ASSESSMENT OF PASSIVE SECURITY MEASURES IN MIXEDUSE BUILDING OFFA, KWARA STATE

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ABSTRACT

Buildings are manmade structures that are primarily meant for shelter. They are designed in different sizes, shapes, forms and functions. Some buildings have only one function and some have multiple functions such as residential and commercial purposes. These types of building are referred to as mixed-use building. One major problem encountered with these structures is the issue of insecurity which is as a result of poor design which makes them more prone to attacks by the terrorist and criminals because of the nature of these buildings and their usage. They are easy target because these terrorists know that huge and valuable properties are stored in them. Theaim of this research is an assessment of passive security design measures in mixed use building. The research method employed is qualitative research where the buildings were randomly selected from the sample population.The criterion for selection is building with three or more significant uses. Significant uses such as residential, commercial, retail, institutional, recreational, and hotel uses. Data was collected through personal observation and analysis of the results from the collected data were discussed and shown in tables and charts using Microsoft office word and power point. It was discovered that passive security measures to consider in mixed-use building are standoff distance, passive security elements on site and access and parking facilities. The study established that 70% of the selected mixed-use buildings in Offa lacked the integration of passive security measureat the design stage. The thesis contributed to knowledge by establishing a clear distance of 1200 millimetres between adjacent security barriers with a height of 600millimeters and above for security design. It is recommended that passive security measures such as maximum standoff between structures, use of carbon reinforced polymer as wall cladding, use of perimeter fence, use of defensive plantings, use of laminated safety exterior glass and the use of chicane and offset road approach should be integrated during the design stage so as to ensure the safety of lives and properties.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

The security of every citizen in a country should be the paramount objectives of every government and the state (Achumba*et al*., 2013). The security and welfare of the people shall be the primary purpose of the government (Adetokunbo, 2013). However, security still remains a prominent problem in the Nigeria despite the fact that it is a primary objective of the government.

Security is crime prevention, security technology and risk management or loss prevention (David, 2015). Security is a situation that exists when actions for the safety of persons, information and property against unreceptive persons and deeds are established (Achumba *et al, 2013*). However, David and Achumba *et al* did not define security in the context of the building and the environment. Therefore securityis when the building is integrated with measures that make persons and properties safe.

According to Azazi (2011), different measures have been put in place by the government so as to curb crime in Nigeria. According to the Global Peace Index (GPI,

2012), Nigeria was ranked low in the GPI despite all the efforts by the government to reduce crime and terrorism. However, even with all these measures to curb insecurity, crime rates and attacks have been on the increase creating fear and insecurity among the citizens. This implies that there is inefficiency in the security of lives and properties throughout the country.

Public building continues to be a major problem to those who are involved in the design and construction. The designers involved in these buildings are faced with the problem of securing the asset and the building. In the design of these buildings, factors such as

the function of the building, the needs of the users and the nature of the work are put in to consideration.The security level of these buildings is determined by the sensitivity of work in the building. For example, a bank will require high level of security because of its nature of work which is keeping money (Adedayo *et al.*, 2017). However, security measures should not only be considered during the design and construction stages, it should be a continued process even when the building is in use.

The Architect is the leader in the building professional team and also responsible for the design of these buildings. Therefore, he shouldintegrate passive security during the design stage. Passive security is a design that prevents threats and does not affect the day to day functioning of the building. If a building is designed, it is important to consider how the security of the building can be achieved sustainably.

Passive security offers lots of benefit. An ideal passive security design is sustainable, safe, and secure and aesthetically pleasing. Therefore, to secure a public building, it is important that the Architect and other professionals involved in the design to make passive security an integral part of the design.

Public buildings such as mixed-use buildings, malls, Banks, airports, ports, hotels, government offices, markets and police stations are seen as easy and soft target by the terrorist because huge and valuable properties are stored in these places. Therefore, theaim of this research is to assess passive security measures in mixed-use buildings in Kwara State.

1.1 Statement of the Research Problem

The question that bothers every Nigerian is that can the security of lives and properties be guaranteed? considering the lingering challenges posed by insecurity and efforts by

the government to ensure the safety of citizens in the country.People have come in to conclusion that the government at all levels have failed in providing a safe and secured environment for her citizens.

Huge amount of funds have been diverted by the government to national security agencies in ensuring security of the citizens but it seems that the security situation in Nigeria appears or at least have remained undefeatable. That means all these funds and efforts are a waste. This is a matter that needs urgent attention because there are other sectors that need serious attention by the government but because of the importance of security, these sectors have been given less attention.

Public buildings such as condominiums, malls, churches, mosques, air ports and market places are more prone to attacks by the terrorist and criminals because of the nature of these buildings and their usage. The terrorists know that it is not possible to completely secure these buildings so they are at risk. There was an incident of bank robbery attack

that occurred in Offa local government area of Kwara State on the 6th of April, 2018

where more than 30 people lost their lives including 13 police officers and several other people sustained serious injury (Leke, 2018). The armed robbers also carted away with millions of naira. Had there been a well established security measures in these buildings, the casualties might have been minimal or not happen at all.

It is not only the role of the government to tackle insecurity, Architects and professionals in the building industries are not left out as they responsible for design and the planning of the built environment. Therefore, a combined

effort from the government and professionals in the building industry will minimize insecurity in public buildings and Nigeria at large.

1.2 Aim and Objectives

1.2.1 Aim

The aim of this work is to carry out an assessmentof passive security design measures in mixed-use buildings towards ensuring a safe and secure environment. To achieve this aim, the following objectives are outlined.

1.2.2 Objectives

1. Identify different types of security threat in mixed-use building.
2. Determine different security design measures to mitigate security threats in mixed- use building.
3. Identify different passive security design elements that can be used to mitigate security in mixed-use building.
4. Proposal fora mixed-use building design integrated with a passive security measures that will guarantee the safety of the building and the users.

1.3 Justification

Security is an incorporated idea of positive peace, fundamental human rights and sustainable development (Pam, 2005). It is therefore the freedom from danger, intimidation, lack of fear, and the assurance of the good life.

Apart from ensuring the safety of lives and property, security also enhance the state of mind as the mind is free from every form of unnecessary worries, anxiety and feelings of insecurity. Therefore, ensuring security of buildings is to say that you are prolonging the life span of the inhabitants.

1.4 Contribution to Knowledge

At the end of this research, professionals in the building industry most especially the Architect being the front runner will have the knowledge of passive security design and understand why it is necessary to incorporate it in the design right from the pre-design and the design stages. Users of public building will also be enlightened on how to maintain security in their immediate environment.

1.5 Scope of Work

The scope of this work involves identifying and implementing different passive security design principles and design consideration in a mixed-use building design. These design principles will reflect in the building and on the proposed site plan. It will also determine and demonstrate the implementation of the most suitable elements and material to use in order to achieve a passive security design.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 History of Mixed-Use Development

Prior to the advent of modern zoning and land-use practice, finely mixed development

was the standard (Stephen, 2013). Contemporary zoning practices allocated land uses

according to their use. Residential purposely used buildings were segregated from

commercial and institutional ones. From the beginning of the twentieth century through

mid-twentieth century,thinly mixed land uses were unusual in new developments. A

typical example is Randolph & Snelling Avenues, located at St. Paul, USA (See Fig

2.1).

Fig 2.1: Randolph & Snelling Avenues, St. Paul, USA
(Source: Design Center r American Urban Landscape, 2003)
f

However, in the 1960s and 1970s mixed use resurfaced, as aninstrument for urban

revival. In big projects among the development communityit is referred to as MXDs

(Mixed-use developments).A typical example is Fashion Island and Newport Center,

Newport, California, USA (See Fig 2.2).

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Fig 2.2: Fashion Island and Newport Center, Newport, California, USA (Source: Design Center r American Urban Landscape, 2003)
f

In the late twentieth century, mixed developments were built on smaller scales in

comparism to older mixed developments(Stephen, 2013). There was much interest in

historic preservation and this lead to the integration with the urban environment. A

typical example is Riverplace, Minneapolis, USA (See Fig 2.3).

Fig 2.3: Riverplace, Minneapolis, USA
(Source: Design Center r American Urban Landscape, 2003)
f

2.1.1 Mixed-use development today

In the late 20th century, mixed use emerged as a major element of Transit Oriented Development (TOD) and Habitable Communities (Jeff, 2003). However, they were referred to as TOD and habitable communities because of their multiple functions. A typical example is East Village, Minneapolis, USA (See Fig 2.4).

Fig 2.4: East Village, Minneapolis, USA
(Source: Design Center for American Urban Landscape, 2003)

According to Jill (2002), mixed-use developments today have three different approaches. They are:

1. Increase concentration of land uses,
2. Increase variety of land uses, and
3. Integrate separated uses.

2.1.2 Advantages of mixed-use building

According to Jill (2002), there are many benefits of mixed-use building. Some of these

benefits include making urban areas active during the day, offers many housing options

for varied home types, decreases auto dependence, add to travel options and forms a

local sense of place.

2.2 Passive Security

Man to a varying degree needs security. From the ancient castle typology to the earliest hill-fort, Architecture has served to be a solution to security of lives and properties (James, 2017). However, other field such as Engineering has also made immense contribution to security of the building and the occupants.This implies that the necessity of security is so linked throughout the history of built environment.

The society continues to debate on the role of Architecture in security (Elizabeth, 2010). It is important for the Architect or Landscape Architect involved in the design of environment to think about how your design protections can be sustainably met. This is called passive security. However, every professional in the building industry have a vital role to play in the security of the environment from generations to generations.

In Architecture, passive security can be defined as incorporating a design feature in a building to prevent threats and attacks while these features remain largely invisible to the users or inhabitants. Applications of these design features take many forms. This ranges from the entire building annexes, to perforated fence design systems, to blockades giving the impression of art installations. The purpose of all these security measures is to prevent or reduce conspicuous attacks and the idea is to make all the deterrents invisible. Thereforemaintaining a secured environment while keeping it totallydiscreet should be the priority of the Architect and other professionals in the building industry. This will at the long run reduce building maintenance cost and ensure a safe, sound and healthy environment.

Different researches have been conducted on issues related to passive security measures and design considerations in public building by various researchers. Some of these related issues are listed below.

i. Enhancing building security ii. Site security design

iii. Historic Design for Defense iv. Nature's Design Response

v. Mixed-use building design

2.2.1 Enhancing building security

After the 11th of September 2001 attack, terrorism act became a big menace to all nations (Building and Construction Authority, 2005). It is not possible to fully prevent a terrorist attacks, but it is very possible to take measures to reduce the effects on the people and buildings. Events in the past have revealed that the use of bombs and explosives is a familiar mode of attack. In such situation, the adverse consequence on building depends on the distance of its blast from the building. However, threats can take other form in a building. Use of radiological agents is another form of attack. Such agents of destruction gain access into the building through air intakes or available openings.

It is difficultto predict which building would be indanger but generally they are public buildings where the aftermath of the attack is massive (Building and Construction Authority, 2005). Even if a building is considered to be at risk, it is not easy to specify the exact severity of the attack. Therefore the best possible solution is to make a building ready in case of any attack. However, this depends on

the design of the building and construction materials and methods. Building owners and designers should adopt a sensitive approach to security.There are practical and useful building safety measures and considerations that may possibly reduce terrorist attacks (Internal Security Department, 2005). These measures are:

2.2.1.1 Provide stand-off distance

A standoff between the building and a possible attack should be provided. It could be done by the use of passive elements such as screen walls, planter boxes, bollards and obstacles (see Fig 2.5) or by implementing security measures such as access control, close watch and exposure.

Low screen wall

Planter boxes and bollards

Bollards.

Fig 2.5:Passive security measures
(Source: Building and Construction Authority, 2005)

2.2.1.2 Check fire proofing

Steel tend to lose when expose to heat, therefore it is required for the steel member of a building to be built with fire fortification comprising an insulation coating of material. This material could be concrete, sprayed-on cementitious coating and dry-boarding (see Fig 2.6).

Fig 2.6: Examples of fireproofing for structural steel
(Source:Building and Construction Authority, 2005)

2.2.1.3 Assess building resistance to progressive collapse

Key elements that are close to possible attacks should be recognized. Evaluation of its ability to resist progressive damage should be done and make availablesuitabledefensive measures. Other structural elements in possible areas of attack should have additional capacities so that when one element is damaged, others will give it supportotherwise building damage will extend and the result will be disastrous (See Fig 2.7).

Fig 2.7: Alfred P Murrah Building, Oklahoma City, Oklahoma, April 19, 1995: Progressive damage that is caused directly by the bomb.
Source: Building and Construction Authority, 2005)

2.2.1.4 Provide Emergency Evacuation Measures

Emergency lighting and exit sign should be provided in staircase and emergency routes. These lighting are referred to self illuminating marking. They are provided as back up light to electric bulb in case there is power outbreak in the building (see Fig 2.8).

Fig 2.8: Self-illuminating markings on a staircase
(Source: Building and Construction Authority, 2005)

2.2.1.5 Provide various security measures

Safety measures such as access control, close watch and detection should be put into practicein the building (see Fig 2.9). These security measures are discussed below.

a. Access control

Security check points should be provided far away from the building outer walls to perform security check on vehicles before accessing the building.

b. Surveillance

CCTV camera should be placed at strategic

locations. c. Detection

Alarm system should be provided to supplement the physical security that is already in place.

Fig 2.9: Various security measures for buildings
(Source: Building and Construction Authority, 2005)

2.2.1.6 Provide reinforced concrete lift shaft and staircase interiors.

Staircase and lift shaft interiors should be made of reinforced concrete. This will help to keep evacuation and escape routes intact (see Fig 2.10). However, the staircase could made with other building material such steel.

Fig 2.10: Reinforced concrete staircase cores
(Source: Building and Construction Authority, 2005)

2.2.1.7 Do away with the use of scissors staircases

A scissors type of staircase should be avoided in building. A scissors staircase is the arrangement of 2 sets staircases in a single staircase core (see Fig 2.11). The advantage is that it will save space. However, if there are damages in the core, it will probably affect the two stairs. Therefore, two sets of staircases should be arranged separately to reduce chances of both being damage when incident occurs.

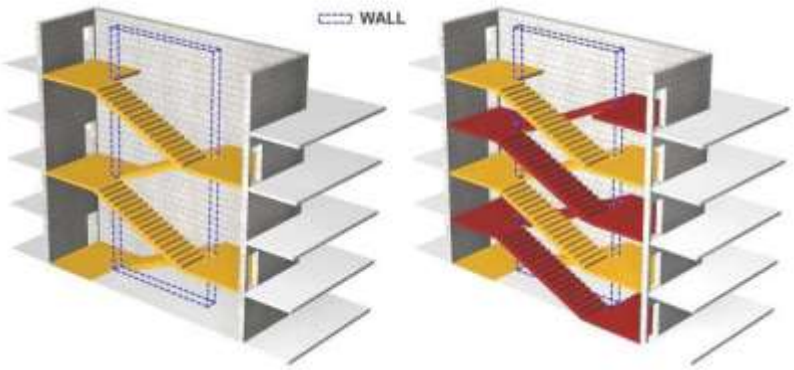

Fig 2.11: Regular staircase Scissors staircase (Source: Building and Construction Authority, 2005)

2.2.1.8 Keep air intake out of reach

The building should be designed in such a way that the air vents heightfor air conditioning systems and mechanical ventilation system prevents easy entry by an intruder (see Fig 2.12). However, they can be located on the lower floor provided there are barricades to prevent any intrusion.

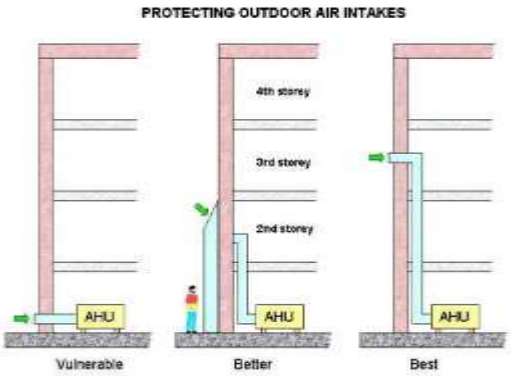

Fig 2.12: Air vents design in building
(Source: Building and Construction Authority, 2005)

2.2.1.9 Provide smoke stop lift lobbies

When fire occurs in public building, people mostly fall victim to smoke than fire itself. This happens because smoke spread through service areas like the lobby and lift shafts and people inhale the smoke from the fire which leads to casualties. Therefore smoke stop lobbies for all lifting shaft should be provided to minimize upwardmovement of smoke in the lift shaft (see Fig 2.13&2.14).

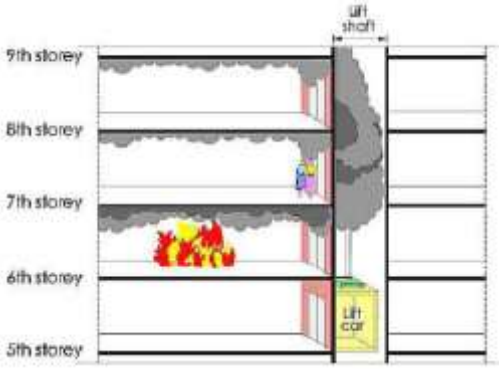

Fig 2.13: Building design without smoke stop lobby
(Source: Building and Construction Authority, 2005)

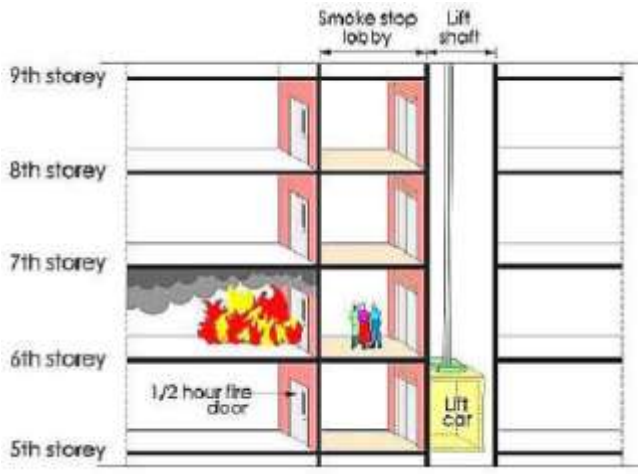

Fig 2.14: Building design with smoke stop lobby
(Source: Building and Construction Authority, 2005)

2.2.1.10 Separate higher risk areas from the main building

Areas such as car parks, mail room and unloading bays should be separated away from

the main building (see Fig 2.15). If it becomes necessary to be within the building complex then they should be placed away from vital columns or beams so that no

vehicleis parked in them.

Fig 2.15: Loading and unloading located outside the main building complex
(Source: Building and Construction Authority, 2005)

2.2.1.11 Avoid the use of common lift systemsand provide clear signage

Design of familiar lift systems should be avoided in building design. Lift serving the car park storey and the main building lift should be separated (see Fig 2.16).

Fig 2.16: Do away with the use of common lift systems
(Source: Building and Construction Authority, 2005)

2.2.1.12 Conduct thorough assessment and investigation of building systems

systems Architects and Engineers involved in a building project should performed thorough assessment and investigation of building systems at the design stage. This will help to prevent catastrophic damage in case there is serious terrorist attack. An example of a building where rigorous assessment was done is theKhobar Towers in Saudi Arabia where on June 25, 1996 the building did not undergo any progressive damaged despite there was an enormous bomb explosion (see Fig 2.17).

Fig 2.17: Khobar Towers, Saudi Arabia on June 25, 1996 (Source: Building and Construction Authority, 2005)

2.2.1.13 Protect against flying glass

Glazing systems should be designed such that it minimizes the harmful effect of flying

glass. A flying glass is a glazing system made of glass which shatters in to sharp , high
velocity fragments whenever there is blasts thereby causing serious to occupants injur

and passersby. There are 3 ways to protect against flying glass. They are:

a. Application of transparent polyster anti-shatter film to glass,

b. Install a blast resistant laminated glass (see Fig 2.18) , and

c. Install a secondary blast resistant glazing on the interior of the existing glazing

exterior.

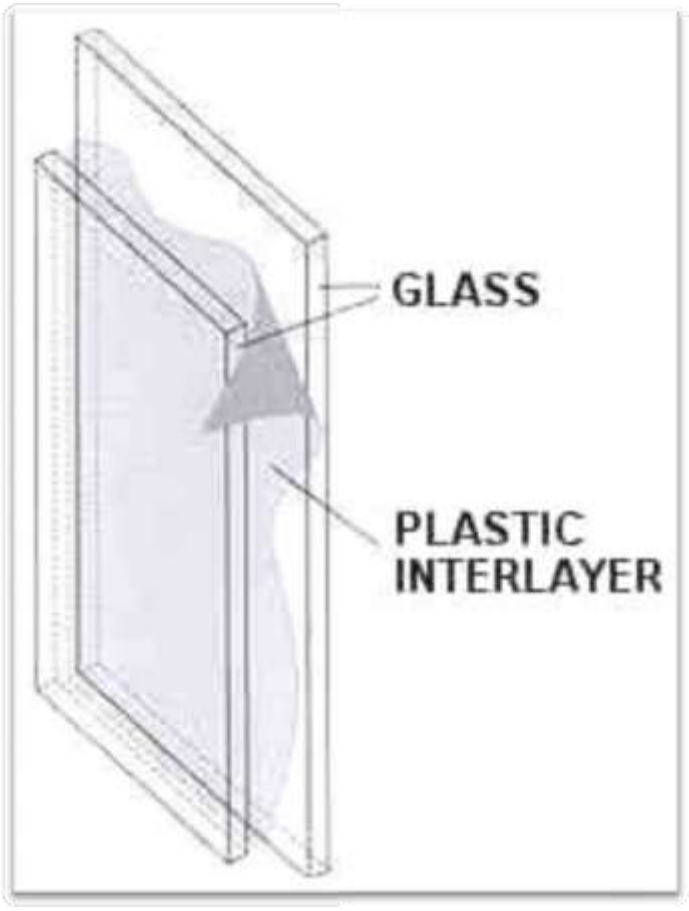

Fig 2.18: Laminated glass(Source: Building and Construction Authority, 2005)

2.3 Site Security Design

Every public building owner is responsible for providing a safe and healthy place for the occupants (U.S Department of Homeland and Security, 2007). In order to achieve this, it is important to include counterterrorism elements in the design. However, the inclusion of these elements does not in any way inhibit the functionality of the building.

As a significant presence in the environment, public building derives its quality from the social, economic and environmental context. These qualities can be best derived when security is an integral part of this vital urban development.

The security of the site is not just a requirement, but aprospect. Therefore, it becomes a challenge for the Architect and Landscape Architect involved in the design of a public building site to do rigorous assessment of site security elements and design considerations to make surethere is a safe environment.

However, in an attempt to secure these public buildings, protection has come at the expense the surroundings. Therefore, it becomes necessary forthe Architect to specify sustainable building materials during the design stage; materials that will be eco- friendly and will not be harmful to the users. Guidelines for site design elements and site security design will be discussed further.

2.3.1 Guidelines for site design elements

The site is divided in to six different zones and site design elements can be applied to different areas within the building perimeter after which proper actions are taken (U.S General Services Administration, 2007). These areas are called ‘‘zone’’. These zones are listed below.

2.3.1.1 Zone one: Neighborhood

This can be the premises or area closeto a building depending on how the site is being used. It includes parking areas, open spaces, streetscape and other frequently used facilities by the visitors.

Elements or Actions

a. Coordinate with the existing and proposed development plans. b. Collaborate with other locality security operations

c. Adjust traffic conditions

d. Consider the inclusion of public right-of-way in the standoff zone e. Consider closing part or all of an existing street if required

f. Set up temporary barriers for heightened level of alert g. Develop and coordinate personal safety programs

2.3.1.2 Zone two: Standoff Perimeter

Standoff security boundary keeps vehicle that are likely to explode at a distance thereby minimizing the risk of a potential destruction.

Elements or Actions

1. Establish the level of security needed, based on accepted threat

2. Ascertain the standoff zone position and dimensions

3. Create a strong perimeter where needed,

using a. Bollards

b. Sculptural or seating

barriers c. Walls

d. Hardened street

furniture e. Fences

f. Topography

g. Dry moats

h. Collapsible

surfaces i. Water

j. Landscaping and plantings

2.3.1.3 Zone three: Site Access and Parking

A variety of elements and services on site can make available access to a building. Vehicles and visitors inspection can also be included in the zone.

Elements or Actions

1. Demarcate drop-off and pick-up areas

2. Site access control

byintegrating a. Inspection

areas

b. Retractable

bollards c. Use of

gates

d. Use of guard

booths e. Use of Sally

ports

3. Check loading and service areas

4. Preserve clear access roads for first responders

5. Set up clear pedestrian passage routes

6. Create secure parking areas within and outside the standoff perimeter such as:

a. Garage parking

b. Surface

parking

c. Way finding and signage

2.3.1.4 Zone four: Site

Supplementary layer of elements may be made available in order to help in avoiding the damage of a facility within the site perimeter.

Elements or Actions

1. Design site facilities, such as furnishings, planters, and vegetation, to provideseveral purposes

2. Provide usable space

3. Weather-protected space should be designated for queuing at entries

4. Design safetymarquees and other self-supporting buildings to unify with the site's architectural quality

2.3.1.5 Zone five: Building Envelope

At the boundary between the site and the building, services occur. These services are responsible for the control of heating, ventilation and air-conditioning (HVAC). Additional surveillance should be provided by security personnel. However, CCTV could also be installed at the entry and exit points to boost surveillance.

Elements or Actions

1. Avoid access to vents or air intakes

2. Design disaster exits to allow easy evacuation from a building

3. Place cameras and light fixtures to maximize visibility

4. Harden the building structure and envelope

5. Design orientation and massing of building to lessen impact of explosion

2.3.1.6 Zone six: Management and Building operations

Layout and building plans can be modified to boost security. Modification such as

separating high risk tenants to the building interior. In a situation where there are

adequate security personnel, added security employee can be provided to enhance

surveillance.

Elements or Actions

1. There should be flexibility in building programming and space planning

2. Consider guards as an option for security operation when faced with site and cost

limitations

2.4 Historic Design for Defense

A layered strategy of defense has been frequently in use since the historic evolution of

security measures (Centre for the Protection of National Infrastructure, 2007).
Inspiration derived from this historic approach adopted a similar strategy called

"defense in depth". These strategies are being used in this modern era as security

measures in modern buildings.

Fig 2.19: Motte and bailey (Source: Integrated Security Guide, 2007)

Fig 2.20: Castle and Moat (Source: Integrated Security Guide, 2007)

New innovation requires new ideas but the design principles remain constant (Integrated

Security Guide, 2007). These design principles is always adopted in new design because
it has been working since the inception of security measures.However, these ever

strategies can be applied in modern buildings but with a more sophisticated materials

and additional mechanical devices.Motte and bailey, Castle and moat and final level of

defense are excellent models demonstrating these principles and they are discussed as

follows:

They are layered defenses designed to mitigate the threat as they advance towards the

asset. This is demonstrated in Motte and bailey principle of defense. See Fig 2.19 and
2.20.Altitude advantage ove the supplies of attack to createnormal surveillance a and

plain lines of sight for quick detection of attackwithin the building. This is demonstrated

in Castle and moat principle of defense.

The final layer of defense is hardened to prevent and delay an attack. Using ditch or

moat around acastle to make sure that access to the building is minimized and fewer

points of access had to be watched.

2.5 Nature's Design Response

Through evolution, flora and fauna have developed. They are specific mechanism which

provide defense in opposition topossible attacks in the building (Integrated Security

Guide, 2007). These means include obvious visual warming; physical preventions to

more discreet concealment and evasion plans and their defense strategies include fight,

patience and distraction. These defense strategies can be applied as a security measures

in buildings. However, in an attempt to secure a building using these strategies, the

safety of the users must be put in to consideration by integrating sustainable

elements.Other defense mechanisms are discussed as follows:

a. Physical defense mechanism such as thorns, backbones, sharpness and body

armorprevents and protects in the natural world by creating standoff distances to stop

access to defenseless parts. See Fig 2.21

b. Mechanical reaction to touch (thigmonasty), brilliantly exhibited by the Venus

fly-trap. This is also used by plants as a deterrent to attack.

c. Chemical resistance generally used by plants and animals.

d. Untimely warning can be provided by natural surveillance in preparation and

readiness against possible attacks. Distressing calls from prey animal are used to caution

the entire community to prevent themselves from attack.

Diversion through camouflage Fortified and layer protection Surveillance provides early warning

Fig 2.21: Nature's physical defense mechanism
(Source: Integrated Security Guide, 2007)

2.6 Mixed-Use Building Design

This section looks at critical aspect of mixed-use building that will contribute to a better mixed-use development. It also covers advantages of mixed-use building, location of mixed-use building, compatibility and configuration of mixed-use building.

Mixed-use buildingcomprises of three or more importantincome producing uses (Stephen,2013). These uses include residential, manufacturing, entertainment, community/cultural, religious, offices, hotel, retail and parking. Therefore, a building is said to be mixed-use if it has a combination of two or more of these uses. However, mixed-use building is not restricted to only these uses. A mixed-use building can accommodate as many as possible significant uses provided they are functional.

2.6.1 Advantages of mixed-use building

Social/ quality of life

a. Pedestrian friendly

b. Societal connectivity

c. Civil amenities/spaces

Environmenta l

a. It is Less auto-

dependent b. There is

focused density

c. It Supports transportations

Economic

a. Public infrastructure is shared

b. Parking facilities are shared

c. There is higher rents

2.6.2 Location of mixed-use building

Mixed-use buildings are best located in or near town centers

2.6.3 Compatibilities of uses

It is very important to consider how compatible the uses are in mixed-use building because developing a mixed-use building can be more complex than a single use building (Jeff, 2003). For example, locating a wood processing factory next to a library may not be compatible because noise generated from the factory will inconvenient those who are reading in the library. Therefore, it is important to consider some factors such as hours of operation, different effect that may need to be managed such as noise and different types of servicing.

2.6.4 Mixed-use configuration

In the design and planning of mixed-use building, it is important to consider the comfort of the occupants and the best outcome of the street and the environments (Auckland Design Manual, 2012). Mixed-use configuration is categorized in to two namely:

a. Vertical mixed-use, and

b. Horizontal mixed-use building

This is the most common form of mixed-use development comprising of non-residential uses on the lower floor and residential uses on the upper floors. Putting residential uses over the street level provides disconnection from noise coming from the street. See Fig

2.22 and 2.23. However, residential uses can also be located on lower floors provided they are adequately screened from noise.

Vertical mixed-use developments are more appropriate for town centers and places where there is demand for retail and commercial activities.

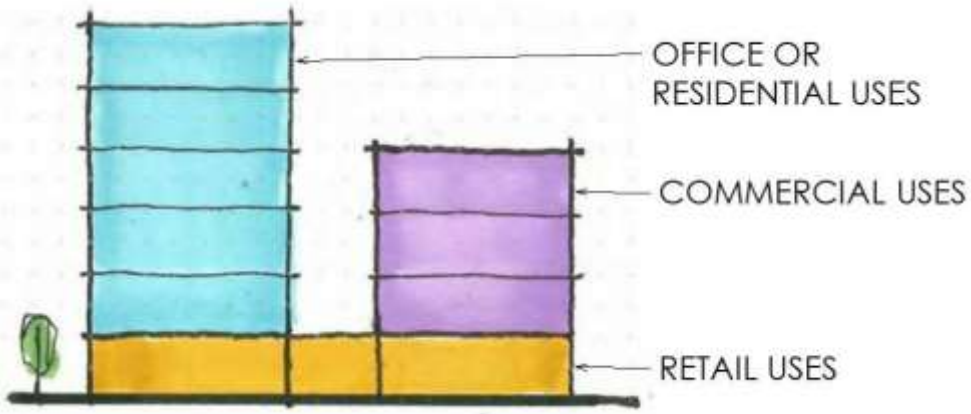

Fig 2.22: Vertical mixed-use configuration
(Source: Auckland design manual, 2012)

Fig 2.23: Vertical mixed-use configuration
(Source: Auckland design manual, 2012)

2.6.4 Better design practice

a. Locate hospitality or retail on street frontages so as to make active the public

territory

b. Avoid residential use on the ground level in location where privacy of the user will

be unduly compromised.

c. Locating office spaces of one or more floors in between the ground level and upper

floors containing residential uses to serve as buffer.

2.6.5 Horizontal mixed-use

Horizontal mixed-use developments are best suitable for large sites where it is feasible

to provide adequate disconnection between buildings that contain dissimilar uses

(Nancy, 2003). See Fig 2.23.

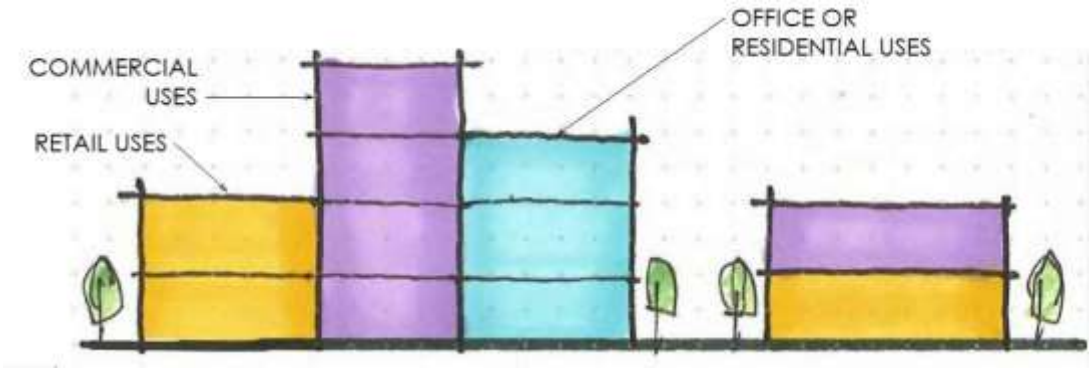

Fig 2.24: Horizontal mixed-use configuration
(Source: Auckland design manual, 2012)

2.6.6 Better design practice

a. Arrangementof buildings to ensure utmost compatibility between uses within a site

and the adjoining areas.

b. Locating business uses close to the street to form an active street outlook.

c. Locate residential units to the back of the site to provide privacy for the residents.

d. The use of buffers such as buildings or landscaping between incompatible uses to

protect residents nnecessary disturbance.
from

e. Integrating quality outdoor spaces for residents within the developments.

CHAPTER THREE

3.0 RESEARCH METHODOLODY

The research methodology used in this work is descriptive research method where the passive security measures in various mixed-use building were assessed in Kwara State.

3.1 Research Methods

Qualitative research methods were employed in this work. Data were collected and gathered from primary and secondary sources. Data collection encompasses assessment of passive security design measures and applications in the selected buildings. Sources of primary data are observation schedules and case studies and source of secondary data were from other researchers that have worked in the area of passive security design.

3.2 Data Type and Sources

Data type in this work includes close of observation of different variables of passive security selected buildings and case studies.

3.3 Population of Study

Six different mixed-use buildings were selected for this study. The criteria for selecting these buildings arebuilding with three or more significant uses. Uses such as residential, commercial, institutional, retail, office, recreational and hotel uses. Selection of the building is based on the listed significant uses so any building with three or more of these uses were selected. These are all located in Kwara State. The selected buildings are: TiamiyuOlatinwo house, Olofa way, Offa Kwara State.

AminuIshola plaza, along Taiworoad,Ilorin. BOA plaza,Ilorin. Harmony holdings, GRA Ilorin. Nicon house, Taiwo road,Ilorin. JMK plaza, Taiwo road, Ilorin.

3.4 Population Study Criteria

The criteria for the selection of various mixed-use buildings in Kwara State is buildings that have at least three different building uses such as residential, institutional, commercial, office, industrial and religious uses.

3.5 Method of Data Collection

For the purpose of this work, data were gathered through various methods in order to acquire valid and adequate information. They are:

1. Observation schedule

This involves listing different variables to check in the selected buildings. Variablesthat are related to the research area. For the purpose of this research work, observation schedules were structured to assess passive security measures and elements employed in the selected buildings.Different variables were outlined so as to adequately assess these measures.

2. Fieldwork research method

This method involves carrying out case studies of the selected buildings by visiting them. It involves close observation of the building and facilities. Observation of the functions, passive security design considerations and features in the buildings.

3.6 Procedure of Data Collection

Six different mixed-use buildings were selected in Kwara State. All the buildings that were visited incorporated at least one passive security design element in their building and they have at least three significant uses. Observation list was drawn

which includes different types of passive security elements applied, number of these elements in the selected building and different security strategies.

3.7 Variables of Study

In order to carry out a detail assessment of passive security measures in the selected buildings, different variables are outlined. These variables are fundamental design features that should be integrated in order to conduct a thorough assessment. Some of these variables are standoff distance, passive security design elements, access and parking features, perimeter fencing and materials and finishes.

3.8 Method of Data Analysis and Presentation

Data gathered from the research work were analyzed through the use of statistical tools such as Microsoft word and power point to do thorough investigation. These data were analyzed descriptively using tables, charts, figures and plates. Analyses of data gotten from observation schedule were done using tables, pie charts and bie charts. The proposed design space analyses were done using plates, figures and tables.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Assessment of Passive Security Measures in Mixed-Use Building

This chapter presents data collected from the visited mixed-use buildings in Kwara State. These data were collected through observation, oral interviews, personal survey and case studies. They are further shown in charts and tables, thereafter interpreted, and discussed.

For the purpose of this work, six different mixed-use buildings were visited for data collection. Staff and visitors in the selected buildings forms the major participants in the research from which data were sourced. This chapter also includes charts and tables and a form of data presentation. These charts and tables aims to understand the frequency and use of various passive security design measures in the building. Also included in this chapter are the site, site location, site inventory and site analysis which contains some of the data acquired in the research.

4.2 Case Studies

4.2.1 TiamiyuOlatinwo house, Offa, Kwara State

TiamiyuOlatinwo house is a mixed-use high rise building located at No 78, Olofa way, opposite Sanni Aba, Owode market, Offa Kwara State. It was designed by Architect Lola IssaAshiru and the consultant is Master building Nig Ltd. The building has a total number 8 floors with a pent house. The ground floor is occupied by the Union Bank of Nigeria. The first floor is used by the NIIT. NIIT is a computer training institute. On the second floor is a cyber cafe while the third floor consists

of lettable office spaces. The ninth floor is the pent house that has a 3-bedroom apartment. The roof deck is used by MTN where their mast is mounted.

There is integration of passive security design measures in the building. Observed stand-off distance in the building is 7meters. Other passive security design measures observed in the building are: secured access and parking, availability of perimeter fencing. However, the integration of these passive security measures are not excellent. There should be provision for all the required passive security measures in the building so as to ensure adequate security of the occupants.

Plate I: A view of TiamiyuOlatinwo house
(Source: Author's fieldwork, 2018)

4.2.2 Harmony holdings

Harmony holding us a mixed-use building located at G.R.A beside Kwara Hotels, Ilorin, Kwara State. It consists of three floors. There is a super-market and DSTV office on the ground and first floor. The second floor consists of office spaces. Passive security measures are well integrated in the building. Observed stand-off distance in the building is 30m. There is perimeter fencing which protect the users from possible threats and attacks. Other passive security measures observed in the

building includes the use of anti-ram low walls, use of bollards and controlled access gate.

Plate II: Perimeter fence at Harmony holdings
(Source: Author's fieldwork, 2018)

Plate III: Anti-ram walls at Harmony holdings
(Source: Author's fieldwork, 2018)

Plate IV: Landscape elements at Harmony holdings
(Source: Author's fieldwork, 2018)

4.2.3 AminuIshola plaza

AminuIsholaplaza is a mixed-use high rise building located at Taiwo road, Ilorin Kwara State. It has a total number of six floors. On the ground floor, there is a microfinance bank and lettable office spaces. From first floor to fifth floor, there are office spaces and a residential apartment on the pent floor. Integration of passive security measures in the building is on the average. It was observed that the stand-off distance in the building is

10. Access to the building and parking spaces are secured. Cars parked within the facility are secured and there is a controlled access gate that checks entry and exit of people and vehicles. There is also a perimeter fencing that prevents unauthorized entry into the building.

Plate V: A view ofAminuIshola Plaza
(Source: Author's fieldwork, 2018)

4.2.4 Adekanola house

Adekanola house is a mixed-use building located at the front of post office.Ilorin Kwara state. It has a total number of 4 floors. The ground floor is used by Sterling bank. The first floor has office spaces used by Nigerian Stock Exchange. The second and third

floor has offices spaces. There are two-controlled accesses in to the building. Cars parked within the facility are secured. It was observed that there is presence of perimeter fencing in the building and the height of the fence is 2 meters. Standoff distance is 15m. There is little provision for all the required passive security design elements.

Plate VI: Access gate and perimeter fence at Adekanola house
(Source: Author's fieldwork, 2018)

Plate VII: Parking spaces inside Adekanola house
(Source: Author's fieldwork, 2018)

4.2.5 Nicon house

Nicon house is a mixed-use building located at Taiworoad,Ilorin Kwara state. Total number of floors in the building is four. The ground floor is used by Seap microfinance bank. The first floor is used by Nicon Insurance while the second and third are office spaces. Passive security measures in this building are very low. Access to the building is not well controlled and monitored because there is no perimeter fence that makes it easy for any criminal to carry out his operation. In addition, there is no guarantee for the security of cars parked within the facility because movement of cars is not well controlled and monitored.

Plate VIII: A view of Nicon House (Source: Author's fieldwork, 2018)

4.2.6 JMK plaza

JMK plaza is a mixed-use building located at Taiworoad,Ilorin Kwara state. Total number of floors in the building is three. There is a super-market on the ground of the building while the first and second floor has office spaces. There is no perimeter

fencing in the facility thatexposes the building and the users to different forms of threat. Access

and parking spaces are not secured because movement of vehicles and people are well controlled thereby putting the live of the users and the building at risk.

Plate IX: A view of JMK Nig Ltd (Source: Author's fieldwork, 2018)

4.3 Findings and Discussion of results

Data collected from the survey and observations carried out in the course of the research are presented in tables and charts within. These data are further interpreted and discussed. Table 1.0 shows the available passive security design elements in the selected buildings.

Various urban design elements can mitigate security threats (National capital planning commission, 2002). Design elements such are planters, bollards, fence and walls, seat bollards, pedestrian light, bench; Architectural lighting and street furniture can reduce threats in a building. Assessments of these elements are done in the selected buildings to determine their level of usage.

The result recorded from these buildings through survey are represented below

Key:

1- Available

0- Not Available

Table 4.1: Passive security design elements on site

S/N	Names of building	Passive security design elements								
		Planters	Bollards	Perimeter Fence	Seat Bollards	Pedestrian Light	Access Gate	Architectural lighting	Street Furniture	Trees and shrubs
1.	Olatinwo House	0	0	1	0	1	1	1	0	0
2.	Harmony Holdings	1	1	1	0	1	1	1	0	1
3	Adekanola building	0	0	1	0	0	1	1	0	0
4	Nicon house	0	0	0	0	0	0	1	0	0
5	JMK Nig Ltd	0	0	0	0	0	0	1	0	0
6	AminuIshola Plaza	0	0	1	0	1	1	1	0	1
	Total	1	1	4	0	3	4	6	0	2

(Source: Author's fieldwork, 2020)

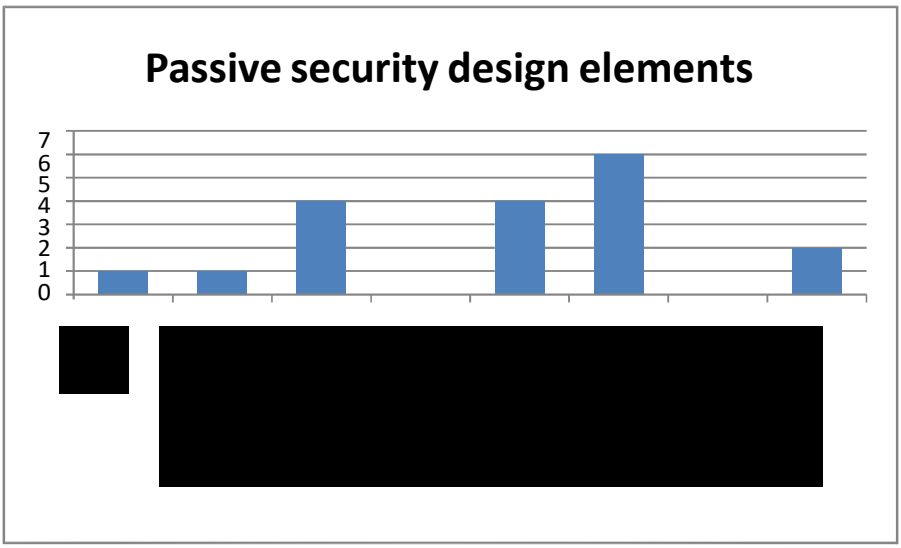

Figure 4.1: Passive security design element available in the selected Buildings (Source: Author, 2020)

Plate X: Passive security design elements used at Harmony holdings in Ilorin in Offa.(Source: Author's fieldwork, 2018)

Plate XI: Passive security design elements used at Olatinwo house

Fig 4.1 shows that Architectural lighting, perimeter fence and access gate are the most frequently used elements as a passive security measure while trees and shrubs, bollards and planters are the least frequently used. All the selected buildings employed the use of Architectural lighting as part of security measures, 70% uses access gate, 15% uses planters and bollards, 30% uses trees and shrubs and none of the building uses street bollards and furniture. This implies that all the passive security design elements should be integrated in mixed-use building design as a security measures in order to boost the security of the building.

Table4.2:Standoffdistancesfromthebuilding

S/N	Names	Standoff distance			
		Below5m	5-10m	10-15m	15&Above
1.	Olatinwo House			●	
2.	Harmony Holdings				●
3	Adekanola building			●	
4	Nicon Insurance			●	
5	JMK Nig Limited			●	
6	AminuIshola Plaza				●
	Total	**0**	**4**	**2**	**0**

(Source: Author's fieldwork, 2020)

Table 4.1 shows that 70% of the entire selected buildings have their standoff distances between 5-10meters and the remaining 30% have theirs between 10-15meters. This implies that a minimum of 5meters distance should be provided in a mixed-use building design as a security measure in order to prevent threat to the safety and well-being of the occupants.

Figure 4.2: Stand-off distance observed in the selectedBuilding (Source: Author, 2020)

Plate XII: Stand-off distance observed at AminuIshola Plaza in Ilorin.

Plate XIII: Stand-off distance observed at Adekanola Building in Ilorin. (Source: Author's fieldwork, 2018)

Table 4.3: Secured parking areas inside and outside the standoff perimeter

S/N	Names	Parking areas		
		Inside the standoff perimeter	Outside the standoff perimeter	None
1.	Olatinwo House	●		
2.	Harmony Holdings	●		
3	Adekanola building	●		●
4	Nicon Insurance			●
5	JMK Nig Limited	●		
6	AminuIshola Plaza	4		2
	Total			

(Source: Author's fieldwork, 2020)

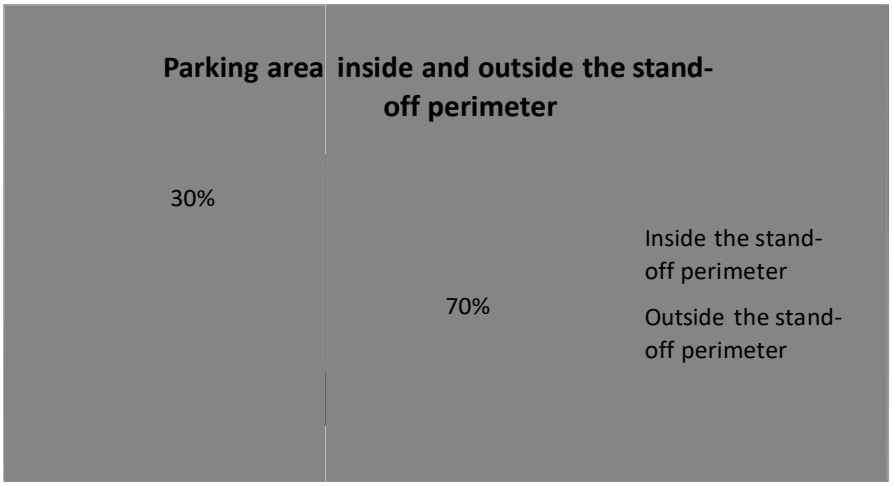

Figure 4.3: Parking spaces available inside and outside the stand-off perimeter (Source: Author, 2020)

Table 4.3 shows the availability of parking spaces both inside and outside the stand-off

perimeter in the various buildings. Majority of the selected building have more parking

spaces within their standoff perimeter and very few make provision for parking outside

the stand-off perimeter. This implies that it is safe to provide parking spaces within the

controlled perimeter. However, parking spaces can be provided outside the perimeter if

there is adequate monitoring and surveillance.

Table 4.4: Perimeter fencing height

S/N	Name of building	Perimeter fence height (m)				
		Below 1.5	1.5- 2.0	2.0- 2.5	2.5 and above	None
1.	Olatinwo House		●			
2.	Harmony Holdings		●			
3	Adekanola building		●			
4	Nicon Insurance					●
5	JMK Nig Limited					●
6	AminuIshola Plaza			●		
	Total	**0**	**3**	**1**	**0**	**2**

(Source: Author's fieldwork, 2020)

Table 4.4 shows that none of the selected buildings have their perimeter fence height below 1.5meters. 50% of the selected buildings have their perimeter fence height between 1.5 – 2.0 meters. 15% of the buildings have their fence height between 2.0- 2.5 meters and 25% of the total building selected does not have perimeter fencing. Therefore, minimum height of perimeter fencing in mixed-use building should be

1.5meters. However, it is safer to provide perimeter fence of between 2.0- 2.5meters height in order to minimize threats and attacks within the building.

4.4 Technical Report

Technical report has been prepared to highlight critical aspect of the research area and how it relates to the security of live and properties. This implies the security of the users and the assets. The users include the occupants of the building and the visitors while the asset includes the building and other ancillary facilities within the premises. Various passive security design elements and features are also included. These elements and measured are applied on the site, the building interior, site access

and parking space and the stand-off perimeter. Summary of how the discoveries and findings during the research were applied in the proposed design will be discussed in this report. The proposed mixed-use building is to be located in the southern part of Offa, along Offa-

Oshogbo road Offa, Kwara State. The proposed site has an approximately total area of

6000 square meters.

Findings from the data obtained about passive security measures within mixed-use buildings in kwara state indicates that the buildings employed the use of an active security measures more than passive measures. Passive security design features were seen to be less frequently used as compared to active ones. Active security measures such as the use of controlled access gates, use of CCTV cameras and mechanized doors are observed in majority of the building. Passive elements and measured such as use of bollards, planters, anti-ram low walls, water bodies, trees and outdoor furniture are less employed. This implies that both active and passive security measures are employed in the buildings but there is more emphasis on the active measures. However, passive security measures offer more benefit as compared to active because it is more safe and sustainable. Therefore, different ways of how these measures have been integrated in to the proposed design are discussed subsequently.

4.4.1 Interior passive security design measures

Integration of passive security design elementsis applied both inside the building and on the site. However, the effective use of these elements inside the building and on the site will create a secured environment. Some of the passive security design elements applied inside the building include the use of laminated safety glass, use of smoke stop lobby, compartmentalization, and separation of sensitive areas from non-sensitive areas to restrict movement of people.

4.4.2 Exterior passive security design measures

Various urban landscape elements can serve as passive security design elements. Some of these landscape elements are integrated in the usable spaces within the site to serve as

a form of delay strategy for any potential terrorist or criminal. These elements includes use of engineered planters, Jersey barriers, anti-ram low walls, fixed and movable bollards, fountains, anti-climb fence, different defensive plantings and chicane road type to serve as a traffic calming measures.

In order to achieve the project aim, different objectives are recognized as guide which will be discussed as follows.

4.5.1 Identifying different types of security threat in building

In order to ensure the safety of the asset, people and mission, security threat to consider in building includes:

a. Unauthorized entry

This is a security threat that involves forced or covert entry of unauthorized persons in to the facility. Protecting the asset and the user of the building from unauthorized entry is an important part of a building design and it requires adequate countermeasures to mitigate this threat.

b. Insider threats

This is one of the most severe threats that may possibly come from people who have authorized entry permission in to the building. This includes disgruntled employee or persons who have free access in to the building through the normal means for example contractors and support personnel.

c. Explosive threat comes in different forms which are as a result of the terrorist choice of weapon. Delivery of large amount of these explosives is done by vehicles.

However, small amounts may be delivered in to the facility through the use of packages, mail or by hand in a less secured area.

d. Ballistic threats

This is a type of threat that may possibly include active shooters, hit and miss drive by shooting and high power-driven rifle attacks directed at specific target within the building facility.

e. Weapon of mass destruction commonly referred to as (WMD). This threat comes in different forms. It can be in form of chemical, biological and radiological. The chances of the occurrence of this threat are low. However, it has a severe damage if it occurs. Delivery of this threat can be done through mail, hand or as a result of unintentional release of toxic industrial agents in to the facility.

4.5.2 Different design considerations to mitigate security threats

In order to mitigate threats coming from unauthorized entry, items to consider as countermeasures include:

a. Access control

b. The use of fence, bollards and anti-ram barriers to control the outer limits

c. Traffic control, remote controlled gates, anti-ram hydraulic drop arms and barriers and parking control system.

d. Forced Entry Ballistic Resistant (FE-BR) building elements.

e. Barrier fortification for man passable openings not more than 240 square millimeters such as air vents and utility openings.

f. Exclusion of hiding places

g. Mechanical locking systems

h. Multiple layer protection

processes i. Clear zone

j. Perimeter intrusions recognition systems k. Video and CCTV close watch technology

l. Alarms

m. Detection devices

n. Acoustic shielding

In order to mitigate threat that comes from authorized person, some items to consider as countermeasures include:

a. Reduce and control access to sensitive areas of the building b. Compartmentalization in the building

c. Video and CCTV surveillance technology

In order to mitigate explosive threats, some items to consider as countermeasures include:

a. Provide secured distance between the threat position and the assets. This is in general called standoff distance. Standoff distance should be provided for vehicle-borne weapons using specialized barriers such as anti-ram fencing or bollards, reinforced street furniture such as planters, support walls, natural or artificial elements such as storm water, berms, ditches and trees.

b. Defended standoff should be provided so as to reduce hand-carried weapons with anti-climb fencing barricades, defensive plants, natural surveillance of habitual occupants and unobstructed spaces, natural access control using exterior and interior pedestrian layout strategies.

c. Consider structural fortification and hazard alleviation design such as ductile framing that is capable of withstanding abnormal loads and stopping

progressive damage, protective glazing and strengthening of other facility components.

In order to mitigate threat that comes from ballistics, some items to consider as countermeasures include:

a. Obscuring screening using trees and hedges, solid fencing, and walls. b. Ballistic resistant materials and product.

c. Locating vital assets away from straight lines of sight through windows and doors.

d. Reduce number and sizes of windows.

e. Physical energy absorption screens such as solids fences and wall earthen parapets.

f. Provide obscure windows to decrease sight lines.

g. Avoid sight lines to assets through vents or other building openings.

h. Use lobby or other door defensive technique to block observation through a doorway from outside the building.

i. Secure compartmentalization of the facility to limit internal mobility. j. Access control within the facility

In order to mitigate threat that comes from weapons of mass destruction, some items to consider as countermeasures include:

a. Perimeter aerationpaths in to the building.

b. Access to air inlets and water systems should be controlled c. Place air intake well above ground level

d. Make available access control to mechanical rooms

4.5.3 Passive security design elements

Various urban design elements have the potentials to provide security. The scale of these elements should be proportional to its primary users and manipulated to the

desired level of the users of the building while creating an unfriendly environment for

potential terrorist and criminals.

Numerous elements can be modified and developed in terms of structural and

dimensions to make availableincorporated hostile vehicular movement (HVM)

(Integrated security guide, 2007). The correct use of these elements does not guarantee

adequate security of the building and the occupants. However, there are several urban
design elements that provide security when used appropriately. These elements are

discussed as follows.

a. Reinforced walls

The engineered wall groups compriseof retaining walls and freestanding walls.

Materials for construction may possiblybe reinforced or mass concrete, masonry, bricks,

natural stone and steel. (See fig 4.4).

Fig 4.4: Reinforced wall barrier with artwork
(Source: National Capital Planning Commission, 2002)

b. **Berms, excavation and ditches** can be used efficiently to stop vehicles from

gaining access to the restricted territory within a facility. Triangular ditches are

effortlessly constructed and are effective against a wide range of vehicular types.

Typical configuration and dimension are shown in (Fig 4.5).

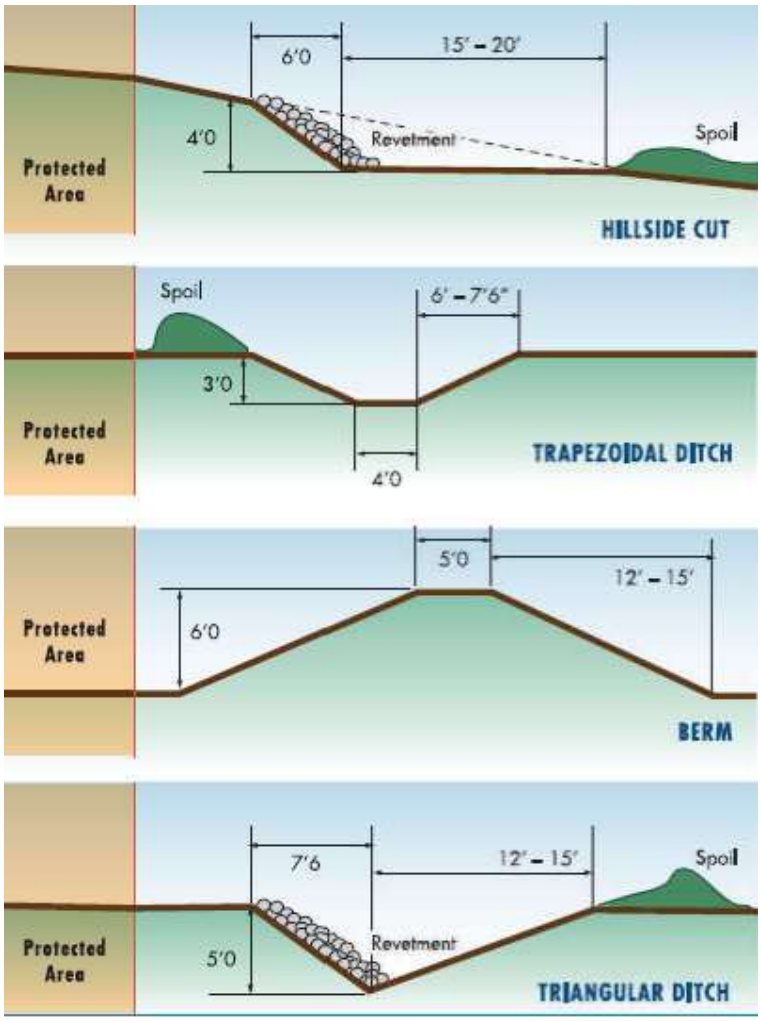

Fig 4.5: Excavations, berms and ditches
(Source: National Capital Planning Commission, 2002)

c. **Ha-ha**

Ha-ha is a form of obstacles that was inventedin England in the century. The 17th

obstacle was used to put off cattle from roving up to a country house while at the same

time the obstruction wall was barely visible to the house. This defense strategy has been

adopted for use at the new setting for the Washington monument.

Installations

Typical concrete walls require heavy reinforcing even though mass concrete may offer

an efficient barrier in such walls as weightymasonry installed in Ha-ha.

Fig 4.6: Ha-ha diagram
(Source: National Capital Planning Commission, 2002)

d. Engineered planters

Well designed planters can serve as an effective barrier. Engineered planters

requiresignificant reinforcing and below-grade deepness to be effective (See Fig4.7).

Fig 4.7: Engineered planter
(Source: National Capital Planning Commission, 2002)

Installation
s

Security guidelines for engineered planters are:

i. Width of the planter should be more than 600millimeters and circular planters should not be more than 900millimeters wide. Horizontal length should not be more than 1800 millimeters.

ii. Maximum distance of 1200millimeters should be maintained between planters and other lasting streetscape elements. Any bigger distance will allow a small car crash and lots of explosives to pass through.

iii. Landscaping within planters should be kept below 750millimeters except when there is special requirement for increased foliage.

iv. Planter's location, design and preservation should create effective conditions for healthy plants.

e. Fixed bollards

Bollard is a vehicle blockade element which consists of cylinder made of steel and filled with concrete positioned in deep concrete footings in the ground to stop vehicle from passing but allows free movement of people. A fixed anti-ram bollard consists of

10millimeters thick steel tube, 22millimeters in diameter and 750millimeters above grade and builds 1200millimeters in a continuous strip foundation. An anti-ram bollard system must be designed to efficiently curb vehicle attack in the building. (See Fig 4.8).

Fig 4.8: Decorative bollards
(Source: National Capital Planning Commission, 2002)

Installations

There is need for bollard to penetrate in to the ground but this may cause difficulties

with the underground services with uncertain location. However, if subversive utilities

will make the fitting of bollard foundations too complicated, a potential solution is to
use bollards with a wide low base. Spacing of bollards be between should

900millimeters and 1200millimeters depending on the predictable traffic and the need of

pedestrians and people with stroller and considerations should be made with people

using wheel chairs and the elderly ones.

f. Heavy objects and trees

Weighty objects such as huge boulders, earthen berms, sculptural objects, thick planting

and trees can be used to prevent vehicle borne attack in building but allows the free

movement of people. (See Fig 4.9).

Fig 4.9: Group of matured palm trees as protection from vehicle intrusion (Source: National Capital Planning Commission, 2002)

Installations

Depending on their heaviness, foot print and height to width ratio, objects used as

obstacle will need changeable degrees of embodiment and reinforcement.

g. Water obstacle

Water is one of the primitive forms of site security design. It is used in the form of

manmade or natural lakes, ponds, rivers, and fountains. The design of the channel of

water can be done such that walls of the pond or mass of the fountain arereinforced to

stop vehicles.

h. Jersey barrier

Jersey barriers are standardized precast concrete element originally developed by New

Jersey, California and other states in the 1940s and 1950s to prevent vehicle ramming in

to oncoming traffic. It was later used for short-term protection in public road and other
building projects. They come in standard lengths of 3750millimeters and

6000millimeters. (See Fig 4.10).

Fig 4.10: Jersey barrier used as vehicle disruption at the White house (left) and Washington D.C (right)
(Source: National Capital Planning Commission, 2002)

Installation

When mounted on a walkway, a jersey barrier decreases effective sidewalk width by

1200millimetersin additionto whatever distance it is placed from the curb.

i. Fences

Fences are traditional security barrier elements. They are intended to primarily

discourage or delay invaders in to facility. Common fence types includes: chain link

fence, monumental fence(metal), anti-climb fence and wire(barbed tape) fence. (See Fig

4.11)

Fig 4.11: Crash rated fence
(Source: National Capital Planning Commission, 2002)

j. Reinforced street furniture

Various streetscape elements can be toughened to serve as anti-ram barriers. These

elements can be planned to be hardened so that they function as facilities and as parts of

physical building perimeter security. The spacing, design, form and detailing of the

perimeter security parts must be designed to tackle the required level of protection for a

building (See Fig 4.12).

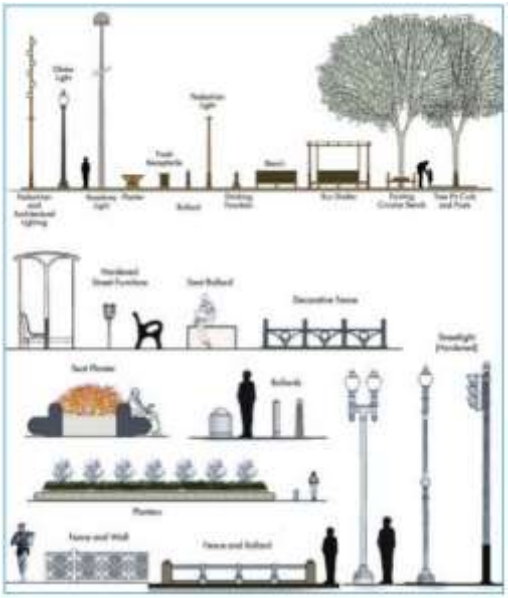

Fig 4.12: Streetscape elements suitable for hardening as security elements (Source: National Capital Planning Commission, 2002)

4.5.4 Design proposal for mixed-use building integrated with passive security design measures

In the design of the proposed mixed-use building, various security design measures are put in to consideration. These design measures are discussed as follows:

1. Usable spaces containing different urban landscaping elements such as fountain, outdoor seat, tress, jersey barriers engineering planters are applied to serve as delay strategies for potential terrorists.

2. Chicane road design and offset approaches is integrated on the site to reduce hostile vehicle approach speed.

3. 900millimeters high fixed bollards with 1200millimeters spacing c/c is applied along the road to serve as vehicle and potential terrorist barrier.

4. 900x4200millimeters engineering planter is applied to serve as a delay strategy for any potential terrorist and vehicle barriers.

5. Tall prickly defense plants such as Berberis Julliane and ilex is applied at the perimeter to delay any form of attack in the building. Height = 2.0 meters.

6. On the building envelope laminated safety glass made up of two 6mm sheets of glass with an inter-layer of polyvinyl butyral(pvb) is applied to resist impact shock and flying glass.

7. 2.0meters high anti-climb fence consisting of vertical bars with horizontal bars as support is applied within the controlled perimeter.

8. Low defensive shrubs such as Mahonia media are applied within the controlled perimeter so that natural surveillance will not be impeded.

9. Controlled access gate is applied at every entrance to the facility to check vehicular and people's movement.

10. Standoff distance from controlled perimeter is 15 meters.

11. Security measures taken inside the building includes use of smoke stop lobby at the,

lift shaft to prevent the spread of smoke to other floors in case of fire outbreak and the use of blast resistant doors to resist impact shock.

Appendix A: Aerial view of the proposed building showing applied passive security design elements (Source: Author's design work, 2018)

4.6 The site

4.6.1 Site selection criteria

Offa has a population of 90,000 (Nigeria's population census,2006). There is increase in the request for goods and services which also increases the demand for buildings where people can obtain these commodities and services.

The projected building located along Offa-Oshogbo will function as focal point for both the inhabitants and visitors. A live, work and play features is integrated for the comfort of the users. Other site selection criteria is the location of the proposed site. It is located close to the Federal Polytechnic, Offa which makes it easily accessible for the staff and students of the school.

Other considerations for site selection are:

a. Accessibility

It is located along Offa-Oshogbo road which is a major road that. Users of the building will find it easily accessible.

b. Topography

The proposed site is characterized with a gentle slope. This will eliminate the need for excavation and re-filling of different part of the site during construction.

c. Future development

The proposed site is a virgin land with an approximately 6000 sq meters area of land. Development on the site will occupy an approximately 3000 sq meters which is about half of the total area. This will provide more space for future expansion.

d. Service utilities

Facilities on the site include electricity, road network, communication and pipe borne water.

4.6.2 Site Location

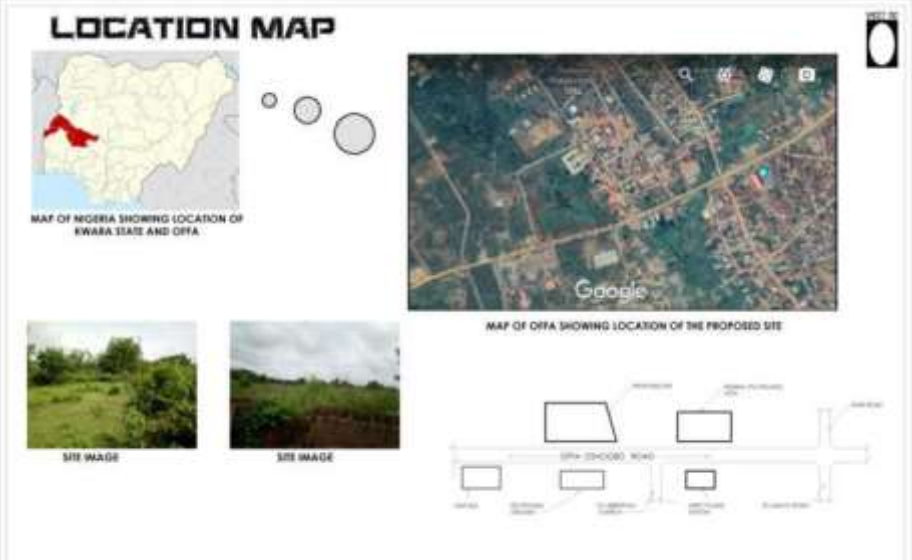

Fig 4.13: Google map of Offa showing location of the site
(Source: Author's field work, 2018)

The proposed site is located alongside Offa-Oshogbo road Offa, Kwara State. It is close to the Federal Polytechnic Offa, temporary site. The site has a trapezium shape with an approximate area of 600 sq meters.

4.6.3 Site Analysis

The Architect's Handbook of Professional Practice defines site analysis as a very important step taken during the design course which entails the assessment of an existing or potential site in relation to the impact from the environment, impact on the adjoining facilities, project budget and program. Therefore, it is a preliminary design actions carried out on the site to examine the site conditions and how these conditions affect the proposed development and the neighboring facilities. Some of the conditions examined during the analysis of the site are:

a. **Vegetation**

The vegetation of the site is savannah with dense shrubs,trees and grassland. Some of the trees will be removed while some will be left to serve as security barriers.

b. Geology

The geology of the site is sedimentary basin made up of alluvial and hydromorphical soil type with rock deposit.

c. **Accessibility**

Access to the site is through Offa- Oshogbo road therefore appropriate standoff distance will be provided to prevent or reduce unwanted invasion or attack.

d. **Rainfall**

The average annual rainfall is 1200millimeters. January has the least amount of rainfall of 10mm. September has the highest rainfall of 2000millimeters.

e. **South-West trade winds**

The south-west trade wind originates from the Pacific Ocean and it comes with cold and humid air. Therefore, more fenestrations will be placed along this path to take advantage of the cool natural air.

f. North-East trade winds

The north-east trade wind originates from the Sahara desert and it comes with hazy air, which is not good for human health. Therefore, trees and shrubs will be planted along these paths to reduce the effects of the wind.

4.7 Proposed Design

4.7.1 Design brief

Majority of crime and attack occurs in public building. They are easy target because of the nature of these buildings. Valuable goods are kept in these building and lots of money is generated on daily basis through selling of goods and provision of services. Users of these buildings are at risk everyday and the fear of attack has discouraged many of them from patronizing them. Offa is a developing town and there is daily increase in the demand for goods and services because of its rapid development. As such there is increase in the demand for building that will serve these purposes.

In these regard, there is need for a mixed-use building with adequate security measures in place to cater for the need of the people.

4.7.2 Design concept

Analogical concept was adopted in the design of the proposed building. Analogy was drawn from an shield. A shield is a part of personal armour placed on the hand or wrist used for protection from attacks such as close-ranged weaponry or

projectiles. it also provide passive protection during combats. Therefore, as an approach to mitigate

security threat in the proposed design, a design concept is derived from the form of the

shield which reflects in the floor plans.

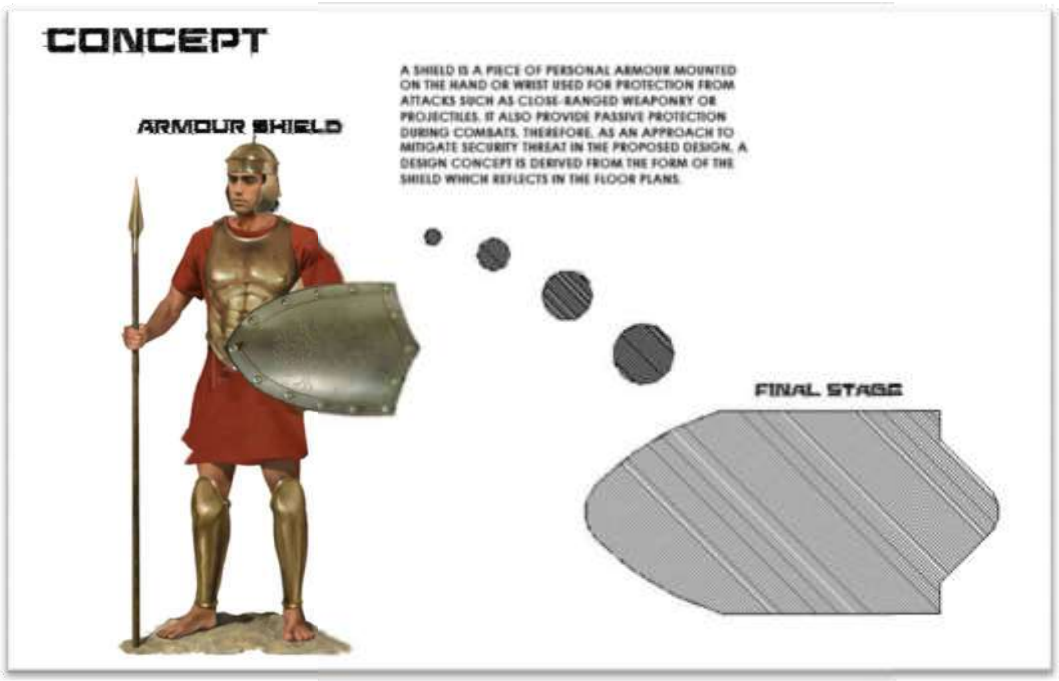

Fig 4.14: Design conceptual analysis (Source: Author's design work, 2018)

4.7.3 Design characteristics

The proposed design is characterized with facilities to cater for the needs of the users. It

constitutes the following facilities.

1. Restaurant
2. Bank
3. Fitness room
4. Cinema
5. Public conveniences
6. Circulation spaces
7. Lift and Escalator
8. Departmental stores

9. Super-market
10. Office spaces
11. Retail shops
12. Partinable spaces
13. Spa
14. Cyber café
15. Residential apartment

4.7.4 Design principles

In the design of the proposed building integrated with passive security measures, a layered approach principle is adopted. Security strategy is most effective when implemented on a number of geographic layers. For the purpose of this work, passive security measures are applied to different layers within the urban scenario in order to mitigate different security threats. These layers are:

a. Asset,
b.
Threshold, c.
Site, and
d. District.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Incorporating Passive security design elements in the design of mixed-use building is very necessary as it can be used to reduce a potential threat or attack in a building. Every mixed-use building may not be able to provide all the required elements but there are some very important elements which must be provided to mitigate threat. As discussed earlier, elements such Architectural lighting, bollards, trees and shrubs, planters, pedestrian light and perimeter fence are frequently employed to serve as security measures in a building.

Standoff distance is the distance between a potential threat and the building. The bigger the distance, the safer the building and the occupants within the building. 70% of the buildings studied have their stand-off distance between 5-10meters and the rest have theirs at more than 10meters. This is a poor security design strategy in a building as criminals will find it very easy to invade a building that is not more than 10m. Therefore, it safer to create a bigger standoff distance as this will help minimize or prevent crime and attack in the building.

Passive security elements are meant to protect the building and the occupants from attacks and not in any way inhibit the welfare and day to day running activities of the users or visitors. Therefore, if these elements are used appropriately, the users of the building will be safe and there will be a sustainable built environment.

5.2 Recommendations

In order to achieve a safe and sustainable building environment, the following design considerations are recommended.

1. Maximum clear distance between adjacent vehicular security barrier elements should not be more than 1200millimeters. This is to stopintrusion of vehicles beyond the blast stand-off perimeter while maintaining convenient access for persons on foot, wheel chairs and push chairs.
2. Structural elements having 1200millimeters clear distance should have a height not less than 600 millimeters. However, it is better if such structures have an increased height of 900millimeters or more to reduce penetration of impact hostile vehicles.
3. Chicane and offset approach to a building or asset should be provided because it helps to reduce unreceptive vehicle approach speed and it considerably reduces threat from a potential vehicle borne attack.
4. Inactive security design measures and elements such as bollards, planters, trees and shrubs, architectural lighting, perimeter fencing, fountains and low-screen walls should be incorporated in the design right from the design stage.
5. Minimum height of perimeter fence should be 2000millimeters. This is to prevent invasion from an unauthorized visitor or potential terrorist.
6. Stand-off distance should be provided between structures.
7. Appropriate security elements should be provided in different zones within the site.
8. Parking spaces should be provided within the stand-off perimeter. However, parking spaces can also be provided outside the stand-off perimeter provided there is adequate surveillance.

9. Carbon reinforced fibre polymer should be used as a cladding material on the walls to serve as a structural hardening material.

10. Laminated safety glass with a plastic interlayer should be applied in the building to reduce the effect of flying glass in case there is any attack in the building.
11. The principle of compartmentalization should be integrated in the design from the design stage so that other compartment in the building are safe even if a potential terrorist succeeded in entering the building.

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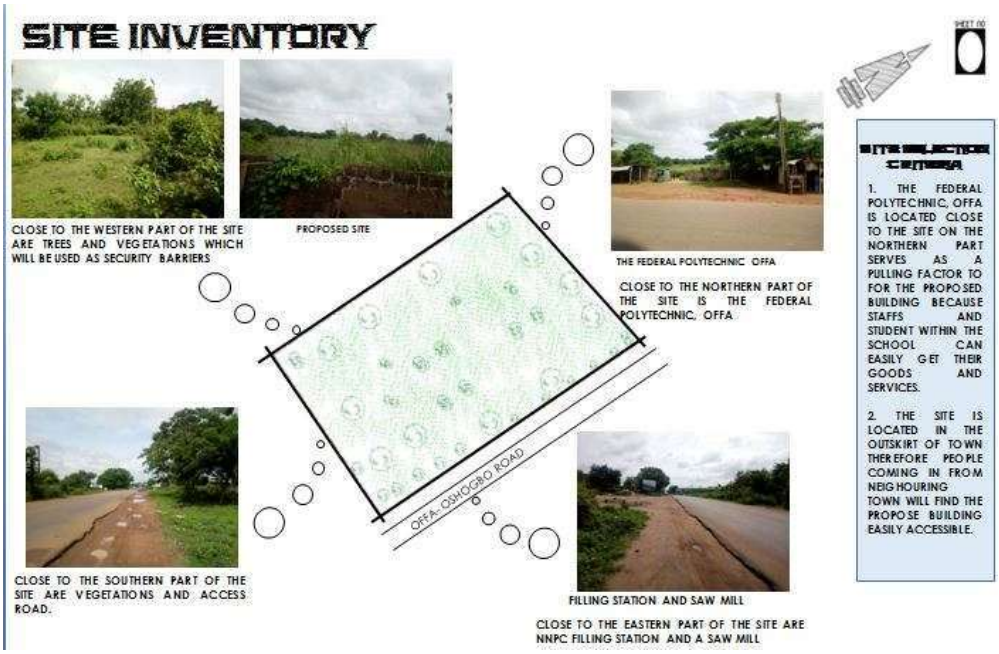
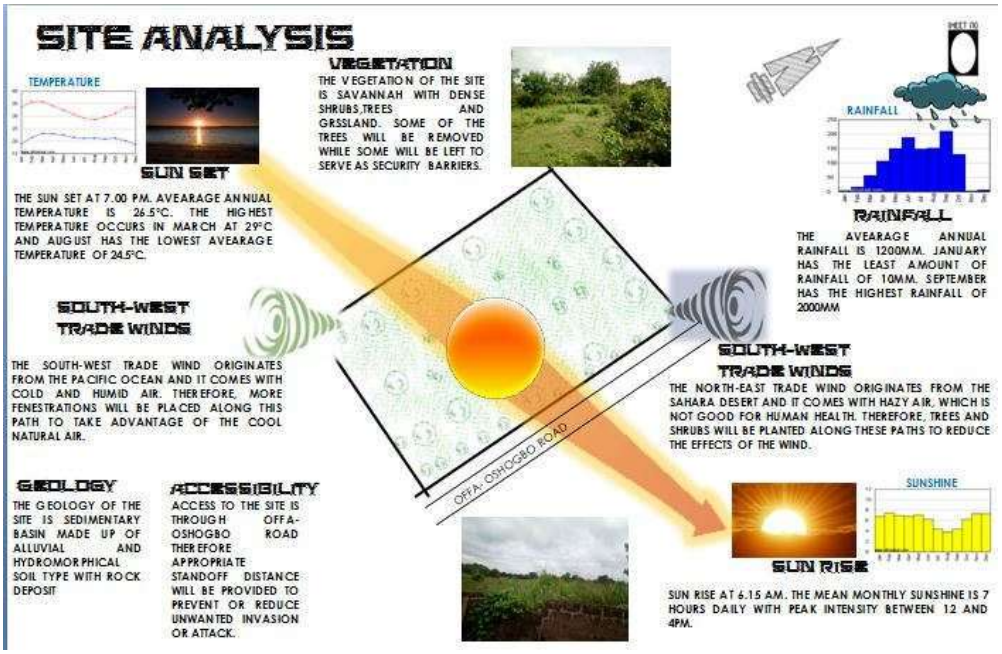
APPENDICES

APPENDIX A: SITE LOCATION MAP

APPENDIX B: SITE INVENTORY

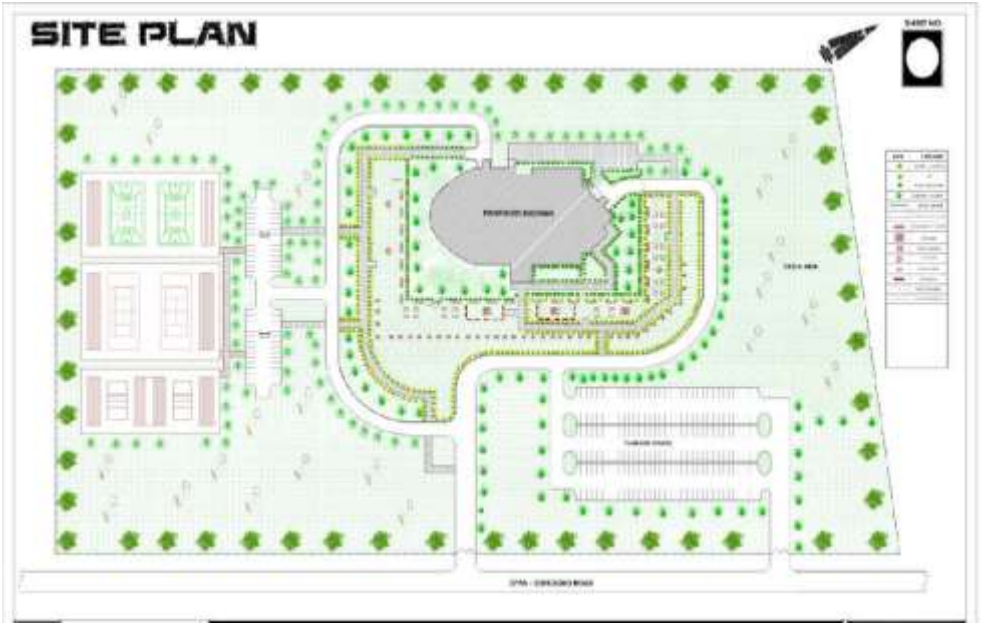


APPENDIX C: SITE ANALYSIS

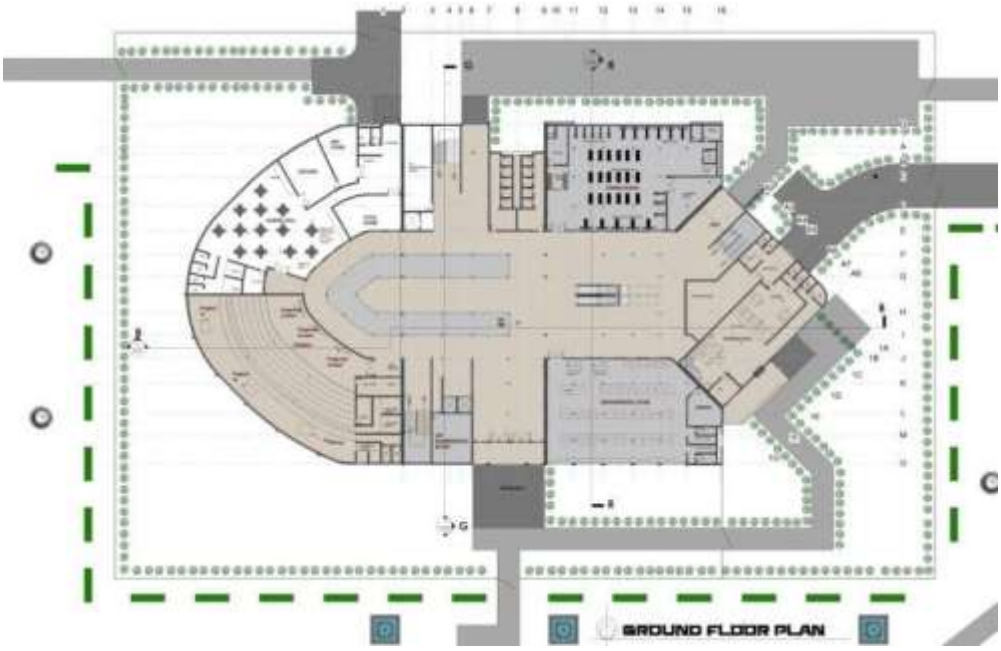


APPENDIX D: APPLICATION SHEET

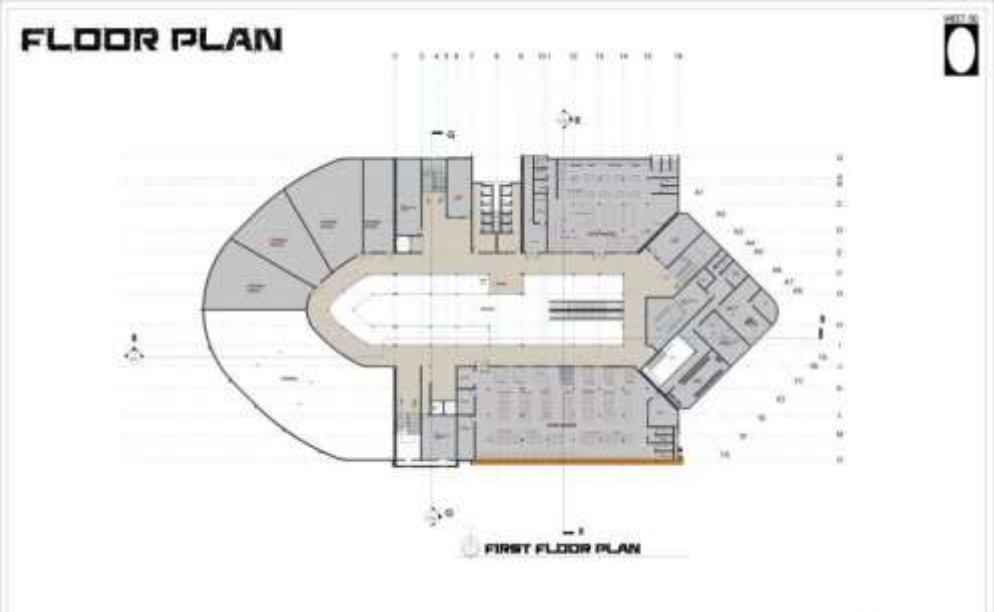
APPENDIX E: SITE PLAN



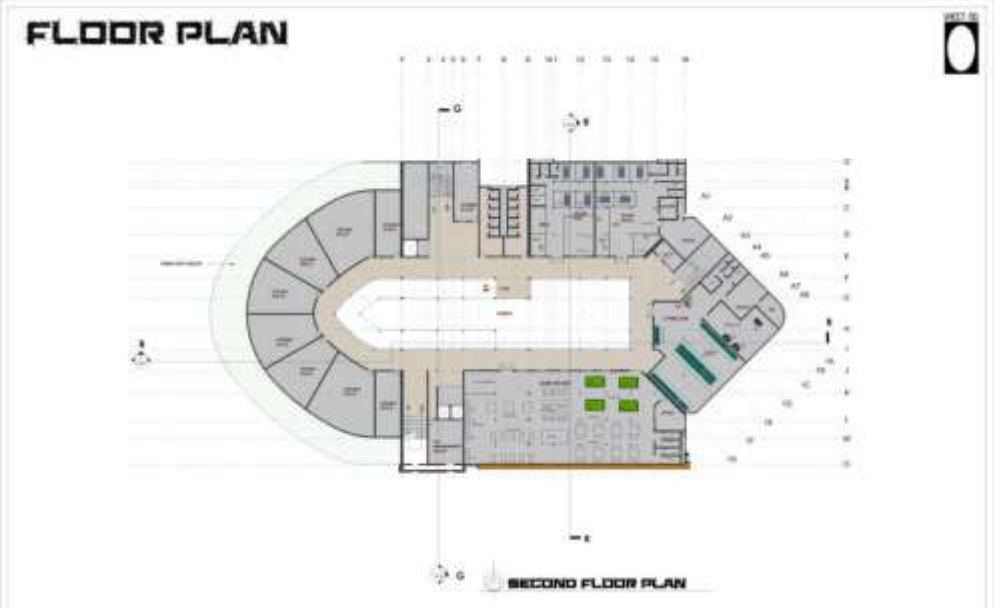
APPENDIX F: GROUND FLOOR PLAN



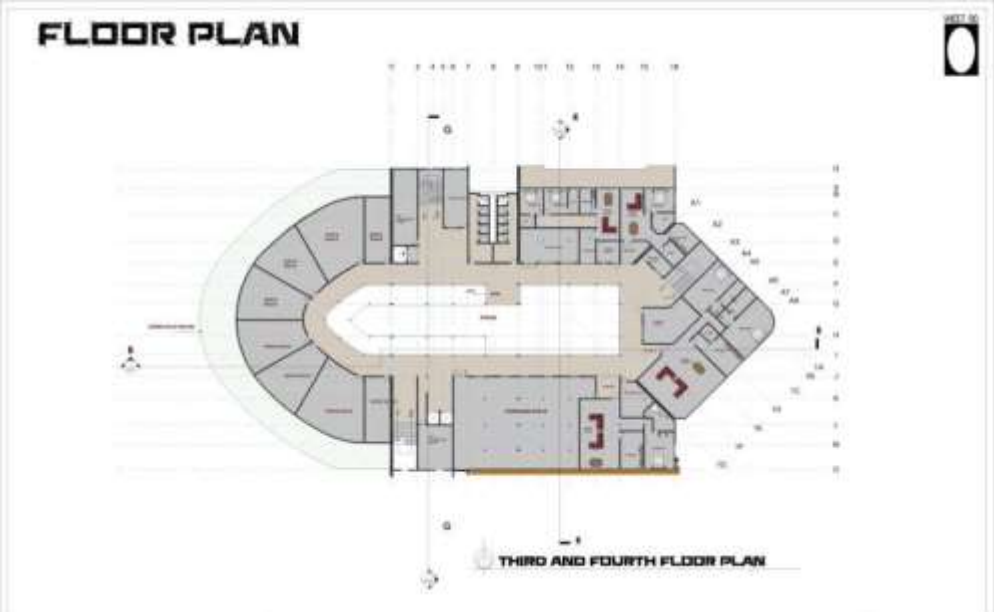
APPENDIX G: FIRST FLOOR PLAN



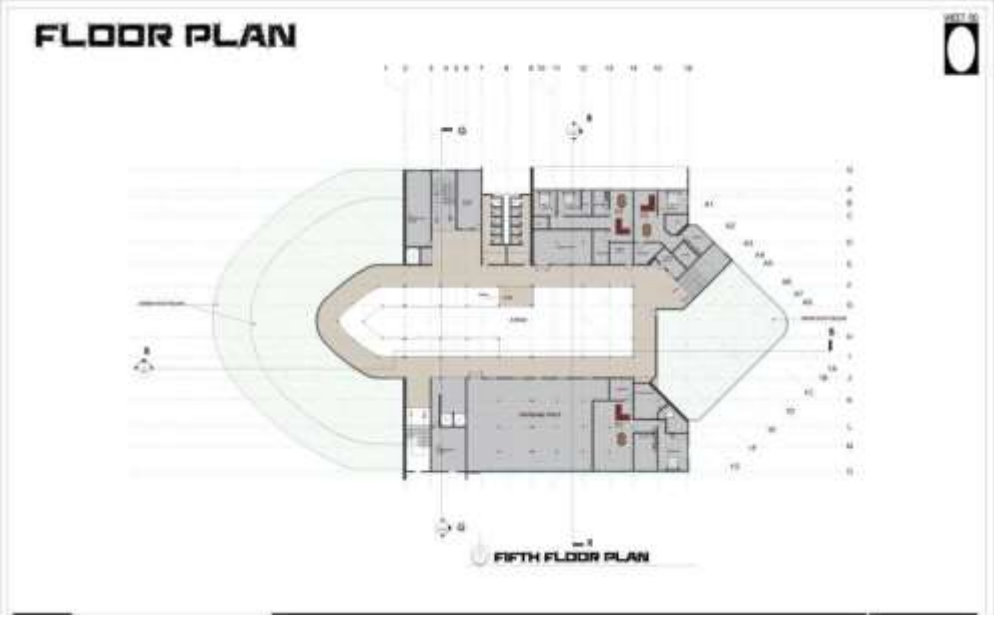
APPENDIX H: SECOND FLOOR PLAN



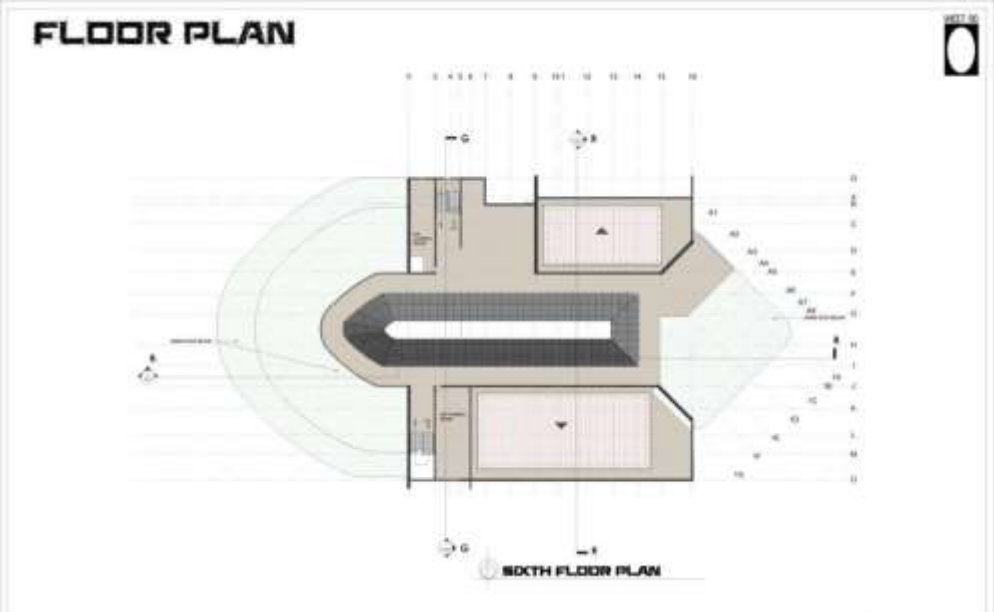
APPENDIX I: THIRD AND FOURTH FLOOR PLAN



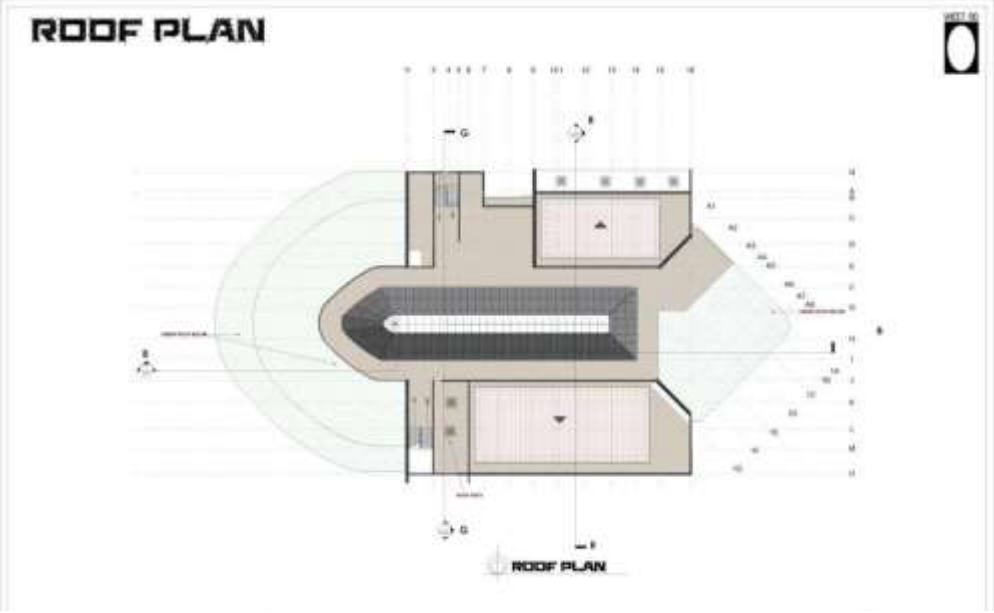
APPENDIX J: FIFTH FLOOR PLAN



APPENDIX K: SIXTH FLOOR PLAN



APPENDIX L: ROOF PLAN



APPENDIX M: SECTION B-B

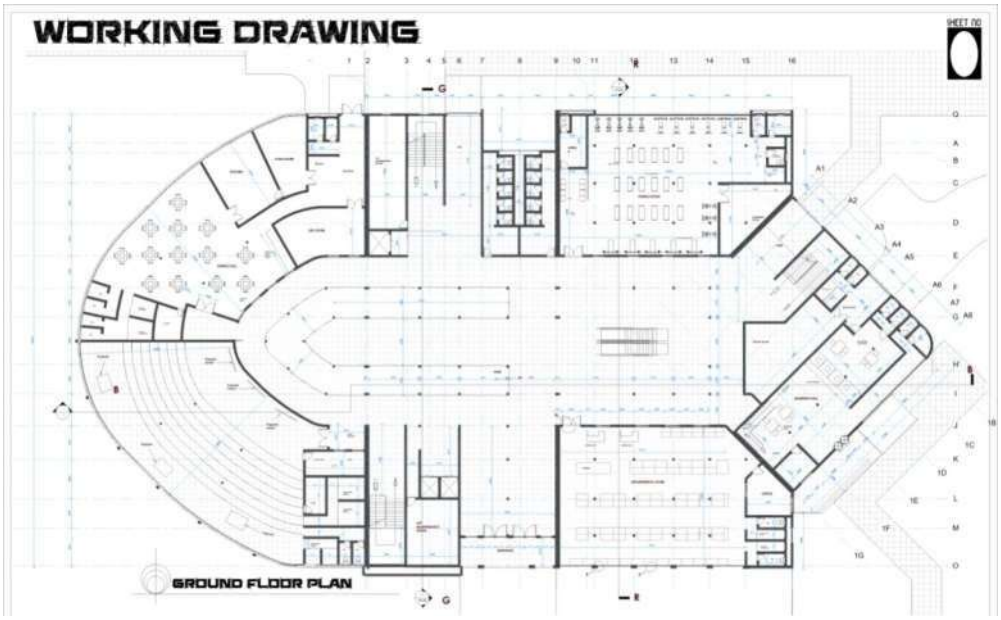
APPENDIX N: SECTION R-R

APPENDIX O: APPROACH VIEW

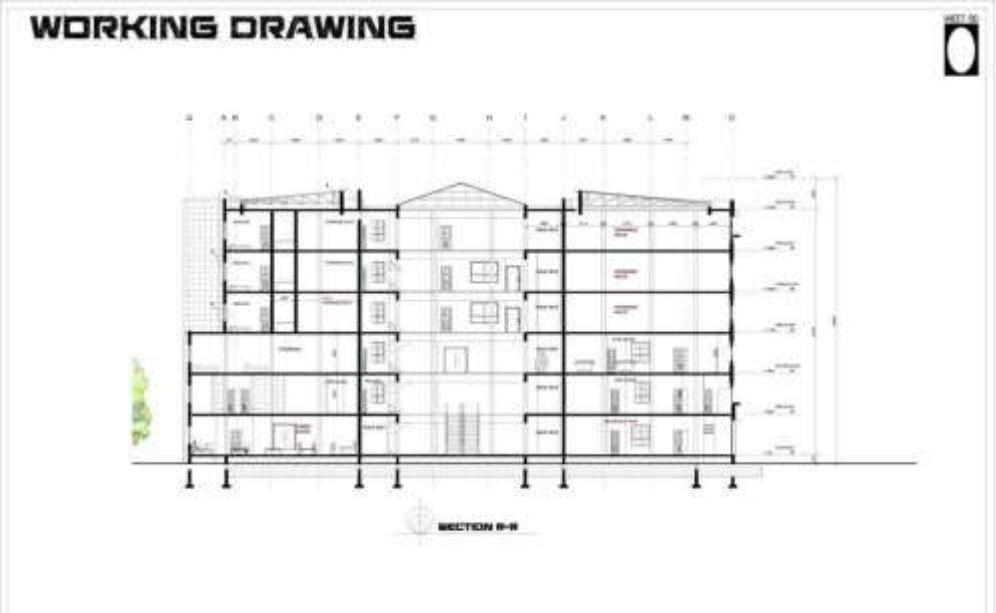
APPENDIX P: REAR VIEW

APPENDIX Q: RIGHT AND LEFT VIEW

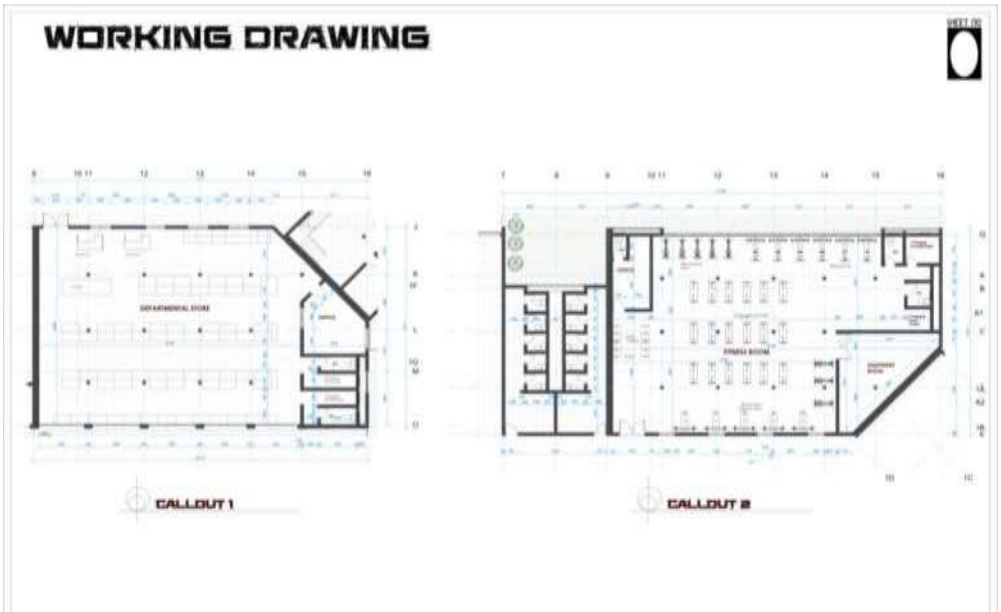
APPENDIX R: WORKING DRAWING



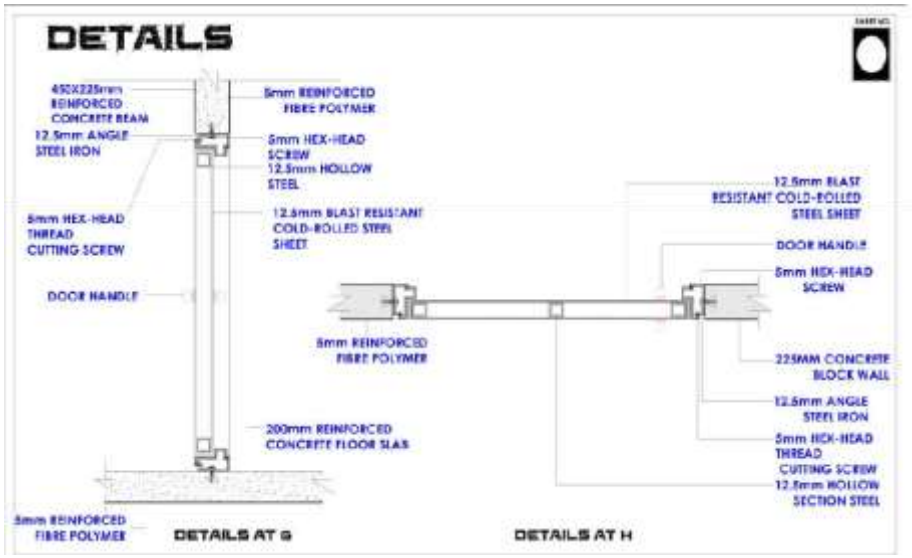
APPENDIX S: WORKING DRAWING



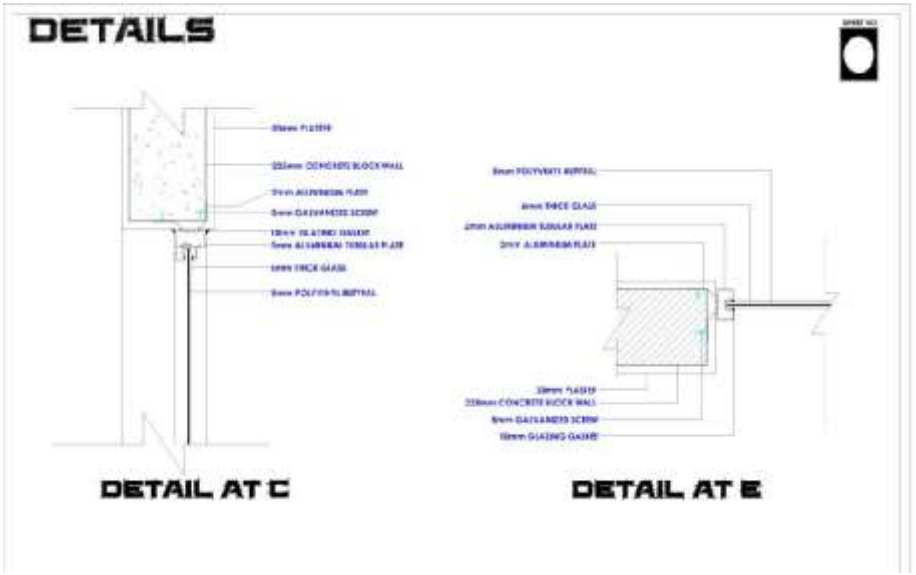
APPENDIX T: WORKING DRAWING



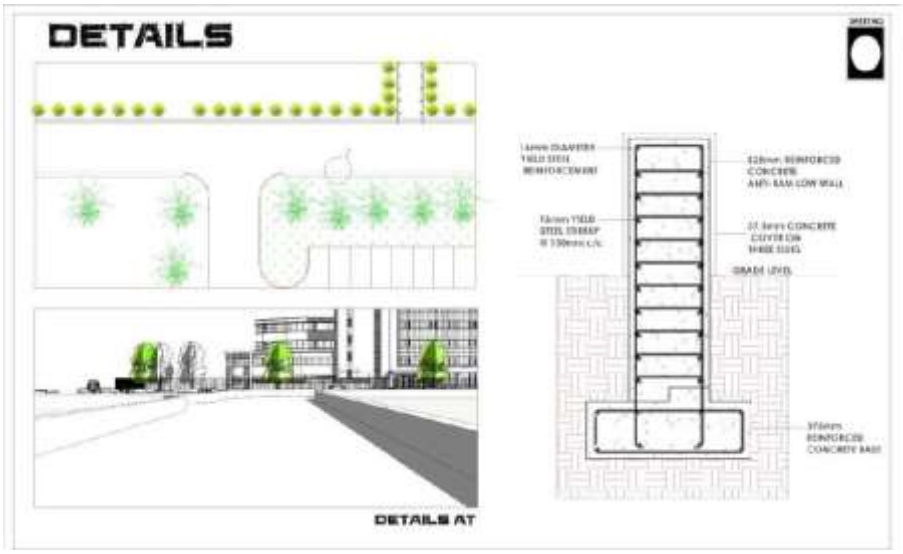
APPENDIX U: BLAST RESISTANT DOOR DETAILS



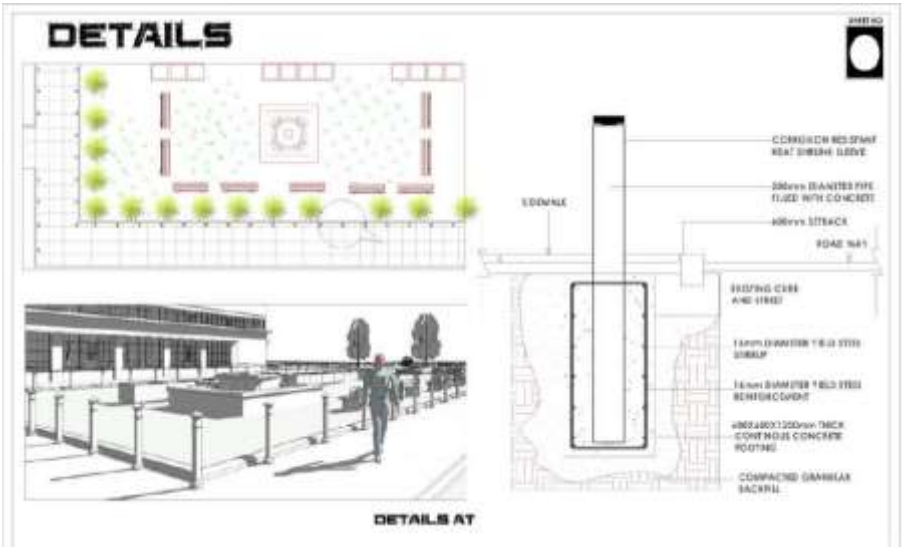
APPENDIX V: LAMINATED SAFETY GLASS DETAILS



APPENDIX W: ANTI-RAM LOW WALL DETAILS



APPENDIX X: BOLLARD DETAILS



APPENDIX Y: ENGINEERED PLANTER DETAILS