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Comparative Assessment of Sandcrete Hollow Blocks and Clay Bricks in Residential Building Construction: A Case Study of Ikorodu, Lagos, Nigeria

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ABSTRACT

This study presents a comparative assessment of sandcrete hollow blocks and clay bricks as walling materials in residential building construction in Ikorodu, Lagos, Nigeria. A mixed method approach was adopted, incorporating literature review, field observations, and analysis of material performance data obtained from previous experimental studies. In Nigeria, particularly in urban areas such as Lagos State, findings reveal that sandcrete hollow blocks are more widely used due to affordability and ease of production and widespread availability, while clay bricks remain an important traditional construction material known for their superior durability and mechanical strength, thermal performance. The study recommends increased promotion of clay and quality control for sandcrete block production. The study concludes that while sandcrete hollow blocks remain economically attractive for residential construction, their structural reliability depends heavily on proper manufacturing practices and quality control. Improved regulation of block production and increased consideration of clay bricks in suitable construction applications can significantly enhance the long-term performance and sustainability of residential buildings in Lagos State.

Keywords: *Sandcrete Hollow Blocks, Clay Bricks, Ikorodu, Residential building construction, Lagos*

INTRODUCTION

Background to the Study

The choice of building materials is a fundamental decision in residential construction because it affects the strength, durability, cost, and overall performance of buildings. In many developing countries, particularly in Nigeria, masonry materials such as sandcrete hollow blocks and clay bricks are commonly used for residential building construction. These materials differ in terms of composition, structural performance, durability, and thermal properties, which influence their suitability for different construction purposes.

Clay bricks, represent one of the oldest building materials used in construction. This is due to their durability and ability to withstand environmental conditions. According to LemKalli et al. (2021), clay bricks possess good mechanical properties and can provide adequate structural support when properly manufactured. They are produced from natural clay materials that are moulded and fired at high temperatures, resulting in a strong and durable building unit. Their high thermal mass also contributes to improved indoor temperature regulation, particularly in warm climates (Al-Sanea et al., 2012). Sandcrete hollow blocks, on the other hand, are widely used in Nigeria because they are relatively cheaper and easier to produce. Sandcrete blocks are manufactured from a mixture of cement, sand, and water and are moulded into hollow units to reduce weight and material usage. Studies have shown that sandcrete blocks allow faster construction and reduce the amount of mortar required during building (Akinyele & Olateju, 2018).

However, despite their popularity, sandcrete hollow blocks have been reported to exhibit certain limitations such as lower compressive strength, susceptibility to moisture penetration, and variations in quality due to poor manufacturing practices (Ede & Aina, 2020). These limitations raise concerns about their long-term performance in residential buildings, especially when compared with clay bricks. The increasing demand for affordable housing in rapidly growing urban areas such as Lagos has intensified the need for reliable and cost-effective construction materials. Understanding the performance

characteristics of different masonry materials is therefore essential for making informed decisions in residential building construction.

Therefore, this study aims to provide a comprehensive comparative assessment of sandcrete hollow blocks and clay bricks in residential building construction in Ikorodu, Lagos State. The study evaluates their mechanical strength, durability, thermal performance, and overall suitability, with a view to informing better material selection decisions that prioritize safety, sustainability, and long-term performance.

LITERATURE REVIEW

Masonry Materials in Building Construction

Masonry construction involves the use of individual units such as bricks, blocks, or stones that are bonded together using mortar. Masonry structures are widely used in residential buildings because they provide good structural strength, durability, and fire resistance. The performance of masonry walls depends largely on the mechanical and physical properties of the masonry units used. Common masonry units include clay bricks, concrete blocks, and sandcrete blocks. Each material has unique properties that influence its suitability for different construction applications. Factors such as compressive strength, thermal conductivity, durability, and cost are important considerations in selecting masonry materials. The integration of walling materials must align with broader urban goals, such as the push for affordable housing and smart city governance in Lagos. (Oduwaye, L., et al)

Clay Bricks: Composition, Manufacturing, and Properties

Clay bricks are manufactured from natural clay that is moulded into rectangular shapes and fired in kilns at temperatures typically exceeding 900°C. The firing process causes chemical and physical changes in the clay, resulting in a strong and durable building unit. Clay bricks are known for their high compressive strength, which generally ranges between 5 MPa and 20 MPa depending on the manufacturing process and clay composition. This feature makes the material suitable for load-bearing structures and long-lasting buildings (Hendry, 2001). Another important feature of clay bricks is their high thermal mass. Materials with high thermal masses have the ability to store heat during the day and release it during the night. This feature makes clay bricks suitable for buildings constructed in warm climatic regions. Clay bricks have been found to have considerable resistance to weathering and environmental degradation. This is due to their dense structure, which resists water absorption. This feature is due to the plasticity of moist clay and the ability of moist clay to set to a rigid material. This feature makes it possible to manufacture bricks with specific properties. By adjusting the constituents, such as the addition of sawdust and polystyrene, the porosity, water absorption, density, compressive strength, and flexural rigidity can be controlled (Githinji et al., 2015). However, this usually involves an increase in porosity and water absorption and a decrease in density and mechanical properties.

Sandcrete Hollow Blocks: Structure, Material Composition, and Functional Rationale

Sandcrete hollow blocks are commonly used masonry materials in Nigeria as well as other West African countries. The blocks are made from a mixture of cement, sand, and water, which is then formed to create hollow rectangular blocks. The hollow nature of the blocks minimizes the weights as well as the required materials, and at the same time, it increases construction speed due to the larger size compared to clay bricks. The compressive strength of sandcrete hollow blocks ranges from 2 MPa to 7 MPa, depending on various factors such as the cement-sand mixture. According to Oyekan and Kamiyo (2011), most of the sandcrete hollow blocks produced in Nigeria do not meet the minimum compressive strength requirement as set by building standards due to inadequate amounts of cement and poor curing methods. Another characteristic feature is the ability of sandcrete hollow blocks to absorb large amounts of water. As a result of their hollow nature, they can easily absorb moisture, which can negatively impact their durability. Despite these negative attributes, sandcrete hollow blocks are widely preferred due to their availability as well as cost. Additionally, the larger size minimizes construction time as well as labour compared to other building materials such as clay bricks. The internal structure of sandcrete hollow blocks can be modified to improve various performance parameters. For example, more rows of hollow blocks can be incorporated to improve thermal resistance by inhibiting heat flow (Wehbe et al., 2021). The design of hollow blocks is an essential engineering parameter. Compared to clay bricks, sandcrete hollow blocks have relatively lower compressive strength with more complicated failure mechanisms (LemKalli et al., 2025).

Housing Quality and Urban Development

Housing quality is an essential factor that affects building development, health, and satisfaction. Research regarding residential facilities and accommodation infrastructure revealed that building quality is an important factor that affects building occupants' satisfaction with residential areas (Ajayi et al., 2022). In addition, the importance of integrating technology, governance, and sustainability is emphasized by current urban development trends. Research regarding the development of smart cities in Lagos emphasized the importance of adopting sustainable building practices and building materials to address the issue of housing in cities (Adelekan & Akinwale, 2022). In this context, the use of digital technologies and social media platforms was identified as an emerging trend to enhance the process of urban planning and governance in Lagos State (Ogunleye et al., 2021). These developments emphasize the importance of research to ensure better decision-making regarding building development and construction.

Despite the wide usage of both materials, there is a knowledge gap in terms of localized comparative studies, which consider the practical realities of construction activities in highly urbanized environments such as Ikorodu, Lagos. Most studies on these materials tend to focus on laboratory results without adequately addressing construction quality, regulatory compliance, and economic considerations. This study attempts to bridge this knowledge gap by combining technical performance with contextual factors affecting material selection.

Statement of the Problem

The rapid growth of residential construction in Ikorodu, Lagos State, has led to increased demand for affordable and reliable building materials. In this regard, sandcrete hollow blocks and clay bricks are commonly used building materials for wall construction. Sandcrete hollow blocks have dominated the construction industry in Nigeria due to their affordability and availability; however, questions have been raised about their structural performance, especially regarding production methods and poor quality control (Oyekan & Kamiyo, 2011). On the other hand, clay bricks have been cited as having high strength and durability; however, their use is limited in contemporary construction practice (Madedor, 1983).

Research Gap

Various research works have been published on the performance of sandcrete hollow blocks and clay bricks in Nigeria. A critical analysis of the available literature reveals that most research works have been generalized or based on controlled conditions (Baiden & Tuuli, 2004). These research works have failed to reflect the reality of construction practice in rapidly growing environments like Ikorodu, where differences in production methods, climatic conditions, and workmanship greatly affect the performance of the constructed facilities.

Moreover, the research has focused more on compressive strength and cost analysis, while other relevant factors have been ignored, such as thermal properties, durability in real exposure conditions, and economic consequences in the long term (Neville & Brooks, 2010). Additionally, the empirical research on the sandcrete block manufacturing process in the study area, considering the inconsistencies in the mix ratio and manufacturing process, has been less investigated in the context of the building industry (Oyekan & Kamiyo, 2011). Another significant gap in the research on sandcrete blocks in the Nigerian building industry relates to the absence of investigations on the discrepancies between the laboratory tests and the actual field conditions. For instance, the laboratory tests have proven the suitability of sandcrete blocks in building constructions, but the actual field conditions have manifested cracks and structural weaknesses in the buildings (Ede, 2010).

Moreover, despite the proven advantages of clay bricks in building constructions, the factors limiting the use of clay bricks in the Nigerian building industry, such as in Ikorodu, have been less researched. For instance, the cost perception and the availability of clay bricks in the Nigerian market have been ignored in the context of the building industry in the study area (Raheem, Momoh, & Soyingbe, 2012). With the above gaps in the research on sandcrete blocks in the Nigerian building industry, the main aim of the research was to conduct a comparative study on the suitability of sandcrete hollow blocks and clay bricks in the building constructions in Ikorodu, Lagos.

RESEARCH METHOD

This study adopts a comparative research approach to evaluate sandcrete hollow blocks and clay bricks used in residential building construction in Ikorodu, Lagos.

Study Area

Ikorodu is in Lagos State, Nigeria, and has experienced rapid population growth and urban expansion. The area has become a major location for residential development due to relatively lower land costs compared to central Lagos Data for the study were obtained from secondary sources, including peer-reviewed journal articles, textbooks, and established building standards such as the Nigerian Industrial Standards (NIS 87:2007) and British Standards for masonry units (BS EN 771). These sources provided reliable data on compressive strength, durability, thermal performance, and material composition.

The study involves:

- Review of existing literature on masonry materials
- Comparative analysis of physical and mechanical properties
- Evaluation of cost, durability, and environmental performance

The materials were assessed based on the following criteria:

- Compressive strength
- Durability and resistance to environmental conditions
- Thermal performance
- Cost and availability

Mechanical and Structural Performance

Compressive and Flexural Strength

One of the most critical considerations in masonry construction is the ability of building units to withstand compressive and flexural loads. The compressive strength of a masonry unit decides its suitability for load-bearing applications, while flexural strength is indicative of its resistance to bending and cracking. Clay bricks, particularly those manufactured from pure or minimally modified clay, have shown compressive strengths of about 2.3 MPa, with flexural strengths around 0.21 MPa (Githinji et al., 2015). These values are sufficient for internal wall applications, and the uniformity of the stress-strain response under compression contributes to predictable load-bearing behaviour and structural safety. The failure of clay bricks under load is typically brittle, with cracks forming and propagating along regions of weakness. The uniform deformation seen in pure clay bricks assessed using techniques like Particle Image Velocimetry (PIV) reflects a high degree of internal cohesion and homogeneity (Githinji et al., 2015).

In contrast, sandcrete hollow blocks, by virtue of their internal cavities, have inherently lower compressive strengths. The presence of voids disrupts the continuity of the load path, concentrating stresses around the cavity perimeters and reducing the effective area over which loads are distributed. Empirical assessments reveal that the compressive strength of sandcrete hollow blocks can be diminished by as much as 33% compared to standard clay bricks when metamaterial-inspired modifications (such as Helmholtz resonators) are incorporated to enhance thermal and acoustic performance (LemKalli et al., 2025). While these reductions may still leave the strength within acceptable building code requirements, they need careful structural design, especially in load-bearing applications. The flexural strength of sandcrete hollow blocks is similarly compromised, as the cavities serve as initiation points for crack propagation under bending stresses. The non-uniform distribution of material and the potential for localized deformation around the hollows further worsen this limitation.

Durability and Weathering

Durability is a multifaceted attribute, encompassing resistance to weathering, freeze-thaw cycles, chemical attack, and mechanical wear. Clay bricks, owing to their dense, fired structure, generally exhibit high resistance to environmental degradation. Their low porosity (in pure form) and strong inter-particle bonding confer robustness against water ingress, freeze-thaw damage, and chemical attack provided the bricks are manufactured to standards and not excessively porous due to modifications (Githinji et al., 2015). Sandcrete hollow blocks, particularly those with large or numerous voids, are more susceptible to moisture penetration and associated degradation. The increased surface area exposed to the environment, coupled with the potential for water accumulation within cavities, can accelerate the deterioration of the block

matrix or reinforcing elements. This vulnerability is worsened in blocks with insufficiently dense or impermeable outer shells, or where cavities are not properly protected from water ingress.

In summary, while both clay bricks and sandcrete hollow blocks can be engineered for durability, the latter's structural discontinuities and increased exposure to environmental agents are a limitation compared to solid clay bricks in demanding residential applications.

Thermal Performance of Masonry Materials

Thermal performance is an important factor in residential building design, especially in tropical climates such as Nigeria. The ability of building materials to regulate indoor temperature affects occupant comfort and energy consumption. Clay bricks typically possess higher thermal mass, allowing them to absorb and store heat during the day and release it gradually during cooler periods. This process helps moderate indoor temperatures and reduce temperature fluctuations within buildings. Sandcrete hollow blocks provide moderate insulation due to the air trapped within their cavities. However, their relatively low density compared to clay bricks means that they store less heat energy. As a result, buildings constructed with sandcrete blocks may experience faster heat transfer, which can affect indoor thermal comfort.

Thermal and Acoustic Performance

- **Thermal Performance:** Clay bricks offer moderate thermal resistance (approx. 0.5 W/(mK)), relying primarily on their mass for temperature regulation (Lemkalli et al., 2025). Sandcrete hollow blocks provide inherent insulation due to the air trapped in their cavities. Innovations like the "Meta-Brick" have shown that engineering these cavities can increase thermal resistance by 8% (Lemkalli et al., 2025), while the integration of polystyrene can further enhance performance (Wehbe et al., 2021).
- **Acoustic Insulation:** Standard bricks provide effective sound attenuation due to their density. However, sandcrete blocks can be optimized with Helmholtz resonators to achieve a noise reduction of up to 20 dB across common frequency ranges (500–2500 Hz), though this again requires a trade-off in structural strength (Lemkalli et al., 2025).

Thermal Performance and Operational Energy

As discussed, the superior thermal insulation potential of sandcrete hollow blocks can contribute to reduced operational energy consumption for heating and cooling. The integration of advanced insulation or energy-harvesting features further enhances this benefit. Conversely, the lower thermal resistance of standard clay bricks may need supplementary insulation measures in regions with extreme climates. The choice between sandcrete hollow blocks and clay bricks should therefore be informed by a holistic assessment of both embodied and operational energy impacts, calibrated to the specific climatic and regulatory context of the residential project.

Limitations of Sandcrete Hollow Blocks in Residential Construction

Having proven the comparative attributes of sandcrete hollow blocks and clay bricks, it is critical to delineate the specific limitations of sandcrete hollow blocks in residential construction:

1. Reduced Mechanical Strength and Load-Bearing Capacity

Sandcrete hollow blocks, by design, have lower compressive and flexural strengths than solid clay bricks. The discontinuity introduced by internal cavities weakens the load path, increases stress concentrations, and reduces the ability of the block to resist both vertical and lateral loads (LemKalli et al., 2025). While design code compliance can be achieved through dimensional adjustments or reinforcement, these measures often offset the material and cost savings that motivate the use of sandcrete hollow blocks.

In applications where high load-bearing capacity is needed such as multi-story residential structures or walls supporting significant superimposed loads sandcrete hollow blocks may need more structural interventions (e.g., infilling, reinforcement) to ensure safety and performance.

2. Complex Deformation and Failure Behaviour

The presence of cavities within sandcrete hollow blocks leads to non-uniform deformation under load, with failure often started at cavity edges or corners (LemKalli et al., 2025). The lack of redundancy in load paths means that localized damage can rapidly compromise the integrity of the block or wall assembly. This contrasts with the more predictable, uniform failure of solid clay bricks, which aids in the assessment and mitigation of structural risks.

3. Vulnerability to Moisture and Environmental Degradation
Sandcrete hollow blocks, especially those with large or interconnected cavities, are more susceptible to moisture ingress, freeze-thaw damage, and chemical attack. Water accumulation within the voids can accelerate corrosion of embedded reinforcements or degradation of the block matrix. Effective moisture barriers, cavity drainage, and protective coatings are needed to mitigate these risks, adding complexity to construction and maintenance.

4. Trade-Offs Between Functional Optimization and Structural Integrity
Efforts to enhance the thermal and acoustic performance of sandcrete hollow blocks such as the incorporation of Helmholtz resonators, expanded polystyrene, or other insulation materials inevitably reduce mechanical strength (LemKalli et al., 2025). The optimization of block geometry for one performance parameter often comes at the expense of another, causing careful balancing of design priorities.

5. Limitations in Architectural Flexibility
While sandcrete hollow blocks enable rapid, standardized construction, their size and geometry can restrict architectural expression and customization. On-site modifications are constrained by the risk of compromising structural continuity, and the creation of complex wall geometries may require supplementary units or specialized blocks.

6. Integration Challenges for Advanced Functional Elements
Although sandcrete hollow blocks offer potential for the integration of energy-harvesting elements (Wehbe et al., 2021), the practical realization of such systems involves challenges in terms of mechanical compatibility, thermal management, cost, and maintenance. The complexity of embedding functional devices within block cavities may limit scalability or restrict adoption to specialized applications.

7. Construction Quality and Consistency
The effectiveness of sandcrete hollow block walls in delivering thermal, acoustic, or structural performance is highly dependent on construction quality. Poor alignment, inadequate mortar bedding, or improper jointing can create thermal bridges, sound leaks, or structural vulnerabilities. The larger unit size of sandcrete hollow blocks magnifies the impact of construction errors compared to smaller, more forgiving clay bricks.

Property	**Sandcrete Hollow Blocks**	**Clay Bricks**
Composition	Cement, sand, water	Natural clay (fired)
Compressive Strength	2 – 7 MPa	5 – 20 MPa
Durability	Moderate (depends on quality)	High
Water Absorption	High	Low to moderate
Thermal Performance	Moderate insulation	High thermal mass
Weight	Relatively light	Heavier
Cost	Low	Higher
Availability	Widely available	Limited in some regions
Construction Speed	Faster	Slower
Structural Reliability	Variable	Consistent

Discussion

The findings from this study reveal a clear trade-off between cost efficiency and performance reliability in the use of sandcrete hollow blocks and clay bricks. While sandcrete blocks dominate residential construction in Lagos due to economic considerations, their performance is highly variable and largely dependent on production quality. This variability introduces structural risks, particularly in cases where regulatory standards are not strictly enforced. Sandcrete hollow blocks remain the dominant masonry material used in residential construction in Lagos due to their affordability and ease of production. Their larger size also enables faster construction and reduces labour requirements, making them attractive for large-scale housing developments. The dominance of sandcrete blocks in Nigeria is largely driven by cost considerations rather than performance efficiency (Baiden & Tuuli, 2004).

However, the structural performance of sandcrete blocks largely depends on the quality of their production. Poorly manufactured blocks with low cement content may fail to meet recommended compressive strength standards, which can compromise the structural integrity of buildings. Clay bricks, on the other hand, offer several advantages in terms of strength, durability, and thermal performance. Their higher compressive strength allows them to support heavier loads and resist structural damage. Additionally, their dense structure reduces water absorption and enhances resistance to environmental degradation.

From a thermal perspective, clay bricks provide better temperature regulation due to their higher thermal mass. Buildings constructed with clay bricks may therefore offer improved indoor comfort in hot climates. Despite these advantages, the higher production cost and limited availability of clay bricks restrict their widespread adoption in many Nigerian cities. Sandcrete blocks remain the preferred option for many builders due to economic considerations. A major challenge in Ikorodu's construction sector is the lack of oversight. Recent research suggests that social media and Digital Tools can act as enablers for smart city development by providing platforms for citizens and regulators to monitor building standards and report substandard materials **(**Agboola, O., et al, 2023).

In the context of affordable housing, the reliance on sandcrete blocks is purely economic. However, the trade-off is often a reduction in thermal comfort and structural safety (Wehbe et al., 2021). By integrating better governance as seen in Lagos's smart city frameworks regulatory bodies can ensure that the "affordability" of sandcrete does not lead to "unreliability.". Occupant satisfaction in residential settings, such as student hostels in Southwest Nigeria, is deeply tied to the quality of building facilities and thermal comfort. (Adebayo, A., et al 2023)

CONCLUSION

This study has presented a comparative assessment of sandcrete hollow blocks and clay bricks as walling materials in residential construction in Ikorodu, Lagos State.The findings indicate that while sandcrete hollow blocks are widely used due to their affordability and accessibility, their structural performance is highly variable and dependent on manufacturing quality. In many cases, substandard production practices lead to reduced compressive strength and durability, which can compromise building safety. Clay bricks, in contrast, demonstrate superior performance in terms of strength, durability, and thermal efficiency. Their dense composition and resistance to environmental degradation make them a more reliable option for long-term structural stability.

However, the higher cost and limited availability of clay bricks restrict their widespread adoption in Nigeria. As a result, sandcrete blocks continue to dominate the construction industry despite their limitations. The long-term economic implications of material failure, maintenance, and energy inefficiency often outweigh the short-term cost savings associated with lower-quality construction materials. To address these challenges, stricter enforcement of quality control standards for sandcrete block production is necessary. In addition, increased investment in local clay brick manufacturing could provide a more sustainable and durable alternative for residential construction.

Ultimately, material selection in building construction should prioritize long-term performance, safety, and sustainability rather than short-term economic advantages.

RECOMMENDATIONS

1. **Enforcement of Standards:** The Standard Organisation of Nigeria should conduct regular "crush tests" on blocks sold in Ikorodu to ensure they meet the 2.5 N/mm² threshold

2. **Thermal Infill:** For sandcrete buildings, the use of expanded polystyrene or bio-based infills in hollow cores should be encouraged to improve energy efficiency
3. **Industrialization of Clay:** Government incentives for large-scale clay brick production in Lagos State could reduce costs and provide a more sustainable alternative to sandcrete.
4. **Long-term Focus:** Developers should prioritize lifecycle performance considering cooling costs and maintenance rather than focusing solely on initial material costs

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