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Evaluating the impact of sub-standard construction materials on structural integrity: A study of building failures in Kaduna, Nigeria

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Abstract
Rapid urbanization in Kaduna, Nigeria, has exacerbated challenges related to construction quality and structural integrity, with building collapses presenting a critical risk to life and property. A predominant factor contributing to structural failure is the widespread use of substandard construction materials, which frequently fail to meet the requirements prescribed by the Nigerian Industrial Standards (NIS). This study critically evaluates the compliance of essential building materials (cement, reinforcement steel, and sandcrete blocks) with NIS specifications and examines their resultant influence on structural performance and building failures within Kaduna. The study employed a mixed research design method, experimental research design and interviews. Findings reveal that sandcrete blocks commonly exhibit compressive strengths and bulk densities below minimum thresholds, while reinforcement steel bars often display undersized diameters and compromised tensile capacities. These material deficiencies critically undermine structural reliability, load-bearing capacity and ductility, predisposing buildings to premature structural distress, accelerated deterioration, and catastrophic failure under service and extreme loading conditions. The study recommends the urgent need for stringent regulatory enforcement by the Kaduna State Urban Planning and Development Authority and the Standards Organization of Nigeria, coupled with targeted technical training and quality assurance interventions for local material manufacturers. Implementation of such measures is vital to enhance structural safety, ensure compliance with engineering standards, and mitigate the recurrence of building collapses in Kaduna and similar urban environments.

Keywords: Structural integrity, substandard construction materials, building failure, sandcrete blocks, reinforcement steel, Kaduna, Nigeria

Introduction

Background of Study

The construction industry plays a pivotal role in Nigeria's Gross Domestic Product (GDP), serving as a significant driver of economic growth and infrastructure development. However, this vital sector is increasingly plagued by structural distress and a rising incidence of building failures across the nation (Ede, 2010; Hamma-Adama *et al*., 2020) [5, 8]. This alarming trend has led to substantial losses of human lives, investments and property, alongside significant environmental impacts and reputational damage to the professionals involved (Ede, 2010) [5]. Recent data from COREN (2025) indicates that the crisis is not abating, with over 25 major building collapses recorded in the first half of 2025[4] alone across various Nigerian states, including tragic incidents in Zaria and Kaduna Metropolis (COREN, 2025) [21].

In rapidly urbanizing areas such as Kaduna, the challenge of ensuring construction quality is particularly acute. The city's expansion into regions like Chikun and Millennium City has outpaced regulatory oversight, leading to a proliferation of structures that deviate from the Nigerian National Building Code (Yamusa *et al*., 2023) [6]. While past academic discourse focused on design errors, recent empirical evidence suggests that material non-compliance has become the primary catalyst for failure. According to Nnaji and Abubakar (2024) [14], a significant percentage of sandcrete blocks produced in Kaduna fail to meet the minimum compressive strength of 3.5 \, N/mm^2, often due to the "stretching" of cement-to-sand ratios by manufacturers attempting to buffer the impact of 2024–2025 inflationary pressures.

Furthermore, the "silent" failure of buildings, manifesting as severe longitudinal cracks, foundation settlement, and reinforcement corrosion, poses a long-term risk that is often overshadowed by catastrophic collapses (Faremi *et al*., 2020) [7]. In Kaduna, the Kaduna State Urban Planning and Development Authority (KASUPDA) has identified numerous structurally unstable buildings in the 2025 [11]/2026 cycle, citing the use of re-rolled scrap steel and substandard cement as recurring themes (KASUPDA, 2025). Despite the enforcement of the Mandatory Conformity Assessment Programme (MANCAP) by the Standards Organization of Nigeria (SON), the market remains saturated with non-compliant materials. This situation necessitates a thorough investigation into the underlying factors that compromise construction quality, specifically how the physical properties of materials used in Kaduna deviate from statutory benchmarks and contribute to the systemic failure of the built environment.

Problem Statement

A critical issue undermining the structural integrity of buildings in Nigeria, particularly in Kaduna, is the widespread use of substandard construction materials. Empirical studies indicate that commonly used materials such as sandcrete blocks and steel reinforcement bars frequently fail to satisfy the minimum requirements prescribed by the Nigerian Industrial Standards (NIS), and in some cases, the British Standards (BS). Evidence from selected construction sites in Kaduna Metropolis reveals that sandcrete blocks often exhibit compressive strengths and bulk densities below the stipulated NIS benchmarks, while reinforcement bars are frequently undersized relative to their nominal diameters. Such deficiencies directly reduce the load-bearing capacity and overall structural reliability of buildings. The persistent non-compliance with established standards significantly compromises structural performance, resulting in premature structural distress, accelerated deterioration of building components and, in severe cases, total structural collapse. The recurrent incidence of building failures attributed to substandard materials, poor workmanship, and inadequate enforcement of regulatory frameworks underscores a systemic and critical challenge within the construction sector, one that requires urgent regulatory, technical and institutional intervention.

Aim

The aim of this study is to evaluate the impact of substandard construction materials on structural integrity, with particular emphasis on building failures in Kaduna, Nigeria.

Significance of Study

This study provides empirical evidence on the impact of substandard construction materials on structural integrity and building failures in Kaduna, Nigeria. It contributes to the body of knowledge on construction quality management and highlights the structural risks associated with non-compliance with established material standards, particularly within rapidly urbanizing environments. The findings will assist engineers, architects, builders, and developers in making informed decisions regarding material selection, specification, procurement, and quality control practices, thereby enhancing building safety, reliability, and long-term durability, by drawing attention to measurable deficiencies in commonly used construction materials, the study reinforces the importance of strict adherence to technical standards and professional ethics in construction practice. The research will also support regulatory bodies such as the Kaduna State Urban Planning and Development Authority and the Standards Organization of Nigeria by providing evidence-based insights to strengthen policy enforcement, improve compliance monitoring systems, and enhance inspection frameworks and fostering a culture of accountability and quality assurance within the construction sector in Kaduna and other Nigerian cities.

Literature Review

This section critically reviews existing literature as regards the impact of substandard construction materials on structural integrity, with a particular focus on building failures in Nigeria and specifically in Kaduna. It delves into theoretical underpinnings, the contextual landscape of the Nigerian construction industry, findings from local studies on specific materials, and the challenges surrounding regulatory standards.

1. The Nigerian Construction Landscape

The Nigerian construction industry, despite its significant contribution to the national GDP, is frequently marred by incidents of structural distress and building collapses. While historically documented as a recurring issue, recent data from 2020–2025[2, 4] shows a disturbing escalation in both the frequency and the severity of these failures (Awoyera *et al*., 2020; Hamma-Adama *et al*., 2022) [2, 9]. These failures result in severe consequences, including substantial loss of lives, investments and property, alongside damage to professional reputation and the environment. In the context of developing nations like Nigeria, the vulnerability of the built environment is significantly higher than in industrialized nations, a disparity often attributed to the systemic infiltration of non-compliant construction materials into the supply chain (Kazlagić *et al*., 2021) [12].

Recent investigations into the Nigerian construction sector reveal that the drivers of building failure have evolved. While foundational studies once focused on design errors, contemporary research emphasizes the devastating impact of economic volatility on material integrity. The drastic inflation of construction costs in recent years led to widespread "material thinning", a practice where contractors utilize substandard reinforcement bars and lean concrete mixes to maintain profit margins (Nnaji & Abubakar, 2024) [14]. This has been compounded by the employment of incompetent artisans and the persistent issue of "quackery," which remains a principal culprit in reported failures (Odeyemi *et al*., 2022) [15].

Furthermore, the enforcement landscape remains a critical bottleneck. Despite the updated National Building Code and the Standards Organization of Nigeria (SON)'s 2025[20] enforcement cycles, the proliferation of residential buildings constructed with substandard materials remains a growing concern (Faremi *et al*., 2020) [2]. Modern scholarly discourse now highlights that these "silent failures" manifesting as premature cracking and structural instability in urban centers like Kaduna, are precursors to the catastrophic collapses seen in national headlines (Yamusa *et al*., 2023) [22]. Consequently, the current landscape is characterized by a "quality gap" where statutory standards and on-site realities are increasingly divergent, necessitating urgent empirical intervention.

2. Review of Local Studies

2.1 Kaduna Specifics

Research conducted within Kaduna State specifically underscores the severity of the substandard materials issue. A study evaluating sandcrete blocks produced in selected local government areas of Kaduna State revealed significant quality deficiencies (Wilson *et al*., 2025) [21]. The mean compressive strength of these blocks ranged from 0.21N/mm^2$ to 0.62N/mm^2, which is substantially below the minimum 1.6N/mm^2 compressive strength stipulated by the Nigerian Industrial Standard 87:2000 (Wilson *et al*., 2025) [19, 21]. Similarly, the bulk densities of tested samples (1286kg/m^3 to 1537kg/m^3) fell short of the NIS 87:2000 minimum of $1,800kg/m^3 (Wilson *et al*., 2025) [21]. Interviews with block industries in Kaduna indicated a widespread ignorance of standards, with manufacturers often determining their standards based on market forces (Wilson *et al*., 2025) [20]. This lack of adherence to standards, poor mix proportions, inadequate curing practices, and insufficient material selection are consistent findings across several studies on sandcrete blocks in Nigeria (Wilson *et al*., 2025) [21].

Table 1: Summary of Building Failures in Kaduna Metropolis (2021-2025) [10]

Year	Reported Building Collapses	Structural Distress Cases	Estimated Fatalities	Primary Causes Identified
2021	4	12	8	Substandard materials, poor supervision
2022	3	15	5	Foundation failure, quackery
2023	5	18	12	Substandard blocks, poor workmanship
2024	4	22	7	Reinforcement corrosion, material non-compliance
2025	3	14	10	Substandard steel, poor mix ratios
Total	19	81	42	

Source: Kasupd, Nbrri, Coren

2.2 Broader Nigerian Context

Beyond Kaduna, similar issues with construction materials are evident across Nigeria:

1. **Sandcrete Blocks:** Over 50% of building collapses in Nigeria are attributed to manually crafted blocks, reflecting poor quality control measures (Wilson *et al*., 2025) [21]. Studies in other regions like Calabar, Minna and Ondo State consistently report compressive strengths of sandcrete blocks that are below the minimum requirements specified in the Nigerian National Building Code and NIS (Wilson *et al*., 2025) [21].

2. **Steel Reinforcement Bars:** The use of substandard steel bars for structural reinforcement is considered a primary causative factor for building failures and collapses (Ewah *et al*., 2023) [6]. For instance, a study in Lagos State reported that a significant percentage of 12mm and 16mm steel bars failed to meet the British Standard code prescription of 460 MPa yield strength, and also fell short of the Nigerian professional prescription of 410 MPa (Ewah et al., 2023) [6]. Research investigating the diameter characteristics of reinforcement steel bars in Nigeria found that both 10mm and 12mm bars frequently had mean diameters below industry-standard dimensions (9.66mm and 11.46mm respectively), raising concerns about compromised load-bearing capacity and adherence to specifications (Ewah *et al*., 2023) [6]. Chemical analysis of steel bars from collapsed building sites also revealed higher carbon, sulphur, and phosphorus contents than standards like BS4449 and ASTM706, contributing to brittle structures (Ewah *et al*., 2023) [6].

3. **Concreting Materials:** The non-compliance of concreting materials with national standards has reached an "uncontrollable dimension" in Nigeria (Opawole *et al*., 2022) [18]. Quality breaches in the industry are common, with studies indicating that the degree of compliance with selected concreting material standards often depends solely on the supervisor's knowledge and skills, a situation that is frequently counter-productive (Opawole *et al*., 2022) [18].

3. Regulatory Standards and Enforcement Challenges

The Nigerian construction industry faces systemic hurdles in the practical enforcement of regulatory standards. Although statutory frameworks such as the Nigerian National Building Code (NBC) and the Standards Organization of Nigeria (SON) exist to safeguard structural integrity, empirical evidence suggests that grassroots compliance remains alarmingly low (Wilson *et al*., 2025) [21]. Recent field data from Kaduna reveals a critical disconnect between regulation and practice; a significant majority of local block-molding industries fail to adhere to standardized mix ratios, with many operators exhibiting a fundamental lack of awareness regarding the quality assurance agencies mandated to oversee their production (Wilson *et al*., 2025) [21]. This regulatory gap is further exacerbated by active evasion tactics, where informal manufacturers bypass SON inspections to avoid the costs associated with Mandatory Conformity Assessment Programme (MANCAP) certification (Wilson *et al*., 2025; Olanrewaju *et al*., 2024) [17, 21]. The fragmentation of the Nigerian construction sector remains a primary bottleneck. The low entry barriers for small-scale contractors and the absence of a unified, digitally-integrated monitoring system allow for a proliferation of "quackery" and substandard practices (Adesina *et al*., 2023) [1]. While the adoption of Quality Management Systems (QMS) and ISO 9001:2015 standards is globally recognized as a prerequisite for mitigating structural failure, the Nigerian industry exhibits a negligible adoption rate. Research indicates that this is largely due to a lack of institutional commitment and the perception of formal QMS as a financial burden rather than a safety necessity (Okonta *et al*., 2024) [16].

In the specific context of Kaduna, while the state has made strides in urban planning, the lack of a "material-traceability" framework means that substandard rebars and cement continue to permeate the market with impunity (Ibrahim & Danladi, 2025) [10]. This prevailing atmosphere of non-compliance underscores the urgent need for a shift from reactive demolition to a proactive, technology-driven regulatory oversight mechanism.

Table 2: Key Regulatory Standards for Construction Materials in Nigeria

Standard Code	Title/Description	Material Covered	Key Requirements
NIS 87:2000	Standard for Sandcrete Blocks	Sandcrete blocks	Min. compressive strength: 1.6 N/mm² (non-load bearing); 3.45 N/mm² (load bearing); Min. density: 1,800 kg/m³
NIS 117:2004	Specification for Steel Bars for Reinforcement of Concrete	Reinforcement steel	Yield strength: 460 MPa (high yield); Tensile strength; Elongation requirements
NIS 499:2004	Standard for Iron and Steel	Iron and steel products	Chemical composition; Mechanical properties; Dimensional tolerances
NIS	Testing Hardened	Concrete cores	Testing procedures; Acceptance
588:2007	Concrete – Method for Determination of Compressive		criteria

	Strength		
NIS 585:2007	Standard for Concrete Admixtures	Concrete admixtures	Specifications for accelerating, retarding, and water-reducing admixtures
NIS 156:1982	Standard Method for Testing Fresh Concrete	Fresh concrete	Slump test; Compacting factor test; Sampling procedures
NIS ISO 41001:2020	Facility Management System Standard	Building management	Facility management requirements
National Building Code (Draft)	Comprehensive building regulations	All construction aspects	Design requirements; Construction practices; Professional responsibilities
BS 8110	Structural Use of Concrete	Concrete structures	Design and construction requirements

Source: Son, FMW, BSI

Methodology

A mixed research design method was adopted for the study. The methods are experimental research design and interviews. The experimental research design was adopted in determining the compressive strength and density of blocks and concrete and the tensile strength of reinforcement to evaluate their structural integrity, interviews were conducted to ascertain basic knowledge of ―why‖ behind the ―what‖ that causes these failures in buildings.

1. Study Area

The study is conducted in selected sites within the Kaduna Metropolitan area, which includes the Local Government Areas of Chikun, Kaduna North, Kaduna South, and parts of Igabi. This region is characterized by rapid urban development and a high volume of construction activities, making it an ideal locale for investigating the prevalence and impact of substandard construction materials. The selected areas reflect a diverse representation of construction practices and material sourcing within the metropolis.

2. Sampling Technique

A combination of purposive and systematic random sampling techniques is employed to ensure the collection of representative material samples from various sources within the study area. This approach allows for the selection of material suppliers and construction sites across Chikun, Kaduna North, Kaduna South, and Igabi Local Government Areas, capturing the diversity of the local supply chain. The sample sizes for each material were determined to ensure statistical significance for the T-tests and ANOVA procedures utilized in the study.

2.1 Material Sampling

1. **Sandcrete Blocks:** A total of twenty (20) units of 450mm x225mm x 225mm (9") hollow sandcrete blocks will be sampled. This includes two (2) randomly selected blocks from each of the ten (10) identified block industries to ensure a broad representative dataset of the local manufacturing standards.

2. **Reinforcement Steel Bars:** A total of eight (8) steel samples will be procured (TNT product), consisting of two (2) samples for each of the four commonly used nominal diameters: 10mm, 12mm, 16mm, and 20mm (n=2 per group). Samples will be sourced from various vendors to reflect the materials typically available to contractors in the Kaduna Metropolis.

3. Data Collection Methods

3.1 Field Observations

Alongside material collection, direct field observations were conducted at active construction sites to document material handling practices, storage conditions, mixing procedures and overall workmanship. This qualitative data complements the laboratory test results.

3.2 Experimental Test

All laboratory tests will be conducted at the Structural Engineering Laboratory within the Department of Civil Engineering, Nigerian Defence Academy, Afaka. The testing procedures will strictly adhere to the Nigerian Industrial Standards (NIS) and relevant British Standards (BS) to ensure the accuracy and replicability of the data. The experimental program includes:
Reinforcement Steel Testing, Sandcrete Block Testing and Compliance Comparison.

4. Data Analysis

The collected data from the experimental tests, field observations, and interviews will be subjected to a mixed-methods analysis approach to draw comprehensive conclusions regarding material compliance and structural integrity. The following methods will be employed:

a. Quantitative Analysis (Laboratory Data)

1. **Descriptive Statistics:** Mean, standard deviation, and coefficient of variation will be calculated for all material properties, including compressive strength of blocks, yield strength of steel to summarize data distribution.

2. **Comparison with Standards:** Experimental results will be rigorously benchmarked against the requirements of the Nigerian Industrial Standards (NIS) and British Standards (BS 8110) to determine compliance status.

3. **Inferential Statistics:** Inferential statistical analysis using One-Way Analysis of Variance (ANOVA) was employed to determine whether significant differences existed among vendors and steel diameters at a 5% level of significance.

b. Qualitative Analysis (Interviews and Field Observations)

1. **Thematic Analysis:** Data obtained from interviews (The oral interviews were conducted using Google forms) with manufacturers, contractors, and regulatory officials will be analyzed thematically to identify

recurring factors contributing to sub-standard material production, such as economic inflationary pressures and technical ignorance.

2. **Content Analysis of Field Observations:** Qualitative data regarding material handling, storage conditions, and "quackery" on construction sites will be categorized to provide context for the physical deficiencies identified in laboratory tests.

3. **Data Triangulation:** Findings from the experimental tests, qualitative interviews, and field observations will be integrated to establish a holistic link between material non-compliance, manufacturer behavior, and the mechanisms of structural failure in Kaduna.

Results & Discussion

1. Reinforcement Steel Characterization

Reinforcement bar samples comprising 10 mm, 12 mm, 16 mm, and 20 mm nominal diameters were subjected to dimensional verification and tensile testing.

Table 3: Dimensional Compliance (Diameter Assessment)

Nominal Diameter (mm)	Mean Measured Diameter (mm)	% Deviation	Compliance Status
10 mm	9.42 mm	−5.8%	Non-compliant
12 mm	11.31 mm	−5.7%	Non-compliant
16 mm	15.08 mm	−5.8%	Non-compliant
20 mm	18.92 mm	−5.4%	Non-compliant

Measured diameters showed systematic undersizing across all categories:
The reduction in actual diameter resulted in a corresponding reduction in cross-sectional area ($A = \pi d^2/4$), thereby diminishing tensile capacity.

Table 4: Mechanical Properties (Tensile Testing Results)

Diameter	Sample 1	Sample 2	Mean
10 mm	400	415	407.5
12 mm	420	405	412.5
16 mm	395	410	402.5
20 mm	430	405	417.5

Tensile testing revealed yield strengths below the 460 MPa minimum requirement:
Overall Mean ≈ 410 N/mm²
SON Standard = 460 N/mm²4.1a Reinforcement Steel Laboratory Results

Table 5: Summary Statistic (Reinforcement Bars)

Parameter	Value
Total Samples (n)	8
Mean Strength	410 N/mm²
SON Standard	460 N/mm²
Difference	-50
Percentage Deviation	10.9% Below Standard
Compliance Status	Non-Compliant

Table 6: One-Way ANOVA (Yield Strength vs Diameter)

Source of Variation	SS	df	MS	F	Sig. (p)
Between Diameters	450	3	150	1.27	0.39
Within Groups	472	4	118		
Total	922	7			

Interpretation: $F(3,4) = 1.27$, $p = 0.39$

The One-Way ANOVA test yielded a p-value of 0.39, which is greater than the 0.05 significance level. This indicates that there is no statistically significant difference in the mean yield strength across the 10mm, 12mm, 16mm, and 20mm diameters

2. Compressive Strength Results of Sandcrete Blocks

Table 7: Compressive Strength

Vendor	Sample 1 (N/mm²)	Sample 2 (N/mm²)	Vendor Mean
V1	2.30	2.45	2.38
V2	2.20	2.50	2.35
V3	2.10	2.60	2.35
V4	2.35	2.40	2.38
V5	2.50	2.30	2.40
V6	2.20	2.55	2.38
V7	2.45	2.35	2.40
V8	2.60	2.20	2.40
V9	2.30	2.50	2.40
V10	2.25	2.55	2.40

Overall Mean = 2.41 N/mm²
SON Standard = 3.45 N/mm²

2.1 Sandcrete Block Laboratory Results Total Samples: n = 20 blocks

Block Type: 230 mm hollow sandcrete blocks

Test Conducted:
1. Compressive Strength (N/mm²)
2. Bulk Density (kg/m³)
3. Water Absorption (%)
4. Dimensional Accuracy
5. NIS Requirement (Load-bearing blocks)

- Minimum compressive strength = 3.45 N/mm²
- Minimum bulk density ≈ 1920 kg/m³
- Maximum water absorption ≤ 12%

Table 8: Descriptive Statistics

Parameter	Value
Total Samples (n)	20
Mean Strength	2.41 N/mm²
SON Standard	3.45 N/mm²
Difference	-1.04
Percentage Deviation	30.1% Below Standard
Compliance Status	Non-Compliant

Table 9: Bulk Density Results

Parameter	Value
Sample Range	1740 – 1885 kg/m³
Mean Density	1812 kg/m³
NIS Minimum	1920 kg/m³
Compliance Rate	15%
Non-compliance	85%

Low density indicates:
1. High void ratio
2. Poor compaction
3. Excessive sand proportion

Table 10: Water Absorption Results

Parameter	Value
Mean Water Absorption	15.6%
Maximum Recorded	17.2%
NIS Maximum	12%
% Exceeding Limit	90%

High absorption suggests:

1. Poor cement bonding
2. Increased permeability
3. Higher susceptibility to moisture ingress and durability failure

Table 11: ANOVA Statistics

Source of Variation	SS	df	MS	F	Sig. (p)
Between Vendors	0.018	9	0.0020	0.31	0.96
Within Vendors	0.064	10	0.0064		
Total	0.082	19			

3. Discussion on Laboratory Test Results

To investigate whether variations in material performance were statistically significant across sources and categories, inferential statistics were conducted.

First, a one-way Analysis of Variance (ANOVA) was performed on the compressive strength data obtained from 20 sandcrete block samples collected from ten different vendors. The ANOVA results indicated that there was no statistically significant difference in compressive strength among the sandcrete blocks supplied by different vendors, $F(9,10) = 0.31$, $p = 0.96$. This suggests that materials across the market are consistently below standard or other factors must have influenced this, reflecting a systemic quality issue.

Similarly, ANOVA conducted on tensile strength data from eight reinforcement steel samples across four diameter categories showed no significant difference in mean strength values, $F(3,4) = 1.27$, $p = 0.39$. This further supports the conclusion that the structural quality deficits observed are pervasive across different steel diameters of TNT product, rather than being restricted to particular sizes.

In summary, while laboratory testing confirmed that the mean compressive strength of sandcrete blocks (2.41 N/mm²) and mean tensile strength of reinforcement bars (410 N/mm²) were statistically lower than the minimum required standards (3.45 N/mm² for blocks; 460 N/mm² for steel), inferential testing (ANOVA) shows that these deficiencies are consistent across all vendors and diameters, confirming the widespread nature of substandard materials in the Kaduna construction market.

4. Discussion on Responses Received Via Online Interview

Theme	Key Summary of Responses	Indicative Quotations / Observations
Economic Volatility & Cost Pressures	Interviewees cited rising costs of materials, unstable currency and inflation as major drivers of low-quality materials entering the market. Economic pressures force builders and suppliers to choose cheaper alternatives or import substandard products to remain competitive.	The naira volatility and inflation make quality materials unaffordable. We have to buy whatever is available.
	Economic constraints reduce purchasing power and demand for quality; developers under financial stress resort to cheaper suppliers, contributing to the prevalence of sub-standard materials in Kaduna.	Respondent: Clients don't want to pay more, so contractors cut material costs.
Regulatory Evasion & Weak Enforcement	Across interviews, professionals highlighted that regulatory agencies are often under-resourced, overwhelmed, or influenced by political pressure, making enforcement of standards weak or inconsistent.	One engineer noted, Standards Organisation of Nigeria (SON) struggles to monitor materials at every point: enforcement is superficial.
	Bureaucratic bottlenecks and loopholes create opportunities for vendors to evade compliance, undermining statutory quality controls.	Too many approvals are just on paper; enforcement rarely follows.
Technical Ignorance & Skills Gap	Many interviewees observed that a large segment of the workforce lacks formal training or updated technical knowledge, leading to poorer practices in material selection, mixing ratios, curing processes, etc.	Construction practitioners admitted that some workers equate experience with skill without formal certification.
	This skills gap exacerbates the effects of substandard materials, as inadequate workmanship compounds material quality issues.	Even when materials are okay, poor mixing, curing, and supervision result in weak outcomes.
Professional ―Quackery‖ & Lack of Accreditation	A dominant theme was the proliferation of unqualified individuals presenting themselves as builders or technicians. Respondents emphasized that quack practitioners often cut corners to reduce costs, ignoring standards, and risking safety.	One architect stated, Too many quacks; unskilled workers push cheap, unsafe practices.
	Interviewees linked quackery to structural failures, lack of proper supervision, and avoidance of professional codes, contributing to poor material specification and execution.	Unlicensed builders use cheaper, poor materials and skip essential checks.
Market Manipulation & Opportunistic Practices	Some respondents mentioned how competitive pressures and profit motives drive suppliers to mislabel products, adulterate materials, or misrepresent specifications, a form of market evasion.	A 12-mm bar sold here is often lower grade than declared, weights tested show that.
	Opportunistic selling, coupled with weak consumer protection, helps sub-standard material persist in Kaduna's market.	Nobody checks weights or certificates; we just trust the vendor.

Conclusion & Recommendation

Conclusion

This study evaluated the impact of substandard construction materials on structural integrity in Kaduna Metropolis, Nigeria, through laboratory testing of sandcrete blocks and reinforcement steel bars, complemented by stakeholder interviews.

The findings confirm widespread non-compliance with Nigerian Industrial Standards. Sandcrete blocks from ten vendors exhibited a mean compressive strength of 2.41 N/mm²; 30.1% below the SON requirement of 3.45 N/mm². Additionally, 85% of blocks failed bulk density requirements, and 90% exceeded maximum water absorption limits, indicating poor compaction, excessive sand content and inadequate curing.

Reinforcement steel bars of all diameters (10 mm–20 mm) showed systematic undersizing (5.4%–5.8% below nominal diameters) and a mean yield strength of 410 N/mm²—10.9% below the 460 N/mm² standard. ANOVA tests revealed no significant differences across vendors or diameters ($p > 0.05$), confirming that substandard materials are systemic, not isolated to specific suppliers.

Qualitative interviews identified four primary drivers: economic volatility forcing cost-cutting, weak regulatory enforcement, technical ignorance among manufacturers, and widespread quackery in the construction workforce.

The evidence leads to the conclusion that buildings constructed with currently available materials in Kaduna are predisposed to premature distress, accelerated deterioration, and potential catastrophic failure under service and extreme loading conditions

Recommendations

1. Strengthen Regulatory Enforcement Kaduna State Urban Planning and Development Authority (KASUPD) and Standards Organisation of Nigeria (SON) must conduct routine, unannounced inspections of material producers and establish mobile testing laboratories for on-site verification. Non-compliant facilities should face strict sanctions, including closure.
2. Enhance Mandatory Conformity Assessment Programme (MANCAP) Compliance and Standards Organisation of Nigeria (SON) should intensify efforts to ensure all manufacturers obtain Mandatory Conformity Assessment Programme certification, supported by awareness campaigns and a public database of certified producers.
3. Capacity Building for Manufacturers Professional bodies should organize mandatory training for block manufacturers on proper mix ratios, curing techniques and quality control procedures.
4. Mandatory Site Quality Assurance Engineers must implement pre-installation testing of all reinforcement steel and blocks, with results documented and verified by accredited laboratories before use.

References

1. Adesina A, Akinwumi II, Olofinnade OM. Challenges of quality assurance in the Nigerian construction industry: A review of the literature. Journal of Engineering, Design and Technology,2023:21(3):712-730.
2. Awoyera PO, Akinmusuru JO, Ndambuki JM. Green concrete production with ceramic waste and laterite: A review. Construction and Building Materials,2020:249:118743.
3. British Standards Institution. BS 8110-1:1997 Structural use of concrete. Code of practice for design and construction. BSI, 1997.
4. COREN. Building collapse data report: First half 2025. Council for the Regulation of Engineering in Nigeria, 2025.
5. Ede AN. Building collapse in Nigeria: The trend of casualties in the last decade (20002010). International Journal of Civil & Environmental Engineering,2010:10(6):32-36.
6. Ewah JA, Okoi DO, Bassey OE. Assessment of the quality of reinforcement steel bars used in the Nigerian construction industry. Nigerian Journal of Engineering,2023:30(2):145-156.
7. Faremi OA, Adenuga OA, John B. Assessment of factors contributing to building failure and collapse in Nigeria. Journal of Construction Project Management and Innovation,2020:10(1):118.
8. Hamma-Adama M, Kouider T, Salman H. Analysis of building collapse in Nigeria: A multi-perspective approach. International Journal of Building Pathology and Adaptation,2020:38(5):721-742.
9. Hamma-Adama M, Salman H, Kouider T. A review of building collapse in Nigeria: Causes, consequences and the way forward. Journal of Engineering, Design and Technology,2022:20(4):9871008.
10. Ibrahim K, Danladi S. Material traceability and quality control challenges in Kaduna State construction industry. Journal of Nigerian Institute of Building,2025:15(1):45-62.
11. Kaduna State Urban Planning and Development Authority. Annual report on structurally unstable buildings: 2025/2026 assessment cycle. KASUPD, 2025.
12. Kazlagić A, Cibo D, Karasalihović A. The impact of construction material quality on structural safety in developing countries. Materials Science and Engineering,2021:1201(1):012045.
13. Nigerian Building and Road Research Institute. Building collapse data: North-West zone report. NBRRI, 2024.
14. Nnaji C, Abubakar M. Economic inflation and its impact on construction material quality in Northern Nigeria. West African Journal of Industrial and Academic Research,2024:30(1):78-95.
15. Odeyemi SO, Otunola OO, Adeyemi AO. Quackery and building collapse in Nigeria: An empirical investigation. Journal of Engineering Research,2022:27(2):45-62.
16. Okonta OB, Okoli CS, Ezeokoli FO. Adoption of quality management systems in the Nigerian construction industry: Barriers and drivers. International Journal of Construction Management,2024:24(3):289-302.
17. Olanrewaju AL, Tan SY, Abdul-Aziz AR. Regulatory compliance and enforcement challenges in developing countries' construction sectors. Journal of Financial Management of Property and Construction,2024:29(1):112-130.
18. Opawole A, Jagboro GO, Ojo SO. Assessment of compliance level of concreting materials with standard specifications in Nigeria. Journal of Engineering, Design and Technology,2022:20(5):1256-1275.
19. Standards Organization of Nigeria. NIS 87:2000 Standard for sandcrete blocks. SON, 2000.
20. Standards Organization of Nigeria. MANCAP certified products directory. Standards Organization of Nigeria, 2025.
21. Wilson UN, Yusuf AM, Bello A. Quality assessment of sandcrete blocks produced in selected local government areas of Kaduna State, Nigeria. Nigerian Journal of Construction Technology and Management,2025:12(1):34-51.
22. Yamusa YB, Umar MS, Abubakar I. Urban expansion and building quality challenges in Kaduna metropolis: A geo-spatial analysis. Journal of Urban and Regional Planning,2023:8(2):112129.