Eco-Friendly Building Construction in Nigeria: The Importance of Sustainable Building Materials

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Abstract

Building construction activities contribute to very serious environmental deterioration and degradation. In recent times we have been confronted globally with a number of environmental challenges such as climate change and depletion in available resources which in turn have severe consequences on humanity. Hence, it has become important that building construction activities be carried out with methods and materials that increase sustainability of the environment. It has been observed that the use of eco-friendly materials can be one way of accomplishing ideal environmental sustainability. This paper reviews literature on sustainability, eco-friendly building materials, as well as their impacts on building construction and conservation. The study carefully looks at locally available building materials in Nigeria, and how a careful comprehensive selection based on their characteristics and application can be used to accomplish sustainability objectives. It also highlighted the enormous benefits derivable from the use of local materials in construction both to man and the environment. The paper concluded by recommending that stakeholders in the building industry should help increase the production and use of eco-friendly building construction materials and components for building construction and conservation in Nigeria.

Keywords: Sustainable; Materials; Eco-friendly; Construction; Conservation

Introduction

Building material is an integral part of the building industry. Materials provide strength, aesthetics and functionality to the building (Jim-kin & Rigdon, 1998). Careful selection of environmentally sustainable building materials is the easiest way for Architects to begin incorporating sustainable design principles in building. Building construction activities bring a lot of damage on the environment creating high levels of unsustainability. Building construction consumes 40% of raw stone, gravel and sand world-wide annually and 25% of

raw timber (Yu, 2008). In the view of the above, Umar & Khamidi (2012) see it that a careful selection of eco-friendly sustainable building materials may be the fastest way for builders to start integrating sustainable design concepts in buildings.

This will imply the use of materials that have minimum negative impacts on the environment in the building construction. Among the five principles of sustainable design, sustainable building materials have been highly recommended.

The paper is looking into those locally available building material which are environmentally friendly and how they can be integrated into construction practices that encourage sustainability.

Conceptual Framework:

This paper explains the concepts of sustainability, eco-friendly building construction and building conservation.

Sustainability

According to Wikipedia, sustainability is a process of maintaining change in a balanced environment in which the exploitation of resources, the direction of investment, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations. It could also be defined as the study of how natural systems function, remain diverse and produce everything it needs for the ecology to remain in balance.

Sustainability is a deliberate attempt to introduce changes in the various human activities that are undertaken in the environment, to strike a balance ensuring prevention of the natural environment, the human health, different ecosystems in spite of the innovations that are coming up today. The Bruthand Commission famously defines sustainable development as “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable building materials are those materials which are used in the construction of building for the purpose of positive impact on the environment. They are materials that meet the need of the present without compromising those of the future generation. They are

regarded as environmentally friendly materials (also known as green building materials) in which their production, placing and maintenance generate low environmental impact, they have to be durable, reliable, or recyclable, include recyclable materials in their compositions, and have to be from resources of the area where the building activity will take place - they have to be local materials.

Eco-friendly building construction:

Construction is the process of constructing a building or infrastructure. Construction generally is applicable to building and to other structures that are not buildings. Building construction therefore involves the act of construction, deconstruction, demolition and renovation of building. Holzer (2018) opines that eco-friendly means earth friendly or not harmful to the environment. It refers to products that contribute to green living, or to practices that help conserve resources like water and energy. Eco-friendly building construction is a method of constructing building is such a way that the environment and its resources are conserved.

Eco-friendly or ecological construction is building a structure that is beneficial or non–harmful to the environment and resource efficient (Murray-White, 2018). It is a type of construction that is efficient in its use of local renewable materials, and in the energy required to build it and the energy generated while being with it.

The understanding that buildings do have negative impact upon our environment requires the response of eco- friendly construction. The eco-friendliness is the use of construction techniques, eco-friendly local material or green materials. Eco-friendly building materials actually help in the balance of the eco-system which is aimed at cleaner environment through the reuse and recycling of waste materials for production of eco-friendly building materials. There has been an increase in the demand for nature-friendly methods of construction, leading to design tools and construction systems for improved energy-efficient houses.

Building Conservation:

The Australian ICOMOS Charter (Burra Charter) (1999) defines conservation as meaning all the process of looking after a place so as to retain its cultural significance. It includes maintenance and may according to circumstance include preservation, restoration, reconstruction and adaptation and will be commonly a combination of more than one of these, the conservation of the built heritage has a contribution to make to the achievement of environmental balance in human affairs or sustainable development (Colm, 2012). The mother of building conservation, looks at how older buildings can be maintained, through rehabilitation or renovations, therefore conservation is an important aspect of sustainability. A new building may achieve high environmental efficiency but it is more sustainable to adapt existing buildings.

Building Construction and their Impacts

According to EPA (Environmental Protection Agency), construction activity can significantly change the surface of a land in large part due to clearing of vegetation and excavation which is common on many construction sites. Amatepy & Ansah (2015) observed that these construction impacts can last throughout the life cycle of the development, because they begin to occur from initial work on site, through the construction period, operational period and to the final demolition when a building can be said to have come to the end of life. These impacts have become a growing concern, nationally and internationally. Similarly, Azqueta (1992) stated that even though construction project development contributes to the economic and social development and enhancing both standard of living and the quality of life, it is also associated with deterioration of the environment.

Cardoso (2005) enumerated the typical negative impacts of construction activities to include waste production; mud; dust; soil and water contamination; damage to public drainage systems; destructions of plants; impact; noise; traffic increase; packing space shortage; and damage to public space. The overall results of these impacts affect human health because they occur with irreversible consequences.

The article published by the Nigerian Real Estate Hub NREH (2017) explained that all types of buildings consume of power. This assertion was supported by Jauda and Busch, (1994) with a research that concluded that 57% of electricity used in developed countries is consumed directly by buildings, out of which 31% is taken by residential buildings and 26%

by commercial buildings; this makes building construction a source of environmental impact in Nigeria.

Construction activities on site require heavy machineries that are powered by electricity; using petrol and fossil finding which heavily pollute the atmosphere. Heating, ventilation, air conditioning use up energy through electricity contributing to green house gas emission that destroy the ozone layer. The atmosphere is also polluted with dusts that come from concrete, cement, stone etc. and as such the air quality is reduced. All these are sources of pollution in the environment which is not good for human health.

Construction activities also result in water contamination. Waste water from concrete wash out from paintings, curing compounds, release of oils, fumes and other pollutants from vehicles and equipment are discharged into the surface water bodies like the rivers, the streams through run-offs after rain. Some seep down to the acquitters and pollute the underground water.

More so, the use of timber and the clearing of vegetation deplete the overall eco life of a particular environ where a construction project is ongoing. This brings about loss of bio diversity and loss of arable bonds desertification. The reduction of these resources makes global warming to be on the increase.

Construction activities also lead to waste generation. Teo & Loosemore (2001) note that construction activities contribute approximately 29% of waste in the USA more than 50% in the UK and 20-30% in Australia but Sterna, (2002) sees these waste as un-necessary. The reason being that they are wastes that have high potential for recycle and re-use. This is where the quest for sustainability in building construction must be driven as a noble course.
Environmentally-friendly building materials are those that provide appropriate service and life span, with minimum maintenance, while minimizing the extraction of raw materials, the pollution from, and energy consumed by manufacturing and use, and that have the maximum potential for reuse or resource recovery.

Characteristics of eco-friendly building materials

Eco-friendly building materials are categorized by some qualities. These qualities include:

- Air pollution: eco-friendly building materials are low in the emissions of volatile organic compounds (VOC).
- Water pollution: Eco-friendly materials prevent soil leaching.
- Performance: they are high in strength and other performance yardsticks.
- Land pollution: Eco-friendly materials reuse waste that would have filled up the landfill eg. Sawdust and fly ash.
- Durability and lifespan: eco-friendly building materials are very durable and possess longer lifespan when compared to conventional materials.
- Recyclables: Recyclable materials are eco-friendly eg. Steel, aluminium etc.
- Energy conservation: materials that require less energy during and after construction are eco-friendly. Some materials also tend to reduce the heat transfer eg. aerated concrete blocks.
- Biodegradable: Eco-friendly materials decompose easily eg. wood or earthen materials etc.

Eco-friendly building materials

Locally available eco-friendly building materials in Nigeria include but not limited to the following: bamboo, bricks, compressed earth blocks, wood, recycled plastics, timbercrete, ashcrete etc.

Bamboo:

Bamboo is a very common building material in southern part of Nigeria characterized by rain forest. It is highly available in Edo, Ondo, Rivers, Ogun, Cross-River, Imo and Abia States. It can be used for many aspects of the building ranging from walling, reinforcements, roofing to flooring. It grows up to 119 cm in 24 hours and 24 m high in 40 to 50 days. Through various researches it has been found that some bamboo species have tensile strength same as mild steel at yield point. Cellulose is the main component present in bamboo which is the main source of mechanical properties of bamboo.

Bamboo has gained popularity in the construction of small buildings in rural and semi-urban areas. In wall construction, bamboo could be used as the only material or used as reinforcements to earth (mud), for roofing as roof frame or roof cover, and for interior of finishes.

It is environment friendly as the plant is readily grown and available and near zero energy is required for its production. The plant regulates the ecosystem by exchange of oxygen and carbon dioxide for the purpose of photosynthesis. Bamboo wastes readily degrade and decay thereby minimizing its effect on environmental degradation to its minimum. More so, bamboo has not shown any sign of underground or surface water contamination.

Manufactured Sand:

Manufactured sand (M sand) is an alternative of river sand. The demand of M sand increased because of deficit availability of river sand. M sand is a by-product of stone crushing industry so it can be available anywhere there is quarry or stone crushing plant and being used in that locality will reduce transportation cost by half.

Manufactured sand is available in Nigeria in quarry sites where stones are crushed to chippings or sliced to tiles. These sites are common at Okigwe in Imo State, Auchi and Okpella in Edo State, Abakiliki in Ebonyi State, Ondo state and other quarries located in northern parts of the country.

M sand is free from chemical impurities such as sulphates and chlorides which improves the properties of concrete like strength and durability. M sand contains no organic materials; hence it gives increased strength of concrete with same cement content. M sand does not harm environment. Sieving at site is also not required for M sand because it is already sieved (below 4.75 mm) which reduces the labour cost and saves time. This overall makes it easier and cheaper than river sand.

Hempcrete:

Hempcrete is bio-composite mixture of shrivelled hemp, lime binder and water. It is one-eight times lighter than concrete in weight. Hempcrete can be used to construct walls, floors and roofs; or moulded (monolithic), sprayed or precast (e.g. hemp bricks or panels). Hempcrete offers both environmental and construction opportunities which can help to deliver sustainable housing solutions.

According to Ministerial Committee on Drug Policy (2007), Nigeria is a major source of West African grown hemp (cannabis) and also ranked world's eight highest consumer of

cannabis. Hemp is grown across the states of Nigeria such as Ondo, Edo, Delta, Osun, Oyo, and Ogun States.

Industrial hemp can grow, under suitable conditions to 4 m height in 12 weeks. Bedliva & Isaacs (2004) opine that on 1 hectare of land is possible to grow 8-10 tons of hemp a year, enough to build a small house 60% the hemp.
Hempcrete just like concrete can be precast, sprayed or moulded. It can be precast in blocks or in prefab-panels. Prefabricated panels with a thickness of 150mm could dry in two days due to an enforced air pressure.

Hempcrete could also be manufactured by projection known as Sprayed Hemp Concrete (SHC). It is an on-site technique where hemp is projected on a shutter board. The shrivelled hemp is mixed with lime. The dry mixture is conducted by air through a hose. Pulverized water is added just before the end of the hose. After filling, the surface is smoothed.
The third method of constructing hemp wall is by moulding known as Mould Hemp Concrete (MHC). Shrivelled hemp fibres are mixed with a lime-based binder with adjusted water content. The mixture is poured in a mould and slightly compacted. The limitation of hemp blocks is that they are not able to carry any load so the blocks are often used to construct non load bearing walls in post-and-beam framed structures.

Construction with hempcrete is relatively easier as it takes less energy to transport a load of hempcrete than concrete due to its lightweight - which is roughly one - eight of what concrete weighs. Hempcrete is resistant to cracks that occur under movement. The hemp and lime product proved to be a natural alternative to cement based concrete. Cement plaster found to be unsuitable as it did not breathe, stopping the escape of moisture and promoting rot; and was not flexible, resulting in surface cracking.
Moreso, hemp being a plant product will absorb carbon dioxide from the atmosphere and release oxygen. It is a fast growing plant and can easily be replenished.

Compressed Earth blocks (CEBs):

Compressed earth blocks are made from earth or mud or laterite pressed into blocks at high pressure in a mould. These blocks are mechanically pressed with the pressure of about 3,000 psi at this pressure original volume of soil reduces by about half. Compressive earth blocks

are inexpensive and best for non-load bearing structures. A coat of Polycarbonate varnish is required to avoid erosion due to wet weather.

> *Unlike the nature adobe block, which is a mixture of earth, water and district cultural adhesive moulded to desired shape with the hand the compressed earth block is supplemented in very small amounts in most cases less than 10 percent with either cement or lime component in its blending process. The blend is not worked to achieve a plastic state but simply blended until the cement lime and earth are thoroughly mixed. Afterwards, the mixture either machine pressed or placed in a mould and compacted with a high level of pressure applied through a hand operated machine. After aeration, the CEBs give a high compressive strength appropriate for three floors constructions but higher potentials can also be attained for up to five floors construction.* (Iwuagwu, 2015, p. 47)

These CEBs can be left unplastered, covered with plaster or can be coated with watered earth. Compressed earth blocks are substantially used to make wall, pavement and other elements of construction. These blocks are of uniform shape and size which requires less mortar for masonry and plaster work thereby reducing the cost of construction. The earth (mud) is widely available in Nigeria, and wastes from buildings constructed with CEBs can readily be reused thereby eliminating the risk of environmental pollution or underground water contamination.

Straw bale:

Straw bales can be made from a range of plants fibres like wheat, barley, blue-grass, flax, hemp, rice etc. Bales of recycled materials like paper, pasteboard, waxed cardboard, crushed plastics and used carpets are currently being explored.

Basically, straw bales are produced on farms referred to as field-bales. They come in a range of sizes, from small 460 mm wide by 350 mm high and 0.8 to 1.2 m long, to commercial bales 525 wide, by 450 mm high, by 1.2 m long. These sizes range from 18kg to 45kg in weight. A newer trend is to use high-density recompensed bales known as ‘strawblocks’ offering far higher compression strength. This is made from a stationary press producing up to 4 MN of force. The choice of bale production depends on straw source, twine tightness, compression and humidity. Straw is an exceptional insulator and resistant to pests and

animals. Due to its deficiency in load-bearing capacity, straw bales are limited to in use to single-storey buildings.

Straw bale as a material has been in use for shelter construction since the age of discovery of stone. It is a natural vegetative resource that is found in great quantities across the continents. Since the 1990's straw bale construction was revived, particularly in North America, Europe and Australia. According to Murray (2005), the first straw bale house built more than one hundred years ago in the USA, paved way for the durability of the material and the reliability of the technology.

In some parts of Nigeria houses are built with a mixture of clay/laterite and straw for wall and roof cover (Adedeji, 2007). Nigerian straw comes from elephant grass, corn stalk, sorghum, wheat, rice and millet. These grasses and plants used for the production of straw bales in Nigeria are grown in almost every parts of the country. For example, rice husks are abundant in states like Ebonyi, Nasarawa, Edo, Ogun etc where rice farms, wheat is grown in northern states like Nasarawa, Kano, Taraba etc, while elephant grass is a very common grass in states like Edo, Imo, Abia, Cross River, Benue, etc.

It is very easy to clear loose straw from site and burn them easily. Adedeji (2007) opines that straw bale looks fragile to fire but when straw is made as a bale, it behaves like solid timber. When straw bale is plastered, its fire resistance is more. The ASTM-E 119 fire resistance test for plastered straw bale wall assemblies in 1993 passed for two hour fire-wall assembly. Otiki (2004) cited in Adedeji (2007) explains that the flexural strength of a plastered straw bale prism shows the ability of a cement plastered straw bale to withstand naked fire up to two hours.

The use of straw bale for building construction is very sustainable and environment friendly. Straw bale construction is energy efficient cost of production is low compared to other building materials, reduction to green house gas emission. It is a locally and readily available material both in Nigeria and around the globe. It is non toxic and so provides a healthy micro climate and it is also a renewable material. Straw bale also produces an excellent thermal insulation. When buildings are constructed with bricks or sandcrete blocks they are further insulated with other materials like foam in the cavity of the walls as the case may be, but with

the straw bale material, the straw leaf comprises of the wall and the insulation at the same time.

Wood:

Wood is a very old building material. Wood is one of the most economically used materials in building construction. Only few building materials possess the environmental benefits of wood.

According to Wimmers (2017), wood has a great potential as a construction material due to its robustness, light weight, eco friendly attributes and capabilities of being prefabricated for building applications. Wood can be used in the construction of floors, beams, columns, staircase, finishes etc. Falk (2009) opines that unlike metals and fossil-fuel-based products (such as plastics), our forest resource is renewable and with proper management a flow of wood products can be maintained indefinitely. The importance of forest based product to building construction cannot be overemphasized. However, sustainability of this resource requires forestry and harvesting practices that ensure the long-term health and diversity of our forest.

Wood is readily available in the rain forest region of Nigeria. Nigeria was once the largest exporter of timber in West Africa. The major areas of timber production are the rain forest areas of Cross River, Edo, Delta, Ondo, and Ogun States. By three years minimum, most of the trees grown in these areas have matured to be cut down.

Nigeria produces both hardwood and softwood. This is an indication that all kinds of wood products are possible to be produced in Nigeria with the right technology. There are different species of wood in Nigeria - they include; Obeche, Mahogany, Iroko, Sapele, White Afara, Black Afara etc. These different species may slightly differ in their physical and chemical qualities.

Wood can be useful in building construction in the areas of foundation, flooring, walling, roofing and roofing. Engineered wood products (EWP) have brought a new dimension in the use of wood as a very good structural material. Such products are finger-joined lumber, laminated veneer lumber, glued laminated lumber etc. The prefabrication system of producing these is commendable for efficient use of material while reducing waste.

Wood is an excellent eco-friendly building materials. It is renewable as they are gotten from planted trees. When there is proper management and implementation of policies, wood flow can be maintained without break or extinction. Practices such as selective cutting, planting lumber in plantations, demanding companies that manufacture wood based products to replant, and other good harvesting practices will make wood an ever retained material. These trees help to remove carbon dioxide from the atmosphere and release oxygen through the process of photosynthesis thereby increasing air quality. Wood has low embodied energy. This has to do with energy required to harvest, and manufacture material from its raw source to where it will be used. When compared to other materials like steel, concrete, cement etc., the embodied energy of wood is lower. Wood has low carbon impact. The carbon in wood is stored in the wood until the wood decomposes. When carbon impact is so compared with other building materials it was found that for the production of about eight times that emitted to produce a tone of framing lumber (Falk, 2009). Also, wood is characterized by reuse/reclyclable; energy efficiency; durability (lifespan); local availability; embodied energy; waste reuse (waste reduction); biodegradable; and pollution reduction in air, land and water.

Wood is a major sustainable material that can be incorporated in sustainable constructions in Nigeria. As sustainability awareness measures and strategies are implemented, it is hoped that Nigeria timber production will increase to pave way for wood products and as sustainable material to be in high use in Nigeria.

Ashcrete:

Ashcrete is the hardened form of coal ash. It is mixture of fly ash, cement and admixture. Fly ash is a by-product of burning coal. It can also be made from municipal solid waste combustor ash. Before the discovery of crude oil, coal used to be the main source of power in Nigeria. Although coal mining has been abandoned by the government, but there is still a vast deposit of coal in Enugu Benue and Kogi.

Ashcrete could be produced by using any of the following means. One method of producing ashcrete is the super fluidizing method. This method involves the mixing of coal-fly ash and cement particles using water with a low water content close to the optimum content, and the fluidization and compaction of the mixture into a pudding-like body by applying vibration. The method relies on the high flowability during vibration owing to the high

bearing capacity of coal-fly ash particles that are glassy and have good grading. The method provides for the mixing of large quantities of coal ash. With less excess water in the mixture, it is possible (i) to use less cement for obtaining the required strength, (ii) to reduce hairline cracks and (iii) to make a more uniform hardened body (Saito, E., Sakamoto, M., Osa, M & Kiyomi, H., 2016). Another method of hardening coal ash is the use of hardening accelerators. In this method, ashcrete, inorganic salts, e.g. NaCl and $CaCl_2$, are used to accelerate the hardening of coal ash. Salt water or sea water is used for mixing. Adding the accelerator greatly increases both initial and long-term strengths.
Research has shown that using water with NaCl content of approximately 3%, equivalent to sea water, ensures that the hardening accelerator works effectively. The mechanism of how accelerators work is only little known. One of the conceivable factors is the acceleration of leaching of Al3+ from coal-fly ash particles at the stimulus of Cl-. The acceleration of hydration owing to the mixing of chlorides is naturally another factor.

Coal-fired power plants use combinations of different types of coal from different sources to ensure stable power supply. The quality of coal-fly ash produced at plants therefore varies considerably. Then, a special method is adopted to select ashcrete mix proportions. Coal-fly ash received is subjected to a flow test (JIS R 5201) and a mix proportion is selected in The test is based on the close correlation between a water-cement and coal-fly ash ratio at a flow of 140 and the optimum water-cement and coal-fly ash ratio. Flow tests have revealed that selecting the optimum water-powder results in linear correlation between the water-powder ratio and compressive strength and between the cement content and compressive strength. Adjusting the cement content to achieve the required strength is therefore possible.

Although coal mining itself may not be eco-friendly as its activities degrade its immediate environment, fly ash can also be produced from combustion of solid wastes. Combustion of solid waste can be used for the generation of power (electricity) while its by-product (fly ash) would be used for the production of ashcrete. This helps to solve a major environmental problem of waste both in the waste in itself and it by-product. This will consequently lead to a cleaner and healthier environment.

Ashcrete is widely used in the construction of buildings and sub-base road construction. Being made from by product, it is environmentally friendly. It is also a way of cleaning up

the environment from the litter and heaps of solid wastes all over the states. Its production has a relatively low embodied energy when compared to ordinary Portland cement (i.e about how much energy is used or consumed in production and transportation of a material). Ashcrete has good workability, reduced heat of hydration and high strength gain. Ashcrete production has relative cost reduction as the amount of Portland cement in ashcrete is reduced and the fly ash used in ashcrete is cheaper than cement. Thermal cracking in ashcrete is prevented because of low heat of hydration. It is a low permeability and resistant to to acids and sulphates attack.

Timbercrete:

Timbercrete is a mixture of binder (cement), fine aggregate (sand) and coarse aggregate (saw dust). The saw dust should be past through a sieve 110-216mm. Similarly, Timbercrete Pty. Ltd. (2015) explains that timbercrete is made primarily from timber waste such as sawdust or recycled timber from discarded pallets and the like. The major difference between timbercrete and concrete is the replacement of the coarse aggregate with timber waste. The sand is carefully selected to maximize its load bearing capacity and minimize water ingress.

It has advantages over clay and concrete blocks. Timbercrete blocks can be moulded into different range of sizes, shapes, textures and colours. It can be used for residential, commercial, industrial, landscape and other applications. Timbercrete has substantially lower embodied energy compared to clay fired bricks and a higher insulation value than the traditional solid masonry blocks. It is up to 2.5 times lighter than concrete or clay and research has shown that it has a higher fire resistance than concrete blocks, timber and steel construction. Timbercrete is a unique workability, which made it possible to be nailed and screwed into just like timber. It has a high load bearing capacity as blocks are typically larger and lighter, which results in easier and faster construction. Timbercrete has poor capacity of preventing airborne sound transmission. According to Timbercrete Pty. Ltd, timbercrete has been tested in the US to be bullet-proof. Timbercrete is cost effective and visually appealing and it can come in range of colours.

Sawdust from timber is locally available in almost all the states in Nigeria especially in the saw mills of the rainforest zone, eg Edo, Ondo, Osun, Ekiti, Delta states etc. Production of timbercrete could help in the construction of cheaper buildings which process can help eliminate open burning of timber wastes that depletes the oxone layer. This will enhance a

cleaner and healthier environment as wastes that were ordinarily dumped in landfills will be usefully converted to the building material.

Recycled Plastics:

Recycled plastics and plastic bottles are available everywhere in Nigeria. The most common water containers are plastic bottles. Most of these bottles are non-degradable and non-recyclable. Most of these plastic bottles end up in landfills, drains and sea beds.

The use of recycled plastic bottles for building construction is gaining more recognition in recent time. Architects and engineers are devising ways of incorporating waste plastic bottles and other plastic materials in building construction to give shape to their imagination, to tailor-fit buildings to their environment, to enable new technologies which harness renewable energy and to strengthen structures such as bridges that must withstand very heavy loads. In recent years, architects in Nigeria have devised ways of using empty plastic bottles filled with sand to construct walls and buildings. Although this idea is not very common yet, attempts are being made to properly develop this concept and make it workable especially in the area of providing cheap housing for low income.

The use of recycled plastics and plastic bottles for building has the tendency of reducing if not totally eliminating waste bottles that end up in our sea beds and land fill. This is an effective way of waste management by refuse reuse which will in turn balance the ecosystem and save the sea animals.

Conclusion and Recommendations

Use of eco-friendly building materials in building construction is no longer an issue of personal choice. Environmental behaviour of building must be put to check to achieve the global goal of sustainability. The paper therefore discussed some natural, durable, reusable or recyclable and locally available building materials as the priority for achieving this sustainability goal. The paper makes the following recommendations:

(i) The use of eco-friendly building materials should be encouraged by building professionals.

(ii) Policy makers in the Nigerian building industry should help review existing laws to encourage the use of eco-friendly building materials.

(iii) Government should give grants to researchers, manufacturers to encourage them carry out further research on eco-friendly building materials in order to improve on the existing ones and make new discoveries.

(iv) The government, professionals and the people should collaborate in the development and acceptance of eco-friendly building materials.

(v) Architects/designers should specify eco-friendly building materials more regularly in their design proposals and explain to their clients the need to prefer these materials to the conventional ones

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