

Indigenous Building Materials for Affordable Housing in Lagos State, Nigeria.

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Abstract: Building materials used from antiquity till date have showed the transient nature of development within human settlements. This has evoked the need for a detailed explanation to the importance which is attached to choice of materials, their usage, where they are used and those who use them. In housing, building materials are as old as mankind and still will stretch for as long as man will be extant. Where we retire and rise reveals how accommodating our fancies are, and this is at the core of human existence. It is relevant to note that as important as housing is, it is faced with a strong challenge to comfort when not treated properly and without adequate consideration of eco-friendly indigenous building materials which influence comfortability, affordability, choice and human development due to their unique properties, occurrence and availability. This paper reviews already propounded literature on indigenous building materials for housing which are sustainable, available and affordable for proper housing. This study aimed at identifying the gap in affordable housing by identifying the dismal situation and suggesting steps to alleviate the imbroglio in housing within Lagos State. In order to achieve this, objectives were drawn which included identifying popularly imported building materials in Lagos State Nigeria, outlining the indigenous building materials which can be found in Lagos state, and further comparing both materials in terms of their sustainability, affordability and familiarity to the climate of Lagos state. In order to identify the materials indigenous to Lagos State, this research points out the locations they can be found, their properties, costs, their application in construction and the built environment. In conclusion, this research suggested the use of more indigenous materials for construction in order to shorten the gap in housing within Lagos, to promote more indigenous use/home made products and to help alleviate the economic quagmire facing Nigeria.

Keywords: indigenous, building materials, housing, affordable, sustainability, Lagos State

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I. Introduction

Building materials are at the core of housing development and have for centuries determined the rate of advancement in human habitation, (Raju Sharma et-al, 2022). Chidiebere Emmanuel Eze et-al, (2021), stated that the diversification cum popularization of primary and composite materials which are eco-friendly and relatively affordable will improve housing development in Nigeria. In studying Alternative building materials, Johnson J, Natalia Anigbogu et-al, (2020) observed that there are divergent views on the actual name to address these building materials. Outlining that they are referred to as ambient building materials, alternative building materials, sustainable building materials, green building materials, environmentally responsible building materials, vernacular building materials, eco-friendly building materials, rapidly renewable or harvested building materials, recycled building materials, and indigenous building materials. This study is focusing on the indigenous materials which are cost effective and are readily available for the use of the inhabitants of Lagos state, Nigeria.

It is very pertinent to address one of the challenges which is at the very core of housing development in the largest city in Nigeria, Lagos state. Abdulrahman and Alege (as cited in Adeniyi, V.O, 2021) stated that Nigeria has been overly dependent on imported building materials for a long time. These materials are slightly costly and out of the reach of the average person. They further stated that between 70 and 80 percent of building finishes are not made in the area. Because of the high cost of building acquisition, it is difficult for the majority of low income earners to access adequate housing, (Abdulrahman and Alege as cited in Adeniyi V.O, 2021). This gap has for years created a society having 70% of its populace living in informal settlements, and has further caused an accretion in its population density, (Rebecca Enobong Roberts and Okanya Ogechukwu, 2022). Again, according to Adewumi J.B et-al, (2022) the cost of construction has been a major deterrent to development over the years and has accounted for a vast majority of project abandonment, delays, and dispute amongst participants in construction projects.

Aim and objectives of Study.

The aim of this research is to identify this dismal situation by assessing trends in construction in order to suggest cost-effective materials for housing development. To achieve this, this research will;

- i. Enlist popularly imported building materials.
- ii. Identity indigenous building materials in Lagos State.
- iii. Compare imported and indigenous building materials.

Study Area

The focus of this study is Lagos state Nigeria. Located in southwestern Nigeria, Lagos is the smallest landmass in Nigeria. Lagos is Surrounded by the Bight of Benin to the south, the international border with Benin Republic to the west, and Ogun State to the east and north making it the only state in Nigeria with only one state bordering it. The National population commission (2016) estimated the population of Lagos to be over 21 million and according to the World population review; the population density was estimated to be 6871/km², occupying 1171.28km².

According to Wikipedia, the greater Lagos area is expected to have 28 million inhabitants as of 2022, an increase of almost 3,000 people every day, or 1.1 million annually (up to 23.5 million in 2018). Therefore, Lagos may have surpassed Kinshasa as the most populous city in Africa. By 2050, Lagos State’s population is projected to increase to 32.6 million people, (Adedeji Afolabi, Rapheal Ojelabi, 2022). Nigeria’s national capital was Lagos until the government decided to relocate it to Abuja, the country’s center, in December 1991. As of 2018, there were around 23.5 million people living in the Lagos metropolitan area in Africa. Lagos is a significant financial hub for Africa and the nation Nigeria as a whole. Lagos is divided into 5 administrative divisions which further has 37 local government areas (LGA) and they are illustrated below;

Divisions	Local Government Areas
Badagry	i. Ajeromi-Ifeledun ii. Amuwo-odofin iii. Badagry iv. Ojo
Epe	i. Epe ii. Ibeju-lekki
Ikeja	i. Agege ii. Alimosho iii. Ifako-ijaiye iv. Ikeja 1 and 2(Capital of Lagos State) v. Kosofe vi. Mushin vii. Oshodi-isolo viii. Somolu (AKASHomolu)
Ikorodu	i. Ikorodu
Lagos	i. Apapa ii. Etiosa 1,2, and 3 (Victoria Island, Ikoyi and Lekki Phase I) iii. Lagos Island iv. Lagos Mainland v. Surulere

For reasons attributed to administration, numerous LGAs were further divided into Local Council Development Areas in 2003. The Administrative division now total 56; Agbado/Oke-Odo, Agboyi/Ketu, Agege, Ajeromi, Alimosho, Apapa, Apapa-Iganmu, Ayobo, Badagry west, Bariga, Coker Aguda, Egbe Idimu, Ejigbo, Epe, Eredo, Etiosa East, Odi Olowo/Ojuwoye, Lekki, Mosan/Okunola, Mushin, Ojo, Ojodu, Ojokoro, Olorunda, Onigbongbo, Oriade, Orile Agege, Oshodi, Oto-Awori, Shomolu, Surulere, Yaba, Iru/Victoria Island, Itire Ikate, Kosofe and Lagos Island West. (Lagos State Government Site/ Lagos State Wikipedia/federal Republic of Lagos/ online Nigeria cited in Familysearch.org 2022)

However, thanks to terms like “urban slum” and “shanty towns”, which describe the relationship between the spread of slums and urban development policies, it is now widely acknowledged that poverty is steadily encroaching on the world’s main cities. (Ganiyat Adeshina-Uthman et-al., 2022). Vanguard newspaper (2014), in its publication announced the rumor that Lagos State Government encouraged many inhabitants who were finding it difficult to live in it, to return to their home states and was even prepared to help them with

financial aid to ease their departure. The urban slums turn into colonies for individuals who are committed to stay in the state and eke out a living as more and more people make their way into it. Slums in Lagos include Agege, Ajegunle, Amukoko, Badia, Bariga, Bodija, Ijeshatedo/Itire, Ilaje, Iwaya, Makoko, Mushin, Oke- Offa Babasale, Somolu and Ikorodu.

II. Literature Review

It is imperative to outline the basis upon which this research is built. To build a necessary premise to satisfy the objectives of this study, certain terms which are of relative importance will be elaborated, upon which this study will base.

Indigenous: A lot of studies have been made in defining the term Indigenous to best fit into the built environment. In which process some other terms have been introduced to aid its proper definition. In his study of indigenous, Chris Cunningham (2003) stated that the term indigenous can be expressed by definition, experience, or world view. By definition he stated that indigenous is used in a variety of ways that are distinct from the concise Oxford Dictionary definition of the word, which is “to be born in a certain place.” This definition relates to being a native of a particular area. He further stated that a lot of alternative terms are used to describe the term indigenous such as First nation as used in America and Canada, Strait islander as in the Aboriginal, Australia and Torres. By experience he quoted that in New Zealand, they express the term indigenous in Maori language as “Tangata Whenua” which means “people of the land”. Other languages such as Igbo as translated by Translate.com expresses the word indigenous as “Umu amaala” which means “the children of the land.” By world view, Chris Cunningham (2003) further elucidated that indigenous is used for those cultures whose world views place special significance on the idea of unification of the humans with the natural world.

Building Materials: Another aspect of this study which is of immense contribution to the built environment is building materials. One of the factors that are increasingly important in determining a project’s quality is the use of building materials. Building materials make up the highest constituent of housing construction in most developing countries especially in Africa, (Ugochukwu and Chioma 2015 as cited in Kehinde et-al, 2018). The use of building materials have been discussed, with concentration on technical and financial methods for selecting the ideal type of material that is most appropriate for particular service circumstances in structures, (S.K Duggal 2008), which goes further to outline that even with the finances, without the materials to build, there would be no reason for construction. During extraction, production, building maintenance, disposal, and recycling, they have a number of detrimental impacts. The choice of material should be taken into consideration by the designers early enough in the project (Doaa Gamal et-al, 2021). Duggal S.K (2008) stated that in today’s technologically advanced world, building materials play a significant role. No area of engineering is conceivable without their use, despite the fact that construction activities represent their most significant application additionally; the building material sector plays a significant role in the economy of our country because the product it produces determines the quantity and caliber of construction activity.

Indigenous Building Materials (IBM): Kehinde Alade et-al, (2018) illustrated that the potential and advantages of indigenous building materials have not been tapped and have since been moving at a very slow pace in Nigeria. They further enumerated two research institutes that are currently responsible for obtaining all functional materials in Nigeria namely, the Nigerian Building Road research Institute (NIBRRI) and the Raw Materials Research Institute (RMRI). These institutes' primary function involves disseminating knowledge about Indigenous materials through seminars, conferences, and workshops. It is a special requirement of NIBRRI to do research on all types of construction materials. They further stated that at various stages of building construction, it is possible to combine laterite-containing rocks and stones to create an enduring strip foundation which is an alternative to the conventional system which can stand the test of time. Stated also is that to bamboo reinforced terracrete, laterite can be used to create concrete-quality slabs when reinforced with bamboo or coconut palm. Timber can be utilized to create high-quality flooring when properly treated and saturated with liquid preservation. Similar to that, when polished and treated to create bamboo floor and foist, they make excellent building floors. When appropriately combined with clay screening, cow dung created a sturdy and attractive floor. In order to further strengthen the flooring’s ability to withstand moisture, fermented leaves and bitumen can be added. Additionally, bricks joined with laterite provide a good building wall with better conductivity than hollow concrete blocks. Also, while coconut palm, bamboo, and timber treated as stakes inside earth constitute a good building wall, stone joined with laterite mortar or lime stabilized mortar produces a desirable building wall with great compressive strength. Because of its cohesive qualities, earth conserves cement when it is necessary to mix cement. To attain the desired strength and stop wall breaking, earth walls can also be reinforced with some additives (vegetable, stems, reed, and straws). In addition to strength, laterite reinforced

with bitumen for walls will have the ability to deter ants and rats. Among the various materials used to construct walls, clay and brick stand out (Kehinde Alade et-al, 2018). According to Bolaji (2000), clay products are important sectors that require immediate exploration taking note of its advantageous aspects in relation to construction.

Housing Components: The term housing components describes the actual parts of dwelling. According to the American society of testing and materials, there are structural and non-structural components in a house. The skeleton of the home, or the structural part, is what supports its weight. The foundation and footings, curtain walls (external) and load-bearing walls (internal) beams and columns, floors and the roof are all structural components. On the other hand, everything else inside, or on top of the house that isn't a structural element are termed non-structural elements (doors, windows, cabinets, suspended ceilings and light fixtures, internal walls) as well as the utility and mechanical systems (electrical ducts, pipes, motors, pumps, and tanks) make up the non-structural elements. The non-structured parts are often permanently linked to the structural elements of the house and supported by the construction of the building. The ultimate cost and quality of these components have a substantial impact on the affordability and sustainability of housing units since they consume a large portion of the money and resources allocated to a housing project.

Affordable Housing: Considering the low living standards of Nigerians within Nigeria, it is essential to provide a cost effective housing system which will benefit all and sundry. According to Alireza Moghayedi et-al, (2021), efforts are being made to fit every cadre of income bracket in the society and to ensure that housing remains a fundamental human right as stipulated by the United Nations Sustainable Development Goals (SDG) 11. Low income people find it challenging to build their own homes or even rent a nice house due to the high cost of these imported materials. With the accessibility of indigenous building materials, even those with low incomes can afford to buy their own homes. The cost of a home as a percentage of a household's total income and disposable income are the two factors used to determine affordability. The price of an affordable home should not be more than five times the household's gross annual income in the case of urban poor people, and rent should not be more than 30% of the household's gross monthly income. Because housing costs are correlated with materials, affordability is influenced by the cost of constructing materials. Costs for constructing supplies abroad are high. However, the most effective way to afford homes is to use inexpensive or free local building materials. Findings revealed that just the direct material item cost for international material (222.76 USD) and the approximate cost of local material (67.66USD), (Elshadai B.W & Conno B.H, 2022). According to the Central Bank of Nigeria, the current rate of the Dollar is bought at ₦425.2 and sold at ₦425.78 at which rate imported Building materials being \$222.76 are sold at ₦94,846.75 and Local building materials at \$67.66 are sold at ₦28,808.27. A difference of ₦66,038.48 (\$155.31). This analysis shows that Affordable Housing was awaiting the availability of indigenous building materials.

Housing Design: The term Housing design describes the applications and requirements of architecture and engineering in the creation of dwelling units. A well designed home realizes a resident's needs, offers a high level of functionality and social interaction on a small footprint, and provides comfort ability based on their activities, lifestyle, and microclimates. It is also safe and well protected. The architectural and engineering requirements for housing such as the materials and utility services must be effective and long-lasting, (Alireza Moghayedi et-al, 2021).

III. Methodology

This study has employed a research review approach, referencing primary and secondary sources.

Popularly Imported Building Materials.History

According to Atolagbe (2009, p. 87), during the roughly one-hundred-year British colonization of Nigeria, "the native technological culture, especially those in construction materials, were lost to the overpowering influences and procedures of their colonial masters." Nearly all indigenous production and manufacturing techniques had either been abandoned or rendered obsolete by the time Nigeria attained a certain threshold of political and economic freedom in 1960. Additionally, "till date, a readjustment towards indigenous values has yet to be achieved with any stunning success among citizens whose native principles have just been self-debased, considered inferior, and unacceptable" (Atolagbe, 2009, p.84). The legacy of colonialism is the status of technological and industrial casualties in Nigeria.

Today

The economy of Nigeria has frequently been referred to as "pretty open.", (Ugochukwu S. et-al, 2014) While economists largely concur that promoting global commerce speeds up growth (Obandan and Okojie,

1998). The price of buildings as well as other construction projects has continued to climb in Nigeria as a result of the government's inability to take decisive action to curb the importing of building materials. This is taking place as Nigeria's population continues to put a strain on the country's housing supply. Nigeria has evolved through time into a storage facility for imported raw and finished goods as a result of the government's refusal to change the mentality of its populace. (The Sun, 2017)

Since the nation's political independence in 1960, Nigeria's total imports have increased significantly. This is supported by numerous surveys. It rose to almost 53.8% & 56.8% in 1981 and 1982, in both, then to around 52.7% through 1992 and 60.0% in 2010. In 1960, it was 23.6%; in 1970, it was 46.1%; and in 1981 and 1982, it rose to about 53.8% and 56.8%. However, it is estimated that Nigeria is over 70% dependent on importation, (Ugochukwu S. et-al, 2014).

Despite the fact that Nigeria and many other African nations are praised for being markets for raw materials and commodities, a study of importation in the nation reveals that Nigeria spent up to N19.5 trillion also on importation of primary raw materials, including building materials, in the country over the course of the previous seven years. (The sun daily, 2017)

According to Nigeria price (2022), the list of imported building materials include;

- i. Reinforcements (8mm to 25mm diameter rebars)
- ii. Doors – (Turkish, Chinese)
- iii. Roofing sheets- (Harvey roof tiles, stone coated roofing sheets)
- iv. Sheet glass
- v. Floor finishes – (Italian wall tiles, china wall tiles)
- vi. Ceiling finishes
- vii. Wood finishes
- viii. Paints
- ix. Plumbing materials

Identification of Indigenous Building materials in Lagos State.

In expressing their study, Alireza Moghayedi et-al, further stated that housing design and a number of economic, environmental and social issues are strongly intertwined. In order to optimize resident well-being and reduce detrimental effects on the local economy, community and environment, sustainable, affordable housing must be designed. All of the stated contributed to the housing design because of the major influence on the affordability and sustainability of housing units as well as the health and well-being of occupants.

David Atulegwu, (2020) listed some natural mineral resources found in Lagos state of which 3 are relevant to this research and they are;

- x. Clay
- xi. Bitumen
- xii. Glass-sand (silica/quartz sand)

Others include

- xiii. Plastics
- xiv. Timber

These natural materials indigenous to Lagos state will be discussed in detail.

CLAY

One of the most significant kinds of structural material is clay products. (S.K Duggal 2008). Most developing countries like Nigeria are financially constrained, hence the need to investigate affordable building materials which are available and readily renewable in various localities. Clay is a natural resource which finds its place in the built environment. As quoted in Adeoti, L et-al, (2022), the geology of Southwest Nigeria reveals a sedimentary basin that has been divided into 5 major formations based on their geological formation age, with their ages ranging from recent to Cretaceous: the Littoral and Lagoon deposits, Coastal Plain Sand, Ilaro Formation, Ewekoro Formation, and Abeokuta Formation overlying the crystalline basement complex. They further stated that with the exception of Ilaro, four of these formations make up the aquifers in the Dahomey Basin, which is where the geological section of Lagos was taken. The clay deposits in Lagos can be found in Agege, Epe, Ikeja, and Mushin, (David Atulegwu, 2020). Clay is used in construction as bricks for walling and as paving stones after kilning. Clay mixed with quartz, sand, chalmette, slag, sawdust, and pulverized coal are the basic materials used to make them. The process of molding, drying and burning clay mass results in structural clay products, often known as building ceramics. Clay is the most important material for making bricks, (S.K Duggal, 2008) Clay has historically been utilized in Nigeria to build structures; in earlier times, it was used to

build huts and even some modern homes.

Properties of clay

Clay can be classified based on their properties, and they are as following

- xv. Chemical properties
- xvi. Physical properties

Chemical Properties: When clay is heated to redness, it acquires hardness and strength. This is a result of micro-structural changes in clay which is a chemical property of clay. The purest form of clay is made up of kaolinite ($2\text{SiO}_2 \cdot \text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$) which also contains quartz, mica, feldspar, Calcite and Magnesite.

Physical Properties: The strength, tensile strength texture, plasticity, porosity, color and fusibility of clay determine the physical classification properties of clay.

A study conducted by Abiodun Murtala A et-al, (2016) At LASPOTECH's Ikorodu Campus in Lagos State, Nigeria, on the evaluation of sub-soil geotechnical properties for shallow foundation and pavement design, showed that there is a brown dolomitic clay top soil that is 0.35 meters thick, followed by dark red lateritic sandy clay that existed up to a depth of about 10 meters, which was underlain by clay soils silty sand to something like a depth of about 16 meters, and silty sandy clay from this point to the bottom of boring at 30 meters. Given that a medium to solid lateritic sandy clay exists up to a depth of about 10 meters and is overlain by another mild to dense silty sand, a suitable form of subsoil will be acceptable for predicted structural loads inside the campus. At 1.0m depth, the bearing capacity is 130 kN/m², while at 2.5 m depth, it is 243 kN/m².

BITUMEN

According to Bukar Adam (2019), Like crude oil, bitumen is one of the abundantly deposited natural resources available in Nigeria and some other nations; it is found in the states of Ondo, Lagos, Ogun, and Edo. The bitumen reserve in Nigeria is enormous and is ranked as the second- biggest deposit in the world and the largest concentration in Africa. Oil sand bituminous is an extremely viscous mixture of the polymeric hydrocarbons found in oil sand. Michele Porto et-al, (2019) defined Bitumen as a virtually inert adhesive and waterproofing substance that is made from crude oil or found in natural asphalt. It is completely or almost completely soluble in toluene and is extremely viscous or almost solid at room temperature. It is widely acknowledged that bitumen's original properties heavily depend on its manufacturing and processing methods as well as the properties of bitumen crude oil. Proper distillation procedures and high-quality crude oils can improve bitumen's characteristics. Higher bitumen yields are typically produced from heavier crude oil. Therefore, it is crucial to have a thorough understanding of the features of bitumen from all angles. This knowledge becomes even more crucial when producing and using bituminous materials for some bitumen applications becomes difficult due to issues including phase discontinuity, mal-dispersion, and instability with polymers and additives.

Properties Of Bitumen

All bituminous materials generally have the ability to block the flow of water. The goods with the largest rate of the base material, such as pitch or bitumen, will provide the best protection, all other things being equal. Light-colored pigmented goods are consequently less effective in this regard than those whose amount of spike or bitumen requires a dark color. In general, materials that are hot-applied and those made of solvent, e.g., not an emulsion, are more better, able to withstand pressure. Emulsions, however, are effective when used to remove water from vertical or nearly vertical surfaces. Bituminous materials have a long lifespan; some bitumen mastic roofs now over 100 years old; nonetheless, they can be impacted by sunshine and other environmental factors.

GLASS-SAND (SILICA/QUARTZ SAND)

The market research conducted by Foraminifera (2022) reveals that The main silica sand reserves in the nation are in the states of Ughella - Delta, Igbokoda - Ondo, Baure - Katsina, Badagry - Lagos, and in the sandy Atlantic coast. Some inland deposits have also been reported In the states of Shebu, Plateau, and Ilaro. Chukwu Philomena (2019) further strengthened its mining in Lagos by enumerating other locations within Lagos with abundance of Glass-sand and they include Apapa, Epe and Lekki in addition to Badagry.

One of the most easily accessible geological minerals is silica sand/quartz, which is used in factories and industries like glass production enterprises. SiO_2 , a really good chemically stable element, is stated to make up an ideal high proportion of silicon dioxide (SiO_2) in silica sand and quartz. SiO_2 is a very high chemically stable element that is claimed to make up a high ideal percent of silicon dioxide (SiO_2) in silica sand and quartz, and it remains essentially unchanged no matter how many cycles it may have undergone during transportation or re-deposition. A variety of glass goods, such as sheet glass for window frames, bottles, mirrors, optical

elements, pharmaceutical apparatus, electric power insulation and condensers, tubes, doors, crucibles, car and airplane bodies, filters, and building blocks, are produced using glass sand. They are also utilized in the petroleum sectors for the production of abrasives and gravel packing. Large amounts of high-quality quartz silica (glass) sands are found in Nigeria. Although there are additional deposits in some inland regions, most of them are connected to the southern sedimentary coastal plain.

Properties Of Glass-sand

Physical and chemical characteristics including hardness, color, melting point, and boiling temperature are among silica's attributes. Under typical conditions of pressure and temperature, silica is a solid, crystalline mineral that is relatively hard. If impurities are present in small amounts of quartz, they may cause the colorless, pure silica to take on a different hue. The melting and boiling temperatures of silica are very high, respectively 3,110 °F & 4,046 °F. Silica must be melted in a large, hot furnace in order to produce glass.

Uses Of Glass-sand

It is typically employed as raw material in the majority of the construction sector and can be used both dry and wet. It can also be used as molding sand, filtration sand, and occasionally in the manufacture of glass.

Therefore its uses include the following;

- xvii. Metal Casting
- xviii. For Glassmaking
- xix. Metal Production
- xx. Paint and Coating
- xxi. Construction

Metal Casting

Ferrous and non ferrous foundry industries depend heavily on this sand, which is shaped into the desired exterior shape. Metal components are cast into the sand, and core sands can indeed be mechanically recycled to create new cores or molds. Metals need SiO₂ for strength.

Glass Making

All varieties of glass are made primarily from silica sand, which is the main ingredient in the process. Glass cannot be made without the aid of this sand since it has a strong and clear chemical purity. Flat glass is made using industrial sand for use in construction and the automobile industry. Silica sand is required for the fabrication of fiberglass insulation and is also used in test tubes.

Metal Production

All of those soap and coloring products are made from silica sand, and the primary chemical components being sodium silicate, silicon tetrachloride, and silicon gels. To manufacture domestic and professional cleaners several chemicals are utilized.

Painting And Coating

Any type of structural and architectural paint & coatings can be improved with the help of this sand, and high purity silica can play a crucial role in attributes like brightness and reflectivity, color consistency, and oil absorption. Silica additives are able to improve color retention, longevity, or resilience to contamination, mildew, cracking, & weathering in architectural paints, which is another usage for them. Low oil absorption always permits increased color loading and better end appearance.

Construction

The main ingredient in the many different types of construction and building materials is silica sand, which also serves as a functional extender by adding durability and anti-corrosion properties. Full grain silica sand is utilized in asphalt mixtures, cement, stucco, roofing tiles, mortar, and flooring compounds.

PLASTICS

Babayemi J.O et-al, (2019) in a recent Research on plastic use in Africa stated that Between 1990 and 2017, 33 African nations (total population: 856,671,366) with data available for more than ten years imported about 86.14 Mt in polymers in native medium as 31.5 Mt of plastic goods. Inferring to the continent (Africa has a populace of 1.216 billion people in 54 nations), between 1990 and 2017, around 172 Mt of polymers & plastics worth \$285 billion were imported. A total of 230 Mt of plastics are thought to have entered Africa over that time period, with Egypt receiving the greatest part (43 Mt, 18.7%), followed by Nigeria (39 Mt, 17.0%), South Africa (27 Mt, 11.7%),

Algeria (26 Mt, 11.3%), Morocco (22 Mt, 9.6%), and Tunisia (16 Mt, 7.0%). Additionally, 8 African nations' principal plastic production contributed 15 Mt from 2009 to 2015. The evaluation revealed that while recycling efforts and heat recovery have just begun in several countries in Africa, environmentally sound end-of-life waste management plastics is still in its infancy there. Nigerians regularly use plastic bags, also known locally as polybags, nylon bags, for shopping and even for food packaging. Plastic bags are widely used in part

because there aren't many alternatives like paper or jute bags that can provide customers with a level of reliability similar to plastic bags, (Margaret Ojochide Aligbe, 2021). The frequent use of plastic shopping bags in Lagos, along with single-use, careless littering, a lack of trustworthy alternatives, and inadequate waste disposal facilities, has a significant influence on the environment, as seen by the annual flooding of Lagos that arises from clogged drainage systems. Plastic bags have gained popularity because they are convenient, affordable, lightweight, and quick to use. Additionally, plastics are renowned for being suitable for a variety of applications.

Usage Of Plastics In Construction Plastics as Aggregate in Concrete Mix

M A Kamaruddin et-al, (2017), evaluated that there are two types of plastic waste: plastic aggregate (PA) & plastic fiber (PF), both of which are frequently used as building materials. In place of natural aggregate (CA) and fine aggregates, Pas are used (FA). The bulk density of the PA is often lower than that of granite, limestone, or basalt. They are therefore most often used for lightweight concrete. By using the mechanical recycling approach, Pas can be obtained. In contrast, polyethylene fiber (PF) reinforcement is utilized to Improve mechanical & strength durability and can be used to replace standard steel fiber. The main disadvantages of using common steel fiber as cement concrete are their susceptibility to corrosion, especially on the surface of the concrete when exposed to saltwater or marine environments without the proper protection.

Recycling Plastics

Plastic is less recycled as compared to other materials that are utilized in significant numbers, like paper, ceramics, glass, and metal. The overall process of recycling plastics is said to be difficult due to the various steps involved in production, distribution, usage, disposal, and sorting. The recycling of plastic wastes, however, can be done mechanically, chemically, or thermally. However, sorting must first take place before the plastic waste can be recycled. This is largely done automatically using technology like electrostatics, floatation, fluorescence, infrared, and spectroscopy. The structural degradation of the trash through the use of techniques like grinding and/or shredding is a necessary step in the mechanical recycling of plastic waste. In contrast, due to the complexity of mixtures made of plastic trash, mechanical recycling is reportedly rather inefficient. The bulk of plastic wastes are instead burned because mechanical recycling is reportedly fairly ineffective due to the complicated structure of mixes of plastic trash. However, it is abundantly obvious from research that mechanical recycling has always been the preferred method for recycling plastic. It is quick and efficient to carry out. Plastic wastes can be chemically changed or broken down to monomers for recycling, which can then be utilized in favor of virgin raw materials to create new plastic products. When plastic trash is thermally recycled, it is heated to a high temperature until it melts, then it is poured into a mold to create new items. High-density polyethylene is one example of a hard plastic product with recycling possibilities.

Properties Of Plastics

New degrees of freedom in architectural design are made possible by the general features of plastics, such as their translucency, the formability, and the fact that when they are reinforced, their strength approaches that of steel. Because there are numerous chemical varieties of plastics, each with distinct properties, it is crucial to choose the one that is most appropriate for the intended function (E. B. Cooper, 1950). Plastics' ability to shift when under stress and then return to their initial position when the force is removed is one of the more crucial characteristics about them. It's crucial to understand that plastic will creep under prolonged stress, and that plastic will gently return to its normal shape once the stress is removed.

TIMBER

The Lagos State department of Forestry Services (2022) states that the designated forest reserve of Lagos state covers 5,220 ha of the estimated 715.4 km² (71440 ha) total forested area. Wetlands and other locations have conservation designations. All forestry-related operations in the state fall under the purview of the Department. These include the production of tree and ornamental seedlings, soil conservation, animal control, and logging and the processing of timber. A third of all logs created in the nation are reportedly transported to Lagos, either as rounded logs transported by land and water or as treated planks that are sold in sawmills & plank markets. These timbers are being used in the state's massive furniture and construction industries, as well as the housing market, pulp and paper production, and other related businesses.

Some known Tree species peculiar to Lagos state were further listed as

xxii. Senegalsis (Lagos Mahogany),

xxiii. Neem (dogoyaro),

xxiv. Agora,

xxv. Cashew,

xxvi. Eucalyptus

And other indigenous tree species are among them. Oko Baba, Ebute Meta, is home to West Africa's largest

market and center for the processing of timber. To meet the varying wood needs in the various industries, there are more than sixty separate plank markets spread out over the state.

Since it can be produced in large quantities and has been utilized in construction for many thousands of years, wood is the only renewable building material. Despite some of the complicated characteristics of wood that make it difficult to employ for construction, architects, engineers, and constructors have been able to successfully use this material to create a variety of structural & non-structural goods. Various nations have different definitions of "wood building." One categorization is based just on a building's structural material, while others may be based on the primary building material in terms of volume. For instance, these variations make it difficult to compare construction figures across the nation, (O. Ekundayo et-al, 2022). Additionally, it makes sense that common consumers are ignorant of the many terminologies pertaining to wood building.

T.A Alayande et-al, (2019) concluded that the use of wood in traditional and religious architecture makes it easier to preserve the region's cultural history, where the region's distinctive features are due to the architectural diversity and use of wood inside its construction. Because wood is a natural heat conductor and insulation material, less energy is required to maintain heat in a building. The less power used, the less harm is done to the environment. Lumber is more resistant to high temperatures than steel because, unlike steel, which can expand or even collapse under extreme heat, timber actually gets stronger under these conditions by curing out. Because it is so resistant to electrical currents, timber is also the perfect material for electrical insulation. Tensile strength, or the capacity to bend under tension without breaking, is another essential quality of wood. Using many low-cost methods, timber may now be easily turned into a sturdy and insect-resistant construction material.

Properties Of Timber

Contrarily, timber is marketed as a "renewable" material with an incorporated fuel source, which implies that it is not "limited" (though over an indefinite time frame). Furthermore, carbon that existed in the kind of carbon dioxide in the atmosphere before the trees' involvement is physically embodied in timber construction products (CO₂), (Jim Hart and Francesco Pomponi, 2020). Thus, it can be claimed that the combined systems of forestry, lumber, and construction can contribute to a plan for segregating carbon to slow down global warming.

IV. Results And Discussion

From the evaluations so gathered, it is noteworthy to mention that Lagos state is well embellished with the necessary raw materials which will ensure the comfortable settlement of its inhabitants. The use of clay for housing is ecologically sustaining and can be better used for affordable housing. Clay has a cooling effect in hot weathers and also a warm effect in cold weathers respectively thereby regulating the ambient temperature within/without its use. It is also very important to point out that clay is readily available in Lagos and can be mined in appreciable quantities as already stated. Clay finds its application in roofs, flooring, walling, cladding and decoratively. Bitumen use in construction complements Clay. Bitumen being waterproof blends in the Damp Proof Course (DPC), Roofing, Flooring, Drainage, Piping and maintenance of buildings. A bitumen, water, and essentially fully hydrated granular clay emulsion for sealants, coatings, and/or mastics is potent. Bentonite and a bitumen are combined in the suitable ratios to create the emulsions, which have properties suited to cold application procedures. These emulsions are also capable of emulsifying high melt bitumen, as stated. (Michael L. Yap et-al, 2004). The use of Glass-sand for construction stretches to More than 300 businesses which use silica sand in their industrial processes, making it indispensable. This requirements of the user industries like glass containers, crystal glass, plate glass, glass fibre, & imaging glass as well as other industries like plumbing templates, ceramic strippers, bricks, filtration for water purification plants wastewater, and swimming pools, as well as being used as an extender or a filler inside the rubber, plastics, paper, and paints industries. It can also be utilized as a rate of discount for the degree of burning of oxides in basic melting and in an unique kind of cement in a variety of chemical industries. Additionally, Portland cement, fire bricks, a variety of mold discharge agents & molding compounds, semiconductors in transistors, as well as silicon industries for the production of computer chips and solar cells need silica sand.

Comparison

Availability

Natural resources abound in traditional African construction. For instance, earth building technology makes use of laterite and loamy soil, both of which are readily available throughout the state. Our ancestors and forefathers built structures on earth that were often up to two stories high without the use of any additional reinforcing materials, and the majority of those structures are still standing today. (The guardian, 2020).

Climate

Majority of these materials are imported from temperate regions with an average temperature of 10 degrees in the warmest months and -3 degrees in their coldest months (Paula Prato Longo et-al., 2019). Whereas Lagos state

is located in a tropical rain forest with an average temperature of 26.9 degrees Celsius (December, January) and 30 degrees Celsius (April), (Climate change knowledge portal, 2022). Building materials' thermal conductivity is regarded as a constant value that is measured in a temperature-controlled setting. In fact, because the temperature and humidity of the outside air fluctuate constantly, the heat capacity for building materials will invariably fluctuate as well. The true thermal conductivity in building materials changes very significantly, especially in areas with high humidity, (Yingying Wang et-al., 2022)

Sustainability

Because of the high levels of greenhouse emissions from building and energy use for cooling, thermal, and lighting, the built environment ultimately contributes to global warming. Local building materials suggest that building carbon emissions could be completely reduced to almost zero. Local building materials are natural safeguards that reduce environmental impact while also being environmentally friendly, climate responsive, and protective. Local building materials have less of a negative environmental impact because of their thermal insulation, energy efficiency, etc. The close closeness of the resources lowers costs and lessens pollution caused by burning fuel for transportation, (Onyegiri and Iwuagwu, 2019)

Affordability

The cause of expensive housing in Lagos state, stems from high price of importation and inflation in general. Low income people find it challenging to build their own homes or even rent a nice house because of the high costs of importing building materials. Due to the accessibility of these indigenous building materials, the cost is reasonable, allowing those with limited incomes to create their own homes.

Recycling

The longevity and age of a substance affect its potential to be reused. When a building in which they are installed is decommissioned, very durable materials may still provide many beneficial years of use and may be simply removed and rebuilt in a new location. Brick, windows, and doors can all be successfully recycled. Reusing wood from old barns in new construction is becoming more and more popular.

Energy efficiency

Iwuagwu and Azubuine (2015) cite studies that show the building industry uses a third or more of the global production and is a major cause of global warming. Regardless of the amount of solar radiation outside, a typical traditional building on earth produces fewer greenhouse gasses, uses less energy, and sustains a high degree of internal thermal comfort.

V. Recommendations and Conclusion

From this research, it is paramount that the government of Lagos State implements the UN SDG 11 goals in;

i. Providing sustainability and affordability in housing for the citizens of Lagos and making room for better innovations in construction by exploring other options which are naturally deposited within the state for the benefit of the people.

It will benefit the State in;

i. Create more revenue by mining in commercial quantities these materials.

ii. Creating more research institutions which will focus on identifying more indigenous building materials which will influence affordable in Housing within the state.

For a commercial city like Lagos, for decades, immigration into its boundaries have been noticed and in order to secure a place for more migrants, it is hoped that sustainable measures are taken to consideration to settle this ever rising gap in citizen settlement within the state. Other cities within Lagos like Badagry, Epe, Ikorodu which have not become populated are areas of focus. These indigenous building materials will diffuse the densely populated areas within the state.

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