

# Investigating the Challenges in Structural Analysis and Design Practices in Somalia: A Path toward Safer Buildings

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## Abstract

Somalia's construction sector grapples with systemic challenges threatening building safety, including fragmented regulations, unskilled labor, and sub-standard materials. Using a mixed methods approach, this study analyzes survey responses from 50 professionals and insights from 15 stakeholders to identify key structural challenges. Key findings reveal that 95% of respondents attribute safety risks to the lack of unified building codes, 85% report poor-quality concrete, and 70% cite high material costs as a barrier to compliance. Interviews with engineers, architects, contractors, and academics confirm that financial constraints, outdated training methods, and inadequate risk management exacerbate these issues. Recommendations include adopting Somalia-specific building codes, establishing a National Construction Authority, and prioritizing vocational training. This study underscores the urgency of systemic reforms to mitigate collapse risks and foster resilient infrastructure.

## Keywords

Construction Sector, Building Safety, Regulations, Unskilled Labor, Substandard Materials, Mixed Methods Approach, Structural Challenges, Unified Building Codes, Concrete Quality, Material Costs, Financial Constraints, Training Methods, Risk Management, Somalia-Specific Building Codes, National Construction Authority, Vocational Training, Infrastructure Resilience

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## 1. Introduction

Recent structural failures in Mogadishu highlight the urgency of addressing Somalia's construction challenges. In August 2023, an eight-story building collapsed in Bakara Market, killing at least three people from one family and leaving a 14-year-old girl missing. The accident, caused by weak materials and regulatory failures, mirrors past tragedies, such as the 2016 mosque collapse that killed 15 worshippers. These recurring incidents underscore the dangers posed by unregulated construction practices and substandard materials like salt-rich beach sand, which weakens concrete integrity. Addressing these issues is essential to ensuring safer infrastructure in Somalia [1].

Somalia's construction sector plays a crucial role in post-conflict recovery but remains hindered by outdated practices, political instability, and weak governance. Frequent structural failures, often worsened by natural disasters, pose severe risks to public safety and inhibit long-term development, emphasizing the need for urgent reforms. While global standards like British Standards and Eurocodes are applied sporadically, the absence of localized codes and enforcement mechanisms perpetuates unsafe practices. This results in frequent building collapse, unreliable structures, and heightened vulnerability to environmental stressors.

### 1.1. Problem Statement

The primary challenges in Somalia's construction industry include a lack of adherence to building codes, reliance on outdated practices, financial constraints, and insufficient professional training. Environmental factors such as extreme temperatures, climate change, and poor-quality control compound these issues and further complicate structural design. The absence of a centralized regulatory authority allows substandard construction practices to persist, increasing risks to public safety. In Mogadishu, rapid urbanization has overwhelmed regulatory bodies, making it difficult to enforce safety standards and resulting in the rise of unsafe multi-story buildings. In rural areas, traditional construction methods, while cost-effective, often fail to meet basic safety requirements, leaving communities vulnerable to disasters. Addressing these challenges is critical to ensuring the safety and resilience of Somalia's built environment.

### 1.2. Research Objectives

This research aims to:

- 1) Investigate the key challenges in structural analysis and design practices in Somalia.
- 2) Assess the impact of these challenges on building safety and construction quality.
- 3) Propose actionable solutions to improve compliance with building codes and enhance structural design practices.

### 1.3. Significance of Study

This research is significant for several reasons. First, it addresses a critical gap in

the literature by providing a comprehensive analysis of the challenges in structural analysis and design practices in Somalia. Second, it offers practical recommendations for policymakers, educational institutions, and industry stakeholders to improve building safety. Finally, by raising awareness about the importance of structural integrity, the study aims to foster a culture of safety and accountability in Somalia's construction industry.

#### **1.4. Structure of the Paper**

This paper is organized into the following sections:

- 1) Literature Review: A discussion of global best practices in structural analysis and design, as well as the challenges faced by developing countries, with a focus on Somalia.
- 2) Methodology: An overview of research design, data collection methods, and analysis techniques used in this study.
- 3) Results: A presentation of the key findings from surveys, interviews, and case studies.
- 4) Discussion: An interpretation of the results, including their implications for building safety and their alignment with existing literature.
- 5) Conclusion and Recommendations: A summary of the findings and actionable recommendations for improving structural analysis and design practices in Somalia.

## **2. Literature Review**

Structural analysis and design are critical components of creating safe, resilient, and sustainable infrastructure. Across the globe, standardized regulations and codes ensure that buildings and structures can withstand environmental forces and human-induced loads, safeguarding lives and property. However, while developed nations have robust systems in place, developing countries, particularly Somalia, face significant hurdles in implementing these standards. This review explores global practices, challenges in developing countries, and Somalia-specific issues in structural analysis and design.

### **2.1. Global Practices in Structural Analysis and Design**

Structural analysis and design are guided by internationally recognized standards that ensure safety, resilience, and sustainability in construction. International codes like the IBC, Eurocodes, British Standards (BS), and ASCE guidelines provide standardized best practices for material selection, load calculations, and ensuring structural integrity [2]. These regulations enable engineers to design structures capable of withstanding environmental and human-induced loads, reducing the likelihood of failures.

### **2.2. Challenges in Developing Countries**

Despite the existence of standardized building codes, many developing countries

struggle with their implementation due to various socio-economic and technological constraints. One of the primary issues is limited access to modern technology and software tools for structural analysis. Engineers often lack the resources to use advanced computational models, leading to inaccurate assessments and suboptimal designs. Furthermore, inadequate training programs contribute to a shortage of skilled professionals, further exacerbating structural safety concerns.

Financial limitations also play a crucial role, forcing developers to resort to cost-cutting measures that compromise material quality and construction standards. Research highlights that in many African nations, resistance to adopting sustainable building practices stems from concerns over increased costs and a lack of awareness about long-term benefits [3].

Building collapses due to poor workmanship and substandard materials are a common issue in many developing nations. In Kenya, over 50% of buildings in Nairobi fail to meet safety standards, according to the National Construction Authority (NCA). Many developers skip mandatory inspections to cut costs, resulting in unsafe structures. The collapse of a building in Ruiru in 2024, which led to multiple fatalities, underscores the dangers of ignoring regulations [4].

Somalia faces similar risks, particularly with low-quality cement and steel, inconsistent enforcement of building codes, and a lack of structural testing facilities. The Kenyan experience serves as a warning, emphasizing the need for stronger regulations, mandatory inspections, and material quality testing to prevent similar tragedies.

### **2.3. Somalia-Specific Challenges**

Somalia's construction sector faces unique hurdles due to political instability, economic hardship, and weak regulatory oversight. A notable issue is the lack of effective risk management practices. Research indicates that the application of risk management in Somalian construction companies is minimal, with little variation across different types and sizes of organizations. This deficiency is attributed to insufficient experience and a limited understanding of risk management principles among local entrepreneurs.

The lack of a centralized regulatory authority has resulted in haphazard compliance with international codes, as engineers selectively apply British, Euro, or American standards without alignment with Somalia's unique context. Somali engineers and developers apply various international codes—Eurocodes, British Standards, American Standards, and Indian Standards—resulting in inconsistencies in construction practices due to the lack of a unified national framework [5].

Financial constraints further impact construction quality, with many projects prioritizing affordability over safety. The use of substandard materials and inadequate structural design methodologies has led to a greater risk of building failures. A study on risk management in Somalia's construction industry found that a lack of expertise and risk mitigation strategies contributes significantly to structural vulnerabilities [6].

## 2.4. Engineering Education and Capacity Building in Somalia

Investing in education and professional training is one key solution to addressing Somalia's structural engineering challenges. After years of civil conflict, Somali universities have made significant progress in rebuilding their engineering programs. As of recent years, approximately 20 universities across Somali areas (Southern Somalia, Somaliland, and Puntland) offer engineering degrees, including civil, telecommunications, and electrical engineering.

The revival of Somali National University (SNU) and the establishment of new institutions like Mogadishu University (MU) and Gollis University (GU) demonstrate the growing emphasis on engineering education. These institutions have introduced rigorous curricula, emphasizing hands-on learning, infrastructure development, and collaboration with international universities. For instance, Hargeisa University incorporates practical training, requiring engineering students to engage in real-world construction projects, ensuring that graduates acquire practical skills necessary for the workforce.

Despite these advancements, challenges remain. Limited infrastructure, a shortage of qualified lecturers, and unstable conditions in certain regions hinder the growth of engineering programs. Moreover, some universities struggle to enroll sufficient numbers of qualified students due to gaps in secondary education [7]. Addressing these issues through government support, international collaboration, and private sector engagement is critical for the sustainable development of Somalia's engineering sector.

## 3. Methodology

### 3.1. Research Design

This study employed an explanatory sequential mixed-methods design, beginning with quantitative surveys to identify trends, followed by qualitative interviews to contextualize findings. A structured questionnaire comprising 20 Likert-scale questions and 5 open-ended prompts was distributed to 50 professionals (engineers, architects, contractors) selected via purposive sampling to ensure diverse representation across experience levels, roles, and project types. Subsequently, semi-structured interviews were conducted with 15 stakeholders, including academics and government officials, to explore emerging themes from the survey.

### 3.2. Sampling Strategy

Purposive sampling was chosen to ensure a broad representation of professionals within Somalia's construction sector, capturing insights from individuals with relevant expertise. Participants were selected based on:

- Experience: Minimum of five years in the construction industry.
- Roles: Engineers (40%), architects (30%), contractors (20%), and academics (10%).
- Geographical Representation: 70% from Banadir, 20% from Somaliland, and 10% from other regions (Puntland, Galmudug, Southwest, and Jubaland). But

most of them were present in Mogadishu (Banadir) by the time of the data collection.

The sample included professionals from varied geographic regions and project types to minimize bias, ensuring that perspectives were not limited to a single locality or sector. This approach provided a comprehensive understanding of Somalia's structural design challenges, enhancing the study's applicability to the broader industry.

### **3.3. Data Analysis**

All participants provided informed consent, and responses were anonymized to protect confidentiality. Quantitative data was analyzed using descriptive statistics (SPSS v28), while qualitative data underwent thematic coding (NVivo) to identify recurring patterns.

## **4. Results**

The survey responses and qualitative interviews have been evaluated to pinpoint principal obstacles in structural analysis and design practices within Somalia. The data collected were systematically examined to identify recurring issues, trends, and their implications on building safety.

### **4.1. Compliance with Building Codes**

According to survey responses, 70% of construction professionals have participated in projects that lack formal building code compliance. Weak enforcement mechanisms together with financial constraints and inadequate technical training create the conditions leading to non-compliance with building codes. When construction projects bypass standardized codes, the resulting inconsistencies create higher risks for structural failures. The construction failure of the Bakara Market building in August 2023, which led to several deaths resulted from inadequate structural reinforcement coupled with poor-quality building materials. Insufficient compliance with foundational and reinforcement requirements puts high-rise buildings at higher risk.

### **4.2. Financial Constraints and Material Quality**

The research results demonstrate that financial limitations lead directly to the selection of inferior construction materials. Developers choose low-quality cement, weak steel, and incorrect concrete mix ratios because 80% of them give priority to reducing costs above following safety standards. According to additional analysis, 52% of participants see high material costs as their primary economic obstacle, whereas 26% blame low client budgets and 22% point to financing accessibility limitations. Contractors face financial pressure, which leads them to skip material testing and quality control procedures, resulting in compromised structural integrity. Building safety inspection failures in Nairobi show that financial constraints result in 50% of structures using non-compliant materials.

### 4.3. Workforce Skill Deficiencies

Construction quality in Somalia faces major challenges due to the insufficient number of skilled workers. Due to the absence of formal vocational training institutions construction workers depend mainly on practical work experience instead of technical education. Construction workers face repeated mistakes in reinforcement placement as well as concrete mixing and structural alignment which damages the structural soundness of buildings. The lack of adherence to Personal Protective Equipment (PPE) protocols creates safety concerns for construction workers. The lack of proper standards requires constant monitoring which results in higher project expenses and schedule setbacks.

### 4.4. Inconsistence Application of Buildings Codes

Somali construction lacks a standardized national building code which results in a fragmented regulatory environment. Engineers and contractors select from Eurocodes, British Standards, American Standards, and Indian Standards to fit project-specific needs and manage costs. The lack of consistency creates mismatches in design features along with variable safety thresholds and unpredictable material requirements. The absence of a standardized regulatory framework makes compliance management across projects very difficult. Analysis of post-conflict states like South Sudan and Libya shows that the lack of central regulation results in extensive construction vulnerabilities.

### 4.5. Substandard Locally Available Materials

The construction sector in Somalia faces serious challenges due to low material quality standards. Limited access to better construction materials combined with their high costs drives 85% of survey participants to associate poor construction material quality with these issues. The study identifies several key deficiencies, including:

- Concrete strength declines due to the weak bonding properties of irregularly sized gravel.
- Beach sand tainted with salt increases corrosion rates in steel reinforcement bars.
- Concrete mix ratios that contain too much water lead to reduced compressive strength, which ultimately causes premature cracking. Rebars that have rusted reduce the structural support beams and columns can deliver.

The structural integrity of multi-story buildings is compromised when low-quality materials are used in their construction. High chloride content exposure in coastal regions accelerates steel reinforcement corrosion which increases the likelihood of progressive building collapse.

### 4.6. Weak Risk Management Practices

Current research shows Somalia's construction industry operates without formal risk management strategies. When construction projects skip geotechnical inves-

tigations and fail to conduct proper structural safety assessments they lead to the development of buildings with unstable foundations. The absence of load capacity analyses makes many high-risk structures vulnerable to settlement cracks and shear failures, which can lead to collapse during extreme weather conditions or seismic events.

#### **4.7. Regulatory Oversight Deficiencies**

A central organizational problem exists due to the absence of an authoritative entity that ensures adherence to safety rules. The irregular enforcement of building codes together with constrained inspection resources leads to common structural standard breaches. The quality of construction projects varies because engineers and contractors independently select building codes. Observations show similar patterns in other post-conflict nations where unrestricted building practices increase the likelihood of design errors and sustained infrastructure weakness.

### **5. Discussion**

#### **5.1. Interpretation Findings**

Systemic challenges plague Somalia's construction sector because of widespread non-compliance alongside financial limitations and insufficient workforce skills. Without standardized building regulations and sufficient regulatory oversight structural weaknesses become widespread. The examination of Kenya, South Sudan, and Liberia demonstrates that these countries face similar construction industry challenges, such as poor enforcement mechanisms, obsolete engineering practices, and dependence on inferior materials.

#### **5.2. Comparative Analysis**

South Sudan struggles with transportation network damage which interrupts the quality material supply chain. South Sudanese engineers adopt informal construction practices for their projects because formal training opportunities remain scarce. The reconstruction initiatives in Liberia encounter obstacles from antiquated engineering educational programs and budgetary limitations which reflect the difficulties Somalia meets [8] [9].

Research comparing different practices shows that construction safety will improve by adopting standardized regulations and training programs alongside international cooperation. The National Construction Authority (NCA) of Kenya established stronger regulatory oversight following building failures which could serve as a model for Somalia to follow. The Somali construction industry would benefit from enhanced compliance and better material standards through the adoption of a centralized regulatory system.

#### **5.3. Implication for Building Safety**

Research reveals that Somalia's building safety is compromised by weak enforcement and irregular safety code application which results in significant threats. The

identified deficiencies indicate an immediate requirement for:

- The study suggests implementing regulatory changes that create uniform building codes while enforcing safety measures across construction projects.
- Labor skill deficiencies require resolution through vocational training programs.
- Quality control measures aim to elevate construction material standards while stopping inferior construction methods.

## **6. Conclusion**

The structural engineering landscape in Somalia reflects both challenges and opportunities. While international building codes provide a framework for safe construction, the lack of enforcement mechanisms, financial limitations, and inadequate training continue to hinder progress. However, the recent resurgence of engineering education and capacity-building initiatives presents a promising avenue for improvement. Strengthening educational programs, investing in modern technology, and fostering regulatory compliance will be essential in ensuring sustainable and resilient infrastructure development in Somalia. Further studies are needed to explore the potential benefits of sustained regulatory frameworks and policy reforms for the overall standards of construction in Somalia, as well as their success in contributing to enhanced safety, compliance, and resilience of buildings.

## **7. Recommendations**

### **7.1. Establish a National Construction Authority (NCA)**

- The nation requires unique building regulations that address its environmental needs and socio-economic context for Somalia.
- The National Construction Authority must issue licenses to construction professionals and perform regular inspections to ensure compliance.
- Implement mandatory testing and certification processes to improve quality control standards for materials.

### **7.2. Improve Vocational Training and Workforce Development**

- Implement formal training programs focused on construction safety procedures and studies in material science.
- Develop collaborative relationships between universities and polytechnic institutions alongside industry stakeholders to improve curriculum relevance.

### **7.3. Enhance Regulatory and Enforcement Mechanisms**

- Deploy digital monitoring technologies for overseeing construction project authorization and adherence to standards.
- Apply rigorous punishments against builders who violate standards or engage in poor construction work.
- Equip municipal authorities with enhanced oversight abilities to manage con-

struction projects more effectively.

#### 7.4. Improve Material Quality and Supply Chains

- The importation and local production of high-quality materials should receive financial and regulatory incentives.
- Set up regional laboratories dedicated to testing the quality of construction materials.

#### 7.5. Foster Public Awareness and Industry Engagement

- Organize building safety awareness campaigns and implement best practice strategies.
- Incorporate local construction firms and developers into policy-making processes to secure practical solutions and widespread adoption.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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