Impact of Traditional Building Techniques on Modern Construction in Southeastern Nigeria

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ABSTRACT

This study investigates the incorporation of traditional building techniques in modern construction practices in Southeastern Nigeria with the aim of promoting cost efficiency, sustainability, and the preservation of the region's architectural heritage. The research explores the integration of traditional elements in contemporary construction. A qualitative research design with case studies and observational analysis were employed; examining six buildings across the five states in Southeastern Nigeria: Enugu, Abia, Anambra, Ebonyi, and Imo. The selected buildings showcased the diverse traditional construction techniques of the Igbo speaking people of the south-east Nigeria. Purposive sampling technique was used to select the case studies that exemplify the use of indigenous materials and traditional methods in modern constructions. Data collection methods included building assessments, photographic documentation, and field observations. Findings reveal the resilient benefits of incorporating traditional building techniques while highlighting challenges such as labor intensity, maintenance requirements, and the need for modernization. The study concludes that integrating traditional building techniques with modern construction practices is vital for creating a sustainable, culturally relevant, and cost-efficient built environment in Southeastern Nigeria. Recommendations focus on a hybrid approach that integrates traditional wisdom with modern standards to foster sustainable development in the region.

Keywords: Traditional building techniques, South-Eastern Nigeria, sustainability, cultural heritage, modern construction

INTRODUCTION

Traditional building techniques have been practiced for centuries across various regions of the world, reflecting unique cultural, environmental, and socio-economic contexts. These techniques utilize locally sourced materials and construction methods passed down through generations, resulting in diverse architectural styles and forms [1]. Similarly, the built environments in South-East Nigeria also are deeply rooted in the

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region's traditional building techniques, environmental conditions, social structures, and cultural practices. These methods, though sustainable and culturally significant, face decline due to the dominance of modern construction materials such as concrete and steel [2]. South-East Nigeria region is the indigenous cultural homeland of the Igbo people. This region, dating back over 250,000 years showcases a population deeply connected to its cultural heritage that has sustained distinct architectural traditions that prioritize functionality, cultural expression, and environmental adaptability [3]. Scholarly studies such as [4] and [5] highlight the use of local materials, such as mud, bamboo, and thatch, which are readily available and well-suited to the tropical climate. These materials provide natural insulation, reduce the need for artificial heating and cooling, and are cost-effective for the local population. Many of the traditional construction methods involved skilled local artisans, thereby fostering job opportunities, and supporting the local economy. Traditional methods, such as the use of earth-based materials like mud and adobe, also demonstrate the potential for sustainable practices, effectively utilizing natural resources and passive design strategies [6]. Wattle and Daub is a method that involves creating a framework of woven bamboo or wooden sticks (wattle), which is then covered with a mixture of mud and straw (daub). This technique is commonly used for constructing walls [7] Adobe Construction involves molding mud into bricks or blocks, which are then dried and used to build walls. These walls are thick and provide excellent thermal insulation [8]. Circular and rectangular buildings; typical traditional Igbo houses often have circular layouts, which are symbolic and functional, allowing for efficient use of space and easier construction. Rectangular layouts are also common, especially in modern adaptations. Bamboo is used for structural frameworks due to its strength and flexibility. Timber, especially from palm trees, is utilized for beams and supports in roofing structures. Thatch, made from palm fronds or local grasses, is commonly used for roofing. It provides excellent insulation against the tropical heat and is readily available in the region. In certain areas, stone is used as a foundation material or for building more durable structures, especially in places prone to flooding. Community-based construction process, often communal with family and community members coming together to build or repair homes fosters a strong sense of community and shared responsibility is usually employed [9]. These indigenous methods of construction have demonstrated sustainable and climatically responsive designs, offering ecological and socio-cultural benefits that modern construction often overlooks [10]. Though the traditional building techniques which evolved to suit the region's climate, resources, and cultural practices hold valuable insights into sustainable construction, rapid urbanization and globalization have led to a decline in their use, resulting in structures that often fail to meet the environmental and cultural needs of the local population [11]. Existing studies have explored various dimensions of traditional building techniques, emphasizing their environmental suitability, cost-effectiveness, and cultural relevance. However, these literatures primarily focus on the preservation of these methods rather than their integration into modern construction frameworks. Limited research addresses how these traditional techniques can be systematically adapted for contemporary urban and rural development demands, leaving a critical gap in understanding their potential role in achieving sustainable development goals. By integrating traditional building techniques with modern construction techniques, it is possible to create eco-friendly structures that retain cultural significance while meeting contemporary standards. The prevailing reliance on imported materials, such as concrete, steel, and glass, which are costly, less environmentally sustainable, and frequently unsuitable for local contexts, underscores the challenges of this shift [12]. However, the architectural landscape of South-Eastern Nigeria is undergoing a significant transformation as traditional methods give way to modern construction practices. This shift raises concerns about the erosion of cultural identity, sustainability, and the socio-economic impact of abandoning locally adapted architectural approaches [13]. Even though the traditional building techniques offer a wealth of insights into sustainable and culturally aligned construction practices, the increasing dominance and impacts of modern construction materials and methods cannot be ignored especially as it concerns sustainability and cultural heritage preservation [14]. By investigating how these traditional methods can be adapted and integrated into modern frameworks, this study aims to bridge the gap between heritage and contemporary demands, fostering a construction industry that respects cultural identity while addressing environmental and socio-economic challenges. Furthermore, the study's findings can guide the viability: these insights may inform policy reforms, promote training and capacity-building initiatives, and encourage collaboration among industry professionals and local communities. The study will also provide a foundation for creating a built environment that is sustainable, culturally significant, and responsive to the aspirations of the local population in South-Eastern Nigeria. Similarly, the findings can lead to reduced environmental impact and carbon footprint, directly benefiting the region by fostering sustainable development and climate resilience.

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The study Area

The South-Eastern region of Nigeria, dominated by the Igbos, sometimes referred as Ibos are one of the largest single ethnic groups in Africa. It encompasses five states: Abia, Anambra, Ebonyi, Enugu, and Imo, making up to 17% of the Nigerian population. The region is enriched with solid minerals and natural resources such as crude oil, natural gas, bauxite, iron ore sandstone, coal, clay, tin and columbite. Precisely, the study focuses on selected states in Southeastern Nigeria, particularly in areas known for their rich architectural heritage and ongoing construction activities that incorporate traditional techniques. The key locations include: (a) Nsukka (Enugu State) – known for its indigenous earth-building techniques, (b) Arochukwu (Abia State) – Recognized for historic wooden and clay structures, (c) Awka (Anambra State) – A hub for both traditional and modern construction innovations, (d) Afikpo (Ebonyi State) – Features vernacular architecture with mud and thatch techniques and (e) Orlu (Imo State) – Exhibits a blend of traditional and contemporary building styles.

Figure 1 Study Area: map showing Africa, Nigeria & the 5 eastern states within Nigeria

RESEARCH METHODOLOGY

Research Design

This study employs a qualitative research design with a focus on case studies and ethnographic analysis. The qualitative approach was selected for its capacity to provide rich, contextual insights into architectural construction practices, focusing on the interplay between tradition and modernity [15].The research adopted an exploratory and descriptive approach allowing for an in-depth examination of how traditional building techniques integrated into contemporary construction methods and modern practices can coexist; highlighting their practical applications and outcomes. This approach was adopted for its ability to provide contextual insights into the multifarious issues surrounding unification and amalgamation of different building techniques and periods in the specific context of south southeastern region of Nigeria [16]. The study population focuses on architectural practices and construction in South-East Nigeria. Purposive sampling was employed to select six case study buildings from the population of study. This non-probability sampling method was chosen because it allows for the deliberate selection of buildings that were accessible for inquiry and analysis and representing construction projects that exemplify incorporation and unification of traditional techniques in modern constructions buildings in the south-east Nigeria. The selection criteria include: (a) Use of Indigenous materials such as laterite, bamboo, palm fronds, adobe bricks etc, (b) traditional construction methods still in practice: rammed earth/adobe, wood framing, natural fasteners etc (c) Integration of traditional elements into modern buildings, and (d) Case studies representing various building types (educational, residential, commercial, religious). A total of 6 case studies were selected, consisting of 2 traditional buildings preserved

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in their original state, 2 modern buildings incorporating traditional techniques, and 2 hybrid structures undergoing renovation with traditional elements.

Data Collection Methods

Data collection in this study primarily relied on photographic documentation and Google Maps analysis, supplemented by on-site inspections conducted where feasible. These methods were chosen to accommodate accessibility constraints while ensuring comprehensive data for analysis [17]. Photographic documentation served as the primary tool for capturing traditional building materials and techniques, other architectural features, focusing on façades, layouts, and decorative elements of the selected case studies. This method provided a visual archive of traditional design elements integrated into contemporary private and public buildings, ensuring relevant and detailed data for analysis [17, 18]. Google Maps analysis was employed to examine spatial arrangements, site orientation, and surrounding contexts of the buildings. This approach offered an alternative means of observation for sites where on-site inspections were not feasible, providing valuable insights into the products of the amalgamation of traditional and modern building techniques practices. On-site inspections were conducted at accessible locations, enabling detailed observations of material choices, structural adaptations, and decorative details [17.19]. These inspections enriched the visual and spatial data obtained from photographs and Google Maps, contributing to a nuanced understanding of the subject of the study. This combination of data collection methods provided a robust framework for addressing the research objectives, ensuring that the study captured both tangible and spatial aspects of the interplay between traditional and modern building techniques in Nigerian architecture [20].

Data Analysis

The data collected were analyzed using thematic analysis and spatial comparative evaluation. These methods were chosen for their ability to extract meaningful insights and identify key patterns in the integration of traditional architectural elements into modern designs [21] This method involved systematically identifying recurring elements such as material use and techniques, decorative motifs, and spatial arrangements within the visual and spatial data [18]. The Information from building assessments, field observations, and available literature are coded to identify key themes and patterns related to the use and incorporation of traditional building techniques in modern construction. Themes such as cultural symbolism, sustainability, and adaptation to modern construction contexts were identified and categorized, offering structured insights into the integration of traditional building features and techniques, into contemporary architectural designs and construction [22]. Data was analyzed through coding key themes from case studies. Codes such sustainability, cost-effectiveness, craftsmanship preservation were categorized into broader themes, allowing for comparative analysis across projects. Spatial comparative evaluation was employed to assess the relationships between the selected buildings and their surrounding urban environments. Google Maps and photographic documentation were analyzed to identify patterns in site orientation, landscape integration, architectural styles, materials, structural techniques and interplay between traditional and contemporary elements [16, 17 and 19]. Together, these analytical approaches provided a comprehensive understanding of how indigenous construction techniques and architectural practices have been preserved and adapted in contemporary building methods in both rural and urban contexts.

Ethical Considerations and Limitations

The study prioritizes ethical norms, including privacy and consent, cultural sensitivity, and data protection**.** Ethical protocols were integral to both online and on-site data collection methods. For online sources, all images, records, and data were properly attributed to respect intellectual property rights [19]. In cases where on-site observations were feasible, permissions from building owners or relevant authorities were obtained to ensure ethical access [15]. The study also adheres to local cultural norms, particularly when documenting or analyzing historically and culturally significant structures, ensuring that indigenous knowledge and traditions are approached with respect and sensitivity. The study's limitations include a sample size of 6 case studies**,** which may not fully represent the diversity of traditional and modern construction practices across the entire Southeastern region of Nigeria [23]. Access restrictions may limit detailed interior assessments, affecting the comprehensiveness of some evaluations [24]. Additionally, the study captures a specific point in time**,**

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meaning that ongoing changes in construction trends, material availability, or environmental conditions may not be fully accounted for in the analysis.

RESULTS

Type A: Use of Indigenous Materials

Case Study 1: Community Primary School, Likke Iheaka, Nsukka

Figure 3: satellite location of school building source: google map

Figure 4: school building source: google map

Description: The Community Primary School in Likke Iheaka, Nsukka, demonstrates the integration of wattle and daub technique for sustainability and promotes cultural heritage, and structural resilience in educational infrastructure. The school buildings are constructed using locally sourced burnt clay bricks, known for their thermal efficiency, durability, and environmental benefits. These bricks enhance indoor comfort by reducing heat transfer, minimizing the need for artificial cooling and, consequently, lowering energy consumption. The school is a bungalow structures with rectangular floor plan, designed to facilitate natural ventilation and daylight penetration.

Construction Technique: The walls were constructed with 225mm thick burnt clay bricks (375mm at corners) for structural strength and thermal insulation. Flat timber members with perpendicular bracing for structural support with long span roofing sheets supported by timber structural members. Wall Openings were Aluminum-framed casement windows with ventilation panels above for improved airflow and single swing metal doors, often incorporating ventilation panels.

Energy Efficiency: The thermal properties of clay bricks reduce reliance on mechanical cooling, leading to energy savings and lower operational costs.

Preservation of Heritage: The use of traditional construction materials retains local architectural identity and supports the community's heritage. The availability of clay within the region minimizes the carbon footprint by reducing transportation emissions and promoting resource efficiency. The school buildings have shown remarkable resilience over time, with minimal maintenance required compared to modern cement-based structures. The durable nature of burnt clay bricks ensures long-term structural integrity.

Remarks: This case study highlights the sustainable and culturally responsive attributes of locally sourced materials. Despite their age, the buildings remain structurally sound, exemplifying the longevity and low-maintenance benefits of clay-brick construction. Future interventions should focus on targeted renovations rather than complete reconstruction, ensuring the preservation of these sustainable architectural practices.

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Case Study 2: A Housing Project Nzam, Anambra State

Figure 5: satellite location of a building in Nzam, Anambra.

Source: google map

Figure 6: Image emphasizing the roofing.
Source: author's field work

Description: This housing project in Nzam, Anambra State, was developed as an affordable housing initiative using Wattle and daub which involves the use of locally available materials, significantly reducing construction costs while promoting sustainability and traditional craftsmanship. The housing unit is a bungalow structure designed to provide cost-effective and functional living spaces.

Construction Techniques: Built with minimal depth, given the lightweight nature of the structure. The use of mud bricks and thatch roofing resulted in approximately 40% cost savings, making the project affordable for lower-income families. Walls were constructed using mud bricks, which offer natural thermal insulation. The roof system was thatched roofs supported by timber structural members; traditional and cost-effective. Wall Openings were Timber-framed casement windows with ventilation panels for improved airflow; with single swing timber doors, often with ventilation panels to enhance cross-ventilation.

Energy Efficiency: Similar to most case studies in Anambra, this project emphasize eco-friendly construction practices by utilizing low-carbon, locally sourced materials. The materials require less energy to produce compared to modern alternatives like concrete and steel, contributing to a lower environmental footprint. While cost-effective, the use of thatch roofing presents challenges in long-term durability and maintenance. However, the materials require frequent replacements and treatment to prevent pest infestations and fire hazards. Ensuring modern safety standards while maintaining affordability remains a key challenge for future adaptations of this construction method.

Preservation of Heritage: By sourcing materials and labor locally, the project stimulated the local economy, created employment opportunities, and preserved traditional craftsmanship skills.

Remarks: This case study illustrates Circular and Rectangular Layouts, illustrating typical traditional Igbo houses, which are symbolic and functional, allowing for efficient use of space and easier construction. Rectangular layouts are also common, especially in modern adaptations. The economic and environmental benefits of traditional building techniques are also highlighted. However, practical challenges in durability and maintenance are of great concern.

Type-B: Modern Buildings Incorporating Traditional Techniques

Case Study 3: Ezi-Urom Ota Community Center, Ebonyi State.

Figure 7: Satellite image showing building Figure 8: image showing community center

Source: Google image

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Description: This case study examines a community center that integrated a circular layout community-based construction and traditional Igbo wooden carvings and motifs into its architectural design. The project successfully blends cultural heritage with modern functionality, creating visually appealing spaces that serve both aesthetic and practical purposes. The structure is a single-story building, designed for multi-functional community use.

Construction Techniques: The walls are constructed with 225mm thick clay bricks, ensuring thermal insulation and structural durability. The carved walls act as a medium to passing down traditions, ensuring continuity for future generations. Gable roofs made of corrugated zinc sheets, supported by timber structural members in moderate to good condition. Ceilings are constructed with flat timber members arranged consistently, supported by thicker perpendicular bracings. Structural elements such as lintels and roof members remain visible and stable, but some sections may require regular maintenance to maintain durability. Wall Openings comprises combination of traditional timber-framed casements and modern aluminum-framed glass casements with double-swing timber doors, often featuring carved wooden panels with intricate designs.

Energy Efficiency: The use of clay bricks reduces environmental impact, as they are locally sourced and require less energy to produce compared to modern materials.

Preservation of Heritage: Symbolisms like motifs reflect cultural beliefs, spiritual practices, and local identity, reinforcing community values. **Culture and economic significant** wooden carvings evidenced in this building illustrate historical events, myths, and everyday life, preserving oral traditions through visual art. However, some of wooden carvings require periodic maintenance to prevent degradation due to humid weather conditions. Similarly, by utilizing locally sourced materials and labor, the project stimulated the local economy, created job opportunities, and supported traditional craftsmanship techniques.

Remarks: This case study highlights the fusion of culture and modern design in a sustainable and economically beneficial manner. While most structures remain in good condition, periodic maintenance of wooden carvings, roofing, and window systems is recommended to enhance both functionality and longevity. Future adaptations of this approach should consider protective treatments for building elements to ensure long-term preservation without compromising cultural integrity.

Type B: Modern Buildings Incorporating Traditional Techniques

Case Study 4: Obonne Guest House, Aba

Fig 9 showing satelite image of the building

fig 10 image showing bricks used in building

Description: This case study is a single-story guest house with a rectangular layout, evolving a central courtyard that serves both functional and social purposes. It exemplifies sustainable design principles of Adobe traditional technique involving the molding of mud into bricks or blocks, which are then dried and used to build walls. These walls are thick and provide excellent thermal insulation. The project not only reduced negative environmental impacts but also enhances economic growth and cultural preservation.

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Construction Techniques: Constructed with handmade clay bricks, reflecting local craftsmanship and providing thermal efficiency suited for the regional climate. The damp-proof course (DPC) height varies, adapting to topographical changes, ensuring structural stability. Some Structural elements were reinforced slabs and timber roof members; some showing visible signs of wear. Corrugated asbestos roofing sheets were supported by timber structural members**.** The ceiling was mainly flat timber members supported by thicker perpendicular bracings, though in poor condition and requiring maintenance. The wall openings were timber-framed casement windows with glazed panels for improved daylight penetration and single- acting swing timber doors with architraves and ventilation panels to enhance airflow.

Energy Efficiency: Traditional handmade clay bricks reduced the carbon footprint associated with production and transportation, Strategic natural ventilation design minimized the need for artificial cooling. Furthermore, the east-west orientation of the building optimized passive cooling.

Preservation of Heritage: The guest house's layout included multi-functional spaces that served as meeting points for cultural and social gatherings; reinforcing community ties. The project also created jobs for local artisans, builders, and material suppliers. It also encouraged increased tourism thereby boosting the local economy. The involvement of local artisans in brick-making and other traditional construction techniques ensures sustainability for future generations.

Remarks: This case study highlights the successful fusion of Adobe traditional building technique to promote sustainability, cultural preservation, and economic development. Though the core structure remains sound, there is need for thorough and regular inspections, particularly the the roof and structural elements to enhance durability while maintaining its traditional character.

Type C: Hybrid structures undergoing renovation with traditional elements

Case Study 5: A Residential Building In Imo State

Figure 11 showing satellite location of the site

Figure 12 image showing timber framing used in modern construction

Description: This case study is one-story timber-framed house constructed in a rural community, utilizing locally harvested hardwood for durability and structural stability. It demonstrates the integration of traditional building techniques with modern construction methods. The project successfully preserved cultural heritage while ensuring sustainability through the use of locally sourced materials and eco-friendly design principles.

Construction Technique: Walls are constructed of timber framing with clay infill, enhancing thermal insulation and reducing energy demands. The house relies entirely on durable, locally sourced hardwood using traditional methods such as mortise and tendon joints. This reduces reliance on imported materials, lowering construction costs and environmental impacts. Suspended floor slabs and ceilings consist of timber structural members. Wall openings included casement windows with Single-acting swing doors with glazed panels above for additional lighting and natural ventilation complemented the window designs.

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Energy Efficiency: The integration of natural ventilation and insulation techniques compensated for artificial cooling and heating. Clay walls provide excellent thermal efficiency, maintaining indoor comfort.

Preservation of Heritage: The project engaged local artisans skilled in timber framing, creating employment opportunities and supporting the preservation of craftsmanship. The house design reflects historic timber construction techniques, ensuring that traditional knowledge is passed down to future generations.

Remarks: This case study highlights the successful adaptation of traditional timber-framing techniques for modern needs, ensuring structural integrity, cultural preservation, and economic benefits. While the building remains structurally stable, regular inspection and treatment is recommended for timber elements to extend their longevity and improve safety.

Case Study 6: Nike Resort, Enugu State

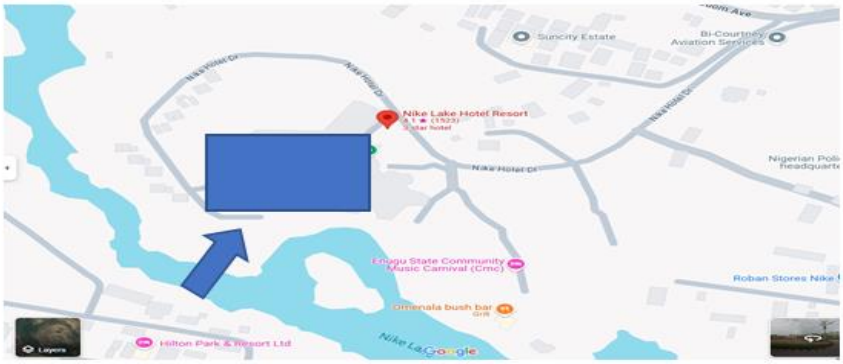

Figure 13. Showing the satellite location of the site

Figure14. Showing the circular traditional layout with thatch roofing.

figure 15. Showing the circular traditional layout with thatch roofing

Description: This case study examines the outdoor relaxation centers in Nike Resort, a hospitality and cultural retreat in Enugu State that integrates circular and rectangular layouts with modern thatch roofing, drawing from traditional Igbo architectural influences. The design successfully merges heritage elements with contemporary construction techniques, creating an eco-friendly and culturally immersive experience. The resort consists of multiple single-story structures designed for lodging, dining, and cultural exhibitions. **Construction Technique:** Circular and rectangular Layout with Modern Thatch Roofing. The dwarf walls were constructed with 300mm-thick laterite earth bricks, offering superior thermal insulation and natural aesthetic appeal. The uninterrupted wall openings ensure cross-ventilation while maintaining cultural aesthetics. Half doors crafted from solid hardwood, featuring hand-carved Igbo motifs that depict folklore, community life completes the cultural narratives. The ceilings were exposed wooden rafters with bamboo infill, arranged in a radial pattern to support the thatch roof structure. The roof covering is simply, a modern thatch of treated palm fronds, reinforced with an underlying bamboo framework ensuring longevity and improved resistance to decay. The combination of circular and rectangular layouts reflects traditional Igbo residential patterns, emphasizing communal living and open interaction. The carved doors and architectural motifs embody Igbo cultural beliefs, spiritual practices, and local artistic expressions.

Energy Efficiency: By using locally sourced materials such as laterite bricks, bamboo, and palm fronds, the project supports local craftsmen, builders, and artisans, thereby stimulating the regional economy. The use of natural thatch roofing reduces reliance on industrial materials and enhances thermal comfort, Laterite bricks require minimal energy to produce, making them an eco-friendlier alternative to cement blocks.

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Maintenance Considerations:

- Though thatch roofing is durable, periodic re-thatching is necessary to prevent water infiltration and maintain insulation properties.
- Exposed timber doors and ceiling rafters require protective coatings to guard against termite attacks and weather degradation.
- Laterite bricks have excellent load-bearing capacity but may require occasional surface sealing to prevent erosion from rainwater.

Remarks: Nike Resort stands as an exemplary model of how traditional Igbo construction techniques can be successfully integrated into modern hospitality architecture. By balancing cultural authenticity with modern functionality, the resort serves as both a tourist attraction and a symbol of sustainable heritage preservation. Future adaptations of this approach should explore bio-based preservatives for timber elements and enhanced drainage systems to improve structural longevity while maintaining the resort's ecological and cultural integrity.

DISCUSSION

Structural Integrity and Current Conditions of Traditional Construction

The case studies conducted in Enugu State and Anambra State highlight the structural performance of traditional buildings, emphasizing both strengths and weaknesses. Adobe and clay-brick constructions, commonly used in older buildings, demonstrated significant thermal efficiency and structural stability [4, 9 and 14]. However, maintenance challenges such as erosion and water susceptibility were observed in structures that lacked stabilization treatments [2, 13 and 25]

For example, Case Study-1 on adobe brick houses in Nsukka, Enugu State indicated that when properly maintained, traditional materials can outperform modern alternatives in terms of durability. However, Case Study-4, Obonne Guest House, Aba, Abia State which assessed wattle and daub structures, showed significant deterioration due to exposure to rain and poor maintenance, supporting the earlier findings of [20, 59] to the fact that traditional structures require frequent maintenance to remain viable and effective.

Factors Influencing the Adoption of Traditional Construction Methods

Structural Durability and Maintenance

The longevity of traditional buildings depends largely on material selection, maintenance practices, and environmental exposure. Clay and adobe structures provide excellent insulation and sustainability benefits, but their durability is enhanced when combined with modern stabilizers like lime or cement [21, 23 and 24]. Case Study-5, which examined a bungalow mud-brick building in Anambra, demonstrated that stabilization significantly improves resistance to environmental degradation. However, Case Study-4, which evaluated untreated adobe building techniques, highlighted rapid deterioration, aligning with the findings of Eze J [2] that unprotected mud structures require extensive maintenance.

Cost-Effectiveness and Local Economic Impact

One of the primary advantages of traditional construction is its cost-effectiveness. Findings from Case Study-2 in Anambra revealed that locally sourced materials reduce construction costs by approximately 40% compared to conventional concrete structures. This result is in consonance with the findings in studies of [20, 21 and 29], who noted that traditional construction reduces dependency on imported materials while boosting local economies. However, availability constraints of traditional materials in urban areas pose a significant challenge. For instance, Case Study-4 found that builders had to import traditional building components from rural areas, which increased project costs. This is consistent with the findings in the studies of [30, 31 and 48]

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that urbanization is leading to material shortages and the decline of skilled artisans proficient in traditional techniques.

Cultural Preservation and Community Engagement

Traditional construction techniques are deeply embedded in cultural heritage and community engagement. The Igbo concept of "Igba Ndu", a communal building process, was observed in Case Study-3: Ezi-Urom Ota Community Center, Ebonyi State, where local artisans and community members collaborated on constructing a mud-brick house, promoting knowledge transfer and social cohesion [16, 21, 24 and 28].

However, integrating traditional methods into modern urban housing developments poses regulatory challenges. Case Study-5, which investigated contemporary housing projects in Imo State, revealed that traditional construction often does not meet zoning and safety regulations. This observation supports the findings by Nwoke P [11] that existing policies often limit the application of traditional techniques in formal urban planning.

Impacts of Traditional building techniques on Modern Architecture

Adaptive Reuse and Sustainability

Modern architecture is increasingly incorporating traditional techniques to enhance sustainability. Case Study-3 in Ebonyi State demonstrated that buildings with adobe and clay-brick walls had superior thermal performance and lower energy costs, supporting Kim et al. [26, 32, 37 and 44], who posited that traditional materials play a crucial role in passive cooling and sustainability. Additionally, Case Study-1 revealed that incorporating circular and rectangular layouts inspired by Igbo architecture optimized space utilization and structural stability, aligning with the advocacy of Oluwakiyesi [9] and others [13, 28 and 33] for hybrid construction approaches that merge traditional and contemporary techniques.

Challenges in Integration with Modern Systems

Despite their benefits, traditional construction methods often struggle to meet modern building codes. Case Study-4, which examined a hybrid construction project in Aba, found that stabilized mud-brick walls offered excellent insulation but failed to meet fire resistance and load-bearing requirements, limiting their applicability in high-rise buildings. This echoes with the works of [20, 45], who stressed the need for material innovations to improve compatibility with modern safety regulations.

The Future of Traditional Methods in Urban Development

The continued relevance of traditional construction methods in urban areas depends on ongoing research and policy reform. Case Study-5, which analyzed an experimental hybrid project using stabilized earth blocks with reinforced concrete, demonstrated that combining traditional and modern techniques can improve sustainability while meeting regulatory standards. This aligns with the findings of [5, 43 and 49] who emphasized the potential of engineered bamboo and stabilized earth blocks in modern construction. These case studies confirm that traditional construction techniques offer significant sustainability, economic, and cultural benefits. However, barriers such as material shortages, regulatory constraints, and environmental exposure hinder their widespread adoption in modern urban centers. Advancements in material science, supportive policies, and enhanced research will be crucial in bridging the gap between tradition and modernity in South-Eastern Nigerian construction.

CONCLUSION AND RECOMMENDATIONS

This study provides valuable and comprehensive insight into how traditional building techniques in South-Eastern Nigeria can inform modern construction practices. Through case studies and observational analyses, it is evident that traditional methods, such as Wattle and Daub, Adobe Construction, Circular and Rectangular Layouts, and community-based construction, offer substantial benefits in terms of energy efficiency, cost-

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effectiveness, and cultural preservation. However, challenges such as labor intensity, maintenance requirements, material limitations, and regulatory constraints were also identified. Despite these challenges, the study underscores the enduring value of traditional construction methods in modern architecture. The potential benefits, ranging from cost savings and sustainability to cultural preservation make them indispensable in contemporary construction. By bridging the gap between traditional and modern methods, this research contributes to the promotion of sustainable and culturally relevant construction practices in the region.

The findings underscore that traditional materials and methods, when thoughtfully integrated with modern construction techniques and technologies, can lead to more sustainable, cost-effective, and culturally appropriate built environments. Future researches should explore innovative ways to enhance the structural integrity of traditional materials while maintaining their ecological and economic advantages. This highlights the need for a balanced approach that preserves architectural heritage while addressing the demands of contemporary building standards and sustainability goals. Based on the study's findings, the following recommendations are advocated:

- Government educational policy makers and architectural institutions should work towards preserving traditional building techniques by incorporating them into educational curricula and training programs for architects, builders, and other construction workers.
- Propagate the integration of traditional materials such as clay and mud bricks with modern techniques involving reinforced structures and waterproofing to enhance durability and sustainability of buildings.
- Invest in the development of local production facilities for traditional materials like clay bricks and mud to boost the local economy and reduce costs associated with transportation.
- Architects and building stakeholders should collaborate with local artisans to ensure that traditional techniques are effectively integrated in modern construction to safeguard cultural relevance while achieving the desired functional objectives.
- Town and regional authorities should implement policies that prioritize sustainable building practices, including the use of traditional materials, in both urban and rural development plans.

Consent

As per international standards or university standards, participants' written consent has been collected and preserved by the author(s).

Ethical Approval

The study protocol was approved by ethic review committee of the department of Architecture in accordance with the ethics guidelines and regulations of the University of Nigeria and followed the Declaration of Helsinki—principles of informed consent, voluntary participation and withdrawal, confidentiality, and privacy of the participants.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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Competing Interests

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