

Assessment of Building Forms of Student Hostels in Tertiary Institutions in Akwaibom State, Nigeria

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Abstract: The study assessed building forms of student hostels in tertiary institutions in Akwa Ibom State, Nigeria. The research design for this study combines survey and experimental research. The target population of the study comprises all the hostel buildings in the higher institutions under study. Purposive sampling technique was used in selecting five (5) Hostels from University of Uyo (M2, W3, W4, W6 and PGW), two (2) Hostels from Akwa Ibom State Polytechnic (Block A and D) and two (2) Hostels from Akwa Ibom State University (VVLodge, and Lemon Lodge). The instrument was validated by a senior academician in this field of study. The instrument used in measurement of this research are produced by credible factories whose products are well used all over the world. Simple random sampling technique was used for the data collection. Mean score was used as a method of analysis. The study revealed that variations in building orientation, layout configuration, and construction materials significantly influence indoor temperature and thermal comfort levels. The study also revealed that hostels with compact forms and inadequate ventilation strategies exhibited higher indoor heat accumulation. The study concluded that building forms that incorporated cross-ventilation and proper spatial planning demonstrated improved thermal performance. One of the recommendations made was that trees and fins should be used as it helps in the reduction of solar gain through radiation while vents and stack effects help in the emission of used and warm air from the interior

Keywords: Building Forms, Student Hostels, Tertiary Institutions, Akwa Ibom State, Nigeria

Introduction

Buildings are designed to offer protection to the occupants against harsh outdoor environments, thereby enhancing optimal indoor comfort. Azeez [1] revealed a rise in the population of students applying for admission into tertiary institutions, leading to an increase in the number of students residing in university halls of residence. This has resulted in overcrowding, as well as overstretching of the facilities.

Markus [2], Ogunsote [3], and Alozie [4] inferred that environmental variables influencing thermal comfort include air temperature, mean radiant temperature, air velocity, humidity, the person's activity level, and clothing. These correspond with Parsons [5], who identified factors affecting thermal comfort to include air temperature, mean radiant temperature, air velocity, relative humidity, intrinsic clothing, as well as level of activity. Alozie opined that thermal comfort is achieved in buildings when these variables are within the accepted range. Satisfaction with the thermal environment is important because thermal conditions are potentially life-threatening for humans if the core body temperature reaches conditions of hyperthermia, that is above 37.5–38.3°C (99.5–100.9°F), or hypothermia, that is below 35.0°C (95.0°F). Buildings modify the conditions of the external environment and reduce the effort that the human body needs to stay stable at a normal human body temperature, which is important for the correct functioning of human physiological processes [6]. Thermal comfort results from a combination of environmental factors and personal factors.

Statement of Problem

Akwa Ibom State, according to Ekpenyong [7], is in a warm-humid coastal climatic zone. Ogunsote highlighted that the prevalent climatic conditions of this zone are high temperature and high humidity for up to eleven months of the year. Ekpenyong opined that these high temperatures and high humidity, coupled with heavy monthly rainfall exceeding 215 mm, are the major causes of discomfort. Building forms have an impact on air temperature, air velocity, humidity, and other determinants of thermal comfort. Alozie, Munonye [8], Ogunsote, and Pathirana have conducted contributory studies on thermal variables and their effects on the thermal comfort of buildings in other climatic zones of the country. However, studies are yet to explore the influence of building forms on the thermal comfort of buildings in the study area.

Research Objectives

The aim of this research was to:

1. Determine the existing building forms of the hostels in tertiary institutions in Akwa Ibom State.

Research Questions

1. What are the architectural forms of the students' hostels in tertiary institutions in Akwa Ibom State?

Building forms

Forms could be termed to be a visible shape or configuration of something, or a particular way in which a thing exists or appears. Ching [9], in his book *Form, Space and Order*, described form as a shape, visual appearance, or configuration of an object. The author noted that, from geometry, forms could be circle, square, triangle, rectangle, etc.

Tewari [10] stated that architectural features such as form affect the indoor thermal conditions of built space. They opined that the building form determines the airflow pattern around the building, thereby affecting its ventilation [11],[12]. Hence, they argued that optimal building form depends on the compactness (Surface Area to Volume Ratio, i.e., S/V) and Perimeter to Area Ratio (P/A). Surface-to-volume (S/V) ratio of a building is a measure of building compactness. It expresses the ratio of the external surface area of the building to the treated floor area. A small S/V ratio is an indicator of high compactness. Perimeter/Area (P/A) ratios indicate radiative gains or loss and efficient ventilation. Low P/A ratios are suitable for cooling-dominated regions. To achieve thermal comfort, P/A for square forms should be 1.0 and for rectangular forms 1.05[13].

Furthermore, Ching stated that forms could be additive, resulting from the accretion of elements to one another, into centralized forms, linear forms, radial forms, clustered forms, as well as grid forms. The forms of a building give rise to a range of effects on the pattern and velocities of air movement into the interior spaces, thereby affecting indoor thermal comfort [14]. The author noted that form should reference both internal structure and external outline and the principle that gives unity to the whole. While form gives a sense of three-dimensional mass or volume, shape refers to the essential part of form that governs its appearance.

Fig 1: Simple Forms

In Figure 1, the first line of forms shows various shapes as the principal identifier of forms. The second line shows different sizes of shapes. Size is the real dimension of form as its characteristics of length, width, and depth identify the individual form. The third and fourth lines describe colour and texture as the surface characteristics of a form.

Forms also have rotational properties that govern the pattern and composition of elements. Position, orientation, as well as visual inertia are relational properties that govern the pattern and composition of elements.

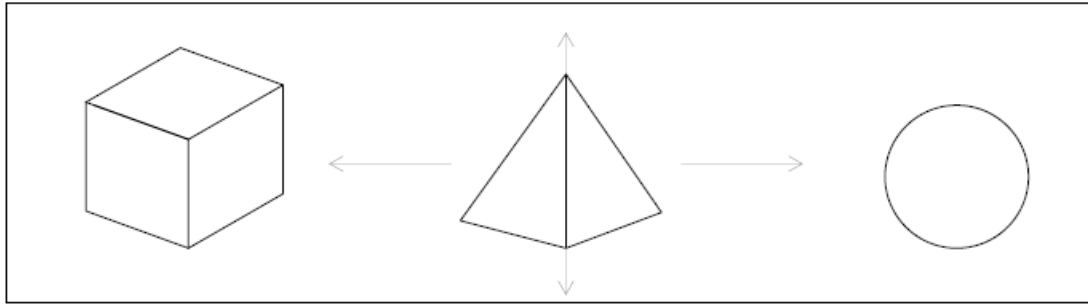


Fig1: Position of Forms(Source:Ching,2015)

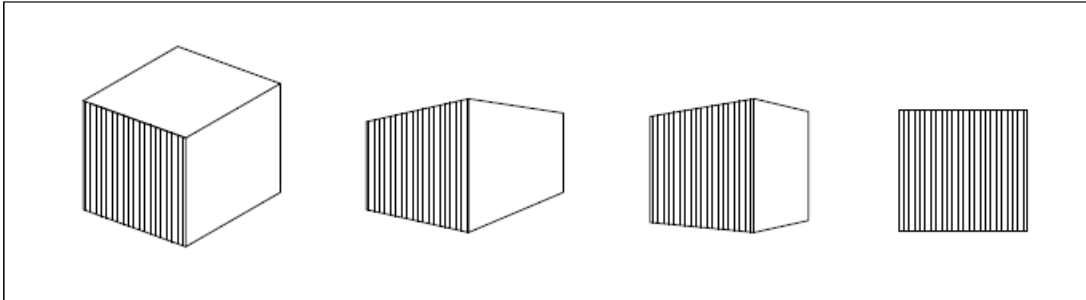


Fig 2: Orientation of Forms(Source:Ching,2015)

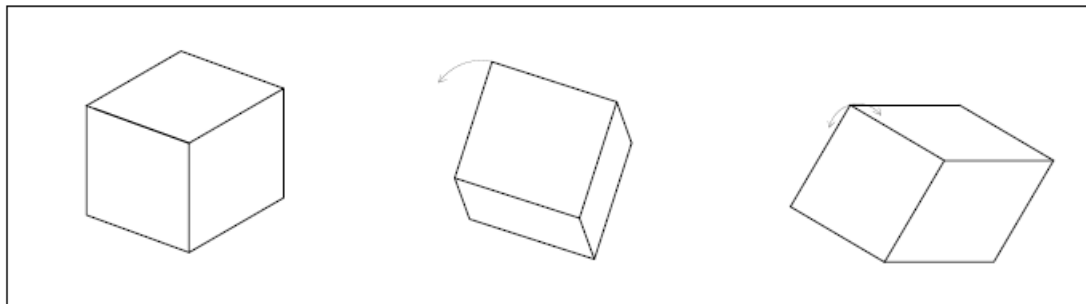


Fig3: Visual Inertia of Forms(Source:Ching,2015)

Figures 1, 2, and 3 describe the position, orientation, and visual inertia of various forms. The degree of concentration and stability of a form depends on its geometry. It is shown here that a form placed on the tip does not have stability, whereas one placed on the base has optimal stability.

From geometry, we know the regular shapes to be the circle, and the infinite series of regular polygons that can be inscribed within it. Of these, the most significant are the primary shapes: the circle, the triangle, and the square.

Dimensional Transformation of Forms

(i) Subtractive Form

Spatial volumes may be subtracted from a form to create recessed entrances, positive courtyard spaces, or window openings shaded by the vertical and horizontal surfaces of the recess. As illustrated, subtractive form is achieved from the removal of a portion of its original volume. Le Corbusier outlined subtractive forms as generous, with the confirmation of the architect's will on the exterior, and the expression of the client's functional needs or satisfaction on the interior.

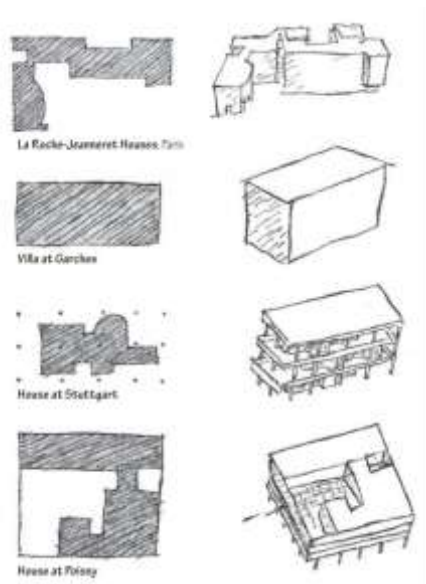


Fig 4: Four Subtractive House Forms by Le Corbusier (1935). (Source: Ching, 2015)

(ii) Additive Form

Additive form is achieved by relating or physically attaching one or more subordinate forms to its volume. Ching described additive forms as resulting from the accretion of discrete elements, characterized by their ability to grow and merge with other forms. Furthermore, the combining elements must be related to one another in a coherent manner, as shown.

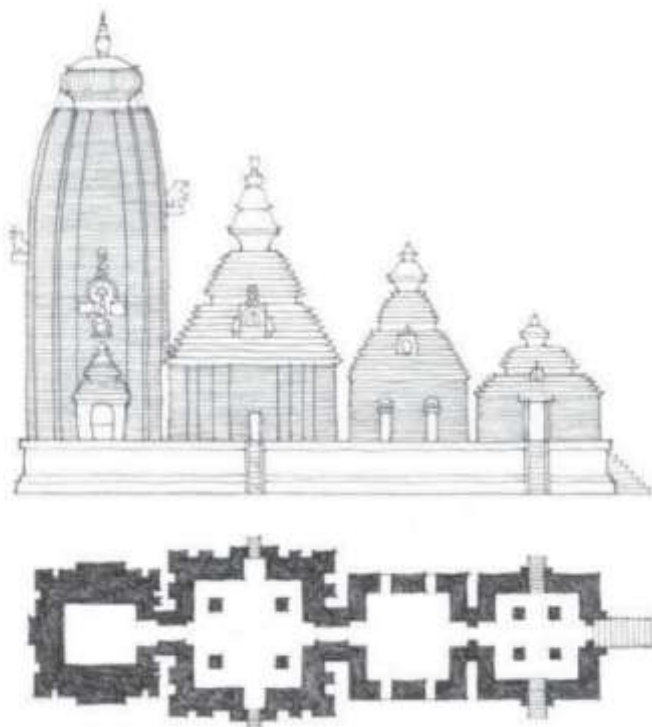


Fig 5: Lingaraja Temple, Bhubaneswar, India, c. A.C. 1100 (Source: Ching, 2015)

Figure 5 shows the addition of several square forms, resulting in an additive form of the Lingaraja Temple. This is also evident in the elevations of the temple.

(iii) Linear Form, Radial Form, Clustered Form

Linear Form:

Linear form could result from a proportional change in a form's dimensions or the arrangement of a series of discrete forms along a line. In the latter case, the series of forms may be either

repetitive or dissimilar in nature and organized by separate and distinct elements.

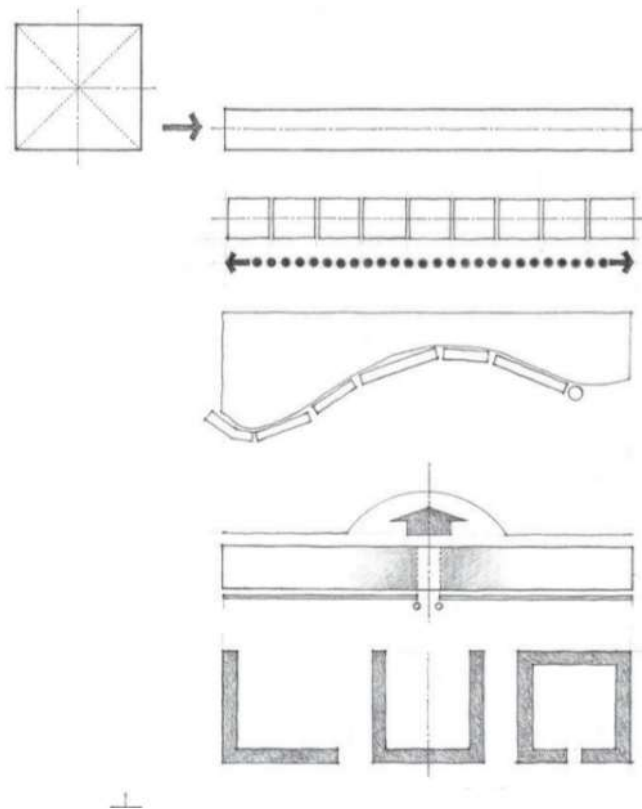


Fig 6: Linear Forms (Source: Ching, 2015)

Figure 6 illustrates a form of similar and dissimilar elements repeated to give rise to a linear form. They portray distinct elements with a direction of horizontality.

Methodology

The research design for this study combines survey and experimental research. The target population of the study comprises all the hostel buildings in the higher institutions under study. Purposive sampling technique was used in selecting five (5) hostels from the University of Uyo (M2, W3, W4, W6, and PGW), two (2) hostels from Akwa Ibom State Polytechnic (Block A and D), and two (2) hostels from Akwa Ibom State University (VVLodge and Lemon Lodge).

The instrument was validated by a senior academician in this field of study. The instruments used for measurement in this research were produced by credible manufacturers whose products are widely used all over the world. Simple random sampling technique was used for data collection. Mean score was used as a method of analysis.

Results And Discussions

Analysis of Data

Research Question 1: What are the architectural forms of the students' hostels?

Table 1: Frequency of the Various Building Forms in the Tertiary Institutions

BUILDING FORMS	FREQUENCY	PERCENTAGE %
L-SHAPED (VVL)	4	11.11
H-SHAPED (W6)	4	11.11
SQUARE SHAPED (M2, W4, ABC, PLL)	16	44.44
RECTANGULAR SHAPE (W3, PGW)	8	22.22
LINEAR SHAPE (D/E)	4	11.11
TOTAL	36	100

Table 1 shows the building forms, frequency as well as their percentages in the study area [15]. The building forms realized in the institutions include L-shaped hostels, H-shaped hostels, Square shaped hostels, Rectangular shaped hostels as well Linear shaped hostels. The name of the hostels that possess these shapes are also stated under the individual forms. Hostel VVL has L-shaped form, Hostel W6 has H-shaped form, Hostels M2, W4, ABC and PLL have Square shaped, Hostel W3 and PGW are Rectangular shaped, while Hostels D/E has Linear shape. The frequency represents the number of rooms where the instruments were mounted. Simple random sampling was used in selecting a room in each of North, South, East and West. L-shaped building form has a frequency of 4 with a percentage of 11.11 %. H-Shaped building form also have a frequency of 4, with a percentage of 11.11 %. Square shape has the highest frequency of 16, with a percentage of 44.44 %. Rectangular shape has the second highest frequency with 8, and a percentage of 22.22 %. Linear shape has a frequency of 4 with a percentage of 11.11 %.

The primary objective of this study was to determine the existing building forms of student hostels in tertiary institutions in Akwa Ibom State and examine their implications for indoor thermal comfort. The findings revealed five dominant building forms, namely L-shaped, H-shaped, square, rectangular, and linear configurations. Among these, square-shaped hostels constituted the largest proportion (44.44%), followed by rectangular forms (22.22%), while L-shaped, H-shaped, and linear forms each accounted for 11.11% of the sampled hostels. These findings indicate that compact geometric forms are the predominant architectural typologies adopted for hostel development within the study area.

The predominance of square-shaped buildings may be attributed to their construction efficiency, structural simplicity, and optimal utilization of available land. However, although compact forms often reduce construction costs and minimize the external surface area of buildings, they may also restrict natural airflow if ventilation strategies are not properly incorporated. In warm-humid climatic regions such as Akwa Ibom State, where high temperatures and humidity persist for most of the year, inadequate ventilation can significantly increase indoor heat accumulation and reduce occupants' thermal comfort. Therefore, building geometry alone cannot guarantee thermal efficiency unless it is complemented by appropriate orientation, window placement, and cross-ventilation strategies.

The results further suggest that building form plays a significant role in influencing indoor thermal conditions. Hostels with forms that permit multiple external wall exposures and facilitate cross-ventilation are more likely to achieve improved indoor comfort than highly compact structures with limited ventilation paths. L-shaped and H-shaped configurations provide greater opportunities for air circulation because their courtyards and extended facades allow prevailing winds to penetrate deeper into occupied spaces. Conversely, square and compact rectangular forms may experience reduced air exchange when openings are insufficient or improperly oriented, thereby increasing indoor temperatures.

These findings are consistent with Ching's theory of architectural form, which emphasizes that building configuration influences spatial organization, airflow, and environmental performance. Similarly, Tewari reported that building form directly affects airflow patterns around buildings and consequently influences indoor thermal conditions through variations in the surface area-to-volume ratio and perimeter-to-area ratio. Buildings possessing lower compactness and better exposure to prevailing winds generally demonstrate superior passive cooling performance compared with highly enclosed configurations. The present findings therefore reinforce the argument that building morphology should be considered an essential design parameter for achieving thermal comfort in tropical climates.

The findings also agree with studies by Ogunsote and Alozie, who established that thermal comfort in Nigerian buildings depends not only on climatic conditions but also on architectural characteristics such as building orientation, ventilation, and form. Likewise, Rupp et al. concluded that passive architectural strategies significantly improve indoor environmental quality while reducing dependence on mechanical cooling systems. The current study extends these observations by demonstrating that differences in hostel building forms within tertiary

institutions contribute to variations in thermal performance under the climatic conditions of Akwa Ibom State.

From a theoretical perspective, the study supports the principles of climate-responsive architecture, which advocate designing buildings in harmony with local environmental conditions rather than relying solely on mechanical cooling technologies. The findings confirm that architectural morphology is an important determinant of building performance and should be integrated into sustainable design frameworks for educational facilities.

Practically, the results provide valuable guidance for architects, planners, university administrators, and policymakers involved in hostel development. Future student accommodation projects should prioritize building forms that enhance natural ventilation through effective orientation, increased window-to-floor area ratios, internal courtyards where appropriate, and adequate spacing between buildings to facilitate wind movement. Integrating shading devices, vegetation, and passive cooling techniques into these building forms will further reduce solar heat gain and improve indoor comfort while minimizing energy consumption associated with artificial cooling.

Overall, the study demonstrates that although square-shaped hostels are the most common building typology in the study area, their thermal performance depends largely on complementary passive design features. Consequently, building form should not be considered in isolation but as part of an integrated architectural strategy that combines geometry, orientation, ventilation, material selection, and landscape design to achieve sustainable and thermally comfortable student housing in tropical environments.

Conclusion and Recommendations

The study concluded that variations in building orientation, layout configuration, and construction materials significantly influence indoor temperature and thermal comfort levels. Hostels with compact forms and inadequate ventilation strategies exhibited higher indoor heat accumulation. In contrast, building forms that incorporated cross-ventilation and proper spatial planning demonstrated improved thermal performance. The results highlight the critical relationship between architectural design decisions and occupants' thermal comfort in tropical climates. Therefore, integrating climate-responsive design principles into future hostel developments is essential to enhance indoor environmental quality and student well-being.

1. Trees and fins should be used, as they help reduce solar gain through radiation, while vents and stack effects assist in the emission of used and warm air from the interior.
2. The sizes of windows in students' hostels should be increased to a minimum of 20% of their floor area. This would help increase airflow, thereby enhancing indoor thermal comfort in the hostels.

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