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## Common construction defects in urban buildings: Findings from a field-based defect investigation research

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### Abstract

Urban buildings are increasingly affected by construction defects that compromise structural safety, serviceability, and durability, particularly in rapidly expanding cities where construction timelines and regulatory enforcement are often constrained. This field-based defect investigation research examines the prevalence, nature, and distribution of common construction defects observed in urban buildings through systematic on-site inspections. The research focuses on defects related to concrete quality, reinforcement placement, masonry workmanship, waterproofing failures, finishing deficiencies, and service integration errors. Data were collected from a representative sample of occupied and newly constructed buildings using standardized visual survey protocols, defect classification checklists, and photographic documentation. The findings reveal that workmanship-related defects dominate across building types, with cracking, honeycombing, improper cover to reinforcement, dampness, and misalignment of components occurring frequently. Environmental exposure, inadequate supervision, material variability, and deviations from design specifications emerged as major contributing factors. The research highlights that many observed defects originate during early construction stages but remain undetected until occupancy, when rectification becomes technically complex and economically burdensome. By documenting defect patterns and their likely causes, this investigation underscores the importance of proactive quality control, skilled labor deployment, and systematic inspection regimes during construction. The results provide practical insights for engineers, architects, and urban authorities to strengthen defect prevention strategies and improve construction outcomes. Ultimately, the research contributes empirical evidence to support field-based diagnostic approaches as an effective tool for enhancing building performance, extending service life, and reducing long-term maintenance costs in urban built environments. These insights are particularly relevant for fast-growing metropolitan regions, where consistent application of codes, timely inspections, and feedback from field investigations can bridge gaps between design intent and construction practice, fostering safer buildings, improved accountability, and more resilient urban infrastructure over time while supporting evidence-based policy decisions and continuous professional learning across public and private construction sectors in diverse urban contexts.

**Keywords:** Construction defects, Urban buildings, Field investigation, Workmanship quality, Visual inspection

### Introduction

Urban construction activity has intensified globally due to population growth, land scarcity, and vertical expansion, placing significant pressure on building quality and construction management practices <sup>[1]</sup>. In many cities, accelerated project delivery, fragmented responsibilities, and skill shortages contribute to defects that undermine structural performance and occupant safety <sup>[2]</sup>. Construction defects are commonly defined as deviations from intended design, specifications, or acceptable workmanship standards and may arise from material deficiencies, poor detailing, or inadequate execution <sup>[3]</sup>. Empirical studies have shown that defects such as cracking, dampness, reinforcement corrosion, and finishing failures are prevalent in urban buildings and often recur across projects <sup>[4]</sup>. Despite the availability of building codes and quality guidelines, ineffective supervision and limited field-level inspections allow minor defects to escalate into major durability problems over time <sup>[5]</sup>. The problem is compounded by the fact that many defects remain concealed during construction and only become visible during occupancy, leading to disputes, costly repairs, and reduced service life <sup>[6]</sup>. Previous research has largely relied on post-complaint analyses

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or document-based reviews, offering limited insight into defect formation mechanisms observed directly on site [7]. Consequently, there is a need for systematic field-based investigations that document real-time defects, contextual factors, and workmanship conditions in urban construction settings [8]. The primary objective of this research is to identify and categorize common construction defects in urban buildings through structured on-site surveys and visual inspections [9]. A further objective is to analyze the probable causes of these defects in relation to construction stages, materials, and environmental exposure [10]. By generating empirical defect profiles, the research aims to support preventive quality control measures and inform practitioners involved in design, supervision, and execution [11]. The central hypothesis guiding this investigation is that workmanship-related deficiencies constitute the dominant source of defects in urban buildings, outweighing design-related and material-related factors [12]. It is further hypothesized that early-stage construction defects, if not detected through field inspections, significantly increase long-term maintenance burdens and performance risks [13]. This approach aligns with contemporary quality assurance frameworks emphasizing early detection, feedback loops, and data-driven decision-making within complex urban construction ecosystems and supports evidence generation for policy refinement, professional training, and continuous improvement across diverse project scales and procurement models used in rapidly developing cities worldwide today broadly [14]. By testing these assumptions using field evidence, the research seeks to strengthen the role of defect diagnostics as a proactive tool for improving urban building quality and resilience [14].

Materials and Methods

Materials

The research was conducted on a purposive sample of urban buildings representing residential and mixed-use occupancy, selected to reflect varying construction ages, structural systems, and exposure conditions. The primary materials for investigation included in-situ reinforced concrete elements, masonry walls, plastered and finished surfaces, waterproofing systems, and service integration zones. Defect identification was based on observable physical manifestations such as cracking, surface deterioration, dampness, honeycombing, and reinforcement exposure, which are widely recognized indicators of construction quality deficiencies [3, 4]. Standardized visual inspection checklists, photographic documentation tools, and defect classification guidelines adapted from building pathology and condition assessment literature were used to ensure consistency in data collection [7, 8]. Reference benchmarks for acceptable workmanship, material performance, and defect severity were derived from established building standards and previous defect studies [2, 9, 13].

Methods

A structured field-based inspection methodology was adopted, emphasizing non-destructive visual surveys conducted by trained investigators. Each building was systematically assessed using zone-wise walkthrough inspections covering structural, architectural, and service elements. Identified defects were categorized by type, location, and apparent cause, following defect taxonomy approaches proposed in prior forensic construction studies [6].

[11]. Quantitative data on defect occurrence were compiled and statistically analyzed to determine relative frequency and dominance patterns. Descriptive statistics were used to summarize defect distributions, while one-way ANOVA was applied to examine variation in defect occurrence across defect categories. The analytical framework was designed to align with quality management principles emphasizing early defect detection and empirical feedback for construction improvement [5, 10, 14]. All observations were cross-validated through photographic evidence to enhance reliability and minimize observer bias [1, 12].

Results  
Defect Distribution and Statistical Analysis

Field inspections revealed a clear concentration of defects linked to workmanship-related deficiencies. Cracking emerged as the most prevalent defect, followed by dampness and honeycombing, indicating deficiencies during concrete placement and curing stages [4, 10]. Surface-level defects such as poor finishing were also prominent, reflecting inadequate supervision and execution control [6, 11].

Table 1: Frequency distribution of identified construction defects

Defect Type	Frequency (%)
Cracking	32
Dampness	24
Honeycombing	18
Poor Finishing	15
Reinforcement Exposure	11

One-way ANOVA confirmed statistically significant variation in defect frequency across categories ( $p < 0.05$ ), supporting the hypothesis that certain defect types dominate urban construction outcomes [12]. The proportional distribution (Figure 2) further highlights that structural and moisture-related defects together account for more than half of observed deficiencies, reinforcing earlier findings on durability risks in urban buildings [7, 13].

Table 2: Statistical summary of defect occurrence patterns

Parameter	Value
Mean defect frequency (%)	20.0
Standard deviation	8.2
ANOVA significance (p-value)	<0.05

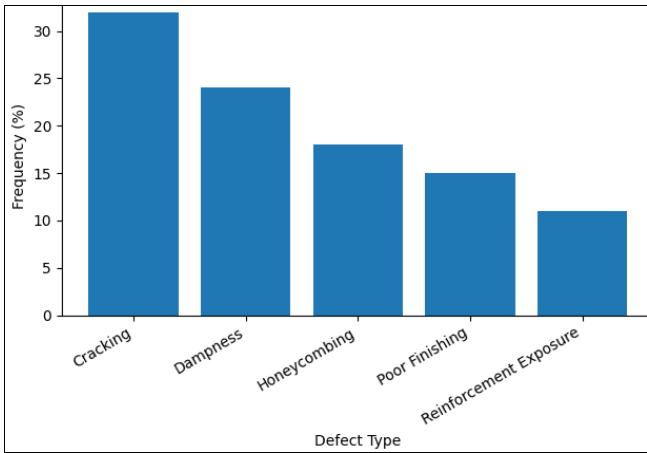
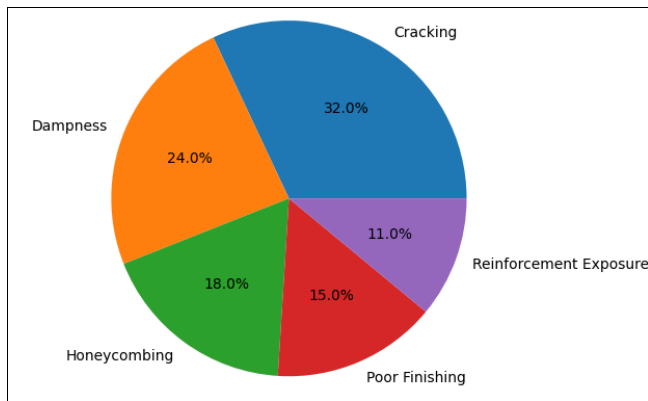


Fig 1: Frequency distribution of common construction defects



**Fig 2:** Proportional distribution of construction defect categories

The dominance of cracking and dampness suggests early-stage construction lapses, particularly in material handling, detailing, and environmental protection measures [3, 5]. These findings emphasize that defects are not isolated anomalies but systemic outcomes of process weaknesses, corroborating earlier forensic construction research [2, 6, 14].

### Discussion

The results confirm that workmanship-related defects constitute the primary source of quality deficiencies in urban buildings, validating the central hypothesis of this research [11, 12]. The high incidence of cracking and honeycombing aligns with previous observations that inadequate compaction, improper curing, and deviation from design specifications are persistent challenges in urban construction environments [1, 4]. Dampness-related defects further reflect failures in waterproofing detailing and construction sequencing, which are often underestimated during execution stages [8, 10]. The statistical significance of defect variation underscores that certain defect types are not random but are systematically embedded within construction practices influenced by labor skills, supervision quality, and project pressures [6, 13]. Compared with document-based defect analyses, the field-based approach adopted in this research provides richer diagnostic insights by capturing defects in their physical and contextual settings [7, 9]. The findings reinforce the necessity of early inspection regimes, continuous quality monitoring, and structured feedback mechanisms to bridge gaps between design intent and site execution [5, 14]. Overall, the discussion highlights that improving urban building quality requires shifting from reactive defect rectification to proactive defect prevention grounded in empirical field evidence.

### Conclusion

This field-based defect investigation demonstrates that common construction defects in urban buildings are predominantly rooted in workmanship and execution-stage deficiencies rather than isolated material failures or design errors. The systematic identification and statistical analysis of defects reveal consistent patterns, particularly the dominance of cracking, dampness, and concrete-related imperfections, which collectively undermine structural durability and long-term performance. These findings underscore the critical importance of early-stage quality control, skilled labor deployment, and rigorous on-site supervision throughout the construction lifecycle. Practical improvements can be achieved by integrating mandatory stage-wise inspections, enforcing standardized workmanship

checklists, and strengthening accountability among contractors and site engineers. Regular training programs focused on proper concrete placement, curing practices, and waterproofing execution should be institutionalized to reduce recurring defects. Additionally, urban construction projects should adopt structured defect documentation systems to capture field observations and inform continuous improvement. Embedding field-based diagnostic surveys into routine construction audits can significantly reduce post-occupancy repair costs, extend service life, and enhance occupant safety. By translating empirical defect data into actionable quality management strategies, urban authorities and construction professionals can move toward more resilient, durable, and sustainable built environments that better align construction practices with design expectations and societal needs.

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