

Beyond Technical Defects: A Mixed-Methods Analysis of the Systemic Causes of Building Collapse in Ghana

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ABSTRACT

Building collapse remains a recurring safety failure in Ghana, yet the relative weight of its causes is contested, with technical defects and institutional weaknesses each cited as primary. This study aimed to identify and rank the major causes of building collapse in Ghana. A sequential explanatory mixed-methods design was adopted, combining a PRISMA-guided systematic review of ten studies, a questionnaire survey of 114 construction professionals in Accra, Kumasi and Cape Coast, and 13 semi-structured expert interviews. Survey items were ranked using the Relative Importance Index (RII), and interview data were analysed thematically and integrated with the survey results through a joint display. The review identified six categories of causes: poor construction practices, design and engineering errors, regulatory failures, maintenance neglect, environmental factors and socio-economic pressures. In the survey, weak enforcement of building codes was the highest-ranked single cause (RII = 0.939), followed by cost-cutting pressure, rapid urbanisation, soil instability and flooding (RII = 0.918–0.926). Environmental and socio-economic items (mean RII = 0.924) and institutional items (0.806) were rated above technical items (0.750), although corruption and informal-sector dominance were rated close to the technical items. The hypothesis that causes in all categories would be endorsed was supported, while the expectation that institutional causes would outrank technical causes was supported only in part. Interviewees described collapse as a systemic failure in which weak enforcement, fragmented accountability and neglected factors such as drainage, survey accuracy and maintenance allow technical defects to be built and to go undetected. The study concludes that technical defects are the proximate causes of collapse, but their persistence is best explained by institutional and economic conditions. Prevention should therefore strengthen regulatory capacity, maintenance oversight and accountability alongside technical quality control. The exploratory sample and perception-based data limit generalisation.

Keywords: Building collapse, Ghana, Systemic failure, Building regulation enforcement, Construction safety

INTRODUCTION

Building collapses are a persistent safety failure worldwide. They range from the 2021 collapse of Champlain Towers South in Surfside, Florida (Pellecchia et al., 2024) to the Rana Plaza disaster in Bangladesh in 2013, in which more than 1,100 people died (International Labour Organization [ILO], 2023). Such failures typically follow mistakes, neglect or natural hazards that coincide with violations of sound design and construction principles (Ebekozi et al., 2023). In developing country they are compounded by deficiencies in the building delivery system, including a large and weakly regulated informal construction sector (Vondráčková et al., 2017), and by limited capacity to enforce building regulations (Asante & Sasu, 2018).

Ghana illustrates the problem. Fact-Check Ghana recorded at least 42 building collapses between 2010 and mid-2023, with about 70 deaths and 329 injuries (Badu-Nyarko, 2023), and seven buildings collapsed in Cape Coast within a single week in 2025 (Kwakye, 2025). These figures are probably underestimates because of inconsistencies in how collapses are recorded. A legal framework exists in the National Building Regulations, 1996 (L.I. 1630), but building inspectors in metropolitan assemblies such as Kumasi work with inadequate logistics and staff and are exposed to political interference that limits their ability to monitor construction (Asante & Sasu, 2018).

Despite this attention, knowledge of why buildings collapse in Ghana is uneven. Most studies examine causes one at a time (poor workmanship, substandard materials, regulatory failure) and rely on case accounts or single-stakeholder perspectives. Few compare the causes against one another using evidence from professionals across the building delivery chain, and fewer still combine such evidence with expert explanation of why the causes persist. Whether technical defects or institutional weaknesses are the more fundamental problem therefore remains unresolved. The answer matters because it determines where prevention effort and resources are directed.

This study addresses that gap by identifying and ranking the causes of building collapse in Ghana and by examining how professionals explain the relationship between technical and institutional causes. It draws on a PRISMA-guided systematic review, a survey of 114 construction professionals in Accra, Kumasi and Cape Coast, and 13 expert interviews. The study is part of a larger investigation of how Building Information Modelling (BIM) and the Internet of Things (IoT) can help prevent building collapse in Ghana; the evidence on causes is reported here in full, and the other components of the investigation are reported separately. The paper contributes (i) a structured synthesis of the causes reported in the Ghanaian and comparable literature, (ii) a professional ranking of causes that separates technical, institutional, and environmental and socio-economic factors, and (iii) an interpretation, grounded in systems and organisational accident theory, of why technical defects persist.

The remainder of the paper is organised as follows. Section II presents the theoretical perspective, reviews the literature on the causes of building collapse in Ghana, and states the study's proposition and hypotheses. Section III describes the methodology, including the systematic review procedure, sampling, instruments and analysis. Section IV presents the survey and interview findings, integrates them, and discusses them in relation to the literature. Section V sets out implications for policy, practice and research. Section VI concludes with recommendations and limitations.

Research Objective

The objective of this study is to investigate the major causes of building collapse in Ghana. It responds to the research question: What are the major causes of building collapse in Ghana? Two supporting questions guided the analysis: (a) how do construction professionals rank technical, institutional, and environmental and socio-economic causes; and (b) how do experts explain the relationship between technical and institutional causes?

LITERATURE REVIEW

Theoretical Review

A building collapse is a sudden failure of structural stability that leads to partial or complete destruction of a building; it is distinct from gradual deterioration, demolition or minor structural failure. Explaining why collapses occur requires attention to both the physical mechanisms of failure and the organisational conditions in which they arise.

Building Collapse as System Failure

Two strands of safety theory are particularly relevant. Normal accident theory holds that accidents in complex, tightly coupled systems arise from unexpected interactions among many small failures and not from a single cause (Perrow, 1999; Shahab Hosseini & Jabbarani Torghabeh, 2012). Building construction fits this description: design decisions, material supply, labour skills, regulation and the physical environment interact, and a fault in one element can propagate through others. Organisational accident theory adds that errors on site lead to harm mainly where latent failures in management, procurement, training and regulation have left the system's defences weak (Reason, 1997; Emuze & Mollo, 2020).

These perspectives distinguish proximate from underlying causes. A poorly cured column or an inadequate foundation is a proximate cause, while the conditions that allow such defects to be built, approved and left undetected are the underlying cause. This distinction frames the present study, which asks not only which causes professionals recognise but also how they weigh technical causes against institutional ones.

The Building Production System as an Analytical Lens

Following this systems view, the building production system can be considered as six interdependent subsystems: design, materials, construction, regulation, maintenance and the environmental interface. Vulnerabilities can accumulate in each subsystem, and collapse is more likely where a defect in one subsystem (for example, an inadequate foundation design) is not detected or corrected by another (for example, inspection or supervision). The lens is used in this paper to organise the causes and to interpret the findings; it is a conceptual device and is not tested as a model here. It also implies that interventions confined to a single subsystem may prove ineffective if weaknesses persist elsewhere in the system.

Empirical Review: Causes of Building Collapse in Ghana

The systematic review described in Section 3.2 identified ten studies that address the causes of building collapse in Ghana and comparable settings. Six categories of causes emerged and are summarised below with their supporting sources.

Poor Construction Practices

Poor construction practice is among the most frequently identified causes. Asante and Sasu (2018), drawing on the perspectives of building inspectors in Kumasi, note that inadequately skilled labour produces structural weaknesses, and Vondráčková et al. (2017) identify workmanship defects as a major contributor to collapse in West Africa. The use of poor-quality cement, steel and aggregate is also widely reported (Boateng, 2020).

Design and Engineering Errors

Aboagye et al., (2025) identify poor load distribution and inadequate foundation design among the main technical challenges in the region. Where such weaknesses occur in multi-storey buildings, a local failure can propagate into progressive collapse, in which the failure of one element triggers extensive or complete collapse of the structure.

Regulatory Failures

Regulatory failure creates permissive conditions in which unsafe practices persist. In Ghana, inspectors in metropolitan assemblies contend with inadequate logistics, limited staff and political interference (Asante & Sasu, 2018). In the Nigerian context, Windapo and Rotimi (2012) recommend an overhaul of planning and

building regulations and stronger enforcement of building codes, and Mrabure and Awhefeada (2021) link corruption and negligence in the issuing of permits to the emergence of unsafe buildings.

Maintenance Neglect and Ageing Structures

Olabosipo et al. (2015) show that postponed maintenance accelerates the degradation of buildings, so that neglect of existing structures can be as hazardous as poor initial construction. Asante and Sasu (2018) associate the problem in Ghana with facility managers who are inadequately trained and resourced to carry out regular maintenance.

Environmental and Natural Factors

Flooding and soil instability are recognised as contributors to collapse (Yilmaz & Marschalko, 2016; Massazza et al., 2019), and seasonal rainfall combined with ineffective drainage is thought to aggravate foundation weaknesses, particularly in informal settlements. In the reviewed studies these factors were described as intensifying existing structural weaknesses and were less frequently identified than construction, design and regulatory causes.

Socio-Economic Pressures

Boateng (2020) attributes collapse in Ghana to institutional failure in the management of urbanisation. High demand for housing in Accra and Kumasi encourages hurried construction, and profit motives may lead firms to economise on materials and supervision. Boateng (2021), using interviews and focus groups with professionals in Ghana, further argues that urban problems such as building collapse are better explained by the policy legacies that organise urban systems than by population pressure alone.

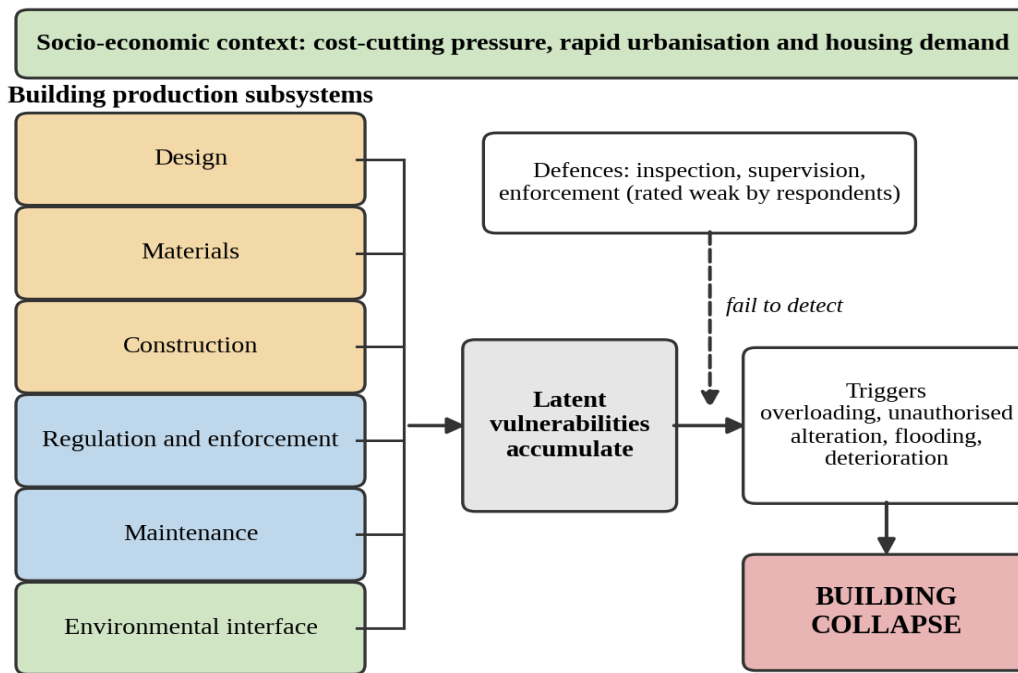
Research Gaps

Three gaps stand out. First, the reviewed studies typically examine causes one at a time, although their own descriptions show that causes interact: poor materials persist where enforcement is weak, and design errors go uncorrected where supervision is absent. Second, the evidence is largely qualitative and case-based; to the authors' knowledge the review identified no study that ranks the causes against one another using evidence from a cross-section of professionals, and behavioural and cultural factors, maintenance systems and climate-related risk remain under-studied. Third, systematic national databases of collapse events and longitudinal records of building condition are lacking, so the literature is mostly retrospective. The present study addresses the first two gaps by ranking causes from professionals' perspectives and explaining the ranking through expert interviews.

CONCEPTUAL FRAMEWORK

Drawing on the systems and organisational accident perspectives in Section 2.1, the study uses the conceptual framework in Figure 1. The building production system comprises six subsystems: design, materials, construction, regulation and enforcement, maintenance, and the environmental interface. Weaknesses in these subsystems produce latent vulnerabilities that accumulate and interact. Whether they result in collapse depends on the defences that should detect them (inspection, supervision and enforcement) and on triggers such as overloading, unauthorised alteration, flooding and deterioration. The surrounding socio-economic context, including cost-cutting pressure and rapid urbanisation, shapes the pressures acting on every subsystem.

The framework also organises the survey. Technical causes correspond to the design, materials and construction subsystems; institutional causes correspond to regulation and enforcement and to maintenance; and environmental and socio-economic causes correspond to the environmental interface and the wider context. It guides the ranking and interpretation of causes in 4.0 and is not tested here as a structural model.



Subsystems interact: a failure in one can propagate to others

Technical causes Institutional causes Environmental and socio-economic causes

Figure 1. Conceptual framework: the building production system and pathways to collapse

Source: Authors' construct, adapted from systems and organisational accident theory (Perrow, 1999; Reason, 1997).

Research Proposition and Hypotheses

The framework leads to one overarching proposition. Proposition 1 (P1): building collapse in Ghana results from the interplay of failures across several subsystems and not from any single factor. Two hypotheses make this proposition testable with the survey data.

If collapse is multi-causal, professionals should recognise causes in every category, and not only in one. This gives the first hypothesis. H1: Professionals will endorse causes in all three categories (technical, institutional, and environmental and socio-economic), so that mean ratings exceed the neutral point of 3.0.

Organisational accident theory further implies that latent institutional failures are more fundamental than the technical defects they allow (Reason, 1997; Emuze & Mollo, 2020), and the Ghanaian studies reviewed in Section 2.2 emphasise regulatory weakness. This gives the second hypothesis. H2: Professionals will rate institutional causes as more important than technical causes.

METHODOLOGY

Research Design

The study formed part of a larger investigation of BIM and IoT for building-collapse prevention in Ghana, and this paper reports the component that addresses the causes of collapse. A sequential explanatory mixed-methods design was adopted under a pragmatist paradigm: a questionnaire survey was followed by qualitative expert interviews that explained and elaborated the survey results, and the two strands were integrated at the

interpretation stage (Creswell & Creswell, 2018). A systematic literature review, conducted first, provided the conceptual base and comparative context.

Systematic Review Procedure

The review followed the PRISMA 2020 guideline (Page et al., 2021). Google Scholar was searched for publications from 2015 to 2025 using the terms “building collapse” OR “structural failure” AND “Ghana” OR “West Africa” AND “causes” OR “factors” AND “construction industry”. The ten-year window was chosen to cover foundational and recent work. Institutional repositories and grey literature, including reports from the Ministry of Works and Housing and professional bodies, were also searched. Figure 2 summarises the screening process.

The searches returned 245 records (240 from Google Scholar and five from repositories and grey literature). After 78 duplicates were removed, 167 titles and abstracts were screened and 116 were excluded because they had no transferable findings for Ghana, were unrelated to building collapse, concerned other infrastructure, or lacked empirical evidence. Of the 51 reports sought for retrieval, 10 could not be obtained, leaving 41 full texts. Thirty-one of these were excluded for insufficient methodological rigour (12, mainly opinion pieces), a lack of focus on Ghana or comparable settings (11) and limited relevance to the topic (8). Ten studies were included and were synthesised narratively by category of cause.

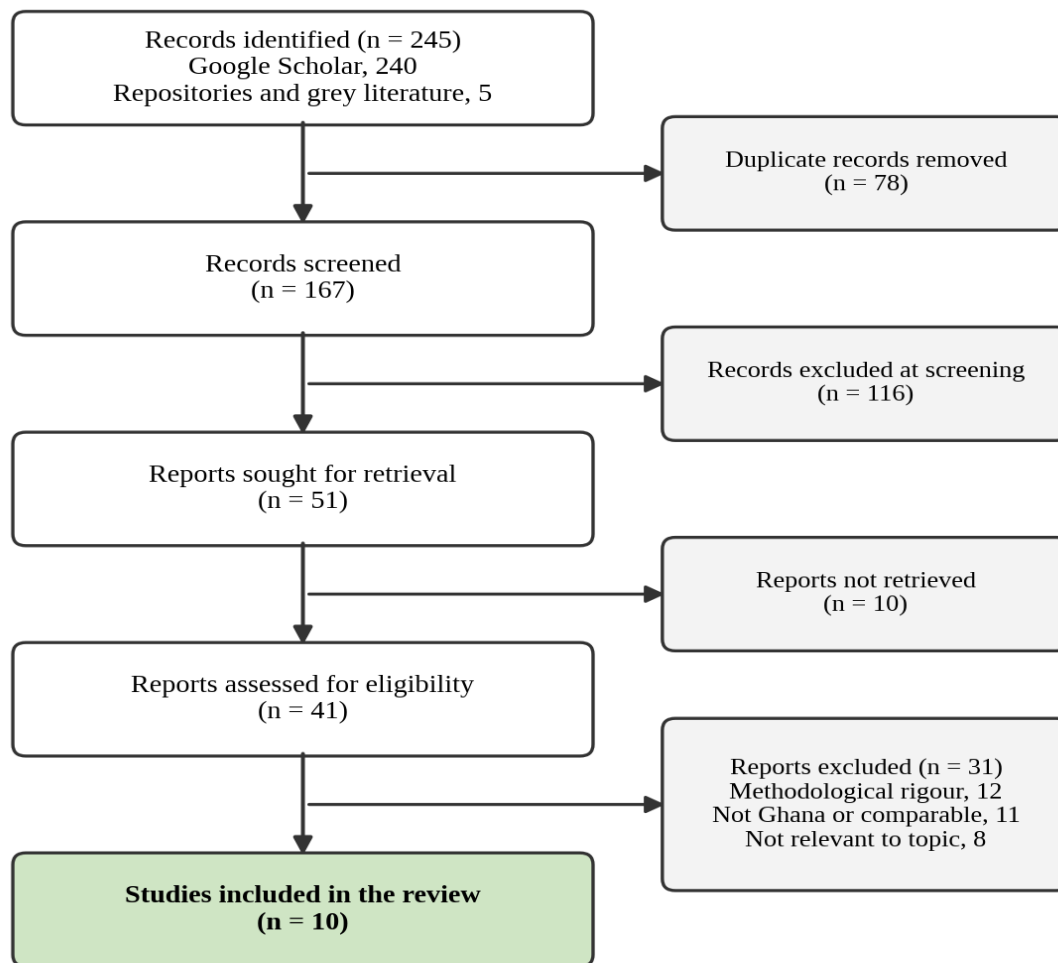


Figure 2. PRISMA flow diagram of the systematic review

Source: Authors’ construct, following Page et al. (2021).

Study Area and Population

The empirical work covered Accra, Kumasi and Cape Coast, where most reported collapses have occurred (Asante & Sasu, 2018; Boateng, 2020). The target population comprised professionals involved in the design, construction, regulation and safety management of buildings: architects, structural and civil engineers, construction managers and site engineers, metropolitan and municipal officers and other development control officials, real estate developers, and built-environment academics. The accessible population in the three cities was estimated at about 1,500 professionals from professional directories and registration data.

Sampling and Sample Size

In the quantitative phase, a stratified approach was used to secure representation of the main professional roles and the three cities. The Krejcie and Morgan (1970) formula gave a benchmark of 306 respondents at 95% confidence and a $\pm 5\%$ margin of error, and the distribution target was raised to 380 to allow for non-response. Of the 380 questionnaires distributed, 130 were returned (34.2%); 16 contained only profile data, leaving 114 usable responses (30.0% of those distributed and 87.7% of those returned). Because the achieved sample fell below the benchmark, the survey results are treated as exploratory and not as population estimates. With $N = 114$ drawn from an accessible population of about 1,500, the margin of error at 95% confidence is approximately $\pm 8.8\%$ (finite-population correction applied) and not the nominal $\pm 5\%$, and the power to separate items with similar ratings is correspondingly lower. The rankings are therefore treated as indicative, and standard errors and confidence intervals are reported in Table 2 so that readers can judge how precisely each item is estimated. In the qualitative phase, purposive sampling selected 13 experts with direct knowledge of building safety, digital construction, regulation and practice in Ghana (Patton, 2015). Interviews continued until no new themes emerged.

Instruments and Procedures

The questionnaire was self-administered and delivered online and in print through professional and academic contacts in the three cities. The part relevant to this paper contained 16 statements on causes of building collapse, grouped as seven technical causes, five institutional causes and four environmental and socio-economic causes, each rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The instrument was reviewed by three academics in construction management and one industry practitioner and was piloted with 10 respondents who were excluded from the analysis.

Semi-structured interviews followed a guide covering the current state of digital adoption, technological, organisational and institutional challenges, socio-technical fit and recommendations. Interviews lasted 45 to 60 minutes, were held face-to-face or by video call, and were audio-recorded with consent. Participants are identified as IP1 to IP13 and had between 18 and 25 years of professional experience; they included real estate developers, municipal building inspectors, structural engineers, architects, academics, and hydrology and geomatics specialists. Table 1 profiles the survey respondents.

Table 1: Profile of survey respondents ($N = 114$)

Characteristic	Frequency (n)	Percent (%)
Role		
Quantity surveyor	22	19.3
Architect	18	15.8
Site engineer / foreman	14	12.3
Construction project manager	13	11.4
Academic / researcher	13	11.4
Structural / civil engineer	12	10.5

Characteristic	Frequency (n)	Percent (%)
Real estate developer / investor	11	9.6
Regulatory / development control official	10	8.8
Construction technician	1	0.9
Collapse experience		
Direct experience of a collapse	74	64.9
No direct experience but knowledge of cases	23	20.2
No experience	17	14.9

Source: Field data, 2026.

Data Analysis

Survey data were analysed with IBM SPSS Statistics 26 and Microsoft Excel. Means, standard deviations and the Relative Importance Index ($RII = \Sigma W / (A \times N)$, where W is the rating given by each respondent, A is the highest possible rating and N is the number of respondents) were computed for each item and used to rank the causes. Category values are the arithmetic means of the item statistics, and 3.0 was treated as the neutral point of the scale. Standard errors ($SE = SD/\sqrt{n}$) and 95% confidence intervals (critical $t = 1.98$, $df = 113$) were computed for each item mean; because RII equals the mean divided by the maximum rating of 5, the RII interval was obtained by dividing the limits of the mean interval by 5. The one-sample t statistic for each item is reported in Table 2. H1 was tested with one-sample t -tests of each item against 3.0; because item-level response counts are not reported, these were computed from the reported means and standard deviations with $n = 114$. H2 was assessed descriptively by comparing category means and RII values and the rank positions of individual items, and was interpreted alongside the interview evidence. Interview transcripts were analysed thematically in NVivo 12 following the six phases of Braun and Clarke (2006), combining a priori codes from the study's theoretical framework with inductive codes. The strands were integrated using a joint display (Creswell & Creswell, 2018).

Ethical Considerations

Participation in the survey and interviews was voluntary. Participants were informed of the purpose of the study, the confidentiality of their responses and their right to withdraw, and consent was obtained before interviews were recorded. Interviewees are identified by code only. Ethical approval was sought from the institutional committee before data collection.

FINDINGS

Respondent Profile

Nine professional groups were represented among the 114 respondents (Table 1). Quantity surveyors (19.3%) and architects (15.8%) formed the largest groups, and regulatory and development control officials made up 8.8%. Nearly three-quarters of respondents (72.8%) had more than five years of experience, and 64.9% reported direct experience of a building collapse while a further 20.2% knew of cases. The survey therefore reflects the perceptions of experienced practitioners with first-hand or close knowledge of collapse events.

Ranking of the Causes of Collapse

All 16 cause statements were rated above the neutral point (means of 3.56 to 4.69), so the RII values discriminate between degrees of agreement and do not separate accepted from rejected causes (Table 2 and Figure 3). The highest-ranked single cause was weak enforcement of building codes by development control agencies (mean = 4.693, $SD = 0.693$, $RII = 0.939$), an item on which respondents also showed little disagreement. Four environmental and socio-economic items followed closely: cost-cutting pressure on developers and contractors

and rapid urbanisation (both RII = 0.926), soil instability and changing rainfall (0.925), and seasonal flooding and poor drainage (0.918). Understaffing of building inspectors (0.835) and neglect of maintenance in existing buildings (0.807) came next. Technical causes occupied the middle and lower ranks (RII 0.712 to 0.779). Improper concrete mixing, curing and placement was the highest-ranked technical cause (0.779), while premature removal of formwork ranked lowest of all 16 items (0.712).

Table 2 adds item-level *t* statistics and 95% confidence intervals for RII. Every interval lies above the neutral point of 3.0 (lower mean limits of 3.34 to 4.56), which is consistent with the *t* tests for H1. The intervals also show how far the ranking can be read. The five highest-ranked items (RII intervals of about 0.89 to 0.96) overlap almost completely, so their order is not distinguishable in this sample, and the same holds within the technical group. The top cluster is separated from the technical items, whose intervals lie mostly between 0.71 and 0.81, but the separation is narrower for the lower-ranked items: the interval for maintenance neglect (0.782 to 0.832) overlaps that of the highest-ranked technical item (0.743 to 0.815), and the intervals for corruption and informal-sector dominance overlap those of all technical items. Because all items were rated above 3.56, the upper limits for the leading items approach the top of the scale (4.82 of 5.00 for enforcement), so a ceiling effect limits discrimination among them (Section 5.2).

Table 2: Ranking of the causes of building collapse in Ghana (N = 114)

Rank	Code	Cause	Category	Mean	SD	RII	t(113)	95% CI (RII)
1	INST1	Weak enforcement of building codes by development control agencies	Institutional	4.693	0.693	0.939	26.08	0.913–0.964
2=	ENV1	Economic pressure on developers and contractors to cut costs	Env./socio-econ.	4.632	0.834	0.926	20.89	0.895–0.957
2=	ENV2	Rapid urbanisation and high housing demand	Env./socio-econ.	4.632	0.744	0.926	23.42	0.899–0.954
4	ENV4	Soil instability and changing rainfall patterns	Env./socio-econ.	4.623	0.856	0.925	20.24	0.893–0.956
5	ENV3	Seasonal flooding and poor drainage	Env./socio-econ.	4.588	0.850	0.918	19.95	0.886–0.949
6	INST3	Understaffing and under-resourcing of building inspectors	Institutional	4.175	1.107	0.835	11.33	0.794–0.876
7	INST5	Maintenance neglect of existing buildings	Institutional	4.035	0.664	0.807	16.64	0.782–0.832
8	TECH5	Improper concrete mixing, curing and placement	Technical	3.895	0.963	0.779	9.92	0.743–0.815
9	TECH3	Poor foundation design and inadequate soil investigation	Technical	3.789	1.026	0.758	8.21	0.720–0.796
10	TECH2	Inadequate or absent structural design and calculations	Technical	3.781	1.037	0.756	8.04	0.718–0.795
11	TECH1	Substandard construction materials	Technical	3.746	1.143	0.749	6.97	0.707–0.792
12	TECH4	Unskilled or insufficiently trained workers and artisans	Technical	3.737	1.097	0.747	7.17	0.707–0.788
13	TECH7	Unauthorised structural modifications	Technical	3.728	1.067	0.746	7.28	0.706–0.785

Rank	Code	Cause	Category	Mean	SD	RII	t(113)	95% CI (RII)
14	INST2	Corruption and political interference in permitting and inspection	Institutional	3.632	1.139	0.726	5.92	0.684–0.769
15	INST4	Dominance of the informal construction sector	Institutional	3.614	1.101	0.723	5.95	0.682–0.764
16	TECH6	Premature removal of formwork	Technical	3.561	1.175	0.712	5.10	0.669–0.756

Source: Field data, 2026. Items are ranked by RII; ties are shown by “=”. Env./socio-econ. = environmental and socio-economic. CI = 95% confidence interval for RII (mean CI ÷ 5); t = one-sample t against 3.0 (df = 113), all $p < .001$.

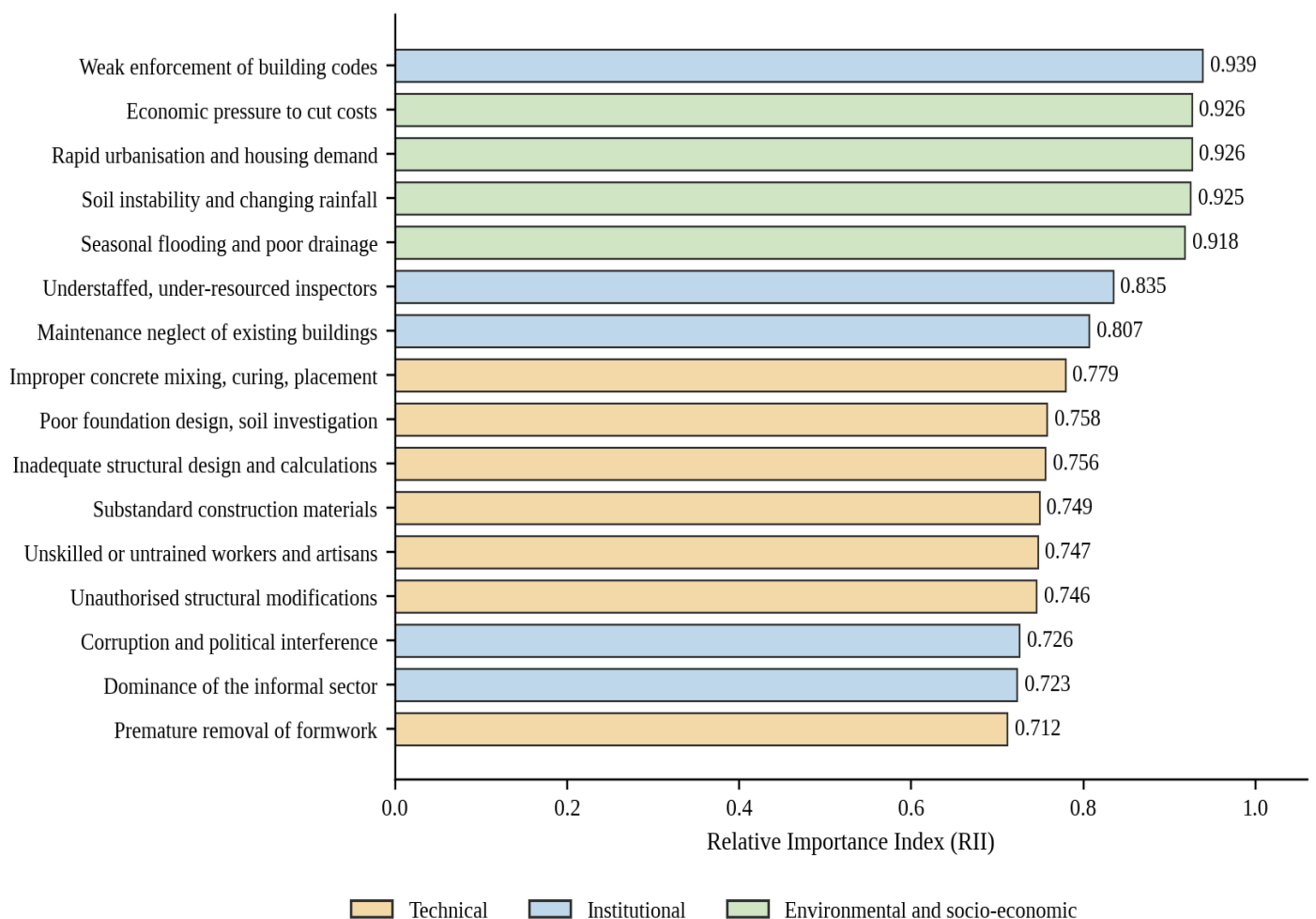


Figure 3. Relative Importance Index of the 16 cause statements

Source: Field data, 2026.

At category level (Table 3), environmental and socio-economic items were rated highest (mean RII = 0.924), followed by institutional items (0.806) and technical items (0.750). Responses to technical items were also the most dispersed (mean SD = 1.07), which suggests less agreement among professionals on the weight of individual technical causes than on the environmental and socio-economic causes (mean SD = 0.82). The institutional category was internally uneven. It contains the highest-ranked item (enforcement) and also two of the lowest-ranked: corruption and political interference in permitting and inspection (RII = 0.726) and the

dominance of the informal sector (0.723), which were rated below every technical item except premature formwork removal.

Table 3: Summary of cause categories

Category	Items	Mean of item means	Mean SD	Mean RII	RII range
Environmental and socio-economic	4	4.619	0.821	0.924	0.918–0.926
Institutional	5	4.030	0.941	0.806	0.723–0.939
Technical	7	3.748	1.073	0.750	0.712–0.779

Source: Field data, 2026. Category values are arithmetic means of item statistics.

Expert Interview Findings

Thematic analysis of the interviews produced one overarching theme: building collapse as a systemic, institutionally rooted failure. Interviewees named the familiar technical causes, including poor structural design, substandard materials, insufficient soil investigation, poor workmanship, early stripping of formwork, weak foundations and unapproved structural alterations. However, they consistently described institutional causes as more fundamental. Weak enforcement of laws and regulations, corruption in permit issuance and inspection, political interference and irregular inspection were seen as decisive because good designs do not protect a building where compliance is not enforced.

“Institutional failures create an environment for technical failures.” (IP3)

“Building collapse should be looked at from a systems perspective as well, rather than purely an engineering perspective.” (IP4)

Interviewees also stressed that collapse rarely has a single cause:

“Building collapse is never caused by one factor; rather, it is caused by several technical, management, regulatory and human failings all at once.” (IP5)

Fragmented accountability was a related concern. Responsibility for safety is divided among developers, consultants, contractors, regulators and clients, which makes it difficult to enforce and easy to evade. On enforcement, one interviewee observed:

“Even the best regulation becomes meaningless without enforcement... only when the bad thing happens do we take action.” (IP8)

Interviewees also identified causes that are rarely emphasised in the literature. The hydrology engineer (IP6) pointed to poor storm-water management and drainage, which lead to erosion, settlement and weakened foundations. The geomatics engineer (IP7) cited outdated or inaccurate surveying that results in misaligned and weak foundations. The developer (IP1) highlighted clients’ cost-cutting and unauthorised design changes during construction. Building inspectors emphasised neglected post-construction maintenance, which they felt official reports overlook. Finally, interviewees distinguished the formal sector, where professional consultants are involved, from the informal sector, where buildings may be constructed without any engineering design.

Integration of the Evidence

Following the sequential explanatory design, the interview themes were used to interpret the survey rankings. Table 4 presents a joint display of the review, survey and interview evidence.

Table 4: Joint display of review, survey and interview evidence

Issue	Systematic review	Survey (RII)	Interviews	Inference
Enforcement of regulations	Regulatory failure widely reported (Asante & Sasu, 2018; Mrabure & Awhefeada, 2021; Windapo & Rotimi, 2012)	INST1 0.939; INST3 0.835	Enforcement seen as the decisive gap	Convergence: enforcement is the dominant cause
Cost pressure and urbanisation	Socio-economic pressures reported (Boateng, 2020)	ENV1, ENV2 0.926	Client cost-cutting and unauthorised design changes (IP1)	Convergence: economic pressure drives technical shortcuts
Drainage, flooding and soil	Described as intensifying rather than primary causes (Yilmaz, & Marschalko, (2016); Massazza et al., 2019)	ENV3 0.918; ENV4 0.925	Drainage (IP6) and survey accuracy (IP7) raised as overlooked	Divergence from the literature: under-recognised cause
Maintenance neglect	Identified as a distinct category (Olabosipo et al., 2015)	INST5 0.807	Inspectors: neglected in official reports	Convergence: important but under-appreciated
Corruption and informal sector	Corruption in permitting reported (Mrabure & Awhefeada, 2021)	INST2 0.726; INST4 0.723	Corruption, political interference and the formal–informal divide emphasised	Divergence: survey rates them lower than the interviews suggest
Technical defects	Poor construction practice and design errors widely reported	TECH 0.712–0.779	Acknowledged, but treated as symptoms of institutional failure	Partial convergence: agreed as causes, ranked below systemic causes

Source: Authors' synthesis of review, survey and interview data.

Assessment of the Hypotheses

Table 5 summarises the assessment. H1 was supported. Every one of the 16 items exceeded the neutral value of 3.0 ($t(113) = 5.10$ to 26.08, all $p < .001$) (item-level statistics are shown in Table 2), and mean ratings in all three categories were well above neutral. H2 was supported only in part. At category level, institutional items were rated above technical items (mean RII = 0.806 against 0.750), and three institutional items (enforcement, inspector understaffing and maintenance neglect) ranked above every technical item. However, two institutional items (corruption and political interference, and informal-sector dominance) ranked below all but one technical item, and the environmental and socio-economic items were rated above both groups. The interviews supported the hypothesis more clearly, since interviewees described institutional causes as more fundamental than technical ones. A formal significance test of the difference between category composites is not reported here.

Table 5: Assessment of the study hypotheses

Hypothesis	Statement	Evidence	Decision
H1	Causes in all three categories are endorsed (mean > 3.0)	All 16 items above 3.0; $t(113) = 5.10$ to 26.08 , $p < .001$; category mean RII 0.750 to 0.924	Supported
H2	Institutional causes are rated above technical causes	Category mean RII 0.806 v 0.750; 3 of 5 institutional items rank above all technical items, 2 rank below all but one; interviews describe institutional causes as more fundamental	Partially supported

Source: Field data, 2026. t-values computed from reported item means and SDs ($n = 114$).

DISCUSSION

Enforcement as the Dominant Single Cause

The three evidence sources agree that weak enforcement is the most important single cause of building collapse in Ghana. The survey places it first (RII = 0.939), interviewees regarded it as decisive, and the review found regulatory failure to be a recurrent theme in Ghanaian and Nigerian studies (Asante & Sasu, 2018; Mrabure & Awhefeada, 2021; Windapo & Rotimi, 2012). The high ranking of inspector understaffing (RII = 0.835) points to a specific mechanism: development control agencies lack the staff and logistics to inspect construction, a constraint documented by Asante and Sasu (2018). In terms of organisational accident theory, weak enforcement is a latent failure. It does not itself break a structure, but it removes the defences that would otherwise detect defective materials, inadequate designs and unauthorised alterations before they cause harm (Reason, 1997; Emuze & Mollo, 2020). The finding supports the argument that a legal framework offers little protection where the capacity to apply it is missing.

Economic Pressure, Urbanisation and the Environment

Environmental and socio-economic items formed the highest-rated group, and their low dispersion ($SD = 0.74$ to 0.86) indicates broad agreement. Cost-cutting by developers and contractors, and rapid urbanisation, were rated as highly as any cause except enforcement. These conditions help explain why technical shortcuts occur: where housing demand is high and margins are tight, incentives to economise on materials, design and supervision are strong, and weak enforcement allows the resulting defects to persist (Boateng, 2020). The urbanisation result should not be read as showing that growth alone causes collapse. Boateng (2021) argues that urban problems such as building collapse are better explained by policy legacies than by population pressure, and the present data are consistent with that view, since respondents rated enforcement and cost-cutting at least as highly as demand.

The high ratings for flooding, poor drainage, soil instability and changing rainfall contrast with the review, in which environmental factors were described as intensifying weaknesses and not as primary causes (Yilmaz & Marschalko, 2016; Massazza et al., 2019). The hydrology engineer's account of drainage-related erosion and settlement (IP6) and the geomatics engineer's concern about inaccurate surveys (IP7) suggest that site-related hazards are under-recognised in the literature. Two cautions apply. First, the four environmental items differ by no more than 0.008 in RII, so their relative order should not be interpreted. Second, the items were worded as statements of agreement and produced means close to the top of the scale, which may partly reflect acquiescence or a ceiling effect. The intervals in Table 2 confirm this: the five leading items have overlapping 95% intervals, and the upper limit for enforcement (4.82) is close to the maximum of 5.00. The RII values therefore separate the leading cluster from the technical items but not the items within it, and future instruments should include reverse-worded items or forced-ranking formats to improve discrimination.

Technical Defects as Proximate Causes

Technical items were rated lower than the other categories but were still strongly endorsed (RII 0.712 to 0.779), and interviewees named them readily. This pattern is consistent with the distinction between proximate and underlying causes. Technical defects are the visible mechanisms of failure, but interviewees treated them as symptoms of conditions that allow defects to go unchecked. The prominence of improper concrete mixing, curing and placement (RII = 0.779) among technical causes is consistent with weak site supervision and quality control, which are functions that enforcement and inspection are meant to secure. The lower ranking of technical causes should not be read as a claim that technical quality is unimportant. A building with inadequate materials or design cannot be made safe by regulation alone, which is why a systems view treats the causes as interdependent (Perrow, 1999).

Where the Evidence Diverges: Corruption and the Informal Sector

The survey rated corruption and political interference (RII = 0.726) and informal-sector dominance (0.723) far below enforcement, although interviewees identified both as important and the review linked corruption in permit issuance to unsafe buildings (Mrabure & Awhefeada, 2021). Three explanations are plausible and should be tested. First, corruption is a sensitive subject, and questionnaire respondents, including those from the public sector (22.8% of the sample), may under-report it. Second, the corruption item combined two concepts, corruption and political interference, which may have diluted agreement. Third, the relatively high dispersion on both items (SD = 1.14 and 1.10) shows that respondents' exposure to these problems differs, so the mean may conceal strong agreement in some groups and disagreement in others. Disaggregating responses by role and sector would clarify this. Until then, the survey result should not be interpreted as evidence that corruption or informality are minor causes.

The second explanation also applies to a wider instrument problem. Two items combined distinct concepts in one statement: INST2 (corruption and political interference in permitting and inspection) and ENV4 (soil instability and changing rainfall patterns). Respondents who agreed with one component but not the other could not express this, so the mean for each item may blend two different views, and the high rank of ENV4 in particular cannot be attributed to either soil conditions or rainfall. Future instruments should split such statements into single-concept items: corruption in permitting and inspection separately from political interference in permitting and inspection, and soil instability and inadequate soil investigation separately from changing rainfall patterns. Doing so would allow each variable to be ranked, and its relationship to enforcement to be examined, in isolation.

A Systems Interpretation

The results support Proposition 1 in two ways. Every category of cause was endorsed (H1), and interviewees described the causes as interacting and not as separate. The expectation that institutional causes outrank technical ones (H2) is supported only in part, because the institutional category is uneven and is itself outranked by the environmental and socio-economic items. A more defensible statement of the finding is that weak enforcement and economic pressure are the dominant causes, while technical defects are important but are the proximate expression of these conditions.

Read together, the findings are consistent with a systems account in which causes reinforce one another across subsystems. Economic pressure and rapid urbanisation increase the likelihood of defects in materials, design and workmanship; weak enforcement and understaffed inspectorates reduce the chance that those defects are detected; neglected maintenance erodes the safety margins of buildings over time; and flooding and unstable soils act as triggers on structures already weakened. These are plausible pathways and not tested relationships, and confirming them would require case-level forensic data. The practical implication is that prevention cannot rely on a single measure. Improving materials testing without strengthening enforcement, or adding inspectors without addressing cost pressures, would leave important pathways to collapse open.

Implications For Policy, Practice and Research

For policy, the results point first to enforcement capacity. Resourcing development control and building inspection units with staff, transport and testing equipment addresses the highest-ranked cause and the mechanism that respondents ranked next, the shortage of inspectors. Accountability arrangements that make responsibility for safety traceable across developers, consultants, contractors and regulators would respond to the fragmented accountability described by interviewees. Because maintenance neglect was rated a major but under-appreciated risk, policy attention should extend beyond new construction to periodic structural condition assessment of existing buildings, particularly older and heavily used ones, and maintenance failures should be recorded in official collapse reporting.

Policy should also address the conditions that reward corner-cutting, for example by strengthening penalties for unauthorised structural alterations and by considering independent verification of critical works. Permitting and land-use processes should incorporate drainage, flood-risk and accurate site-survey requirements, which respondents and interviewees identified as under-recognised. For the informal sector, where buildings may be constructed without engineering input, differentiated arrangements such as simplified compliance routes, artisan training and certification are needed, alongside gradual formalisation.

For practice, firms and project teams should treat quality control of concrete work (mixing, curing, placement and formwork removal) as a supervised and documented activity, since improper concrete practice was the highest-ranked technical cause. Developers and clients should recognise their role in cost-cutting and unauthorised design changes, which interviewees identified as sources of risk, and design changes should be approved and recorded by qualified professionals. Professional bodies can support this through continuing professional development on site supervision, maintenance and drainage design.

Digital technologies may help address the enforcement and inspection bottlenecks identified here, although this study did not test them. Where inspectors are understaffed ($RII = 0.835$), BIM-based permit submission with automated code-compliance checking could reduce the review effort per application and leave inspector time for site visits. IoT sensing on site, such as embedded temperature and strength monitoring in curing concrete or tilt, settlement and moisture sensors in foundations and drainage, could give inspectors time-stamped, remotely accessible evidence of the concrete and foundation conditions that respondents and interviewees identified as weak points. Digital audit trails for approvals and design changes would also make permitting decisions traceable, which bears on the concerns about corruption, political interference and unauthorised alterations. These tools supply information and do not enforce anything: they still depend on agencies with the authority and capacity to act on the data, which links back to the enforcement finding.

For research, three directions follow. A national, forensically documented collapse database is needed to test the causal pathways proposed here and to replace perception data with case evidence. Larger and more representative samples, disaggregated by role, sector and city, would allow the divergent findings on corruption and informality to be examined. The review also found little consideration of digital tools in Ghanaian collapse studies, and the potential of technologies such as BIM and IoT to support inspection and monitoring (Ebekozi et al., 2023) raises a follow-up question: whether such tools can compensate for weak enforcement or depend on it.

CONCLUSION

This study investigated the major causes of building collapse in Ghana using a systematic review, a survey of 114 professionals and 13 expert interviews. The review identified six categories of causes. In the survey, weak enforcement of building codes was the highest-ranked cause, followed by cost-cutting pressure, rapid urbanisation, soil instability and flooding. Environmental and socio-economic items and institutional items were rated above technical items as groups, although corruption and informal-sector dominance were rated close to the technical items. Interviewees described collapse as a systemic failure in which weak enforcement, fragmented accountability and neglected factors such as drainage, survey accuracy and maintenance allow technical defects to reach completion and remain undetected. The proposition that collapse is multi-causal was supported: every category of cause was endorsed (H1), although the expectation that institutional causes outrank

technical ones was only partly supported (H2). The study concludes that technical defects are the proximate causes of collapse in Ghana, but that their persistence is best explained by institutional and economic conditions. Prevention therefore requires action across the building production system and not technical quality control alone.

RECOMMENDATIONS

The evidence supports five recommendations. First, government should resource development control and inspection agencies with staff, logistics and equipment, and make accountability for safety traceable across all parties. Second, regulators should extend oversight to existing buildings through periodic structural condition assessment and should record maintenance failures in collapse reporting. Third, permitting processes should require drainage, flood-risk and site-survey information, and enforcement should target unauthorised structural alterations. Fourth, firms and professional bodies should strengthen site supervision and quality control of concrete work, with clear responsibility for approving design changes. Fifth, a differentiated strategy is needed for the informal sector, combining simplified compliance routes, artisan training and gradual formalisation.

Limitations And Directions For Future Research

The findings should be interpreted with caution. The achieved survey sample ($N = 114$) fell below the benchmark of 306 calculated for the accessible population, and questionnaires were distributed through professional and academic contacts, so the results are exploratory and are not population estimates. The data are perceptions and not forensic evidence on individual collapses. All cause items were positively worded and drew high agreement, which limits discrimination among the highest-rated items, and reliability coefficients for the cause categories are not reported. Two items (INST2 and ENV4) each combined two concepts, and the confidence intervals in Table 2 show that the ranking within the leading group of items is not statistically distinguishable. The systematic review searched a single database (Google Scholar) and grey literature, included ten studies and did not cover French- and Portuguese-language literature. The empirical work was concentrated in Accra, Kumasi and Cape Coast, and the findings may not transfer to smaller towns and rural areas. Future studies should use larger, disaggregated samples, forensic collapse records and longitudinal designs.

Declaration of Interest

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