



UNDERSTANDING CONSTRUCTION DEFECT PATTERNS DURING THE DEFECTS LIABILITY PERIOD: IMPLICATIONS FOR RESIDENTIAL PLANNING IN MALAYSIA

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Abstract

Construction defects present a persistent challenge within Malaysian residential projects, impacting long-term sustainability and the goals of national housing policies. This paper moves beyond mere defect occurrence, examining lessons learned from their occurrence during the defects liability period. A case study of 160 terrace house units in Kuala Terengganu was chosen. The research adopted a mixed-method approach. First, a quantitative research method was adopted to identify the type of defects. These data were sorted and transferred into the SPSS software version 29 using frequency analysis to analyse the defect patterns. The qualitative research method involved analysing the defects sheet list and conducting semi-structured interviews with the project manager and the site supervisor to investigate the causes of these defects. The data were then transcribed and analysed using content analysis. Findings reveal that architectural works are predominantly affected, with poor material quality, substandard workmanship and inadequate supervision identified as primary contributors. These insights hold significant implications for urban and housing planning, informing the strategic integration of quality assurance into residential development. It also provides actionable recommendations for policymakers and industry stakeholders to enhance building standards, minimise defects and promote a more resilient and sustainable residential built environment.

Keywords: Construction defects, residential projects, defects liability period, quality

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INTRODUCTION

The rapid pace of urbanisation in Malaysia has elevated the construction sector to a significant position within the national economy. However, alongside this growth, construction defects—defined in this study as non-conformities or failures in workmanship, materials, or design that deviate from specified standards—have emerged as a persistent and critical issue (Sellakutty & Rajendran, 2017; (UiTM) et al., 2023). These defects undermine not only structural integrity and aesthetic quality but also long-term sustainability outcomes in residential developments.

Defects are frequently attributed to deficiencies in project planning and implementation, including inadequate coordination among stakeholders, failure to identify early warning signs, and weak quality control practices (Najihah et al., 2023). Importantly, construction defects are not merely technical issues; they directly affect planning implementation mechanisms, including delays in approvals and certifications, increased inspection burdens, enforcement actions during the Defects Liability Period (DLP), and weakened feedback loops for improving future developments. As a result, defects contribute to cost overruns and inefficiencies, with studies estimating that approximately 2%–6% of contract values are spent on rectification works (Muhammuddin et al., 2023; Olanrewaju et al., 2021).

Despite regulatory frameworks such as the Housing Development Act (which mandates a 24-month DLP) and broader national policies (e.g., National Construction Policy 2030 and National Housing Policy 2030), existing studies indicate a gap between policy intent and on-the-ground implementation, particularly in relation to governance, enforcement, and stakeholder accountability. Furthermore, while prior research has identified general causes of defects, there remains limited empirical integration between defect occurrence data and planning decision-making processes, especially how defect trends inform approvals, inspections, and continuous improvement mechanisms in residential projects.

Research Gap

Current literature tends to (i) examine defects from a technical or cost perspective, or (ii) discuss policy frameworks at a high level, but rarely connects defect occurrence with planning implementation processes and governance mechanisms in a structured and evidence-based manner. There is also insufficient clarity on how defect data can be systematically utilised to strengthen regulatory feedback loops and improve future project delivery.

Research Questions / Objectives

Accordingly, this study addresses the following questions:

1. What are the most prevalent types and causes of construction defects in Malaysian residential projects?
2. How do these defects impact planning implementation processes, particularly approvals, inspections, and enforcement during the project lifecycle?
3. What gaps exist between regulatory frameworks and actual practices in managing construction defects?
4. How can defect occurrence data be leveraged to improve governance, feedback mechanisms, and sustainable residential planning outcomes?

By addressing these questions, this research aims to provide actionable insights for project teams and policymakers to enhance construction quality and strengthen planning implementation practices. Ultimately, improving defect management contributes to more sustainable, resilient, and high-quality residential development in Malaysia, aligning with broader national and global sustainability goals.

LITERATURE REVIEW

Definition of Construction Defects

Construction defects are generally defined as deficiencies in design, workmanship, or materials that result in failure to meet intended performance or contractual requirements (Isa et al., 2016; Lambers et al., 2023). They may occur during construction or after handover and include both visible (patent) and hidden (latent) defects (Alabi et al., 2024). In this study, construction defects refer to observable or latent non-conformities arising from design, materials, workmanship, or process failures that compromise building performance, quality, or compliance. This definition enables defects to be examined not only as technical issues but also in relation to planning implementation processes such as approvals, inspections, enforcement, and feedback mechanisms.

Types, Causes and Categories of Construction Defects

Existing studies show consistent patterns in defect types and causes within residential projects. Architectural defects are most frequently reported, followed by structural and mechanical defects, while electrical defects are less common (Olanrewaju et al., 2021). However, this trend may reflect visibility bias, as more noticeable defects are more likely to be reported by occupants (Amin, 2010). Defects are typically classified into patent defects, which are detectable during

inspection, and latent defects, which emerge during occupancy (Alabi et al., 2024).

The causes of defects are well established, including poor workmanship, inadequate supervision, substandard materials, design inconsistencies, and documentation errors (Sandanayake et al., 2021). Among these, workmanship and human-related factors are often the most significant, particularly in contexts with limited skilled labour. These upstream factors—workmanship quality, site supervision, and compliance with specifications—interact to influence defect occurrence. Weaknesses in these areas increase the likelihood of defects, which subsequently affect planning processes such as approvals, inspections, enforcement during the Defects Liability Period, and regulatory feedback loops.

Despite these insights, the literature remains fragmented, often separating defect types from their underlying causes and lacking integration with planning implementation. To address this, this study adopts and refines the classification by Najihah et al. (2023), which categorises defect causes into design, material, documentation, workmanship, lack of protection, maintenance, natural factors, vandalism, user abuse, and wear and tear. This framework is selected for its comprehensive coverage and its ability to distinguish between controllable factors and external influences, making it suitable for analysing governance and regulatory responses.

Defects Issues in Residential Projects in Malaysia

In Malaysia, construction defects remain a persistent issue in residential developments despite existing policies and regulatory frameworks. Homebuyer dissatisfaction continues, particularly in low- and medium-cost housing, with common defects affecting key building elements such as roofs and walls (Talib et al., 2015). While the number of completed housing units has increased, the prevalence of defects highlights a gap between housing delivery and quality outcomes.

These defects not only affect building performance and user satisfaction but also disrupt planning implementation processes, including delays in approvals and certifications, increased inspection requirements, and enforcement actions during the Defects Liability Period. Furthermore, the absence of systematic feedback mechanisms limits the ability of regulatory bodies to learn from defect trends and improve future developments.

Accordingly, this study contributes by integrating defect types and causes into a unified framework, prioritising key defect drivers, and establishing a linkage between defect occurrence and planning implementation processes. This provides a practical basis for improving construction quality and strengthening planning governance in residential development. This persistent

issue underscores the need for a more robust understanding of defect characteristics and their underlying causes within the Malaysian context (Olanrewaju et al., 2021). Specifically, previous research on Malaysian residential projects indicates that faulty design, poor workmanship, and substandard materials are principal contributors to construction defects (Shooshtarian et al., 2024), with non-structural cracks being particularly prevalent (Najihah et al., 2023.). Further investigations into defects in Malaysian residential projects have also highlighted issues stemming from improper installation techniques and inadequate soil analysis, which contribute significantly to various structural and aesthetic deficiencies (Abdul-Rahman et al., 2012). The rapid development and demand for housing projects in Malaysia have led to increased reports of defects, indicating that latent defects, which often surface after the defect liability period, are frequently linked to poor workmanship, climate conditions, and design flaws, including material selection and supervision during construction (Sahi et al., 2022; Saufi et al., 2023).

METHODOLOGY

This study adopts a mixed-methods research design to provide a comprehensive understanding of construction defect patterns and their underlying causes in Malaysian residential projects. The integration of quantitative and qualitative approaches enables both statistical identification of defect trends and in-depth exploration of causal factors, thereby strengthening the overall analytical rigour. A case study of 160 units of terrace houses in Kuala Terengganu is chosen as the sample. Kuala Terengganu was chosen since it is among the states experiencing rapid growth for the construction of residential projects and the fastest district in terms of construction rate in Terengganu. The project defect sheet list reported by the home buyers was analysed manually to investigate the types of defect occurrence according to the work discipline i.e., architectural defects, structural defects, mechanical defects, and electrical defects. The data obtained was transferred into Statistical Packaging for Social Science (SPSS) Version 29 and analysed using frequency analysis.

Next, an online semi-structured interview with the project manager and site supervisor was conducted to ascertain the causes of each defect identified previously. Moreover, both had experienced managing projects for more than 28 years. The interviewees were contacted using phone calls to set the date and time for the interview. They agreed to be interviewed via Google Meet on 26 January 2023 at 3:00 p.m. This data was transcribed and analysed using content analysis.

FINDINGS

Types of Defects

Table 1 outlines the overall type and number of defects by element according to work disciplines. In addition, it also ranks the most defective element based on their work disciplines.

Table 1: Types and Numbers of Elemental Defects According to Work Discipline

Element/Work discipline	Total no of defects	Rank
A) Architectural		
1. Roof	132	5
a) Blockage of gutter system and rainwater downpipe	104	
b) Missing roof tiles	28	
2. Staircase	52	6
Peeling off paint	52	
3. Wall, Floor and Ceiling Finishes	2524	1
a) Peeling of paint at wall	558	
b) Dirty and stain mark	542	
c) Peeling of paint at ceiling	380	
d) Plaster crack	256	
e) Unevenness of paint	196	
f) Poor finishing of wall plaster	185	
g) Watermark at ceiling due to roof leakage	164	
h) Poor installation of floor tiles	158	
i) Plaster peeling	76	
j) Fungus on the wall	9	
4. Windows & Fittings	438	3
a) Poor fixing of window	222	
b) Dirty and stain mark at window	188	
c) Hairline crack	28	
5. Doors	670	2
a) Dirty and stain mark at door	200	
b) Door leaf damaged	182	
c) Door frame damaged	138	
d) Poor fixing of door	94	
e) Door leaf difficult to open	56	
6. Sanitary Fittings, Fixtures & Toilet Cubicles	288	4
a) Loose fittings / Improper installation of fittings	164	
b) Incomplete installation of plug socket	86	
c) Dirty and stain mark	38	
B) Structural		
1. Wall	138	1
Wall crack	138	

Element/Work discipline	Total no of defects	Rank
2. Floor	114	2
Floor crack	114	
3. Ceiling	70	3
Ceiling crack	70	
4. Skirting	32	6
Skirting crack	32	
5. Floor trap	50	5
Blockage of floor trap	50	
6. Drainage	66	4
a) Drainage crack	32	
b) Blockage of drainage	34	
7. Pipe	10	7
Blockage of pipe	10	
C) Mechanical		
1. Pipe Installation	98	1
a) Wrong pipe installation	48	
b) Plumbing equipment damaged	26	
c) Overflow of pipe	24	
D) Electrical		
1. Electric Supply System & Fittings	96	1
a) Dirty socket	86	
b) Dirty ducting	6	
c) Unplugged fitting	4	

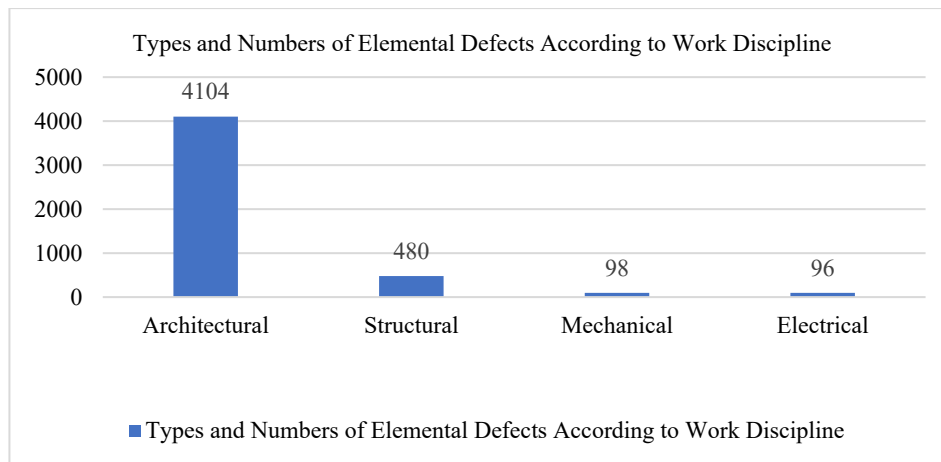


Figure 1: Types and Numbers of Elemental Defects According to Work Discipline

Figure 1 illustrates the distribution of elemental defects according to work discipline. Architectural defects recorded the highest number of cases (4,104), followed by structural (480), mechanical (98), and electrical defects (96).

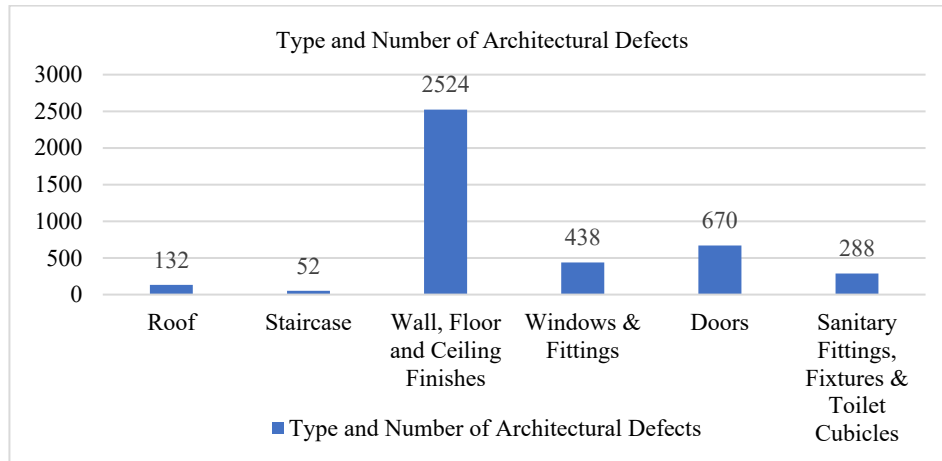


Figure 2: Type and Number of Architectural Defects

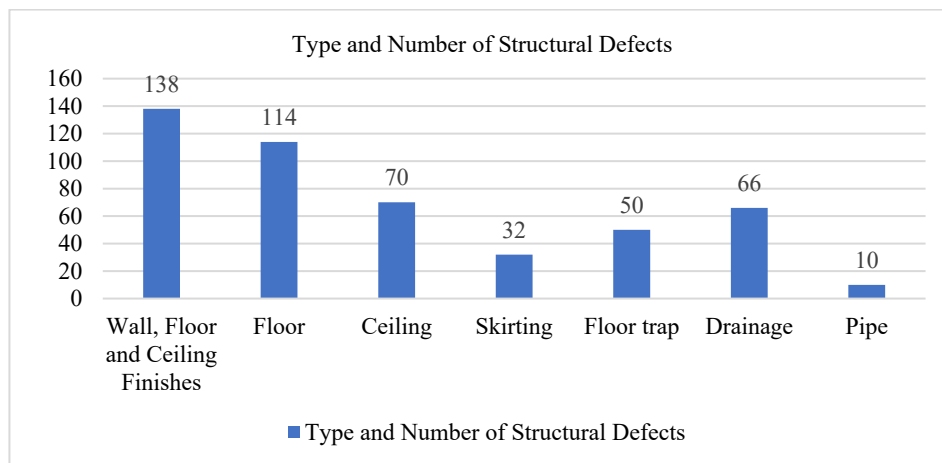


Figure 3: Type and Number of Structural Defects

As illustrated in Figure 2, architectural defects were predominantly associated with wall, floor, and ceiling finishes, accounting for 2,524 cases. This was significantly higher compared to other architectural elements such as doors (670 cases), windows and fittings (438 cases), and sanitary fittings, fixtures, and toilet cubicles (288 cases). Roof and staircase defects recorded the lowest frequencies, with 132 and 52 cases, respectively. The findings indicate that finishing-related works contribute substantially to the overall architectural defects during the DLP.

Figure 3 demonstrates the pattern of structural defects identified in the residential projects. The most frequently reported defects involved wall, floor,

and ceiling finishes (138 cases), followed by floor defects (114 cases). Defects related to ceiling, drainage, floor traps, skirting, and pipes were comparatively lower. The low occurrence of pipe defects (10 cases) suggests that plumbing-related structural issues were less significant compared to finishing and flooring defects. Architectural works are disproportionately affected by defects when compared to other work disciplines such as structural, electrical, and mechanical elements. This suggests a critical area requiring intensified attention during the design, construction, and inspection phases, particularly concerning the finishing and aesthetic aspects of residential units. The prevalence of architectural defects may indicate deficiencies in detailing, material application, or supervision specific to these visible and often user-facing elements. Seven architectural elements were involved with Wall, Floor and Finishes being the most defective elements recorded. Meanwhile Staircase was identified as the least defective work. In structural works, building cracks as the most defective element and pipe works was identified as the least defective element in mechanical works. Only one element as involved in both mechanical and electrical works. For mechanical works, wrong pipe installation is the major defective works occurred and overflow of pipe is the least defective work. Meanwhile, only electrical supply system and fittings were recorded in electrical works.

Causes of Defects

Table 3 presents the 32 causes of defects in architectural works. Amongst these causes, four principal causes emerged: poor workmanship, works not accordance to specification, lack of supervision and a pervasive lack of supervision. These causes frequently interact to exacerbate the incidence of defects, underscoring critical areas where existing construction processes and their oversight require immediate and substantial modification (Najihah et al., 2023). Poor workmanship directly results in defects installations and finishes and inadequate construction management (Fromsa et al., 2020).

Table 2: Causes of Architectural Defects and Its Frequent Causes

Element	Causes of defects	The most frequent causes of defects
Wall, Floor and Finishes	Works not accordance to specification	1. Poor workmanship 2. Works not accordance to specification 3. Lack of supervision 4. Lack of protection
	Lack of protection	
	Poor workmanship	
Doors and Fittings	Works not accordance to specification	
	Inappropriate door material	
	Lack of supervision	
	Wrong measurement of doors and doors margin	
	Exposed to weather	
	Lack of protection	
	Poor workmanship	

Element	Causes of defects	The most frequent causes of defects
Ceiling finishes	Works not accordance to specification	
	Roof leakage	
	Poor workmanship	
	Lack of supervision	
Windows and Fittings	Lack of protection	
	Poor workmanship	
	Different floor level	
	Works not accordance to specification	
	Lack of supervision	
Sanitary Fittings, Fixtures and Toilet Cubicles	Works not accordance to specification	
	Poor workmanship	
	Lack of supervision	
	Lack of protection	
Staircase	Lack of protection	
	Works not accordance to specification	
Roof	Poor workmanship	
	Works not accordance to specification	
	Lack of supervision	

Works not accordance to specification can lead to premature failure and aesthetic compromises and is influenced by factors affecting the use of substandard materials (Faremi et al., 2020). Critically, the lack of effective supervision often allows both poor materials and workmanship to go unaddressed, perpetuating the cycle of defects. The inability of the supervisory team to identify and rectify poor-quality materials at critical junctures is a substantial contributing factor (Sin et al., 2024).

Table 3: Causes of Structural Defects and Its Frequent Causes

Element	Causes of defects	Frequent causes of defects
Building Crack	Poor workmanship	1. Poor workmanship 2. Works not accordance to specification 3. Lack of supervision 4. Lack of protection
	Works not accordance to specification	
	Lack of supervision	
	Roof design failure	
Blockage	Lack of protection	
	Poor workmanship	
	Works not accordance to specification	
	Lack of supervision	
Drainage	Lack of protection	
	Poor workmanship	
	Works not accordance to specification	
	Lack of supervision	

Table 4 provides crucial insights into the nature of structural defects in residential projects. Like architectural works, poor workmanship, works not in accordance with specification, lack of supervision and lack of protection are the four most frequent causes of defects. The table consistently identifies poor workmanship as a frequent cause for building cracks, roof failures and drainage problems. This indicates that a significant portion of structural defects stems directly from the inadequate execution of construction tasks by labour. Work not in accordance with specification directly results in defects installations and finishes that can compromise the structural integrity and functionality of various building elements (Fromsa et al., 2020). Lack of supervision is due to the inability of supervisory teams to identify and rectify poor-quality materials (Sin et al., 2024). Thus, directly correlates with an increased incidence of defects. Addressing these overarching findings is paramount for developing robust quality assurance frameworks and fostering genuinely sustainable residential planning in Malaysia.

Table 4: Causes of Mechanical Defects and Its Frequent Causes

Element	Causes of defects	Frequent causes of defects
Pipe installation	Works not accordance to specification	Works not accordance to specification

Table 5: Causes of Electrical Defects and Its Frequent Causes

Element	Causes of defects	Frequent causes of defects
Electric Supply System and Fittings	Lack of protection	Lack of protection Works not accordance to specification
	Works not accordance to specification	
	Lack of supervision	

Table 5 and 6 indicates causes for both mechanical and electrical defects. It is found that works not accordance to specification is a primary cause of defects in both disciplines. This signifies a fundamental breakdown in translating design intent and technical requirements into built reality. When construction deviates from approved plans, material specifications, or performance standards, the resulting structures are inherently vulnerable to defects. Clear and carefully prepared specifications are crucial for conveying technical requirements, but their misuse or non-use can lead to disputes and defects. Problems with plumbing systems are commonly reported by residential building owners, and if left unaddressed, these defects can lead to significant damages and repair costs (Gurmu & Mudiyansele, 2023).

DISCUSSION

This paper provides crucial insights for policymakers, industry practitioners, and all stakeholders involved in Malaysia's residential projects. It offers a

foundational understanding necessary to minimise defects and ensure the long-term durability and dependability of residential constructions. The persistent issue of construction defects, notably within architectural works and predominantly attributable to poor material quality, deficient workmanship, and inadequate supervision (Najihah et al., 2023), necessitates a fundamental re-evaluation of current planning and development paradigms.

From a planning perspective, these observed defects are not merely isolated construction failures but are indicative of broader systemic challenges embedded within the residential development lifecycle (Yarnold et al., 2023). The Malaysian government's focus on quality and durability, as articulated in the National Housing Policy 2030, clearly acknowledges the gravity of this issue. The identified root causes suggest that existing planning regulations, building codes, and enforcement mechanisms may be insufficient or inadequately implemented. Integrating comprehensive quality assurance proactively into the entire residential planning lifecycle is therefore paramount. This entails several key strategies:

- a) **Pre-Construction Planning and Design Review** -This requires the implementation of more stringent reviews of proposed materials and construction methods during the planning permission application process. Patel et al., 2021 suggested that the developers should be mandated to submit detailed quality management plans outlining how materials will be sourced, quality checked and installed to meet national standards.
- b) There is a need to enhance the capacity and frequency of independent site inspections and supervision by regulatory bodies, as current inspections often have limitations. This would ensure strict adherence to approved plans, established building standards, and quality management protocols throughout the construction period (Salvi & Kerkar, 2020). In developing countries, effective quality management practices are critical, and challenges are often attributed to ineffective quality management systems (Odiba et al., 2021).
- c) **Post-occupancy evaluation and feedback loops:** Utilising data and feedback gathered during the DLP is essential to refine future planning guidelines and construction practices (Lee et al., 2020). Establishing a robust feedback mechanism allows "lessons learned" from defects to directly inform improvements in subsequent projects, creating a continuous improvement cycle within the planning and construction ecosystem. This can involve assessing the impact of defects to make sustainable decisions on continuous improvement activities (Milion et al., 2021). Defect reporting and building inspection processes are crucial before handover to new owners.

Addressing construction quality directly contributes to Malaysia's overarching sustainable urban development goals. By ensuring the long-term durability and dependability of residential constructions, the nation fosters a more resilient and sustainable conscious construction industry. Government agencies and planning authorities must foster greater collaboration with developers, contractors, and homeowners to establish a shared culture of quality and accountability. This includes strengthening regulatory frameworks, providing clear and accessible guidelines, and promoting transparent communication channels (Al-Otaibi et al., 2025). Educational initiatives targeted at project teams can also significantly enhance both cost-efficiency and overall construction quality, as supported by academic understanding of effective project management (Aqlima et al., 2024; Fromsa et al., 2020). Ultimately, the strategic imperative is to shift the focus from reactive defect rectification to proactive defect prevention, thereby embedding quality assurance as a core principle of residential planning strategy across Malaysia.

CONCLUSION

The research critically underscores the imperative of effective management of construction defects in Malaysian residential projects, particularly during the DLP. By thoroughly examining defect occurrences, the research sheds light on underlying systemic issues that, if addressed, could foster a more robust and sustainable construction industry. The findings clearly demonstrate that architectural defects are the most prevalent, with their primary causes consistently identified as poor material quality, poor workmanship and inadequate supervision.

For residential planning in Malaysia, this research provides crucial evidence to inform and enhance existing quality assurance frameworks, policy interventions, and sustainable practices. The direct links established between construction defects and national policies underscore that construction quality is not merely an operational detail but an integral and foundational component of broader national development objectives. By strategically addressing the root causes of defects, Malaysia can proactively advance towards developing a resilient and sustainable construction industry, thus enhance the livability of its urban areas.

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