

**ADOPTION OF ALTERNATIVE MATERIALS FOR CONSTRUCTION
PROJECTS IN EDO STATE**



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**BEING A PROJECT SUBMITTED TO THE DEPARTMENT OF QUANTITY
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FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE (B.SC.) IN
QUANTITY SURVEYING**

DECEMBER, 2025

DECLARATION

I declare that this project is an original work carried out by me, **Martha Aitekere Esekie** with Matriculation Number **ENV2002803** in the Department of Quantity Surveying, Faculty of Environmental Sciences, University of Benin, Benin City.

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CERTIFICATION

We certify that this project with the title: **Adoption of Alternative Materials for Construction Projects in Edo State**, submitted by **Martha Aitekere Esekie**, with Matriculation Number **ENV2002803**, has satisfied the regulations governing the award of Bachelor's Degree in Quantity Surveying from the University of Benin, Benin City, Edo State.

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DEDICATION

This work is wholeheartedly dedicated to God Almighty, whose grace, wisdom, and strength guided every stage of this project. His presence has been my constant help and source of inspiration throughout this journey.

I also dedicate this project to my parents, in loving memory, my siblings for all they have done for me and how they have been there for me and mostly importantly to myself, for not giving up and surviving this journey.

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ABSTRACT

The study aims to assess the level of adoption of alternative materials with a view to promoting the use of alternative construction materials. The population targets are Engineers, Quantity Surveyors, Builders and Architects, who are major stakeholders in the construction industry. The research method used was quantitative analysis, and a total of 185 responses were obtained. The findings demonstrate that materials with proven performance, familiarity, and accessibility dominate adoption, while innovative bio-based and agro-waste materials remain underexploited. Addressing cultural biases, enhancing public education, developing local processing infrastructure, and implementing supportive policies are essential for promoting sustainable construction practices in Edo State. Innovative materials such as rice husk, palm kernel shells, coconut coir, hemp, and sheep wool should be supported through pilot programs and research to build confidence in their performance. For enhancing the level of adoption, educational campaigns and technical training to increase knowledge of the benefits and proper use of alternative materials, development of local processing facilities and supply chain.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Sustainable construction in countries like Nigeria still developing, have been a bit of a hassle in implementation due to hindrances like lack of awareness, infrastructural gaps and cost. The construction industry is a significant contributor to Nigeria's economy, yet it faces numerous challenges, including high costs, environmental concerns, and resource scarcity.

With growing focus on the use of alternative materials as a way of lowering environmental effect and supporting economic efficiency, the worldwide construction sector is undergoing a paradigm shift toward sustainability. In Nigeria, a country grappling with rapid urbanization and population growth, the construction sector is pivotal to infrastructure development and economic growth (Olaseni, M, 2012). However, the environmental consequences of conventional building materials, including high energy consumption and carbon emissions, have prompted interest in more sustainable alternatives. The integration of alternative materials presents an opportunity to address these challenges while promoting sustainable practices. The use of reusable materials in Nigerian Construction industry is constrained but is gaining traction.

Alternative building materials, such as bamboo, lumber, laterite, and agricultural byproducts, provide substantial ecological advantages because they are readily available, biodegradable, and have low embodied energy (Olotuah & Adesiji, 2012). Despite these advantages, their adoption in Nigeria remains limited, largely due to perceived or actual cost implications, lack of awareness, technological constraints, and inconsistent policy support (Eze E.C, 2023).

The rising cost of building is a source of concern to most Governments in the world, especially in countries still developing. One possible cause is the rising cost of building materials since a larger portion is incurred from building materials (Yalley & kwan, 2008).

There is an acute lack of affordable houses which is largely due to the high cost of the conventionally processed construction materials such as steel and Portland cement. The importance of alternative materials in sustainable construction cannot be overstated. Traditional building materials, such as concrete, steel, and brick, have significant environmental footprints due to their high energy consumption and carbon emissions during production. In contrast, innovative materials offer more sustainable alternatives that can help reduce the environmental impact of construction (Nturanabo, Masu & Kirabira, Okoduwa, et. al., 2024, 2019, Omaghomi, et. al., 2024). Alternative materials play an important role in the betterment of energy efficiency of building.

Furthermore, money is still a major consideration when choosing a building project in Nigeria, where financial constraints and budget overruns are frequent problems (Aibinu & Jagboro, 2002).

As a result, a better knowledge of the cost dynamics associated with alternative resources is critical. This comprises not just the original purchase price, but also lifetime costs, maintenance, and long-term economic advantages. According to research, while some alternative materials may have greater upfront prices, their long-term savings and environmental benefits can surpass these initial investments (Asif, Muneer, & Kelley, 2007).

As Unegbu et al. (2017) emphasizes, renewability is only the first step, true sustainability considers the entire life cycle to ensure lasting environmental benefits.

This study seeks to address that gap by investigating the financial viability, market accessibility, and long-term economic ramifications of alternative construction materials in Nigeria.

1.2 Statement of Problem

Generally, conventional construction materials such as Portland cement are more harmful to the environment and are not very cost-efficient in the long run. Another issue experienced in the Nigerian construction industry, is people's lack of awareness towards the importance of these alternative materials and the life span and cost efficiency in the long run.

Despite rising awareness of environmental sustainability and the potential benefits of alternative construction materials, their use in Nigeria remains surprisingly low. While materials like bamboo, lumber, laterite, and agricultural leftovers are abundant and environmentally friendly, they are sometimes disregarded in favour of more traditional materials like cement, steel, and concrete. One of the main deterrents is the perception and ambiguity about the cost consequences of employing alternative resources. In the Nigerian construction industry—where projects are highly cost-sensitive and budget-driven—stakeholders prioritise short-term financial considerations over long-term sustainability. This has resulted in limited investments in alternative materials due to concerns about affordability, durability, and accessibility. Many developers and builders rely on traditional materials like concrete and steel, even when more environmentally friendly options are available (Kibert, C. J. (2016). Without full cost studies and economic models that account for local variables, stakeholders are left to make decisions based on assumptions rather than evidence. This not only stifles the expansion of sustainable construction but also contributes to the ongoing depletion of natural resources and environmental damage. Understanding the true financial impact, considering both initial and long-term costs—can help dispel myths, inform policy, and encourage the adoption of sustainable building techniques that correspond with global environmental goals.

1.3 Research Questions

- 1) What is the level of awareness of alternative building materials that can be adopted for construction projects in Edo State?
- 2) What is the level of adoption of alternative materials for construction projects in Edo State?
- 3) What are the factors influencing the adoption of alternative materials for construction projects?

1.4 Aim and Objectives

The study aims to assess the level of adoption of alternative materials with a view of promoting the use of alternative construction materials.

The objectives include:

- 1) Examining the types and level of awareness of alternative materials that can be adopted for construction projects in Edo State.
- 2) Examining the level of adoption of alternative materials for construction projects in Edo State.
- 3) Examining the factors influencing the adoption of alternative materials for construction projects.

1.5 Scope of Study

This study focuses on examining the use of alternative materials in the Nigerian construction industry, the cost implications and the barriers experienced. This study will be focused on Nigeria, majorly Benin City, Edo State. The study will cover the reasons why people may or may not usually opt for these alternative materials options. It will look at why alternative materials like stabilized earth, rammed earth, reclaimed wood and so on, are a good investment in the Nigerian economy, using Edo State as the case study.

1.6 Significance of Study

This study explores the cost implications of utilising alternative materials in the construction sector of Nigeria. As the country grapples with rapid urbanisation, environmental degradation, and the need for sustainable development, understanding the economic impact of alternative materials becomes crucial. This research aims to provide insights into how the adoption of alternative materials can influence construction costs, promote sustainability, and contribute to the overall economic growth of Nigeria. This study will be of important benefit to stakeholders in the Nigerian construction industry such as architects, engineers, contractors, developers, policymakers, researchers, and environmentalists. The research fills an important knowledge gap by examining the cost impacts of incorporating alternative construction materials, which is a frequently overlooked factor that prevents the built environment from adopting sustainable practices.

This will first create empirical data on the cost dynamics i.e., upfront, operating, and life cycle costs of alternative materials versus conventional materials. This will allow all stakeholders to decide based on economic viability rather than on assumptions or misunderstandings.

Second, the finding from this study will help to promote sustainable construction practices in Nigeria through pointing out the potential long-term economic and environmental benefits of alternative materials.

1.7 Definition of Terms

1. **Alternative materials:** Alternative materials are materials made from natural resources or processes such as bamboo or recyclable materials like recycled steel or plastic and can be used as a substitute or alongside conventional materials.

“Alternative Building Materials” (ABM) are building materials used as a total or partial substitution for conventional building materials.

Such substitution is motivated by the aims of reducing cost, addressing environmental issues, or remedying lack (or shortage) of conventional materials (Marut et al., 2020)

2. **Sustainability:** Has to do with the planning of buildings or construction in ways that are good for the environment.
3. **Cost implication:** Potential financial effect.
4. **Sustainable Construction:** A building practice that seeks to minimize environmental impact, reduce energy consumption, and utilize resources efficiently. Sustainable construction involves developing and managing buildings in a responsible way that protects health, conserves resources, and follows environmentally friendly principles (Kibert, C. J. 2016)
5. **Conventional Materials:** These are widely used construction materials such as cement, steel, concrete, and bricks that often involve high embodied energy and environmental costs due to their production and extraction processes.
6. **Adoption Barriers:** Factors that hinder the acceptance or widespread use of certain materials or technologies. In this study, these may include financial constraints, lack of technical knowledge, regulatory challenges, and cultural perceptions regarding alternative materials.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of the Construction Industry

The construction industry is critical to global economic development because it provides the infrastructure that allows other industries to function and grow. It covers a vast range of operations, including the construction of residential, commercial, and industrial structures, as well as infrastructure including roads, bridges, and water systems. This sector provides large employment opportunities

In summary, the construction industry is a dynamic and essential part of the global economy. As it navigates challenges related to productivity, sustainability, and labor, it is increasingly leveraging technology and innovative practices to build more efficiently and responsibly.

2.2 Overview of Alternative Materials

Alternative materials are derived from resources that can regenerate within a human lifetime, such as bamboo, timber, straw, recycled materials, and other bio-based products. These materials are often biodegradable, energy-efficient to process, and have lower embodied carbon compared to conventional options like concrete and steel (Kibert, 2016). Their use in construction promotes environmental sustainability, cost-effectiveness, and resource efficiency.

In line with global goals for climate resilience and sustainable development, as well as local initiatives to reduce construction-related carbon footprints, the construction industry in Edo State, Nigeria, is undergoing a model shift towards sustainability, with a key component being the increased use of alternative materials—resources that are naturally replenished and have a lower environmental impact than traditional building materials.

2.3 Types of Alternative Materials Adopted for Construction in Edo State

In Edo state, several alternative materials are gaining popularity gradually. Some of these locally sourced materials are listed below:

- 1) Bamboo
- 2) Compressed earth blocks
- 3) Rice husk
- 4) Palm kernel shells and fibre
- 5) Coconut husk and coir fibres
- 6) Laterite (stabilised earth)
- 7) Hemp (kenaf)
- 8) Earth/mud/adobe
- 9) Plant-based thatch (e.g. elephant grass, raffia palm)
- 10) Recycled steel
- 11) Sheep wool
- 12) Asbestos fibre
- 13) Sisal fibre
- 14) Stone dust
- 15) Periwinkle shells
- 16) Groundnut shells
- 17) Bagasse boards (sugarcane residue pressed into partition boards)
- 18) Recycled plastic.

BAMBOO

As the country faces challenges such as deforestation, high construction cost, carbon emission from conventional building materials, bamboo presents a viable alternative that aligns with global sustainability (Akinlabi et al, 2017).

Bamboo grows to maturity between 3 to 5 years and can be harvested unlike timber which would take far more years to reach maturity. (Lobovikov et al, 2007).

Recognized as a sustainable and alternative resource for construction, bamboo is harvested and regrows with minimal environmental impact. Compared to materials like concrete, steel, and plastic, it requires very little energy to produce. Furthermore, bamboo helps prevent erosion and flooding, and it regulates local climates through photosynthesis. This crop is typically harvested annually, taking only mature stems and allowing younger ones to continue growing. The root system remains intact after harvesting, enabling further growth, similar to grass. Bamboo is also biodegradable, as its products can be burned or processed in sewage. As a building material, bamboo offers significant flexibility, strength, and versatility. These beneficial qualities make it suitable for almost any part of a building – from foundations to roofs – when properly treated and applied. Its easy availability, low cost, and high strength provide advantages within the construction industry, allowing it to substitute for scarcer traditional materials like steel and asbestos in reinforcing cement. Despite being lightweight, bamboo is a robust building material after treatment against pests. It possesses the characteristics of a hardwood, being both light and exceptionally strong. Bamboo structures are typically light, flexible, durable, and offer some resistance to natural disasters like earthquakes. Economically, bamboo is one of the least expensive building materials, adding to its technical advantages as a sustainable option. Other key benefits include its suitability for prefabrication, easy assembly, and simple replacement of structural components. Its parts can be readily taken apart and reused, further solidifying its sustainability. Beyond buildings, bamboo is used for fences, bridges, and scaffolding. It can also reinforce concrete and soil-cement. Similar to other plant fibers, bamboo fiber can even serve as a replacement for steel in reinforcing concrete and mortar, using meshes of bamboo strips to create thin, fiber-cement-like materials (Faisal Auwalu Koko, 2019).

For Nigerian construction, bamboo offers notable advantages.

1. Its environmental friendliness stems from its superior carbon absorption compared to many trees (Nath et al., 2015), and it reduces the need for carbon-intensive materials like cement and steel.
2. Economically, bamboo is readily available, which makes it a compelling choice for low-cost housing initiatives in Edo State.
3. In terms of structural integrity, bamboo's tensile strength rivals that of steel, and its compressive strength can surpass concrete in certain applications (Janssen, 2000). Its inherent flexibility also provides a degree of earthquake resistance, a relevant factor in some Nigerian regions. Moreover, bamboo's natural thermal insulation properties can lessen the demand for energy-intensive cooling in Nigeria's tropical climate (Oyedepo, 2012).

Uses Of Bamboo in Construction

Structural Elements

Beams, columns, trusses, especially in lightweight or low-rise buildings. Engineered bamboo (like bamboo laminated panels) is used similarly to timber.

Flooring and Wall Panels

Bamboo boards and tiles are popular for flooring and interior cladding due to their durability and aesthetics.

Scaffolding

Widely used in parts of Asia (like Hong Kong) due to its strength-to-weight ratio.

Roofing and Thatching

Split bamboo or bamboo mats are used in traditional roofing techniques in tropical regions.

Bridges and Pavilions

Lightweight, flexible, and strong; bamboo is ideal for small footbridges or outdoor shelters.

Prefabricated Housing

Bamboo is used in eco-friendly modular homes or emergency shelters.

Compressed Earth Blocks

Compressed Earth Blocks (CEBs) are solid building bricks created by mixing soil and water, sometimes with a stabilizer such as cement or lime, and then compacting this mixture under high pressure using a mechanical press. These blocks offer an environmentally friendly and energy-efficient substitute for traditional bricks. Nigeria is seeing a rise in the use of Compressed Earth Blocks (CEBs) as a sustainable alternative in construction. In Edo State, environmental, economic, and socio-political factors have all played a role in this increasing adoption (Oyelami & Van Rooy, 2016).

Edo State is experiencing growing problems with deforestation and the environmental damage caused by fired clay bricks. Compressed Earth Blocks (CEBs) offer a solution as their production doesn't require firing, leading to significantly lower carbon emissions and reduced dependence on firewood or fossil fuels (Waziri et al., 2013). Additionally, Edo State's plentiful lateritic soils provide a local source for CEBs, which lowers transportation costs and encourages self-sufficiency. From an economic standpoint, CEBs are a cost-effective choice for low-income housing and community buildings, potentially reducing construction costs by up to 30% compared to conventional block work due to less need for cement and steel reinforcement (Deboucha et al., 2011). This economic appeal has attracted both governmental and non-governmental bodies focused on affordable housing projects within Edo State.

RICE HUSK

Rice husk, also known as rice hull, is the hard, protective outer covering of rice grains that is separated from the grain during the milling process. It's essentially the chaff of the rice.

Constituting roughly 20% of harvested rice weight, rice husk is a byproduct of rice milling that was historically regarded as agricultural waste, leading to environmental issues because of its bulk and slow breakdown. Nevertheless, recent innovations have redefined rice husk as a valuable alternative resource, offering sustainable solutions across energy production, construction, and material science (Nworie et al., 2024).

Rice husk is becoming a go-to material in building. One smart way it's used is by adding it to clay bricks. This makes the bricks better at insulating against heat and lighter to handle, which helps in designing buildings that use less energy (Akinyele and colleagues noted this in 2015). Studies have even shown that bricks with just a small amount of rice husk (around 2%) are strong enough and don't absorb too much water for our homes.

Another clever trick is turning rice husk into ash, called RHA, by burning it carefully. This ash can replace some of the cement we use in concrete, making it last longer, especially in coastal areas where things can get tough on buildings (Vincent-Uzogbe et al., 2023). In places like the Niger Delta, including Edo State, RHA has been found to make concrete stronger and more resistant to damage from water and salt (Vincent-Uzogbe et al., 2023).

Because there's so much rice husk available, it's also being used to make water-resistant boards, an eco-friendlier option than traditional wood. By mixing the husk with natural glues like starch, they're creating boards that are strong, don't get damaged by water easily, and are cheap to make (Temitope, A. K. et al., (2015). These boards are increasingly popular for making furniture and wall coverings, especially when people want something sustainable and affordable.

Using rice husk in these ways is a win for the environment and the economy. It means less waste, fewer trees being cut down, and less pollution (Alhassan & Alhaji, 2017). It also helps local businesses grow, makes building materials cheaper, and gives rice farmers another way to earn money by selling their leftover husks. In places like Edo State, where jobs are needed and poverty is a concern, these kinds of innovations are really important for making things better in the long run.

Palm Kernel Shells and Fibre

Palm kernel shells (PKS), a material generated from palm oil production, are increasingly being acknowledged as a sustainable and alternative resource for the construction sector, notably in Edo State, Nigeria. Employing PKS not only tackles environmental issues related to waste but also brings economic and structural benefits to building projects.

One of the major participants in Nigeria's palm oil sector is Edo State. Large volumes of palm kernel shells (PKS), which are frequently regarded as agricultural trash, are produced as a result. Nonetheless, PKS is receiving more and more attention as an environmentally beneficial, alternative material, especially for sustainable building applications (Sulymon, 2005).

Application in Construction

1. Light Weight Concrete Aggregate

Palm kernel shells have been effectively used as a partial or total replacement for coarse materials in concrete production. Studies show that utilizing PKS creates lightweight concrete with sufficient compressive strength for non-load-bearing structures.

For instance, concrete with 100% PKS achieved about 16 N/mm² strength after 28 days, suitable for lightweight construction (Sulymon, 2005). In Edo State, lightweight concrete could be beneficial for rural housing projects aiming to reduce construction costs.

2. Cement Tile Reinforcement

Palm kernel shells particles have also been incorporated into cement tiles. According to (Edeh et al 2024), cement tiles reinforced with 20% palm kernel shells outperformed conventional tiles in terms of enhanced flexural strength, decreased water absorption and porosity.

3. Interlocking Paving Stones

The creation of interlocking paving stones is another creative use for PKS. PKS might be effectively utilized to create paving blocks that satisfy the strength specifications for sidewalks and low-traffic roads, according to research by Oluwakayode (2021). These environmentally friendly paving stones may help create more sustainable infrastructure in cities like Benin City.

4. Asphaltic Concrete Replacement

Palm kernel shells have been tested as a partial substitute for asphaltic concrete in road construction. Oyedepo, Olanitori, and Olukanni (2015) state that PKS-modified asphalt mixtures are suitable for light-to-medium traffic roads and have good stability, which is especially helpful for rural road networks in Edo State where economical materials are crucial. Because of these characteristics, PKS-cement tiles are ideal for use in Edo State's humid regions.

Structures built with PKS-based concrete show better thermal insulation, resulting in lower energy needs for cooling (Olutoge, Quadri, & Olafusi, 2012). Utilizing PKS reduces environmental pollution from agricultural waste and unlike gravel, they are alternative and cheaper, hence reducing the overall cost of construction.

Coconut Husk and Coir Fibres

Edo State, Nigeria, produces a lot of coconut husk and coir fibers from its coconut processing. These materials used to be seen as just agricultural waste. However, because

they are plentiful, cheap, and have good physical characteristics, there's increasing interest in using them as sustainable building materials (Omaliko, Ezenwanma, & Ezema, 2023). Using these fibers is viewed as a step towards more environmentally friendly and low-carbon building methods in the state.

Application in Construction

1. Making Stronger Concrete:

When you mix coconut fibres into concrete, it makes the concrete stronger and less likely to crack or break under bending. A study by Omaliko (2023) found that adding just a little bit of coconut fibre (around 0.5–1% of the concrete's weight) makes it tougher, less brittle, and even more resistant to fire. This stronger concrete is a great option for building affordable homes, smaller beams, and floor slabs, which are common in Edo State's housing.

2. Better Earth Blocks:

Research has shown that adding coir fibre (the coarser part of the coconut husk) can make compressed stabilized earth blocks (CSEBs) much better. It makes them stronger when pulled apart or bent, and it even helps them absorb less water (Hossain, I, 2015). This means CSEBs become more durable and can handle the humid weather in southern Nigeria, including the rural parts of Edo State, much better.

3. Tougher Roofing:

Coir fibres have also been successfully used to make roofing tiles stronger and less likely to crack. A study by Atoyebi, Osuolale, and Ibitogbe (2019) found that roofing tiles with coir fibre mixed in could handle more stress and were less prone to breaking compared to regular cement tiles.

4. Stronger Soil:

Mixing coir fibres into clay-rich soils can make the soil stronger and more stable, so it can hold more weight. Babafemi (2019) reported that soil reinforced with coir fibre had better resistance to shearing (sliding) and was less likely to expand and shrink with changes in moisture. This is useful for building roads and foundations in areas of Edo State that have tricky, expansive clay soils.

5. Natural Insulation:

Coir fibres can also be made into natural insulation panels that are good at keeping heat in or out and reducing noise (Aladenika, Olanrewaju, & Olaitan 2021). These panels are an alternative alternative to man-made insulation and could help make buildings in Edo State more energy efficient.

Using coconut husk and coir fibers offers several key benefits. It helps cut down on waste by finding a use for agricultural byproducts that would otherwise end up in landfills or be burned. It also means we rely less on man-made, non-alternative materials for building. Economically, it creates new ways for coconut farmers and people in rural areas to earn money. Finally, because buildings made with these materials are better at regulating temperature, they need less energy for cooling, saving resources.

Laterite (Stabilised Earth)

Laterite is a type of soil and rock material rich in iron and aluminum oxides. It forms in hot, wet tropical and subtropical regions through intense and prolonged weathering of the underlying parent rock. Laterite, a soil rich in iron and aluminum oxides, is abundant in Nigeria, particularly in Edo State. Its adoption as an alternative building material is growing due to its affordability, availability, and environmental friendliness. Stabilized laterite, often reinforced with cement or lime, offers a sustainable alternative to conventional building materials like concrete and fired bricks (Oyelami, C.A, 2017)

Applications in Construction

1. Compressed Stabilized Earth Blocks (CSEBs)

Laterite soil, when mixed with stabilizers such as cement or lime, is used to produce compressed stabilized earth blocks (CSEBs). These blocks exhibit enhanced strength, durability, and weather resistance compared to traditional mud bricks (NBRRI, 2021). Oyelami (2017) suggests that CSEBs can reduce housing construction costs by up to 20%, offering a sustainable solution for affordable housing.

2. Wall Construction

In many rural and peri-urban communities in Edo State, laterite is used to make sun-dried bricks for wall construction. These walls provide excellent thermal comfort, helping to regulate indoor temperatures without the need for extensive energy inputs. The natural reddish-brown colour of laterite also offers aesthetic advantages, often eliminating the need for additional wall finishes.

3. Soil Stabilization for Infrastructure

Laterite soils can be stabilized with additives such as cement and bone ash to improve their mechanical properties. According to research published by Oyelami (2017), stabilized laterite exhibits increased compressive strength and lower permeability, making it suitable for road subgrades, embankments, and foundation works.

One major plus of using laterite in Edo State is that it's plentiful and easy to get, which saves money and effort on transportation and buying. It's also a more affordable option for construction compared to conventional materials that often need to be brought in (NBRRI, 2021). From an environmental perspective, producing stabilized laterite blocks is more sustainable because it uses less energy than firing traditional bricks, leading to a lower carbon footprint (Oyelami 2017).

HEMP (KENAF)

Kenaf is a fast-growing, non-wood plant that produces strong fibers from its bast (outer) and core (inner) sections. These fibers are utilized in various applications, including textiles, paper, and increasingly, in construction materials. Existing research has demonstrated that kenaf stands as an optimal fiber source for biocomposites, showcasing various favorable physical properties and ecological benefits over synthetic alternatives (Austin, Conner C., et al., 2024). Kenaf's fibers are known for their high tensile strength, making them suitable for reinforcing composites and producing lightweight, durable building materials. The fast-growing, fibrous plant known as kenaf, which is indigenous to tropical regions, has drawn interest in Nigeria due to its potential in sustainable construction. In Edo State, its use is being explored to encourage environmentally friendly building methods, lessen dependency on traditional materials, and boost local economies.

Application In Construction

1. Stronger Concrete with Kenaf:

Adding kenaf fibres to concrete mixes can make them stronger. Research by Oyeniran and others (2018), showed that laterite mortar mixed with kenaf fibres had improved compressive strength, especially when the right amount of fibre was used and the mortar was cured properly. This suggests that concrete reinforced with kenaf could be used in various structural parts of buildings.

2. Keeping Buildings Comfortable and Quiet:

Kenaf fibres are great at insulating against heat and sound. Panels made from kenaf can effectively control indoor temperatures and reduce noise, making them a good choice for sustainable building designs that focus on making occupants comfortable.

3. Eco-Friendly Kenafcrete Blocks:

Kenafcrete, a material made by combining kenaf fibres with lime-based binders, offers a sustainable alternative to traditional concrete block. Kenafcrete blocks are lightweight, resistant to fire, and provide good insulation, making them suitable for environmentally friendly construction projects.

Kenaf is a highly alternative resource because it grows very quickly and can be harvested in just 4–5 months, ensuring a consistent supply of raw material (Ogunbode, 2018). Furthermore, as it grows, kenaf soaks up a significant amount of carbon dioxide from the atmosphere, helping to lower carbon emissions in the construction industry.

EARTH/MUD/ADOBE

For a long time in Edo State, Nigeria, building with earth, mud, and adobe has been a fundamental part of how things were constructed. Now, with a growing focus on sustainable development and eco-friendly building, there's renewed interest in using these materials again. Earth-based materials offer many benefits, like being sustainable, affordable, and having a very low impact on the environment. This renewed approach fits with the broader goals of lowering the carbon footprint of construction and encouraging environmentally sound building methods in the region.

Applications of Earth/Mud/Adobe in Construction

1. Building Walls with Affordable Adobe Bricks:

Adobe, which are sun-baked bricks made from earth mixed with straw and water, has a long history of use for building walls in Edo State. Besides being inexpensive, adobe bricks are excellent at keeping the inside of buildings cool in the heat, reducing the need for air conditioning (Olaniyan, S. A. 2023). They are especially practical for housing in rural areas and for low-cost projects where getting hold of conventional building materials might be difficult.

2. Using Simple Mud to Hold Bricks Together:

Mud mortar, often used with adobe or other earth bricks, is a basic but effective material for joining them together. In Edo State, it's commonly used to stick earth blocks together when building walls. This method helps the walls store heat during the day and release it at night, which naturally helps keep homes energy-efficient. Plus, mud mortar is natural and doesn't harm the environment.

3. Finishing Walls with Natural Earth Plaster:

Earth-based plaster, made from earth, clay, and natural binders, is used as an environmentally friendly alternative to synthetic paints and plasters. It's particularly popular in the countryside and on the edges of cities in Edo State for finishing walls inside and outside. This natural plaster allows walls to breathe, which helps control moisture levels and prevents mold from growing.

4. Using Earth Blocks for Foundations:

In many rural communities in Edo State, mud and earth blocks are also used to build foundations. While they are often strengthened with cement or other materials, these blocks still make use of the natural and plentiful resources found in the area. This reduces

the need to rely on materials brought in from elsewhere, like concrete blocks, making construction more affordable and sustainable (Ojo & Adeyemi pointed this out in 2018).

Plant-Based Thatch

In Edo State, Nigeria, plant-based thatch has a long history as a roofing material for both homes and community buildings. With a growing interest in sustainable construction, thatch is being increasingly appreciated for its eco-friendly and alternative nature (Godwin, H.C et al 2024). Choosing thatch supports global efforts in sustainable construction by promoting energy efficiency and environmental awareness.

Application in Construction

1. Traditional Roofing in Rural Areas:

Thatch is still a common roofing choice in the countryside of Edo State, especially for traditional homes. It's a great insulator, naturally keeping the inside of buildings cooler in the region's hot weather. The traditional method involves weaving plant materials tightly together to create strong, long-lasting roofs that provide shelter from rain and sun.

2. Eco-Friendly Buildings for Tourism:

The growing eco-tourism scene in Edo State is also using plant-based thatch for roofing. Hotels, lodges, and resorts in the state are choosing thatched roofs to create environmentally friendly and authentic accommodations that reflect the local culture. The natural look of thatch blends well with the environment, making the eco-tourism experience even better.

3. Preserving Culture and Heritage:

Thatch is important for keeping Edo State's cultural heritage alive. Traditional thatched roofs are a key part of the region's unique architectural style. Continuing to use them supports local culture, showcases traditional building skills, and boosts community pride.

This way of building is deeply connected to the history of the Edo people, and using it helps ensure that local craftsmanship and materials are preserved (Mogaji, I. J., 2024).

The downside of thatch is that it is susceptible to wear and tear over time and requires regular maintenance.

Recycled Steel

Instead of being made totally from raw iron ore, recycled steel is made from scrap or used steel products. Old steel objects, such as appliances, automobiles, construction materials, and industrial scrap, are gathered, melted down, and turned into new steel products instead of being mined and produced from raw iron ore.

By reducing the demand for virgin raw materials, recycled steel preserves natural resources and drastically lowers carbon emissions linked to the manufacturing of new steel (Ojonimi et al., 2018).

Using recycled steel greatly lessens environmental damage by reducing the need to mine iron ore and cutting down on energy use compared to making new steel (World Economic Forum, 2023). Recycling steel requires about 75% less energy than producing it from scratch, which helps lower greenhouse gas emissions and fight climate change. Economically, recycled steel often costs less than new steel, saving money on big construction projects. This cost-effectiveness makes it a good choice for developers and contractors in Edo State who want to be both affordable and sustainable (Ojonimi et al., 2018).

SHEEP WOOL

Although traditional building in Nigeria, especially in Edo State, has mostly used earth-based materials, there's a growing curiosity about other alternative resources like sheep wool. The increasing focus on environmentally friendly and energy-efficient building

methods has sparked conversations about incorporating natural fibers such as wool into local construction practices.

Sheep wool is a promising natural construction material lauded for several key properties. Its ability to trap air makes it an **excellent thermal insulator**, keeping buildings comfortable in both hot and cooler Nigerian climates (Dénes T-O, 2022). The fibrous nature of wool also provides **good soundproofing**, valuable for acoustic insulation. Significantly, wool offers **natural fire resistance** with a high ignition point and self-extinguishing capability (Patrucco, A. et al., 2024), unlike many synthetic options. Finally, wool can **regulate moisture** effectively without losing its insulation capacity, making it well-suited for the humid conditions often found in Edo State. In essence, sheep wool offers natural thermal and acoustic insulation, good fire resistance, and moisture regulation, making it a potentially valuable and comfortable building material.

The use of sheep wool in Edo State's construction sector is currently minimal, mainly due to limited commercial sheep farming and low public awareness. Nevertheless, a growing niche of environmentally conscious builders and researchers at universities like Ambrose Alli University and the University of Benin are exploring wool as a more sustainable and cost-effective alternative to harmful synthetic insulation, suggesting a possible shift in building projects.

Encouraging the use of sheep wool in construction could boost sheep farming and lead to the development of new industries in Edo State, such as wool processing and the manufacturing of insulation products.

Other alternative materials in construction include:

cork, straw bales, flax fibre, jute, ramie, palm fibre, bagasse (sugarcane fibre), cornstarch plastic (PLA), rice husk board, wheat straw board, mycelium (mushroom roots), wood

wool, banana fibre, cotton insulation, pine resin, cellulose insulation, Adobe bricks, Cob, Clay plaster, Natural clay bricks, Lime plaster, Earthen floors, Terra-cotta tiles, Bentonite clay, Hemp fiberboard

Biodegradable bioplastics, Soy-based resin panels, Flax-based composite panels, Corn-based polylactic acid (PLA), Seaweed-based bioplastic, Algae-based construction panels, Recycled cotton panels, Lignin-based biopolymer, Casein-based bioplastics (milk protein) Hemp-lime concrete, Fly ash concrete, Slag-based concrete, Geopolymer concrete, Ferrock (iron-based concrete alternative), AshCrete, Recycled aggregate concrete, CarbonCure concrete (CO₂ infused)

Papercrete (paper and cement), Myco-crete (fungi-based bio-concrete), Hemp fibre insulation, Straw bale insulation, Cork insulation, Cellulose (recycled paper), Wood fibre insulation, Aerated clay, Expanded cork panels, Seaweed insulation, Natural latex foam, etc.

2.4 Examining the Level of Adoption of Alternative Materials for Construction Projects in Edo State Nigeria

Currently, Edo State has a low to moderate level of use of alternative building materials, including compressed earth blocks, laterite, rice husk, coconut coir, palm kernel shells, hemp (kenaf), recycled steel, earth/mud (adobe), plant-based thatch, and sheep wool. Slowly, the movement is expanding, mostly among private eco-builders, a few research institutes, and non-governmental organizations that support sustainable housing. However, several obstacles still prevent widespread implementation.

In Edo State, the adoption of alternative building materials varies significantly. Earth/mud/adobe remains highly prevalent in rural areas as a traditional method, though it's often viewed negatively in urban settings. Materials like Compressed Earth Blocks and laterite (stabilized earth) see moderate use, particularly in rural housing, some eco-friendly

projects, and generally in suburban areas (for laterite) due to their affordability and accessibility. Plant-based thatch also has moderate adoption in specific rural contexts like tourism lodges and farmhouses.

On the lower end of adoption are rice husk, coconut husk and coir fibres, and palm kernel shells. Rice husk sees limited experimental use, while coconut fibres are used in small-scale alternative boards and erosion control but are uncommon in mainstream buildings.

Palm kernel shells are primarily used for energy, with limited trials in concrete blocks.

Finally, materials like hemp (kenaf) and sheep wool have very low adoption, almost non-existent due to a lack of local processing, farming infrastructure (for hemp), and limited sheep farming/wool processing (for wool). Even recycled steel sees low adoption due to limited recycling infrastructure despite some awareness.

2.5 Factors Affecting the Adoption of Alternative Construction Materials in Edo State, Nigeria

The factors affecting the adoption of alternative construction materials have to do with those things that are currently in place, those things that are absent but need to be put in place, which generally have effect on people and stakeholders willingness to adopt these materials.

These factors include:

1. Cultural and Perception Issues

Cultural perceptions are a major hurdle in promoting alternative materials like earth blocks, thatch, and mud in Edo State. A common association links building with mud, thatch, and palm kernel shells to poverty and a lack of development in rural areas (Mogaji I.J. et al., 2024)

Urban residents often desire concrete and steel buildings as symbols of being modern and wealthy, leading them to see earth or thatch structures as inferior or "outdated" (Olaniyan,

S.A. 2023). This deeply rooted prejudice limits the interest of many homeowners and developers in adopting alternative, traditional materials, despite their lower cost and greater sustainability.

2. Lack of Public Awareness and Education

A significant barrier is the limited knowledge among the public, contractors, and some building professionals about the performance and advantages of alternative materials (Eze E.C. et al., 2023) and (Mogaji I.J. et al., 2024).

Many are unaware of the structural soundness, fire resistance, and energy efficiency of alternatives like compressed earth blocks, hempcrete, or recycled steel. The slow adoption rate is due to a lack of education campaigns, demonstration projects, and exposure to modern applications.

3. Absence of Strong Government Policies and Standards

Currently in Edo State, there aren't any official building rules, standards, or benefits that mandate or encourage the use of alternative construction materials. Because no regulations are pushing alternative materials, developers don't have any legal or financial reasons to pick them over traditional materials. This lack of policy discourages investment in sustainable building methods.

4. Weak Industrial and Processing Infrastructure

A significant challenge in using alternative materials for construction in Edo State is the underdeveloped industrial infrastructure for their processing. Materials like rice husk, palm kernel shells, kenaf fibers, and sheep wool all require specific processing to meet construction needs. For instance, rice husk needs to become panels or a cement substitute, palm kernel shells need crushing and sorting, kenaf fibers need retting and drying, and sheep wool needs cleaning and pest treatment. However, the lack of local facilities for this processing leads to limited availability, higher prices, and inconsistent quality control

(Ojonimi et al., 2018). Because of these issues, developers often prefer the more easily sourced conventional materials over the uncertain and potentially costly supply of alternatives.

5. Cost Challenges and Lack of Scale

While some alternative materials like laterite are cheaper, others such as processed hempcrete or recycled steel can cost more due to small production volumes, expensive imported equipment, and a lack of skilled labor. Achieving affordability for many alternative materials in Edo State depends on scaling up local manufacturing. The construction industry's risk-averse nature further amplifies this challenge, as stakeholders prefer materials with established, predictable performance and lower upfront costs (Wibowo, Gao, and Gao (2020)

6. Technical Challenges and Skill Gaps

Many construction professionals in Nigeria don't have enough knowledge about newer building materials like kenaf composites, bamboo, and recycled materials. This lack of familiarity hinders their use because these professionals aren't well-versed in the materials' properties, advantages, and how to build with them (Olawumi & Chan, 2024).

7. Supply Chain Limitations

Even though the basic materials for alternative construction are plentiful (like earth, rice husk, and palm kernel shells), the way they get to builders is disorganized. There are not many reliable suppliers, the availability of materials can be unpredictable, and the quality, especially of natural fibers, can vary. These weak supply chains mean builders risk project delays, inconsistent material quality, and potential financial problems, making them cautious about depending on alternative materials (Ramage et al., 2017).

8. Safety and Durability Concerns

Abundant raw materials for alternative construction (earth, rice husk, palm kernel shells) are hampered by fragmented supply chains with a few organized suppliers, irregular availability, and inconsistent quality (especially natural fibers). These weaknesses create risks for builders, discouraging their reliance on alternative materials (Ramage et al., 2017).

9. Resistance to change

10. Economic instability

11. Inadequate research and development

12. Perception of inferior quality

13. Client and market demand

14. Poor standardization of materials

15. Corruption in procurement processes

16. Lack of industry collaboration

17. Building codes and standards

18. Lack of Economic incentives and taxes

SN	FACTORS	SOURCE
1	Cultural and perception issues	Mogaji, I. J., 2024 Olaniyan, S. A. 2023
2	Lack of Public Awareness and Education	Eze E.C . et al., 2023 Mogaji IJ et al., 2024
3	Absence of Strong Government Policies and Standards	Mogaji IJ et al., 2024
4	Weak Industrial and Processing Infrastructure	Ojonimi et al., 2018
5	Cost Challenges and Lack of Scale	Wibowo, Gao, and Gao 2020
6	Technical Challenges and Skill Gaps	Olawumi & Chan, 2024
7	Supply Chain Limitations	Ramage et al,2017

8	Resistance to change	Agboola, S. A., Mustapha, F. Y., et al
9	Economic instability	Ramage et al,2017
10	Safety and Durability concerns	Ramage et al., 2017
11	Inadequate research and development	S. A., Mustapha, F. Y., et al
12	Perception of inferior quality	V. Emodi, S. Yusuf & K. Boo
13	Client and market demand	John Olusegun
14	Poor standardization of materials	Emodi, Yusuf & Boo (2014)
15	Corruption in procurement processes	John Olusegun Eze E.C . et al., 2023
16	Lack of industry collaboration	Eze E.C . et al., 2023
17	Building codes and standards	Agboola et al. (FJS) (2024)
18	Lack of Economic incentives and taxes	Emodi et al., 2014

Table 2.1: Factors Affecting the Adoption of Alternative Materials and Sources

2.6 Effect of Adopting Alternative Construction Materials on Cost Performance of Construction Projects

1. Initial Construction Cost

MATERIALS	IMPACT	REASON
Local materials (e.g., laterite, adobe, compressed earth blocks)	Lowers initial cost	Local materials (e.g., laterite, adobe, compressed earth blocks)
Processed alternatives (e.g., hempcrete, recycled steel)	May increase initial cost	Requires specialized processing, skilled labor, and sometimes imported technologies (Ramage et al., 2017).
Natural insulation materials (e.g., sheep wool, coir fibre panels)	Increases initial cost slightly	It is more cost efficient in energy consumption in the long run

Table 2.2: Initial Construction Cost of Adopting Alternative Construction Materials

In Edo State, because of the local availability of earth, laterite, thatch, and agricultural waste (like rice husk, coconut husk), **initial costs often decrease** if these materials are used correctly.

1. Labour and Skilled Workforce Cost

Using alternative materials like adobe blocks, thatch roofs, or earth walls often requires skilled artisans who are knowledgeable in these traditional or natural building methods. If these skilled workers are readily available locally, labor costs tend to stay low. However, if specialized training is needed for newer materials like hempcrete or rice husk panels, labor costs can temporarily rise. In Edo State, traditional earth-building skills are still present in rural areas, which helps keep labor costs down for projects using earth-based materials (Olaniyan, S. A. 2023).

2. Maintenance and Lifestyle Cost

Alternative materials often prove their worth over time when it comes to upkeep. For instance, earth-based buildings like those made of adobe or compressed earth blocks can last for many years with minimal and inexpensive maintenance, usually just needing occasional plastering or sealing. While plant-based thatch requires more frequent replacement (lasting around 5–10 years), potentially increases overall costs unless its lifespan is extended with chemical treatments. On the other hand, materials like recycled steel and sheep wool insulation offer long-term durability.

Transportation and Supply Chain Costs

Transportation costs for alternative materials in Edo State depend heavily on where they come from. Locally available options like earth, laterite, and coconut husk lead to major reductions in these costs. On the other hand, materials that need to be imported or undergo industrial processing, such as hemp, recycled steel, and high-tech panels, can have higher initial transport expenses. Notably, in Edo State's rural areas, materials like earth, bamboo,

thatch, and laterite are often accessible within a short distance of the building site, resulting in significant savings (Eze E.C. et al., 2023).

CHAPTER THREE

RESEARCH METHOD

3.1 Preamble

The research methodology serves as the blueprint for collecting, analyzing, and interpreting data in a way that ensures reliability and validity of the study outcomes. The research presents the design, area of study, target population, sampling technique and sample size, data needed and sources, research instrument, data collection method, and method of data analysis.

3.2 Research Design

The choice of the design is resultant of the need to explore and document the available alternative construction materials, their level of adoption, factors and cost implications. This research is a cross-sectional survey conducted using questionnaires to gather data. It is concentrated in Edo State, aiming to improve the level of adoption of alternative materials. The professionals sampled will be from Edo State. These professionals include Quantity Surveyors, Architects, Contractors and Engineers.

3.3 Study Area

This study focuses on Edo State. The choice of area is due to the availability of these alternative building materials but low implementations. The research aims to enhance understanding of the importance of alternative materials, their cost, their level of adoption, and factors affecting the adoption of these alternative building materials.

3.4 Target Population

This study encompasses all the stakeholders involved in construction projects within Edo State. Table 3.1

Table 3.1: Target Population

S/N	Target population	Number of Professionals	Sample	Percentage distribution of professionals
1	Quantity surveyors	126	40	14.7%
2	Architects	186	59	21.6%
3	Builders	250	79	28.9%
4	Civil/Structural Engineers	300	95	34.8%
	Total	862	273	100%

SOURCE: Nigerian Institute of Quantity Surveying, Nigerian Institute of Architects, Nigerian Institute of Builders, Nigerian Society of Engineers.

3.5 Sampling Techniques and Sample Size

To refine the scope of this study, a convenient sample method was employed. The sample size was calculated using the Yamane (1967) formula to ensure appropriateness and representativeness.

$$n = \frac{N}{1 + N(e)^2}$$

Where:

- n = sample size
- N = total population
- e = level of precision (margin of error, usually $0.05 = 5\%$)

Sample

$$n = \frac{826}{1 + 826(0.05)^2}$$

$$n = 273$$

3.6 Method of Data Collection

Data for this study will be collected using a structured questionnaire designed to capture relevant information on Adoption of alternative materials for construction projects in Nigeria. The responses will be analysed using Mean Item Score (MIS) for objective 1 and 2, and factor analysis for objective 3.

Table 3.2: Method of Analysis

SN	OBJECTIVES	METHOD OF ANALYSIS
1	Examining the types of alternative materials adopted for construction projects in Edo State.	Mean Item Score
2	Examining the level of adoption of alternative materials for construction projects in Edo State.	Mean Item Score
3	Examining the factors influencing the adoption of alternative materials for construction projects	Factor Analysis

Mean Item Score

Mean Item Score (MIS), a descriptive statistical measure used to assess the average performance or level of a group across a set of responses or items. It is calculated by summing the scores of all individual items and dividing it by the total number of items.

Mean Item Score formula is expressed as:

$$MIS = \frac{\sum(fi \times xi)}{N}$$

where:

fi = Frequency of Likert scale score

xi = Assigned numerical value for each response category

N = Total number of responses

Likert scale score are as follows:

Strongly agree = 5

Agree = 4

Moderate/neither agree nor disagree = 3

Disagree = 2

Strongly disagree = 1

Factor Analysis

Factor Analysis is a multivariate statistical technique used to identify underlying relationships among a large set of observed variables. It helps in data reduction by grouping related variables into fewer unobserved dimensions, known as factors. The main purpose is to determine whether several variables can be explained by a smaller number of latent constructs, thereby simplifying data interpretation while retaining most of the original information (Field, 2018).

The method assumes that observed responses are influenced by both unique variance (specific to each variable) and common variance (shared among variables). By extracting and rotating factors, researchers can detect patterns of correlation, highlight the most significant variables, and assign them to factor groupings.

$$X = \mu + \Lambda F + \epsilon$$

X: A vector of observed variables.

μ : The mean vector of the observed variables.

Λ : The matrix of factor loadings, representing the strength of the relationship between each variable and each common factor.

F: A vector of the latent common factor scores.

ϵ : A vector of unique error terms, which includes both specific variance for each variable and random error.

For this research, Table 3.3 will be used to interpret KMO value.

KMO/MSA value	Adequacy of the correlations
Below 0.50	Unacceptable
0.50–0.59	Miserable
0.60–0.69	Mediocre
0.70–0.79	Middling
0.80–0.89	Meritorious
0.90 and higher	Marvellous

Table 3.3: Interpretation of KMO Value

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS, AND INTERPRETATION

4.1 Preamble

This chapter discusses the research findings derived from survey responses. The collected data is analyzed and interpreted to highlight the “Adoption of alternative construction materials in Edo State”.

It examines the demographic profile, the types of alternative materials that can be adopted, the level of adoption in Edo State, and factors affecting the adoption of alternative construction materials in Edo State. A total of 185 responses out of 273 have been returned.

4.2 Demographic Information of Respondents

To ensure comprehensive analysis, demographic data such as profession, highest level of educational attainment, years of experience and the professional body they belong to.

Table 4.1: Demographic Information

Category		Frequency	Percentage
Professional	Quantity Surveying	32	17.30%
	Engineer	52	28.10%
	Architect	39	21.10%
	Builder	62	33.50%
	Tota	185	100%
Years of professional experience	0-5 years	95	51.35%
	6-10 years	46	24.86%
	>10 years	44	23.78%
	Total	185	100%
Highest level of education attainment	B.SC/B.TECH	93	50.30%

	M.SC	49	26.50%
	HND	5	2.70%
	PHD	22	11.90%
	ND/OND	8	4.30%
	PGD	8	4.30%
	Total	185	100%
Membership of professional organisation	MNIQS	32	17.30%
	MNSE	52	28.10%
	MNIA	39	21.10%
	MNIOB	62	33.50%
		185	100%

4.3 Demographic Analysis

The respondents are professionals in the construction industry, such as Quantity Surveyors, Engineers, Architects and builders. They provide feasible insight into the adaptability of alternative materials, their current level of Adoption in Edo state and what factors affect the adoption.

4.4 Experience Level

So far, most of the respondents have an experience level 0-5 years (51.35%), followed by 6-10 years (24.86%), and greater than 10 years (23.78%). Their feedback may reflect future industry attitudes, since they represent the upcoming generation of decision-makers as they are more open to innovation.

4.5 Educational Background

In terms of educational background, a significant portion of respondents (50.30%) hold a B.Sc/B.Tech , followed by M.Sc holders (26.50%), PhD (@11.90), OND/ND and PGD (@4.30% respectively), and HND (@2.70%). This indicates that all the professionals have

a formal education in fields related to construction, strengthening the credibility of the response provided.

4.6 Professional Qualification and Membership

For professional qualifications, 17.30% of respondents are members of the Nigerian Institute of Quantity Surveyors (MNIQS), 28.10% hold memberships in the Nigerian Society of Engineers (MNSE), 21.10% are members of the Nigerian Institute of Architects, and 33.50% are members of the Nigerian Institute of Builders. This suggests that a significant proportion of the respondents are certified professionals, further validating the accuracy and authenticity of the survey.

4.7 Examining the Types and Level Awareness of Alternative Materials that can be Adopted

Materials such as bamboo, earth, stone dust, recycled plastic, palm kernel shells, and so on can be adopted as an alternative to conventional materials or used alongside the conventional materials.

Table 4.2: Level of Awareness of Alternative Materials

MATERIALS	Mean Item Score	STANDARD DEVIATION	RANK
Bamboo	4.55	0.96	1
Recycled steel	4.27	0.91	2
Earth/mud	4.21	0.88	3
Laterite (stabilised earth)	4.14	1.00	4
Recycled plastic	4.13	1.06	5
Stone dust	4.12	1.05	6
Palm kernel shells and fibre	3.70	1.13	7
Plant-based thatch	3.70	1.02	8
Compressed earth blocks	3.66	1.14	9
Asbestos fibre	3.57	1.21	10
Coconut husk and coir fibre	3.56	1.16	10
Sisal fibre	3.45	1.20	12
Periwinkle shell	3.38	1.21	13
Sheep wool	3.34	1.30	14
Rice husk	3.28	1.22	15
Bagasse boards	3.14	1.36	16
Hemp (Kenaf)	3.04	1.23	17
Groundnut shell	2.96	1.08	18

The table shows respondents' perceptions of various alternative construction materials, based on their frequency of mention/use, Mean Item Score (MIS), and ranking.

Top-Ranked Alternative Materials: Bamboo (MIS = 4.55, Rank 1), Recycled Steel (MIS = 4.27, Rank 2), Earth/Mud (MIS = 4.21, Rank 3)

Bamboo (MIS = 4.55, Rank 1):

The most preferred alternative material. Its high ranking reflects its strength, versatility, availability, and cost-effectiveness in construction. Bamboo is widely recognized for structural applications and sustainability.

Recycled Steel (MIS = 4.27, Rank 2):

Highly valued for durability and structural performance. The strong score suggests respondents see recycled steel as a practical, eco-friendly alternative to virgin steel, reducing environmental impact while meeting construction standards.

Earth/Mud (MIS = 4.21, Rank 3):

The ranking of this material, showing the importance as locally sourced, low-cost, and sustainable options. Their strong position highlights their acceptance in traditional and modern housing, especially in resource-constrained contexts.

Lowest ranked materials like Bagasse boards (MIS= 3.14 RANK 16), Hemp (MIS= 3.04 RANK 16), Groundnut shells (MIS= 2.96 RANK 18). These are bio-based and sustainable but generally rated lower. Their limited ranking suggests issues with awareness, durability, or large-scale applicability in the local construction industry.

4.8 Examining the Level of Adoption in Edo State

Based on the respondents, bamboo, recycled plastic and recycled are the most adopted and groundnut shells, sheep wool and rice husk are the least adopted.

Table 4.3: Examining the Level of Adoption in Edo State

MATERIALS	Mean Item Score	STANDARD DEVIATION	RANK
Bamboo	4.02	1.03	1
Recycled plastic	3.98	1.12	2
Recycled steel	3.90	1.04	3
Compressed earth blocks	3.86	1.01	4
Stone dust	3.68	1.10	5
Earth/mud	3.65	1.14	6
Laterite (stabilised earth)	3.28	1.15	7
Plant-based thatch	3.08	1.41	8
Asbestos fibre	2.87	1.25	9
Palm kernel shells and fibre	2.86	1.35	10
Coconut husk and coir fibre	2.84	1.42	10
Bagasse boards	2.83	1.23	12
Sisal fibre	2.79	1.23	13
Hemp (Kenaf)	2.78	1.38	14
Periwinkle shells	2.56	1.16	15
Groundnut shells	2.50	1.16	16
Sheep wool	2.44	1.20	17
Rice husk	2.40	1.11	18

Highly Adopted Materials: Bamboo (MIS = 4.02, Rank 1), Recycled plastic (MIS = 3.98, Rank 2) and Recycled steel (MIS = 3.90, Rank 3)

Bamboo (MIS = 4.02, Rank 1):

Bamboo is the most adopted alternative material in Edo State. Its high adoption reflects its availability, affordability, strength, and cultural familiarity in construction. This aligns with global trends where bamboo is recognized as a sustainable alternative for structural and finishing works.

Recycled plastic (MIS = 3.98, Rank 2) and Recycled steel (MIS = 3.90, Rank 3):

These are also widely adopted, relying on indigenous, locally available, and low-cost building solutions. Their ranking reflects their role in affordable housing delivery and traditional construction practices.

Strong adoption here highlights recognition of recycling practices and steel's structural reliability. This suggests that Edo's construction sector is gradually aligning with sustainable modern practices.

Least Adopted Materials: Groundnut Shells (2.50, Rank 16), Sheep Wool (2.44, Rank 17) and rice husk (2.40, Rank 18)

Materials such Groundnut Shells (2.50, Rank 16), Sheep Wool (2.44, Rank 17) and rice husk (2.40, Rank 18) rank at the bottom.

These are mostly agro-waste and fibre-based options. Their low adoption suggests limited awareness, lack of standardization, technical challenges, and cultural skepticism about their durability and suitability for mainstream building projects.

Bamboo, recycled plastic and steel dominate adoption, showing that builders prioritize materials with strength and familiarity. Most fibre-based and agricultural by-products are underutilized, pointing to untapped potential that requires policy support, research, and awareness campaigns.

4.9 Examining the Factors Influencing the Adoption of Alternative Materials for Construction Projects

According to respondents, factors like cultural perception, lack of public awareness, resistance to change and so on, are all factors that influence the adoption level of alternative materials.

Table 4.4: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.895
Bartlett's Test of Sphericity	Approx. Chi-Square	1221.549
	df	153
	Sig.	.000

According to George and Mallory (2003), a significant value of less than 0.05 indicates that the data does not produce an identity matrix, and are thus acceptable for factor analysis. This is in tandem with Pallant (2005) study, which agrees that the Bartlett's test of sphericity should be significant ($p < 0.05$) for the factor analysis to be considered appropriate. The KMO index ranges from 0 to 1, with 0.6 being suggested as the minimum value for a good factor analysis (Tabachnick and Fidell, 2007). The KMO measure of sampling adequacy of this study achieved a value of .880, greatly exceeding the recommended minimum value of 0.6 and the Bartlett's test of sphericity was also statistically significant at .000 (< 0.05), thus supporting the use of factorability of the correlation matrix as shown in Table 4.4.

Table 4.5: Coefficient matrix

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18
F1	1																	
F2	0.39	1																
F3	0.444	0.564	1															
F4	0.428	0.545	0.535	1														
F5	0.375	0.401	0.441	0.505	1													
F6	0.341	0.561	0.567	0.536	0.497	1												
F7	0.24	0.196	0.126	0.128	0.238	0.253	1											
F8	0.183	0.308	0.254	0.226	0.177	0.306	0.462	1										
F9	0.587	0.483	0.467	0.47	0.464	0.583	0.265	0.361	1									
F10	0.422	0.45	0.455	0.475	0.516	0.498	0.268	0.22	0.453	1								
F11	0.457	0.55	0.546	0.613	0.556	0.568	0.223	0.302	0.581	0.55	1							
F12	0.245	0.316	0.322	0.302	0.235	0.302	0.261	0.322	0.326	0.259	0.372	1						
F13	0.363	0.352	0.245	0.372	0.287	0.28	0.347	0.346	0.345	0.283	0.441	0.354	1					
F14	0.208	0.296	0.252	0.263	0.214	0.193	0.377	0.363	0.304	0.279	0.312	0.302	0.309	1				
F15	0.154	0.216	0.213	0.279	0.315	0.177	0.294	0.206	0.204	0.35	0.29	0.203	0.215	0.299	1			
F16	0.238	0.292	0.257	0.295	0.238	0.294	0.239	0.254	0.273	0.214	0.356	0.272	0.276	0.139	0.352	1		
F17	0.135	0.169	0.214	0.247	0.153	0.211	0.148	0.251	0.23	0.26	0.201	0.202	0.213	0.266	0.254	0.384	1	
F18	0.188	0.191	0.112	0.127	0.203	0.167	0.273	0.138	0.232	0.272	0.292	0.056	0.235	0.232	0.285	0.213	0.3	1

Table 4.6 shows the communalities of the factors affecting the adoption of alternative construction materials after extraction. Tabachnick and Fidell (2007) stated that the communalities should contain values above 0.3, as values less than 0.3 indicate that they do not fit well with the other variables in the component. The values as seen from the table all consist of items greater than 0.3, thus indicating that all variables fit well together in the component.

Table 4.6: Communalities

	Initial	Extraction
Cultural and perception issues	1.000	0.474
Lack of public awareness and education	1.000	0.569
Absence of Strong Government Policies and Standards	1.000	0.613
Weak Industrial and Processing Infrastructure	1.000	0.624
Cost Challenges and Lack of Scale	1.000	0.565
Technical Challenges and Skill Gaps	1.000	0.606
Supply Chain Limitations	1.000	0.667
Safety and Durability Concerns	1.000	0.615
Resistance to change	1.000	0.595
Economic instability	1.000	0.59
Inadequate research and development	1.000	0.675
Perception of inferior quality	1.000	0.534
Client and market demand	1.000	0.435
Poor standardization of materials	1.000	0.471
Corruption in procurement processes	1.000	0.502
Lack of industry collaboration	1.000	0.63
Building codes and standards	1.000	0.621
Lack of Economic incentives and taxes	1.000	0.63

Extraction Method: Principal Component Analysis.

Table 4.7 shows the number of factors affecting the adoption of alternative construction materials and their respective eigen values. The latent root or Kaiser's criterion of retaining challenges factors with eigen values exceeding 1.0 was employed. However, four factors with eigen values exceeding were retained, resulting in 6.555, 1.68, 1.174 and 1.006 selected which explains 36.415, 9.335, 6.524 and 5.59 percent of the variance respectively. This infers that the first cluster of challenges factors accounted for 36.415

percent; the second cluster of challenges factors accounted for 9.335 percent, the third cluster accounted for 6.524 percent and the fourth cluster accounted for 5.59 percent. These four clusters of adoption factors together have a cumulative percentage of 57.863 percent of the total importance, which highlights their significance from the eighteen factors shown.

Table 4.7: Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.555	36.415	36.415	6.555	36.415	36.415	4.881	27.119	27.119
2	1.68	9.335	45.75	1.68	9.335	45.75	2.428	13.489	40.608
3	1.174	6.524	52.274	1.174	6.524	52.274	1.645	9.139	49.747
4	1.006	5.59	57.863	1.006	5.59	57.863	1.461	8.116	57.863
5	0.861	4.783	62.647						
6	0.809	4.496	67.143						
7	0.774	4.302	71.444						
8	0.682	3.788	75.232						
9	0.628	3.49	78.723						
10	0.609	3.383	82.106						
11	0.52	2.89	84.996						
12	0.502	2.79	87.786						
13	0.446	2.479	90.264						
14	0.428	2.38	92.644						
15	0.398	2.211	94.855						
16	0.387	2.153	97.008						
17	0.295	1.641	98.649						
18	0.243	1.351	100						

Extraction Method: Principal Component Analysis.

An inspection of the scree plot on Figure 4.1 reveals a break after the first factor (Cultural and perception issues (F1)) and another after the second factor (Lack of public awareness and education (F2)), followed by a third break after the third factor (Absence of Strong

Government Policies and Standards (F3)) and a final break after the fourth factor (Weak Industrial and Processing Infrastructure (F4))

The steep slope shows the large factors while the gradual trailing off shows the rest of the factors that have an eigen value less than 1. The three large cluster factors, which are positioned on the steep slope were retained. To aid the interpretation of these three factors, varimax was performed which gave rise to the pattern matrix as shown in Table (NR)

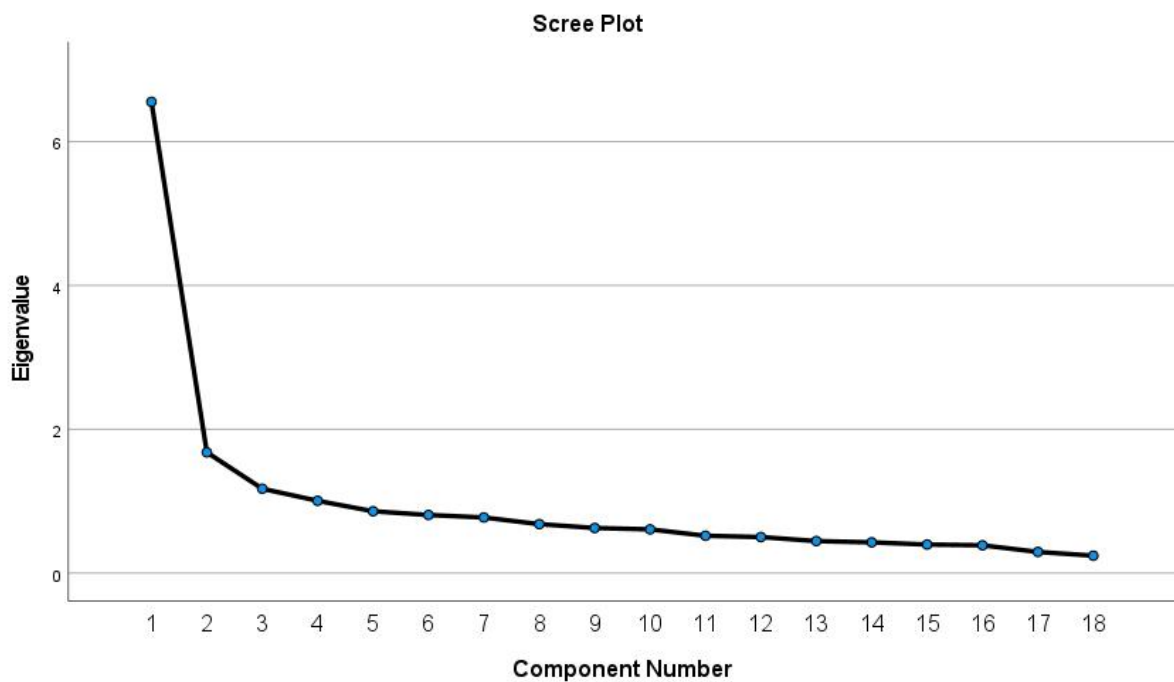


Figure 4.1: Scree plot

Table 4.8 shows the factor analysis reporting the four cluster factors of factors affecting the adoption of alternative construction materials. The table shows the summary of cluster importance factor grouping for factors affecting the adoption of alternative construction materials.

Table 4.8: Rotated Component Matrix

	Component			
	1	2	3	4
Inadequate research and development	0.76			
Weak Industrial and Processing Infrastructure	0.747			
Absence of Strong Government Policies and Standards	0.747			
Technical Challenges and Skill Gaps	0.746			
Lack of public awareness and education	0.702			
Resistance to change	0.697			
Cost Challenges and Lack of Scale	0.684			
Economic instability	0.652			
Cultural and perception issues	0.63			
Safety and Durability Concerns		0.741		
Supply Chain Limitations		0.737		
Poor standardization of materials		0.614		
Client and market demand		0.547		
Perception of inferior quality		0.516		
Lack of industry collaboration			0.741	
Building codes and standards			0.74	
Lack of Economic incentives and taxes				0.755
Corruption in procurement processes			0.408	0.525

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

A Rotation converged in 7 iterations.

Factor 1: Information and Infrastructural Barrier

The factors that are loaded under this component are: inadequate research and development, weak industrial and processing infrastructure, absence of strong government policies and standards, technical challenges and skill gaps, lack of public awareness and education, resistance to change, cost challenges and lack of scale, economic instability cultural and perception issues. The component was named “Information and Infrastructural Barrier”.

Lack of awareness, cultural perception and absence of strong government policies support Mogaji, I.J (2024) as factors affecting the adoption of alternative construction materials.

Factor 2: Market Barrier and Supply and Demand Availability

This reflects practical and perception-related obstacles that hinder the uptake of alternative construction materials. This factor is shaped by safety and durability concerns, supply chain limitations, poor material standardization, weak client and market demand, and perceptions of inferior quality. These market-related constraints align with findings by Rampage et al. (2017) and Emodi et al. (2014), who similarly identified availability issues and negative perceptions as major barriers to adoption.

Factor 3: Material and Market Deficiencies

This component has a two-factor loading which are: building codes and standards, lack of economic incentives and taxes.

The first strongly loaded variable, building codes and standards, reflects the regulatory rigidity within the construction sector. Existing codes are predominantly tailored to conventional materials such as concrete and cement, leaving limited provisions for natural, recycled, or emerging alternative materials. The absence of standardized testing protocols, certification procedures, and clear approval guidelines often results in regulatory hesitation and prolonged approval processes. These barriers discourage developers and professionals from adopting alternative materials due to increased perceived risk, compliance uncertainty, and potential cost overruns.

The second loading, lack of economic incentives and taxes. Without tax breaks, subsidies, or targeted financial support, alternative materials remain costlier to develop, process, and scale. High import duties on processing equipment, insufficient government procurement

policies, and limited access to affordable financing make conventional materials more economically attractive. As a result, there is little motivation for investors, builders, or consumers to transition toward greener, low-carbon material options.

Both factors support the claims by Emodi (2014) and Agboola et. al, (2024)

Factor 4: Regulations and Government incentives

Regulations and Government incentives are important for the adoption of these materials. This component has 2 factors loadings under it: Lack of Economic incentives and taxes, corruption in procurement processes. Regulations and Government Incentives reflect the policy and governance barriers limiting the adoption of alternative construction materials. The factor is driven by two key loadings: lack of economic incentives and taxes, which makes innovative materials financially uncompetitive, and corruption in the procurement process, which skews material selection toward established suppliers rather than sustainable or cost-effective alternatives. Together, these regulatory and governance deficiencies weaken market fairness and reduce opportunities for wider material diversification in the construction sector.

This is supported by Emodi et al., (2014). These are critical factors that affect the adoption of these materials

4.10 Discussion of Findings

From analysis, it was observed that the top three ranked Alternative Materials are Bamboo with a Mean Item Score of 4.02, Recycled plastic with a Mean Item Score of 3.98, and Recycled steel with a Mean Item Score of 3.90, respectively. While the lowest ranked materials Groundnut Shells with a Mean Item Score of 2.50, Sheep Wool with a Mean Item Score 2.44, and rice husk with a Mean Item Score of 2.40. These are bio-based and sustainable but generally rated lower.

The study shows that the adoption of alternative construction materials in Edo State is low to moderate, shaped by material properties, cultural perceptions, availability, and infrastructural capacity. Bamboo is the most adopted material (MIS = 4.02, Rank 1), valued for affordability, strength, flexibility, and cultural familiarity, supporting studies by Akinlabi et al. (2017), Janssen (2000), and Oyedepo (2012) highlighting its structural suitability, rapid growth, and environmental benefits.

Recycled Plastic (3.98, Rank 2) and Recycled steel (MIS = 3.90, Rank 3), shows moderate adoption, consistent with Ojonimi et al. (2018) and Broadbent, C. (2016), as an eco-friendly alternative reducing energy use and carbon emissions.

Low-adoption materials such Groundnut Shells (2.50, Rank 16), Sheep Wool (2.44, Rank 17) and rice husk (2.40, Rank 18), remain underutilised despite alternative and economic benefits. Limited uptake shows the lack of awareness, standardisation, technical knowledge, and doubt, as highlighted by Temitope, A. K. (2015), Omaliko et al. (2023), and Sulymon (2005).

The study identified 18 factors influencing adoption, with: Lack of public awareness and education, Weak industrial and processing infrastructure, Resistance to Change, as the most critical. This supports Mogaji, I. J., (2024), Eze E.C (2021), and Ojonimi et al. (2018), who noted that societal attitudes, insufficient knowledge, and poor local processing facilities limit the uptake of alternative materials. Lower-ranked factors such as Building codes and standards, Supply Chain Limitations, and Safety and Durability Concerns, play a supportive role, indicating that adoption is primarily influenced by perception, knowledge, and material familiarity rather than policy alone.

In summary, the findings demonstrate that materials with proven performance, familiarity, and accessibility dominate adoption, while innovative bio-based and agro-waste materials

remain underexploited. Addressing cultural biases, enhancing public education, developing local processing infrastructure, and implementing supportive policies are essential for promoting sustainable construction practices in Edo State.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary of the Study

This study examined the **Adoption of Alternative Construction Materials in Edo State**, with the aim of assessing their availability, level of adoption, and the factors influencing their use in construction projects. The research specifically focused on professionals in the construction sector, including Quantity Surveyors, Architects, Builders, and Engineers. The study was motivated by the growing global need for sustainable construction practices and the underutilization of locally available alternative materials in Edo State.

The study employed a **cross-sectional survey design**, utilising structured questionnaires to collect data from 273 targeted professionals. Data were analysed using **Mean Item Score (MIS)** to rank alternative materials and **Factor Analysis** to rank factors affecting adoption.

Overall, the findings reveal that while alternative materials are available, adoption is constrained by societal perceptions, limited awareness, and technical capacity, rather than purely economic or policy limitations.

5.2 Conclusion

The study shows that types of alternative materials adopted in Edo State include bamboo, compressed earth blocks, earth/mud, recycled steel, rice husk, palm kernel shells, coconut coir, hemp (kenaf), and sheep wool. Among these, bamboo, recycled steel and plastic are the most widely used due to their affordability, availability, strength, and cultural

familiarity. Bamboo demonstrates versatility and sustainability for structural and finishing applications, while earth-based materials provide thermal comfort and cost-effective solutions, particularly in rural areas. Materials such as rice husk, groundnut shells, hemp, and sheep wool have low adoption, reflecting technical challenges, limited processing infrastructure, and a lack of public awareness.

Regarding the level of adoption, the findings indicate that bamboo, earth/mud, and compressed earth blocks enjoy high adoption, while recycled steel is moderately used and other fibre- and agro-waste-based materials remain underutilized. The study shows that adoption is stronger for materials with proven structural performance, local availability, and cost-effectiveness, while novel or less familiar materials face hesitancy from builders and clients. This confirms that Edo State's construction sector prioritises reliability and cultural familiarity over experimental or advanced alternative materials.

The factors affecting adoption include cultural perceptions linking alternative materials to poverty, lack of public awareness and education, weak industrial and processing infrastructure, technical skill gaps, supply chain limitations, and cost challenges. Lower-ranked factors such as corruption, building codes, and lack of economic incentives have a minor but supportive effect. These findings highlight that both socio-cultural attitudes and systemic constraints significantly influence whether alternative materials are accepted and utilized in construction projects.

5.3 Recommendations

To improve the adoption of alternative materials, it is recommended that bamboo, earth/mud, and compressed earth blocks continue to be promoted through demonstration projects, emphasizing their affordability, structural reliability, and environmental benefits. Innovative materials such as rice husk, palm kernel shells, coconut coir, hemp, and sheep

wool should be supported through pilot programs and research to build confidence in their performance.

For enhancing the level of adoption, educational campaigns and technical training for builders, contractors, and clients should be implemented to increase knowledge of the benefits and proper use of alternative materials. Development of local processing facilities and supply chain improvements will ensure consistency, affordability, and quality, particularly for fibre- and agro-waste-based materials as Edo State is rich in them.

To address adoption barriers, policies and regulations should encourage the use of alternative materials by integrating them into building codes, offering economic incentives, and standardizing production. Public awareness initiatives should target cultural perceptions and demonstrate the durability and modern applicability of these materials. Investment in research, skill development, and industrial infrastructure will be crucial for scaling up production, ensuring sustainability, and unlocking the full potential of alternative construction in Edo State.

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APPENDIX**SURVEY QUESTIONNAIRE**

THE DEPARTMENT OF QUANTITY SURVEYING,
FACULTY OF ENVIRONMENTAL SCIENCES,
UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA

**ADOPTION OF ALTERNATIVE MATERIALS FOR CONSTRUCTION
PROJECTS IN EDO STATE**

Dear Respondent,

I am writing to invite you to participate in a research study that aims to **Assess the ADOPTION OF ALTERNATIVE MATERIALS FOR CONSTRUCTION PROJECTS IN EDO STATE**. This study is part of a research project towards the award of a BSc in Quantity Surveying at University of Benin. Your participation is entirely voluntary, and you have the right to withdraw from the study at any time. The data collected will be kept confidential and anonymous and will only be used for academic purposes.

If you have any questions or concerns about the study, please reach out to the researcher.

Name of Researcher: **ESEKIE Martha Aitekere**

Phone Number: 07080428159

Email Address: marthaesekie@gmail.com

**ADOPTION OF ALTERNATIVE MATERIALS FOR CONSTRUCTION
PROJECTS IN EDO STATE**

To be completed by Architects, Builders, Engineers and Quantity Surveyors

Please complete this survey by supplying the necessary information for each section.

Rest assured that the data you provide will be handled with the utmost confidentiality.

SECTION ONE**GENERAL INFORMATION**

PLEASE KINDLY TICK THE OPTION THAT APPLIES TO YOU

1. Profession of Respondent?

(A) Architect [] (B) Builder [] (C) Engineer [] (D) Quantity Surveyor []

2. Years of professional experience?

(A) 0-5 years [] (B) 6 to 10 years [] (C) 11 to 15 years [] (D) 16 to 20 years []

(E) above 20 years []

3. Highest level of educational attainment

(A) ND/OND []

(B) HND []

(C) B.sc/B.Tech []

(D) PGD []

(E) M.Sc /M.Phil. []

(F) PhD []

4. Please specify if you are a member of any professional organizations or associations.

(A) MNIA [] Reg.Arc []

(B) MNIOB [] Reg.Bldr []

(C) MNSE [] Reg.Egnr. []

(D) MNIQS [] Reg.QS []

5. Telephone number (Optional) _____

SECTION TWO

1. WHAT IS THE LEVEL OF AWARENESS OF ALTERNATIVE MATERIALS FOR CONSTRUCTION PROJECTS IN EDO STATE?

Please indicate your agreement with your level of awareness of the following types of alternative materials that can be adopted for construction project using the following scale: 1 = Very unaware, 2 = unaware, 3 = moderate, 4 = Aware, 5 = Very aware

S/N	ALTERNATIVE MATERIALS	1	2	3	4	5
1	Bamboo					
2	Compressed earth blocks					
3	Rice husk					
4	Palm kernel shells and fibre					
5	Coconut husk and coir fibre					
6	Laterite (stabilised earth)					
7	Hemp (Kenaf)					
8	Earth/mud					
9	Plant-based thatch					
10	Recycled steel					
11	Sheep wool					
12	Asbestos fibre					
13	Sisal fibre					
14	Stone dust					
15	Periwinkle shell					
16	Groundnut shell					
17	Bagasse boards					
18	Recycled plastic					

SECTION THREE

2. WHAT IS THE LEVEL OF ADOPTION OF ALTERNATIVE MATERIALS FOR CONSTRUCTION PROJECTS IN EDO STATE

Using the scale below, kindly indicate your agreement with the level of adoption of the following alternative construction materials in Edo State: 1 = Very High, 2= High, 3= Moderate, 4 = Low, 5= Very low

S/N	ALTERNATIVE MATERIALS	1	2	3	4	5
1	Bamboo					
2	Compressed earth blocks					
3	Rice husk					
4	Palm kernel shells and fibre					
5	Coconut husk and coir fibre					
6	Laterite (stabilised earth)					
7	Hemp (Kenaf)					
8	Earth/mud					
9	Plant-based thatch					
10	Recycled steel					
11	Sheep wool					
12	Asbestos fibre					
13	Sisal fibre					
14	Stone dust					
15	Periwinkle shells					
16	Groundnut shells					
17	Bagasse boards					
18	Recycled plastic					

SECTION FOUR

3. WHAT ARE THE FACTORS INFLUENCING THE ADOPTION OF ALTERNATIVE MATERIALS FOR CONSTRUCTION PROJECTS?

Using the scale below, kindly indicate your level of agreement with the factors influencing the adoption of alternative materials for construction projects.

1 = Strongly Agree, 2= Agree, 3 = Neither agree nor disagree 4 = Disagree, 5 = Strongly disagree

S/N	FACTORS	1	2	3	4	5
1	Cultural and perception issues					
2	Lack of public awareness and education					
3	Absence of Strong Government Policies and Standards					
4	Weak Industrial and Processing Infrastructure					
5	Cost Challenges and Lack of Scale					
6	Technical Challenges and Skill Gaps					
7	Supply Chain Limitations					
8	Safety and Durability Concerns					
9	Resistance to change					
10	Economic instability					
11	Inadequate research and development					
12	Perception of inferior quality					
13	Client and market demand					
14	Poor standardization of materials					
15	Corruption in procurement processes					
16	Lack of industry collaboration					
17	Building codes and standards					
18	Lack of Economic incentives and taxes					