

Prospects and Challenges of Compressed Stabilized Laterite Bricks in Enhancing Sustainable Housing Development in Nigeria

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Sustaining housing development especially to the medium/low-income group of the society has become a huge challenge particularly because of the huge capital outlay required to do so. Thus, acquisition of indigenous building materials by way of Compressed Stabilized Laterite Bricks (CSLBs) has been suggested as a way out.

This paper evaluated CSLBs as a building material for sustainable housing construction. The study focused primarily on evaluating its physical properties as a building material as well as a measure of its level of acceptability for housing construction among the populace. The study was carried out in four local governments namely; Ogbomosho North, Ibadan Southwest, (in Oyo State) Ado-Odo Ota, (Ogun State) and Agege Local Government in Lagos State, Nigeria.

The methodology adopted was survey method which involved the administration of 600 questionnaires on randomly selected household heads out of which 551 responded. The data obtained was analyzed using various statistical tools.

The result showed that there is apathy towards acceptability and use of CSLBs for housing construction due to lack of knowledge about its physical properties. It was also found out that non-availability of CSLBs in the open market was a major determinant of the apathy.

The paper concluded that to ensure sustainable housing development via CSLBs, there must be continuous sensitization of the populace by stakeholders through construction of model houses with CSLBs. More researches on fabrication and production of the CSLBs making machines so as to make it more readily accessible should also be funded.

Keywords: Acceptability, Compressed Stabilized Laterite Bricks, Housing, Housing construction.

1.0 Introduction

The importance of housing in human history cannot be overemphasized. Housing is seen as one of the best indicators of a person's standard of living and of his or her place in society (UNCHS, 1993). Furthermore, Venkatarama Reddy (2004) is of the view that housing and building conditions also reflect the living standards of a society. Thus, the importance of access to adequate and affordable housing took the front burner in the mid 20th century. The low-income group whose population is on the increase due to rapid urbanization and population growth evidently became the most vulnerable in terms of lack of access to decent and affordable housing in developing countries. This has led to various researches into development of locally available building materials and construction techniques to enhance access to housing for all.

In 1976, the Human Settlements conference in Vancouver gave new impetus to this approach, condemning the transposition of Western building techniques for low-cost housing and recommending the design of technologies suited to climatic, social and cultural contexts (Rigassi, 1985). The conference also recommended the gradual reduction of imports of products and services linked to construction, and the drawing up of norms and regulations which covered the basic needs of end-users whilst taking account of their economic possibilities.

The acquisition of local building materials and techniques to guarantee access to decent and durable housing for all by the year 2000 was adopted in December 1988 by the General Assembly of the United Nations with the slogan "Global Strategy for Housing to the year 2000". The Assembly proposed relying on a vast formal and informal private sector participation in housing provision. This strategy was aimed at removing the dependence on the public sector for housing provision by exploring the erstwhile ignored wealth of existing human resources and their building cultures and social dynamics.

The building culture of pre-independence Nigeria was an absolute dependence on earth building techniques such as use of adobe bricks (sun-dried bricks) and wattle and daub (mud wall construction). These techniques were predominant in major rural and semi-urbanized towns and cities in Nigeria. These techniques were durable, adequate and accessible enough for them to meet their housing needs. The techniques were also sustainable since they do not deplete the natural resources of the environment neither do their production processes lead to the emission of gases that causes global climate change.

However, post-independence rural centres in Nigeria acquired new status as a result of independence on October 1, 1960. This period was immediately followed by the “oil boom” of the 1970 and 1980 which brought about an unprecedented prosperity and development of the nation. There were massive improvements on infrastructural development particularly in state capitals and major cities and towns. Thus, the towns became increasingly urbanized and became an urban-oriented society. The crave for Western building techniques led to the gradual extinction of the erstwhile earth building techniques. Thus, while other countries were developing various earth building techniques to meet the housing needs of their populace, the technique became associated with the poor in Nigeria and not fashionable for housing purposes.

The paper examined the current housing situation in Nigeria vis-a-vis the reasons that led to the gradual extinction of earth building technology in the study area. The paper also examined the potentials of CSLBs as a sustainable alternative which has sufficient production flexibility to enable it to be integrated into both formal and informal sectors of building activity (Rigassi, 1985).

The paper concluded that CSLBs is a sustainable construction technique. It is affordable, durable and accessible. It was however observed that there is an apparent apathy towards its use due to lack of knowledge about its physical and socio-economic properties. Respondents are of the opinion that concerted efforts have to be put in place to sensitize the populace about its applicability in building construction. This could be done by encouraging public-private sector participation in constructing public houses with CSLBs in major cities of the country. Continuous researches that will encourage the use of CSLBs should also be encouraged through construction of prototype houses across the country.

2.0 Trend of Housing Needs and Supply in Nigeria

Nigeria has a population of 140,003,542 according to the report of the 2005 National Population Census (FRN, 2007). The average population density according to (UNDP, 1999) is approximately 124 persons per square kilometre, making Nigeria one of the most densely populated countries in the world. Access to decent and affordable housing to this large population is a daunting challenge which has made housing an issue of national importance. This view was supported by Adam and Agib (2001) who posited that provision of housing for developing countries is one of the most important basic needs of low-income groups. It has been established that the poverty level of most Nigerians made it difficult for them to own

houses (Daramola et al, 2005) since land and construction costs are mostly beyond their means.

One of the major challenges confronting sustainable housing provision in Nigeria apart from the socio-economic factor is dearth of accurate statistics on housing needs and supply. This ought not to be so because research finding by Nubi (2000) shows that an average urban dweller spends between 40-60% of his income on house rent. Few statistics available paint a gloomy picture of the housing situation in Nigeria. Various researchers had projected the housing needs to be between 5000 units to 720,000 housing units annually using various parameters such as national level projection and an estimate of 9 units annually per 1000 population.

Records of housing supply over the decades shows that, there was a plan to deliver 202,000 housing units to the public between 1975 and 1980, but only 28,500 units, representing 14.1% was achieved. Between 1981 and 1985, out of 200,000 housing units planned to be delivered, only 47,200 representing 23.6% was constructed (Ademiluyi and Raji, 2008). In the National Rolling Plan of 1990-92, government promised to increase housing supply from 4.8 million to 5.9 million by 2000. The 1991 housing policy estimated that 700,000 housing units are to be built annually if housing deficit is to be cancelled. In summary, it was stated that between 1973 and 2006, the Federal Housing Authority (FHA) built only 30,000 housing units nationwide (Akeju, 2007). The FHA estimated that it constructed a total of about 10,000 new housing units annually. Furthermore, to meet ever-growing demand, the country needs ten times more or at least 100,000 new housing units annually (Adejumo, 2009). The current housing deficit in Nigeria is thus estimated at between 12 million and 16 million homes (Peterside, 2007).

3.0 Historical Overview of Earth Building Technology

Earth is the most basic, and the most ubiquitous, building material known to man (Walker and McGregor, 1996). It has the benefit of being easily worked using the simplest of agricultural tools, yet it is capable of fulfilling the most demanding of roles. Earth as a building material involves a construction technique utilizing soil (usually sub-soil) in combination with other materials.

Earth (soil) as a building material has been used for thousands of years by civilizations all over the world. According to Pollock (1999), the use of earth as a building material dates

back to at least the Ubaid Period in ancient Mesopotamia (5000 – 4000 B.C.). Ancient monumental structures which are still objects of tourist attraction such as ancient temples, fortifications, and pyramids as well as part of the Great Wall of China were built with soil. Soil still continued to enjoy patronage as a building material but with varying degrees of improvement in techniques as a result of improved technologies. Many different techniques have been developed in using earth as a construction material. It was observed that the methods used vary according to the local climate and environment as well as local traditions and customs (Adam and Agib, 2001).

Earth building technique was popular in Nigeria until the influx of cement blocks into the country immediately after independence. Most pre-independence houses were built of earth building techniques of mud wall or sun-dried bricks. Thus, the central core of the towns constitute of houses built with these techniques. The houses range from bungalows to one or sometimes two storey buildings. The houses served their purpose of providing adequate shelter for the inhabitants. They were also durable to the extent that some of the buildings dated between 50 and 100 years. The durability is also dependent on regular maintenance.

Plate 1: House Built of Mud Wall Technique



Source: Field Study (2008)

It can be summarized therefore that an understanding and appreciation of traditional earth building can inform innovative and appropriate uses of earth in new construction. This knowledge is expedient since it has been suggested that at least 50% of the world's population still live in earth houses (Easton, 1996). The utilization of earth in housing construction is one of the oldest and most common methods used by a larger percentage of

the developing countries' population (Arumala and Gondal, 2007). It is the most readily available and cheap material found everywhere. It is easy to work with, requires less skills and as such, it encourages and facilitates unskilled individuals and groups of people to participate in their housing construction on self-help basis. It offers a very high resistance to fire and provides a comfortable built living environment due to its high thermal and heat insulation value. Presently, development in earth building production techniques range from the most rudimentary, manual and craft-based to the most sophisticated, mechanized and industrial (Houben et al 1994). A lot of new generation manual, mechanical and motor-driven presses have also been invented leading to the emergence of a genuine market for the production and application of the compressed earth block {Rigassi, (1985); Guillaud, Odul, & Joffroy, (1985)}.

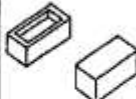
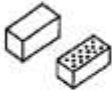






4.0 The Potentials of CSLBs as a Sustainable Alternative for Affordable Housing

The term "Compressed Stabilized Laterite Bricks" (CSLBs) is used in this study as a generic name to cover a wide range of derivative building materials from laterite/soil/earth in which a stabilizer or soil additive has been added to alter the properties of the soil and to improve its engineering properties including compaction, density, bearing strength and safety (i.e. – fire). The addition of a stabilizer differentiates it particularly from compressed earth bricks (CEBs) and from other traditional earth building technologies – whether moulded into a brick or compressed in machines.

The CSLB is the modern descendant of the moulded earth block, more commonly known as the adobe block. The idea of compacting earth to improve the quality and performance of moulded earth blocks is, however, far from new, and it was with wooden tamps that the first compressed earth blocks were produced. The first machines for compressing earth probably date from the 18th century. But it was not until the beginning of the 20th century that the first mechanical presses, using heavy lids forced down into moulds, were designed. But the turning point in the use of presses and in the way in which compressed earth blocks were used for building and architectural purposes came only with effect from 1952, following the invention of the famous little CINVA-RAM press, designed by engineer Raul Ramirez at the CINVA centre in Bogota, Columbia. With the '70s and '80s there appeared a new generation of manual, mechanical and motor-driven presses, leading to the emergence today of a genuine market for the production and application of the CSLB.

CSLB is a product of scientific research. Its applicability becomes advantageous when stabilizing additives, technical assistance, and machinery are available and affordable. The CSLB is a scientific improvement upon the traditional earth building technique. The CSLB being moulded in steel forms comes out in very regular shape and size, and much denser. According to Bush (1984), comparative tests of unstabilized and stabilized soils show that both dry and wet strengths of cement stabilized soils (CSLBs) are stronger and more water resistant than the best unstabilized soils. According to Arumala and Gondal (2007), CSLBs are safe alternatives to masonry. They are low cost and can be designed to be earthquake resistant (NZS 4297: 1998, NZS 4298: 1998, NZS 4299: 1998). Compressed earth blocks are non-toxic, are sound resistant, fire-resistant, and insect-resistant. Furthermore, they stated that CSLBs have excellent insulating properties - reducing heating and cooling costs. In addition, CSLBs are inexpensive, strong, made with locally available materials and are dimensionally uniform. Workers with little prior building knowledge and experience can be used for the wall construction. They are resistant to sound transmission, fire, insect damage and durable if properly protected. The mass of the CSLBs walls makes the walls energy efficient systems. Little energy is needed for their production compared to other wall systems and soil is an environmentally friendly material.

Figure 1: Comparison between CSLBs and Other Masonry Materials

| Characteristics | Unit | CEB | Fired bricks | Adobas | Concrete blocks |
|-------------------------------|--------------------|---|---|---|--|
| SHAPE AND SIZE | | | | | |
| Type | |  |  |  |  |
| l x w x h | cm | 29.5 x 14 x 9 | 22 x 10.5 x 6.5 | 40 x 20 x 10 | 40 x 20 x 15 |
| APPEARANCE | | | | | |
| - Surface | | smooth | rough to smooth | irregular | rough |
| - Visual aspect | | medium to good | good to excellent | poor | average |
| PERFORMANCES | | | | | |
| - Wet compressive strength | Mpa | 1 to 4 | 0.5 to 6 | 0 to 5 | 0.7 to 5 |
| - Reversible thermal dilation | % | 0.02 to 0.2 | 0 to 0.02 | - | 0.02 to 0.05 |
| - Thermal insulation | W/m ² C | 0.81 to 1.04 | 0.7 to 1.3 | 0.4 to 0.8 | 1.0 to 1.7 |
| - Density | kg/m ³ | 1 700 to 2 200 | 1 400 to 2 400 | 1 200 to 1 700 | 1 700 to 2 200 |
| - Durability | | low to very good | low to excellent | poor | low to very good |
| USE IN MASONRY | | | | | |
| | | load-bearing  without render | load-bearing  without render | load-bearing  with render | infill  with render |

Source: Rigassi (1985)

4.0 Assessment of Factors affecting Patronage of CSLBs for Affordable Housing

The viability and sustainability of CSLBs for affordable housing construction has been established in previous sections. It can be concluded that the material is not only durable, it is also cheap and affordable, fire resistant and environmental friendly. The advantages and disadvantages of CSLBs are summarized in Table 1.

Table 1: Summary of Advantages and Limitations of CSLBs

| Advantages | Limitations |
|--|---|
| <ul style="list-style-type: none"> • Soil is available in large quantities in most regions. • Cheap and affordable - in most parts of the world soil is easily accessible to low-income groups. • Ease of use - usually no very specialized equipment is required. • Suitable as a construction material for most parts of the building. • Fire resistant - non-combustible with excellent fire resistance properties. • Beneficial climatic performance due to its high thermal capacity, low thermal conductivity and porosity. • Low energy input in processing and handling soil - only about 1% of the energy required to manufacture and process the same volume of cement concrete. • Environmental appropriateness | <ul style="list-style-type: none"> • Reduced durability - if not regularly maintained and properly protected, particularly in areas affected by medium to high rainfall. • Low tensile strength – poor resistance to bending moments, to be used only in compression e.g. bearing walls, domes and vaults. • Low resistance to abrasion and impact - if not sufficiently reinforced or protected. • Low acceptability amongst most social groups - considered by many to be a second-class and generally inferior building material. • On account of these problems - earth as a building material lacks institutional acceptability in most countries and as a result building codes and performance standards have not been fully developed. |

Source: Adam and Agib (2001)

Despite the advantages of CSLBs in providing affordable housing for the populace particularly for the low-income group, it has been observed that there is not a wide-spread use of the material. While many pay rent to live in houses built of mud but plastered with cement, they consider it as degrading to build their own houses with earth building techniques of which CSLBs is a scientific improvement. This paper thus investigated the reasons behind the decline in use of CSLBs for housing construction by the urban populace.

4.1 Materials and Methods

The study was carried out in four local government areas of selected States in Southwest Nigeria. The randomly selected local governments are Ogbomoso North, Ibadan Southwest in Oyo State, Ado-Odo Ota in Ogun State and Agege Local Governmet in Lagos State. The

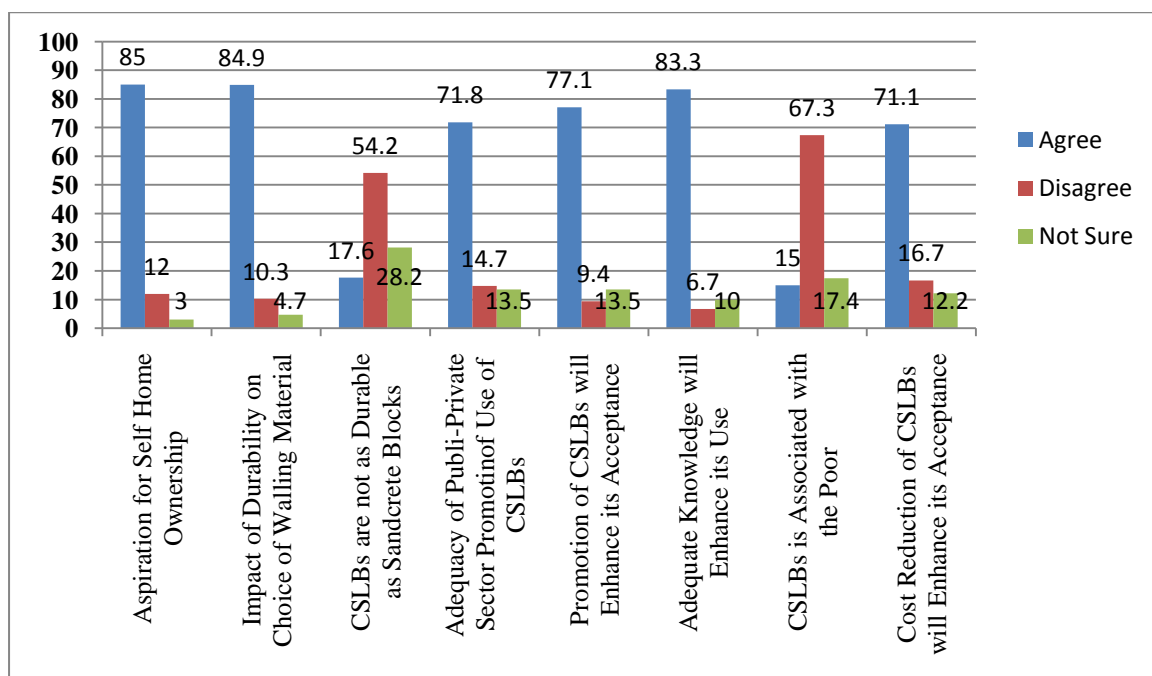
sample frame for the field study was 600 household heads. The instrument of research was the questionnaire designed with the primary objective of eliciting the following information from the respondents; to examine the relationship between peoples’ knowledge of CSLBs and the influence this may have on its acceptability for housing construction; to ascertain whether low cost implication of a walling material is a determinant in its choice for building construction; and to examine the role of public-private partnerships in the promotion of CSLBs for low-cost housing.

A total of 150 questionnaires were distributed in each of the local governments out of which 551 valid questionnaires were returned at the end of the exercise. The data obtained from the field exercise was analysed and presented using descriptive statistical method.

4.2 Results and Findings

The result of the field survey is summarized in Figure 2. The result shows that majority of the respondents (85%) have a high aspiration for self home ownership. This is a confirmation that housing represents one of the best indicators of the living status of a person in the society.

Figure 2: Assessment of Factors affecting Patronage of CSLBs for Affordable Housing



Source: Field Source (2008)

Majority of the respondents are of the opinion that their choice of walling material for their houses will be dependent on the durability of the walling material. It was again observed that a large percentage (54.2%) of respondents have the knowledge that CSLBs is as durable as the widely used sandcrete blocks. Hence, it can be inferred that majority will opt for the use of CSLBs as a walling material, but this is not the case. A survey of other factors that can affect patronage of CSLBs for housing construction was assessed. The study revealed that larger percentage of respondents are of the opinion that adequate knowledge about the physical properties of CSLBs coupled with adequate promotion of the use of the material will enhance its usage.

5.0 Conclusion

The study established from literature that CSLBs is a sustainable and cheaper alternative to sandcrete blocks. The field study also shows clearly that CSLBs being a derivative of earth building technology is not associated with the poor. The paper concluded that the aspiration of home ownership by majority of respondents could be explored to market the acceptance of CSLBs for affordable housing construction through adequate promotion and enlightenment campaigns by the public-private sector in Nigeria.

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