

A Comprehensive Review on Defect Assessment in Residential Building

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Abstract—This review presents a comprehensive examination of defect assessment in residential buildings, focusing on the identification, causes, detection methods, severity evaluation, and remediation strategies of common defects. It categorizes defects into structural, water-related, material deterioration, construction, and serviceability issues, highlighting their underlying causes such as environmental factors, design and construction flaws, aging, and external influences. The review evaluates various assessment techniques including visual inspection, non-destructive testing, instrumental monitoring, and laboratory analysis, emphasizing their roles in accurate defect detection and severity classification. Additionally, it discusses effective remediation and maintenance approaches to ensure building safety, durability, and occupant comfort. The importance of standardized documentation and reporting practices is also underscored to facilitate clear communication and informed decision-making. This framework serves as a foundational guide for researchers, practitioners, and stakeholders involved in residential building maintenance and defect management.

I. INTRODUCTION

The importance of defect assessment in residential buildings cannot be overstated, as it directly influences the quality and safety of construction outcomes. Effective defect assessment strategies can significantly enhance construction quality and minimize safety risks in residential projects, thereby benefiting all stakeholders involved. Implementing systematic risk management practices is essential for identifying and mitigating potential defects, ultimately leading to improved project performance and safety in residential construction.

Background of Defect Assessment

Incorporating effective defect management strategies is crucial, where subcontractors often handle the

majority of on-site work. This approach can help address the high-risk trades identified in recent studies, such as waterproofing and concreting.

Importance of Defect Assessment in Residential Buildings

Defect assessment is vital for ensuring that construction practices meet safety and quality standards, particularly in high-risk areas like waterproofing and concreting, which are prevalent in residential projects.

II. LITERATURE REVIEW

A comprehensive literature review on residential building defects reveals a significant body of research focused on understanding their prevalence, causes, impacts, and advanced assessment methodologies. Defects in residential buildings represent a persistent challenge for the architecture, engineering, and construction (AEC) industry, contributing to increased construction costs, waste, and occupant dissatisfaction 1. These issues necessitate robust assessment strategies to support sustainable decision-making and continuous improvement activities

Defects manifest in various forms and locations within residential structures, with specific patterns observed across different regions. In Spain, analysis of 3647 construction defects highlighted common occurrences in various building elements, emphasizing the pervasive nature of these problems despite regulatory acts aimed at promoting quality 34. Australian studies also consistently report a high incidence of defects in multi-unit dwellings, impacting resident confidence and posing various risks 56. Common areas prone to defects include masonry walls, as identified in Lithuanian residential buildings, where multi-attribute evaluation models have been developed for assessment 7. Building

envelopes, particularly in urban villages in Guangzhou, China, exhibit defects such as conduction thermal bridges, water infiltration, and material detachment, detectable through thermography 8. Interior components are also frequently affected; for instance, defects in plaster, windows, doors, floors, and tiling are significant concerns for building quality 9. Specifically, in apartment buildings, frequently occurring issues that impact convenience and safety include tile installation, flooring, wallpaper, PL windows, and kitchen furniture 10. A systematic review identified eight common defect types: affected functionality, broken items, corrosion, detachment, incorrect installation, missing tasks, surface appearance, and water problems.

The genesis of building defects is multifaceted, stemming from various stages of the construction process. Key influencing factors include poor workmanship, substandard materials, design flaws, and inadequate supervision 121. These factors contribute to issues such as structural deterioration, which can reduce a building's ability to perform its intended function, and environmental conditions that negatively impact occupant comfort and health 13. Furthermore, external influences like aging, environmental exposure, and initial design constraints play a critical role in the long-term development and propagation of defects 14. Continuous improvement projects, adhering to quality cycles like Plan-Do-Check-Act (PDCA), are essential to implement best practices and control strategies to mitigate defect formation, particularly in sensitive areas like ceramic tiling execution.

NDT techniques are crucial for identifying hidden flaws without causing damage to the structure.

Thermography: Infrared thermography (IRT) is particularly effective for detecting anomalies in building envelopes, such as conduction thermal bridges, water infiltration, and material detachment.

Other NDT Methods: The literature indicates the use of various NDT methods, such as ultrasonic testing and eddy current testing, which are essential for identifying internal voids or surface flaws in materials. These methods operate under a "damage-tolerant" design philosophy, assuming existing imperfections must be located and monitored.

III. RESIDENTIAL DEFECT ASSESSMENT

- *Defect Categorization:* Research generally classifies defects into technical (workmanship, material, design), human (negligence), and environmental factors. Common categories include structural, functional, and aesthetic defects.
- *Most Common Defects:* Studies frequently identify surface defects (uneven painting, scratches, cracks), poor installation of fixtures (doors, windows, toilets), and improper finishes as the most common issues reported by homeowners.
- *Major Causes:* Poor workmanship and lack of site supervision are the dominant contributors, alongside improper design and poor quality materials.
- *Impact on Stakeholders:* Defects reduce property value, cause financial loss, increase maintenance costs, and reduce client satisfaction.
- *Assessment and Mitigation:* Effective assessment requires a systematic framework for quality control and inspection throughout the project, not just at final handover.
- *Timing of Defects:* While many defects are identified at handover, they can also appear later during the warranty period, emphasizing the need for robust post-construction inspection.

Commonly Investigated Areas

- *Walls (cracks, peeling paint)*
- *Flooring/Tiling (incomplete grout, uneven surfaces)*
- *Plumbing and Water Leaks*
- *Windows and Doors (broken handles, improper fixing)*
- *Roofs (covering failures, leak)*

VII. CONCLUSION

1. **Proactive Management is Essential:** To minimize costs and improve quality, developers and managers must implement proactive, rather than reactive, defect management systems.
2. **Special Attention to Wet Areas:** Due to the high frequency of water-related issues, specific focus must be placed on waterproofing and plumbing, particularly in bathrooms and kitchens.

3. Significance of Independent Inspections: A significant number of homes are handed over with multiple, often latent, defects. The use of independent, professional building inspectors at handover is recommended to ensure that defects are identified and rectified before they become severe, long-term problems.
4. Warranty Period Utilization: Property owners should actively use the warranty period, especially the first 12 months, to report defects, as the number of valid defects often increases after the initial handover.

Improving construction quality control in new-build housing using thermography. *Energy and Buildings*, 66, 222–231.

In summary, the key to reducing the impact of defects is through rigorous, well-documented, and timely inspection regimes that focus on both structural components and interior finishes.

REFERENCES

- [1] Valdes, F., Gentry, R., Eastman, C. & Forrest, S. (2016). Applying systems modeling approaches to building construction. Paper presented at the 33rd International Symposium on Automation and Robotics in Construction, ISARC 2016.
- [2] Vargová, A. & Pavčková, M. (2013) Noise perception in residential building environment. *Advanced Materials Research*, 649, 281–284.
- [3] Vine, E. (1996). Residential building code compliance: Implications for evaluating the performance of utility residential new construction programs. *Energy*, 21(12), 1051–1058.
- [4] Vine, E., Williams, A. & Price, S. (2016). The cost of enforcing building energy codes: an examination of traditional and alternative enforcement processes. *Energy Efficiency*, 1–12. doi:10.1007/s12053-016-9483-2.
- [5] Zhang, D., Haas, C. T., Goodrum, P., Caldas, C. H. & Granger, R. (2011). Analysis of a rework reduction program for construction productivity continuous improvement. Paper presented at the Annual Conference of the Canadian Society for Civil Engineering 2011, CSCE 2011, Ottawa.
- [6] Taylor, T., Counsell, J. & Gill, S. (2013). Energy efficiency is more than skin deep: