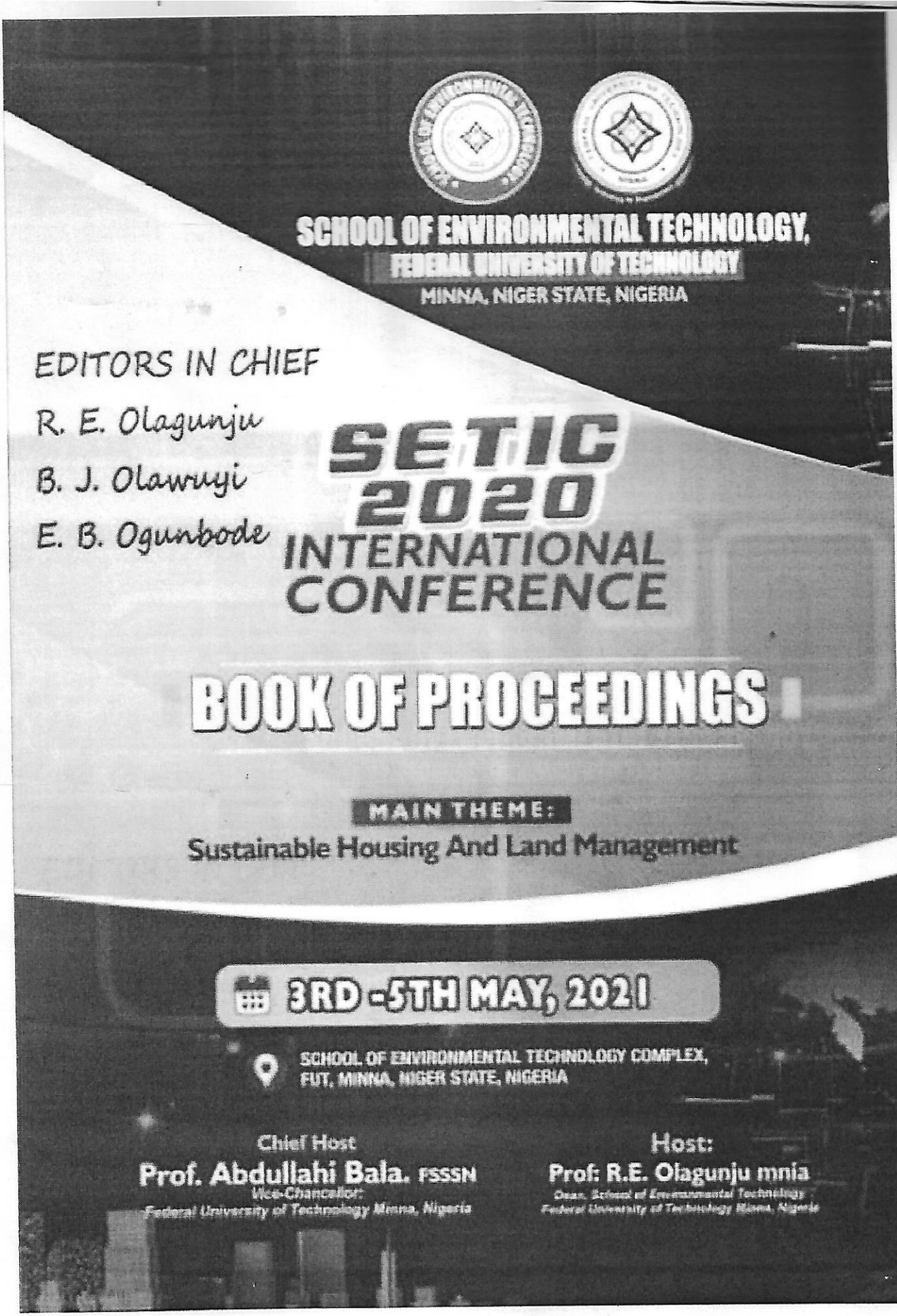
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SETIC 2020
INTERNATIONAL CONFERENCE
BOOK OF PROCEEDINGS
MAIN THEME:
Sustainable Housing And Land Management
3RD -5TH MAY, 2021
SCHOOL OF ENVIRONMENTAL TECHNOLOGY COMPLEX,
FUT, MINNA, NIGER STATE, NIGERIA
Chief Host
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School of Environmental Technology International Conference (SETIC 2020)

3RD – 5TH MAY, 2021

Federal University of Technology Minna, Niger State, Nigeria

CONFERENCE PROCEEDINGS

EDITORS IN CHIEF
R. E. Olagunju
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PREFACE

The School of Environmental Technology International Conference (SETIC 2020) is organised by School of Environmental Technology, Federal University of Technology Minna, Nigeria, In collaboration with Massey University New Zealand, Department of Civil Engineering Faculty of Civil Engineering and Built Environment Universiti Tun Hussein Onn Malaysia, Malaysia Centre For Professional Development and Industrial Project Development School of Professional and Continuing Education (SPACE) UTM-KL Malaysia, Global Academia, Department of Architecture, Faculty of Engineering and Architecture, Istanbul Gelisim University Istanbul Turkey, Sustainable Environmental and Technology (SET) Research Group, Department of Architecture, Universiti Sains Islam. The main theme for this year conference is "SUSTAINABLE HOUSING AND LAND MANAGEMENT". This promotes and encourage innovative and novelty for policy issues for inclusive and sustainable housing, access to finance for housing and land development, sustainable building materials, building cost management, sustainable and resilient cities, geoinformatics for land management, rapid urbanization, sustainable land use and spatial planning, gender issues in access to land.

The responses from participants for this conference are overwhelming, well attended, and successful. The operation mode was Virtual for all participants who choose the oral presentation mode. While, Physical for all poster medium presenters. Our participants are from various Universities and other sector across the globe, from countries like United State for America (USA), Turkey, Malaysia, China, Saudi Arabia, Kenya, New Zealand just to mention a few. Hence, this conference provides a good platform for professionals, academicians and researchers to widen their knowledge and approach on latest advances in research and innovation. Papers presented in this conference cover a wide spectrum of science, engineering and social sciences.

Finally, a note of thanks must go to SETIC 2020 Local Organizing Committee (LOC) for their remarkable dedication in making this conference a success. We hope the event will prove to be an inspiring experience to all committee members and participants.

ACKNOWLEDGEMENTS

The effort put together in achieving the success of SETIC 2020 is predicated on the feat of the first and second edition of School of Environmental Technology International Conference held in 2016 and 2018, respectively. The support and goodwill from Vice-Chancellor of Federal University of Technology, Dean School of Environmental Technology, Dr Dodo Y. A., Dr Moveh S. and many other highly motivated people are highly appreciated.
It is also my privilege and honour to welcome you all, on behalf of the Local Organizing Committee (LOC) to the 3rd edition of the Biennial School of Environmental International Conference (SETIC 2020). This Conference which was earlier schedule for 7th to 11 April, 2020 is holding now (3rd to 5th May, 2021) due to the challenges of COVID-19 Pandemic and the ASUU-FGN crisis which made our public Universities in Nigeria to be closed for about one year. We thank God for keeping us alive to witness the great SETIC2020 event, in an improved form exploiting the new-normal situation posed by the Pandemic for a hybrid (i.e. both physical and virtual) form of Conference participation.

The conference provides an international forum for researchers and professionals in the built environment and allied professions to address fundamental problems, challenges and prospects Sustainable Housing and Land Management. The conference is a platform where recognized best practices, theories and concepts are shared and discussed amongst academics, practitioners and researchers. This 2020 edition of SETIC has listed in the program a Round Table Talk on Housing Affordability beyond COVID-19 with selected Speakers from across the globe available to do justice on the topic of discussion.

Distinguished Conference participants, permit me to warmly welcome our Keynote and Guest Speakers:

- Prof. Ts. Dr. Mohd Hamdan Bin Ahmad, *Deputy Vice Chancellor (Development) Universiti Technology Malaysia (UTM)*;
- Assoc. Prof. Dr. James O.B. Rotimi, *Academic Dean Construction, School of Built Environment, College of Sciences, Massey University of New Zealand*;
- Assoc. Prof. Sr. Dr. Sarajul Fikri Mohammed, *General Manager, Centre for Professional Development and Industrial Project Development School of Professional and Continuing Education (SPACE), UTM-KL*
- Prof. Ts. Dr. Zanail Abidin Akasah, *Visiting Professor on Sustainable Solar Integrated Design Building Design, International Micro Emission University (IMEU)/HIMIN Ltd. China & Senior Research Fellow, The Architects Resourcery, Jos, Nigeria*;
- Ar. Dr. Elina Mohd Husini, *Department of Architecture, Faculty of Engineering & Built Environment, Universiti Sains Islam*;
- Asst. Prof. Dr. Yakubu Aminu Dodo, *Department of Architecture, Faculty of Engineering and Architecture Istanbul Gelisim University, Istanbul Turkey*

and the five Speakers for our Round Table Talk on Housing Affordability Beyond COVID-19

- Dr. Muhammad Mustapha Gambo, *Manager, Policy, Research and Partnerships, Shelter Afrique, Nairobi, Kenya*;
- Prof. Dr. Soumia Mounir, *Department of Architecture Ecole Nationale d'Architecture d'Agadir [The National School of Architecture of Agadir], Morocco*

- Dr. Said Alkali Kori, *General Manager Projects and Portfolio management, Family Homes Fund, Federal Ministry of Finance, Abuja;*
- Ts. Dr. Sasitharan Nagapan, *Department of Civil Engineering, Faculty of Engineering and Built Environment, Universiti Turn Hussein Onn Malaysia, Malaysia;*
- Dr. Mercy Nguavese Shenge, *AIA Assoc. Historic District Commissioner, City of Rockville, MD, USA.*

for accepting to share from their knowledge, wealth of experience and be available to interact with participants on varied issues on "**Sustaining Housing and Land Management**".
As reflected on the Conference program, the Conference activities will be Virtual for power point presenters to run in four parallel sessions on the Zoon platform while the participants for Poster presentations (mostly Postgraduate students) are expected to have their Posters displayed in the Environmental Complex Building of the Federal University of Technology, Minna. With a total of One Hundred and One (101) articles captured in the Conference Proceedings covering the seven subthemes of the Conference, I have no doubt that we are all in for an impactful experience at SETIC2020 as we brainstorm, exchange ideas, share knowledge and participate in evolving more approach to sustainable housing and land management drives.

I implore us all to enjoy every moment of the deliberations and ensure we maximize the great opportunity offered by the Conference to network for better research and career development as we also make new friends.

I also on behalf of myself and the LOC express our appreciation to the Dean, School of Environmental Technology and the entire Staff of the School for giving us the opportunity to steer the ship for SETIC2020. To the Reviewers and various Committees that served with us, I say thank you for helping us through despite the pressure of work.

Thanks, and God bless you all.

Olawuyi, B.J. (PhD)
Chairman, LOC
SETIC2020

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DECLARATION

PEER REVIEW AND SCIENTIFIC PUBLISHING POLICY STATEMENT

3rd MAY 2021

TO WHOM IT APRIL CONCERN

I wish to state that all the papers published in SETIC 2018 Conference Proceedings have passed through the peer review process which involved an initial review of abstracts, blind review of full papers by minimum of two referees, forwarding of reviewers' comments to authors, submission of revised papers by authors and subsequent evaluation of submitted papers by the Scientific Committee to determine content quality.

It is the policy of the School of Environmental Technology International Conference (SETIC) that for papers to be accepted for inclusion in the conference proceedings it must have undergone the blind review process and passed the academic integrity test. All papers are only published based on the recommendation of the reviewers and the Scientific Committee of SETIC

Babatunde James OLAWUYI
Chairman SETIC 2020
Federal University of Technology, Minna, Nigeria

Papers in the SETIC 2020 Conference Proceedings are published on www.futminna.edu.ng, AND ALSO SELECTED PAPERS WILL BE PUBLISHED IN REPUTABLE JOURNALS

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PROFILE OF KEYNOTE SPEAKERS AND GUEST SPEAKERS

SETIC 2020 organisers wishes to thank our keynote speakers, and Guest speakers for accepting to create time to share from their rich wealth of knowledge and interact with delegates and participants on varied issues being examined at this year's conference. A brief profile of each keynote speaker is provided here, this would allow for future interaction and networking with them.

Prof. Ts. Dr. Mohd Hamdan Bin Ahmad
Deputy Vice Chancellor (Development)
Universiti Teknologi Malaysia

Prof. Ts. Dr. Zainal Abidin Akasah
(Visiting Professor)

Associate Prof. Dr. James O.B. Rotimi,
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Istanbul Gelisim University, Istanbul Turkey

Ar. Dr. Elina Mohd Husini
Department of Architecture Faculty of Engineering & Built Environment, Universiti Sains Islam Malaysia

ROUND TABLE PANEL SPEAKERS

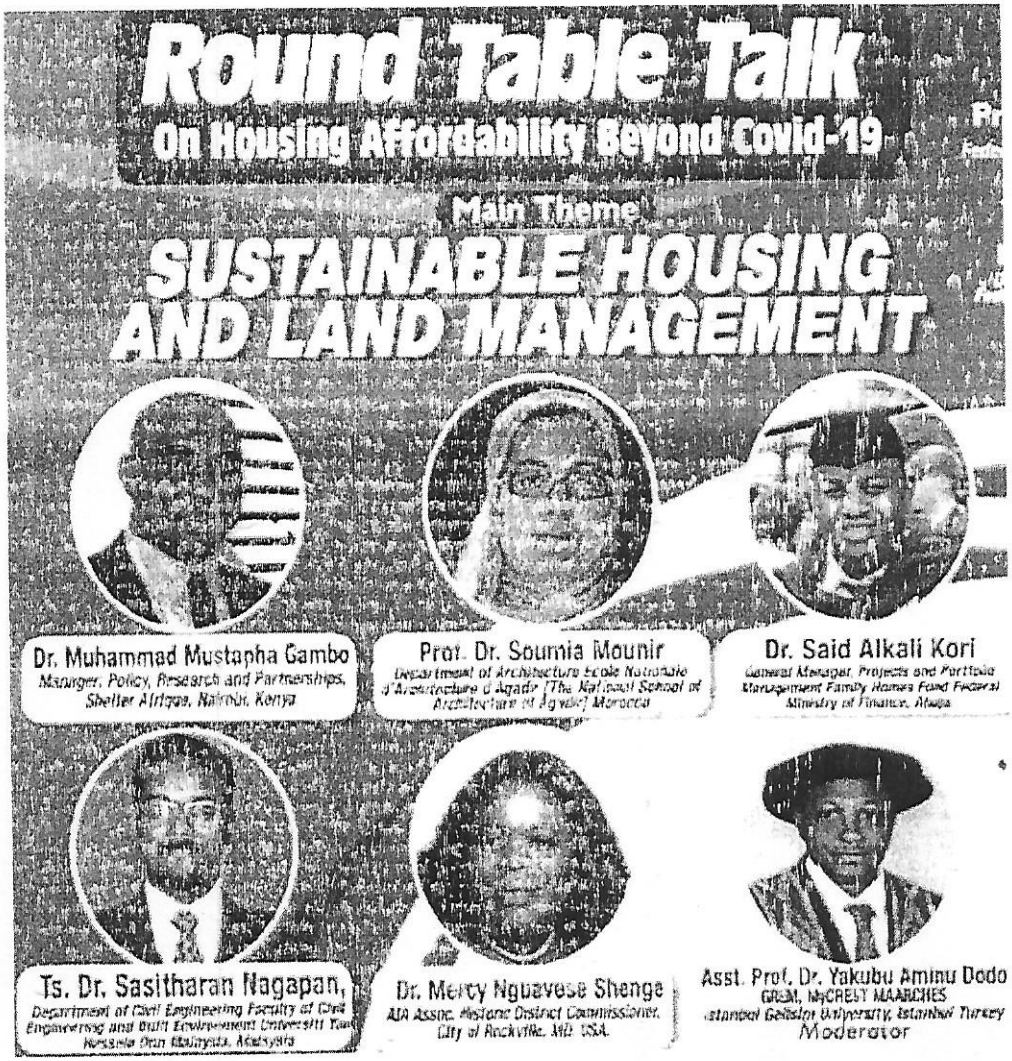

TABLE OF CONTENT

ASSESSMENT OF AN INTEGRATING DESIGN APPROACH OF PASSIVE COOLING PRINCIPLES IN HOTELS IN MINNA, NIGERIA

Shamfe, I., & Philip, A.

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ABSTRACT

Over the years, hospitality has thrived on the high side of energy demand and consumption; accounting for up to 20% to 50% of global energy consumption. In Nigeria, the cost of energy has generally shot up astronomically to a frightening position which mandates the need for sustainable buildings that yield efficient energy conservation through passive means. In order to achieve thermal comfort in hotels in Northern Nigeria where the average temperature is considerably high for most parts of the year, it is vital for the building envelope to reduce heat gain to keep the indoor air temperature lower than outdoor temperature; hence, the need for passive cooling building design approach. This study aims at assessing the passive cooling design techniques in hotels within Minna, Nigeria. The study adopts a rather descriptive research method with the use of purposefully and well-structured observation schedules to assess attendant level of integration of passive cooling principles in the design of hotels in Minna, Nigeria. The findings which were presented using tables, pictures and charts show a low level of implementation and use of passive cooling principles in the design of hotels within the study area. Architects, and other professionals in the built industry should incorporate passive cooling features in hotel buildings as an inherent part of the design; which is a recommendation this paper puts forward. This paper concludes by advocating for the compliance of passive cooling principles in the design and construction of hotels in Minna, and generally in Nigeria to further preach the global gospel of energy conservation and sustainability.

Keywords: *Energy, Hotel, Passive Cooling, Sustainability, Thermal Comfort.*

INTRODUCTION

Over the years, developing countries have witnessed critical problems of energy crisis as a result of rapid increase in cooling requirements of building most especially during the hot periods of the year. Due to the high demand for improved quality standard of living, the energy consumption in buildings is on the rise, and this factor threatens the very existence of the both the environments and its habitats (Hilton Team, 2015). The rapid advancement in technology has brought about mechanized innovations such as air conditioners that have being duly employed in the building sector to cool the indoor environment. The use of this mechanized equipment to cool the building has contributed significantly to the energy consumption of building and in turn, this has contributed to the greenhouse gas emission in the environment. According to the International Energy Agency (IEA), buildings consume about 40% of the world's energy production. Building energy use also produces 33% of all annual carbon dioxide emissions, significantly contributing to the climate changes brought about by the accumulation of this heat-trapping gas (IEA, 2013).

In a bid to achieve thermal comfort in buildings, heating and cooling systems in buildings results into a high level of energy consumption. As the standard of living increases, the level of energy demands also increases and with it is the cost of making it available (Lewis, 2004). Buildings such as offices, schools, hotels, and other public buildings as well as residences most often make use of conditioning plants and are installed almost without proper adaptation of the buildings to these new appliances. This leads to excessive energy consumption and high cost of maintenance, and may also have negative impact on the building life span (Lauber, 2005).

Lewis (2004) identified that as a result of massive energy consumption levels incurred by cooling systems especially in the tropics, members of the built environments have ventured into researching into other passive means of thermal control in order to achieve thermal comfort. One of such passive means of thermal control is passive cooling, which is the central focus of this paper.

Passive cooling deals with the processes of heat dissipation that occurs naturally, that is without the use of any mechanical components or systems (Bodach *et al.*, 2016). Passive design is also about seeing that the whole building fabric and spaces within responds excellently well and effectively to local climatic and site conditions so as to maximize the comfort level of the occupants of the building. In Hotel and hospitality facilities designs within North-Central Nigeria, the use of passive cooling design techniques has been speculated by earlier researchers as a means to foster thermal control and achieve thermal comfort (Ibrahim, 2017).

Therefore, this paper aims at assessing of passive cooling design techniques in hotels in Minna, for the purpose of creating a sustainable environment. The assessment of design elements for Heat Prevention/Reduction, Thermal Moderation and Heat Dissipation serve as objectives employed in this research work in achieving the earlier stated aim.

LITERATURE REVIEW

An overview of a hotel

A hotel is often a full service lodging facility which is intended primarily for tourists and vacationers. It is a place used for vacation, relaxation or as a daytime getaway (Parpairi, 2017).

Thermal comfort

Thermal comfort can be described as the state of the mind which expresses satisfaction with the thermal environment and is also assessed by subjective evaluation means. This feeling of satisfaction is achieved as the heat released by the human metabolism is allowed to dissipate, which in turn helps to maintain the thermal balance of the surrounding (Jonesa *et al.*, 2017).One major design factor that must constantly be in mind through all the design stages of a building is the means of achieving a building which will be thermally comfortable for the occupants.

Thermal comfort in hotels

Since the accommodation industry majorly constitutes one of the largest sectors of the travel and tourism industry. According to Jonesa *et al* (2017), observations reveal that the hotel industry ranks as one of the most energy-intensive subsector of the tourism industry, with about 50% of the energy consumption due to space conditioning.

Passive means of thermal control in hotels in Minna, Niger State.

Minna, the capital of Niger State in Nigeria, popularly called the Power State experiences a typical tropical continental climate with distinct seasonal regimes, oscillating between cool to dry and humid to wet. These two seasons reflect the influence of tropical continental air masses (Ibrahim, 2017).

This study aims to investigate possible techniques that may be used to integrate passive strategies in the cooling design of buildings in the city taking into consideration the high humidity during summer.

Passive cooling

Passive cooling in buildings includes the utilization of normal procedures to accomplish balanced indoor conditions. Chan & Mackenzie (2013) outlined that maintaining a comfortable surrounding within a space relies on decreasing the amount of heat gains into the space and the removal of excess heat from the space. Passive cooling in a public building covers every single characteristic procedure and systems for cooling structures. It is the cooling without any form of energy intake, other than sustainable energy source. Passive cooling techniques are al so closely connected to the thermal comfort of the occupants.

It is additionally maximised to expand the effectiveness of sustainable cooling with mechanically helped heat exchange methods, which upgrade the normal cooling procedures. Such applications are called "hybrid "cooling system (Mohamed, 2017). Vitality utilization is kept up at low levels; however the effectiveness of the frameworks and their application is extraordinarily moved forward. In order to cool a building through passive means, the architect needs to have sufficient knowledge of the behaviour of heat in a building.

Passive cooling preventive techniques

Protection from or prevention of heat gains encompasses all the design techniques that minimizes the impact of solar heat gains through the building's envelope and of internal heat gains that is gene rated inside the building due occupancy and equipment. According to Krestiniti (2017), passive cooling techniques includes the following design techniques:

i. Heat prevention/reduction, (Reduce heat gains)
ii. Thermal moderation (Modify heat gains) and
iii. Heat dissipation (Removal internal heat)

Solar and heat protection techniques (Reduce heat gains)

A building must be adapted to its climatic region and its microclimate. It is very important to minimize the internal gains of a building in order to improve the effectiveness of passive cooling techniques. The site design is affected by financial contemplations, zoning regulations and nearby advancements, all of which can meddle with the configuration of a building, as to the episode sun based radiation and the accessible wind. Vegetation can bring about wonderful outside spaces, as well as enhance the microclimate around a building and lessen the cooling burden. Sunlight based control is the essential configuration measure for heat gain protection. The utilization of different shading devices to keep the constriction of the episode sun based radiation from going into the building is discussed by Kapiki (2010).

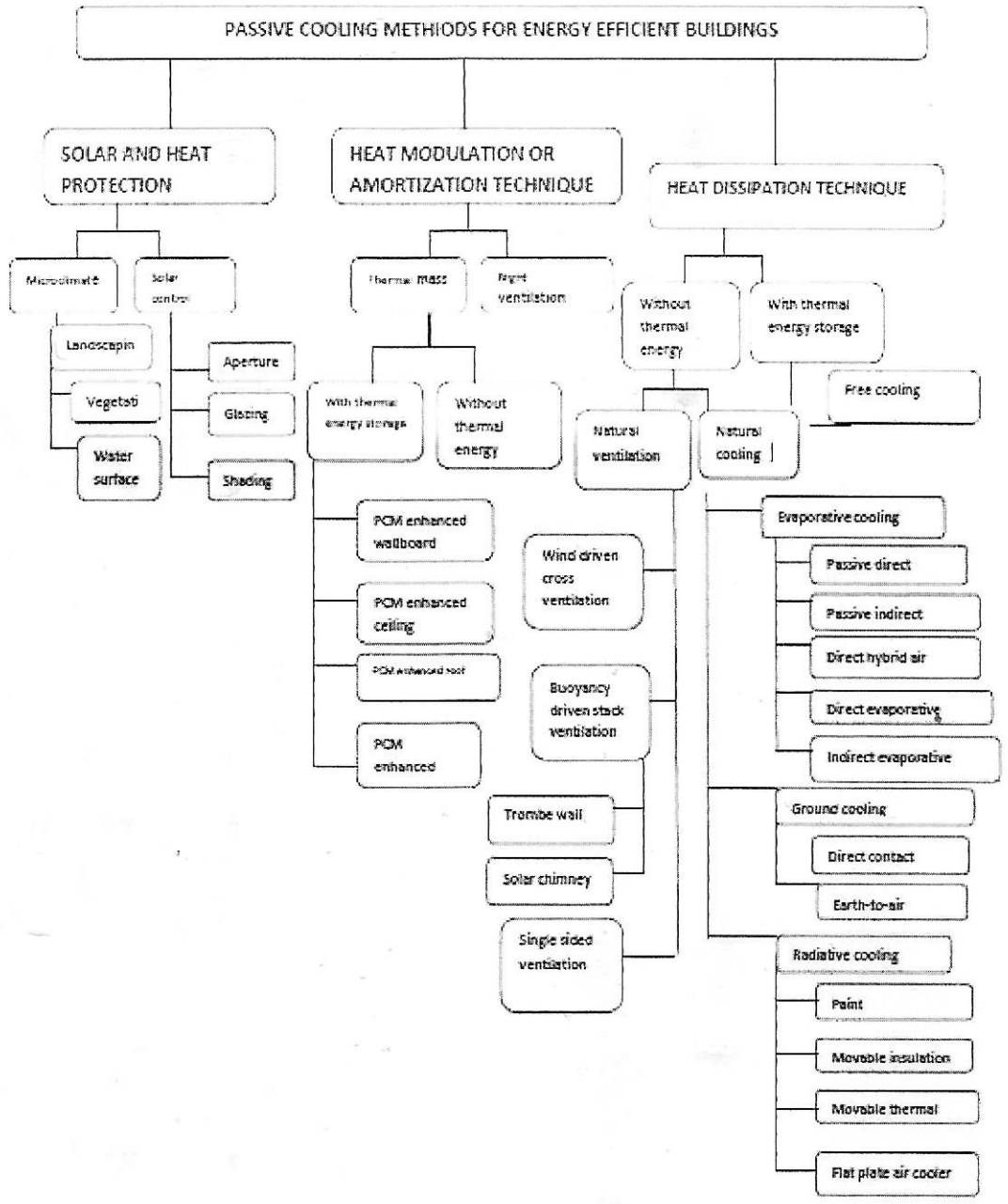

Figure 1: *Classification of passive cooling methods in energy efficient structures.*
Source:*Krestiniti (2017)*

Microclimate

Climate is the average of the atmospheric condition over a long period of time over a large region. Climate of a place may differ from the climate of the environment areas, due to the distinctive sorts of exercises performed by the occupants in the different areas.

The use of fitting arranging components, for example, *vegetation* and *water elements* can adjust the microclimatic state of a range. The primary stage in controlling higher future inside temperatures in structures is to attempt however much as could reasonably be expected to make the outer air as cool as would be prudent. Within the built surroundings this involves enhancing the infrastructure of trees, open spaces, parks, water features and open water (Chong & Ricaurte, 2014). Rooftop gardens, green walls and green roofs can also be used in a building for its cooling effect.

Solar control

Solar radiation reaches the external surface of a structure in direct, reflected and diffuse for.ms and penetrates to the interior through transparent elements such as glass. The admission of solar radiation into an interior space may cause discomfort, such as high indoor temperatures, visual and thermal discomfort to the occupants, harm to touchy articles and decorations (Gu *et al.*, 2014). Therefore, it is very important that solar radiation should be controlled by paying apt attention the *Aperture, sun shading devices* and *Glazing* used for openings.

Heat modulation or amortization techniques (Modifying heat gains)

Upadhyay *et al* (2017) outlined that the heat control of a building could be accomplished by two routines. In the first system the warm mass of a building (components built of materials with high warmth limit) retains warmth amid the day and controls the measure of indoor temperature swings, lessens top cooling load and exchanges a piece of the consumed warmth to the inside of the building in the night hours. The left over cooling energy can then be covered by natural cooling techniques. In the second method of the vacant structure is pre-cooled during the night by night ventilation which stores coolness and then transfers the coolest into building in the early hour following day, therefore reducing energy consumption for cooling by about 21% (Gonzalez & Yousif, 2015).

Heat dissipation technique (Remove internal heat)

The avoidance and modulation of heat gains cannot maintain indoor temperatures at a control level. A more cooling strategy at an advanced level includes heat removal to heat sinks, such as the upper atmosphere and the ambient sky, by the natural processes of heat transfer (Wang *et al.*, 2015). The design of a structure is a very important factor which affects the cooling potential of a natural cooling technique. Natural cooling refers to the use of natural heat sinks for excess heat dissipation from interior spaces, includes natural ventilation, evaporative cooling, radiative cooling and ground cooling.

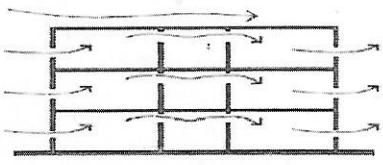

Figure 2: *Concept of wind-driven cross ventilation system.*

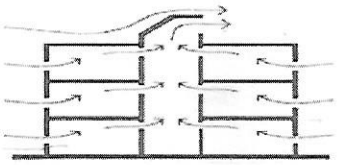

Figure 3: *Concept of buoyancy driven stack ventilation system.*

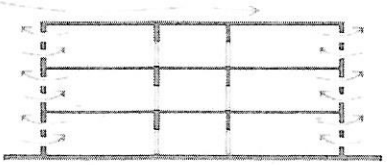

Figure 4: Concept of single-sided ventilation system.
Source: Kapiki (2010)

RESEARCH METHOD

The research employed a rather descriptive method of research highlighting investigations into the 'what' rather than the 'why' of the subject matter being studied. This paper engaged the use of purposefully and well-structured observation schedules to obtain relevant data for the study, as it relates to relevant knowledge obtained from literature (Palinkas & Soydan, 2012). A sample of hotels in Minna, Niger State was selected and used for the study. Purposive Sampling was used for the selection of samples, as selection was done based on hotels in Minna that were most suited for assessing design elements for passive cooling and also accessibility due to the security-sensitive nature of certain hotels. The variables observed in the samples taken were targeted towards assessing design features that cater for the following;*Heat prevention/reduction, (Reduce heat gains), Thermal moderation (Modify heat gains) and Heat dissipation (Removal internal heat).*

RESULTS AND DISCUSSION

The results obtained from the observation schedule were documented using tables as shown below:

From **Table 1,**results show that 30% of hotels sampled made use of indoor plants and also trees and shrubs as sun shading devices. Also, 20% of the sampled hotels met an estimated green cover area range of 25-30%. None of the sampled hotels featured green roofs or green walls and 40% had their buildings along the North-South direction. These results obtained reveal low level of integration of climate and natural design measures both in the design of buildings and planning of site, thereby minimizing heat prevention or reduction and reduction of heat gains within the sampled hotels.

Table1:*Assessment of passive cooling features that aid heat prevention/reduction*

S/N	HOTELS	Use of Indoor plants	Use of trees /shrubs for sun shading	25-30% site green cover area	Green walls/ green roofs	North-south building orientation
1	Doko Hotel	X	✓	✓	X	✓
2	Dogon Koli Hotel	X	X	X	X	✓
3	Saftec Hotel	X	X	X	X	X
4	Yanna Hotels	X	X	X	X	X
5	Falana Suites	✓	✓	X	X	X
6	Princess az-zahra lodge	X	X	✓	X	X

7	Master class Hotel	✓	X	X	X	X
8	Yayi Hotels	X	X	X	X	✓
9	Mairuwa Hotels	X	X	X	X	X
10	Mar Haban hotel	✓	✓	X	X	✓
	Total (%)	30	30	20	0	40

✓– Available X – Not available.
***Source:** Authors*

From **Table 2,** only 10% of the sampled hotels had water bodies which help with evaporative cooling, 100% of the hotel buildings featured tinted glass and reflective glass for glazing along openings (which is good for heat reduction) and 50% of the sampled hotels featured opening-wall ratios of 35-45% and 50% also had minimum distances between buildings on site of about 6m.

Table 2:*Assessment of passive cooling features that aid heat prevention/reduction*

S/N	HOTELS	Opening-Wall ratio of 35%-45%	Use of reflective/ tinted glass	Water bodies	≥ 6m Distance between buildings on site
1	Doko Hotel	✓	✓	X	X
2	Dogon Koli Hotel	X	✓	X	✓
3	Saftec Hotel	X	✓	X	✓
4	Yanna Hotels	✓	✓	X	X
5	Falana Suites	✓	✓	X	X
6	Princess az-zahra lodge	X	✓	✓	✓
7	Master class Hotel	✓	✓	X	✓
8	Yayi Hotels	X	✓	X	✓
9	Mairuwa Hotels	✓	✓	X	X
10	Mar Haban hotel	X	✓	X	X
	Total (%)	50	100	10	50

✓– Available X – Not available.
***Source:** Authors*

Table 3:*Assessment of passive cooling features that aid thermal moderation*

S/N	HOTELS	PCM enhanced wallboard	PCM enhanced ceiling	PCM enhanced roofs
1	Doko Hotel	X	X	X
2	Dogon Koli Hotel	X	X	X
3	Saftec Hotel	X	X	X
4	Yanna Hotels	X	X	X
5	Falana Suites	X	X	X
6	Princess az-zahra lodge	X	X	X

7	Master class Hotel	X	X	X
8	Yayi Hotels	X	X	X
9	Mairuwa Hotels	X	X	X
10	Mar Haban hotel	X	X	X
	Total (%)	0	0	0

✓– *Available* *X – Not available.*
Source: *Authors*

Furthermore, **Table 3** shows that none of the hotels within the sample employed Phase Change enhanced Materials (PCM) for walls, roofs and ceilings; thereby decreasing tendencies for the buildings to function effectively for thermal moderation (modifying heat gains).

Table 4:*Assessment of passive cooling features that aid heat dissipation*

S/N	HOTELS	High level windows in rooms	Nature based atriums/courtyards	Bright Colours for interiors	Heat insulating wall materials
1	Doko Hotel	X	✓	✓	X
2	Dogon Koli Hotel	X	✓	✓	X
3	Saftec Hotel	X	X	✓	X
4	Yanna Hotels	X	X	✓	X
5	Falana Suites	X	X	✓	X
6	Princess az-zahra lodge	X	✓	✓	X
7	Master class Hotel	X	X	✓	X
8	Yayi Hotels	X	X	✓	X
9	Mairuwa Hotels	X	X	✓	X
10	Mar Haban hotel	X	✓	✓	X
	Total (%)	0	40	100	0

✓– *Available* *X – Not available.*
Source: *Authors*

Also, from **Table 4,** it is apparent that none of the hotel buildings featured high level windows in rooms and heat insulating materials for wall construction. In addition, only 40% of the hotels featured nature based courtyard or atriums and then, all the hotels were seen to employ bright colours for interior finishes in rooms which is really good for heat dissipation.

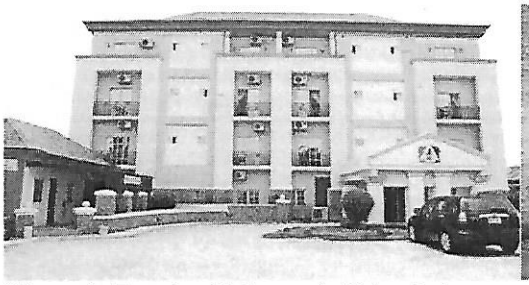

Figure 5: *Façade of Princess Az-Zahra lodge*

Figure 6: *Single room at Master Class hotels*

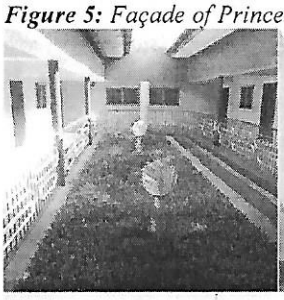

Figure 7: *Courtyard at Doko hotels*

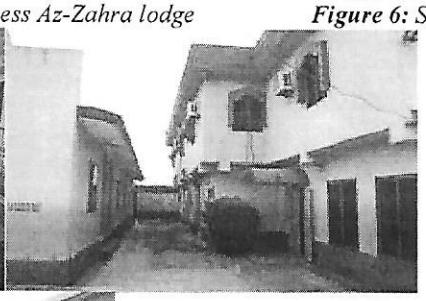

Figure 8: *showing distance between buildings in Mairuwa hotels*

Figure 9: *Façade ofSaftec hotels*

Source: *Authors field work (2020)*

CONCLUSIONS

Results obtained from the study reveal that although certain natural and vegetative elements were featured in the sampled hotels, they were not sufficient as to functioning as adequate sun-shading, evaporative cooling, air purification, thermal regulating and passive cooling devices. Also, these sampled hotels insufficiently incorporated heat dissipation, moderation and dissipation strategies and techniques in their designand construction.

This study therefore concludes by specifying that passive cooling techniques have not generally been incorporated as strong features in the design of hotels in Minna, Nigeria as sustainable measures for fostering thermal comfort.

RECOMMENDATION

Passive cooling should be adopted as a design principle for hotels and hospitality buildings, as Government policy for health and wellbeing of hotel users as regards thermal comfort and sustainability. Local and indigenous vegetation, water bodies and other natural passive cooling features should be used in the development of hotels and hospitality buildings around North Central Nigeria, as this will make for better connection between people and the local climate

within the particular area where the hotel is located as well as aid thermal comfort and wellbeing.

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