

Investigation the utilisation of laterite and clay as sustainable buildings materials

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ABSTRACT: Utilization of clay and laterite as sustainable building materials has become source of concern to construction industry due to its positive effect on the social, economic and environmental aspects to humanity and society. Rising, rural and urban population in developing nations such as Nigeria has led to the more demand and effective utilization of these gifted materials in development of housing, roads, dams, air fields, and others infrastructures. This research is aimed at investigation the use of laterite and clay as sustainable construction materials. The research findings are expected to be of benefit to construction industry, stake holders and local users; towards effective utilization of these available raw building materials in construction industry. It will also encourage the need for further academic research on these two important materials in construction industry.

1 INTRODUCTION

The construction industry is very back bone to the socio-economic development of any nation. In many countries, the yardstick for the measurement of national progress is based on the degree of contributions of the construction industry to the nation's economic, social, environmental and political advancement. Mogbo (2001) described the building and construction sector in Nigeria as being 'important' and 'crucial' to her economy. Abiola (2000) identified building materials as one of the principal factors affecting the effective performance of the Nigerian construction industry. The building materials sector is the major contributor to the construction industry in any nation because materials constitute the single largest input in construction often accounting for about half of the total cost of most or any construction products (Mogbo, 2001; Okereke, 2003 Kern, 2004).

In some United Nations reports (UNCHS, 2001; UNCHS, 2002; UNCHS, 2004), 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 materials which have been in local production from ancient times using small-scale rudimentary technologies, such as laterite, clay, gravel, thatch, straw, stabilised mud, Azara tree, bamboo stick and innovative materials which are materials developed through research efforts aimed at providing alternatives to import-based materials e.g. fibre-based concrete, ferro-cement products etc.

The establishment of the Centre for Earth Construction Technology (CECTech) by the National Commission for Museums and Monuments and the French Embassy in Nigeria are efforts towards promoting the use of sustainable building materials technology as a partial or complete substitute for block work, flooring (Lamort, 2001).

2 THEORETICAL CONSIDERATIONS

Historic overview of Institutional for Sustainable Building Materials

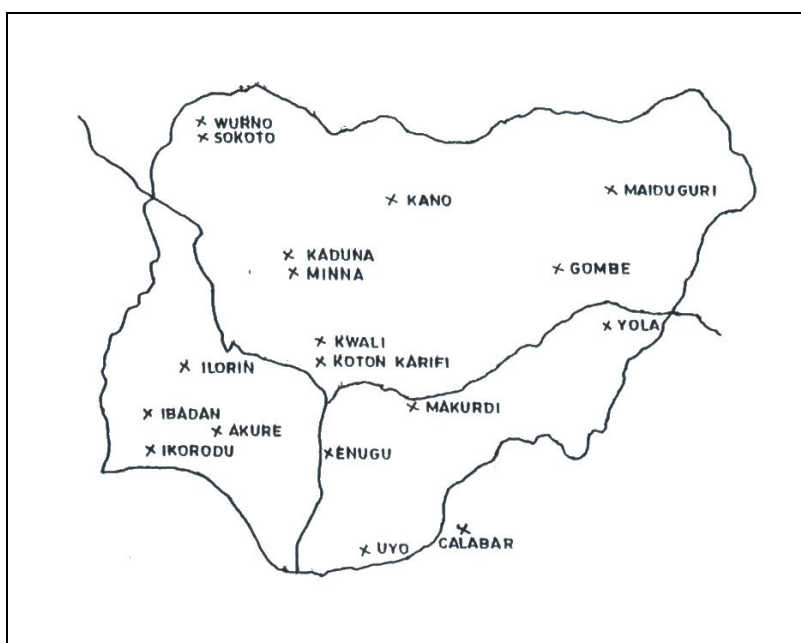
Research activities in sustainable building materials started in Nigeria during the colonial era under the platform of the West African Building Research Institute (WABRI) which was an institution for collabo-

rative research in the then British West African colonies of the Gambia, Sierra Leone, Ghana and Nigeria but this arrangement came to an end in 1962. Nigeria remained without an organised institute until July 24 1975 when the Federal Government approved the establishment of a National Construction, Building and Road Research Institute (NCBRRRI). In June 1976, the National Science and Technology Development Agency (NSTDA) were set up as a central body to administer and control all Federal Government research institutes. NCBRRRI was taken over and in its place the Nigerian Building and Road Research Institute (NBRRI) was established on April 1, 1978. With the creation of a separate ministry of science and technology to replace NSTDA, the NBRRI came under the Federal Ministry of Science and Technology in October 1979.

2.1 Sources of laterite and clay as sustainable Building Materials in Nigeria

There are many locally available resources such as laterite and clay which can be exploited and readily be applied to the local production of low cost construction materials product. Okereke (2003) identified sources of materials on which laterite and clay can be categorised as sustainable building materials. Fig. 1 show some states in Nigeria where laterite and clay materials are predominate. One of the disadvantages of laterite and clay is lack of international standard as other building materials, which makes it non comparable with other building materials in the construction industry.

Distribution of Laterite and Clay (Sources: Nigeria Geological Survey Department (2000))



3 PROBLEMS AND LIMITATIONS IN USE OF LATERITE AND CLAY MATERIALS IN CONSTRUCTION

3.1 Factors affecting utilisation of laterite and clay materials

Some factors that limits the adoption and effective utilization of laterite and clay as sustainable building materials is the low demand for these products in construction activities (UNCHS, 2001). The lack of patronage of these products by societies also implies that the market will not be viable. Also low knowledge of potentials benefits from utilisation of laterite and clay materials. In 1976, the Federal Government of Nigeria established seven clay bricks factories in Enugu, Kaduna, Mubi, Mina, Jos, Makurdi and Lagos with the aim of improving the use of laterite and clay products in the construction of housing and other infrastructures. These plants were designed with an installed capacity of 1.5 million bricks annually, as at the year 2002, they were on the average running at 15 to 25 percent capacity due to low patronage of its products (Sanusi, 2000; Okereke, 2003). This is largely due to general feelings that the products are of low quality.

3.2 *Inappropriate Use of laterite and clay as Building Materials in Construction*

The use of local building materials in some instances is unpopular due to wrong application in construction works. The result is that the materials would be abandoned not because it is unfit for use but because there was a lack of basic knowledge of benefits and skilled workmanship. Sanusi (2003) identified four problems of using sustainable building materials as follows: that the full range of what constitutes sustainable building materials is not known; the lack of basis for cost comparison between sustainable building materials and the conventional materials; technical limitation with the use of these materials; and legal problems where these materials are not considered useable by planning authorities and when used are considered as temporary structures.

4 RESEARCH METHODOLOGY

4.1 *Research approach*

This paper investigates the utilisation of laterite and clay in the Nigerian construction industry by conducting a structured questionnaire survey in Kano and Kaduna states in Northern Nigeria. The questionnaire was designed to elicit responses in four key areas. These areas include A: Respondent's Background; B: Utilisation of Laterite and Clay in the industry; C: Knowledge on Sustainable Construction D: Effecting Factors of Laterite and Clay Utilisation for Sustainable Construction: Improving Laterite and Clay Utilisation for Sustainable Construction. The aim is to find the main problems encountered in the use of these materials and their potential benefits to the construction industry.

4.2 *Sampling and Data collection*

The potential survey population in this research primarily includes all professionals in suitable construction companies, however, surveys operate on the basis of response from respondent sand their responses being analysed. The questionnaires were self-administered. One hundred and forty (140) questions were distributed, 120 were answered out of which 115 were used in the analysis.

Types of Companies

	Companies	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	building	7	33.3	35.0	35.0
	engineering	2	9.5	10.0	45.0
	civil	10	47.6	50.0	95.0
	others	1	4.8	5.0	100.0
	Total	20	95.2	100.0	
Missing	System	1	4.8		
	Total	21	100.0		

4.3 *Profile of Respondents*

The respondents were from construction companies in Kano (40) Kaduna (26) and others (10) representing a cumulative 83.02% of the total responses. A total 70% of respondents were engaged in private construction companies while 25% were in public establishment. The remaining 5% were self-employed, in private sector. The respondents having educational qualifications of Bachelor of Science/Engineering and Master of Science represented 51.51% and 29.24% of the responses respectively and at least 85% of the respondents had over five years of work experience. The distribution of respondent's position by profession is given in Table 1.

Table 1. Current Post of Respondent

Respondents		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	project manager	6	28.6	30.0	30.0
	site supervisor	1	4.8	5.0	35.0
	site engineer	8	38.1	40.0	75.0
	clerk of works	5	23.8	25.0	100.0
	Total	20	95.2	100.0	
Missing	System	1	4.8		
Total		21	100.0		

4.4 Measure

Majority of the data collected during the survey are either nominal or ordinal data with the former converted to ordinal for the purpose of data analysis. This is in line with De Vaux's (2000) suggestion that to arrive at aggregated statistics. Nominal data sourced were mainly on information about the respondents such as profession and type of organisation. All the questions asked were close-ended having various numbers of possible responses as well as provision for other responses not included in the options. The provision of the 'other (please specify)' option was included to reduce rigidity which may artificially constrain the responses (Fellows and Liu, 2001). The use of close ended responses of (yes) or (no) was restricted and ranges of possible judgments were open to the respondent by the use of a three, four or a five point Likert scale. For example, where respondents are requested to indicate the level of utilisation of laterite and clay, the following qualifications were used. Strongly Disagree 1 point Disagree 2 points, Not Sure 3 points, Agree 4 points, and Strongly Agree 5 points.

5 RESULTS AND DISCUSSIONS

5.1 Reasons for specifying on laterite and clay

The builders and civil engineers are the principal actors for sustainable building materials utilisation in building constructions. Site engineers assume the role of as, professional advisers to the contractor on utilisations of materials on site. Relative to this, respondents were asked to indicate the problems encountered in utilisation of laterite and clay in constructions activities. Seventy percent of them indicated that the site engineers with bachelor degree are solely responsible while 13%, 11% and 7% are of the opinion that the builders, engineers, follows respectively. Further, respondents were asked to state if those responsible for specifying materials actually carry out their duties. By cross-tabulation, 77% of those who said site engineers are responsible believe that they perform their duties while 92% of those who choose the builder believe that they in the second position. This finding is in line with Rosen (1974) assertion that civil engineering are top users of laterite and clay in the construction industry.

5.2 Some benefits derived from laterite and clay identified by the respondents includes:

- i. Providing affordable cheaper housing and infrastructures.
- ii. Reducing cost of constructions.
- iii. Provision of employment opportunity.
- iv. Meeting increasing demand for their products.
- v. Energy conserving alternative.

Other benefits highlighted by the respondents include:

- a) The development and propagation of utilisation of laterite and clay construction industry.
- b) Promoting the economic strengths of societies in a country.
- b) Provides a source for further research for present and future generations.

5.3 reasons for discrimination in the use of laterite and clay materials

Several possible reasons were identified from this research, discrimination in the use of laterite and clay materials, these include: doubtful durability and life span of the sustainable building materials; low aesthetic value; poor social acceptability by general public; non-commercial status and lack of standards. The results of the survey indicated that: doubtful durability for a cumulative majority (70%) of respondents. Poor social acceptability and user prejudice account for a cumulative 63% major responses. At least 34% of the respondents identified lack of standards as a reason for discrimination. Common problems encountered in the use of laterite and clay materials. Table 2 below shows the Problems encountered in the use of sustainable building materials.

Table 2. Problems of sustainable building materials

s/no	Utilization problems encountered	Frequency	Percent
1	Limitation in design performance	45	29%
2	Inadequate supply of products in markets	30	19%
3	Structural problems	21	13%
4	Excessive cost implication	21	13%
5	Non compatibility with other materials	18	11%
6	None conformity with international standardstandardstandard	13	8%
7	Constructability problems	9	6%

6 SUMMARY OF FINDINGS

Laterite and clay materials have potentials for being adopted as alternatives to conventional or modern building materials even though it has been found to suffer persistent use and discrimination in construction industry. There have been many researches into their use, but implementation of the results of such researches has been limited by lack of patronage from societies and governments. Some of the sustainable materials used in building construction include earth, stone, thatch, clay, lime and pozzolana.

Some of the reasons found to have contributed to this persistent discrimination include doubtful durability and life span, poor social acceptability, as well as the lack of well-established standards for these materials. For those involved in the use of these materials, their choices are often influenced by promotional and creative reasons and the common problems encountered include: lack of trained personnel, poor structural performance of some of these materials and limitations in design forms in the use of sustainable building materials.

The areas of potential benefit of incorporating laterite and clay materials in building construction include:

- a. Providing affordable housing for the people though, the general bias is that it will only be suitable for low-income cadre of society.
- b. Reducing costs of construction since materials found locally will be used thus eliminating costs associated with manufactured products and transportation.
- c. The development and propagation of indigenous technology and the provision of employment. These will invariably contribute to the economic growth of the nation.
- d. Providing source of research for both students and professionals of construction disciplines.

6.1 Conclusion

e. The performance of laterite and clay materials over long periods of time, in provision of shelter in all climates, and for all structural conditions is still not completely understood, nor utilize. But, they hold a promise of ready availability, low energy costs and simplicity of equipment requirement in the exploitation and utilisation. They also have the potential to enhance a sustainable construction practice.

f. It is recommended that research findings on the utilisation of sustainable building materials are especially on the failures on Utilisation of laterite and clay materials would place a different light on the future of building construction in general and offer solutions to some of the problems outlined in this paper. Furthermore, initiatives should be taken by co-operatives, non-governmental organisations (NGOs) and government agencies, to promote the awareness on use of sustainable building materials in order to popularise their use. The materials can be used in construction of secondary schools, higher institution building, government's offices, markets, recreational parks and motor parks and for further research.

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