



# 2019 NATIONAL CONFERENCE ZARIA

## CONFERENCE PROCEEDINGS

EDITORS:

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Prof. M. L. Sagada

THEME:

# EXTENDING THE FRONTIERS OF ARCHITECTURE



JUNE  
18 - 20



School of Post-Graduate Studies,  
Ahmadu Bello University, Zaria.



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OF THE  
2019 AARCHES NATIONAL  
CONFERENCE**

18<sup>th</sup> - 20<sup>th</sup> June 2019

School of Postgraduate Studies, Ahmadu Bello University, Zaria, Nigeria

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## KEYNOTE ADDRESSES





## ASSESSMENT OF COURTYARD FUNCTIONS IN CORPORATE OFFICE BUILDINGS, IN ABUJA, NIGERIA

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### ABSTRACT

*It has been discovered that courtyard create micro-climate when properly designed. The corporate office which incorporates many administrative functions, consumes lots of energy due to lighting and cooling, as thus necessitates a medium of energy efficiency which the courtyard helps to provide. The aim of this research is to identify courtyard functions as it affects the effectiveness and use of the courtyard in promoting natural lighting and ventilation while also optimizing health and wellbeing of the users. The scope of the research covers government secretariat buildings situated in AMAC, Abuja. Descriptive research approach was utilised in carrying out the research using observation method, data was collected by means of observation schedule from field work. Stratified random sampling technique was used to study office buildings in Abuja, the primary data obtained was analysed using SPSS software, pie chart and bar charts were used to show the results. The result revealed that, 100% of the 8-sample size assessed, had element of recreation in the form of greenery, 75% had element of circulation in the form of walkways and driveways whereas 25% had element of meditation in the form of shade of colourful plant. 50% of the courtyards were effective, as two courtyard functions could be identified, 25% were very effective as all three functions could be identified while 25% were less effective as only one function could be identified. It is therefore recommended that, all three functions of the courtyard should be well considered in the design of courtyard in corporate office to optimise its utilization and effectiveness.*

**Keywords:** *Courtyard, Design Considerations, Energy, Office, Wellbeing*

### INTRODUCTION

According to Younis (2016), Courtyard should be introduced into office buildings in tropical climate regions, in order to provide indoor thermal comfort and a cut in energy consumption. The aim of this research is to identify courtyard

functions as it affects the effectiveness and use of the courtyard in promoting natural lighting and ventilation while also optimizing health and wellbeing of the users. Heat gained by buildings should be minimised, this is an important concept in building design, as this has great implications on both the economy and

cost of operating such buildings. Many authors have demonstrated that the air temperature within the courtyard is usually lower than the air temperature at the inside of the building, thus the courtyard serve as a heat exchange point between itself and servant spaces thereby providing cooling in the building (Rajapaksha and Hyde, 2005).

The significance of the paper reflects the possible comfort conditions that can be achieved through the use of courtyard in office building, the positive implication it will have on the health of users of such building, besides lowering down on the cost of operating such buildings thereby helping to improve the power supply capacity of the country. The scope of the paper would cover some selected government secretariat offices that use courtyard or atrium in the building, to save time and cost while carrying out the research. The limitation of this research is gaining full acceptance into some research areas in order to collect data for the research, this is majorly due to the prevailing insecurity challenges within the country where people are suspicious of others, this makes taking of photographs not easy, at times impossible. Samples were based on stratification and obtaining of permission from relevant authorities of the offices in -order to carry out the research.

The research would be a yardstick guide for safety and effectiveness within the office space while promoting courtyard usage, even as temperature within the country keep increasing and rainfall keep decreasing due to climate changes as a result of ozone layer depletion.

### **Study Area**

Abuja has six area council: Abaji, Abuja municipal (AMAC), Gwagwalada, Kuje,

Bwari and Kwali area council. Of the six Area Councils, Abuja municipal area council (AMAC), is the largest, most developed and constitutes of the bulk of the built area in the FCT. AMAC is situated between Latitude 8°40' and 9°20' north of the equator and longitude 6°40' and 7°40' east of the Greenwich meridian. It constitutes of six main districts, namely Asokoro, Maitama, Garki, Central area, Utako and Wuse with some developing districts such as Apo, Gaduwa, Gudu, Lokugoma, Kaura, Durumi, Katampe, Gwarinpa, Kagini, Karsana, Kubwa, Guzape, Kado and Gwagwa

### **THEORETICAL FRAMEWORK**

Energy consumption in buildings is primarily linked to three factors: the climate, design and occupant factors (Wouters and Delmotte, 2005). Before the concerns for status, aesthetics and improved environmental quality, climatic conditions have been a major determinant for buildings. The need to minimize operational energy in the running of active systems has focused attention on two sets of factors, the demand side and the supply side efficiency. Supply side efficiency comes from the elements of the building that drive the need for power in the building whilst the demand side efficiency is related to the elements that use power (Rajapaksha and Hyde, 2005). The incorporation of a courtyard into a building form offers a micro-climatic buffer zone between the out-door and indoor environments of the building, from the climate design viewpoint, a courtyard building presents a greater flexibility in promoting larger areas of internal passive zones, which can be profitable for natural ventilation and daylight. Courtyards don't have a specific shape, as they are either rectangular,

square or circle. These forms have derived other forms such as U shape, L shape, T shape, V shape, H shape and Y shape due to ecological aspects such as site limitation, topography, building orientation and function (Fatma, Lokman *and* Mohmed, 2016). Courtyard design can be fully or semi enclosed or surrounded by only two walls.

### Design Considerations for Courtyard

According to Almhafdy, Ibrahim, Ahmed and Josmin, (2013) and Bulus (2016) in every study of courtyard the following are variants that are constants: functions, configuration, orientation, wall enclosure

and natural elements within the courtyard. Courtyard functions in various ways, which ranges from being used as a meeting place, gardening, cooking, working, playing, and sleeping to keeping of animals. Invariable this various function can be categorised as, social, leisure and micro-climate (Edwards, 2006). In order for the courtyard to receive sufficient sunshine, the aspect ratio (AR) must be put into consideration and it is defined as the degree of openness to the sky (Sthapak and Abir, 2014). Therefore, the greater the aspect ratio the more exposed the courtyard will be to the sky and can be calculated using the formula:

$$\text{Aspect ratio} = \frac{\text{Area of the courtyard floor}}{\text{Average height of the surrounding wall}}$$

Therefore, in the instance in which more sunlight is required into the building, the courtyard is wide and shallow (high aspect ratio) but when less sunlight is required, it should be made narrow and deep (low aspect ratio) in order to serve as a sunlight protector.

It is worthy of note that, courtyard configuration could be fully enclosed, semi enclosed, and semi open. The courtyard creates micro-climatic conditions particularly when some variables are taken into consideration such as the orientation, volume and ventilation. A study was carried-out on polygonal courtyard forms (non-typical form) and its shading performance to develop a shading calculation tool for courtyards (Ahmed and Mohamed, 2006), the study concluded that courtyard geometry and proportions have a significant influence on the shading produced on the internal surface. The orientation of courtyard usually depends on the building layout and it affects the ventilation effect or wind

speed. It has been argued that the right orientation of a courtyard can improve thermal comfort within the building, as the building should be oriented with respect of solar angles and wind direction (Antonio and carvalho, 2015). There is a general believe that courtyard orientation should be such that the elongated side is best to face north south direction (Bulus, 2016). It has been discovered that increased height of courtyard walls will cause reduction in the degree of air temperature in the courtyard as well as the rooms in the nearby location to the courtyard. The design variants of courtyard wall enclosure include, its shape, size and details of the enclosing wall of the courtyard. Courtyard wall enclosure components such as walls, doors and windows need to be considered during the design stage. Wall enclosure can play a very important role in the micro-climate conditions of the courtyard through natural ventilation techniques. Placing natural elements in a courtyard

produce some environmental benefits, as plants such as: trees, shrubs and flower within a courtyard can significantly affect the thermal comfort as they provide shade and oxygen in the courtyard (Almhafdy, *et al* 2013). It has been found that water body (pool) and water spray within the courtyard produces some thermal effect, the courtyard with pool, tent and water spray during sunny hours provided significant cooling effect within the internal surroundings of the courtyard.

According to a study by Sthapak and Abir, (2014), the courtyard acts as an interaction point for users of the building. It encourages them to act as a group, promotes visual privacy when the court is visually secluded by screening or walled entrances. It serves as a relaxation spot especially when the climate is conducive to out-door activity and it promotes acoustical privacy, enclosure elements work as a noise barrier between the courthouse and the outside area (Sthapak and Abir, 2014). The courtyard can play a role in promotion of sound health, simply by the architect adding courtyard features such as shade, water, trees and flowers, wind tower, pavement and colours which could all provide a positive effect towards the five senses of the human body (Rust, 2010). The courtyard is generally referred to as a microclimate changer due to its ability to reduce high temperatures, channel breezes and adjust the degree of humidity.

The courtyard can bring about some environmental benefits if the space and the surrounding servant spaces maintain favourable environmental conditions for thermal comfort. The airflow, thermal mass and passive solar all regulate heat transfer between the courtyard, its adjacent servant spaces and the out-door

environment. In the tropics, the courtyard can be exposed to overheat and transfer solar heat to adjacent occupied servant spaces, in order to avoid this issue, airflow effect, shading and thermal mass must be promoted (Rajapaksha and Hyde, 2005). Airflow is the major effect which dictates the thermal environment inside the courtyard, this effect is what causes comfort cooling for occupants, structural cooling, controlling of excess heat and the removal of heat from interior spaces. Airflow effect is caused due to wind pressure effect or stack effect which can be regulated either by wind permeability of the geometry or wind permeability of the enclosure. It is worthy of note that air flow effect is much more felt in a semi enclosed courtyard, such courtyard promotes cross ventilation through the courtyard and attached servant spaces. The wind that moves across the building increases the pressure fields around the building, creating high pressure zones at the openings in the enclosed envelop.

### **Functions of the Courtyard**

The functions of the courtyard have been the same all throughout time, from the ancient civilization, classical civilization, middle- ages and renaissance civilization to the modern-day civilization (Oliver, 2003). An archaeological survey found at Ur on the Euphrates River in Mesopotamia in 2000 BC revealed that the plan of the courtyard was square shaped and was surrounded by rooms. Garden and water features were two signs for the courtyard, thus it's used as a cooling tool in climates that are warm (Fatma, *et al.* 2016).

It has been observed that the courtyard serves as a transitional space, as transition is one of the basic concepts of architecture. The courtyard does not just

allow for passage from open space to close space, but it also links between everything that have different qualities such as from narrow space to large space and from regular space to irregular space, it can also be seen as a bridge (Journal, 2015). The courtyard house has played many purposes including cooking, sleeping, working, and playing, it has functioned as a transition space between outside -inside and between rooms. The central uncovered area in a roman building was referred to as an atrium, which is a form of glass covered courtyard with a central pool used for collection of rain water. In some Islamic countries in North Africa and the Middle East, the courtyard in the Dar, follows the philosophy “privacy and seclusion with a minimal display of the occupant’s social statues to the outside world. Courtyard offers isolated space for people, with sheltered courtyard trees, a pool and some out- door furniture. In the modern era, the courtyard first entered to the west coast of North America and revealed in the southern California due to the influence of Spanish colonialism (Fatma, *et al.* 2016). The following are general functions that can be deduced from the above:

- Recreation
- Circulation and Connectivity
- Meditation

According to Home and Garden (2018), the elements that aid in meditation are water, shade of colourful plants and seclusion area with shade. Recreation entails activities involving leisure, such activities as: games, play or the feeling of nature.

**RESULT AND DISCUSSION**

Data was collected from field exercise using observation schedule. The data was then analysed using IBM statistical package for social science software (SPSS). The descriptive analysis from SPSS were interpreted using Microsoft excel spread sheet program by generating charts and distribution frequencies. Descriptive method was adopted by this research, stratified random sampling technique was used to sample data, a total of eight (8) buildings were studied, and four sample each, from two unit subset of government system. This represented 40% of sample size of 20 buildings as obtained from Morgan’s table of samples

*Table 1: Variable Measurement for Availability and Use of Courtyard in Eight Selected Government Secretariat Buildings in Abuja, Nigeria*  
Scale factor: Available =1, Not Available =0

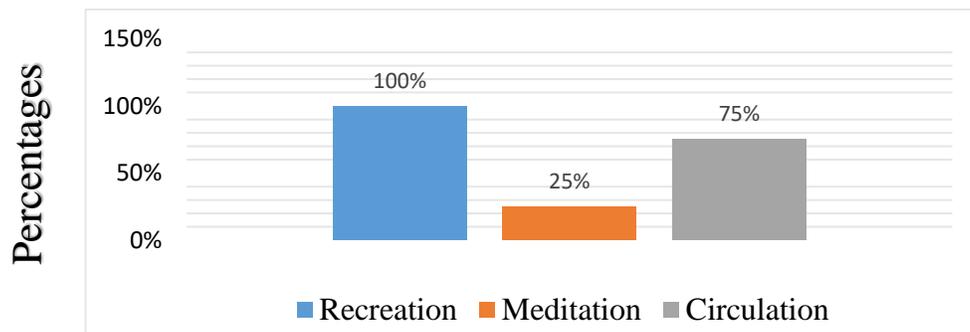
Building	Recreation	Meditation	Circulation	Remark
<b>Federal Ministry of Environment</b>	1	0	0	Less Effective
<b>Federal Ministry of Agriculture</b>	1	0	1	Effective
<b>Head of Service of The Federation</b>	1	0	1	Effective
<b>Department of Education</b>	1	1	1	Very Effective
<b>Abuja Municipal Area Council</b>	1	0	1	Effective
<b>Abuja Metropolitan Management Council (AMMC)</b>	1	0	1	Effective
<b>Abuja Geographic Information System (AGIS)</b>	1	1	1	Very Effective
<b>Ministry of Works Power and Housing</b>	1	0	0	Less Effective
	8	2	6	
	100%	25%	75%	

Source: Field Work, 2018

Remarks are being made based on the number of functions that is being identified in the courtyard: courtyard with all functions are very effective, the ones with two functions are effective whereas courtyard with only one function is less effective.

**Courtyard Utilization**

From table 1, it was noticed that element of recreation could be found in all the courtyard in the form of greenery, as this aid recreation. Meditation element was less observed in the courtyard in the form of shade of colours of greenery, while most of the courtyard served as a means of circulation and connectivity between spaces.

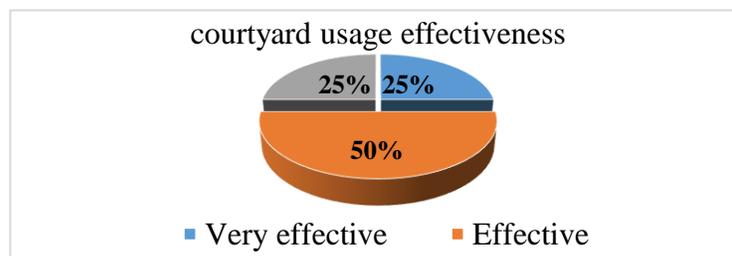


*Fig 1: Courtyard utilization based on function  
Source: Field Work, 2018*

**Courtyard Condition**

From the data set collected in table 1, it is observed that the courtyard usage effectiveness is such that 25% of the buildings were very effective, as all functions of the courtyard were found. 50% of the buildings were effective as

two of the courtyard function were identified whereas 25% of the courtyard condition were less effective when compared to the rest as only one of the courtyard function was observed



*Fig 2: Courtyard effectiveness based on assessment of functions  
Source: Field Work, 2018*

Based on the literature review, courtyard functions should consist of recreation, meditation, circulation and connectivity

elements of which effectiveness was deduced.



*Plate 1: Very effective courtyard as observed in Abuja geographic information system (AGIS)  
Source: Field work, 2018*



*Plate 2: Effective courtyard as observed in Head of service of the federation Abuja  
Source: field work, 2018*



*Plate 3: Less effective courtyard as observed in Ministry of Power Works and housing Abuja  
Source: field work, 2018*

## CONCLUSION

Recreation relaxes and refreshes the body, circulation create interconnectivity but meditation help the users of the building get in touch with their inner consciousness. The findings from the study reveal that all three functions of the courtyard are not given due consideration in office buildings in Abuja. when courtyard is not utilised effectively it makes them less attractive nor desirable thus encouraging office spaces without courtyard leading to high energy

consumption and poor environmental condition of users.

## RECOMMENDATION

1. Courtyard should be designed with consideration for its three functions, so as to optimise the courtyard usage and effectiveness.
2. Government should enact policies that will mandate courtyard placement and effectiveness within the office space, to serve for natural ventilation and lighting

3. Workers and designers of office space should be educated of the importance of meditation elements in office spaces, as this helps users maintain a sound and renewed mind

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## THE EFFECTS OF ARCHITECTURAL DESIGN ELEMENTS TOWARDS IMPROVING AIRFLOW MOVEMENT IN LOW-RISE RESIDENTIAL BUILDINGS, IN URBAN HOT- HUMID CLIMATE IN OBOSI, ANAMBRA STATE, NIGERIA

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### ABSTRACT

*Improvement of airflow movement is necessary in low-rise residential buildings in hot-humid climate of the tropics as it helps to maintain adequate thermal comfort in buildings. When the airflow is distorted due to inappropriate architectural design and poor implementation of architectural elements in such buildings, via, poor passive design approach, inadequate building openings, lack of interplay of architectural-environmental design considerations etc., they will cause high risk of some climatic-environmental related problems such as thermal discomfort or stresses. The Study area is Obosi Urban, Anambra State, Nigeria. It is a densely populated urban area both in low-rise residential buildings and populace. The study adopted systematic simple random sample techniques with 5% imagine of error for both primary and secondary data collection methods, which involved direct field investigation and administration of questionnaires. The study through experimental empirical analysis and analysis of variance (ANOVA) reveals the inadequate indoor climate condition of the occupants of the area. The analysis reveals strong effects of poor implementation and use of architectural elements in low-rise residential buildings. Consequently, the study tends to suggest that adequate architectural design and proper implementation of its architectural elements through passive architectural design approaches, improve architectural space design, proper interplay of architecture and environment in residential building design, use of buildings shading devices, proper architectural design to achieve microclimatic condition around the buildings in the tropic, will not only improve indoor climatic condition of the low-rise residential buildings, but will sustain the thermal condition of the occupants in particular and enhance adequate sustainability of the buildings and environment at large; especially in hot-humid condition of the area.*

**Keywords:** *Airflow movement, architectural design, hot-humid climate, low-rise residential buildings, use of architectural design elements*