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A REVIEW OF THE USE OF INDIGENOUS BUILDING MATERIALS IN CONTEMPORARY ARCHITECTURE IN NIGERIA

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ABSTRACT

Over the years architecture has transcended borders, peoples and places. Different styles had come and gone but certain elements, materials, techniques and styles persist; some of which include materials like stone and timber used in constructions since humanity engaged in building. Notably, building materials constitute the single largest input in construction and have great influence on the value and appreciation of the architectural profession and its products. Generally, materials are locational, contextual and geographical. People build with materials within their reach and place. Regrettably, however, in Nigeria there has been a persistent discrimination against the use of indigenous building materials even when they are readily and abundantly available. This work reviewed the use of indigenous building materials in the practice of present day architecture in Nigeria. It reviewed those indigenous building materials that could be exploited to match the needs of contemporary architecture. It was discovered that there are a lot of readily available building materials which when properly processed could be effectively used in the contemporary architecture. It concluded that the use of indigenous materials are not only cost effective and environmentally friendly but when used correctly, these natural alternatives match the strength and durability of many mainstream construction materials and as such should be employed in our contemporary architecture.

Keywords: Indigenous Building Materials, Contemporary architecture, Use, Standards. Nigeria

INTRODUCTION

The debate on the appropriate technology for Nigeria and other Third World countries has remained unsettled, even as the gap in technology widens between the developed and developing countries of the world. The two popular, but opposing schools in the technology debate have been, whether the third world countries should start to develop their technology from the basics – a continuation of the practice of their progenitors – or, import technology at its present level obtainable in the developed world. The technology question cannot be ignored. This is because it is not only an indicator of a country's economic standing in the committee of nations, but also an undisputed parameter for measuring the adequacy of life essentials. This includes housing, feeding and the general welfare of the citizenry.

Atolagbe (1997), argued that only by a combination` of both methods through a gradual adoption can a worthwhile development be fostered in the economies of the Third World. Architecture and the delivery of buildings

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for a sustainable environment is an integral aspect of technology. It is thus, in keeping with the adaptation argument, using indigenous technology to achieve modern technology update that informed this study.

Investigative studies into adaptive indigenous Architecture have, thus far, concentrated on building materials and appropriate technology or method. For example, Nwoke and Ugwuishiwu (2011), observed that experts have evaluated raw materials such as bamboo, oil palm fibre, palm kernel fibre and coconut palm fibre that are locally available, relatively less expensive, low energy demand during production, environmental friendly and 100% bio-gradable as possible substitutes for conventional building materials such as steel reinforcement and steel mesh.

The search for cheaper alternative building materials has led to the exploration of abundant, naturally occurring materials such as bamboo, coconut fibres, sisal and oil palm fibres which can be obtained locally at low cost and low levels of energy using local manpower and technology. The use of these locally available materials as substitute for the conventional materials in reinforced concrete elements can cut construction costs by as much as between 30% and 80%.

Indigenous building raw materials like bamboo, mud, wood, thatch etc, have been from time immemorial used in the construction of various forms of housing across Nigeria. For example, Denyer (1982) noted that the house in which the Oba of Benin, Oba Eweka I received his early childhood education at Use near Benin City on Siluko road within 1200 AD was built with mud, wood, sticks, and thatch materials. Furthermore, Mr Offert Dapper, a Dutch who visited Benin City in 1668, observed that houses were built with mud, the walls were plasterd with mud mortar, and the surface of the plaster work was kept smoth (Braide, 1987). The use of most of these materials in building construction has greatly diminished despite their readily availability, ease of use and cheap production cost. The need for research in this area is driven by high cost of conventional materials, difficulty for accessing funds for construction /building development as well as the need to maintain ecological balance

The aim of this work therefore is to review some of the various building materials and their physical properties to indicate their strengths, weaknesses as well as how they can be harnessed for maximum utilization in today's Nigerian architecture.

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The Concept of Indigenous Building Materials (IBM)

According to United Nations reports UNCHS (1985,1992), the building materials sector was split into three production groups:

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

(ii) Traditional materials, which are those materials that have been in local production from ancient times using small-scale rudimentary technologies, e.g. laterite, gravel, thatch, straw, stabilised mud, Azara and raphia palm; and

(iii) Innovative materials which are materials developed through research efforts aimed at providing alternatives 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 Indigenous Building Materials (IBM).

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;). This has led to the creation of global political agendas and researches on the potential for wide application of IBM.

The term 'indigenous' when used with building material is a relative term. It has to do with belonging to a place, growing or occurring naturally within a region. For instance, Omole (2000) noted that building materials produced in America, Britain or France are local (indigenous) products at home, but become imported to other countries that import them. The same is applicable to materials produced in Nigeria, Gambia or Cameroun; they are indigenous to the countries of their origin. In view of this, Omole defined the term Local Building materials as those materials used in building works, that are sourced within our immediate environment, with ease and requiring little or no further processing before use. The performance of indigenous raw materials over a long period of time, in all climates, and for all structural conditions is still not completely understood nor worked out. But they hold promise of ready availability, low energy costs and simplicity of equipments required in exploitation and utilization.

RESEARCH METHODOLOGY

The study in a nutshell reviews how much impact the indigenous building materials have on the contemporary architecture in Nigeria. Qualitative studies approach was therefore used. Primary data were gotten through interviews and case studies, while the bulk of secondary data were gotten from books and the internet. There is a survey of various indigenous building materials. Each one was studied critically, to ascertain how much of its characteristics and properties are utilized in the Nigerian Contemporary Architecture.

The Emergence of Nigeria Contemporary Architecture

What people now have as modern architecture or contemporary Nigerian architecture is a preponderance of imported motifs and models that have little links with the socio-cultural heritage. This may probably explain the disappearance of the indigenous courtyard type of house in Nigerian urban centers and also open space architecture and settlement pattern, all of which is obsolete now. Izomoh (1994) ascertained that this modern architecture also known as contemporary architecture is demonstrated by many buildings in many Nigerian urban areas. These buildings, he explained, has international identifications found anywhere in Europe, America, Russia and Japan. Furthermore he reiterated that this category of architecture is reflected by the buildings with directly or indirectly imported building materials, foreign building techniques, styles, forms and norms. The documented history of modern architecture in Nigeria dates back from the early nineteenth century with the coming of the colonialist and later, the Brazilian slaves. Up to the middle twentieth century, the hybrid style produce by these two events was the dominant style. It was however, in the fifties that modern architecture as conceived in Europe emerged in Nigeria, with clear guidelines and conceptualization. Institutional and

residential buildings benefitted from this style (Izomoh 1994 Materials used in Nigeria contemporary architecture include concrete, reinforced concrete, glass sheets, plastics, steel and aluminum sections.

Indigenous Building Materials in Nigeria

Adogbo and kolo(2009) noted that there are many locally available resources which can be exploited including small-scale raw material deposits, agricultural products and residues, industrial wastes, low-cost and renewable sources of energy, unskilled and semi-skilled labour, and established technologies which can readily be applied to the local production of low cost materials. Stulz and Mukerji (1988) and Okereke (2003) identified sources of materials on which indigenous building materials rely and standardize them into three broad classes: naturally occurring raw material deposits; agricultural products and residues; and products of manufacturing process. Table 1 show some states in Nigeria where these materials predominate

Table 1 Availability of Raw Materials in Nigeria

Type of Material	States predominately found
Granite	Plateau, Ondo, Ado Ekiti, Bauchi, Abia and Ebonyi
Limestone	Anambra, Cross Rivers, Benue, Imo, and Bendel
Marble	Kwara, Bendel, Benue, Plateau and Kaduna
Laterite	All States
Clay	Cross Rivers, Ondo, Oyo, Sokoto, Gombe, Kano, Niger,
Natural fibre	Imo and All States Anambra.
Bamboo	Eastern Nigeria
Timber	Eastern and Western Nigeria

(Source: Kogbe, 1989,; Okereke 2003,)

The traditional materials employed in the construction in Nigeria is as diverse as the ethnic groups in the country, ranging from mud, mud bricks, stones, marbles, bamboo, timbers and straws.

Laterite

Laterites are soil types rich in iron and aluminum, formed in hot and wet tropical areas. Nearly all laterite are rusty-red because of iron oxides. They develop by intensive and long lasting weathering of the underlying parent rock. Tropical weathering (laterization) is a prolonged process of chemical weathering which produces wide variety in the thickness, grade, chemistry and ore mineralogy of the resulting soils. The majority of the land area containing laterite is between the tropics of cancer and Capricorn.The ecological and environmental benefits arising from the use of local building materials (especially those based on earth) are plentiful. It helps to reduce the amount of cement used in global building processes and consequently the amount of CO2 emitted and energy used for construction. The thermal insulation and thermal mass properties of building materials have been proven to significantly affect the amount of energy required for heating or cooling and, consequently, the total amount of electricity used in residential houses. With its high density and valuable thermal inertia qualities, earth walls allow the storage of solar heat during the day

and its slow release during the night, thus contributing to indoor comfort and reducing electricity consumption. In addition, earth walls remarkably regulate the humidity of indoor air due to their permeability to water vapor.

Building with earth without the required know-how and without regular maintenance undoubtedly led to the bad image that some people place on earthen structures today. However, this construction technique has been proven empirically, technically and scientifically. It has educational resources, which can be taught or valued as do all other materials. Implementing earth (adobe, CEB, cutting lateritic) for the realization of decent housing should be made by respecting the specific nature of the material. The architectural beauty of earthen construction is realized in several countries through the world (Canada, France, the United States, *etc*.), and those in Nigeria are evidence of the potential of this material. Figures (1 and 2) below show photos of the degree of contrast that exists in the realization of earthen structures depending on how the materials are produced and implemented.
The discomfort associated with earth construction is therefore not inherent to the material, but with how it is used. However, a certain amount of money is required to ensure a comfortable standard of living. Its availability, like other local building materials, may also contribute to the socio-economic development of localities where these materials are used by reducing the amount of exported materials for building realizations.



Plate 1. A photo of poorly constructed lateritic adobe house



Plate 2. Another photo of poorly constructed lateritic adobe house



Plate 3: A photo of classrooms with stone and Compressed Earth Blocks (CEB) with good implementation.



Plate 4: Photo of another section of classrooms with stone and Compressed Earth Blocks (CEB) with good implementation.

Bamboo

In Nigeria bamboo abounds in large quantity in the rain forest of the south-south and south-east geopolitical zone of the country. Bamboo is naturally sustainable as it can grow to full maturity within 3-6 years depending on the specie, unlike other timbers. Bamboo can be used to construct the following types of elements in building: Walls, Roofs, Bridges, Houses, Flooring, ceiling, furniture etc.

Apart from the fact that bamboo is readily available in Nigeria, other factor or properties of bamboo that makes it a sustainable building material include its renewability, high tensile strength, resistance to pests, sturdiness and flexibility. Building with bamboo is cheap, durable and sustainable; therefore Nigeria should tap into her vast reservoir and develop technologies that will harness this natural building treasure.

Timber/wood

Timber is one of the most prominent building materials in Nigeria and finds application in wall construction, floors, doors, windows, claddings, ceiling, roofing and furniture making. Timber is natural and renewable. It has a high strength to weight ratio and is easy to work with, making it especially useful even where only basic technology and procedures are available (Apu, 2003). According to Douglas (1995) timber remained the most predominant building material until the last half of 19th century. According to the raw material research and development council of Nigeria RMRDC (1998) roof structures and ceiling noggins of most buildings are constructed with timber because of it workability and durability. Other desirable characteristics of wood include its readily availability, environmental sustainability, flexibility of space arrangement and ability to be mass produced. It can also easily be shaped to desired form by simple hand tool.

Marbles

Marble is a non-foliated metamorphic rock composed of recrystallized carbonate minerals, most commonly calcite or dolomite. Geologists use the term "marble" to refer to metamorphosed limestone; however, stonemasons use the term more broadly to encompass non metamorphosed limestone. Marble is commonly used for sculpture and as a building material.

Nigeria is endowed with large deposits of marble located in all parts of the country. Marble, the principal raw materials for cement manufacture, are very essential for a rapidly growing nation like Nigeria. These industrial rocks can be said to be already in extensive use in Nigeria. They are used mostly for one purpose – the production of building and constructional materials. Several cement factories have been built by government and even individuals to utilize the marble deposit in their respective areas such as Dangote Cement Company Plc located at Obajana in Kogi State. Marble are extremely valuable industrial rock raw materials. Construction and cement manufacturing industries are principal consumers. They are also used in the production of chemicals, fertilizer,

Marble Occurrences In Nigeria

Extensive deposits of marble exist throughout the country. A few of them are currently being exploited and only these will be reviewed

State	Location
Kogi	Jakura, Ekinrin-Adde, Itobe, Ubo River, Okoloke
FCT	Burum,Takalafia, Takusara, Kusaki, Kenada, Ele
Oyo	Igbetti, Alaguntan
Niger	Kwakuti
Kwara	Elebu Bugum, Oreke, Owa-Kajola, Babanloma, Eleja, Oke Oyan, Ibare/Oja/Agunjin
Edo	Ukpilla, Akoko-Edo, Etsako, Igara, Ate
Nassarawa	Muro Hills, Ugya,
Imo	Okigwe
Ebonyi	Afikpo, Abakaliki, Ohaozara, Ezza north and south
Abia	Ohafia
Taraba	Jalingo
Ekiti	Ijero

Uses of Marbles in Contemporary Architecture

Marble has many decorative and structural uses such as:

(i) Marble is used for outdoor sculpture as well as for sculpture bases in architecture.
(ii) It is used in exterior walls and veneers, flooring, decorative features, stairways and walkways.
(iii) Marbles are used for the manufacture of cements.
(iv) Marbles are used in the production of tiles.

The use or function of the marble may also affect the feasibility of applying certain treatments, but type of use is not the primary factor in the major types of deterioration and damage to which marble is susceptible.



Plate 5: pictures of marble in use in residential building.

Potential Benefits of the use of Indigenous Building Materials

There are several benefits that could be accrued through the use of indigenous building materials. They are as follows.

(i) Providing affordable housing for the citizenry though, the general bias is that it will only be suitable for low-income cadre of society.

(ii) Reducing costs of construction since materials found locally will be used thus eliminating costs associated with manufactured products and transportation.

(iii) The development and propagation of indigenous technology and the provision of employment. These will invariably contribute to the economic growth of the nation.

(iv) It will provide a source of research for both students and professionals of building and construction disciplines.

Some Challenges of Indigenous Building Materials in Nigeria

There are certain challenges that face indigenous building materials. They are as follows

(i) Quality of Output:

Generally, the quality of output of any productive process is a function of the technology adopted and the availability of national or international accepted standards. Even though standards are identified to be the basic framework for promoting quality production, there are hardly any available for indigenous building materials (UNCHS, 1985). This lack or unavailability of standards means that the output of the productive process will not have a basis for standardization and acceptance.

(ii) Demand for Indigenous Material:

Another factor that limits the adoption of indigenous building material is the wide-scale low demand for these products (UNCHS, 1985). The lack of patronage of the indigenous products then implies that the market will not be viable. In 1976, the Federal Government of Nigeria established seven clay brick factories and though 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 (Sanusi, 1993; Okereke, 2003). This is largely due to consumer bias and the general feeling that indigenous products are of low quality.

(iii) Inappropriate Use of Indigenous Building Materials in Construction

The use of indigenous building materials in some instances is unpopular due to wrong application in construction. The result is that the material would be abandoned not because it is unfit for use but because there was a lack of skilled workmanship.

CONCLUSION

The performance of indigenous building materials over long periods of time, in all climates, and for all structural conditions is still not completely understood, nor worked out. But, they hold a promise of ready availability, low energy costs and simplicity of equipment requirement in the exploitation and utilization. They also have the potential to enhance a sustainable construction practice. Though, there are potential benefits associated with the use of indigenous building materials for building construction, they are yet to be fully explored. Engineers, architects and builders will require retraining to think in terms of these materials; standards and specifications need to be established; pricing and subsidy structures will have to be changed to give encouragement to the production of indigenous materials; most difficult of all, the general public,

those who build or decide what is to be built, need to be re-educated to think in terms of building with indigenous materials rather than what has become conventional. There is the possibility of using local raw materials in place of the conventional materials in contemporary architecture in Nigeria, yet people keep running away from the use of these materials not withstanding their readily availability, cheap production cost and ease of use. 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 indigenous building materials fashionable to use.

Research findings have shown that the use of alternative construction materials can contribute positively to the construction industry especially in the protection of the environment. This work recommends three (3) key issues:

(i) That further studies should be carried out on indigenous raw materials in order to determine their actual properties and quantities available.

(ii) That standards need to be established on those materials that have been studied, tested and confirmed to have met specified standards

(iii) That the professionals and potential clients in the building industry should rethink on the need to adopt these materials.

This 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 organizations (NGOs) and government agencies, to promote the awareness on indigenous building materials in order to popularize their use. These materials can be used in construction of secondary schools, markets etc.

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