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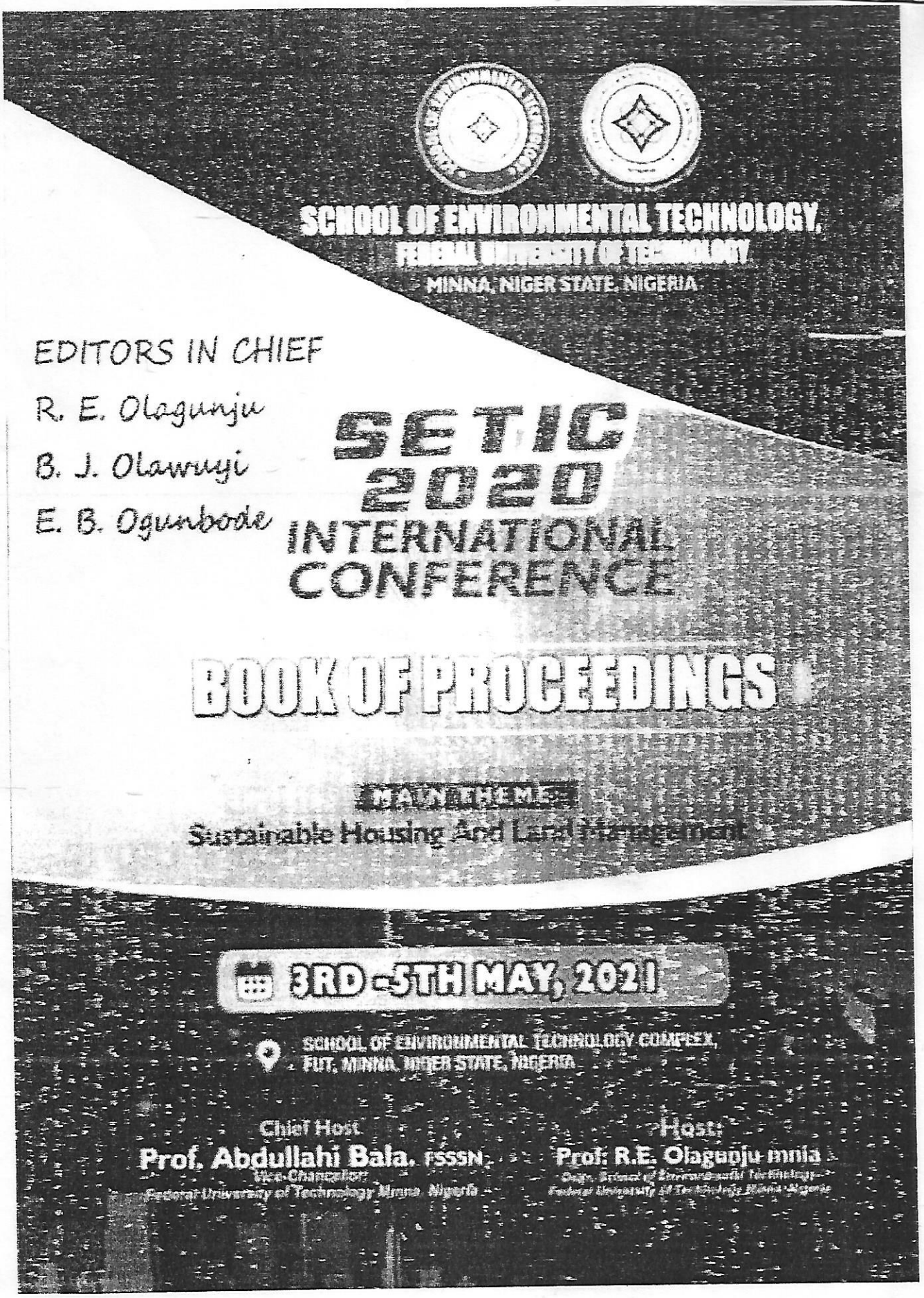
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CONFERENCE
BOOK OF PROCEEDINGS
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Sustainable Housing And Land Management
3RD -5TH MAY, 2021
SCHOOL OF ENVIRONMENTAL TECHNOLOGY COMPLEX,
FUT, MINNA, NIGER STATE, NIGERIA
Chief Host:
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School 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

B. J. Olawuyi

E. B. Ogunbode

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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

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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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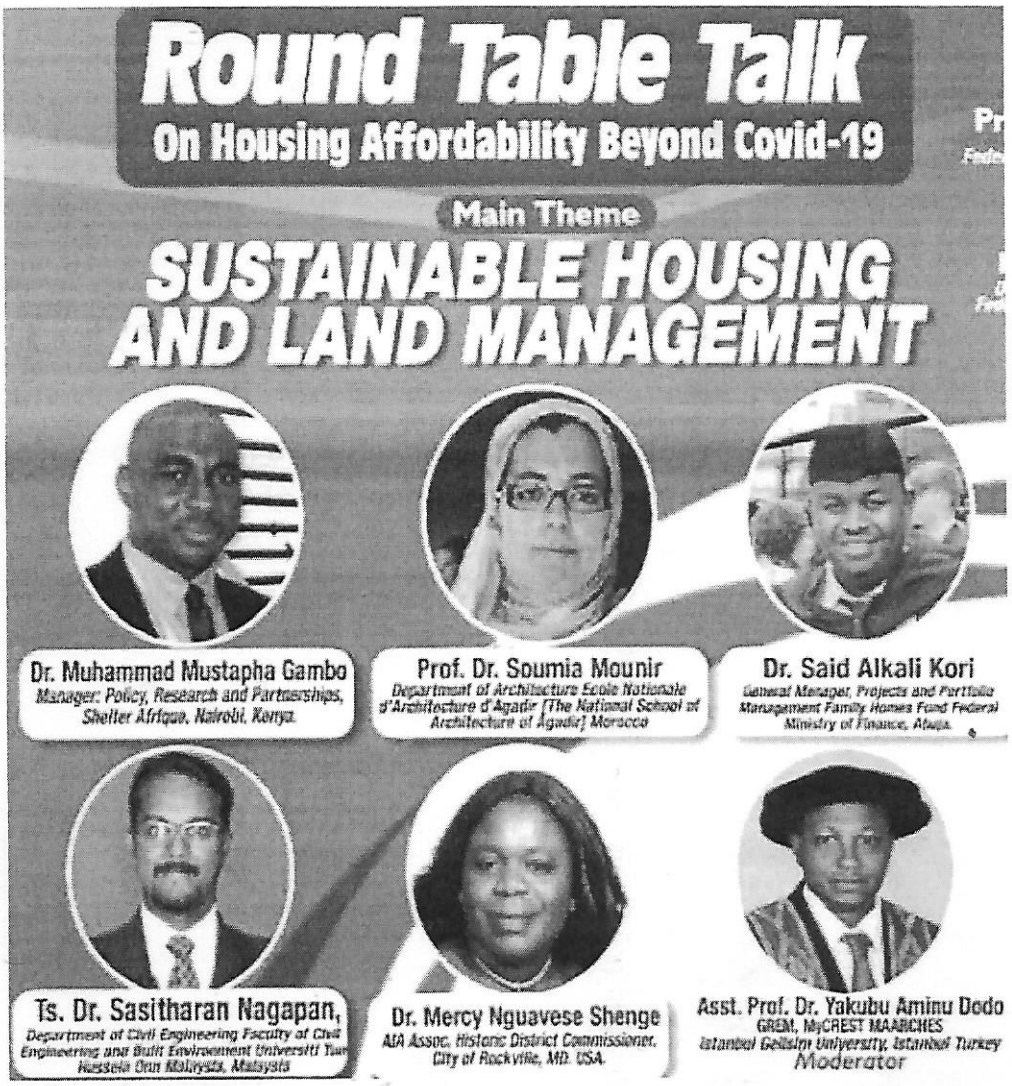
PROFILE OF KEYNOTE SPEAKERS AND GUEST SPEAKERS

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.

ROUND TABLE PANEL SPEAKERS



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Evaluation of Passive Cooling Design Considerations in Faculty of Basic Medical Science Buildings in Northern Nigeria

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Abstract:
The most substantial discuss currently in the built environment of architectural practice and education is "Passive Design" because it has progressively become difficult for professionals to ignore its concern, considering the energy supply gap especially in Nigeria.Mechanical form of cooling,lighting and ventilating of educational buildings has continuously proven to be unsustainable. More so, it is important for faculty buildings to maintain a conducive thermal environment because of the negative impact, the lack of such could have on student's cognitive abilities and academic performance.This paper aims to identify the passive cooling design strategies incorporated inFaculty of Basic Medical Science Buildings in Northern Nigeria. The study adopted a descriptive survey method and data on passive cooling design strategies were collected through observation schedule.The random sampling method where the frequency of use and effectiveness of passive cooling design strategies were studied in six (6) sampled faculty buildings. Indicative findings from the studied samples were statistically analyzed and interpreted to show if the passive cooling design strategies were appropriately integrated to achieve thermal comfort. The result showed that passive cooling design considerations were not properly integrated in Faculty of Basic Medical Science Buildings in Northern Nigeria.It is recommended that passive cooling design strategies such as proper building orientation, adequate landscape elements, proper openings, adequate building envelope, thermal insulation, and adequate shading devices should be appropriately incorporated in the design of buildings, particularly faculty of Basic Medical Science Buildings to achieve thermal comfort.
Keywords: Faculty Building, Passive Cooling, Design Strategies, Natural Ventilation,Thermal Comfort

INTRODUCTION

The most substantial discuss currently in the built environment of architectural practice and education is "Passive Design" as it has progressively become difficult to ignore the concerns by professionals in the built environment (Stamas*etal.*, 2008).Empirical evidenceshighlight the continuous increase in temperature and greenhouse emission as a result of massive urbanisation, industrialization and advancement in technology(IPCC, 2014). However,green architecture or green design has been discussed by various scholars as an approach in advancement of sustainable architecture towards eliminating the emission of greenhouse gases (Bulus*etal.*, 2017).

According to the American Society of Heating, Refrigerating and Air Conditioning Engineers,themechanical equipment has a higher maintenance and low replacement regime generally than natural ventilation approachASHRAE (2004). One of the ways of preventing high rate of dependence on active energy system for indoor comfort is for the designers to cater for the extreme temperature through adoption of Passive Cooling design considerations from the design stage (Akande, 2010).

The incorporation of Passive Coolingdesign strategies is aimed towards mitigating potential negative impact of greenhouse emissions on the well-being of the building occupants and the environment through the use of an "eco-friendly" construction materials and principles (Jackie, 2019). In addition, Passive measures, specifically natural rather than active means of cooling, can significantly reduce the energy intake and are adopted according to the local climate (Hatamipour and Abedi, 2008). In general, passive design balances all aspects of the energy use in a building (Rosenlund, 2009). The need to reduce the consumption of energy and give users more controlover their immediate environments, are good reasons for designers now to re-evaluate the role of natural ventilation in buildings and to become familiar with thebasic principles involved (Hyde, 2017).

This study assesses and evaluates the design features for passive cooling in Faculty of Basic Medical Science Buildings to help architects and other built environment professionals achieve the desirable indoor environmental air quality. This would encourage new ideas in the design of Faculty buildings and also encourage the use of passive cooling design techniques in Faculty designs especially in the hot-dry climatic region.

Passive Cooling Towards Thermal Comfort in Faculty ofBasic Medical Science Buildings

Passive cooling design uses free renewable energy sources such as the sun and wind to provide ventilation, cooling, and lighting needs for buildings. This furthermore removes the need to use mechanical ventilation and cooling. Adopting passive cooling means decreasing differences between outdoor and indoor temperatures, improving indoor air quality and making the building both a better and more contented environment to live and work in. it can also decrease energy use and environmental effects such as greenhouse gas discharges. Interest in passive cooling design has developed recently - particularly in the last decade – as a part of crusade towards sustainable architecture. Well-designed envelopes maximise cooling movements of air and excludes the sun in the hot season.

There are many kinds of passive cooling strategies that can be suggested for use in hot – dry climate such as northern Nigeria. Design strategies that decrease the use of mechanical cooling systems include the selection of suitable glazing for windows or skylights, proper window placement and daylighting design, proper sized shading of glass when heat gains are being avoided, the use of light or reflective-coloured materials for the building envelope and roof, careful siting and wise orientation decisions alongside appropriate landscaping design. The above passive cooling elements are considered when improving the performance of a complex system designed to provide occupants with a comfortable, safe, and attractive living and work environment.

According to Abbaszadeh (2006),thermal comfort is regarded as a state of mind that is satisfactory with the thermal environment.Furthermore, it is assessed by subjective evaluation as a result of the nature of factors to be considered such as humidity, air velocity, metabolic rates, clothing levels,physiological state, radiant and air temperature. The occupant's satisfaction with their environment is importantas it affects health and productivity. Surveys have shown considerable correlation between optimal thermal comfort with improved cognitive abilities and productivity. However, thermal discomfort can result in sick building syndrome which has negative impact on the occupants (Mujtaba and Halil, 2017). Adoptingpassive cooling strategies is considered as a better alternative to mechanical cooling in providing satisfactory thermal comfort to building occupant. More also, this will help to lower the energy requirement of academic buildings which requires mechanical cooling systems and reduce greenhouse emissions(Hyde, 2017).

METHODOLOGY

Research Method and Data Collection

The research method adopted for this study is the descriptive survey method. Data collected for the research were obtained from primary sources and include: Case studies, use of observation schedule. Case studies were carried out on existing faculty of Basic Medical Science buildings within the study area. The variables assessed are; window placement, daylighting design, the selection of suitable glazing for windows or skylights, size of openings, building envelope and orientation, roof material, use landscaping features, were evaluated using observation schedule. Also, photographs of the buildings were taken in order to show the variables observed on the field as shown in plates I – VI taken from the case studies.

Plate I: Use of landscape elements at Birnin-Kebbi

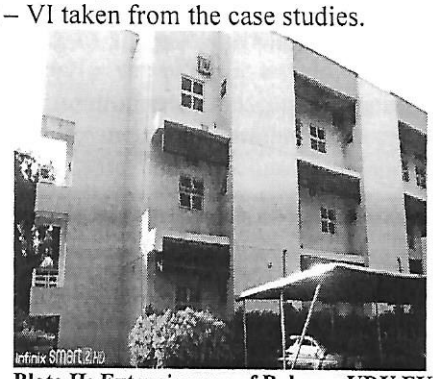

Plate II: Extensive use of Balcony,UDU FUBK Sokoto

Plate III: Use of windowsand low application of vegetationat FUBK Birnin-Kebbi

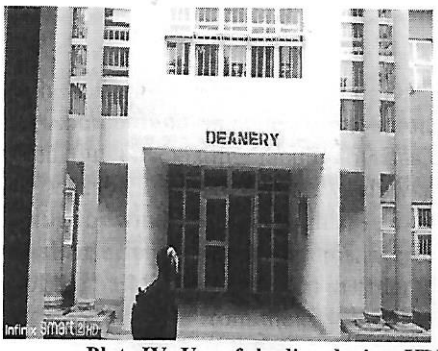

Plate IV: Use of shading devices UDU Sokoto

Plate V: Faculty building with vertical shading horizontal shading device

Plate VI: Faculty building with device

Sampling Technique and Sample size

The research employed the use of purposive sampling based on the size of the faculty of Basic Medical Science buildings in Northern part of the country. Fourfaculty buildings were selected and assessed.

Table 1:Sample size, acronym, location and number of buildings observed

S/N	Sampled faculties	Acronym	Location	No. Of buildings observed
1	Faculty of Basic Medical Science UDU Sokoto	UDUS	UsmanDanfodio University, Sokoto	1
2	Faculty of Basic Medical Science KASU	KASU	Kaduna State University, Kaduna	1
3	Faculty of Basic Medical Science BUK	BUK	Bayero University Kano, Kano	1
4	Faculty of Basic Medical Science ABU	ABU	Ahmadu Bello University, Zaria	1

Variables for the study

The data collection instrument used in this study to assess thermal comfort design features in faculty building is structured observation schedule. As listed in Table 2.0, variables such as proper window placement and daylighting design, the selection of suitable glazing for windows or skylights, proper sized shading of glass when heat gains are being avoided, the use of light or reflective-coloured materials for the building envelope and roof, careful siting and wise orientation decisions alongside appropriate landscaping design

Table 2: Parameters used for assessing thermal comfort design features in faculty buildings

S/N	Parameter
1	Vegetation (landscape)
2	Shading Devices
3	Openings (windows, courtyard and atrium)
4	Thermal mass and Insulation.
5	Building Orientation

RESULT AND ANALYSIS

The Tables 1 and 2 shows the selected faculty of Medicine buildings in Northern part of Nigeria, their location, number of buildings observed and the parameters used to assess them respectively. An assessment was done to determine if the passive cooling strategies used in the faculty of Basic Medical Science buildings studied were properly integrated.

Table 3: Degree of use of passive cooling elements in the sampled buildings

S/N	The degree of presence of element	Score
1	Very high	5
2	High	4
3	Moderate	3
4	Low	2
5	Very low	1
6	Not available	0

DATA REPRESENTATION AND ANALYSIS

a) Landscape Elements

The various types of landscape element (vegetation) were assessed to evaluate their degree of effectiveness on the selected facilities. The analysis shows that trees, shrubs and grasses have higher application on faculty buildings as they are the dominantly used landscaped elements with 100% and hedges at 67%.

Table 4:Passive Cooling Design Elements (landscape)

SN	Institutions	Trees	Hedges	Shrubs	Grasses	Climbers
1	UDUS	✓	✓	✓	✓	*
2	KASU	✓	✓	✓	✓	*
3	BUK	✓	✓	✓	✓	*
4	ABU	✓	✓	✓	✓	*
Total		4	4	4	4	0
Percentage		100%	100%	100%	100%	0%

b) Solar Shading Element

The shading elements used at the selected facilities were closely observed and a chart was projected to show the analysed result. Majority of the selected faculty buildings uses deep verandas (balcony) and landscape element for shading which were scored on their effectiveness.

Table 5: Passive Cooling Design Elements (landscape)

SN	Institutions	Horizontal fins	Vertical fins	Egg crate	Balcony	Landscape
1	UDUS	✓	✓	*	✓	✓
2	KASU	*	*	*	✓	✓
3	BUK	✓	✓	*	✓	✓
4	ABU	*	✓	*	✓	✓
TOTAL		2	3	0	4	4
PERCENTAGE		50%	75%	0%	100%	100%

d) Thermal Mass

The thermal mass materials used at the selected facilities were also observed and a chart was projected to show how effective they wereadopted. The faculty of Basic Medical Sciences in KASU shows considerablethe use of stone work on the external walls mainly for aesthetic rather than for insulation. More alsoceramic tileswere used internally as floor finishes for cooling as shown in Figure 1.

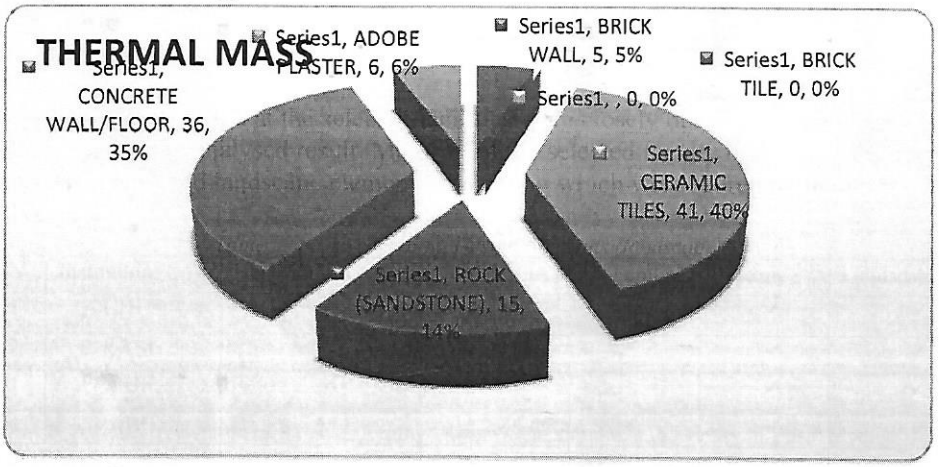

Figure 1:Material with high thermal massused in the facilities

e) Windows

The various types and form of windows were assessed. the height and positioning of windows was checked for window effectiveness on the selected facilities. The assessment showed as represented in Figure 2that 45% were fixed, while 55% of the studied buildings have projected windows. The observation also showed that 33% of Faculty of Medicine Buildings observed have clerestory windows particularly in UDUS.

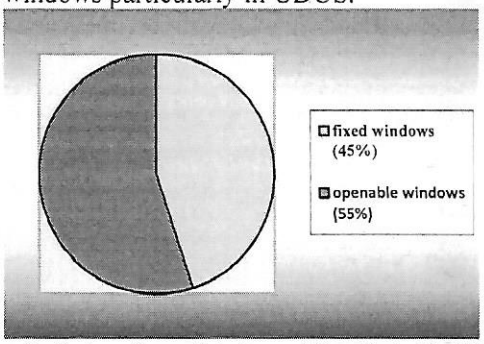

Figure 2: Various formsofwindows at the selected facilities

F) Courtyard

Courtyards used at the selected Basic Medical Science Buildings were observed to determine their level of effectiveness. After the observation, a chart was projected to show how effective they were utilized. The result of the assessment in Figure 3 showed that 66%of all courtyards observed were square orrectangular in shape, while 17% were either circular or oval in shape like that of the faculty of basic sciences in BUK.

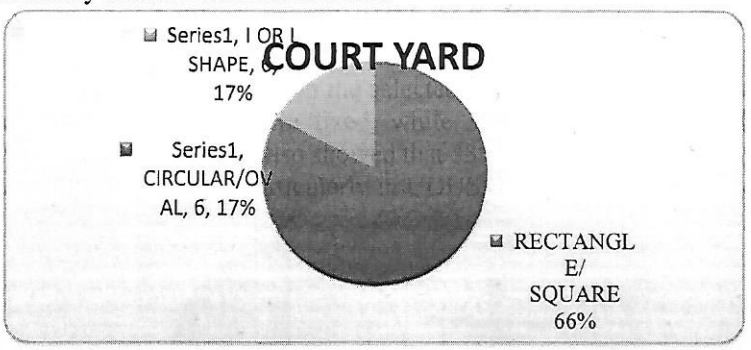

Figure 3: form of courtyard at the selected facilities

G) Building Orientation

From literatures reviewed, the building longitudinal axis should be along the East-West direction, so that the north and southern facades takes the lesser amount of solar radiation during the summer period. Hence, this paper assessed the different orientations adopted in siting the selected buildings. The result as shown in Figure 4indicates that 75% buildings have their longitudinal axis along are the North - South direction while the 25% East – West. This implies that orientation of a building was not giving proper consideration to reduce solar heat gain as it affects the room temperature and thermal comfortof occupants

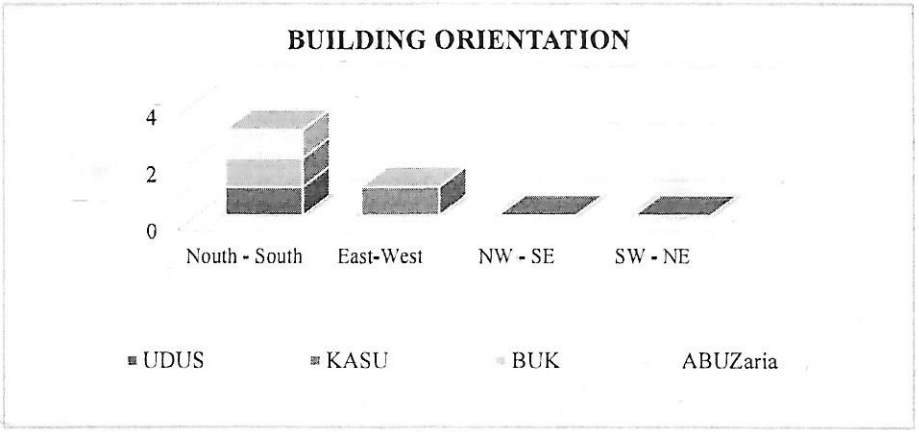

Figure 4: Building orientation

FINDINGS

From the results presented above, it can be deducted that passive cooling design strategies were not properly incorporated or designed for in faculty of basic medical science buildings in northern Nigeria. This non integration of these cooling elements has led to the use of artificial cooling methods which consume very large amount of energy and release harmful gases like greenhouse gases into the environment.

CONCLUSION

The concept of passive cooling design strategies proposes using design strategies to decrease reliance on mechanical cooling and ventilating. As analysed, the faculty of Basic Medical Science Buildings in Northern Nigeria were designed with little considerations for passive cooling design strategies as most of the buildings rely on artificial cooling and ventilating which have adverse effect on the environment. It is recommended that designers and developers in the built environment should resolve to adopt passive cooling design strategies to reduce over reliance on mechanical means of cooling, thereby ridding the environment of harmful gases.

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