RESEARCHERID
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[Olotuah * *et al.*, 7(12): December, 2018]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

ECOLOGICAL APPROACH TO SUSTAINABLE HOUSING DEVELOPMENT IN NIGERIA

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DOI: 10.5281/zenodo.2297832

ABSTRACT

Housing is a major need of humanity which is highly deficient in many developing countries. Research findings have shown that there is a monumental deficiency in housing, in qualitative and quantitative terms, in the urban centres in Nigeria. Housing development is severely hampered by a myriad of factors in Nigeria. Because housing is central to quality of life and consumes large amounts of resources it contributes significantly to sustainability. Ecological approach to housing, which is environmentally-friendly and low-cost is a proposal that could contribute to sustainable housing development in Nigeria. This paper examines the application of ecological approach in housing development in Nigeria. It discusses low-carbon initiatives and solutions that are prevalent in the country, and recommends various passive design strategies that could be adopted in ecological housing in Nigeria. It asserts that the adoption of local building resources mainly sourced on-site with little embodied energy for their production, and the operation of cooperative housing is a functional approach that could be adopted to achieve ecological housing development in Nigeria.

KEYWORDS: buildings; cooperative; ecological housing; functional approach; sustainable development.

1. INTRODUCTION

Research findings have shown that there is a monumental deficiency in housing, in qualitative and quantitative terms, in the urban centres in Nigeria [1-5]. There is the problem of improper co-ordination of urban planning which has given rise to illegal structures sprouting up in urban centres.

The increase in the quantity of the dwelling stock in Nigeria over the years does not match the population explosion experienced in urban centres, resulting in severe overcrowding in existing housing, rapid deterioration of housing conditions, the growth of squatter settlements in the cities, and the emergence of slums. Buildings in the slums are constructed with materials of poor quality (aggregates, concrete, sandcrete blocks), and are poorly maintained [6-10].

The housing development that is geared towards improving the welfare of the general populace (the poor majority) and their living environment is a critical need for Nigeria especially in the urban centres. Initiatives to achieve environmentally-friendly housing are imperative in achieving sustainable housing development in the country. Key sustainable factors are taken into consideration in housing development to ensure environment-friendliness, user satisfaction, well-being, and productivity. Sustainability in the built environment involves promoting energy-efficient buildings and minimizing negative impacts on the environment.

Ecological approach in housing adopts sustainable architecture principles and this involves environmentally-conscious design techniques. This is achieved through choosing the right building materials and suitable environmental designs. Ecological housing meets environmental and socio-economic considerations, is environmentally friendly, and meets the housing needs of the people.

This paper explores the use of ecological principles in housing development in Nigeria. It examines various passive design principles that are climatically appropriate for tropical climates of Nigeria, and it investigates existing housing development projects across the country where ecological principles have been taken into cognizance. It examines the concept of low-carbon initiatives particularly as it relates to the use of indigenous building materials locally in Nigeria rural and urban centres.

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2. ECOLOGICAL HOUSING

In eco-architecture, buildings are perceived as part of the larger ecology of the planet and as living habitats. Beyond being a product or as a work of art, a building is considered to have a close connection to its environment, society, climate, region, and planet. The practice of eco-architecture started at the wake of the rise in prices of fossil fuels consumed in buildings in the 1970s, which resulted in the search for alternative sources of energy to power buildings. Consequent upon the hike in the oil prices, there were alarming predictions on the depletion of fossil fuels and natural gas. This led to the increase in the demand for renewable energies and buildings that are less dependent on limited oil but supported by solar power, biomass, and other renewable sources.

The main greenhouse gas in the atmosphere is carbon dioxide (CO_2), and buildings generate 50 percent of manmade emissions. If the rate of emission of greenhouse gases does not abate, the UK Meteorological Office has predicted severe impacts by 2080 which could include a rise in global average temperature of 3^{o}C over the 1961 to 1990 average [11]. Other substantial impacts could be higher sea levels.

Essential considerations for achieving ecological housing include orientation of buildings and selection of materials. In the tropics, openings and walls are protected from the sun under a large roof eave in order to achieve good thermal interiors. Since Nigeria falls within the tropics, western orientation for fenestrations need be avoided, because of overheating by the sun. It is better for the longer side of the building with more openings to be orientated to face the north-south direction to avoid larger portions of buildings being exposed to direct sun rays. Consideration need to be given to the function of each room in a house and the type of light and heat they would require from the sun.

The choice of materials for a building affects the environmental impact of buildings. Generally, building materials require processing that accounts for some energy. The processing may be minimal, as in the case of houses constructed with locally-sourced materials such as clay, or extensive as in the case of exotic buildings constructed with contemporary materials. An example of contemporary materials is cement, the production of which accounts for 5% of the global manmade CO_2 emissions. Selection of materials is therefore vital in ensuring energy efficiency in buildings. The two types of energy considered in buildings are embodied energy and operational energy. The embodied energy is the amount of energy required to produce and transport a material to the site for use, while the operational energy refers to energy required while a building is in use throughout its whole lifetime.

3. LOW-CARBON INITIATIVES IN ECOLOGICAL HOUSING IN NIGERIA

Because it has been widely observed that a great quantum of carbon dioxide (CO_2) is emitted to the atmosphere through the whole life-cycle of a building, it is vital to seek housing solutions relating to energy saving, emissions control, production and application of materials, and the use of renewable resources towards achieving sustainability [12, 13]. Carbon dioxide is emitted into the atmosphere during the production of building materials, the construction of a building, and the operation, renovation, rehabilitation and demolition of the building. The construction industry is intensively growing and actively developing worldwide. The industry is however responsible for such environmental burdens as high energy and water consumption, solid waste generation, global greenhouse gases (GHG) emissions, external and internal pollution, and depletion of natural resources. Annually, building construction in the world consumes 25% of the global wood harvest, 40% of aggregate (sand, stone, and/or gravel), and 16% of water. It generates 50% of global output of GHG and agents of acid rains [14].

In Nigeria the use of low carbon materials and low carbon construction techniques is indigenous. For example, building earth is the traditional material for construction and has been used for centuries. Solid Interlocking blocks (SIB) used in building construction and particularly housing schemes began to gain foothold due to the strong need to accelerate the masonry construction process in the construction industry. The traditional masonry method is labour intensive, and hence slower, due to the presence of a large number of mortar joints. Interlocking blocks differ from conventional blocks in that the units are assembled together using geometrical features incorporated in the units without the aid of mortar.

The solid interlocking blocks of lateritic composition stabilized with cement were also developed by the Nigerian Building and Road Research Institute, NBRRI. The main aim of the development was first, to equal or exceed the structural performance of conventional masonry systems, and second, to provide a more economical and rational solution for the masonry system thus leading to more competitive designs.

Research findings show that the development of solid interlocking blocks has many merits over the conventional types. Substantial cost savings are achieved due to the elimination of bedding mortar in the superstructure **(**except in ring beams and in high gables), and it accelerates construction, thereby reducing workmanship and cost. In the system freely-available subsoil is the main raw material. The blocks do not require costly burning, and transportation costs are minimized since block production takes place on the site. Unskilled labour is trained in both block-making and building with the material. Besides, the speed of construction is a valuable feature of the system, which is much faster than in the use of other building methods. Moreover, owing to lateritic composition of the material, it is environmentally friendly as blocks are produced under high compression from the subsoil, without the need for the fuel-wood used to burn bricks. The process is thus sustainable. The pollution caused by the combustion of fossil fuels, and the costs of energy required for the manufacture of building materials are main challenges for high energy-intensive products, like concrete, bricks, plastics, and metals [15].

4. DEVELOPING ECOLOGICAL HOUSING IN NIGERIA

There are three options of ecological housing development available, viz: traditional sustainability, modern sustainability, and high-tech sustainability. The traditional sustainable housing makes recourse to the use of local building materials obtained, processed, and used on site. In such a production process the energy input is minimal, and since there is little or no transportation process involved, the embodied energy expended is reduced to the minimum. The clay that is obtained on-site to produce adobe blocks is a good example of traditional sustainable material. However, the challenge with traditional sustainability is that such housing lacks social acceptability to many in the urban centres in Nigeria.

Modern sustainability goes a little higher than the traditional type. In this case, materials may be sourced and produced off-site. Some modern building materials and initiatives may be added to improve the value of locally sourced building materials to be more socially acceptable to the people. Examples are the addition of some percentage of cement to earth to produce stabilized earth interlocking blocks or burnt bricks used extensively for housing in Nigeria and other countries of the world.

The third category is the high-tech sustainable housing where components are manufactured and assembled in a fully sophisticated and computerized environment as practiced in some advanced nations of the world. Such housing depends largely on steady power supply and high level of technology. This level of housing is not practicable in Nigeria owning to the low level of development in the country, particularly the instability in power generation, distribution, and supply.

In adopting ecological housing, the energy input into the housing need be reduced to the minimum. This could be achieved through design, materials, and construction initiatives. In the area of materials, the sourcing, transportation, manufacturing, and construction of materials are vital to the reduction of embodied energy used in housing production. This is particularly important as building materials constitute the largest single input in housing construction. If building materials for construction of housing are sourced on-site with little or no transportation involved, embodied energy utilized will be low. Where the manufacturing process to finish stage is minimal less embodied energy would be required. Also, the use of simple construction processes that would not require heavy machineries and burning of fossil oil would impact less on the environment, making such housing to be environmentally friendly. Nigeria is richly endowed in raw materials for the production of building components and materials [16-20]. The raw materials include silicon, iron ore, clay, limestone, timber, and gypsum. Some of the raw materials have been lying largely untapped and have, therefore, been insufficiently used for desirable purposes. In spite of the large deposits of raw materials in the country, building materials have either been imported as manufactured goods or have been manufactured locally with high import content of raw materials. Consequently, the building materials industry has been poorly developed in the country. The poor development of the building materials industry accounts for the shortage of building materials suffered in the housing industry since importation of the materials has become a very costly venture because of the depreciated value of the Nigerian currency.

In Nigeria, ecological housing could be developed by non-profit organisations such as cooperative societies, religious bodies, or staff housing for organized private sectors and other non-profit private initiatives. Cooperatives started in Nigeria in 1934 after the submission of the Strickland Report on the introduction of cooperative societies into Nigeria [21]. They exist in every state of the federation, with each state having its own apex cooperative organisation, which serves as an umbrella for the smaller and functional cooperative unions and societies.

The cooperatives facilitate house ownership for their members by giving them housing loans, and embarking on the construction of housing units (blocks of flats, tenement buildings) for the benefit of the members. Housing cooperatives are in a position to provide housing for their members without using their own funds but their

names to facilitate the construction. Members are also relieved of the burden of looking for funds for housing development. The cost of the buildings will be lower in this arrangement since building materials can be purchased directly from building materials manufacturers.

5. CONCLUSION

This paper shows that sustainable architecture promotes energy-efficient buildings, minimizes negative impacts of buildings on the environment, and minimizes climate change while reducing pollution and improving air quality and health of the populace. Because of the effects of global warming, it is imperative that principles of sustainable practices should be adopted in housing development. The paper asserts that ecological housing is feasible in Nigeria. Owing to the modest achievement of sustainable practices in Nigeria like the use of adobe blocks, development of laterite interlocking blocks and adoption of composite walling materials, ecological housing is feasible if properly encouraged. Consideration of the principles of ecological housing could be brought to bear on mass housing projects in Nigeria that would ease housing deficit and poor quality arising from lack of essential services and basic infrastructure. A functional approach to achieving ecological housing development is the adoption of local building resources mainly sourced on-site with little embodied energy for their production, and the operation of cooperative housing.

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