

# Redressing Earth Building Adaptation in Nigeria; A post use evaluative study of Compressed Earth Building Low-cost housing project in South East Nigeria. The Avu-Owerri Redemption Housing Experience.

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**Abstract:** Low-cost housing projects are a fundamental part of developing sustainable homes for the population in third world countries. Nigeria is the most populated country in Africa, and is experiencing problems such as rapid population growth rate, uncontrolled urbanisation, housing deficit estimated at 17 million units, deforestation and erosion which directly affect the population's well-being. These problems prompted the then Imo State Government in 2002 to construct eighty units of Compressed Stabilised Earth Brick (CSEB) low cost houses for the public at Avu-Owerri. By constructing this demonstration houses, the unfamiliar simple technologies used were meant to be spread to the society, showing the population the advantages they hold in cost, durability and comfort compared to the conventional ways of building they have been adopting. Fifteen years after, a post use assessment shows that over one hundred and twenty conventional houses has been built around the project site within the estate. This paper takes a critical study/analysis of the reasons and courses of this shift from the initial government intentions. Corruption on the side of administrators and ignorance on the side of the public were found to be one of the primary courses of decline in use. Field studies reviled possible remedies and were proffered.

**Keywords:** Earth Building, Low-Cost Housing, Housing Deficit, Earth Blocks

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## I. INTRODUCTION

Several governments in Nigeria, both at the federal and state levels, have attempted to address housing problems through several housing programmes. These programmes included urban mass housing schemes; site and services, promoting private sector participation; national housing fund etc (FMW&H 2001). These attempts never fully addressed the root of the problem, as all the effort were only geared towards finance, and little on methods of housing provision. As such, when the meagre funds are available, conventional building materials such as sand Crete blocks, concrete, aluminium, steel, etcetera were used in designing and constructing the houses. This method is capital and energy intensive and with heavy dependence on importation which runs counter to the socio- economic climate in Nigeria.

The reality on ground is that Nigeria has acute housing problems but does not have adequate capital resources and the matching technology to construct conventional houses to meet housing demands. According to the provisional result of the 2006 census, the country has 140,003,542 people, made up of 71,709,859 males and 68,293,683 females (Newsday, 2007, Jan.30.).

In the 1991 head count, the country had about 89 million people. By 2006, fifteen years later, the country's population had increased to over 140 million, a phenomenal increase of over 55 million people within this period, indicating one of the highest fertility rates in the world. The summary of it all is that the economy has not kept pace with the population growth. According to Seo and Mordi (2002)'s "Human Development Nigeria 1998", the unprecedented growth of Nigerian population is largely responsible for the housing problems in Nigeria. The inevitable outcome of this explosion is the aggravation of urban blight and squalor, resulting in majority of urban dwellers living under subhuman conditions in slums and illegal settlements without employment and any visible means of livelihood.

As a result of the increase in population, the magnitude of housing problem in the country is enormous. According to Ajanlekoko (2001), the housing requirement of the nation then was between 500,000 and 600,000 units annually. If this estimated annual requirement is to be provided from 2001 to today in order to meet our housing demand (at the average of N3million, per unit), the cost would be enormous and indeed unrealizable. The Federal Mortgage Bank of Nigeria (FNBN) posited in December 2010 that Nigeria would

need about N42trillion to solve her housing deficit, (Daily Sun, 30th Dec. 2010).The housing deficit in the country by the end of 2010 stands at 16 million units.

### **STATEMENTN OF THE PROBLEM**

It is evident that the use and application of compressed stabilised earth buildings (CSEBs) for low cost housing are successful in many developing countries of Africa, (Mubaiwa, 2002), (Zami and Lee, 2008), in Nigeria the situation is not the case. Stabilised Earth Construction is yet to be widely adopted to address the problem of low cost housing crisis in Nigeria. There are few estates and experimental housing formations designed and built with stabilized earth materials in Nigeria.

Information on their performance in use is not known because post- occupancy evaluative studies on the estates are lacking. Yet mass adoption of this method will depend on this feedback information. The lack of this information has negatively affected government intervention policies and the application of this method in solving the ever lingering housing deficit problems.

## **II. THE PROJECT**

A new housing estate, “Redemption Housing Estate” built with compressed stabilized earth brick in Obinze-Avu, Owerri North LGA, Imo State in 2000 by Imo state government, was aimed at achieving good quality buildings at an affordable cost to the civil servants and the general public. The houses built with sundried Compressed Stabilized Earth Brick were experimental in nature and are meant to alleviate pressing housing problems arising from the long years of military rule in Nigeria. The Proposed two hundred and fifty houses, took off with initial sixty units. The government wanted low cost houses that could be built in a short time, to fulfil the governor’s campaign promises. The earth bricks as well as the roofing tiles were locally sourced and manufactured on the site making use of laterite soil (earth) for the wall, and coconut coir and sand for the roofing tiles.

Fig1. Elevation showing the two (2) Bedroom detached units, Redemption Estate Avu, Owerri



## **III. BACKGROUND OF DESIGN/BUILDING**

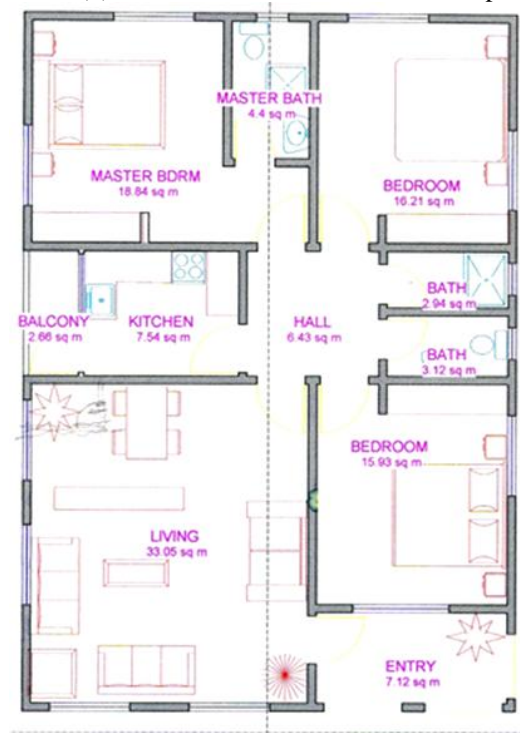
The sixty housing units were made up of:

- Three bed room detached houses, twenty units.
- Three bed room semidetached houses, ten units.
- Two bed room detached units, twenty units.
- Two bed room semidetached units, ten units.

The project was designed and supervised by the authors for Habitat consult limited (developers) Abuja in 2000. The walling (compressed stabilized earth) and roofing materials were produced on site using locally made Cimva Ram compressing machine for the bricks and fibre moulds for the roof tiles.

The buildings were designed to use local materials to achieve a high quality building fabric, with low environmental impact within a cost of approximately N1.2 million (8,000 US Dollars) for the two bed room units and N1.5 million (10,000 US Dollars) for the three bed room units on the average as against the prevalent N2.5 million (17,000 US Dollars) and N3million (20,000 US Dollars) respective cost of equivalent conventional units.. The houses are bungalows, designed to be compact with minimal circulation spaces to reduce cost. The bedrooms as well as the living rooms are well ventilated with a head room of 2.8m to enhance thermal comfort. The Compressed Earth Bricks and mortar were used to build the external and internal walls of the houses. The foundation footing was constructed with 150mm hollow sandcrete blocks and the over site concrete raised 450mm above the ground level to protect the earth bricks.

Fig2. Plan showing the two (2) Bedroom detached units, Redemption Estate Avu, Owerri



#### **AIM**

A post occupancy evaluation of the estate was carried out by the authors for three years spanning from 2012-2015. Since this was the first Compressed Earth Building estate project within the South-East region, the study was perceived to be a pointer for the progress of CSEB in the region. The aim was to evaluate Post-construction performance assessment of residential Compressed Stabilized Earth Buildings (CSEBs) in Imo State Nigeria using Redemption housing estate as pilot project.

#### **IV. IN-DEPTH INTERVIEW OF END USERS**

##### **Residents Interview;**

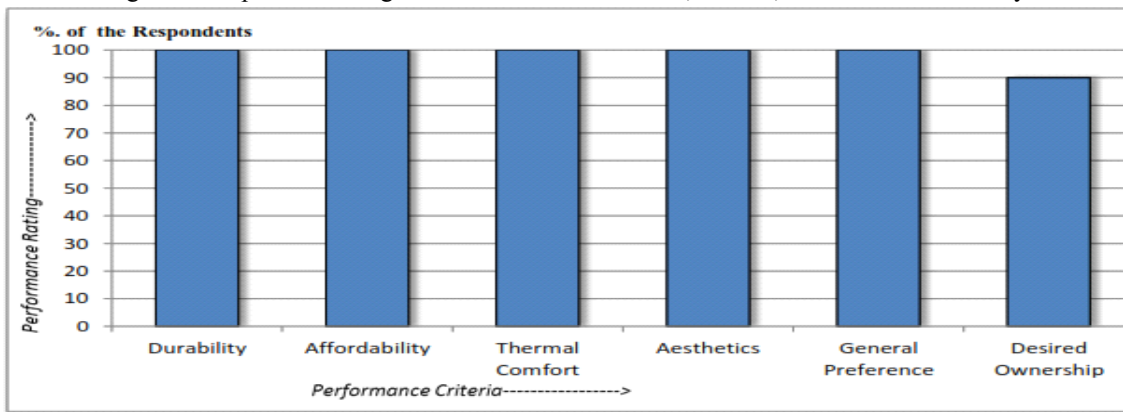
Fifty (20) residents living in CSEB Redemption Housing Estate were interviewed in-depth interview on five key performance issues:

- Durability and Construction of house.
- Affordability of house
- Thermal Comfort of houses.
- Aesthetics
- Desire for ownership

All said the houses have displayed good thermal comfort and resistance to weather erosions.

Out of the 20 tenants interviewed, 18 will willingly purchase the houses if more were built considering cost of house at completion and the favourable climate experienced by the occupants.

Fig3. Redemption Housing User Assessment of CSEB; Source; Author's Field Survey 2015



**Designers and Building Contractors of Imo State Housing Cooperation (IMSHC) Assessment.**

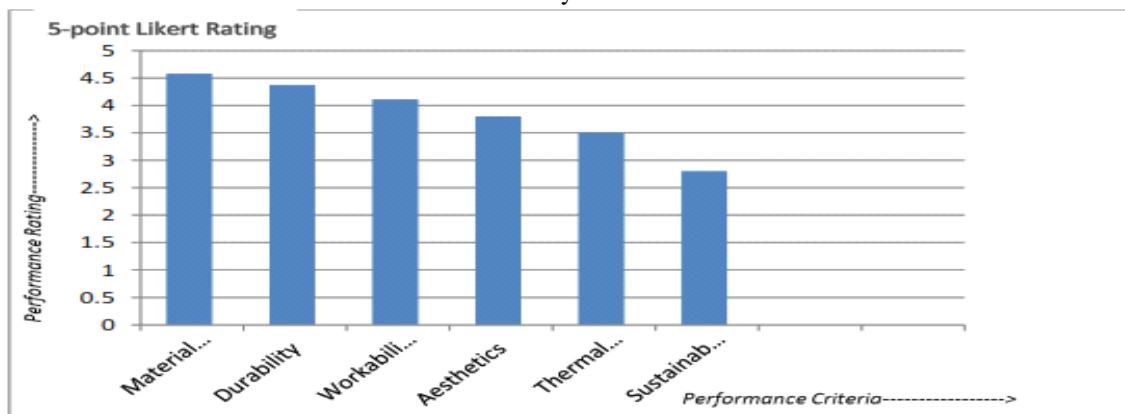
The 10 questionnaires administered on designers and administrators of IMSHC were analysed using the Statistical Package for Social Sciences (SPSS). Means and frequencies generated.

Respondents were asked to assess a range of criteria for potential specification and selection of earth as a building material if they were to adopt it in all their projects (having seen the pilot project demonstrated) against a five-point Likert scale in line with:

- Functionality factor (Thermal Comfort, Adaptability/Workability)
- Aesthetic factors
- Material Cost of construction
- Structural/Construction factors of design (Durability, Sustainability)

The results, shown below indicate that ‘material cost’ was accorded the highest important rating (4.58) followed closely by durability (4.37) and easy workability.

Fig4. Factors influencing the specification of CSEB in the Nigerian construction industry Source; Author's Field Survey 2015.



**Administrators' of IMSHC Rating of Some Factors Impeding C S E B s**

Administrators at IMSHA were asked to comment on a number of factors that impeded the extensive use of earth over these years.

The cooperation operates only Site and Services or Develop to DPC and Sale, the home owners depend only on registered contractors for the construction of their homes, thereby are compulsorily made to use the conventional method of construction.

Respondents opined that lack of technical knowledge on earth construction and the registered contractor's reluctance to learn and adapt to earth building techniques as a factor.

The administrator's non-adoption of CSEB after the pilot project, were expressed to be due to fear of losing market.

## V. DISCUSSION

This project has demonstrated that earth brick is economically viable aesthetically and technically appropriate for domestic construction in South Eastern Nigeria. Earth brick masonry works well in our environment, achieving high levels of user comfort and owner occupier satisfaction.

Simply put, earth brick masonry has the potential to improve building quality, reduce the environmental impact of construction create healthier homes and most importantly help to greatly reduce our prolonged housing deficit. While these materials are relatively easy to use by non-specialists, the market is not yet developed. Government interest and policy statements in ways of solving our housing deficit is very necessary at this time.

Technical research, building code, product development and contractor skills are areas that require further investigation and investment.

Fig5. 2 Bedroom Semi-dethatched & dethatched units, Redemption Estate Avu, Owerri.



## VI. CONCLUSION

Nigeria still faces major issues concerned with perceptions and attitudes towards earth building on the one hand, and lack of technical knowledge and building codes on the other.

This research shows that a number of bias social attitudes especially on the side of administrators of public housing projects need to be addressed through publicity, public consultations, government policy and more demonstration projects in each of the 36 States of the Federation. Most administrators tend to be at home with costlier houses for cost manipulations.

## VII. THE WAY FOWARD

While earth brick masonry is a relatively simple form of construction, very few people in the contemporary Nigeria construction industry are familiar with it. Although use of these materials has been slow in gaining recognition, they could be our hope in solving our present housing deficit problem. However, basic guidance is necessary for non-specialists. Such guidance will be an opening for further research and implementation of earth design and construction improvement techniques targeted towards adoption of new codes of practice and standards to promote the use of earth in construction.

Additionally, short courses and workshops would assist designers, contractors and developers to specify and use earth in housing projects.

There is a limited range of proprietary materials currently available on the market. Indigenous manufacturers looking for opportunities to diversify into more sustainable products will be encouraged by a projected growing demand for unfired clay products. Technical research, development and testing of products could lead to more inexpensive and innovative products, perhaps avoiding the need for use of conventional materials for domestic houses.

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