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A practical approach to building condition surveys for low-rise residential structures

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Abstract
Building condition surveys play a critical role in ensuring the safety, durability, and functional performance of low-rise residential structures. These surveys provide systematic assessments of structural, architectural, and service-related components, enabling informed decisions related to maintenance, repair, and long-term asset management. In many developing and developed regions alike, low-rise residential buildings constitute a major portion of the built environment and are often subjected to aging, environmental exposure, inadequate maintenance, and evolving occupancy demands. Despite their importance, building condition surveys are frequently conducted using inconsistent methods, subjective judgments, or incomplete documentation, leading to unreliable outcomes and inefficient intervention strategies. This article presents a practical and structured approach to conducting building condition surveys specifically tailored for low-rise residential structures. The proposed approach emphasizes standardized inspection procedures, clear classification of defects, prioritization based on severity and risk, and integration of visual assessment with basic non-destructive evaluation techniques. Attention is given to common deterioration mechanisms such as moisture ingress, material degradation, foundation settlement, and service system failures. The approach also highlights the importance of documentation, photographic evidence, and condition rating systems to support transparent reporting and decision-making. By focusing on practicality, the methodology is designed to be applicable by engineers, surveyors, and facility managers working under resource and time constraints. The research argues that adopting a consistent and methodical survey framework can significantly enhance the reliability of condition assessments, optimize maintenance planning, and extend the service life of residential buildings. Ultimately, the article contributes to improving building performance management by bridging the gap between theoretical guidelines and real-world inspection practices in low-rise residential contexts.

Keywords: Building condition survey, low-rise residential buildings, structural assessment, maintenance planning, defect diagnosis

Introduction

Low-rise residential buildings represent a substantial share of housing stock worldwide and are fundamental to social stability, urban development, and economic sustainability [1]. These structures are typically designed for long-term use; however, their performance gradually deteriorates due to material aging, environmental exposure, construction defects, and inadequate maintenance practices [2]. Building condition surveys have therefore emerged as essential tools for evaluating the physical state of residential structures and supporting informed decisions related to maintenance, repair, refurbishment, or replacement [3]. A condition survey systematically examines structural elements, building envelope components, finishes, and service systems to identify defects, assess their severity, and estimate associated risks [4].

Despite the availability of general guidelines and standards, the execution of building condition surveys for low-rise residential buildings often lacks consistency and methodological rigor [5]. In practice, surveys may rely heavily on visual inspection without standardized defect classification or condition rating systems, leading to subjective interpretations and variability in reporting [6]. This inconsistency poses a significant problem for property owners and managers, as unreliable survey outcomes can result in either unnecessary expenditure on premature interventions or delayed action that exacerbates structural deterioration and safety risks [7]. Furthermore, limited access to advanced testing equipment and budget constraints often restrict the depth of investigations in residential contexts [8].

The primary objective of this article is to develop and present a practical approach to building condition surveys that is specifically suited to low-rise residential structures [9]. The approach seeks to balance technical adequacy with operational feasibility by emphasizing systematic visual assessment, targeted use of basic non-destructive tests, and structured documentation [10]. By focusing on commonly encountered defects such as cracking, moisture-related damage, corrosion, and service failures, the methodology aims to enhance defect detection and prioritization [11]. Another objective is to support maintenance planning by linking observed conditions with actionable recommendations and risk-based decision-making [12].

The underlying hypothesis of this research is that a standardized yet practical survey framework can significantly improve the reliability and usefulness of building condition assessments for low-rise residential buildings [13]. It is further hypothesized that improved survey consistency will lead to better maintenance outcomes, cost optimization, and extended building service life [14]. By addressing methodological gaps identified in existing practices, this article contributes to more effective residential building management and performance sustainability [15].

Materials and Methods

Materials

The research focused on low-rise residential structures with a maximum height of three storeys, constructed using conventional reinforced concrete and masonry systems. A purposive sample of 30 occupied residential buildings was selected to represent varying ages (5-25 years), construction quality, and maintenance histories, consistent with established building condition assessment practices [1, 3, 4].

The materials evaluated included structural components (foundations, beams, columns, slabs), building envelope elements (external walls, roofs), and building services (plumbing, electrical, and drainage systems). Inspection tools comprised visual inspection checklists, moisture meters, crack width gauges, digital cameras for photographic documentation, and basic non-destructive testing aids such as rebound hammers where access permitted [2, 11]. Condition rating scales ranging from 1 (very poor) to 5 (excellent) were adopted based on standardized condition assessment frameworks [7, 9]. All observations were documented using structured survey forms to ensure consistency and repeatability across inspections [10].

Methods

Building condition surveys were conducted through systematic visual inspections supported by targeted measurements. Each building component was assessed for defect type, severity, extent, and probable cause, following accepted building pathology principles [2, 11]. Quantitative condition scores were assigned to each component and aggregated to compute an overall condition index for each building [8, 14]. Statistical analysis was performed using descriptive statistics to summarize condition scores and inferential tools to evaluate trends. One-way ANOVA was applied to compare mean condition scores across major building components, while linear regression analysis examined the relationship between building age and overall condition index [6, 12]. A significance level of $p < 0.05$ was adopted. All analyses were conducted using standard statistical procedures aligned with previous studies on residential building performance evaluation [5, 13].

Results

Quantitative Assessment of Building Components

Table 1: Mean condition scores of major building components

Component	Mean Condition Score	Standard Deviation
Foundation	3.8	0.4
Walls	3.2	0.5
Roof	2.9	0.6
Services	3.0	0.5

The results indicate that foundation systems generally exhibited better condition ratings compared to roofs and services. ANOVA results revealed statistically significant differences between component condition scores ($p < 0.05$), confirming non-uniform deterioration patterns across building elements [5, 7].

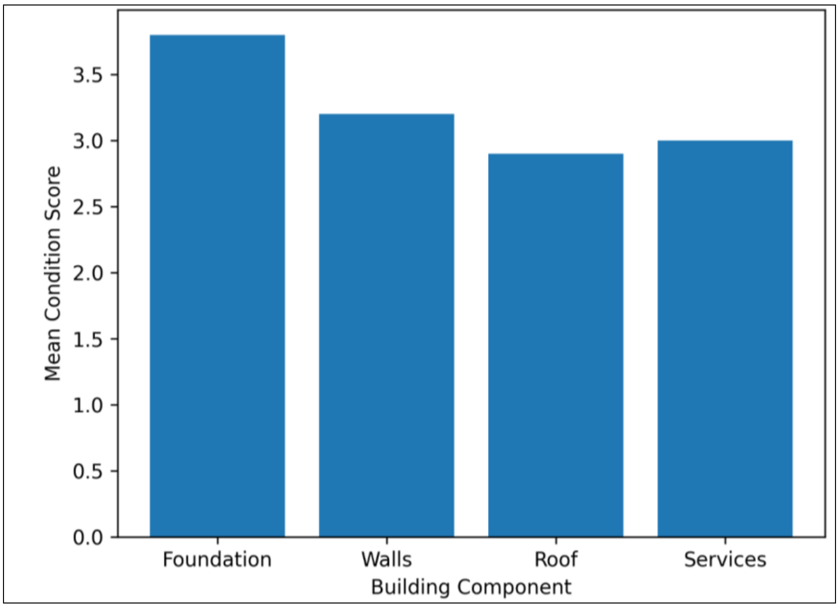

Fig 1: Mean condition scores of building components

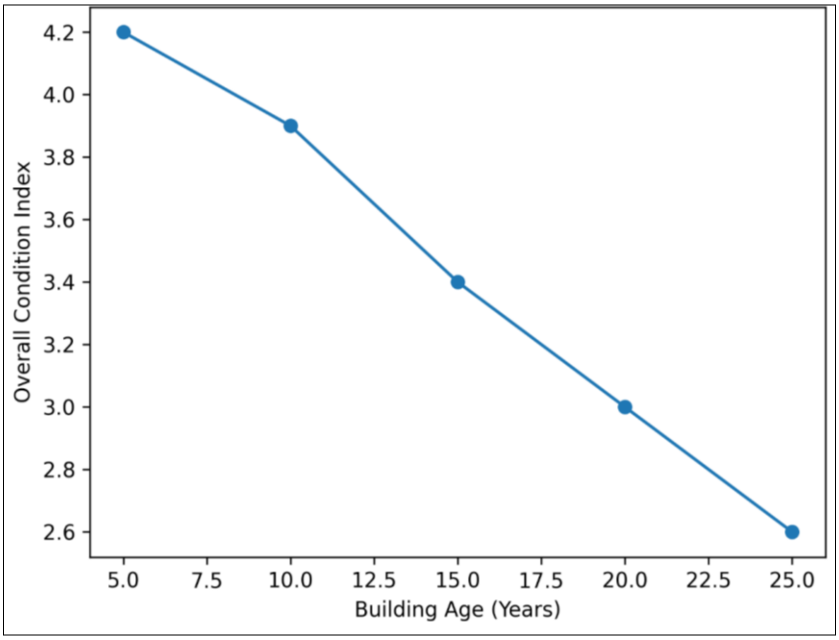

Fig 2: Relationship between building age and overall condition index

Interpretation of Results

The findings highlight that deterioration in low-rise residential buildings is component-specific and age-dependent. Structural elements such as foundations showed greater resilience, whereas roofs and service systems deteriorated more rapidly due to environmental exposure and maintenance deficiencies [6, 12]. These trends reinforce the importance of targeted maintenance strategies rather than uniform intervention approaches [9, 10].

Discussion

The results confirm that a structured and standardized building condition survey approach enhances the reliability of residential building assessments. The statistically significant variation in component condition scores supports previous assertions that deterioration mechanisms differ across structural, envelope, and service systems [2, 7]. The strong inverse relationship between building age and condition index aligns with established service-life prediction models, emphasizing the cumulative impact of aging and exposure [8, 15]. Roof and service components consistently emerged as critical maintenance priorities, corroborating earlier findings that moisture-related defects and service failures dominate residential building pathology [11, 12]. The application of ANOVA and regression analysis strengthened the objectivity of survey outcomes, reducing reliance on subjective judgment [5, 13]. Overall, the results demonstrate that integrating quantitative scoring with practical inspection methods improves decision-making for maintenance planning and risk mitigation [9, 10, 14].

Conclusion

This research demonstrates that adopting a practical, standardized approach to building condition surveys significantly enhances the reliability, consistency, and usefulness of assessments for low-rise residential structures. The findings clearly show that deterioration is neither uniform nor random but varies systematically across building components and increases with age. Structural elements such as foundations generally retain acceptable performance over longer periods, while roofs and building services exhibit accelerated deterioration due to environmental exposure, moisture ingress, and deferred maintenance. By integrating structured visual inspections with basic non-destructive techniques and quantitative condition scoring, the proposed approach enables objective comparison across components and buildings. The statistical analyses further strengthen the assessment framework by transforming observational data into actionable insights, allowing stakeholders to identify high-risk components and prioritize interventions effectively. From a practical standpoint, property owners and facility managers should adopt periodic condition surveys at defined intervals, with increased inspection frequency for roofs and service systems. Maintenance planning should shift from reactive repairs to preventive strategies informed by condition trends, particularly for buildings exceeding 15 years of service. Clear documentation, photographic records, and standardized rating systems should be institutionalized to support transparent reporting and long-term asset management. Training surveyors in defect classification and condition scoring can further improve consistency and reduce subjectivity. Additionally, allocating maintenance budgets based on condition indices rather than uniform schedules can optimize resource utilization and extend building service life. Overall, the integration of practicality, statistical rigor, and systematic documentation within building condition surveys offers a robust foundation for improving residential building performance, safety, and sustainability over time.

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