

# The Art and Reactionary Elements on the use of Alternative Building Materials in the Benin Metropolis

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**Abstract:-** The housing crisis in our urban centres is chronic. The cities are characterized by rapid growth, high demand, but poor housing. At present, the Benin metropolis is undergoing an explosive urban population growth due to rural-urban population drift compounded by the current insecurity and unemployment in the northern part of the country. The awareness of affordable low cost housing for the middle and low income earners is growing daily. The inadequacy has become a great concern all over the world thereby making it a priority to many international, local governmental and non-governmental organizations. Exploring the reuse of readily available alternative traditional building materials like earth, bamboo etc., which had been substituted with conventional materials such as cements, steel, glass etc. is inevitable. The human and environmental reactions to the process of conceiving, designing, construction and commissioning of dwelling units to help tackle and give sustainable impact on the housing shortage for the middle and low income earners of the society is growing daily. Appropriate use of earth in construction will produce cost-effective and comfortable buildings. Earth and bamboo are viable alternative building materials, reusable, biodegradable, sustainable resources and construction for adaptation to climate change. The integration of computational design into traditional building material enhances the optimum delivery of housing in the Benin Metropolis.

**Keywords:-** Earth, Bamboo, Low-Cost Housing, Growth Rate, Rural-Urban Migration, Settlement, Computational Design, Digital Design, Parametric Modeling, Generation Algorithm.

## I. INTRODUCTION

The housing sector plays an important role in countries' economies, having fixed assets of 10 – 20% of gross economic activity in the country (European Commission, 2005). The consequent increase in growth rate, coupled with the inability of many families to provide their own houses, it becomes expedient that the government plays a significant role in solving their housing problems. Olotuah (2000) stated that housing as an element of the environment is one of the indices of civilization, historical

and cultural evidence and a reflection of the economic values of the society. It impact on the satisfaction, human efficiency, health, social behavior and general well-being of the people.

This study investigated the different actors in the provision of low-cost housing; its impact on the people within the area of study – the Benin metropolis. Housing for low and middle income has to be built at low-cost by taking some financial measures, using alternative materials, simple construction methods and compact designs (sharing common walls) Erkelens (1983).

Housing is a mirror of the economic, socio-cultural and historical values of a society. It is one of the yardsticks to measure the degree of civilization of a country. It has an influence on the health, efficiency, social behavior satisfaction and general welfare of the people making it a worthy study (Olotuah, 2000). Adamolekun, Ahianba & Gbakeji (2019) asserted that housing enhances a better or improved health for the citizenry. Living in sub-standard housing conditions can result in higher risk of infectious disease transmission and other chronic diseases. It further shows that the provision of basic physical infrastructures in the built environment will impact positively on the mental and physical health of the people. This is why policies are being formulated, relevant academic research, debates, discussions, and sizeable numbers of literatures are put together towards alleviating the problem.

Melnikas (1998) described housing as a specific and relatively limited, physically, biologically socially close place where people and groups of people can live their biosocial life, by receiving services, performing house chores and other biosocial activity. It is an unaffiliated and intended space where a household can live a comfortable life without any bias or influence. It includes inhabited conventional dwellings and other dwelling units. Adamolekun (2023) opined that housing is 'a shelter or dwelling place with relevant services and infrastructure which guarantees privacy, physical, health, social integration, physiological identity and psychological well-being of the occupants (household) in a built environment'.

In this study, the following concepts are relevant and are to be considered: sustainable housing, low-cost housing and alternative building material (the art and reactionary elements). The Theory of housing as a Private Property is relevant. It's a right in our constitution, though not enforceable.

Explaining the statement 'the art', this refers to the way, how and to what extent the introduction of alternative building materials being used in a building is perceived. Going further, 'reactionary elements' are all factors

existing and assumed to interfere with an already constructed building. The relationship between the art of introducing indigenous materials and the reactionary scope that sustains it lies in the hand of an architect.

In view of housing conditions, the choices of houses are defined based on occupation, beliefs, and other factors. In spite of all, there is a need to accommodate those from the rural settlements that had engaged in high rate of rural-urban migration. This can be achieved through the provision of low-cost housing.

## II. THE BENIN METROPOLIS

The study area considered in this paper is the Benin Metropolis, made up Local Government Areas namely; Oredo, Ikpoba Okha, and Egor. .

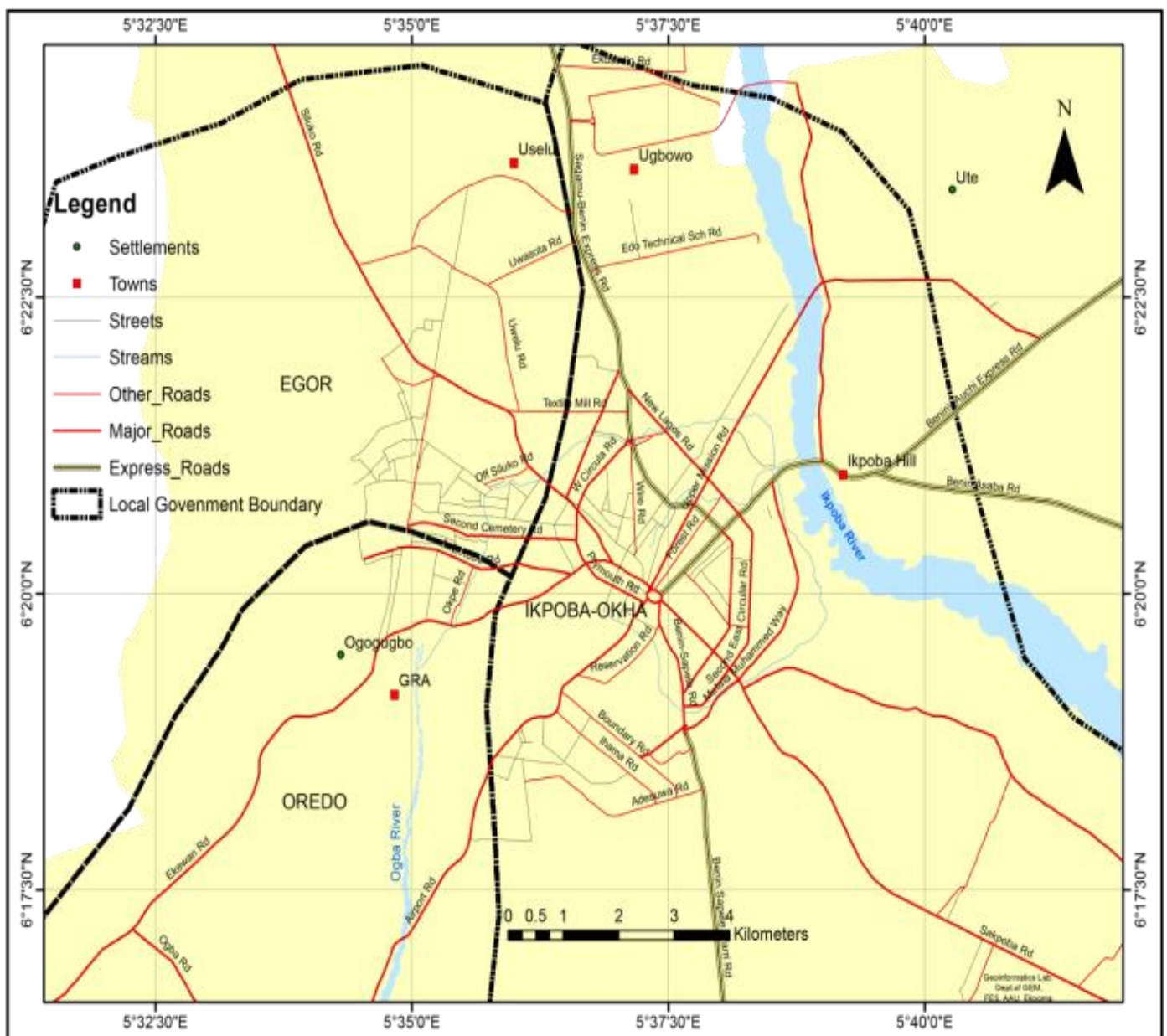


Fig 1 Map of Oredo, Egor and Ikpoba - Okha Local Government Communities.  
Source: Department of Geography & Environmental Management, A.A.U. Ekpoma, 2022.

The economic engagements of the Benin metropolis has varieties of economic activities which include manufacturing, commerce, industrialization, construction works, banking, farming, craftiness, trading, vocational aptitude, transportation, carving and other technical works (Eseigbe 2011). The segregated local crafted land use pattern is rather haphazard compared to other various sectors that form an urban area.

The population of the 3 (three) local government areas of study is very important to the purpose of this paper since it will deal with provision for human and environment. This population data by Local Government Area of Benin metropolis is given by 2006 Census and sourced by The National Population Commission, Benin City, Edo State (2009) as:

Table 1 Population Census of Three Local Government Area of Benin Metropolis in 2006.

L.G.A	Population	Male	Female
Egor	339,889	168,029	171,870
Oredo	374,671	189,393	185,278
IkpobaOkha	371,106	185,132	185,974
Total	1,085,676	542,554	543,112

Source: National Population Commission, 2009.

Eseigbe (2011) using geometric growth model of population projection at the growth rate of 3% came up with the population of Benin metropolis in 2006 – 2020 as follows (Table 2):

Table 2: Population of Benin Metropolis in 2006 Projected on a 3.0% Growth Rate to 2020.

Year	Population	Percentage of Growth Rate
2010	1,221,938	3.0%
2011	1,258,596	3.0%
2012	1,296,354	3.0%
2013	1,335,245	3.0%
2014	1,375,302	3.0%
2015	1,416,561	3.0%
2016	1,459,058	3.0%
2017	1,502,830	3.0%
2018	1,547,915	3.0%
2019	1,594,352	3.0%
2020	1,642,183	3.0%

Source: Eseigbe, J.O. (2011) Unpublished Ph. D Thesis, Ambrose Alli University, Ekpoma, Edo State.

### III. THE PRIVATE PROPERTY THEORY

There are various existing theories on housing but for the course of this paper, The Private Property Theory will be considered. Every Man wants to have a legitimate right and free claim to whatever that belongs to them. By this, there are specific and various uses of assets, tied down by beliefs, subjective ideologies and preferences and determining whatever the uses of the property is as they deem right (Snare, 1972; Bejrum & Jaffe, 1989).

According to Nelson Mandela’s book, ‘Long Walk to Freedom’, and about his house in Orlando West, Soweto, it was noted that “It was the opposite of grand, but it was my first true home of my own and I was mightily proud. A man is not a man until he has a house of his own.” Man over the years always works to having permanent attached structures of different sizes, and complexity in shape. Modifications of existing properties are also man’s choice as his existing environment gets upgraded. Using currently reachable technologies, new structures are constructed (Jaffe, 1989). The cause for modern civilization is property and its bases are evenly distributive justice. By this, Housing (dwelling units) and other constructions were made to serve this purpose and others (Jaffe & Sirmans, 1982; Nigh & Jaffe, 1987).

Looking vividly into Private Authority Theory, taking decisions is an exclusive right enabling one to have authority irrespective of such decisions conflicting with the interests of others in the society. Personal decisions about one’s assets, right to exclusive authority becomes necessary because by this, one has claim to the use of an asset in a personal and private way as specific from communal usage. The term ‘Private ownership’ will be pointless if there is no clear indication and authorization of the right to use the said assets. Private property, private ownership or/and home ownership are all the same. The concepts, Private property in housing are relatable with high level of private ownership of assets and properties.

In countries that shares same Anglo-American heritage, for instance, the United Kingdom, Australia, United States of America, and New Zealand, housing is regarded as private property. Best referred to as 'home-owning societies' (Kemeny, 1981). In Nigeria, it is called a 'home - owning society' as the right to housing is enshrined in the county’s Constitution.

### IV. PROVISION OF LOW COST HOUSING IN THE BENIN METROPOLIS

The provision of low cost housing in the Benin metropolis, Edo state and Nigeria generally has remained a mirage despite numerous National Housing Policies schemes and major development in modern building technologies.

Predominately, Man settles as a colony. This is defined by the land mass and borders, complexity of occupations and beliefs. This settlements can be in either two form namely. Rural Settlement and Urban Settlement.

The quest for greener pastures has made Man voluntarily or involuntarily moved within these two settlements creating deficiency to the receiving end and underdevelopment and isolation of the take-off area. This is understood more by the term ‘rural-urban migration’, that is the voluntary or involuntary movement of people from their rural settlement to an urban settlement. The rate of growth in any society has an effect on the urban resources of such city.

Defining Urbanization, Mesh (2014) highlighted urbanization as the gradual drift of the rural dwellers to urban society. Presently, The Benin Metropolis is undergoing rapid urbanization, leading to the destabilization of the initially planned landscape and allocations to the urban settlements thereby resulting to demand for dwelling houses, basic infrastructures, health, and method of waste disposal, education, transportation and commercial facilities among others. The challenge to be challenged in urbanization is seen more in the provision of adequate quality and sustainable housing, occupations and skills dependency, basic social infrastructures, improved healthcare, good waste disposal methods, drainage system among others.

Using traditional and alternative building materials to the known conventional building materials to provide answers to the housing challenge is the main purpose here.

This does not satisfy Castells (1997) definition of housing as an essential commodity, fixed commodity and an investment. The valuation of investing in recent low income houses is less. Aimed at promoting and providing home ownership for low and middle income earners in Nigeria, these schemes are yet to make substantial impact on the housing deficit due to the cost of conventional building materials.

Looking at the two low cost housing projects in the Benin metropolis and knowing low income earners can benefit from it as it tackles housing problems. The Federal Housing Estate, Iwogban on Lucky way, Ikpoba hill, Benin City and University of Benin Teaching Hospital (UBTH), both are low cost houses provided by the Federal Government of Nigeria under President Shehu Shagari administration, 1980. The low cost houses in Ugbowo which consist of 352 housing units were built on part of University of Benin acquisition 150 units was provided but as a result of change of Government in December 1983, 202, two bedroom housing units were abandoned. The beneficiaries of the Housing unit were prevented from occupying it due to the court case legitimating the dwelling units between Management of UBTH and University of Benin. As this occurred, the elements of the building deteriorates, opening it place has since become a hiding place for criminals. The issue had been resolved as at present by the Urban and Regional Development department under the Federal Ministry of Works and Housing.

This story is important and exemplary to aid understanding the art and the reactionary of low cost housing in the Benin Metropolis.

## V. SUSTAINABLE HOUSING

Sustainability is important for effective continuation of a certain course or operation. It is the conservation for an almost balanced relationship between man and his environment (ecosystem) and as such avoiding the reduction in quality of the environment, its resources and man himself.

Sustainable Housing can be achieved by planning, design and making maximum use and reuse of all energy created in and around a building, the eco-system and other given scope of life. But in all, the result is comfort and lessening the operational costs of erecting or organizing the society.

Sustainable development was defined by Taiwo & Adeboye (2013) as meeting the needs of the present, without tampering with the assumed ability of the coming generations meeting their own needs. Sustainable Housing is making affordable houses for low and middle income earners, with adequate waste and sanitary facilities and environmentally friendly renewable building materials.

The term 'sustainable housing' is commonly used to describe sustainable development in the housing industry, which includes:

- Improving dependability, lowering maintenance requirements and costs, and increasing user satisfaction.
- Reduced environmental and financial costs over the lifecycle.
- Increasing opportunities for housing materials been reused and recycled.
- Refurbishing older assets, buildings and repurposing existing buildings as new housing stock are priorities.
- Using renewable energy sources, as well as natural site features (natural ventilation, lighting, etc.).
- Producing less waste within and outside a building (not just through surplus materials but via optimal use of land and time, including minimizing impacts on local biodiversity).

Sustainable Housing requires Sustainable building materials as obtained by Calkins (2009), defining sustainable building materials as materials that are environmentally responsible because they have a strong influence on the lifetime of the end product and should not pose any significant health hazards or environmental risks. Sustainable building materials should be energy efficient, cost effective, capable of reducing or eliminating waste, less toxic, and cost effective. Furthermore, the building's owner should be able to enjoy low maintenance or replacement costs while improving the health and productivity of the occupants. There should be remarkable design flexibility and cost savings associated with changing space configurations (www.GreenBuilding.com, 2009).

## VI. LOW COST HOUSING: THE RELEVANCE OF ALTERNATIVE CONSTRUCTION TECHNOLOGY (ACT)

Comparing Alternative Construction Technology (ACT) to Conventional Construction Technology (CCT) is important to know which one of the two has a lesser cost in housing provision for middle and low income earning group. This explains the use of locally sorted building materials in the provision of low cost housing in the study area but of great significance is the technology employed. To achieve Low cost housing delivery in Nigeria, the use of local (alternative) building materials is to be considered (Ahianba, 2013). The speed of construction and quality production without affecting the quality of construction using less costly alternative materials and technologies must be given more attention.

Alternative Construction Technology (ACT) refers to a process of construction in which the emphasis is on the use of natural, traditional and alternative materials as against modern architecture that uses mainly conventional building materials (Deepa, 2006). It encourages cultural enriching. This alternative materials are mainly of minimal maintenance, low cost and sturdier, reliable, good thermal comfort and of utmost importance enhancing a healthier environment than when conventional materials are used.

Conventional Construction Technology (CCT) is defined as a process of construction of totally imbibing modern architecture construction process. This includes as refined limestone (cement), reinforcement rods, precasting products, steel, prefabricated components, and timber or plywood formwork. (Deepa, 2006). The technologies involved in the construction process and its materials are usually imported, expensive, sometimes scarce or customized for its user. Here building materials goes against local, traditional and alternative materials, thereby making the costlier for the low and middle-income earners can afford. There have been investigation and conclusions that housing units consists basically building elements as walls, foundation, roof, sanitary fittings, windows, doors fittings etc. Also, walls is the most expensive with 19% and next on highest portion is the roof carcass which is 15% of the total cost of the building element.

According to (Author survey, 2021), in the Benin metropolis, between November - December 2020 and January 2021, a bag of 50kg cement was N3,700 - N4,000 Daily Trust newspapers (2021) reported, like other dailies that “cement producers to slash price for Federal government 300,000 houses” in their low cost housing to be built under Economic Sustainability Plan (ESP). The pilot scheme is in Dei Dei, Abuja. The question is ‘who will slash price for low and middle income group?’ Each of the one or two bedroom houses costs approximately N2,000,000 (two million naira only). The mortgage plan is for N30,000 per month earners, paying minimum N10,000 monthly for about 15years.

Fact shows that, conventional construction technology (CCT) couldn't minimize the high demand of houses due to affordable cost within short time and quality production. Any strategy to address this challenge will need to take into account the particular constraints linked to developing societies. The need of alternative construction technology (ACT) is the best solution to address these and other related challenges and build sustainable housing for the majority of the population (USAID, 2009).

## VII. THE USE OF EARTH AS AN ALTERNATIVE CONSTRUCTION TECHNOLOGY

Earth, an indigenous building material is one of the oldest materials used in building construction throughout history.

Earthen architecture is organic, sustainable, coherent, cultural, structured, and gotten from nature with a strong mutual with the environment. Looking at the harsh climatic conditions in the Benin metropolis,, earth is suitable as it gives thermal comfort, it has high insulation to heat, it is significant with the level of comfort to the inhabitants, expected and convertible energy efficiency in cooling and heating of a housing unit (Diala, 2017).

Earth constructions has low tensile strength and its buildings are highly susceptible to damage by water action, preservative measures become desirable. It is one of the most used materials for construction globally. Earth as a building material requires zero energy for production, has the lowest environmental impact of any material and it is 100 % recyclable. The construction of homes with earth has long illustrious past. In the history of our fore fathers, they lived in shelter built from traditional building materials especially earth. Low cost housing delivery in Nigeria will be better achieved by the use of local (alternative) building materials (Ahianba, 2013). Earth as a building material, has its challenges as not all soils are suitable for application as building material. Besides, there are some drawbacks as the loss of strength due to saturation, durability and its sensitivity to erosion by rain impact. This necessitates the use of appropriate technology.

Rammed Earth is an ancient, traditional raw materials of earth, chalk, lime and gravel. They have a good structural capacity and are subject to less shrinkage. Through rammed earth constructions, foundation footing can be made of high compressive strength, done by filling and compacting mould or to fill into a given formwork, hence the focus in this research is Compressed Stabilized Laterite Block (CSLB). Laterite is a soil formed by intense weathering in tropical climates and characterized by a high iron and aluminum concentration giving it its characteristic red colour (Kasthurba, Santhanam& Mathews, 2007).

The Benin Metropolis is characterized by plains in most parts and isolated hills in a few other places. The geology comprises of: alluvium; the Benin formation; drift/top soil and Azagba - Ogwashi formation. It is marked by top reddish earth, composed of sands, discontinuous clay sequence and clay soils (Ikhile, 2016). Soil profile consists of laterite that is reddish brown in colour. Using as a building material, some characteristics such as the grain size distribution, mineralogical and chemical composition, clay content and organic material content are analyzed. This will help in analyzing the earth for construction works. Some of the required tests include, sieving sedimentation, and consistency tests and cohesion.

CSLB technology is a modern improvement to traditional building methods for structural constructions, load-bearing strength and resilience against the climate. Stabilized with 5% cement or lime and compressed either with a manual, hydraulic or motorized compressing to produce structural masonry units with greater strength and longevity than the average fired brick. Evacuation of earth can be used for rainwater harvesting and percolation systems in flood-prone regions. It can also be used to increase water security and sufficiency and also to solve the problem of reduced water-table capacity. Compressed Stabilized Laterite Block (CSLB) is recommended for walls as appropriate alternative choices for stakeholders, provided that the quality of the products is suitable.

The introduction of CSLB production increases its qualities in terms of strength and cohesiveness of the soil thereby reducing moisture movement and achieving optimum compressive strength. CECTech (1995) opined the resultant effect of stabilization amongst others to include: increase in dry density of soil; improvement in tensile and compressive strength as related to each other, resistance to water erosion, dry and wet compressive strength (Ahianba, 2013).

### VIII. INTEGRATION OF COMPUTATIONAL DESIGN INTO TRADITIONAL BUILDING MATERIALS.

Computational design is the process of generating, optimizing, and refining designs across numerous domains, from architecture and engineering to product design and more, through the aid of computer algorithms, simulations, and data-driven methodologies.

Caetano *et al.*, (2020) using parametric modeling and generative algorithms frequently, computational design enables architects and designers to produce unusual and complicated designs that were previously challenging to realize using only traditional design techniques. Computational design can provide a number of advantages when used in conjunction with conventional building materials including wood, concrete, brick, and steel.

In contrast to Computational Design, which involves using computing to create designs, Digital Design is a method of using computer tools in the design process.

(Menges, A. and Ahlquist, S., 2011), which were based on analog computation, provide an illustration of Computational Design that is not Digital Design. On the other hand, Digital Design that is not Computational Design includes the straightforward use of a Computer Aided Design (CAD) tool as a drafting tool without explicitly using calculation.

Caetano, I. and Leitao, A., (2020) some crucial features and uses of computational design facilitate and enhances the traditional art and reactionary elements on the use of alternative building materials in the Benin metropolis include:

- Design Efficiency: Computational technologies let architects promptly examine and evolve through a wide range of design choices. This effectiveness can result in optimal designs that are pleasant to the eye and robust.
- Complex Geometries: The shapes and forms that traditional building materials can adopt are frequently confined. It is possible to create complex, unusual geometries using computational design, which can improve a building's visually appealing qualities.
- Structural optimization: By using computational design to assess complicated structural loads and stresses, more effective, lightweight, and efficient designs that make better use of conventional materials can be created.
- Customization: Using computational design, architects can adapt their designs to particular site conditions and user requirements. Buildings with this amount of modification may be better suited to their surroundings and uses.
- Resource Efficiency: Using traditional materials in conjunction with computational methodologies can help promote sustainable and environmental-friendly construction methods by optimizing material utilization and reducing waste.
- Innovative Assemblies: Computational design can provide ideas for fresh approaches to putting conventional materials together, resulting in innovative construction processes and techniques.
- Parametric Design: By using parametric modeling, architects can build flexible designs in which modifications to one part of the design update all associated aspects. This can increase coordination between various design disciplines and streamline the design process.
- Simulation and Analysis: Using computational tools, architects are able to model and assess a variety of design elements, including thermal behavior, daylighting, and energy efficiency. Better design decisions result from this.
- Communication and Visualization: Through visuals and interactive models, computational design tools enable clearer communication of design intent to clients, builders, and other parties involved.
- Innovative Facades: Using computation in the design of complex buildings that respond to climatic variables, maximize daylighting, and control solar heat gain can be highly advantageous.

Table 3 Comparative Cost Analysis of Blockwall, Roof, Plastering, Lintel and Columns of One Bedroom Convertible.

<b>A</b>	<p><u>SANDCRETE BLOCKWALLS</u> Approximate number of blocks (230mm) = 1,780 pieces. Estimated cost of buying, ₦814,222.00</p>	<p><u>COMPRESSED STABILISED LATERITE BRICKS.</u> Approximate number of bricks required = 5,696 pieces. Estimated cost of production and laying, ₦529,244.00 <b>35% Less</b></p>
<b>B</b>	<p><u>ROOF LONGSPAN ALUMINIUM WITH WOOD CARCASS</u> Approximate metre runs of long span aluminum roofing sheet required= 181 metre runs complete with wood or timber carcass. Estimated cost of buying and laying or fixing= ₦ 848,761.00</p>	<p><u>LONGSPAN ALUMINIUM WITH BAMBOO CARCASS.</u> Approximate metre runs of Longspan aluminum roofing sheet required complete with BAMBOO carcass= 181 Metre runs. Estimated cost of buying and fixing= ₦ 595,910.00 <b>30% Less</b></p>
<b>C</b>	<p><u>PLASTERING SANDCRETE BLOCKWALL CEMENT AND SAND PLASTERING.</u> Plastering using cement and sand (1:6) = 367m<sup>2</sup> Estimated cost= ₦ 403,700.00</p>	<p><u>COMPRESSED STABILISED LATERITE BRICK WALLS CEMENT AND SAND PLASTERING.</u> Plastering using cement and sand (1:6)= 367m<sup>2</sup> Estimated cost = ₦ 403,700.00</p>
<b>D</b>	<p><u>LINTEL REINFORCED CONCRETE LINTEL</u> Reinforced concrete Lintel complete with steel reinforcement and timber formworks = 3.5m<sup>3</sup> Estimated cost = ₦ 527,558.00.</p>	<p><u>REINFORCED CONCRETE LINTEL</u> Reinforced concrete lintel complete with BAMBOO reinforcement and timber formworks = 3.5m<sup>3</sup> Estimated cost = ₦ 358,000.00 <b>32.12% Less</b></p>
<b>E</b>	<p><u>COLUMNS (2NOS) COLUMNS (2NOS)</u> Reinforced concrete columns complete with steel reinforcement and timber formworks : = 0.32m<sup>3</sup> Estimated cost = ₦ 48,338.00  <b>OVERALL: ₦ 2,642,579.00</b></p>	<p><u>REINFORCED CONCRETE COLUMNS</u> Reinforced concrete columns complete with BAMBOO reinforcement and timber formworks : = 0.32m<sup>3</sup> Estimated cost = ₦ 33,184.00 <b>31.35% Less</b> <b>OVERALL = ₦1,920,138.00</b> <b>27.34% Less</b></p>

Source: Author’s Design and cost analysis, (2021)

**IX. RECOMMENDATIONS**

Government’s involvement in the provision of low cost housing in Nigeria has not achieved its desired result due to the rising cost of building materials and poor implementation of housing policies which are revised from time to time. To ensure adequate provision of affordable low cost housing in the Benin metropolis, the use of sustainable alternative building materials is imperative. There is widespread tendency towards the use of sustainable local materials and earth as one of the predominant materials for building of modern houses. It was used for construction of residential buildings in the past and with appropriate technology / building construction techniques, earth and bamboo through systemic realisation of contemporary architecture have the potential to provide the modern standard of houses that satisfy aesthetic requirements.

From this paper, the following recommendations are made:

- The formulation of national policy on housing for the poor / low income should include the promotion of the use of earth construction. This can be achieved through publicity, research development, training and pilot projects.
- There is the need to develop earth building codes, standards, and regulatory procedures to streamline planning permission for earth buildings.

- Earthen Architecture is affordable, durable, feasible, environmentally-friendly, cost-effective, alternative to modern time's construction materials with related methods, techniques and practices. Though highly susceptible to damage by water action, low resistance to wear and tear and mechanical damage, the use of mortar-proof chemical additive (which is inexpensive) and cement-sand plaster will put to check these perceived defects. Besides, stone foundations raised above ground level overhanging eaves to protect the bottom from running water. It is recommended that damp proof membrane (which is used for conventional building materials) be employed to protect the wall from capillary action of underground water.
- Earth constructions has a tendency to have low tensile strength, bamboo roofing structure becomes more ideal due to its light weight. Though the option of hardwood roof structure is not ruled out if it becomes desirable. Columns with bamboo reinforcement in concrete in the wall framework will suffice. Since the thermal performance of a compressed or rammed earth wall and compressed stabilized laterite bricks (CSLB) depends on its density, porosity and water content 230mm thick wall is recommended. It guarantees good sound insulation, low thermal conductivity, low embodied energy, excellent control of indoor air moisture, affordability amongst others.

## X. CONCLUSION

This paper has highlighted the reaction of people to the evolution of building materials and the benefits of revisiting the use of alternative building materials as a means of solving the problem of shortage of housing among the middle and low income earners. The purpose of this study is not to condemn the use of modern building materials but to demonstrate the use of alternative building materials with relevant building technologies that will complement it thereby resulting in the provision low-cost and affordable housing.

The case of rising homelessness among the urban poor is precarious and needs urgent attention. The use of earth construction in many parts of the world is on the increase because of rising energy costs caused by the use of modern building materials. Appropriate use of earth in construction will produce cost-effective and comfortable buildings because research showed that earth structures have lower embodied energy than buildings made from conventional materials. Earth is versatile, adaptable and can be used to reflect architectural diversity and can, as well, be employed in the provision of housing for different classes of people.

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