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Original Research Article

Experimental Assessment on the Durability and Water Absorption of Locally Sourced Sandcrete Blocks

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Abstract: With the high demand for affordable housing in developing nations, locally sourced materials have become a significant focus for cost-effective and sustainable building solutions. This study investigates the durability and water absorption characteristics of sandcrete blocks made from locally sourced materials, including sharp sand, laterite, and ordinary Portland cement (OPC). Blocks were produced with a mix ratio of 1:6 (cement:sand), 1:4:2 (cement:sharp sand:laterite), and 1:3:3, respectively, maintaining a water-cement ratio of 0.5. The samples were cured for 7, 14, and 28 days and tested for water absorption, compressive strength, and visual durability under wet-dry cycles. Compressive strength at 28 days reached 4.57 N/mm² for laterite-enhanced samples compared to 3.88 N/mm² for standard sandcrete. Water absorption was 9.8% for standard mix and 7.3% for laterite mix. Blocks with laterite exhibited better durability under cyclic wetting and drying conditions. Locally sourced sandcrete blocks with laterite are suitable for low-cost housing in rural areas with moderate environmental exposure.

Keywords: Sandcrete Blocks, Experiment, Durability, Compressive Strength, Water Absorption.

1. INTRODUCTION

Affordable housing remains a persistent and critical challenge in many developing countries, including Nigeria, where rapid urbanization and population growth outpace infrastructure development and housing supply (UN-Habitat, 2016). The increasing demand for housing has necessitated the exploration of low-cost, sustainable, and locally available building materials that can be effectively utilized in both rural and urban settings (Oyenuga, 2015). Sandcrete blocks have emerged as one of the most commonly used walling units due to their relatively low cost, availability of raw materials, and moderate compressive strength (Oyekan & Kamiyo, 2011). Their simplicity in manufacturing and adaptability to local construction practices further supports their widespread use across West Africa (Agbede & Joel, 2008). Despite these advantages, concerns persist regarding the long-term performance of conventional sandcrete blocks, especially in areas exposed to high humidity, seasonal rainfall, or other harsh environmental conditions (Aguwa & Sadiku, 2011). Standard sandcrete blocks, typically composed of cement and river sand, often exhibit high porosity and poor resistance to water ingress, leading to durability issues such as efflorescence, mold growth, and structural weakening (Raheem *et al*., 2012). In response to these limitations, researchers have increasingly explored the incorporation of locally sourced alternative materials such as laterite, clay, rice husk ash, and sawdust ash into sandcrete formulations to enhance performance and reduce costs (Adesanya & Raheem, 2009; Ezeokonkwo & Akinyemi, 2014). Laterite, a soil type rich in iron and aluminum oxides, is abundant in tropical regions and has shown promise as a partial substitute for sharp sand in sandcrete production (Mustapha & Tanimola, 2013). Its fine particle size and cohesive nature contribute to reduced water absorption and improved internal bonding when properly blended with cement (Ameh & Dimas, 2018). Moreover, the presence of clay fractions in laterite can reduce capillary suction, limiting the rate of moisture ingress and enhancing dimensional stability (Olufowobi *et al*., 2014). Previous studies have also reported improvements in thermal insulation and energy efficiency when laterite is used in building blocks (Raheem & Ogunleye, 2013), making it suitable for tropical housing applications. Water absorption remains a crucial parameter in assessing the durability of masonry units, as high absorption is directly linked to reduced service life, especially under wet-dry or freeze-thaw cycling (Neville, 2011). Excessive water penetration can deteriorate the cement matrix and compromise structural integrity over time. Consequently, identifying material combinations that offer low water permeability while maintaining acceptable strength characteristics is essential for sustainable construction (Usman *et al*., 2017). The mechanical performance of sandcrete blocks is also influenced by the mix ratio, curing method, and quality of local materials used. Researchers such as Jimoh and Awe (2007) and Olanipekun *et al*., (2006) have demonstrated that modified sandcrete blocks incorporating various additives can still meet Nigerian Building Code requirements for non-load-bearing walls. Moreover, using indigenous materials like laterite supports local economies and aligns with the goals of green building by reducing transportation energy and environmental impact (Abalaka, 2012). This study builds on these findings by evaluating and comparing the performance of three sandcrete compositions using locally available materials. The research aims to determine the compressive strength, water absorption, and resistance to environmental deterioration of each formulation under simulated service conditions. Through this, the study seeks to identify practical and eco-friendly alternatives to conventional sandcrete blocks for low-cost housing in regions with moderate moisture exposure.

2. MATERIALS AND METHODS

2.1 Materials Collection

Ordinary Portland Cement (OPC), locally available sharp sand, and laterite were used in the production of the sandcrete blocks. The sharp sand was washed and sieved to remove impurities, while laterite was air-dried and pulverized to a uniform particle size.

2.2 Mix Design and Proportioning

Three sets of block mixtures were prepared:
Sample A: 1:6 cement to sharp sand.
Sample B: 1:4:2 cement, sharp sand, and laterite.
Sample C: 1:3:3 cement, sharp sand, and laterite.

A water-cement ratio of 0.5 was maintained for consistency.

2.3 Block Moulding and Curing

The blocks were molded using steel molds measuring 450 mm × 225 mm × 150 mm. After 24 hours of setting, the blocks were demolded and submerged in a curing tank. Curing periods of 7, 14, and 28 days were applied to assess strength and durability changes over time.

2.4 Laboratory Testing

Compressive Strength Test: Conducted in accordance with BS EN 772-1:2011 using a compression testing machine.

Water Absorption Test: Each sample was oven-dried to a constant weight, immersed in water for 24 hours, and then weighed again. Water absorption (%) was calculated.

Durability Test (Wet-Dry Cycle): Blocks were subjected to 5 cycles of wetting and air-drying, visually assessed for cracks, spalling, and surface degradation.

2.5 Data Analysis

Results were compiled and analyzed using SPSS for mean values, standard deviation, and graphical representation.

3. RESULTS AND DISCUSSION

Table 1: Compressive Strength Results

Sample	7 Days (N/mm²)	14 Days (N/mm²)	28 Days (N/mm²)
A (Standard)	0.82	1.59	3.88
B (Modified)	1.00	2.08	4.57
C (Laterite)	0.60	1.00	2.87

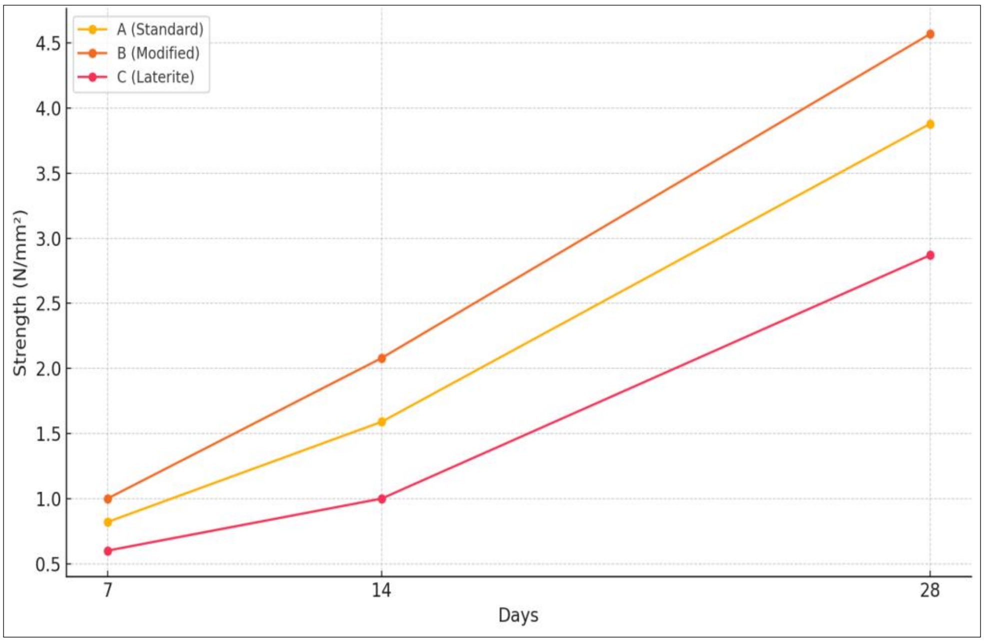

Figure 1: Compressive Strength vs. Curing Time

Blocks with modified compositions (Sample B) achieved the highest strength at 28 days, exceeding the minimum 3.5 N/mm² standard for non-load-bearing walls (NIS 87:2004).

Table 2: Water Absorption Results

Sample	Water Absorption (%)
A (Standard)	9.8
B (Modified)	7.3
C (Laterite)	6.5

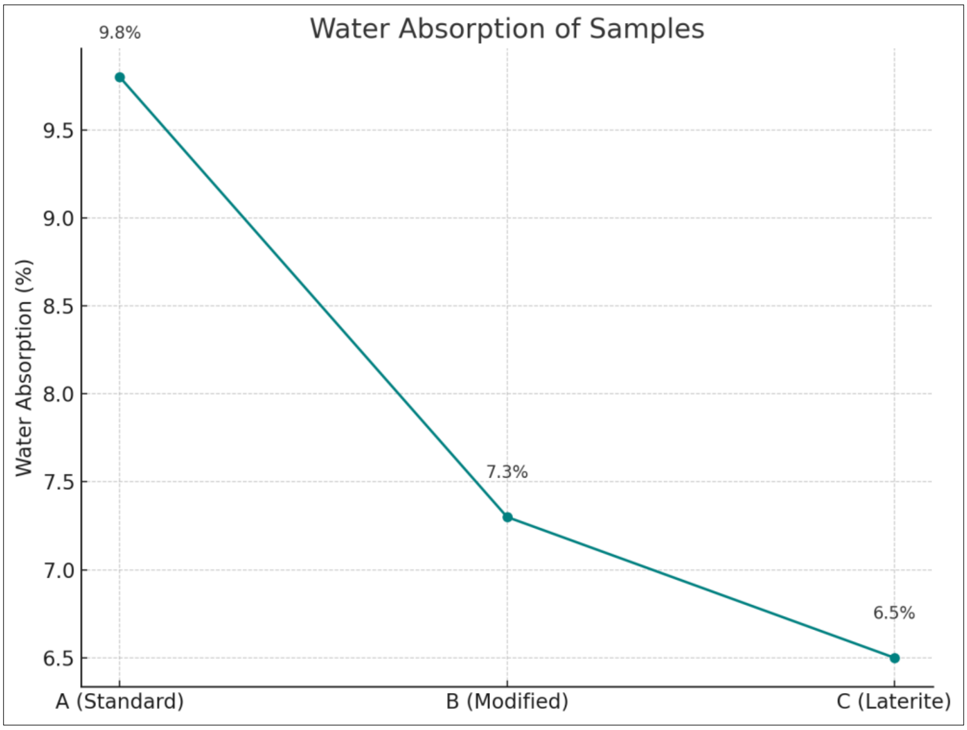

Figure 2: Water Absorption Comparison

Sample C recorded the lowest water absorption, attributable to finer lateritic particles reducing pore connectivity. This property is desirable for applications in humid or rainy regions.

4. Durability Assessment
Under 5 cycles of wet-dry testing:
Sample A: Minor surface cracking and efflorescence.
Sample B: No visible defects.
Sample C: Slight edge chipping but structurally intact.

These observations indicate that the modified blocks, especially Sample B, possess superior durability against environmental exposure.

5. CONCLUSION

This experimental study has provided valuable insights into the potential of using locally sourced materials in the production of sandcrete blocks, particularly focusing on mixtures incorporating laterite and sharp sand. The results reveal that such combinations not only meet the basic structural requirements but also offer considerable improvements in durability and water resistance compared to conventional sandcrete blocks made solely with river sand and cement. Among the tested samples, Sample B (a 1:4:2 mix ratio of cement, sharp sand, and laterite) exhibited the most favorable performance across various key indicators, including compressive strength and water absorption. The superior performance of Sample B suggests that an optimal blend of sharp sand and laterite can enhance the structural integrity of sandcrete blocks. Its compressive strength values increased significantly over the curing period, demonstrating its ability to gain strength over time in a consistent and reliable manner. Additionally, the reduced water absorption observed in Sample B implies that this mix is less permeable, which can contribute to greater longevity and resistance to moisture-related degradation, such as cracking, efflorescence, or mold growth. The practical implications of these findings are substantial, especially for regions where access to industrial building materials is limited or cost-prohibitive. By leveraging widely available and often underutilized materials like laterite, builders and developers can reduce construction costs without compromising on quality. This makes the approach particularly beneficial for rural and semi-urban communities seeking affordable and sustainable housing solutions. Moreover, the environmental benefits of incorporating laterite cannot be overlooked. Laterite is abundantly available in many tropical and subtropical regions, and its use reduces the dependence on mined river sand, which is becoming increasingly scarce due to over-extraction. Utilizing laterite in sandcrete block production thus supports environmental conservation efforts while promoting the use of indigenous resources. In summary, this study supports the broader adoption of laterite-blended sandcrete blocks in building construction. The enhanced strength, lower permeability, and cost-effectiveness of Sample B make it a promising alternative to conventional block formulations. With proper mix design and quality control, these alternative blocks can serve as a reliable building material for housing projects, particularly in areas with moderate moisture exposure. Future research could further explore long-term durability, thermal performance, and the impact of different curing methods to fully establish the viability of this sustainable construction approach.

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