairo University, Egypt

Professor Dr. Yasser Mahgoub Faculty of Architecture, Galala University, Egypt

Dr. Joseph Adeniran ADEDEJI, Federal University of Technology, Akure, Nigeria

Dr. Laura P. Spinadel, BUSarchitektur & BOA GmbH, Competence Center URBAN MENUS for Smart Urban Development, Austria

Professor Dr. Carlo ALBERINI, Mohammed VI Polytechnic University, Morocco.

for the delivery of their insightful keynotes, I am sure these talks will invoke profound intellectual discoveries. So, ladies and gentlemen, I hope you enjoy the excellent academic and cultural atmosphere of the ICCAUA2022 and wish you all a productive conference ahead. Only on my own personal note, I just would like to say it has been a real privilege to be the chairman of this conference and thanks for all of your amazing work and patience that I appreciate.

Dr. Hourakhsh A. Nia
Alanya HEP University, Turkey
May 11, 2022

CONTEMPORARY AFFAIRS ARCHITECTURE AND URBANISM | **ICCAU**'22 |

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**Alanya HEP University, Alanya, Turkey**

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## *Themes of the ICCAUA2022 Conference*

**Architecture and Technology**

Environmental Sustainability - Smart Buildings - Green Architecture and Urban Planning - Climate and building - Climate Change Adaptation - Interior Architecture - Architectural History and Theory - Architectural Planning and Design - Sustainable Environmental Design and Technology - Design and Technology of Building Structures - Computers in Architecture - Landscape - Energy Conservation

**Sustainability and Urban Design**

Landscape Architecture and Urbanism - Sustainable Urban Development - Urban ecology - Housing and Urban Environments - Urban Aesthetics - New Urbanism - Urban Transport planning, management, and strategies - Disaster Risk Management - Regeneration and Urban Renewal - Urban Sprawl - Healthy and Productive Economy - Chemicals, Waste and Air Quality

**Heritage and Cultural Landscapes**

Revitalization - Gentrification - Adaptive reuse - Morphology

**Habitat Studies / Infra Habitation**

Infra Habitation - Emerging cities - Gated communities - Conflict and divided territories - Slums - Affordable houses - Resilience, Disaster and Conflicts

**Civil Engineering**

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