Evaluating the Design Characteristics of Courtyards in Ohafia Urban Centre, Abia State, Nigeria

Ochi, Ejimofor
Dept. Of Architecture, ABSU
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Abstract
This research assessed the design features of courtyards in specific residential structures located in Ohafia Urban Centre, Abia State, Nigeria, focusing on aspects such as their geometric shapes, spatial measurements, directional positioning, and material composition. The increasing importance of passive architectural methods in tropical climates necessitated an exploration of how courtyards fit into modern residential designs and their effects on environmental comfort levels. A descriptive survey research approach was utilized, involving the organized observation and measurement of a total of thirteen randomly chosen residential buildings that incorporated courtyards in the designated area. Information was gathered through in-field measurements of courtyard shape, orientation, height, and material features, alongside photographic records and an analysis of architectural sketches. The obtained data were examined using descriptive statistical methods, particularly frequency analysis and percentage calculations. Results indicated that rectangular courtyards constituted the majority, making up 38.46% of the buildings sampled, followed by square (23.08%), triangular (15.38%), irregular (15.38%), and circular shapes (7.7%). Regarding spatial measurements, courtyard areas varied from 18m² to 30m², with 30m² emerging as the most common size (46.15%), which suggests a preference for relatively larger courtyard spaces in the examined area. Height distribution indicated that 2400mm was the most frequently occurring height (46.15%), while 6200mm was noted as the least common height (7.69%). The orientation assessment showed that courtyards primarily faced the North-East (38.46%) and South-East (30.77%), implying a moderate awareness of climate-responsive design in architectural choices. Surface analysis indicated that grass was the most prevalent ground cover (38.46%), followed by concrete surfaces (30.78%), with shading structures and water elements each making up 15.38%. The study concludes that while courtyards exist within the residential structures of Ohafia Urban Centre, their design traits are predominantly shaped by the layout of the plots and the preferences of developers, rather than a strong adherence to climate-conscious design principles. It is suggested that architects should incorporate more intentional passive design features in courtyard layouts to improve environmental comfort and promote sustainability in residential architecture.

Keywords: *Architecture, shading, grass lawn, orientation.*

Introduction:

The effectiveness and efficiency of energy utilization in buildings (residential, commercial, industrial and institutional) have become a vital issue in the generation of indoor comfort. Fatima (2016) and Sadaghifam, Zahraeee, Meynah and Kiani (2015) observed that energy generation is likely to fall in the next future, it therefore becomes necessary to consider other methods of achieving indoor thermal comfort, especially through the incorporation of passive cooling systems in buildings and buildings designs. There is a continuous increase of residential buildings in the urban centers in Nigeria, due to growing populations which

appreciate the higher material prosperity and life standard. As a result, energy demand has increased especially in the area of using mechanical methods of achieve indoor comfort of buildings. Although, since the 1970s, buildings developers, engineers and architects are better aware of design strategies that are capable of lowering energy usage in buildings (Moghimi, Zaharim and Sopian, 2011). Nevertheless, emphasis has now include the development of effective passive strategies to bring down energy demands of buildings and encourage the use of traditional non-mechanical option of creating indoor comfortability through methods like ventilation (Alozie Nwobia and Eze, 2017), courtyards (Fatima, 2016) and towers (Noble, 2007). Noble further observed that in hot, dry and humid regions, vernacular design techniques involved architectural elements in providing a cooling environment such as high opening widows, building orientation, and shading device. While in the United States of America, ventilation tunnel is popular in the region (Fatima, 2016). In Middle Eastern countries, 'Mashrabiyya' as ventilation are used in the humid area, whereas in the dry area they use wind tower and courtyards. However, Muhavisen (2006) noted the significant role played by courtyards in achieving indoor thermal comfort, especially in humid regions, during warm periods. Courtyards housing is one of the oldest forms of residential dwelling development. Tofigh and Sertyesilisik (2015) noted that courtyard provided in buildings presents a great flexibility in promoting areas of internal passive zones in buildings and therefore passive architecture. A courtyard can provide security, privacy, and a comfortable place within the building. It also provides a private and isolated space through which all rooms grouped around it receive sunlight, natural ventilation and visual as well as physical communications (Tofigh, and Sertyesilisik (2015).

Study Location:

The study area, Ohafia Urban centre is the local government headquarters of Ohiafia Local Government area. It is located in the Abia North senatorial zone; astride the rolling landscape of the continuous Leru – Uturu, Arochukwu rolling hills. Rainfall activity is intense, but heavy in the months of April to early November, with a little disruption in the month of August to allow intermittent rainfall break. Dry season is pronounced in the months of December to February. Ohafia urban centre performs the function of a higher order urban centre in the region, attracting population from adjacent rural areas. This accelerates the increase in the population of the area, requiring residential buildings to provide inhabitations for the people. Hence, the need to design residential buildings with courtyard so as to improve the indoor conduciveness of the buildings.

Methodology:

Thirteen residential buildings with courtyard were randomly selected in the area for investigation.

Investigations carried out required articulate observation and measurement of related structures. This was necessary so as to identify the shape, size and orientation of the courtyards already located in the residential buildings.

Results and Decisions:

Examination of existing courtyards in Ohafia urban centres

Generally, and from fields observations, most developers or architects exclude courtyards from buildings designs. Nevertheless, the residential buildings identified with courtyards were investigated and measured to ascertain the predominate design forms, shapes, sizes, positioning 9oreintation), architectural elements employed shading devices, and usage (Bulus 2016), considered them to be specification forms (Shapes) Lists (SFL). For this analysis, data

presented in table 6 were used. We based our analysis on the number of residential buildings with courtyard which totaled, 13, drawn from Ohafia the courtyards.

Table 1: various forms of courtyards in Ohafia Urban area

Shapes	No of Residential Buildings	Percentage Value
Irregular	2	15.38
Square	3	23.08
Triangular	2	15.38
Rectangular	5	38.46
Circular	1	7.7
Total	13	100

In table 1, rectangular courtyards were still more in number, (38.46%) .Possible explanation to this could be the nature of existing plot shapes in urban centres in the state, which is rectangular, with fewer square and irregular (accidently plot shapes). In addition, Bulus (20160 observed that rectangular and square form courtyards are mostly common for residential buildings.

Sizes

The sizes of the courtyards were relatively reflective of size plot spaces. In an uncompromizing architectural standard, courtyards are supposed to be provided for in the buildings-design, taken sizes as it is structurally allocated to it by the Architect. Given that, some of the courtyards in the buildings were 'accidental courtyard'. Accidental because it were marginally less than appropriate. Courtyards are provided to serve architectural values and ensure lighting and cooling of the building's interiors.

Hence, sizes of buildings determine the commensurate courtyards which must be spacious enough to fulfill the ecological need. Given the above, sizes of courtyards as observed in the selected urban centers are presented in Table 2.

Table 2: courtyard sizes and areas in Ohafia urban area

Sizes/areas	No of Courtyard	Percentage Value
$18m^2$	3	23.09
$20m^2$	2	15.38
$26m^2$	2	15.38
$30m^2$	6	46.15
Total	13	100

In Table 2: 6(46.15%) courtyards were largest in size and area $30m^2$. This is because Ohafia is a quasi-urban area, with ambience of space that could allow developers ample opportunities to include and increase the sizes of courtyards. In fid 3 a building plan with ample courtyard was provided for. This plan had been used in one the houses in Ohafia urban.

Table 3: Heights of Courtyards in Ohafia Urban Centre

Height	No of Courtyard	Percentage Value
2,400mm	6	46.15
3000mm	3	23.08
4,100mm	3	23.08
6,200mm	1	7.69
Total	13	100

In table 3, and given the quasi nature of Ohaifa urban centre, the most common heights of the courtyards are 240mm, while the lowest is 6,200mm.

Orientation of courtyards

The courtyards were positioned in different directions which responsibly affected the passive cooling functioning of the courtyards. For this reason, we identified the courtyards are facing. These directions include; North south, North East, East west, South west, North west and South East.

Table 4: orientation of courtyards in Ohafia urban

Orientation	No of courtyard	Percentage value
North East	5	38.46
South West	2	15.38
North West	2	15.38
South East	4	30.77
Total	13	100

In Table 4, 5(38.46%) courtyards respectively face North East and South east. While, 2 courtyards each face, south west and North West in Ohafia urban area.
Shading devices, grass lawn and water body.

Table 21: surface nature of the courtyards in Ohafia urban

Materials inhabiting the courtyards	No of courtyards	Percentage value
Shading device	2	15.38
Grass lawn	5	38.46
Concrete hard surface	4	30.78
Water pool	2	15.38
Total	13	100

In Ohiafia, even as presented in table 21, 5(38.46%) courtyards were covered with grass; 4(30.78%) courtyards with concrete hard surface, and courtyard each covered with shading devices (15.38%) and water pool (15.38%). Due to the scarcity of surface water bodies, or existence of wetlands, in addition to area lying 200 meter above sea level, the likelihood of most the courtyard surface drying up to allow the emergence of dry and dusty sand is very comprehensible, especially as rainy season recede.

Discussion of findings

Examination of existing courtyards in the selected urban centers

Given the result presented in table 1 to 5, various dimension of the physical attributes of the courtyards investigated in the study area, were examined. Specifically, table 1 showed that the shapes of courtyards existing in the area were triangular, square and irregular, although more than 38% of the courtyards were rectangular in shape. In addition, it was also revealed that rectangular shaped courtyards were prominent in the urban centers selected. In the case of courtyards sizes, result showed that the sizes of courtyards ranged from $18m^2$ – $30m^2$, with $20m^2$ being more prominent in Aba, in Ohafia.

In the area of height, it was discovered that in Ohafia, the percentage of courtyards with 6200mm height was 7.69%.

In ohafia, more courtyards, (38.46%) were positioned in the north east direction, in terms of shading devices, grass lawn and water body, in ohafia, courtyards covered with grass lawn were more in number 35.46%, followed by concrete hard surface, 30.78%

Conclusion

This research investigated the design features of courtyards located in Ohafia Urban Centre, Abia State, Nigeria, focusing on aspects such as their dimensions, shapes, direction, height, and material composition within chosen residential structures. The results indicated that rectangular courtyards predominated, representing 38.46% of the analyzed buildings, while other shapes like square, triangular, irregular, and circular types appeared with lesser frequency. This demonstrates a notable inclination towards geometrically regular forms of courtyards, which is significantly impacted by the existing plot configurations and standard residential architectural styles in the region. Additionally, the research highlighted that courtyard dimensions ranged from 18m² to 30m², with the 30m² size being the most prevalent at 46.15%. This finding implies that the size of courtyards is heavily influenced by the available space of plots and the flexibility in the design of residential projects in Ohafia. Concerning height, a significant number of courtyards fell within the 2,400 mm range, making up 46.15% of the analyzed properties, indicating moderate vertical proportions that could affect both ventilation and natural lighting efficiency. An analysis of orientation indicated that courtyards were mostly oriented toward the North-East (38.46%), closely followed by the South-East direction (30.77%). This suggests some consideration for climatic factors in determining courtyard placement, although the pattern of orientation choices implies that not all decisions are informed solely by optimized passive design strategies. The study also assessed the surface attributes of courtyards, revealing that those with grass cover were the most prevalent (38.46%), succeeded by concrete surfaces (30.78%), while the use of shading structures and water features was less frequent (15.38% each). This reflects a moderate integration of soft landscaping, though numerous courtyards still do not adequately include passive cooling strategies that would improve thermal comfort. In summary, the research concludes that although courtyards exist in certain residential properties within the Ohafia Urban Centre, their design traits are influenced primarily by plot layouts and the preferences of developers rather than a comprehensive approach to architectural or climatic design. The prevalence of rectangular shapes, moderate courtyard dimensions, and minimal incorporation of enhanced passive design elements suggest that there is a need for better architectural expression in courtyard design in the area. It is recommended that architects and developers focus more on designing courtyards that respond to climatic conditions, emphasizing aspects like proper orientation, suitable sizing, and the inclusion of shading structures, greenery, and water features to improve thermal comfort, environmental quality, and overall effectiveness of buildings in residential developments situated within Ohafia Urban Centre.

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