Malaysian Journal of Sustainable Environment
Special issue, Dec (2024) 195-218
doi: 10.24191/myse.v11i3.3918

SIGNIFICANT SOLUTIONS IN MINIMISING CONSTRUCTION DEFECTS OCCURRENCE DURING DEFECT LIABILITY PERIOD (DLP) FOR RESIDENTIAL PROJECTS IN KUALA TERENGGANU

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Received: 06 March 2024
Accepted: 25 September 2024
Published: 31 December 2024

ABSTRACT

Construction defects are a widespread problem in Malaysia, just as they are in other countries throughout the world. Furthermore, a significant proportion of the construction defects that have arisen are not adequately documented. Particular defects have the potential to bring about the emergence of further problems. It is possible to prevent the creation of several additional problems if the basic defects are identified and resolved at an early point in the process. The primary objective of this research was to recommend significant solutions toward minimising construction defect occurrence during the defect liability period for residential projects in Kuala Terengganu. To gather insights, a questionnaire survey targeting 71 registered building surveyors was conducted and 30 positive responses were returned in a usable format with a 42% response rate. The survey instrument gauged their perspectives on mitigating construction defects. Correspondingly, 30 questionnaires were collected and analysed using descriptive analysis and Confirmatory Factor Analysis (CFA) using SPSS software version 29 to derive findings. The results emphasize the importance of implementing a six-phase approach to efficiently minimize construction defects. These phases include raising awareness, conducting investigations, *identifying defects, evaluating findings, implementing remedies, and pursuing financial recovery. Such a systematic approach holds promise for offering substantial solutions to mitigate construction defects in residential projects, serving as valuable references for stakeholders including the construction industry, developers, and the public. Moreover, this study fills a notable gap in the existing literature and enhances understanding of construction defects, paving the way for the adoption of improved construction methodologies in the future.*

Keywords: *Construction defects, Significant solutions, Minimising, Residential projects*

INTRODUCTION

Malaysian residential developments are plagued by recurrent construction defect, which pose a threat to the country's rapidly developing construction sector (Isa et al., 2021; Kartina et al., 2018). These defects frequently arise due to deficiencies in project implementation, with project overseers being cognizant of early indicators that allow for proactive steps to tackle underlying problems (Isa et al., 2010; Jorgensen, 2009). According to the Housing Development Act (HDA), there is a requirement for 24 months after receiving the keys where contractors and developers are responsible for any defects. This highlights the need for them to reduce the occurrence of defects during this time, in line with sustainable construction practices and Sustainable Development Goal 11 (Hassan et al., 2022).

The National Housing Policy 2030 in Malaysia takes a comprehensive approach to addressing construction defects in affordable housing, prioritizing the quality and durability of residential properties (Olanrewaju, 2021; Zolkafli et al., 2014). Research efforts focus on hidden defects and strategies to raise awareness among property buyers, aligning with the policy's goals. Additionally, the policy anticipates significant transformations in the construction industry, incorporating technology to mitigate defects and improve overall efficiency (Rahimin et al., 2023; Khotamov, 2023).

Defect Liability Period (DLP) is a mechanism that guarantees contractors are held responsible for any shortcomings, thereby satisfying their legal and contractual obligations to address and fix defects (Zhao et al., 2021). Furthermore, it is economically advantageous to addressing defects during this period, as the early identification and rectification of problems are generally less costly than dealing with them after the period has concluded (Raj et al., 2020). During this stage, it is essential to ensure the quality and durability of the construction by making necessary adjustments to meet standards and improve long-term performance (Choi et al., 2020). Furthermore, it allows for the observation and evaluation of the building's performance under real-life situations, providing valuable insights for enhancing future construction practices (Jafari & Valentin, 2021). This research is focusing on the area of Kuala Terengganu. REHDA (2021) identified Terengganu, especially Kuala Terengganu as among the states that have rapidly completed residential projects with 872 numbers of residential projects. Kuala Terengganu also had been identified as the fastest district in terms of construction rate in the state of Terengganu (National Property Information Centre, 2023). Sandanayake et al. (2021) stated that reducing defects requires multiple processes to identify important gaps and trends before conducting a systematic analysis and implementing a framework. Benarroche (2019) suggested examining the terms of contracts and regulation coverage, enforcing quality management systems, and moving quickly to reduce construction defects. Relearning defects is crucial to addressing construction defects. Research endeavours aim to recommend significant solutions towards minimising construction defects occurrence during DLP for residential projects in Kuala Terengganu

LITERATURE REVIEW

Construction Defects

Construction defects occur when there are defects in the design, craftsmanship, or materials used during the construction of a building or structure. These defects result in the building or structure not meeting its intended performance or contract requirements (Lambers et al., 2023; Sellakuty et al., 2017; Kraus et al., 2017). In recent years, there has been a growing recognition of construction defects in the Malaysian construction industry, as evidenced by several studies (Sandanayake et al., 2021; Dzulkifli, 2021; Sravani & Chandgude, 2020; Sellakutty et al., 2017). Despite the progress made in building technology, the occurrence of construction defects continues to be a persistent problem, emerging as the most frequent issue in construction projects in Malaysia (Sravani & Chandgude, 2020). The defects primarily arise from insufficient design and construction practices, resulting in a decrease in the overall value of the structures. Moreover, they have a substantial influence on the calibre and long-term expenses of residential construction (Gurmu & Cole, 2018). Alomari (2021) emphasised the widespread occurrence of construction problems on a global scale, underscoring their importance within the construction industry. To fully appreciate the significance of these defects, project teams need to understand their consequences and relationships (Isa et al., 2011; Olanrewaju et al., 2010; Jorgensen, 2009). It is possible to address ongoing issues with newly constructed homes both domestically and globally by studying and using the lessons learned from these experiences (Hopkin et al., 2016).

In addition, Lambers et al. (2023) stated that construction defects have a substantial impact on the quality of performance, leading to regular increases in project costs and delays in the schedule, mostly because of the necessity for redoing the work. According to Alomari (2021) and Ibrahim et al. (2016), construction defects refer to the incorrect installation of a building component, resulting in its failure. According to Yacob et al. (2019), defects are defined as imperfections that diminish the state of being flawless, whereas damage to a building happens when construction work or building materials are not functional.

Defect Liability Period (DLP)

The DLP is the most important and complicated phase in the project stage, particularly in managing defects issues. DLP is intended to supplement this liability by determining how and when the contractor must correct the faulty work that becomes apparent during this stage. During this phase, many defects, such as minor and major defects, will be discovered and recorded in the schedule of defects. As stated in the PWD Standard Form of Contract PWD203A (Rev 1/2010), the contractor is responsible for rectifying the defects before issuing the Certificate of Making Good Defects. The project is handed over to the client. However, this process should not end here. Tracking the inter-relationships and the “ripple effect” of the causal relationships of defects appears possible. The project team should learn and re-learn the nature of the defects documented so that similar mistakes/ defects will not be repeated in future projects. Furthermore, Shafiq et al. (2020) and Asante et al. (2017) also added that DLP can assist both owners and contractors in managing their respective risks under the construction contract since it establishes a contractual obligation for the contractor to return to the job site and correct any defects discovered in the work it has completed.

DLP, which begins on the day of Vacant Possession, is typically in place for 18 to 24 months. Throughout this period, the house owner has the right to report any issues regarding the quality of the house. However, since the end product's quality is of little concern and the less knowledgeable owners on defects issues, these issues are increasing. Therefore, most homebuyers nowadays outsource the task of reporting defects to a third party. The DLP provisions are specified under the standard types of construction contracts, i.e., PAM 2018 Clause 15 – Practical Completion and Defects Liability and PWD 203A Clause 48 – Defects After Completion.

Defects Issues in Residential Projects in Malaysia

According to the findings of Azmin et al. (2022), residential projects in Malaysia tend to have several problems that affect their quality and functionality. The infiltration of moisture, the deterioration of the outer facade, sanitary difficulties, and construction that does not meet standards are all examples of common defects that are frequently seen in buildings. The presence of these defects has the potential to result in dissatisfaction among inhabitants, disagreements between clients, developers, and maintenance groups, and potentially even legal action. According to Azmin et al. (2022), defective products can be traced back to a variety of factors, including human error, improper work processes, design problems, and construction variations.

Through the findings of the research carried out by Hassan et al. (2022), Azmin et al. (2022), Plebankiewicz and Malara (2020), Suffian (2013), and Chohan et al. (2011), it has been discovered that a sizeable fraction of quality failures and defects occur during the construction phase. This highlights how important it is to improve building methods and put in place quality control mechanisms that are effective.

As stated by Azmin et al. (2022), it was discovered that the cheap housing sector in Malaysia was subjected to criticism for inferior construction, which resulted in the establishment of housing complexes that were defective and unacceptable. The fact that non-structural fractures were the most common and major construction defects in Malaysian construction projects was brought to light by Hassan et al. (2022), which demonstrates the widespread incidence of structural difficulties. According to the findings of Chohan et al. (2011), private housing in Malaysia frequently exhibits common architectural defects such as moisture, facade deterioration, and challenges with hygiene.

A significant problem that Malaysia is dealing with is the presence of defects in residential projects, which has a direct influence on the quality of housing and the maintenance of. It is vital to implement a comprehensive strategy to address these issues (Hassan et al., 2022; Azmin et al., 2022; Plebankiewicz and Malara, 2020; Suffian, 2013; Chohan et al., 2011). This strategy should include improved building procedures, stringent quality control measures, and efficient maintenance approaches.

RESEARCH METHODOLOGY

This study applied a case study research design focusing on a residential project in Puncak Temala, Kuala Terengganu, Malaysia as the case study area of investigation and gathering surveys from building surveyors registered with the Royal Institution of Surveyors Malaysian (RISM). Quantitative data were gathered through structured questionnaire survey to gauge the significant solutions to minimise construction defects occurrence during DLP for residential projects from registered building surveyors perspective. The participants were provided with multiple options to reduce construction defects for 12 elements in residential projects, categorised into four disciplines: architectural, structural, mechanical, and electrical.

The choice of respondents for the study involves selection using the Purposive Sampling technique. Building Surveyors were chosen as respondents in this research because a building surveyor is a professional in construction who offers expert guidance on real estate and building issues (Ali & Woon, 2012; Isnin et al., 2016). The determinant criteria required in this research questionnaire is that the building surveyors involved must be registered with RISM in 2022. The registered building surveyors also need to have at least 2 years of experience working in this industry and they have experience in making defects reports during the defects liability period. The number of populations for this research is 86. Then, a sample size for the building surveyor was calculated using a Raosoft sample size calculator, providing a confidence level of 95% and a margin of error of 5% with a relevant number for the respondents' sample size calculated was 71. The questionnaire survey was distributed online through Google Forms questionnaire.

In analysing and evaluating the results of this study, quantitative approaches were used involving data and information analysed through the perception survey method. Quantitative data obtained through structural questions involving Likert scale-type questions contained in structured questionnaire forms were analysed by using the SPSS software. In analysing and evaluating the results of this study, quantitative approaches were used involving data and information analysed through the perception survey method. Quantitative data obtained through structural questions involving Likert scale-type questions contained in structured questionnaire forms were analysed by using the SPSS software. The data was analysed using descriptive analysis involving frequency distribution and mean and presented in the form of tables. Further analysis was done through the inferential analysis based on CFA to analyse the significant variables by measuring the relationship between factors and variables.

RESULTS AND DISCUSSION

The significant solutions to minimise construction defects occurrence during DLP for residential projects in Malaysia were assessed based on the descriptive analysis. The findings on significant solutions are shown in Tables 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12.

According to Zaki and Ahmad (2017), the interpretation of the mean score measured by considering the mean score 1.00 to 1.89 is very low, 1.90 to 2.69 is low, 2.70 to 3.49 is moderate, 3.50 to 4.29 is high and 4.30 to 5.00 is very high.

Element 1: Architecture Defects – Wall, Floor and Finishes

Table 1. Solutions to Minimise Defects-Wall, Floor and Finishes

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1	Enhance the quality by strict supervision in the construction site	0	0	0	6	19	4.75	Very high
2	Ensure the labour has appropriate training and experience	0	1	1	3	20	4.68	Very high
3	Improve the method of installations	0	0	2	6	17	4.60	Very high
4	Select the suitable materials that have been specified in the building plan	0	0	2	7	16	4.56	Very high
5	Ensure the site manager conducts daily or weekly quality inspections	0	2	3	5	15	4.32	Very high
6	Ensure there is a good arrangement of manpower	1	0	6	7	11	4.08	High
7	Ensure that the drawings' designs are well-prepared	1	1	6	7	10	3.96	High

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree

Source: Author

There are seven solutions to minimise defects for element architectural under walls, floors, and finishes have seven solutions considered. The findings show that scores for the solutions ranged from 4.08 to 4.75 with the highest score being item no five which enhances the quality by strict supervision in the construction site with mean = 4.75, followed by item no six and item no one with a mean score = 4.68 and 4.60. The lowest mean score for these solutions is item no four which ensures that the drawings' designs are well prepared with a mean score = 3.96. Next, item number two has a mean score of 4.56, followed by item number three with a mean score of 4.32. The last one is item number seven with a mean score of 4.08 with a high mean interpretation.

Element 2: Architecture Defects – Windows & Fittings

Table 2. Solutions to Minimise Defects-Windows and Fittings

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Enhance the quality by strict supervision in the construction site	0	0	0	6	19	4.76	Very high
2.	Ensure the labour has appropriate training and experience	0	0	1	6	18	4.68	Very high
3.	Follow the manufacturer's instructions	0	0	2	7	16	4.56	Very high
4.	Select the suitable materials that have been specified in the building plan	0	0	1	12	12	4.44	Very high
5.	Ensure the site manager conducts daily or weekly quality inspections	0	1	4	5	15	4.36	Very high
6.	Ensure there is a good arrangement of manpower	0	0	5	8	12	4.28	High
7.	Ensure that the drawings' designs are well-prepared	1	0	2	11	11	4.24	High

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Solutions to minimise defects for element architectural under windows and fittings have seven solutions considered. The findings show that scores for the solutions ranged from 4.28 to 4.76 with the highest score are item no five which enhances the quality by strict supervision in the construction site with mean = 4.76, followed by item no six and item no two with a mean score = 4.68 and 4.56. The lowest mean score for these solutions is item no four which ensures that the drawings' designs are well prepared with a mean score = 4.24. Next, item number one has a mean score of 4.44, followed by item number three with a mean score of 4.36. The last one is item number seven with a mean score of 4.28 with a high mean interpretation.

Element 3: Architecture Defects – Doors & Fittings

Table 3. Solutions to Minimise Defects-Doors and Fittings

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Follow the manufacturer's instructions	0	0	0	8	17	4.68	Very high
2.	Enhance the quality by strict supervision in the construction site	0	0	1	6	18	4.68	Very high
3.	Improve the installation methods of doors and fittings	0	0	1	9	15	4.56	Very high
4.	Select the suitable materials that have been specified in the building plan	0	1	1	8	15	4.48	Very high

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Element architecture for doors and fittings consist of four solutions being considered. The findings from the above table show that scores for the solutions ranged from 4.48 to 4.68 with the highest score being item no three and item no four which followed the manufacturer's instructions and enhanced the quality by strict supervision in the construction site with the same mean score= 4.68, followed by item no one with mean score = 4.56. The lowest mean score for these solutions is item no two which selects the suitable materials that have been specified in the building plan with a mean score = 4.48.

Element 4: Architecture Defects – Ceiling Finishes

Table 4. Solutions to Minimise Defects-Ceiling Finishes

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Enhance the quality by strict supervision in the construction site	0	0	0	6	19	4.76	Very high
2.	Ensure the labour has appropriate training and experience	0	0	0	7	18	4.72	Very high
3.	Improve the application methods of ceiling finishes	0	0	2	6	17	4.60	Very high
4.	Ensure the site manager conducts daily or weekly quality inspections	0	0	4	5	16	4.48	Very high
5.	Select the suitable materials that have been specified in the building plan	0	0	2	10	13	4.44	Very high
6.	Ensure there is a good arrangement of manpower	1	0	3	12	9	4.12	High

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Solutions to minimise defects for element architectural under-ceiling finishes have six solutions considered. The findings show that the highest score is item no four which enhances the quality by strict supervision in the construction site with a mean = 4.76, followed by item no five and item no one with mean scores = 4.72 and 4.60. The lowest mean score for these solutions is item no six which ensures that the drawings' designs are well prepared with a mean score = 4.12. Next, item number two has a mean score of 4.44, followed by item number three with a mean score of 4.48.

Element 5: Architecture Defects – Sanitary Fittings, Fixtures & Toilet Cubicles

Table 5. Solutions to Minimise Defects-Sanitary Fittings, Fixtures and Toilet Cubicles

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Improve the installation methods of sanitary fittings, fixtures, and toilet cubicles	0	0	0	5	20	4.80	Very high
2.	Ensure the labour has appropriate training and experience	0	0	1	3	21	4.80	Very high
3.	Enhance the quality by strict supervision in the construction site	0	0	1	7	17	4.64	Very high
4.	Ensure the site manager conducts daily or weekly quality inspections	0	1	3	5	16	4.44	Very high
5.	Ensure there is a good arrangement of manpower	1	0	1	13	10	4.24	High

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Element architecture for sanitary fittings, fixtures, and toilet cubicles consists of five solutions being considered. The findings from the above table show that, scores for the solutions were ranging from 4.24 to 4.80 with the highest scores being item no one and item no four which improve the installation methods of sanitary fittings, fixtures and, toilet cubicles to ensure the labour has appropriate training and experience with the same mean score= 4.80, followed by item no two with mean score = 4.64. The lowest mean score for these solutions is item no five mean score = 4.24. Lastly, item number three has a mean score of 4.44.

Element 6: Architecture Defects – Staircase

Table 6. Solutions to Minimise Defects-Staircase

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Enhance the quality by strict supervision in the construction site	1	0	1	6	17	4.80	Very high
2.	Improve workmanship quality	0	0	1	3	21	4.72	Very high
3.	Employing qualified labour forces	0	0	0	7	18	4.72	Very high
4.	Improve the methods of installation	0	0	1	9	15	4.56	Very high

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Element architecture for the staircase consists of four solutions being considered. The findings from Table 7 show that, scores for the solutions ranged from 4.56 to 4.80 with the highest score being item no two which enhance the quality by strict supervision in the construction site with a mean score= 4.80, followed by item no three and item no four with the same mean score = 4.72. The lowest mean score for these solutions is item no one which improve the methods of installation with mean score = 4.56.

Element 7: Architecture Defects – Roof

Table 7. Solutions to Minimise Defects-Roof

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Improve workmanship quality	0	0	1	3	21	4.80	Very high
2.	Enhance the quality by strict supervision in the construction site	0	0	0	6	19	4.76	Very high
3.	Improve the methods of installation	0	0	0	7	18	4.72	Very high
4.	Employing qualified labour forces	1	0	0	5	19	4.64	Very high

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Solutions to minimise defects for element architectural under roof have four solutions considered. The findings show that scores for the solutions ranged from 4.64 to 4.80 with the highest score being item no three which improves workmanship quality with a mean score = 4.80, followed by item no two and item no one with mean score = 4.76 and 4.72. The lowest mean score for these solutions is item no four which employing qualified labour forces with a mean score = 4.64.

Element 8: Structural Defects – Blockage

Table 8. Solutions to Minimise Defects-Blockage

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Improve workmanship quality	0	0	0	4	21	4.84	Very high
2.	Enhance the quality by strict supervision in the construction site	0	0	0	5	20	4.79	Very high
3.	Improve the methods of installation	0	0	0	9	16	4.64	Very high
4.	Employing qualified labour forces	1	0	1	5	18	4.56	Very high

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree

Source: Author

Solutions to minimise defects for element structural under blockage have four solutions considered. The findings show that scores for the solutions ranged from 4.56 to 4.84 with the highest score being item no three which improves workmanship quality with a mean score = 4.84, followed by item no two and item no one with a mean score = 4.79 and 4.64. The lowest mean score for these solutions is item no four which employs qualified labour forces with a mean score = 4.56.

Element 9: Structural Defects – Drainage

Table 9. Solutions to Minimise Defects-Drainage

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Improve workmanship quality	0	0	0	7	18	4.73	Very high
2.	Enhance the quality by strict supervision in the construction site	0	0	1	7	17	4.64	Very high
3.	Improve the methods of installation	0	0	2	7	16	4.56	Very high
4.	Employing qualified labour forces	1	0	1	8	15	4.44	Very high

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Solutions to minimise defects for element structural under drainage have four solutions considered. The findings show that scores for the solutions ranged from 4.44 to 4.73 with the highest score being item no three which improves workmanship quality with a mean score = of 4.73, followed by item no two and item no one with a mean score = 4.64 and 4.56. The lowest mean score for these solutions is item no four which employs qualified labour forces with a mean score = 4.44.

Element 10: Structural Defects – Building Cracks

Table 10. Solutions to Minimise Defects-Building Cracks

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Enhance the quality by strict supervision in the construction site	0	0	0	5	20	4.80	Very high
2.	Improve workmanship quality	0	0	1	3	21	4.80	Very high
3.	Employing qualified labour forces	1	0	1	5	18	4.56	Very high
4.	Improve the methods of installation	1	0	1	8	15	4.44	Very high

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Solutions to minimise defects for element structural under building cracks have four solutions considered. The findings show that scores for the solutions ranged from 4.44 to 4.80 with the highest score being item no two and item no three which enhance the quality of strict supervision in the construction site and improve workmanship quality with the same mean score = 4.80, followed by item four with mean score = 4.56. The lowest mean score for these solutions is item no one which improves the methods of installation with a mean score = 4.44.

Element 11: Mechanical Defects – Pipe Installation

Table 11. Solutions to Minimise Defects-Pipe Installation

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Improve workmanship quality	0	1	0	2	22	4.80	Very high
2	Employing qualified labour forces	0	0	0	5	20	4.80	Very high
3	Enhance the quality by strict supervision in the construction site	1	0	0	6	19	4.76	Very high
4.	Improve the methods of installation	0	0	0	10	15	4.60	Very high

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Element mechanical for pipe installation consists of four solutions being considered. The findings from Table 12 show that, scores for the solutions ranged from 4.60 to 4.80 with the highest score being item no three and item no four which improve workmanship quality and employing qualified labour forces with the same mean score = 4.80, followed by item two with mean score = 4.76. The lowest mean score for these solutions is item no one which improves the methods of installation with mean score = 4.60.

Element 12: Electrical Defects – Electrical Installation

Table 12. Solutions to Minimise Defects-Electrical Installation

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Employing qualified labour forces	0	0	0	6	19	4.76	Very high
2.	Enhance the quality by strict supervision in the construction site.	0	0	0	8	17	4.68	Very high
3.	Improve workmanship quality	0	1	0	6	18	4.64	Very high
4.	Improve the methods of installation.	0	0	0	9	16	4.63	Very high

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Element mechanical for pipe installation consists of four solutions being considered. The findings from Table 12 show that, scores for the solutions ranged from 4.60 to 4.80 with the highest score being item no three and item no four which improve workmanship quality and employing qualified labour forces with the same mean score = 4.80, followed by item two with mean score = 4.76. The lowest mean score for these solutions is item no one which improves the methods of installation with mean score = 4.60.

Element 12: Electrical Defects – Electrical Installation

Table 12. Solutions to Minimise Defects-Electrical Installation

Item	Solutions To Minimise Defects	Frequency					Mean	Interpretation
		SD	D	M	A	SA		
1.	Employing qualified labour forces	0	0	0	6	19	4.76	Very high
2.	Enhance the quality by strict supervision in the construction site.	0	0	0	8	17	4.68	Very high
3.	Improve workmanship quality	0	1	0	6	18	4.64	Very high
4.	Improve the methods of installation.	0	0	0	9	16	4.63	Very high

Notes: SD-Strongly Disagree D-Disagree M-Moderate A-Agree SA-Strongly Agree
Source: Author

Lastly, element electrical for electrical installation consists of four solutions being considered. The findings obtained as illustrated in Table 13, the highest mean score was item no. Four with mean score = 4.76 and item no. two with mean score = 4.68. The lowest mean score for these solutions is item no one which improved the methods of installation with a mean score = 4.63.

These solutions to minimize defects have been answered and selected by the registered building surveyors. Based on Table 2 to Table 13, all solutions obtained very high levels of mean measurements with a mean score of 3.51 and above. This shows that these solutions are interpreted as high-level and acceptable.

Therefore, all the solutions to minimise defects were determined based on the highest obtained mean score of 3.51 and above based on the highest mean obtained.

Table 13. Confirmatory Factor Analysis on Solutions to Minimise Occurrence of Defects

Work Discipline	Solutions	CV	Remark
Wall, Floor & Finishes	Improve the method of installations	0.944	Significant
	Select the suitable materials that have been specified in the building plan	0.966	Significant
	Ensure the site manager conducts daily or weekly quality inspections	0.963	Significant
	Ensure that the drawings' designs are well prepared-	0.931	Significant
	Enhance the quality by strict supervision in the construction site	0.993	Significant
	Ensure the labour has appropriate training and experience	0.844	Significant
	Ensure there is a good arrangement of manpower	0.906	Significant
Windows	Select the suitable materials that have been specified in the building plan	0.886	Significant
	Follow the manufacturer's instructions	0.863	Significant
	Ensure the site manager conducts daily or weekly quality inspections	0.958	Significant
	Ensure that the drawings' designs are well-prepared	0.815	Significant
	Enhance the quality by strict supervision in the construction site	0.993	Significant
	Ensure the labour has appropriate training and experience	0.800	Significant
	Ensure there is a good arrangement of manpower	0.872	Significant
Doors & Fittings	Improve the installation methods of doors and fittings	0.783	Significant
	Select the suitable materials that have been specified in the building plan	0.938	Significant
	Follow the manufacturer's instructions	0.805	Significant
	Enhance the quality by strict supervision in the construction site	0.914	Significant

Ceiling Finishes	Improve the application methods of ceiling finishes	0.886	Significant
	Select the suitable materials that have been specified in the building plan	0.895	Significant
	Ensure the site manager conducts daily or weekly quality inspections	0.835	Significant
	Enhance the quality by strict supervision in the construction site	0.993	Significant
	Ensure the labour has appropriate training and experience	0.859	Significant
	Ensure there is a good arrangement of manpower	0.992	Significant
Sanitary Fittings, Fixtures & Toilet Cubicles	Improve the installation methods of sanitary fittings, fixtures, and toilet cubicles	0.813	Significant
	Enhance the quality by strict supervision in the construction site	0.898	Significant
	Ensure the site manager conducts daily or weekly quality inspections	0.954	Significant
	Ensure the labour has appropriate training and experience	0.970	Significant
	Ensure there is a good arrangement of manpower	0.955	Significant
Staircase	Improve the methods of installation	0.948	Significant
	Enhance the quality by strict supervision in the construction site	0.886	Significant
	Improve workmanship quality	0.967	Significant
	Employing qualified labour forces	0.959	Significant
Roof	Improve the methods of installation	0.946	Significant
	Enhance the quality by strict supervision in the construction site	0.916	Significant
	Improve workmanship quality	0.967	Significant
	Employing qualified labour forces	0.966	Significant
Blockage	Improve the methods of installation	0.775	Significant
	Enhance the quality by strict supervision in the construction site	0.974	Significant
	Improve workmanship quality	0.884	Significant
	Employing qualified labour forces	0.975	Significant
Drainage	Improve the methods of installation	0.937	Significant
	Enhance the quality by strict supervision in the construction site	0.911	Significant
	Improve workmanship quality	0.836	Significant
	Employing qualified labour forces	0.933	Significant

Building Cracks	Improve the methods of installation	0.919	Significant
	Enhance the quality by strict supervision in the construction site	0.947	Significant
	Improve workmanship quality	0.972	Significant
	Employing qualified labour forces	0.967	Significant
Pipe Installation	Improve the methods of installation	0.957	Significant
	Enhance the quality by strict supervision in the construction site	0.993	Significant
	Improve workmanship quality	0.978	Significant
	Employing qualified labour forces	0.919	Significant
Electrical Installation	Improve the methods of installation	0.920	Significant
	Enhance the quality by strict supervision in the construction site	0.973	Significant
	Improve workmanship quality	0.961	Significant
	Employing qualified labour forces	0.949	Significant

Source: Author

Kaur et al. (2023) state that Bartlett's test is used to determine the interrelationship between variables, while KMO assesses the adequacy of the sample. The Kaiser-Meyer-Olkin (KMO) formula is utilised to assess the adequacy of a sample size for research purposes. The KMO value must exceed 0.5. Values ranging from 0.5 to 0.7 are considered average, values ranging from 0.7 to 0.8 are considered good, values ranging from 0.8 to 0.9 are considered very good, and values above 0.9 are considered excellent. This indicates that the sample size is sufficient for factor analysis. The determination of whether the correlation matrix is an identity matrix, indicating the absence of relationships between variables, is accomplished by the utilisation of Bartlett's test of sphericity. The multicollinearity of the variables was assessed using Bartlett's test of sphericity. The maximum acceptable value for the outcome of Bartlett's test is 0.05. (Kaur et al., 2021; Field, 2009).

To summarise, the results indicate that the KMO value was 0.628, and Barlett's Test of Sphericity showed significant results with a p-value of less than 0.01. Additionally, the analysis of anti-image correlation and commonalities value indicated 59 significant options to minimise defects.

Therefore, the model was deemed both accurate and statistically significant when it reached the predetermined threshold value (Sammuel, 2017; Field, 2013; Dillon and Goldstein, 1984).

CONCLUSION

The research emphasises the importance of solutions in minimising the occurrence of construction defects in residential projects. The results and conclusions of this study can be a valuable starting point for industry practitioners, policymakers, and stakeholders to implement methods to reduce the occurrence of construction defects. Therefore, guaranteeing the long-term dependability and durability of residential constructions throughout the nation. The findings also serve as evidence in favour of the government's ongoing endeavours to enhance building standards and practices to create a more ecologically sustainable and resilient nation.

ACKNOWLEDGEMENT

The writers would like to thank the registered building surveyors for contributing to the research project and providing vital information. Their comments were very helpful and are gratefully acknowledged. In addition, this study was funded by a research grant from the Malaysian Research Assessment (MyRA) for the Fundamental Research Grant Scheme with Project Code: 600-RMC/GPM ST 5/3 (040/2021).

FUNDING

This study was funded by a research grant from the Malaysian Research Assessment (MyRA) for the Fundamental Research Grant Scheme with Project Code: 600-RMC/GPM ST 5/3 (040/2021).

AUTHOR CONTRIBUTIONS

All authors contributed to the design of the research and the write-up. All authors have read and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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