

## Assessment of the Effectiveness of Local Building Materials used for Building Construction in Maikunkele Local Government Area of Niger State

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### Abstract

The study was carried out to assess the effectiveness of the use of Local building materials used for building construction in Maikunkele Local Government Area of Niger State. To achieve this, two research questions and two hypotheses were formulated to guide the study. A survey research design was used for the study. A total of 50 respondents comprising 30 residents and 20 masons were used as the population for the study. A structured questionnaire which was developed by the researchers was used for data collection. The instrument was validated by three lecturers in the department of industrial technology education, Federal University of Technology, Minna. The reliability of the instrument was found to be 0.77 using Cronbach Alpha Formular. The data collected was analyzed using mean and standard deviation for the research questions while, the t-test statistic was used to test the hypotheses at 0.05 level of significance. The findings of the study revealed that local materials such as clay and timber easily absorb water when used in water lodged areas; stones used for local buildings are not usually cut to workable size before they are used and stones are not easily accessible. Consequently, it was recommended among others that people should avoid areas with clay soil, torrential flooding or slopes in order to minimize costs for special foundations and damp proofing elements.

**Key words:** Assessment, effectiveness, local building materials and building construction

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### Introduction

In most of our urban centres, the problem of housing is not only restricted to quantity but to the quality of available housing units. This results in overcrowding in houses and as well increases pressure on available infrastructural facilities. Rapid growth in population creates problems toward adequate and efficient supply and distribution of basic utilities and services for the city inhabitants.

A recent World Bank report noted that two of the most critical urban development issues in Nigeria are – (a). Financing of urban infrastructure and (b) institutional arrangements for housing delivery. According to United Nations reports (UNCHS, 1985; UNCHS, 1992), the building materials sector was split into three production groups:

Modern or conventional building materials which are materials based on modern conventional production methods like concrete, steel and glass;

traditional production materials are those that have been in use from ancient times using small-scale rudimentary technologies, e.g. laterite, thatch, straw, stabilised mud, and raphia palm;

and innovative materials are those developed through research efforts aimed at providing alternatives to import-based materials e.g. fibre-based concrete, Ferro-cement products etc.

However, despite the general popularity of both the modern and innovative building materials in

the market, there exist calls for the return to traditional materials, referred to in this study as local building materials. Amongst the reasons advanced are high cost the modern and innovative building materials and their inadequate supply in the market (UNCHS, 1990; Lilly and Wai, 2001). Furthermore, the need to revert to IBM is also traceable to prevalent dictates of some neo-global concepts vis-à-vis sustainability, and the use of biodegradable and renewable materials (Mahgoub, 1997; Adams, 2000, Mourshed, 2000; Peakstoppairies, 2005).

In Nigeria, the establishment of the Centre for Earth Construction Technology (CECTech) by the National Commission for Museums and Monuments and the French Embassy in Lagos is an effort towards promoting the use of earth technology as a partial or complete substitute for block work, flooring etc. The Raw Materials Institute and the Directorate for Food, Roads and Rural Infrastructure (DFRRI) was also set up by government to encourage the utilisation of local building materials in the construction of buildings.

Despite Federal Government access to factors of housing production, the country could at best expect 4.2% of the annual requirement from her. Substantial contribution is expected from other public and private sectors. It should be acknowledged that private sector developers

account for 83 of urban housing (Federal Office of Statistics, 1999). Various studies have, at different times, revealed the problems of housing production. Agbola (1987), Okpala and Onibokun (1986) recognised finance as part of housing problems but ranked land and building materials higher. Many benefits that are offered by earth construction are often under-utilized in the developed world where the use of Local material (LM) as a low-embodied material is often the case (Middendorf, 2001). Historically, LM has been the most widely known and used building material in construction and probably has been the most important of all building materials (Legget, 1960). Recent reports indicated that, about half of the world's populations are still living in earth buildings (McHenry, 1984; EBAA. Australia). Of all urban housing units worldwide there are about 25 % that does not conform to building regulations while 18% are considered non-permanent structures (Habitat, 2001). However, it must be noted that earth buildings are not a phenomenon of the Third World countries only, but also in developed countries (EBA New Zealand, 1998). Hence, this study is designed to assess the usage of local building materials for building construction in maikunkele local government area of Niger state.

### Statement of the Problem

The main drawback of local building materials such as soil material, raphia palms, bamboo, timber and among others is the need for continuous maintenance and the lack of durability and resistance to water (Bahar *et al.*, 2004). Most researches done in this area has always focused on processed durability or strength. All aspects should be considered to produce sustainable, durable, safe and environmental friendly homes and buildings. However, earth construction suffers from shrinkage cracking, low strength and lack of durability (Bahar *et al.*, 2004; Guettala *et al.*, 2006). In addition, most earthen materials are unsuitable for homes of more than two stories, as they are unable to carry the load of the super structure walls. The sub structures need to be thicker than the super structure in the same building. Thus, labour costs would be very high indeed (Farnsworth, 1999). The challenge of

modern and new requirements, the need for sustainable low cost buildings to house people and the lack of knowledge in this area justify the need for more research to be focused on the strength and durability of earth block.

### Purpose of the Study

This study is aimed at:

- 1- Identifying the factors that are limiting the use of Local building materials.
- 2- Examining the modes of application in the use of Local building material for building construction.

### Research questions

The study answered the following Research Questions:

1. What are the factors limiting the use of Local building materials?
2. What are the modes of application involved in the use of Local building material for building construction?

### Hypotheses

The following hypotheses were developed and tested at 0.05 level of significance

- There is no significant difference between the mean responses of residents and masons regarding the factors limiting the use of Local building materials.
- There is no significant difference between the mean responses of residents and masons regarding the modes of application involved in the use of Local building material for building construction.

### Methodology

Descriptive survey was adopted because it involves the use of questionnaires and interviews to determine the opinion of the respondents (the resident and mason in this community). Therefore short interview sessions were held with most of the respondents, because most of them cannot speak English. This study covers the entire Maikunkele area. Maikunkele, is an excellent example of the rural-recreational area and is located in Bosso local government of Niger state covering land area of about 932768km<sup>2</sup> and about 170,123,740 population as at 2011 (tageo.com 2011). Not only is the area partly rural, it also has a unique population demographic with a growing number of seasonal residents who have cottages within the

community. Purposive sampling techniques were used to select 30 resident and 20 masons in building with locally made materials in this selected area.

The instrument used for the data collection was a structured questionnaire developed by the researcher. It consisted of two parts in which the first was used to obtain information from the respondents on their personal characteristics, and the second was divided into two sections A and B. Section A and B consisted of the questions addressed by the study. All items are to be responded to by indicating the appropriate respondent's best perception using four point rating scales. Strongly agree (SA) Agree (A) Disagree (DA) Strongly Disagree (SD). To ensure validity of the instrument, a draft copy of the questionnaire was submitted to three experts in department of Industrial and Technology Education, Federal University of Technology Minna before administering it to respondents. Cronbach Alpha method was used to determine the reliability of the instrument and it was found to be 0.77.

**Research question 1**

What are the factors limiting the use of local building materials?

**Table 1: Mean Responses of Residents and Masons on Factors limiting the use of Local Building Materials  $N_1=30, N_2=20$**

S/N	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_r$	Remark
1	Local materials such as clay and timber easily absorb water when used on water logged areas.	3.67	3.65	3.66	Agreed
2	Stones used for local buildings are not usually cut to workable size before they are used.	3.74	3.55	3.65	Agreed
3	Stones not always easily available.	3.54	3.46	3.50	Agreed
4	Materials like clay contain numerous amounts of impurities.	3.67	3.65	3.66	Agreed
5	Some local materials such as timber and bamboo are not resistant to eventual impacts.	3.47	3.59	3.60	Agreed
6	Early decay of bamboo.	3.74	3.55	3.65	Agreed
7	Slow setting of lime in stones.	3.60	3.59	3.60	Agreed
8	Local materials compared to modernized materials vary in physical properties.	3.54	3.59	3.57	Agreed
9	Local materials require more labour to work with.	2.35	2.45	2.40	Disagreed
10	Local building materials like clay suffer shrinkage and cracking.	3.67	3.65	3.66	Agreed
11	Doubtful durability and life span of the indigenous building materials.	3.54	3.46	3.50	Agreed
12	Houses built with Local materials have low aesthetic value.	3.60	3.59	3.60	Agreed
13	People believe that houses built with local materials lack standards and specification.	3.74	3.55	3.64	Agreed
14	Locally built houses are looked on as archaic.	3.63	3.67	3.65	Agreed

Key:  $N_1$ =Number of Residents,  $N_2$ =Number of Mason,  $\bar{X}_1$ =Mean of Residents,  $\bar{X}_2$ = Mean of Mason,  $\bar{X}_r$ = Average mean of Residents and Masons.

The data presented in table 1 revealed that the respondents agreed with all the items with mean score ranging between 3.50 – 3.67 except item 9 which has mean score of 2.40. This signifies that all the items are the factors limited the use of local building materials except item 9.

The analysis of data for the research questions and hypotheses were accomplished using the mean and t-test. The mean was used to determine the degree of acceptance or rejection in research question while t-test was used to test the hypotheses of two groups of respondents at 0.05level of significance. The mean of 2.50 was used as decision point for every questionnaire item, consequently, any item with mean respondent of 2.50 and above was considered to be agreed and any item with response of 2.49 and below was equally considered as disagreed in section A and B. the t-test was used to test the hypothesis at 0.05 Level of significant to compare the mean response of the groups. A critical value of  $\pm 1.96$  was selected based on the degree of freedom at 0.05 level of significant. Therefore any item with t- calculated value less than the critical was regarded as not significant. While any item with calculated value equal or greater than the critical was regarded as significant.

**Results and Discussion**

The result of data analyzed for the research questions and hypotheses were presented as follows:

**Research Question 2**

What are the modes of application involved in the use of local building materials for building construction?

**Table 2: Mean Responses of Residents and Masons on the Modes of Application involved in the use of Local Building Material for Building Construction.  $N_1=30, N_2=20$**

S/N	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_t$	Remark
1	Materials such as bamboo can be used for simple suspension bridges.	3.74	3.55	3.65	Agreed
2	Bamboo and timber can be used for scaffolding and formwork in building construction.	3.54	3.59	3.57	Agreed
3	Local materials such as timber and bamboo can be used as fencing materials on building construction sites.	3.80	3.78	3.79	Agreed
4	Stones can be used for pavements, slabs and gutters.	3.54	3.46	3.50	Agreed
5	Stones can serve as aggregates when preparing concrete for building foundations.	3.60	3.59	3.60	Agreed
6	Stones obtained locally are primary elements in cement production.	3.67	3.65	3.66	Agreed
7	Timber in local building construction can be used for doors, windows and furniture.	3.74	3.55	3.65	Agreed

Key:  $N_1$  = Number Residents,  $N_2$  = Number of Masons,  $\bar{X}_1$  = Mean of Residents,  $\bar{X}_2$  = Mean of Masons,  $\bar{X}_t$  = Average mean of Residents and Masons.

The data presented in table 2 revealed that the respondents agreed with all the items with mean score ranging between 3.50 – 3.80. This signifies that all the items are modes of application involved in the use of local building materials for building construction.

**Hypothesis 1**

There is no significant difference between the mean responses of residents and Masons on the factors limiting the use of local building materials.

**Table 3: t- test analysis of Residents and Masons on the Factors limiting the use of Local Building Materials.  $N_1=30, N_2=20$**

S/N	ITEMS	$S.D_1$	$S.D_2$	t-test	Decision
1	Local materials such as clay and timber easily absorb water when used on water logged areas.	0.48	0.48	0.16	NS
2	Stones used for local buildings are not usually cut to workable size before they are used.	0.45	0.58	1.55	NS
3	Not always easily available.	0.52	0.54	0.6	NS
4	Materials like clay contain numerous amounts of impurities.	0.48	0.48	0.16	NS
5	Some local materials such as timber and bamboo are not resistant to eventual impacts.	0.49	0.57	0.08	NS
6	Early decay of bamboo.	0.45	0.51	1.55	NS
7	Slow setting of lime in stones.	0.49	0.50	0.08	NS
8	Local materials compared to modernized materials vary in physical properties.	0.5	0.50	0.37	NS
9	Local materials require more labour to work with.	0.49	0.59	0.08	NS
10	Local building materials like clay suffer shrinkage and cracking.	0.48	0.48	0.16	NS
11	Doubtful durability and life span of the indigenous building materials.	0.45	0.63	0.08	NS
11	Houses built with Local materials have low aesthetic value.	0.50	0.49	0.89	NS
12	People believe that houses built with local materials lack standards and specification.	0.56	0.49	0.16	NS
13	Locally built houses are looked on as archaic.	0.51	0.47	0.36	NS

Key:  $N_1$  = Number Residents,  $N_2$  = Number of Masons,  $S.D_1$  = Standard Deviation of Residents,  $S.D_2$  = Standard Deviation of Masons, NS = Not Significant.

The t-test analysis in table 3 revealed that there is no significant difference in the mean response of Residents and Masons on the factors limiting the use of local building materials. All the items were accepted because they fall within t-value of  $\pm 1.96$ .

**Hypothesis 2**

There is no significance difference between the mean responses of residents and masons on the modes of application involved in the use of local building material for building construction.

**Table 4: t- test analysis of Residents and Mason on the modes of application involved in the use of local building material for building construction.  $N_1=30, N_2=20$ .**

S/N	ITEMS	$S.D_1$	$S.D_2$	t-test	Remark
1	Materials such as bamboo can be used for simple suspension bridges.	0.5	0.5	0.6	NS
2	Bamboo and timber can be used for scaffolding and formwork in building construction.	0.49	0.5	0.08	NS
3	Local materials such as timber and bamboo can be used as fencing materials on building construction sites.	0.48	0.48	0.16	NS
4	Stones can be used for pavements, slabs and gutters.	0.45	0.5	1.55	NS
5	Stones can serve as aggregates when preparing concrete for building foundations.	0.5	0.5	0.37	NS
6	Stones obtained locally are primary elements in cement production.	0.4	0.42	0.19	NS
7	Timber in local building construction can be used for doors, windows and furniture's.	0.4	0.46	0.83	NS

Key:  $N_1$  = Number Residents,  $N_2$  = Number of Masons,  $S.D_1$  = Standard Deviation of Residents,  $S.D_2$  = Standard Deviation of Masons, S = Significant, NS = Not Significant.

T-test analysis in table 4 revealed that there is significant difference in the mean response of Residents and Masons on the modes of

application involved in the use of local building material for building construction. All the items

were accepted because they fall within t-value of  $\pm 1.96$ .

### Discussion.

Result obtained from table 1 revealed that all items identified except 9 are the factors limiting the use of local building materials. This is in line with the view which WHO noted in FOA (1990) that many people avoid local materials such as clay and timber because they easily absorb water when used on water logged areas. The FOA (1990) stated further that trees are living organisms and contain large amounts of water. For this reason, people try to avoid using them as building materials. It is necessary to reduce the moisture content of finished wood products to below 25% if they are to be used as building materials. This was traditionally achieved through air-drying under shelter for several months or years of which many people cannot do.

The finding on houses built with local materials having low aesthetic value is in line with Camila (2002) who stated that influences of foreign countries have refrained people from preserving and using traditional buildings materials and styles. Instead people preferred to live in houses built with concrete blocks that are popular and accepted socially. The finding on doubtful durability and life span of indigenous building materials is also in consonance with view of Camila (2002) who stated that durability of building depends on a variety of factors – the design, construction methods, and purpose of the buildings, its aesthetics and the owner. The owner is the primary determinant on the lifespan of a building and that may also be affected by current and local fashions in architecture, lifestyles and economics. In addition, new materials which are being developed for exterior cladding, roofing and to replace preserved timber are difficult to assess as their durability and suitability for construction has not been proven over the long term.

Research question three dealt with the modes of application involved in the use of local building material for building construction.

The finding on Materials such as bamboo can be used for simple suspension bridges is in agreement with the view of Wang and Shen,

(1987), who stated that Bamboo has a very long history with human kind and it is one of the oldest building materials. In ancient China it is used for bridges suspension and extended to industrial applications due to advances in processing technology and increased market demand. It has also been widely used in building applications, such as flooring, ceiling, walls, windows, doors, fences, housing roofs, trusses, rafters and purling (Hardin, 2009). It is also used in construction as structural materials for bridges, water transportation facilities and skyscraper scaffoldings. The finding on Local materials such as timber and bamboo used as fencing materials on building construction sites is in line with the opinion of Janssen (2000) who stated that there are several differences between bamboo and wood and that is reason why is being used as local building material. In bamboo, there are no rays or knots, which give bamboo a far more evenly distributed stresses throughout its length. Bamboo is a hollow tube, sometimes with thin walls, and consequently it is more difficult to join bamboo than pieces of wood. Bamboo does not contain the same chemical extractives as wood, and can therefore be glued very well. According to RMRDC (2004), in all the states bamboos are used as scaffolding materials. Other uses include fencing, yam stakes, environmental amelioration, handicrafts and fuel wood. In the construction of story buildings, bamboo culms are used as pillars to provide temporary support for the decking. The use of bamboo for this purpose has opened up domestic trade for bamboo culms. Bamboo is also used in the construction of mud houses. In these areas, bamboo culms are used as frames to provide the skeleton for building. The mud is then used to cover the entire skeleton. Houses built this way usually have very straight walls, and they are stronger than mud houses built without bamboo. There are some situations where bamboo is used as poles for aerial antenna, electrification, rafters, fishing traps, etc. RMRDC (2004) further reported that the current uses of bamboo in Nigeria represent only a fraction of economic activities in the country. It has been traditionally used as fuel, food, for rural housing, shelter, fencing, tools, and various other purposes. In modern days, it is being used as industrial raw

material for pulp and paper, construction and engineering materials, panel products, etc.

The hypotheses tested revealed that there was no significant difference between the mean responses of the mason and the residence on the factors limiting the use of local building materials and on the modes of application involved in the use of local building material for building construction. The outcome is not new, because both the residents, mason and house owners can identify things that will lead to improvement of construction of local building and enhancement in mode of construction to help meet up with the future challenges in building industry.

### Conclusion and Recommendation.

The study established that certain factors militate against the actualization of building houses using local materials. It has shown that the adoption of different modes of application in use of local materials can result in the provision of adequate housing for different categories of people at a very cheaper and affordable rate, which will in turn lead to improved quality of life among residents of public housing. The delivery system of local materials for housing projects can be vastly improved by considering options for alternative design and techniques. These play an important role in the economic development for formal and informal sector. Technical sustainability, such as energy efficiency, diversification, life-cycle analysis of materials, control, responsibilities, impacts on nature and health, should receive more attention. Awareness on Social perception and attitude influence negatively on choice of design and material should be given due attention. In the pursuit of a sustainable society, improvements in the performance of the built environment have a considerable effect, and it is essential to provide tools for assessing relative performance of building designs by the building professionals. Building professionals especially the architects, engineers and artisans need to be trained and encouraged to use local materials.

Based on the findings of this study, the following recommendations are made:

I. People should avoid areas with clay soil, torrential flooding or slopes in order to minimize

costs for special foundations and damp proofing elements.

II. People should patronize local materials in building their houses in order to reduce dependence on foreign building materials.

III. The government should provide fund and conducive environment for research on the use of local building materials in building houses for Nigerian citizens.

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