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RESEARCH ARTICLE

POSTMODERNISM ALTERNATIVE TO LOW CARBON ARCHITECTURE

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ABSTRACT

Evaluation of the environmental effects of the construction industry reveals that building contributes to the increasing proportion of carbon dioxide in the environment. With this backdrop, a stark redirection in design and construction approaches to mitigate the adverse effects of existing pro-carbon modern practice is urgent and imperative. This research work is aimed at introducing a new style of building design that integrates both vernacular and modern building materials in order to achieve the low carbon benchmark. The methodology adapted in this research work was based on literature survey. However, this study posits that postmodernism, which had its roots in historicism and straight revivalism, yet sought to humanize modern architecture by relating buildings to their larger physical and social context and re-establishing the use of traditional laterite material is recourse for low carbon building designs. Moreover, the study pointed out that these vernacular materials should be re-interpreted in modern form by integrating the laterite with granulated tires stabilized with cement. Other policy issues are discussed.

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INTRODUCTION

Contemporary trends in architecture favour sustainability and environmental consciousness. With the recent increases in fossil fuel prices worldwide, coupled with climate change, global consciousness is awakened, especially in the architecture, to find solutions to these challenges. Recourse to this problem involves finding design alternatives that reduce carbon emissions. China for instance, loses 200 billion dollar annually as a result of pollution arising from airborne carbon exhaust intricately linked to construction (Beltran, 2011). This study posits that postmodernism, which had its roots in historicism and straight revivalism, yet sought to humanize modern architecture by relating buildings to their larger physical and social context and re-establishing the use of traditional classical or vernacular lateritic material is recourse for low carbon building designs. However, this study points out that these vernacular materials should be re-interpreted in post-modern form by integrating the laterite with granulated tires and stabilized with cements.

Vernacular building Materials

The use of laterite predates 1807. Its red colour is attributed to the presence of high content of iron. Laterite is found in abundant in sub-tropical region which experience high rain

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fall, and found in large quantities in Africa, Australia, India, South East Asia and South America. (Lemounga *et al.*, 2011)

Laterite Reinforced with Granulated tyres

Utilization of granulated tyres as stabilising material, has become quite popular in recent years, especially in earth-block and rammed earth building construction (Arayela, 2000). However it has been established in literature that the addition 4% cement, and 4% granulated tyre to laterite as stabilised material can result to strength and durability equivalent up to 7% cement mixture to laterite (Chee-Ming, 2007). An assessment of the building construction industry in Europe postulated that mineral removed for construction is estimated as 4.8 ton per inhabitant per year, this, however is as much as 64 times the weight of an average person. In fact, Brown and Lutz-Carillo (2009) reinforces the need for reduction in weighted building material in construction as important of Earth sustainability. Granulated tyre as stabilised composition material proffers good solution to this challenge, due to the fact that rubber density is by far less than that of clay (Stephen, 2015)

Compressed earth brick

Compressed Earth Block (CEB) is used in walls construction, to meet both structural performance and aesthetic. United Nations Organization and other NGOs encourages the use of

laterite and local materials because they cost lower and are environmentally responsive to affordable housing (Lemougna *et al.*, 2011; Yomi Michael, 2012).

Laterite bricks in wall construction

Laterite bricks are an excellent construction material, has good thermal insulation properties, durability and compressive strength. Laterite can be stabilized with cement, fiber, and granulated tyre. Hydra form block were widely used in residential, and public buildings in many cities in Nigeria, for instance in Lagos, Abuja, and Akure to enhance thermal performance of building interiors. Research have proved that hydraform has trice the efficiency of concrete block, and nearly twice the efficiency of fired clay bricks in its thermal insulation characteristics (Adedeji *et al.*, 2010, www.hydraformnigeria.com).



Figure 1. School of Earth and Mineral Sciences, FUT, Akure. Use of Brick facing as Wall Finishing



Source : (www.mdpi.com/journal/sustainability)

Figure 2. Ikeja Plaza Building, Awolowo way, Ikeja. The use brick facing, recesses and horizontal

Wall constructed in earth, could be found in many cities across the Nigeria for instance in Abuja, Electronic Laboratory Hall in the Federal University of Technology Akure, and Obasanjo Estate in Ado-Ekiti. Moreover, constructed interlock laterite block could also be utilized as facing bricks. These earth materials are environmentally friendly, durable and required less maintenance (Ogunsote and Adedeji, 2012).



Source: (www.mdpi.com/journal/sustainability.)

Figure.3.(a) CEB construction in Cameroon; (b) Adobe construction in the USA

Moreover, they are good insulating materials, and provide optimum thermal comfort for building occupants. Walls constructed in laterite bricks can save cost, and improve aesthetic.

Characteristics of vernacular architecture

Term vernacular architecture refers to buildings, built by their dwellers, their design being influenced by climatic conditions, geographical location and cultures. It entails inherent undocumented knowledge on how to effectively utilize available materials to create conducive built environment, amenable to dwellers life style. With time, vernacular buildings proved to be sustainable and withstand all environmental challenges (Zhai, 2010).

Post- modernism

Modernism and postmodernism can be attributed to cultural orientation and tendencies in art, architecture, design (Shafique and Akhtar, 2012). Modernism started as international style in 1950s, and transformed to Postmodernism only in the 1970s. The style is marked by revival of ornamentation and humour, antithesis of plain and formal facades of modernism. The functional and simple form of Modernism is substituted by more aesthetical and complex forms and Architects rediscovered impressive and symbolic context in architecture and forms patterns (<http://en.wikipedia.org/w/index.php?oldid=426755050>). Moreover, Post -modernism is extravagant architectural style that was a reaction against modern architecture. It emphasis is that architecture should be expressive, symbolic, and experimented with abandoned architectural features such as Classicism, kitsch, eclecticism, and vernacularism (Nesbitt, 1996; Kahl, ?). Protagonist of Postmodernism includes Venturi whose work is an adaptation of symbolism in design was appreciated by many artist and observers who comprehended his traditionally inspired projects (Condorcet, 1955).

Samples of some prominent post-modern buildings:



Figure 4. Auditorio de Tenerife in Santa Cruz de Tenerife by Santiago Completed 2003



Figure 5. Neue Staatsgalerie in Stuttgart, Germany by James Stirling and Michael Wilford, 1984



Figure 6. Wells Fargo Center in Minneapolis by César Pelli. Completed 1988



Figure 7. Messeturm in Frankfurt, Germany By Helmut Jahn. Completed 1991

Historicism

According to, Condorcet (1955) historicism is a term applied to the behaviour and method of solving current problems and forecast the future on the basis of experience of past. Post-modern architects and artists recalled readapting history, which had been greatly neglected by modernist. Postmodernist in their effort to challenge the idea of originality followed the notions of recopying other famous architects and artists works with the intention of exposing them more in modernized manner (Nesbitt, 1996). Considering the architectural work of Swiss born Mario Botta, the past incorporates vital information, artefacts, original techniques and ideas that can aid architects in inventing modernized building expression that is quite acceptable in the contemporary time. In line with this he advocates that architects should carry on with using the previous work, not as pastiche, but they should rather be considered as guide to educate them about potentialities of contemporary time (Condorcet, 1955). Botta, also emphasised that *"It is the task of the architect, therefore, to re-create the*

forms and memories of the past, in new and relevant ways" (Paine, 2012)

Examples of Postmodernism which are inspired by strip use in historical buildings:



(Photograph: Ashley Paine, 2010). Figure 8. Siena Cathedral, Siena, 13th-14th Century. (Photograph: Ashley Paine, 2012)

Figure 8. Mario Botta: Watari-um Art Museum, Tokyo, 1985-90

Vernacularism

This is broadly employed in architecture relating to tourism and culture. Since tourists needed to be provided with comfortable environment, readily available material which expresses local form, shape and folklores to reflect the identity of people living in that region are used. The success of this depends to great extent on the level of honesty of the designer to create simple design or highly expressive and monumental design. (Contemporary Architectural Expression, ?)

Historical revivlism

The post-modernism concepts evolution is to bridge the gap created by modernism, and these gap includes, the absence of interaction among building users, contextual, and the traditional meaning of built environment (Al-Lahham, 2014). Moreover, other authors have defined revivalism in architecture as the *"use of visual styles that consciously echo the style of a previous architectural era"* (Wikipedia, ?) Historical revivalism is not a modern architectural fashion, and its presence dated back to European Renaissance. A good example of historical revivalism is the work of Egyptian architect, Farouk Alghohary. He adapted internal courtyard system and used arches with orderly arranged in hierarchal order and stucco screen for windows. His intention of these is to portray the connection between contemporary and past as shown in the figure below. Another notable example is the work of another Egyptian architect Salah Abo Seif.



Example of Islamic Revivalism by Farouk Al Gohary

Figure 9. Oriental Weavers Headquarters, Heliopolis, Cairo



Example of Islamic Revivalism by Ashraf Salah Abo Sief.

Figure 10. Apartment Building, Al Mokattam District, Cairo

In his attempt to portray Islamic culture and heritage in the Apartment Building Cairo, he harmonized the entire building envelope, and intentionally disregards utilization of any modern architectural visual elements. Instead he adapted dwarf arches and timber pergola, as shown in following figure (Salam, 2007)

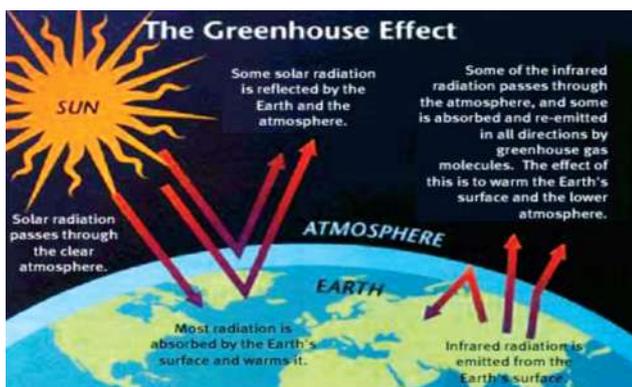
Low carbon architecture

Low carbon transformation can be comprehended as Greenhouse Gas emissions route that keep GHG concentration to a level that would not cause any hazard to the environment. Table I below show sample of gas and constituent carbon and carbon related gasses (Dhar *et al.*, 2013).

Greenhouse Gas	Global Warming Potential for 100-Year Time Horizon	Average Radiative Forcing (W m ⁻²)
Carbon Dioxide (CO ₂)	1	1.66
Methane (CH ₄)	21	0.48
Nitrous Oxide (N ₂ O)	310	0.16
Per fluorocarbons (PFC)	6,500–9,200	0.34
Hydro fluorocarbons (HFC)	140–11,700	0.34
Sulphur hexafluoride (SF ₆)	7,400–23,900	0.34

Source: IPCC Fourth Assessment Report, Working Group I, table 2.14 (2007)

Building contributes invariably to the increase of green house gas emissions much more than any other sector of the economy. However, emissions resulting from building construction and use have escalated in recent years. The figure below explains green gas house effects (Ochsendorf, 2012).



Source: www.arcticportal.org/greenhouse-gases

Figure 11. The Greenhouse Effect

Concept of sustainability in vernacular architecture

The UNCED Brundtland Commission 1987 define sustainable architecture as building “that meets the needs of contemporary society without denying future generations of the ability to

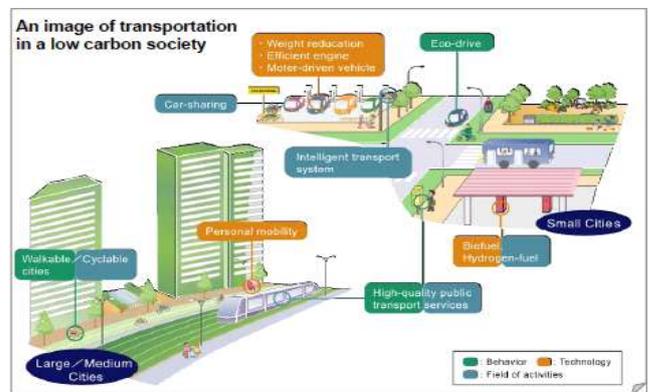
meet their needs” (www.architecture.com/climatechange) Sustainable architecture in boarder sense is an appropriate utilization of our immediate environment without performing any dangerous activity that could endanger it , materials and energy should however be improved. The concept of sustainability is that our activities and action today on this planet shouldn’t cause a harm or constraint to the life of coming generations (Sirija, 2013). Sustainability can be viewed in vernacular architecture in the way it’s portrays mixture of climatic condition of a place, in other words, using available material at hand, with simple techniques to create interesting architecture that suit people life style and socio-economic condition of the region. In sustainability notions, analysing environmentally friendly characteristics of vernacular architecture gives a good basic knowledge to designers engaged in future design of sustainable built environment (Halicioğlu, 2012).

Carbon city design

Many world cities, such Tokyo, New York, London have accepted the notion of becoming low carbon. It has been reported that approximately 1050 cities in USA, 40 cities in India, and over 100 cities in China, have set up objective low carbon city plan to realize the goal of reducing carbon emission (Su *et al.*, 2013) Low Carbon City can be defined as “ a city that comprises of societies that adapts sustainable green technology, green practices and emit relatively low carbon to avoid negative carbon impacts on climate change” (http://esci-ksp.org/wp/wp-content/uploads/2012/04/Low-Carbon-Cities-Framework-and-Assessment-System.pdf).

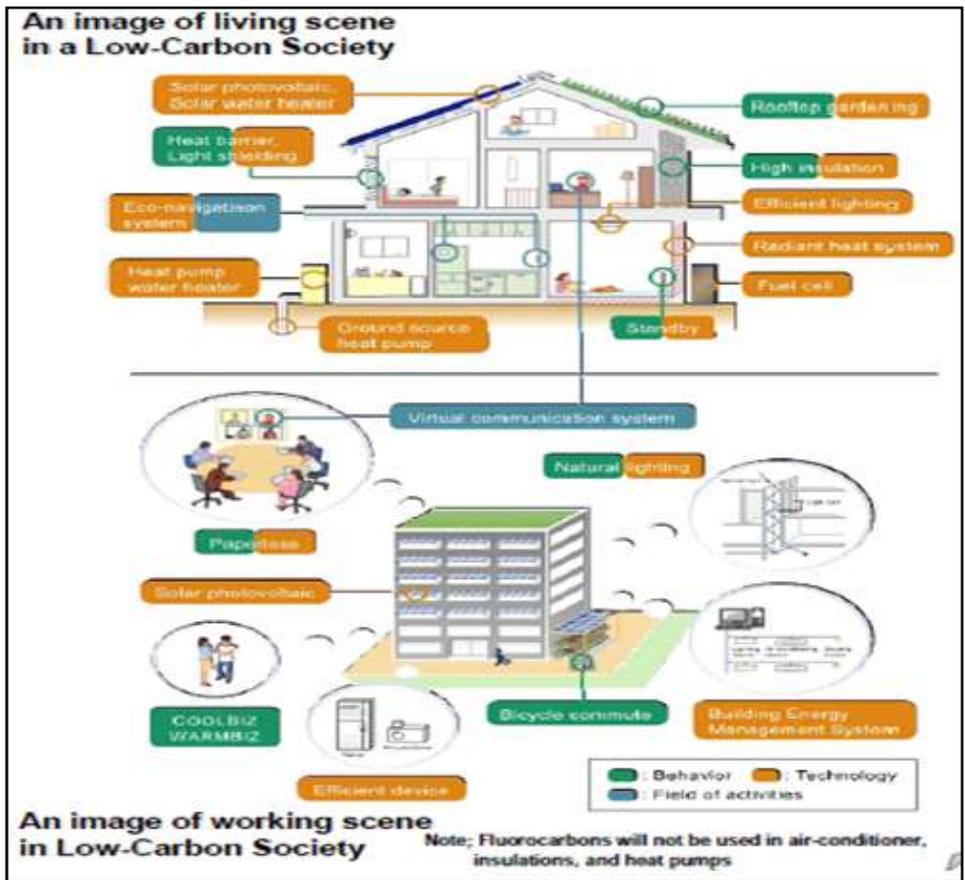
There is urgent need for all countries of the world to create low carbon societies. This can be achieved only by adapting the following principles:

- Minimizing carbon emissions in all sectors.
- People should try and live simpler and rich life, in other word public should change from quantity consuming society to quality oriented one. These changes should be through consumer choice.
- Coexistent with the natural environment, I.e. people should interact with environment in a manner not to cause any harm to it (https://www.env.go.jp/earth/info/pc071211/en.pdf).



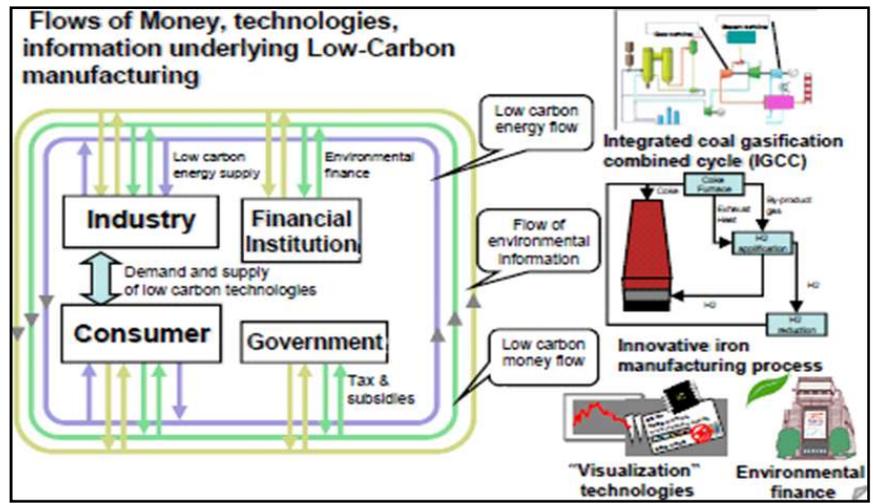
Source: https://www.env.go.jp/earth/info/pc071211/en.pdf.

Figure 12. Transportation in Low carbon city



Source: <https://www.env.go.jp/earth/info/pc071211/en.pdf>

Figure 14. Living scene in Low carbon city



Source ; <https://www.env.go.jp/earth/info/pc071211/en.pdf>

Figure 15. Industry in Low city carbon

Post-Modernism and low carbon building

Post-Modernism as a style embracing plural approaches

According to Charles Siegel (2008) post-modernism based on architectural theory can be group into:

1- Avant-Gardism Architecture:- The most popular protagonist of this idea is Peter Eisenman.

His most popular work figure --Wexner Centre, Frank GeharY - figure--, Daniel Libeskind - designed the Freedom Tower New York figure--

2- Humanist Architecture: - This school argued that all traditional buildings are based on patterns that gave them quality of being – ‘a life’ (Siegel, 2008). Robert Venturi in his book ‘Complexity and contradiction in Architecture’ published in 1966, explored this life giving ideology and criticised the

modernist from two points; Firstly, because they opposed tradition, and secondly, however, they adapted rationality and excessive simplicity (Gelernter, 1995).



(Photograph by Mike Evteev)

Figure 16. Peter Eisenman, Wexner Center (1989).

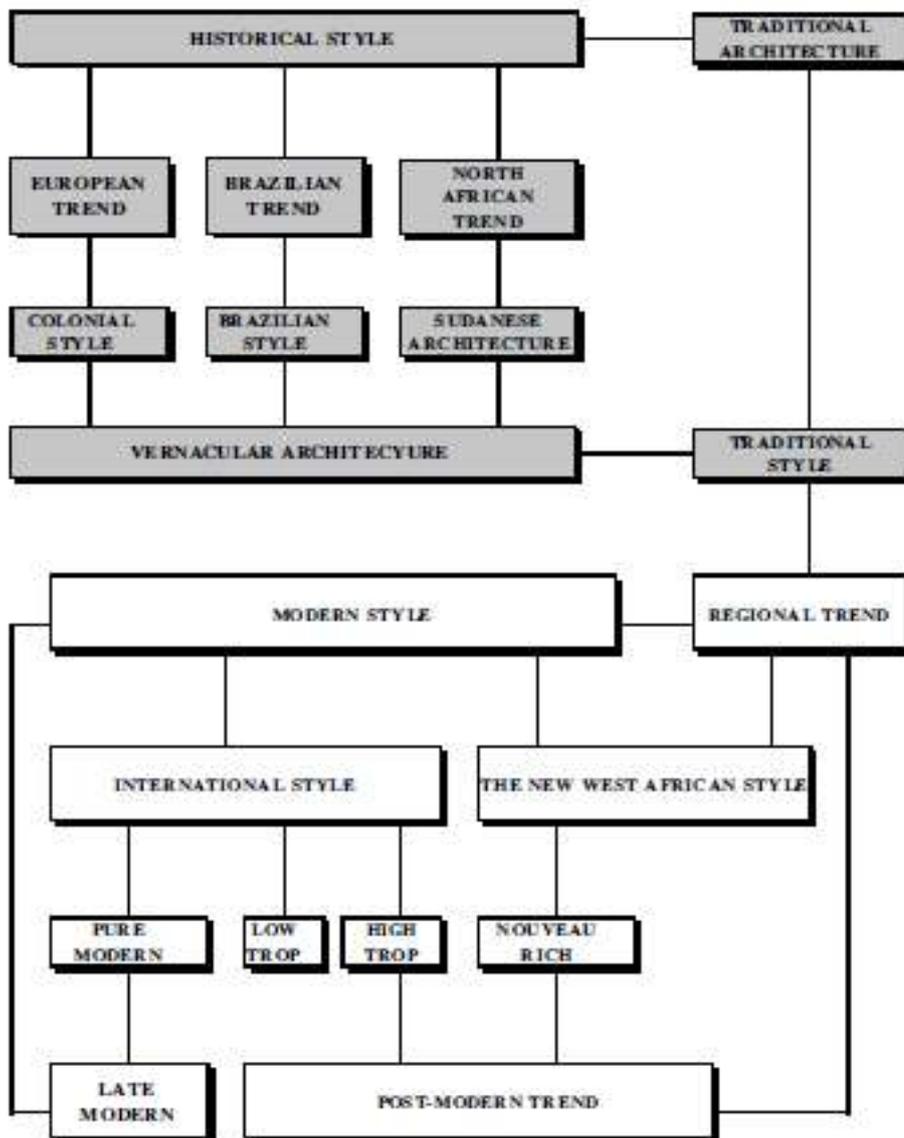
Figure 17: Frank Gehry, Stata Center (2004)
(Photograph by Tjeerd Wiersma.)



Source: (wikipedia encyclopaedia)

Figure18. Freedom Tower New York

Post-modernism style of architecture have lent emphasis to comfort, traditional building and social life of building occupants, and these are manifested in historicism, straight revivalism and neo-vernacularism which entail marrying traditional concept of building with modern one (<http://sdngnet.com/Files/Lectures/FUTY-AR-403/Lecture%20Notes/Modern%20Trends%20in%20Architecture%20070113g.pdf>).



Source:<http://sdngnet.com/Files/Papers/Journal%20Publications/Classification%20of%20Nigerian%20Architecture.pdf>.

Figure 19. The evolution of Nigerian Architectural styles

However this give indication that post-modernism accepts any variant styles or concept, therefore, integrating vernacular building material in contemporary building for sustainable development can be achieved by integrating literate with granulated tyre and cement.

Northern Nigeria as a case study area

Breif history of Nigeria

Nigeria is the most populous country in Africa, according to 1993 census with a population estimated as 120 million. There are about 400 ethnic groups in Nigeria and more than 300 local dialects. The dominant tribes are Hausa, Yoruba and Igbo. The country was under British rule between (1861 to 1960) AD (Cordelia, ?).

Vernacular architecture of northern Nigeria

The most influential factors that affected architecture in northern Nigeria is the advent of Islam in Northern Nigeria, and the popular Brazilian styles; however North African influences on Northern Nigeria was as a result of the Sudanese styles. The interaction of traditional architecture with these historical architectural style generated vernacular (<http://sdngnet.com/Files/Papers/Journal%20Publications/Classification%20of%20Nigerian%20Architecture.pdf>). Architecture of northern Nigeria

Case study of some post-modern buildings in Abuja

1-Adamawa plaza, Garki, Abuja



Source: (Enwerekowe, O, 2011)

Figure 20. Adamawa Plaza Garki Abuja

Nigerian Communication commission headquarters, Maitama, Abuja



Source: (Enwerekowe, O, 2011)

Figure 21. Nigerian Communications Commission, Maitama, Abuja (front view)

S/No	ITEM	COMMENT
1	Location	In Shagari Road Abuja, the building was commissioned in 2002
2	Designer	El Mansur Atelier Co.
3	Plan	Generated from African, rectangular form with central court yard.
4	Form	The building is having covered atrium with translucent roof to enhancing interior lighting.
5	Finishes	Exterior finishes are slate gray granite and mosaic tiles, and glazing, ceilings are suspended mineral acoustic fibre ceiling board.
6	Ornamentation	Utilizes both traditional/cultural & international/ classical styles
7	Walls	Characterized by interior ornamentations curtain glass wall & sleek-tilling.
8	Shadings	Windows are recessed; provide both shading and aesthetically appealing.

S/No	ITEM	COMMENTS
1	Location	Maitama, Abuja, was officially commissioned in 2006
2	Plan	The plan is circular based, asymmetrical, 10 storey building
3	Form	It is elliptical form, with water fountain located in the central court yard covered with steel girder roof trusses, giving sense of traditional form.
4	Shading	Windows are recessed to provide shading with projected fins
5	Materials	Modern material are married with traditional earth block
6	Ornamentations	More or less symbolic to conform together to form dynamic timelessness.
7	Interior court yard system	It is an Asian influences.
8	Steel roofing system	This portrays a modern thatch roof.

S/No	ITEM	COMMENTS
1	Location	Located on Herbert Macaulay way, in central business district, Abuja
2	Designer	Designed by Sheltarc Associate, and constructed by Julius Berger Nigeria. PLC.
3	Form	The four towers are symmetric but not similar. Buildings are rectangular with central covered court yard
4	Walls	Tinted reflected glass covered 80% of the entire building facade
5	Shadings	Façade is protected by recessed
6	Design concept	Glazed massive column in the four corner of the building are not constructional elements but rather portrayed the significance oil sector in the economic of the nation
7	Ornamentations	Four glazed column in the corner are for ornamentation purposes
8	Walls	Reflective cladding on elevation portrayed Nigerian nation legacy'' unity in diversity''

Nigeria national petroleum corporation corporate headquarters, central business district, Abuja



Source: (Enwerekowe, O, 2011)

Figure 22. NNPC, Headquarter

APPRIASAL OF THE CASE STUDIES

Post-modern trend, just like its predecessors, it is not just a search for newly generated architectural patterns, but rather a finishing point in the for quest for absolutism, and tailored environment- an environment that majority of its designers, adjust their design and construction strategies in order to meet client needs and (Enwerekowe, 2007). Generally, numerous research proved that, laterite is more sympathetic to buildings users in the tropical region, as in northern Nigeria, which is characterized by hot humid to hot dry climate. Utilization of laterite stabilised with granulated tyre, compressed earth bricks and adobe is more appropriate for the fact that they are low carbon construction materials, having characteristics of being good thermal insulating material, and durable.

Having investigated some prominent headquarters buildings in Federal capital Territory Abuja, which represent post-modern architecture of Nigeria, it is imperative as to:

- Integration of laterite bricks in the construction of walls for its good thermal insulation properties in these national buildings, by doing so, the public may patronize it and this will help in reducing the construction cost and reliance on cement and concrete. Hence reduces carbon dioxide emissions to achieve sustainable development and energy efficiency.
- Utilization of laterite burned bricks as cladding material for building façade and as cladding for building shading devices to enhance building elevation. Moreover, the use of earth based roofing tiles materials are considered as environmentally friendly.
- By adapting these laterite environmentally friendly material, by government and organization at national level, the public patronize it, thusly, bringing about entirely new post-modern style that incorporate both modern and traditional building material.

Conclusion

The contemporary architectural style of Nigeria documented in this research work is characterized as post-modernism. The introduction of new construction material and techniques, the vernacular architecture with its impressive ornaments is losing significance to post-modern style. In fact, the use of the popular vernacular courtyard system that was well appropriate to Northern Nigeria is currently downplayed and even where it was used, it has been covered with modern roof.

Thusly, architects should invent a new vocabulary, which adopts a unique architectural style sympathetic to people life style, culture and context. This would be achieved by marrying vernacular and post-modern material and techniques. Since Post-modernism recalls the significance of traditional architecture and classical vernacular in contemporary styles and plural approaches, it also recalls advantages of low carbon peculiarities of these materials. Moreover, government policies in tandem with these ideas are germane to its sustainability and low carbon environment.

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