Enhancing Building Safety: Evaluating the Role of Regulatory Control Agencies in Mitigating Building Collapse in Nigeria"

While numerous studies have explored the causes of building collapses, there is a noticeable dearth of research examining the pivotal role that development control and regulatory agencies play in averting such incidents. This study delves into the efficacy of development control agencies in mitigating building collapses in Nigeria by scrutinizing architectural designs and monitoring construction processes. Both the design and construction phases were thoroughly investigated using a both quantitative and qualitative methodologies. The paper also utilizes a case study approach, specifically participatory observation, to assess the functions of development control agencies, a novel approach. The study also focused on documented cases of building collapses within the designated study area. Findings from the study reveal a prevalent lack of necessary approvals for most collapsed buildings. While design quality was generally acceptable, the implementation of design specifications and quality standards was found to be deficient. Consequently, this study advocates for the imposition of substantial fines, penalties and demolition on individuals or entities contravening building and construction guidelines and regulations. Furthermore, it underscores the imperative need for robust prosecution procedures targeting developers and property owners associated with collapsed buildings

Key words: Building collapse, Regulatory Agencies, Approval process, Construction Monitoring, Compliance

Introduction

The built environment is a testament to human innovation and progress, reflecting the intricate balance between architectural creativity and engineering precision. Buildings are integral to the fabric of any society, providing shelter, functionality, and cultural identity. Their safety is crucial to protect lives, maintain economic stability, and nurture thriving communities (Ibrahim, 2019). A safe built environment enhances community resilience against natural disasters, accidents, and unforeseen events (Windapo and Rotimi, 2012). Well-constructed and maintained structures can withstand earthquakes, storms, fires, and other emergencies, minimizing damage and facilitating swift recovery. Every built structure is expected to satisfy the functional objectives of safety, serviceability and economy (Ede, 2010). However, the solidity of these structures can be

compromised when essential safety measures are not diligently upheld. A building collapse occurs when a portion or the entire structure of a building fails and suddenly gives way, members caved-in, crumbled or buckled; the building can no longer stand as originally built (Akinyemi, Dare, Anthony, & Dabara, 2016). Failures in buildings can occur at any time, during their construction and after they have been inhabited.

Building collapse is a universal problem that has resulted in disruption, loss of lives and capital costs, as well as negatively affecting the image of the construction industry and its practitioners (Ibrahim, 2019; Adenuga, Osuizugbo and Imoesi, 2022). The incidents of Building collapse in Nigeria is becoming increasingly alarming, a month hardly passes by without a building collapsing in one state around Nigeria (Akinyemi, *et al.*, 2016); Effiong and Nissi, 2019). Building collapse is not limited to Nigeria or even Africa (Asante and Sasu, 2018). Building have collapse in Iran, Bangladesh, Turkey and the United State of America (Heidari, Sheikhi,and Jafari, 2019; Manik, Yardley, and Dhaka, 2013).

In the midst of numerous instances of building collapses, scholars have also shown a keen interest in identifying methods to reduce the frequency of such incidents especial in developing countries. Research conducted by individuals such as Oloyede (2010), Akinyemi *et al*. (2016), Ibrahim (2019), Effiong and Nissi (2019), Okeke, Sam-Amobi, & Okeke (2020), and Oyebode (2021), as well as Adamu, Gobi, Muhammad, Abdullahi (2023), and Orikpete & Ewim (2023), consistently attribute building collapses to the actions or inaction of development control and regulatory agencies. According to Asante and Sasu (2018), these agencies' institutional mechanisms and capacity established to prevent building collapses are severely deficient.

Although there have been many researches on building collapse in Nigeria and many developing countries, there is paucity of research on factors associated with regulatory authorities. There are

also no research that has looked into building planning, approval process, quality of design and monitoring compliance on site all together in preventing building collapse.

While numerous studies have investigated building collapses in Nigeria and other developing countries, there is a notable scarcity of research focused on the factors related to regulatory authorities. Furthermore, there is a noticeable absence of research that explores aspects such as building planning, the approval process, the quality of design, and on-site compliance monitoring in the context of preventing building collapses. This paper adopts a case study approach, specifically participatory observation, which, to the best of the author's knowledge, has not been previously employed to assess the functions of development control agencies.

This paper delves into the multifaceted responsibilities of regulatory agencies with the primary aim of preventing building collapses and ensuring building safety. It accomplishes this by scrutinizing their functions in the approval and granting of permits, conducting inspections, monitoring construction activities, and ensuring compliance with regulations. We aim to underscore the indispensable significance of these agencies in upholding the integrity of the built environment.

Development Control and Regulatory Agencies

In the complex tapestry of modern society, regulatory agencies serve as guardians of order, safety, and the public interest. According to Ibrahim (2019) regulatory agencies play a crucial role in preventing building collapses by establishing and enforcing standards, codes, and regulations that ensure the structural integrity, safety, and quality of buildings. The need for effective regulatory agencies in the realm of construction and building safety cannot be overstated.

The Nigerian Urban and Regional Planning Law, Decree No. 88 of 1992 is a detailed law and an all-encompassing one which is capable of bringing considerable development to every part of the nation if fully implemented. The 1999 Constitution of the Federal Republic of Nigeria places the

responsibility for establishing construction standards in the concurrent legislative list. This implies that building standards are determined collectively by the three levels of government, which include the Federal, State, and Local Governments. However, in the event of any discrepancies or conflicts among these standards, the federal standards take precedence. Consequently, Nigeria has established building codes, regulations, and bye-laws at both the federal and state levels, as well as at the local government level.

Nevertheless, Effiong and Nissi (2019) noted that Lagos and numerous other states have taken steps to comply with the Decree by enacting their own Urban and Regional Planning laws. However, it is crucial to acknowledge that several provisions within these laws have not been effectively put into practice or enforced across all levels of government. Consequently, this incomplete implementation has contributed to a slowdown in the nation's overall development.

The key regulatory functions of development control /regulatory agencies in preventing building collapse are;

1. Development and enforcement of building codes: Regulatory agencies create and update building codes that outline the minimum requirements for design, construction, and maintenance of structures. These codes cover various aspects such as structural integrity, materials, fire safety, electrical systems, plumbing, and more. Enforcement of these codes ensures that buildings are constructed to withstand various forces and conditions.

2. Review plan and grant building permit: Before construction begins, regulatory agencies review architectural and engineering plans to ensure compliance with building codes and regulations (Adamu *et al*. (2023). The department is supposed to have qualified personnel with integrity to expertly and diligently vet and approve the drawings (Dimuna, 2010)

3. Quality control and Material: Regulatory agencies may set standards for construction materials and methods to ensure durability and safety. They might also monitor the sourcing, quality, and installation of materials to prevent the use of substandard or defective products (Oyebode, 2021).

4. Occupancy and use inspection: After construction, regulatory agencies inspect buildings to ensure that they are safe for occupancy and that they meet all the necessary safety requirements for their intended use (Ede, 2010).

5. Education and outreach: Regulatory agencies should engage in educational activities to inform architects, engineers, contractors, and the general public about building codes, safety standards, and best practices. This helps ensure that all stakeholders are aware of their responsibilities and how to comply with regulations.

6. Investigation and enforcement: In the unfortunate event of a building collapse, regulatory agencies may conduct thorough investigations to determine the cause. Ibrahim proposed that if violations of building codes or regulations are found to be contributing factors, enforcement actions such as fines or legal actions can be taken against responsible parties.

Requirement for Building permit

Aside the land documents/proof of ownership of land these are the following documents need for building permit to be granted in Kaduna state; Architectural working drawings & details, sealed, stamped, and endorsed by the architect (all developments), a copy of the architect's professional practice, structural working drawings and structural calculation sheets & details, sealed, stamped, and endorsed by the engineer, soil investigation report (multi-story developments that exceeds three floors), letter of attestation of design, sealed, stamped, and endorsed by the engineer, mechanical & electrical working drawings & details, sealed, stamped, and endorsed by their

respective engineers (all developments), letter of responsibility of supervision by a registered professional (Builder or Civil Engineer).

METHODOLOGY

The study's aim and objectives were successfully accomplished through the utilization of a mixed research approach, incorporating both quantitative and qualitative research methods. Participant observation played a significant role in the study's methodology. George (2023) defines participant observation as a research method in which the researcher fully immerses themselves in a specific social setting or group, meticulously observing the participants' behaviors, interactions, and practices. This immersive approach allowed for the examination of various activities, such as the provision of recommendations/queries and comments following the vetting of designs (Architectural, structural, mechanical and Electrical working drawings). It also includes active participation during inspection/monitoring operations and site visits in the event of building collapses.

To support the achievement of the study's objectives, the researchers relied on records, specifically monitoring and site visit reports, sourced from the Monitoring and Compliance Department of the Kaduna State Urban Planning and Development Agency (KASUPDA), Zaria Zonal office. It's important to note that the Zaria zonal office of KASUPDA oversees six local governments, namely Zaria, Sabon-Gari, Giwa, Makarfi, Kudan, and Soba. The study was carried out between the between the period covering April 2018 and October 2022. The study also looked into the cases of building collapse that occurred within the study area within the same period. Only buildings with more than one floor were considered form the study.

FINDINGS AND DISCUSSION

Table 1 shows the outcomes of the evaluation conducted to assess the quality of design submissions for approval. During the specified period, the working drawings submitted to the monitoring and compliance department were evaluated against the minimum criteria necessary for permit approval. Among these submissions, 50.8% received approval, while the remaining 49.1% are currently pending approval and have been subject to queries.

Table 1: Building permit/ Approval and application

S/N		Frequency	Percentage
1	Approved	165	50.8
2	No-Approval	157	49.1
3	Submitted Application for Approval	321	100

Table 2 provides an overview of the reasons behind the non-approval of design submissions. To further elaborate, the designs that did not receive approval were thoroughly examined, revealing the following breakdown:

Architectural Working Drawings (52%): Most issues with architectural drawings stemmed from the absence of a registered architect's seal on the drawings and the failure to attach a valid license. Incomplete architectural drawings included missing sheets for site plans, sections, doors & window schedules, and fence design. Other deficiencies in architectural design were inadequate setback around the building, insufficient parking space, space sizes falling below the basic minimum, and disparities between the site plan and the shape/dimensions stated in the Certificate of Occupancy (C of O) or site analysis report.

Electrical Working Drawings (37.5%): Non-approval reasons for electrical working drawings encompassed incomplete submissions, such as missing power or lighting layout details, earth and lightning protection information, and CCTV/fire alarm layout. Inaccurate calculations in the distribution board (DB), as well as the absence of an Electrical Engineer's seal and practice license, were major factors contributing to non-approval.

Mechanical Working Drawings (32%): The rejection of applications was primarily due to the absence of a Mechanical Engineer's seal, and practice license, pipe sizing, and design of air containing system.

Structural Working Drawings (27%): The queries raised regarding structural drawings included the omission of structural calculations, detailing issues concerning structural members (especially slabs), and in some cases, the absence of soil tests. Soil tests were a minor cause of non-approval because they are typically required for constructions taller than two stories or in areas with unstable soil, which is relatively rare in the study area. The absence of a Civil/Structural Engineer's seal and stamp on the drawings was also noted as a significant factor. Moreover, the lack of a letter of responsibility for supervision by a Registered Civil Engineer or Builder was a leading cause of non-approval. Structural working drawings play a critical role in preventing building collapses as they outline the structural arrangement, steel reinforcement bar sizes, and spacing to be used during construction.

Table 2: Assessment of quality of design submitted

	Working Drawing	**Reason for non-approval**	**Nr**	**%**
1	**Architectural**	Incomplete working drawing, Set-back, ARCON seal and stamp, Inadequate packing space, Size of space below basic minimum size, Site layout not matching C of O	62	39
2	**Electrical**	Incomplete design, Distribution Board, Electrical-Engineer seal and practice license	33	21
3	**Structural**	Incomplete/Faulty design and calculation, Letter of attestation of design, Letter of responsibility for supervision, Soil test, Civil structural Engineer seal and stamp	28	18
4	**Mechanical**	Mechanical-Engineer seal, a-c design, pipe sizing, AC layout and design	34	22

Table 3 provides insights into the results of site visits conducted during the review period, focusing on various aspects of construction and compliance:

1. **Supervision (22%):** Only a limited number (22%) of the visited construction sites had the presence of registered professionals supervising the work. This indicates a low level of professional oversight, which is crucial for ensuring construction quality.
2. **Setback Violations (36%):** Violations related to setback regulations were observed on 36% of the visited sites. Setback violations involve buildings encroaching on required distances between structures, often disregarding the minimum setback guidelines.
3. **Alterations to Approved Designs (21%):** Alterations to the originally submitted or approved building designs were identified on 21% of the visited sites. Such modifications may lead to discrepancies between the approved plans and the actual construction.

During the site visits, the following specific structural aspects were inspected:

Column Compliance (62%): Approximately 62% of the sites demonstrated total or substantial compliance with the specified standards for columns in multi-story buildings.

Structural Beam Compliance (54%): Compliance with structural beam requirements was observed at a slightly lower rate, with 54% adherence to the prescribed standards.

Rebar Size and Spacing in Slabs (91%): A high level of conformity, at 91%, was found concerning the size and spacing of reinforcement bars (rebar) in slabs.

However, it was noted that the involvement of professionals in the management and production of buildings was generally lacking on most construction sites. This absence of professional oversight can lead to the delivery of substandard construction projects.

Setback violations were prevalent, particularly in medium and low-density areas. This could be attributed to land scarcity, which puts pressure on designers to optimize space and economize land use. Some developers also deviated from the approved plans, constructing multi-story buildings instead of the approved fences or bungalows.

Foundation depth emerged as a crucial factor for ensuring building stability. Violations related to foundations included inaccuracies in depth and reductions in the width and thickness of footings, often driven by cost-cutting measures.

Non-compliance with structural design standards was observed in columns, with rebar sizes not strictly adhering to the design specifications. Some buildings were found to lack proper structural designs altogether.

While rebar size and spacing in slabs generally demonstrated substantial compliance, non-compliance issues were related to slab thickness, often affected by cost considerations. Developers' sometimes under-reinforced beams, as steel bars are relatively easy to cut, further contributing to cost reduction efforts.

In summary, the findings from these site visits highlight the need for enhanced supervision, adherence to setback regulations, and strict compliance with structural and design standards to ensure the quality and safety of construction projects

Table 3: Monitoring of ongoing construction

		Compliance		**Non-Compliance**	
		Nr	%	Nr	%
I	Presence of registered Structural Engineer or Builder on site during visit	28	22	128	78
B	Architectural work				
I	Setback violation	59	36	105	64
Ii	Alteration of design	34	21	128	79
C	Structural elements				
I	Foundation	103	62	61	38
Ii	Rebar in column	98	61	66	40
Iii	Rebar in beam	89	54	74	46
Iv	Rebar in slab	147	91	15	9

The inspection and monitoring of construction work are governed by Section 6.v and viii of the building permit regulations, which stipulate the following:

1. Setting-Out Inspection: Developers are required to invite the Kaduna State Urban Planning and Development Agency (KASUPDA) for an inspection of the proposed development's site layout before commencing excavation.

2. Ongoing Monitoring: KASUPDA is mandated to monitor the development throughout the construction process until project completion.

Furthermore, the building permit conditions emphasize that any developer who fails to adhere to these inspection and monitoring requirements risks having their planning permission revoked or withdrawn. However, it has been observed that developers seldom invite the department for inspections as required. When construction commences, they also rarely invite the Agency or the Department of Monitoring and Compliance to oversee their construction activities. Ideally, it is the responsibility of developers, whether individuals or private entities, to invite the agency or department for inspections. During these inspections, a compliance form is typically filled out, and upon satisfactory inspection, the developer receives a certificate of stage completion, covering various construction phases such as setting out, substructure, superstructure (suspended floor), structural roofing, electrical and mechanical systems testing, and commission approval.

Regrettably, many developers seem to intentionally disregard these legal requirements. As a result, staff members of the Department of Monitoring and Compliance are often compelled to conduct unscheduled monitoring exercises to identify and inspect ongoing construction work. Ideally, the monitoring team should be able to conduct monitoring activities regularly. However, logistical challenges, including the availability of patrol vehicles, as well as the staff's dual responsibilities

of vetting designs and conducting monitoring exercises, hinder their ability to go out on these inspections as frequently as needed.

The staff members believe that the combined responsibility of vetting designs and monitoring construction can be overwhelming. They have expressed concerns that the current practice of having the same set of individuals responsible for both approving and monitoring construction projects makes the department/agency less efficient. These two activities are distinct and when carried out concurrently, they can negatively impact efficiency.

Case I: Building Collapse of a Two-Storey Building in Sabon-Gari, Zaria

i. Section of the building collapsed on 28/8/2019.
ii. The building is over 40 years old and appeared uncompleted and dilapidated.
iii. Partial collapse after rainfall, no casualties.
iv. The building had no approval.
v. Cause of collapse: Dilapidation and poor maintenance.

Case II: Collapse of a Storey Building on Nuhu Bamali Road, Gaskia Layout, Zaria

i. Occurred on September 1, 2019.
ii. The building was a single-story structure with a shop on the ground floor and a bedroom upstairs.
iii. No casualties or injuries.
iv. Observation revealed under-reinforcement, with 8mm steel bars for beams, 12mm steel bars for columns, and wide spacing (300mm) for stirrups.
v. The building had no approval.
vi. Cause of collapse: Under-reinforcement.

Case III: Anguwan Kaya, Zaria

i. Occurred on June 8, 2018.
ii. A one-storey building under construction collapsed.
iii. The second-floor slab was being cast when the collapse happened, resulting in three deaths and multiple injuries.
iv. The column buckled as the first structural member to fail.

v. The building had an application for approval in process, but construction began before approval was granted.

vi. Conclusions: No approval, defective structural members, non-adherence to design specifications, lack of professional supervision.

Case IV: New Jos Road, Zaria

i. Occurred on January 3, 2020.

ii. A one-storey building on New Jos Road. Comprised of ground floor lockup shops and first-floor flats. One person was injured.

iii. Mode of failure: Column buckling on the ground floor.

iv. Observation revealed under-reinforcement with 12mm mild steel for columns, 8mm shear links at 300mm spacing, and columns not extended from ground to upper floor.

v. Inadequate number of columns.

vi. No use of structural drawings in construction.

vii. The building lacked approval from the planning authority.

viii. A further test was conducted on the remaining member of the building. The result of the rebound hammer test result is shown below.

Column	C1	C2	C3	C4	C5	C6	C7	C8	
Average reading KN/mm	23.4	25.4	15	16.4	13.6	19.6	18.4	26.4	
Remark	Fair	Fair	Poor	Poor	Poor	Poor	Poor	Fair	

Slab	S1	S2	S3
Average reading KN/mm	29.2	18.6	22.8
Remark	Fair	Poor	Fair

Case V: Nagoyi Building Collapse

The collapse occurred on September 9, 2022, The collapsed structure was a two-storey building consisting of two-bedroom flat apartments on each floor. Prior to the collapse, repair work was initiated on some columns that exhibited signs of failure on September 8, 2022. Occupants reported hearing an unusual cracking sound from the building on September 9, prompting them to evacuate the block before it collapsed. Before the collapse On July 14, 2022, KASUPDA issued a "stop work notice" and an "Enforcement Notice" to the developer/owner based on several observations:

i. Carrying out development without an approved permit.
ii. Improper alignment of columns from the ground to the first floor.
iii. Sagging/failed staircases.
iv. Poor workmanship.

The notice also directed tenants to vacate the structures and instructed the developer to submit a structural integrity test report, which was not complied with. On July 30, 2022, the structures were marked as "not fit for habitation," and tenants were directed to vacate. A re-inspection of the site on September 1, 2022, aimed to check the compliance level of the vacation notice, which was not adhered to. The building collapsed eight days later.

This case highlights a tragic collapse resulting from a combination of factors, including unauthorized development, structural misalignment, inadequate maintenance, and non-compliance with enforcement notices. Building safety measures, such as obtaining the necessary permits, ensuring proper structural alignment, and addressing structural deficiencies promptly, are crucial to preventing such disasters.

Conclusion and Recommendation

The study looked into the role of regulatory agencies play a vital in upholding building safety standards. There was absence of necessary approvals for most collapsed buildings. While the quality of design was generally deemed acceptable, the regulatory agency lacks an adequate number of professionals to thoroughly assess drawings. Furthermore, the enforcement of design specifications and quality standards on construction sites was found to be deficient. Developers often fail to engage relevant professionals to oversee their projects. The crucial tasks of inspecting and monitoring construction work, essential for ensuring compliance with building regulations and upholding construction quality and safety, face challenges related to developer non-compliance, logistical constraints, and staff members' dual responsibilities, casting doubts on the department's efficiency.

The study's examination of building collapse cases highlights various contributing factors, including structural decay, inadequate maintenance, under-reinforcement of structural components, deviation from design specifications, absence of professional supervision, and construction without proper approvals. Building collapses can result in dire consequences, including loss of life and property damage, underscoring the paramount importance of adhering to building codes and regulations and ensuring structural integrity in construction projects. Notably, no one has faced prosecution for any building collapse incidents.

To address these issues, the study recommends a restructuring of KASUPDA, proposing the creation of a separate Building Control and Monitoring agency dedicated to overseeing construction and building activities. The current system, where the same individuals approve and monitor construction, is seen as inefficient. Additionally, the study suggests imposing significant fines on those who fail to seek approval or obtain building permits before construction and on those who possess permits but do not involve the Agency in monitoring. Furthermore, integrity tests should be conducted on dilapidated and abandoned building projects before allowing construction to resume.

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