



Construction Methods Commonly Used For Low Cost Housing Technology In Nigeria

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Abstract: Adequate shelter for all people is one of the pressing challenges faced by the developing countries. The dream of owning a house particularly for low-income and middle-income families is becoming a difficult reality. Hence, it has become a necessity to adopt cost effective, innovative and environment-friendly housing technologies for the construction of houses and buildings for enabling the common people to construct houses at affordable cost. Census in the early Fifties showed that there were about 56 cities in the country and about 10.6 percent of the total population lived in these cities. This rose dramatically to 19.1 percent in 1963 and 24.5 percent in 1985. Today, the national population is estimated to be about 180 million with the urban population constituting about 60 percent. The phenomenal rise in population, number and size of our cities over the past few years have manifested in the acute shortage of dwelling units which resulted in overcrowding, high rents, poor urban living conditions, and low infrastructure services and indeed high crime rates. Various programs have been implemented to address housing problem. Despite all these interventions, Nigeria's housing problems still remain intractable. This research compares construction cost for the traditional and low cost housing technologies. Nigeria are used as a case study for the investigation. Construction methods of foundation, walling, roofing and lintel are compared. Strength and durability of the structure, stability, safety and mental satisfaction are factors that assume top priority during cost reduction. It was found from the questionnaire analysis that about 26.11% and 22.68% of the construction cost can be saved by using low cost housing technologies in comparison with the traditional construction methods in the case studies for walling and roofing respectively. This proves that using low cost housing technologies is a cost effective construction approach for the industry.

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1. Introduction

Housing delivery is a highly contentious and politicised issue that is of great concern to administrators, scholars and the public in Nigeria. In the last few decades, the influx of people into urban areas, the natural population increase and inadequate responses by the government have contributed to the worsening housing situation in the country, to the extent that economic development and the welfare of the citizens are adversely affected (1). These problems are more critical in the cities, where huge housing supply deficits, dilapidated housing conditions, high cost of housing as well as proliferation of slums and squatter settlements exist (2,3). As a result, a large majority of urban residents, particularly the low-income earners who constitute about 50 percent of Nigeria's 180 million people are forced to live in conditions that constitute an affront to human dignity

(4). In many developing countries, housing crisis is escalating unabated despite a number of new policies, programs and strategies being engaged in by public and private sectors in addressing this problem. The majority of those in need of housing in many less-developed nations in Africa, Asia and South America are in the low income cadre and some require special housing programs to be able to live in decent housing. Since market solutions and funds may not be suitable for housing this category of people and in view of the vital role housing plays in the socioeconomic and political development of any nation; governments in these countries have over the years been engaged in public housing provision. In Nigeria however, from the debut efforts of the Lagos Executive Development Board (LEDB) in 1928 to date, public housing provision in this country has continued to lag behind the demand for housing, as almost 90 percent of the

nation's housing stock is provided by the informal sector (5). A number of challenges are militating against the provision of housing for the urban poor in Nigeria. These challenges include high rates of urbanization and population growth (6), absence of proper monitoring and evaluation of public housing policies and programs (1), lack of easy access to land and other housing inputs (5), cost of imported building materials (7) among others. As a result, public housing in Nigeria has been criticized for failing to generate tangible and sustainable housing production, distribution and acquisition mechanisms to meet increasing housing demand, particularly by low-income earners (8). This paper focuses on the use of local building materials as an affordable strategy of housing the urban poor in Nigeria. The focus on urban area is based on the evidence that there is more severe housing problem in the urban areas than the rural areas both in their intensity and complexity.

2. Review of related literature

2.1 *Housing needs in Nigeria.*

Various governments in Nigeria have often expressed interest in housing provision for the masses. A review of past efforts indicates that the achievement level of the various national housing programmes was low. Rapid urban growth associated with accelerated tempo of socio-economic development has seriously aggravated the shortage of dwelling units, resulting in overcrowding, high rent, slum and squatter settlements which are visible features of urban centres throughout the country. Estimate and indicator of the magnitude of housing shortage vary. In summary, they all indicate massive shortages in total housing required. The total housing needs of the country in urban and rural areas were put to some 8 million units by the year 2000 by Federal Ministry of Works and Housing, and 12-14 million units in 2007 (9). A more recent estimate puts the figure even higher at 16-17 million units (10). At an average cost of 2.5 million naira per housing unit, Nigeria will require 35 trillion Naira to fund the housing deficit of 14 million housing units (11). A recent study based on the salary structure of public servants in Nigeria showed that no public servant in Nigeria below salary grade level 13 in the federal civil service and salary grade level 16 in the Imo state civil service can afford a property costing N4.75m on a 25 years mortgage at 6 percent if he devotes 50 percent of his salary per annum to housing (11). At 18 percent mortgage rate, only a federal permanent secretary or his equivalent on grade level 17 can afford the same house. This shows that in the absence of some assistance and affordable strategies, adequate housing is unaffordable to most law abiding Nigerians.

2.2 *Major challenges in delivery of low-cost housing in Nigeria*

There has been significant progress in the formulation and implementation of housing policies in the past decades, many challenges still effectively hinder progress in housing development in developing countries, particularly for low income and other vulnerable groups. These constraints include but are not limited to: Poor promotion of security of tenure, Inadequate supply of affordable land, Poor Infrastructure and services, Utilization of local building materials and technologies, Adjusting standards for building and land subdivision.

2.3. *Local building materials/African architecture as alternative*

The architecture of Africa has been seen and labelled international. The definition of architecture as the art and science of building has over the years seen a lot of reforms to include usability, acceptability and comfortability. That African architecture does not have documented scientific approach to its design and construction does not mean that it fails to satisfy these conditions. A building system proven to satisfy thermal comfort, aesthetics and sustainability and being a major part of the daily life of its occupants cannot be anything short of architecture. African traditional architecture is essentially sustainable and had evolved culturally to suit the people. Usually, earth, timber, straw, stone/rock and thatch were constructed together with the simplest of tools and methods to build simple, liveable dwellings. Although globalization has relegated them as being 'primitive', this 'primitive' classification comes partially from the building materials and their relatively low technological uses when compared to present day western (Architectural) construction techniques which result in skyscrapers. Present interpretations of

sustainability have given them a new status as likely technologies for the contemporary world. Along with the others that have been re-devised, earth has of late gained acknowledgement as a suitable technology for contemporary buildings. Africa as a tropical continent between the Atlantic (west) and Indian (east) oceans has an over 5000 year's old recorded history that shows buildings and monuments made of numerous natural materials available in abundance in its geographical landscape. Looking into history particularly on the African continent; Egypt, Nigeria, Kenya, Mali etc, we hear and sometimes carry out studies on the New Gourn Village by Hassan Fathi, the Ancient Kano and Zaria cities by the indigenous craftsmen, the Great Mosque of Djenné directed by Ismaila Traoré, and a few other examples. These buildings have lasted for over one hundred (100) years at the least and have proved themselves to be outstanding works of architecture that have not only

stood the taste of time but are cheap, comfortable with little or no carbon footprint. Having such immense potential, traditional African architecture particularly building with adobe bricks is worth looking into. Its indigenous architectural practice had been shaped by ideologies of sustainability though according to (20) it was done in ignorance. Developed from naturally existing materials and cyclical possibilities of their regeneration, they impacted on the judicious use of earth's resources in the construction of its villages and hamlets, the cities and urban centres as well as the temples, tombs, monuments and religious edifices. Predictably, earth/mud/adobe has been one of its most important and chief building material combined with timber (mostly from palm trunks), palm/coconut/grass thatch and straw bales as roofing; all materials abundantly available in the settlements. In entirety, Africa's traditional architecture made certain that its use of the resources neither diminished their availability, nor adversely affected the ecological balance upon which it relied on as an agrarian society. The introduction of modern technologies such as the concrete blocks and slabs during the industrial periods had relegated traditional components and methods to the background and it became the goal of those in the wattle- and-daub houses to remake them with the new trend material; concrete blocks, in spite of the obvious truth that they did not present the same kind of thermal comfort. The native dwellers thus replaced their comfortable, low- cost and sustainable houses with the modern opposite which were the current fashion and expressed advancement, modernity and a show of affluence and status in the social hierarchy. Recently, amidst these unsustainable practices earth construction has received greater attention as a building material that can be very affordable and still deliver the same modern needs (21).

3. Analytical Approach

3.1 The Traditional Construction Methods

The traditional construction methods are used in the case study. The detail procedures of each step used for the case study are as follow:

i) Foundation: Foundation is the lowest part of the structure which is provided to distribute loads to the soil thus providing base for the super-structure. Excavation work is first carried out, then earth-work is filled with available earth and ends with watering and compaction in a 6" thick layer.

ii) Cement concrete: Plain cement concrete is used to form a leveled surface on the excavated soil. The volumetric concrete mix proportion of 1:4:8 (cement: sand: aggregate), with a 6" thick layer for masonry foundation and column footings is used. Plain cement concrete is finished on the excavated soil strata and mixed by manual process.

iii) Wall construction: Size stone masonry for foundation is constructed for outer walls and burnt brick masonry of a 9" thick layer for main walls and a 4 ½" thick layer for all internal walls. Good quality table-moulded bricks are used for the construction.

iv) Reinforced cement concrete slab and beam: The normal procedure to cast reinforced cement concrete slab is to make shuttering and provide reinforcement and concreting. Good steel or plywood formwork is used, with proper cover blocks between bars. Both aggregate and sand used are clean, with aggregate being ¾" graded. After the concrete is poured, it is properly consolidated.

v) Plastering: Plastering is used for the ceiling, inside and outside walls. Joints are raked before plastering and proper curing is ensured.

vi) Flooring: For the flooring purpose, the earth is properly filled and consolidated in the ratio of 1:4:8 (cement: sand: aggregate) concrete.

vii) Plumbing: Good quality plumbing materials are used and passed hydraulic test before using it.

viii) Painting and finishing: Before the painting process, surface is prepared with putty and primer and a ready-made paint is used.

3.2 Low Cost Construction Technologies

It is found that cost-effective and alternative construction technologies, which apart from reducing construction cost by the reduction of quantity of building materials through improved and innovative techniques, can play a great role in providing better housing methods and protecting the environment. It should be noted that cost-effective construction technologies do not compromise with safety and security of the buildings and mostly follow the prevailing building codes. The detail procedures of each step used for the case study are as follow:

i) Foundation: Arch foundation is used in which walls are supported on the brick or stone masonry. For the construction of the foundation, the use of available materials such as brick or concrete blocks can be made to resist lateral forces buttresses at the corner.

ii) Walling: Rat trap bond technology is used in the case study. It is an alternative brick bonding system for English and Flemish Bond. The reduced number of joints can reduce mortar consumption. No plastering of the outside face is required and the wall usually is quite aesthetically pleasing and air gaps created within the wall help making the house thermally comfortable. In summer, the temperature inside the house is usually at least 5 degrees lower than the outside ambient temperature and vice versa in winter.

iii) Roofing: A filler slab roofing system is used which based on the principle that for roofs which are simply supported, the upper part of the slab is subjected to compressive forces and the lower part of

the slab experience tensile forces. Concrete is very good in withstanding compressive forces and steel bears the load due to tensile forces. Thus the low tensile region of the slab does not need any concrete except for holding steel reinforcements together.

iv) Flooring: Flooring is generally made of terracotta tiles or color oxides. Bedding is made out of broken brick bats. Various patterns and designs are used, depending on shape, size of tiles, span of flooring, and client's personal preference.

v) Plastering: Plastering can be avoided on the walls, frequent expenditure on finishes and its maintenance is avoided. Properly protected brick wall will never lose its color or finish.

vi) Doors and windows: As door and window frames are responsible for almost half the cost of timber used, avoiding frames can considerably reduce timber cost. Door planks are screwed together with strap iron hinges to form doors, and this can be carried by 'holdfast' carried into the wall. The simplest and cost effective door can be made of vertical planks held together with horizontal or diagonal battens. A simplest frameless window consists of a vertical plank of about 9" wide set into two holes, one at the top and one at the bottom. This forms a simple pivotal window. Wide span windows can be partially framed and fixed to walls or can have rows of pivotal planks.

3.3 Cost Effectiveness Of Using Low Cost Housing Technologies

The construction methods of walling and roofing are selected for the detail cost analysis based on available resources from the interviews. *Table 2* summarise the cost analysis of the traditional construction methods and the low cost housing technologies in the case studies for walling and roofing respectively. It is found that about 26.11% and 22.68% of the construction cost, including material and labour cost, can be saved by using the low cost housing technologies in comparison with the traditional construction methods for walling and roofing respectively. All these were deduced from the questionnaire used that contain thirty six questions.

Suggestion for reducing construction cost in this paper is of general nature and it varies depending upon the nature of the building to be constructed and budget of the owner. However, it is necessary that good planning and design methods shall be adopted by utilizing the services of an experienced engineer or an architect for supervising the work, thereby achieving overall cost effectiveness.

4. Findings And Discussion

Terrace house is usually considered suitable for middle-income group whereas, flats are found more economical for low-cost housing projects. Also, the respondents believe that the major factor that

difference between the two is the quality of the finishing materials used. Admittedly, lower quality materials are used for low-cost housing projects. Other factors such as construction methods are approximately the same. *Table 1* as shown in appendix illustrates the construction methods commonly used in different type of affordable housing projects. Based on the finding there are no major differences between the construction methods used for different type of housing development. The majority asserts that the most commonly used type of building frame is concrete, as it is considered much more economical than steel or timber. Half of the respondent agrees that precast concrete wall is a suitable choice for affordable housing while 25% believe that concrete blocks are more suitable. As for roofing technique, the respondents believe that the most common types are trusses and prefabricated steel.

As for the criteria's used for selecting finishing materials for affordable housing, it is evident that developers and contractors commented that the most important criteria that they considered are the initial cost, followed by the durability of the material. However, they do agree that the aesthetic value and the maintenance cost of the material should be considered as well. They also asserted that the main difference between low-income housing and middle-income housing project is the quality of the finishing materials that they use.

There are several limitations regarding the application of the presented building materials as deduced from the questionnaire. For example, there may be organizational, political, and financial constraints. Aid agencies can often play an important role, in several respects. However, the authorities should create the right conditions. In each country, a technological institute can follow the technical developments and investigate the possibilities and limitations of certain building materials and aid-giving models. Due to the growth of cities and urban regions worldwide, in the future the focus of the promotion of sustainable building materials will increasingly be on semi-urban applications, in projects with higher housing densities. This presents a challenge for the improvement of sustainable building materials. Herewith, technological development and increasing the scale of the production of these sustainable materials are important.

5. Conclusion

Nigeria has been experiencing a very high rate of population growth and urban expansion. This has posed serious problems for physical and socio-economic development because of the inability of existing institutions and mechanisms to cope with emerging challenges. Thus, over-crowding of the

living space, poor sanitation, decaying infrastructure, growing rate of unemployment and under-employment, inadequate and overstretched community and social services are some of the indicators of the problems as they affect urban development. The implication of all these is that the urban poor are displaced and deprived access from decent and affordable housing, thereby rendering most of them “homeless”.

This research has examined the national housing need, the national housing provision and the major constrains in delivery of low cost housing in Nigeria. The research recognizes the problem of inadequate housing as a critical challenge to sustainable urban growth and cities’ development. It underscored the fact that urbanization process is irreversible in Nigeria; rather than allowing it to degenerate into a developmental predicament; it must of necessity be turned into opportunities for growth and development. In conclusion, there are no common understanding or guidelines referred to by all the developers and contractors as regards to construction technologies used in affordable housing development. The stakeholders in the construction industry decide on the details of the projects case by case, based on their experience, preference, and the location. Hence, the most important criteria considered is the overall cost of the building. Thus, the quality, sustainability, and user’s demand are not taking into account. Further research needs to be carried out to assess and evaluate the construction technologies used in different housing projects in order to identify the best practices and the area’s which require improvement. The knowledge gained could help build a framework for constructing affordable houses which are cost-effective, sustainable and have a higher quality and better performance.

6. Recommendation

The recommendations based on our findings are as follows:

i) The re-invention should not be on the material alone, but the methods in which the material and its products are utilized for creating architectural splendour in structures. Really, these innovations are important in that collectively, they have evolved a methodology to architecture that is supported on the traditions of the African building custom.

ii) Government should encourage the use of local building material for construction so as to reduce building cost by using them in government projects instead of using the imported building materials.

iii) Entrepreneurs wishing to go into the production of local building material should be encouraged through tax relief and incentives.

iv) Government should not be engage on direct housing construction and should allocate land to

individuals and allow them construct their own home. Direct housing construction by the government is costly; still the quality of the houses is in doubt.

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Appendix

Table 1: Construction Methods used for different type of affordable Housing in Nigeria

	<i>Construction Method</i>	<i>Semi-detached</i>	<i>Apartment</i>	<i>Flat</i>	<i>Terrace</i>
Building Frame	concrete	91%	80%	88.5%	88.5%
	Steel frame	8.5%	17%	2%	5%
	Timber frame	0%	5%	2%	5%
External Wall	Precast concrete	50%	50%	50%	50%
	Ceramic block	11%	11%	11%	11%
	Concrete block	25%	25%	25%	25%
	concrete	13.8%	13.8%	13.8%	13.8%
Roofing	Timber roofing	11%	11%	11%	11%
	Trusses	30%	30%	30%	30%
	Fabricated steel	19.4%	19.4%	19.4%	19.4%
	Prefabricated steel	36%	36%	36%	36%

Table 2: Cost of analysis of the traditional construction methods and the low cost housing technologies used

No	Item	Unit	Rate [#]	Conventional brickwork		Rat-trap bonded brickwork	
				Quantity	Amount [#]	Quantity	Amount [#]
Materials							
1	Bricks	No	0.02	350.00	7.00	284.00	5.68
2	Sand	m ³	0.32	0.28	0.09	0.17	0.05
3	Cement	No	6.17	0.67	4.13	0.40	2.47
Labour							
1	Highly skilled	No	1.70	0.35	0.60	0.35	0.60
2	Semi-high skill	No	1.49	1.05	1.56	0.80	1.19
3	Unskilled labour	No	1.06	2.96	3.14	1.96	2.08
Add 2% tools and plant charges					0.34		0.25
Add for scaffolding-superstructure: 0.42/ m ³					0.42		0.42
Total [per m ³]					17.71		13.08
Savings					26.11%		

6/20/2020