Review of Strategy for Assessing the Thermal Performance of Institutional Building Form in Hot Dry Climate of Nigeria

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Abstract: Achieving comfortable indoor environment in buildings in hot climates requires enormous amounts of cooling energy specifically if passive design techniques were not considered from the outset of the construction process. For instance, overheating in building experience in tropical climates of Nigeria impacts severely on occupants' productivity and well-being. This paper reviews existing construction and technological strategies of improving energy efficiency in hot climates with a focus on institutional buildings. The review covers in particular design of building form/shape, passive cooling techniques, thermal comfort and building performance assessment tools. The paper provides also a critical reflection on the effectiveness and suitability of each strategy to address the wider issues of sustainability of the building sector.

Keywords: Energy efficiency, Thermal comfort, Institutional buildings, sustainability, passive cooling, hot climates

1.0. INTRODUCTION

In recent years, Nigerian government has invested much in financing the construction and upgrading of public facilities in its higher institutions across all levels. Higher educational institutions and universities across the 36 states of the federation were funded towards provision of ideal teaching and learning environment, (Douglas, 2018). Educational institution buildings are places for teaching, learning, research, these activities are offered in many built facilities such as academic/administrative offices, classrooms, workshops, laboratories, theatres/studios, sports facilities, arenas, accommodation facilities etc. In many developed countries of the world, such as UK, USA and Europe, University environment is part of the urban city setting, where urban services are shared as a common facility, a purposeful energy efficiency plan with technical and behavioural improvement measures is required for a higher education building to achieve sustainable energy performance. (Nelson, 2015).

According to Chryso and Aimilios (2018), Educational buildings in developed countries are responsible for extensive consumption of energy. Energy is required to provide thermal comfort to occupants, its reduction is recognized as an essential need for implementing greenhouse strategies by many governments, as such policies and targets are therefore set at certain periods. Thermal comfort perception affects all manner of building occupants, it is determined by climates, building type, form shape, height, materials used in constructing building and user perception factors. For achieving desired quality indoor environment devoid of any health risk and improved students' productivity, buildings desire to be tested for performance across all stages of its development. Assessment of institutional buildings towards solving phenomenon of overheating in hot dry climates of Nigeria is the concept of this research. Knowledge about energy use in building, thermal comfort, building forms energy consumption and assessment, are essential but sometimes actual consumption may differ from the estimated in terms of buildings parameters, physical characteristics and occupant's use of building. (Mishra, et al, 2017; Shide, and Amin, 2019). Globally the building sector accounts for more electricity use than any other sectors, offices buildings accounts for 48-68% of electricity consumption, 13-37% lighting and 12- 25%, equipment load, according to Building energy efficiency guideline for Nigeria (BEEG, 2017). Nigerian electricity demand exceeds the supply and even the supply remains unreliable. The available power supply in Nigeria is less than 41% of the total installed capacity Energy sources used in buildings in Nigeria amounts to 0.4% hydro, 17% oil and gas and 82% biofuels and waste. Electrical energy consumption by offices buildings is majorly for cooling and lighting; 40-60% used for air condition, 13-37% lighting and12-25% office equipment.

Building form refers to the roof, walls, floors and foundations of a building. Form shape is a parameter that is exposed to the environment which affects internal temperature and heat loss. The smaller the external area of a building the less opportunity there is for heat to escape. While, building geometry refers to measurements relating to building configuration and arrangements, in broader sense it relate with building components, its envelope interact with interior and mediate the difference between outdoor and desired indoor conditions. Forms play the leading role in achieving energy efficiency of a structure and must be considered in design planning and construction. Good design of form can minimize and downsize heating and cooling requirement or eliminate need for them all. (Hanan, 2014; and Zero Carbon Hub, 2016.)

According to Chryso & Aimilios, (2018), assessment of institutions (education) building form for thermal performance is an essential measure to reduce CO_2 emission to the environment. In order to ensure thermal comfort, reduce the phenomena of overheating good indoor environmental quality is desired. Indoor environmental quality (IEQ) is the conditions inside a building, air quality, lighting, thermal conditions, ergonomics and their effects on occupants. Strategies for addressing IEQ include those that protect human health, improve quality of life, reduction in stress and potential injuries. It can enhance the lives of building occupants and increase the resale value of building. (Zero carbon Hub, 2016). In UK, there has been increase evidence of overheating in buildings in homes retrofitted to satisfy more demanding energy efficient standards. Overheating has serious health consequences on occupants of building, and it can lead to discomfort or loss of life. Andy and Micheal,(2012), reported that summer heat in 2013 in Europe alone has caused the death of 35,000 people and 2000 in UK, due to daytime temperature rise between 26^0C-37^0C and 19^0C.

Several studies were conducted on passive cooling design techniques of different buildings and forms in hot climates, majority from Arab, UAE and North/ West Africa, (Hanan, 2014; Marwa, et al., (2015); Abbas, (2015); Fahad & Steve, (2017); Maryam, and Ahmad, (2017); Alshenaifi & Sharples, (2018); Farshad, (2018); and Mahamood, et al, (2018). Most global research that reviewed offices buildings are largely on context of commercial offices not institutional education buildings. Hanan, (2014), Fahad & Steve, (2017), offered useful guides on application of passive principle on multi storey high rise commercial offices buildings and the use of integrated environmental solution (IES) tool for assessments. The application of this strategy on low rise buildings in hot-dry climates is vast on residential buildings alone even in Nigeria by researchers, (Maryam, and Ahmad, 2017; & Mahmood, 2018). Research specifically on educational institution, low rise buildings with complex shape, varying geometry and multi-functional utility spaces; (offices, studios, classes, etc), are scarce and really conducted. There is a major gap created an absence of data to refill the countries Building Energy Efficiency guidelines, codes and energy use index for this category of buildings; (Institutional offices and Educational buildings), etc. (BEEG, 2017and National Energy Support Programme, (NESP, 2017).

1.2 Aim and Objectives

This research paper is a literature search on key variables for assessing the thermal performance of institution building in hot dry climates of Nigeria. The purpose is to achieve provision of thermally comfortable indoor environment quality to the users. The literature focus on climate, Forms/ shape parameter, thermal comfort and indoor environmental quality and simulation tool required for assessment of performance and sustainable energy reduction. Objectives are:

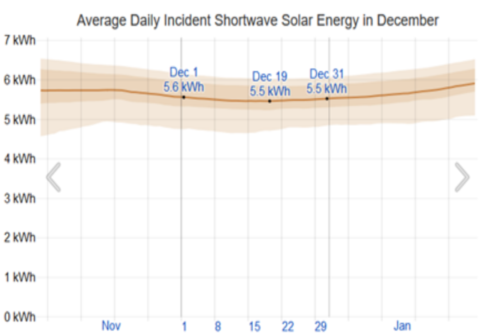
- To examine the effectiveness of using literature that guide on passive design techniques and approach in hot dry climates.
- To find literature that explains processes of solving the phenomenon of overheating that creates thermal discomfort in offices buildings.
- To learn process of optimizing form energy efficiency for achieving thermal comfort and indoor environment quality to the occupants.
- To find literature that guides on selection and application of simulation tool for thermal performance assessment of institutional buildings.

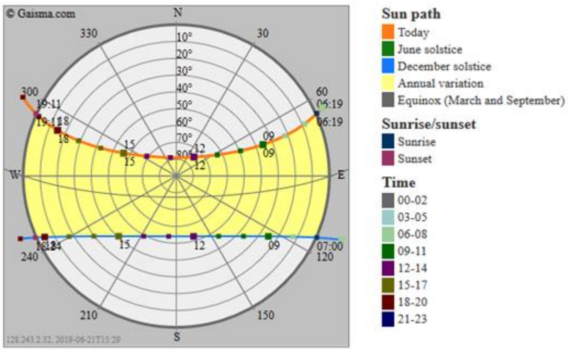
Good literature can provide tangible guidelines towards answer the following research questions: Does literature on passive techniques provide effective guide on achieving energy efficiency of buildings form in hot dry climate of Nigeria? What specific literature explains solutions to the phenomena of overheating in building interiors? How does literature of simulation tool (IES VE), help in thermal achieving sustainable assessment? And how does building form/shape literature influence performance optimization for building users?

2.0 STUDY AREA BIRNIN KEBBI

2.1 Location and Climate

Birnin Kebbi is 235 meters above sea level. It is located along latitude 12.45°N, and longitude 4.20°E. A Sudan savannah region of hot and dry climate. The Institution, Federal university Birnin Kebbi is 9km from the city centre close to Kalgo town. Wet season is hot and mostly cloudy lasts for 2.1 months, dry season is sweltering and partly cloudy. The cool season lasts for 2.4 months. Temperature varies from 18°C to 40°C and is rarely below 16°C or above 42°C. The hot season temperature has an average daily high temperature above 38°C. The hottest day of the year is April 9, with an average high of 40°C and lowest of 27°C, and cold season average daily high temperature below 33°C. The coldest temperature average low in a year is 18°C and highest, 32°C. (Fig.1). Shortest day is December 22 with 11 hours, 24 minutes and the longest day is June 21, with 12 hours, 51 minutes of daylight. Sunrise early as 6:16am and sets at 6:14pm. In November 19, sunset at 7:12pm. Windier part of the year lasts for 7.3 months, with average wind speeds of more than 2.8 m/s, February 9. Average hourly wind speed is 3.8 m/s. Humidity for comfort level is based on dew point. Lower dew points make body drier and higher more humid. Solar energy reaching the surface of the ground have average during December of 5.5 kWh while lowest average is 5.5 kWh. (www.weathersparks.&www.gaisma.com).

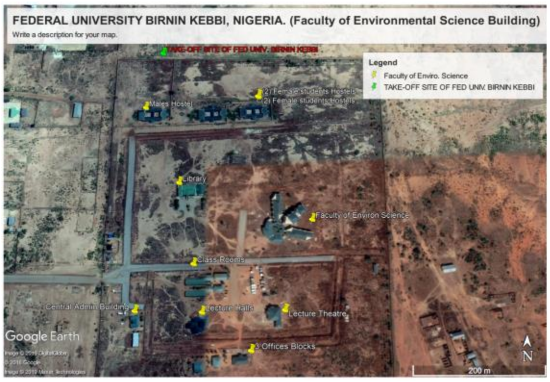




Figure,1: *A.; The average daily shortwave solar Energy.* *Figure,2: Birnin Kebbi Sun path Diagram.*

2.2. Case study building

The Faculty of Environmental Science building of Federal university Birnin Kebbi is situated in the Kalgo districts area of Birnin Kebbi, Kebbi state of Nigeria. This building was completed and occupied in 2016, it is an education institutional building complex that accommodates staff (academic and non-academic) and students offering built environment courses in the university. It has 3 departments; Architecture, Building and Quantity Surveying.



Figure,3: *The Site extended Arial (Take off Site) of the faculty building.* ***Figure,4:*** *Closer Arial View*

Table 1: *Building Physical Data*

Name of Building	Photo	Basic Information
Faculty of Environmental Sciences, Federal University Birnin Kebbi, Nigeria.		Category: Main Building Case study. Building Type: Education Institutional Faculty Building with Staff Offices Location: Kalgo, Birnin Kebbi, Nigeria. Floor Area: GFA: 2003.19m^2, 1st Floor: 371.79m^2. Number of floors: 2 Construction year: 2015. Cooling source: mechanical ventilation with using air conditioning systems Heating source: Natural sunlight, Ventilation: Windows fenestrations.

Table 2: *Ground Floor: Functional Spaces and Building Technical Data, Faculty of Environmental Science, FUB/K.*

S/No	Functional Spaces	Number Required	Unit Area (m^2)	Total(m^2)
1.	Offices	45	23.13	1040.85
2.	Design Studio	1	125.31	125.31
3.	Workshop	1	125.31	125.31
4.	Lecture Hall	1	125.31	125.31
5.	Common Rooms	3	26.43	79.29
6.	Reception Hall	3	28.43	85.29
7.	Toilets for offices	47	1.87	87.89
8.	Toilets spaces for Students (m & f)	2	12.43	24.86
9.	stores	3	6.45	19.35
10.	Data Room	3	26.45	79.35
11.	Veranda	1	100,23	100.23
12.	Paved Walkway	1	30.00	30.00
13.	Central Offices Walkway	1	80.15	80.15
	TOTAL			2003.19m^2

Table 3: *1st Floor Plan spaces*

S/No	Functional Spaces	Number Required	Unit Area (m^2)	Total(m^2)
1.	Offices	5	23.13	115.65
2.	Faculty Conference Hall	1	125.31	125.31
3.	Reception Hall	1	28.43	28.43
4	Toilets for offices	5	1.87	9.35
5	stores	1	6.45	6.45
6	Data Room	1	26.45	26.45
7	Staircase area	1	60.15	60.15
	TOTAL			371.79m^2

- Total floor space area in (m^2), from table 3 and 4 is 2374.98m^2. To calculate the roof area, minus 10% of roof deck.

Table 4: *Table indicates the ratio of natural lighting/ventilation provision and number of air conditioning units.*

S/No	Functional Spaces	Provision spaces/units	Windows Natural lighting(m^2)	Ventilation area (m^2)	Air Condition units
1	Offices	50	0.72	1.44	50
2	Studio & Lect. hall	3	77.76	25.92	12
2	Faculty Conference H.	1	25.92	8.64	6
3	Reception Halls	3	12.98	4.32	6
4	Toilets for offices	50	72.00	36.00	-
5	stores	4	2.88	1.44	-
6	Data Room	4	25.92	8.64	8
7	Central walkway	4	5.76	2.88	-
8	Toilets for offices	8	11.52	5.76	-
	TOTAL	127	235.46	95.04	82

3.0 METHODOLOGY

A total of 35 publications, peer reviewed journal papers/ articles, books and website pages were consulted on relevant areas of the research topic; assessment of thermal performance of institutional building form in hot dry climate of Nigeria, from the context of indoor environmental quality (IEQ), which discusses the phenomena of overheating in buildings. 8 papers on passive cooling principles in hot/dry climates. 7, institutional building and form Energy characteristic, 8, other climates, 7, thermal comfort and 5 on IES VE simulation tool. All selected publications sited are within 2010-2019, are chosen form Elsevier (Buildings and Energy, Renewable & sustainable Energy Reviews, Science Direct, Energy & Buildings, and Energies, etc), Buildings journal, Emeralds journals, International journals, SET, PLEA, conferences and policy documents such as CIBSE, CARBON Hub, ASHRAE, and BEEG. Expressing general literature on strategies, methodologies, parameters and guidelines for sustainable improvement on buildings in hot dry climates of Nigeria.

Table, 5: Number of Publications Reviewed

S/No	Publications	Number
1.	Passive Cooling	8
2.	Climates	8
3.	Institutional Buildings/ Forms	7
4.	Thermal Comfort	7
5.	IES Simulation Tool	5
TOTAL		35

- Five to seven items in each strategy were highlighted in the case key headlines of this literature.

3.1 Literature Review Strategy for Buildings in Hot climates

Reviewing literature on passive cooling techniques in hot dry climates is important because it offer some viable solutions for dictating minimum thermal comfort standard requirement for occupants of buildings, (table,6) relates information on building design approach explanation on passive design strategy (Hanan, 2014 & Douglas, 2018).

Table 6: Summary of key passive design strategies in hot dry climates

S/No	Key passive Strategies	Hot and Dry Climate
1	Climatic conditions	• High ambient temperature, solar radiation levels, direct/reflected sunlight and dust storms.
2	Microclimate design approach	• Compact forms, shade and shelter for public spaces, glare control; roughness/ low reflective colours, evaporative cooling: by strategic inclusion of vegetation, windward location close to water bodies if feasible, protected urban edges from hot winds, narrow winding roads/ alleys, and mixed building heights.
3.	Building design approach	• Orientation: Windows facing mainly north and south with overhangs or external shading • Building form: Compact geometry reducing skin area, buffer zones and thermal zoning, day lighting, night cooled mass systems and evaporative cooling towers • Materials: Roof with high solar roof index (SRI), example; cool roof exhibits a combination of high reflectivity and high emissivity. High thermal mass, exterior insulation for reducing heat gains during the day and windows, visible light transmission (VLT) > 60% is ideal for good day lighting in offices, classroom and design studios for visual clarity.

Source: BEEG, (2017).

3.2 Building forms/shape strategy

Energy saving strategy on building and increase supply in operation are many and comes in different dimensions apart from changes to its mechanical and electrical operations or system, building form (roof, walls, floors and windows/openings) may also provide savings using passive techniques by preventing outdoor heat into building interiors, keeping indoor heat out and controlling the flow of heat from building fabric surfaces. (Nick, 2016). In consideration to form energy performance, manipulation of form shape and characterization can considerably influence the building energy performance according to (Wan-Sharuzzatul Suraya & Mohmed, 2014; Farshad, 2018; Tergu & Gadi 2018). Other form requirements include:

- Determining the types of form for assessment, (institutional, industrial or residential) and consider them under, case studies and main studied building.
- Set time frame for the conduct of building survey, inventories and investigations. Example, (1) year time frame to be taken for field survey visit, case study and simulation work.

- Obtaining and collecting data for Input, (primary and Secondary source); building physical data, design data, surveyed and measured data.
- Case studies and base study building shall be chosen within area or the climatic zone in institutions on varying form shapes (Linea, (L) geometric and Courtyard, etc.
- Adherence to the provision of Building Code, regulations/ byelaws for Nigeria/Kebbi state to be used.

3.3 Passive cooling techniques

Literature reviewed are on specific guides:

- Passive cooling process entails the removal of an undesired heat substituting cool air, ventilation, blockage of heat passages and provision/ retention of cold air in the building interiors.
- Note the methods of form assessment and procedures for passive and active energy consumption.
- Utilizing one or some of the primary passive solar energy configurations as a strategy like, voiding direct solar gain, indirect solar gain, isolated solar gain, Heat storage, Insulation and glazing and passive cooling.
- Note that passive design techniques are easy to be applied on design and new buildings. Existing buildings can be adapted or "retrofitted".
- Passive solar technologies convert sunlight into renewable energy, knowledge/ literature will give good guide.
- Identify literature on sets of defined parameters such as climatic conditions, form, width, length and height, external walls, roofs, glazing area, natural ventilation and occupants' thermal comfort, for cooling.
- Identify literature on form self-shading, external shading, shading using vegetation that are significant to in cooling approach and energy savings. (Hanan, 2014 and Building Bulletin 101, 2018).

3.4 Thermal comfort review of strategy

Thermal comfort is state of mind in respond to perception of the physical environment. Thermal comfort is defined by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) as "that condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation" (ANSI-ASHRAE Standard 55, (2013). Climatic factors associated with thermal comfort are air temperature, air speed, mean radiant temperature and relative humidity. Activity and clothing are personal factors involve. The implications of thermal comfort in the human activities are increasingly considered in various energy management literature, (Meshak & Ola, 2014, Diana, 2017, & Building Bulletin 101, 2018).

Human beings have different form of cold and heat perception in indoors of buildings, there are factors that and this has to do with the perception of thermal comfort on occupants inside buildings which also depends on the heat balance of the body. According to Marwa, et al, (2015). In hot climates where overheating is experienced and energy consumed is used for powering air conditioning for cooling in summer, passive cooling strategy is convenient to remove or balance the heated interiors certain factors are considered in the assessment of thermal comfort such as:

- Adopt literature on thermal comfort concepts, human comfort models, indicators and standards.
- Aim to achieve; thermal control, optimization methods, and practical or scientific method of assessments.
- Desire to check heat admission and emission from, lights, electrical appliances, outside sources through the walls, windows and roofs of the buildings.
- Learn from literature technologies for measuring and validating heat temperature in buildings without the need for mechanical cooling. Relate the literature with respect to climate of study area, hot dry climate,
- Emphasize process of on the ambient and personal perception parameters control (adaptive thermal comfort) in ascertaining thermal comfort and thermal sensation.
- Note the indices, related to the Predicted Mean Vote (PMV), PMV index (PI), Actual Mean Vote (AMV), and the Predicted Percentage Dissatisfied (PPD), with their modifications and variants, indicating several applications to different situations in indoor environments instrumentation.

- Note also, Tn-thermal neutral temperature Tm-indoor resultant air temperature-G transfer function – human physiology and thermal sensation-d physical stimuli Kd psychological and behavioural impact coefficient l adaptive coefficient clo, clothing insulation,1 clo¼0.155 m2K/W.

- Knowledge on control strategies on indoor applications using models, such as parametric model, statistical and hybrid.

- Identify the U-Value, V-Value and G-Value in specific case for necessary considerations. (Gerhard, et al, 2012).

3.5. Building Simulation Tool

These are tools, models and computer software's widely used for analysing built infrastructure and providing guides in design, engineering construction, maintenance/retrofitting of buildings. Thermal models are now being developed by professionals for specific parametric assessment and investigation of specific natural and physical phenomena associated with building and users. The tools can be software's, models, added plug-ins that can serve as standalone models. (Ncube, & Riffat, 2014). The IES VE is an Architect & Engineering tool used in investigation and comprehensive analysis of bioclimatic strategies even before design starts. It can be connected to many BIM packages, it can process varieties of sustainable applications tasks, (table 6). It has other advantages such as, ease in transfer/export of files, visual advantages, brilliant colour codes, sorting, flexible interfacing and has single platform for modelling, prediction and evaluation. There is advantage using IES VE for thermal performance assessment because it is recognised as a solution for existing building assessments, and this informed the reason for its review in this literature. (www.iesve.com/webinar).

Table, 8: *The IES VE Tools and Task:*

S/no	SIMULATION TASK	IES VE TOOLS
1.	Weather Data	Weather shift
2.	BIM Data	Revit and Excel
3.	Project Communication	IESVE Navigation
4.	Thermal comfort Analysis	Psych-chart & Micro Flo-CFD
5.	HVAC System Optimization	Apache HVAC
6.	HVAC System Sizing	ASHRAE Loads
7.	Import Meter Schedules	Ergon (IES Cloud)
8.	Climatic Analysis	VE Gaia
9.	Lighting Design	Light Pro & Flux Pro
10.	Day lighting Glare	Radiance IES
11.	Solar Simulation	Sun cast on IESVE Cloud
12.	Natural ventilation Design	Macro Flo & Apache Sim
13.	Envelope Simulation	Parametric Batch Processor
14.	Energy Modelling & Renewable	Apache Sim
15.	Geometric Master Planning Tools	Model IT & OSM
16.	Geometric Components	Sketch Up
17.	Compliance for ASHRAE Standard 55	ASHRAE 91.55 Navigator

Source: *IESVE, Limited, Webinar@iesve.com., Glasgow, UK.*

Added enhancement to IESVE tool include; model IT enhancement, high concentration photovoltaic renewable options, shading control and python script/easy copying & pasting of data.

3.6 Sustainable improvement & assessment guidelines

Technical improvement sourced literature from diverse studies regardless of climates, building type, form type, passive techniques and established building rating systems they are worthy in achieving sustainable improvement and desired goal. Some of the literature are: Wan-Sharuzatui Suraya, & Mohamed (2014) and Teguh & Gadi (2018) discuses form manipulation and characterization of different shapes geometry and composition on energy performance in conservation and reduction. Salwa et al, (2017) and Rami, et al, (2019), utilizes solar advantage by using PV films and panels and integrating same on building to increase the electricity supply. Research by Adrian, et al, (2015), suggested space cooling, using air desiccant materials and solar energy to reduce energy consumption, which offers good reliability and comfort control level, and a viable low carbon alternative. Lucelia, et al, (2015), research on mitigating overheating effects of insulated timber building using plaster board and comparing against concrete element in the UK climate, demonstrating high level of assessment techniques on timber material. All the research offers a useful guide towards providing reliable literature.

4.0 ANALYSIS

4.1 Analysis of Building Form Character

From (Table, 1), and google earth figure, (3 & 4); the faculty building is situated at the take-off site campus of the university together with other buildings to support teaching and learning. The overall site area designated for the is (950m X 985m), on evenly plain land, no landscape, isolated trees that cannot provide any reasonable shading to the building. The entire building shape makes orientation difficult, entrance to the main faculty building was not properly located, main entrance door is located in-between the studio and lecture hall, see photo, (table,1). The studios are having the largest concentration of panel windows persistently affected by solar radiation. The building is curvilinear in geometry a combination of circular and axial transition of 3-linea forms, (department buildings) attached from the circular form and central courtyard at an acute angle of 60^0 between, (figure, 4). However, there were no define exits ways located within the faculty complex. Walls of offices are recessed around the window premises, but difficult in achieving desired orientation makes control the shading device insignificant. The roof has a parapet wall and roof gutter (along the curved studios areas), the roof gutter only provides ¼ shading along the panel's windows, still the incident solar radiation will have direct access through the glazing to the interiors.

The zonal climate and high temperature, average 40^0C (Fig.1), as a result of year round solar radiation in this region offers useful guide for utilizing passive strategy that can focus on tapping from solar radiation endowment to the use of building integrated photovoltaic system, as an alternative renewable energy source. Regardless, changing roof covering material with low U-value type, roof colour/material, lamination of roof and insulation are other ways of roof protections against interior overheating. The faculty building can accommodate any of these sustainable renewable energy potentials for improvement considering the nature of its roof structure. (Nigerian Energy Sector Programme (NESP), 2015).

This analysis describes the base case study building and its surrounding built environment where this facility is located. It is ideal to analyse the physical environment and building physical structure that will guarantee development of idea for viable passive cooling strategy towards insuring provision of thermal comfort in any type of building. Utility spaces will be match with standard provision of the building code/ user in studio, lecture hall and offices spaces. Existing interior spaces measured will provide useful input data for accomplishment of any required simulation task (see table 6) using IES VE tool. Accordingly finding from literature on roof, floor and the walls will be considered for any sustainable energy efficiency improvement.

Passive solar technology literature emphasizes on using renewable energy alternatives, such as sunlight without having to use active mechanical systems, such technologies convert sunlight into renewable energy. The technologies include direct and indirect solar gain for space heating, solar water heating systems based on the thermosiphon, use of thermal mass and phase-change materials for slowing indoor air temperature swings, solar cookers, the solar chimney for enhancing natural ventilation, and earth sheltering. This approach is fundamental to the energy performance of a building, (Carbon trust, 2018). Improving and maintaining the building fabric offers many advantages and opportunities Low rise buildings in hot dry climates receive the overall heat impact on roof more than any other form element, the studied building has 235.46m^2 of glazing, (table,4), the large glazing panel from the west side (façade area), creates an aperture for solar heat admittance into studios, classrooms and workshop, these are important learning spaces. Ventilation is half (0.5) of the glazing this makes the building at disadvantage position. Heat from the (coloured) roof covering and critical form shape all added to the overall overheating. About 84 Air conditioning units are installed these is economically unsustainable. IES VE tool, in (table,6) provides ranges of simulation task to guide on nature of maintenance required. The building from this angle has failed in performance and require passive sustainable maintenance.

5.0 CONCLUSION

Literature review offer strategic guide on any form of building improvement techniques the performance of form in any climate is a requirement to fulfil for achieving sustainable energy efficiency. The paper discuses literature on assessment guidelines outlined methodology of using passive design techniques and simulation tool IES VE, for institutional education building on form/shape. It is evident this subject has been globally discussed extensively on issue, policies of global warming and ways to reduce CO_2 emission in buildings. Literature guide discussed on methods of reducing overheating in buildings, ensuring minimum standard provision of thermal comfort, reducing cooling energy cost, improving the indoor environmental quality of the occupant and users and in hot dry climate of Nigeria. It will also strengthen the research development by revealing step by step guidelines for assessing performance of offices building for sustainable development of the built environment sector.

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