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Assessment of Design Characteristics Of The Existing Courtyards In Aba Urban, Abia State, Nigeria

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ABSTRACT

The paper examined the architectural characteristics of courtyards in Aba urban, Abia State, Nigeria, One hundred and thirteen residential buildings with courtyards were randomly selected in the study area. Results indicate that more than 37% of the courtyards were rectangular in shape, while the orientations of 32% of the residential buildings were facing Southeast direction. It was recommended: that design of residential buildings should strictly articulated by an architect, so that inclusion of courtyards in residential buildings becomes imperative.

Keywords: Architecture, Rectangular, Orientation, Shapes

INTRODUCTION

Improved economy and increase urban population in Nigeria and in the study area, (Abia State) requires more buildings (commercial, residential, institutional and industrial) to be built to accommodate the increasing human activity. This condition increased the built-up environment thereby exacerbating the urban microclimate, incidentally requiring more mechanized methods of achieving indoor thermal comfort. Alozie, Nwobi and Eze (2017), Fatima (2015) and Nobel (2007) identified these mechanical methods to include: air conditioners, contrasting with non-mechanize methods like; courtyards, 'mashrahiyya', wind towers, high widows and ventilation tunnels. Hence, courtyards are in most cases not provided in residential buildings in the state nor other passive cooling systems, such that reliance on air conditioners to cool building indoors becomes imperative.

Day and night temperatures in the urban centers are likely to be higher, ranging from 27°c to 30°c (Alozie, Odim and Alozie, 2015). This means that both day and nights will be hot especially in the dry seasons. Fatima (2015) and Alolzie, *et al,* (2017) equally observed that relative humidity will be around 75% to 95% and will never be less than 60% in the night. Therefore, residential and non- residential buildings will be subject to significant cooling necessities due to the high intensity of heat passing from building external envelope necessitating the need to rely on mechanical cooling systems to gain indoor thermal comfort which will incidentally increase energy consumption of necessity is the dearth of research in the area of courtyards on indoor influence of thermal comfort of residential buildings in Abia State, Nigeria. Similar works by Alozie *et al,* (2015) and Alozie et al, (2017) emphasized on measurement of air temperature on indoor thermal comfort and the use of ventilation as a passive cooling measure to achieve indoor thermal comfort in Umuahia Urban; these works are apt but did not cOver the whole Abia State. Even the work on ventilation was carried out in 2017. Odim (2008) and Odim (2013) were also consistent on measuring comfort levels of buildings facing variously from the sun as well as the impact of shaded and non - shaded windows on warm-humid climate.

Similarly, Fatima (2016) worked on the role of courtyards in improving indoor thermal comfort of office buildings in Kuala Lumpur and Johor in Malaysia, though similar in content but differs in case study, research focus and time. Adunola and Ajibola (2016) work centered on factors significant to thermal

comfort with residential neighbourhoods of Ibadan metropolis and preferences in adult resident's use of spaces. In addition, Adebayo, Anyba, Oyetola and Audu (2013); Adunola (2015) and Akande and Adebamowo (2010) emphasized in separate but similar contexts, on the measurement of indoor thermal indices in warm-humid Nigeria. Other related works include: Abdulkareem (2016); thermal comfort through the microclimates of the courtyard; a critical review of the middle-eastern courtyard house as a climate response; Shapak and Bandyopadhyay
(2017) identified that courtyard alongside other social and cultural roles are significant in achieving indoor thermal comfort in Chhaltisgarrh India; and Adwan and Muhsen (2016) also recognized the role of traditional courtyard and materials in achieving indoor comfort.

Yet these works, differed in geography, time and research focus, although similar in content, In terms of methodology, most of the works adopted descriptive method of analysis, whereas quantitative method of analysis was adopted in this work.

Given the issues highlighted above, the work studied the influence of courtyards in achieving indoor comfort in residential buildings in selected urban centers in Abia State Nigeria.

Study area:

Aba urban is comprised of two Local Government Areas, namely: Aba North and Aba south. The area is notable for fast commercial activities, inhabiting one of the longest market centres in Nigeria Population size is high and demand more residential buildings to accommodate the increasing population. The pressure on accommodation has put pressure on developers to overlook the necessity of including courtyards in the design of the residential buildings and sites. In terms of climate, rainfall activity is sufficient with ample sunshine, dry seasons, are only experienced in the months of December to February. This means that rainfall in the area can last as much as eight to ten months.

METHODOLOGY:

One hundred and thirteen residential buildings were randomly selected to serve the purpose of investigating the structural charactertic nature of the courtyards in the area. Observation and measurements of respective courtyards were carried out. Results obtained were subsequently analyzed.

RESULT AND DISCUSSION

Examination of existing courtyards in Aba Urban

Field observation most revealed that most developers or architects exclude courtyards from buildings designs. However, the residential buildings identified with courtyards were investigated and measured to ascertain the predominate design forms, shapes, sizes, positioning (orientation), architectural elements employed shading devices, and usage (Bulus 2016), considered them to be specification, data presented in Tables, going forward were used. We based our analysis on the number of residential buildings with courtyard which totaled, 113, drawn from Aba urban. The courtyards investigated in Aba, showed the following relationships as recorded in tables below.

Table 1: various forms of courtyards in Aba

Shapes	No of Residential Buildings	Percentage value
Irregular	12	10.67
Square	30	26
Triangular	13	12
Rectangular	40	36
Circular	18	15.33
Total	113	100

Result in Table 1 showed that rectangular form courtyards were still more in number, (36%) among the residential buildings with courtyards. This means that even in Aba urban, rectangular shaped courtyards are more in number but less when compared with the result from Umuahia urban centre.

Table 1: courtyard sizes and areas as observed in Aba urban

Sizes/Areas	No of courtyard	Percentage value
$18m^2$	18	16
$20m^2$	42	37.33
$26m^2$	38	33.33
$30m^2$	15	13.34
Total	113	100

In table 2, total area of the surveyed courtyard in Aba urban ranged form $18m^2$ to $30m^{2.}$ As indicated by Bulus (2016) and Tablada, (2013), width, length and height are used to describe the courtyard aspect ratio. Not less than 28 (37.33%) courtyards in Aba urban were $20m^2$ in size, while 38 (33.33%) were $26m^2$ in size. The least size of $18m^2$, were 18 (16%) courtyards.

Sizes

The sizes of the courtyards were relatively reflective of size of plot spaces. In an uncompromising architectural standard, courtyards are supposed to be provided for in the building-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 lightning and cooling of the building 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 centres are presented in Table 2:

Courtyard Heights:

Table 3: heights of courtyard in Aba Urban

Variation in Heights (Bulus, 2016)	No of Courtyards	Percentage Value
2,400mm	36	32
3,000mm	30	26.67
4,100mm	24	15.38
6,200mm	23	20.00
Total	113	100

We relied on the works of Bulus, (2016) to assume our own standard of measurement. Bulus in his work about courtyards in Nigeria measured the heights of courtyard by relying on a preferred standardized average height for courtyards in Nigeria.

Hence in Table 3: 36 (32%) of the courtyards in Aba were 2,400mm in heights followed by courtyards, of 3,000m, 30 (26.67%) courtyards with highest length of 6,200mm were 23 (20%).

Orientation of courtyards

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

Table 4-: Orientation of courtyards in Aba urban

Orientation	No of Courtyard	Percentage Value
North East	33	29.20
South West	18	16
North west	25	22.16
South west	37	32.74
Total	113	100

In Table 4, 37(32.74%) of the courtyards in Aba are facing southeast direction, while 18 (16%) of the courtyards are facing southwest. The implications of these results is that it affects tremendously the ability

of the courtyards to generate passive Cooling measures that will make the indoors of the building conducive.

Shading Devices, Grass Lawn and Water Body

Table 5: Type of Materials Occupying the Courtyards in Aba urban

Materials	No of courtyards	Percentage value
Shading device	9	8
Grass lawn	32	28
Hard core	45	40
Pool of water	27	24
Total	113	100

In table 5, the following materials inhabit the courtyards in Aba, shading device 6(8%), grass lawn, 32 (28%), hard core, 45 (40%) and water pool, 27 (24%). Those covered with water pool is likely to increase in intensity. In fact, it may extend to other surfaces, since Aba is vulnerable to perennial flooding. The shading devices are made of overhangs (bulus, 2016, Tabiada, 2013).

DISCUSSION OF FINDINGS

Examination of existing courtyards in the selected urban centres

Given the results presented in Table 1 to 5, various dimensions 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 37% of the courtyards were triangular in shape. In addition, in the case of courtyards sizes, result showed that the sizes of courtyard ranged from $18m^2$ – $30m^2$, with $26m^2$ being more prominent in Aba. In the area of heights, it was discovered that in Aba, the percentage of courtyards with 62000mm height was 20%. Furthermore, more than 32% of the courtyards in Aba were positioned in the Southeast direction. In terms of shading devices, grass lawn and water body, not less than 40% of the courtyards in Aba were covered by hardcore, and 25% of them covered by grass lawn.

CONCLUSION

The swift growth of urban areas and commercial development in Aba Urban, Abia State, has increased demands on property development, causing numerous builders and designers to forgo traditional passive cooling methods, especially courtyards, in favor of densely constructed environments. This research examined the physical and design attributes of existing courtyards within 113 selected residential structures in Aba Urban to assess their potential as microclimatic regulators in a warm-humid tropical setting. The data gathered indicates that the courtyards found in Aba Urban display considerable architectural diversity:

i. Form and Geometry: Most courtyards are rectangular (36%), with square courtyards at 26%, circular at 15.33%, triangular at 12%, and irregular shapes at 10.67%.

ii. Size and Scale: The area of the courtyards varies from 18 m^2 up to 30 m^2, with dimensions of 20 m^2 (37.33%) and 26 m^2 (33.33%) being the most frequently occurring. A number of these areas are categorized as "accidental courtyards," as their small size results from plot limitations instead of intentional bioclimatic design.

iii. Vertical Proportions: The heights of courtyards are mainly low to mid-rise, with 2,400 mm (32%) and 3,000 mm (26.67%) representing the most frequent measurements, which affects the aspect ratios required for efficient stack-effect ventilation.

iv. Orientation and Solar Response: A considerable share of courtyards is oriented towards the South-East (32.74%) and North-East (29.20%). In effective passive design, the direction of courtyards is crucial for shading effectiveness and cross-ventilation efficiency; poorly chosen orientations negatively impact the courtyard's capability to act as a thermal buffer.

Surface Materials and Softscaping: Hard and paved surfaces are the most prevalent form of courtyard ground coverings (40%), followed by grassy areas (28%), water features (24%), and designated shading elements (8%). The dominance of hardscape materials leads to heat retention from thermal mass during high radiation periods, thus affecting indoor temperature comfort levels. In summary, while courtyards serve as an efficient and sustainable passive cooling approach that can alleviate high temperatures (ranging from 27°C to 30°C) and high relative humidity (between 60% and 95%) common to Aba, the designs of existing courtyards in the region are frequently hindered by unsuitable orientation, incorrect sizing, insufficient softscaping, and an emphasis on hard surfaces. To enhance indoor thermal comfort and lower reliance on mechanical air conditioning, future architectural approaches in Abia State should implement thoughtful, climate-aware courtyard design principles—focusing on advantageous solar orientation, appropriate aspect ratios, increased greenery, and integrated shading solutions.

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