

EVALUATION OF THE FACTORS AFFECTING RESIDENTIAL BUILDING MAINTENANCE FOR PROGRAM PERUMAHAN RAKYAT (PPR): USER'S PERSPECTIVE

Kai Wen Khor

Abstract

Program Perumahan Rakyat (PPR), also known as The People's Housing Program, is an affordable housing programmes in Malaysia for the government to address the issue of squatters living illegally in urban areas. However, the building of PPR have degraded and grown increasingly vandalised, the issue of building maintenance is a major concern and still on the rise. The residents of PPR have been negatively impacted by this persistent and poorly handled maintenance issue. Hence, the purpose of this study is to enhance the building maintenance of PPR, ultimately fostering a harmonious living environment for its occupants. A total of 380 respondents who are residents live in PPR, Kuala Lumpur was received. The data had been analysed by Statistical Package for Social Science (SPSS) and tabulated using the Cronbach's Alpha Reliability test, and measure of central tendency. In the Cronbach's Alpha Reliability test, all data had successfully exceeded the value of 0.900, which indicates the data are highly reliable to be used for analysis. The findings revealed that inappropriate material selection is the primary factor affecting building maintenance. The study also emphasises the importance of providing regular training in construction industry. This research is intended to be valuable to the Malaysian construction stakeholders in delivering the factors affecting residential building maintenance, Post Occupancy Evaluation (POE) from the perspectives of the users, and the strategies in improving the building maintenance.

Received: 13 June, 2025
Revised: 21 October, 2025
Accepted: 15 January, 2026

*Department of Surveying, Lee Kong Chian
Faculty of Engineering and Science,
Universiti Tunku Abdul Rahman, Jalan
Sungai Long, Bandar Sungai Long,
Cheras, 43000, Kajang, Selangor,
Malaysia.*

Corresponding author:
khorkw01@gmail.com

DOI: <https://doi.org/10.54552/v87i1.294>

Keywords:

Program Perumahan Rakyat (PPR), People housing program, Post occupancy evaluation, Building maintenance

1.0 INTRODUCTION

One of the most significant affordable housing programmes in Malaysia is known as Program Perumahan Rakyat (PPR). The main purpose for the Malaysian government in constructing it is to offer low-income people access to affordable housing and to address the problem of squatters living illegally in urban areas (Hashim, *et al.*, 2015). However, PPR provided by the government faced problems in maintenance and service. Even though the government allocates a budget for PPR within the first 5 years, however, once the period has passed, the maintenance cost for the PPR will be reduced or eliminated (Sulaiman, Hasan, and Jamaluddin, 2016).

Building maintenance expenditures are significant all over the world, representing almost 50% of the overall construction sector revenue (Lateef, 2009). Tan, *et al.*, (2014) specified that the maintenance cost in the US market is foreseen to grow by 5.60% per year. The maintenance cost involves over two-thirds of contracts and signifies nearly 50% of the construction firm's overall revenue in many countries such as Hong Kong, the USA, and Saudi Arabia. (Islam, *et al.*, 2021). According to Kwon, *et al.* (2020), in a large-scale building, the maintenance-related cost for mechanical, electrical, and plumbing (MEP) makes up about 50% of life cycle cost (LCC).

The main functional criteria of a building are interior comfort, weather tightness, optimal use, durability, strength, and stability. Consequently, authorities, experts, and professional bodies who are considered to have an appropriate understanding of the needs and expectations of the inhabitant plan, build,

develop, and manage buildings following the specifications and standards (Awasho and Alemu, 2023). Post Occupancy Evaluation (POE) is a continuous process that systematically assesses the performance and efficiency of one or more building-related components concerning a range of factors, such as sustainability, aesthetics, accessibility, productivity, cost-effectiveness, functionality, safety, and security (Zimring, *et al.*, 2007). POE offers immense possibilities for enhancing the performance of a building when occupants are used as a benchmark in evaluation, covering technical performance and satisfaction of the occupants (Mustafa, 2017). Therefore, Post Occupancy Evaluation (POE) will be in use as a tool to evaluate the satisfaction of the occupants, and as a guide for future development in helping to improve the design and performance of a building (Nurhayati, *et al.*, 2015).

Based on the Malaysian Budget 2016, the Ministry of Urban Wellbeing, Housing, and Local Government (KPKT) will receive an allocation of RM863 million to continue PPR's plan to develop 22,300 apartments and 9,800 terrace homes. In Malaysia, there are a vast number of buildings, and the number is growing in the public and private sectors. (Lateef, 2009). Nevertheless, Malaysia continues to have a problem with poor building maintenance practices, and neither the public nor the private sectors can successfully maintain their structures due to a variety of problems (Hauashdh, *et al.*, 2020). Hence, the objectives of this research are to identify the factors that affect building maintenance, to evaluate factors affect building

maintenance by using Post Occupancy Evaluation (POE), and to determine the strategies in improving building maintenance.

2.0 LITERATURE REVIEW

In this study, several papers and journals which are related to the factors affecting building maintenance for PPR from the point of view of the user's perspective will be discussed. Next, the POE technique will be used and discussed the factors affecting building maintenance. Moreover, the strategies for improvement of building maintenance will be determined.

2.1 Definition of Building Maintenance

From the point of view of Khalid *et al.* (2019), the term building maintenance refers to a standard that has been established to maintain, improve, or restore each facility. According to Adejimi (2005), the objectives of building maintenance is to maintain the building in initial structural, functional, and aesthetic states, in resulting increase value to the building for a better market price. Moreover, building maintenance able to extend the life span of a building, ensuring health and safety of a building to the occupants. In many countries, building maintenance is turning into a serious problem as the number of older buildings increases (Islam, *et al.*, 2021).

2.2 Types of Maintenance

There are two types of maintenance, which is planned maintenance and unplanned maintenance. Planned maintenance is maintained on a schedule based (Ofori, Duodu, and Bonney, 2015). On the other hand, unplanned maintenance is often of an emergency or unpredictable situation (Olanrewajau, *et al.*, 2015). Figure 1 illustrates the maintenance types.

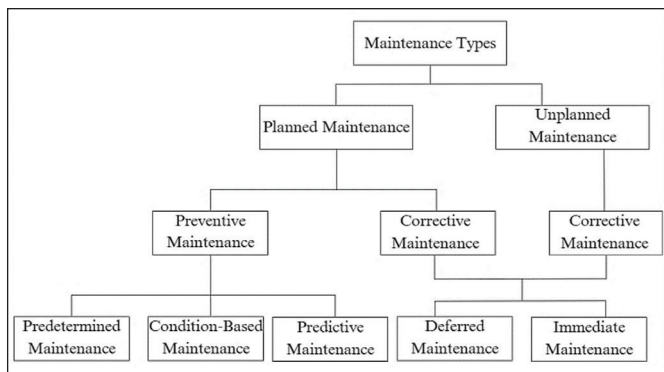


Figure 1: Maintenance types

2.2.1 Preventive Maintenance

A preventive maintenance is the replacement of the building parts based on the schedule, and the work can be carried out before the occurrence of a failure (Waziri & Vanduhe, 2013). Activities of preventive maintenance include replacements, adjustments, and lubrications. For instance, replace the door locks or hinges every 5 years whether the lock able to function or not. Eti, *et al.* (2006) stated that the main purpose of preventive maintenance is to maximise the reliability and extend the life of the components. In addition, the implementation of preventive maintenance able to reduce the need of corrective maintenance, as a result, reduce the repair cost (Au Yong, Ali,

and Ahmad, 2014). Preventive maintenance can be subdivided into three types, which are predetermined, condition-based, and predictive maintenance. Predetermined maintenance, also known as scheduled maintenance, which the activities is carried out at a fixed time interval according to the condition of the components. Next, condition-based maintenance is performed to monitor the condition of the component such as cost and availability regularly. While predictive maintenance is to measure the degradation of the components and carried out the maintenance activities before the expected failure time (Sarhini, *et al.*, 2021).

2.2.2 Corrective Maintenance

A corrective maintenance is carried out after the failure is identified and is aimed at restoring an asset back to a condition in which it can perform its intended function. It can be implemented in both planned maintenance and unplanned maintenance. In planned maintenance, a building component able to function until failure occurs. On the other hand, unplanned maintenance occurs when the building components fail to function in emergency and unpredictable situation (Sarhini, *et al.*, 2021). The failure normally caused by the inappropriate installation, poor design or poor materials (Ofori, Duodu, and Bonney, 2015). Corrective maintenance is subdivided into two types, which are deferred maintenance and immediate maintenance. Deferred maintenance is a set of maintenance activities that are not immediately initiated and delayed due to limitations such as cost, materials, and labour. Whereas immediate maintenance is implemented instantly to avoid damage (Sarhini, *et al.*, 2021).

2.3 Factors Affect Building Maintenance

Building maintenance is crucial to retain the functionality of the building, particularly as the building age over time. Also, building maintenance acts as a role in improving to enhance the building to meet the requirements and expectations of its occupants. However, inadequate building maintenance practices continue to persist in Malaysia due to various factors.

2.3.1 Inappropriate Material Selection

One of the key factors that leads to the early deterioration of building components is selection of the substandard and defective materials. The durability, strength, cost, and aesthetic appeal are frequently reflected in the quality of a material (Waziri, 2016). In the design phase of a building, choosing the appropriate material can minimise the maintenance requirements in the future (Islam, *et al.*, 2021).

Besides, the quality of the material can be affected by the environment (Olanrewaju, *et al.*, 2015). Malaysia is a tropical country which has rainfalls and high humidity all year round. The buildings have to exposed to the sunlight, wind and rain, which mean that the external components of the building will be deteriorated if using the inappropriate materials (Ahzahar, *et al.*, 2011). For example, paintwork on the external walls normally peeled off due to the excessive weather in Malaysia (Tan & Md Azree, 2013). Therefore, it is important to select the paint which can withstand the extreme weather in a time frame of 5 years.

2.3.2 Poor Workmanship

Construction industry is a labour-intensive. Therefore, construction workers play a main role in providing a high-quality of building to minimise the building maintenance works, from the start to the end of the project (Olanrewaju, *et al.*, 2015). According to Tan and Md Azree (2013), a poor workmanship can worsen the quality and performance of a building, such as poor construction method. Besides, a poorly designed foundation design might cause ground movement, which would be visible as fractures in the brick walls, a change in the building, and may even a sagging roof and many more (Hassan, *et al.*, 2016).

2.3.3 Poor Design

According to the Olanrewaju, *et al.* (2015), the buildings designed without considering the maintainability aspect will lead to difficulty in maintenance. When designing or constructing a building, the maintenance aspect needs to be considered to ensure that the maintenance can be performed with minimum cost and time (Olanrewaju, *et al.*, 2015).

Poor design can be categorised as defects in civil drawings, architectural drawings, and construction drawings (Waziri, 2016). The two essential factors in the construction process that affect the life cycle of a building are design and maintenance (Kiong and Akasah, 2012). Most of the client would like to minimise the project cost during the design phase. The common design errors are reducing the size of column, reinforcement bar, and foundations. These will cause to uncertainty in the future as the structure may unable to withstand the load, in resulting lead to building failure (Ahzahar, *et al.*, 2011).

2.3.4 Poor Supervision

One of the contributions to the factor affects building maintenance is poor supervision. A poor supervision can lead to construction defects, which caused to a poor-quality of building. Numerous causes of construction defects may be obvious to the naked eye or hidden deep within the structure (Waziri, 2016). Supported by Waziri (2016), the construction defects generally are caused by the design do not meet the professional standard and code. Construction defects normally can lead to structural defects, inadequate of drainage system, inadequate fire protection systems and many more, which are resulting in increasing of the complexity of the building maintenance (Meor Hasan, *et al.*, 2016). Such construction defects can lead to a poor-quality of project delivery.

According to earlier research by Okuntade (2014), adequate monitoring will reduce the majority of building faults, resulting in minimising the building maintenance throughout operation. Therefore, a quality of site supervision during the construction stage has a huge influence on the performance of the project (Dalibi, 2016). The experience and knowledge of a site supervisor is important to provide the high-quality of construction projects. A site supervisor who lacks the knowledge and required experience in supervision may cause to a building require constant maintenance (Waziri, 2016).

2.3.5 Lack of Maintenance Culture

In the Malaysian construction industry, the lack of preventive building maintenance still exists and resulting in poor building

maintenance (Au Yong, Ali, and Ahmad, 2014). This issue may happen due to a poor maintenance culture and a lack of knowledge of building maintenance. Maintenance culture is the way of thinking, perception, behaviour, values, and the basic assumptions of any person, group, or society that considers that maintenance is important (Abiodun, Olayemi, and Joseph, 2016). When a person, group, or society has the maintenance culture, they will have the actions and attitudes to maintain, protect and preserve the facilities, which can lengthen the lifespan of the building. On the other hand, a poor maintenance culture can lead to shorten a building's lifespan (Waziri, *et al.*, 2013). Therefore, by adopting the preventive maintenance work able to help in lengthening a building's lifespan.

2.3.6 Designer's Responsibility

A designer plays a main role in minimising the maintenance practice requirement when come to the operation. The responsibility of a designer is to make sure the expectations and requirements are met during the design phase and reflected during the construction phase (Islam, *et al.*, 2021). Supported by Chohan *et al.* (2010), the designers are often unaware of the effects of their design decisions until the POE. For example, an irregular architectural shape of a building cause difficulties when comes to maintenance work (Islam, *et al.*, 2021).

A designer has to consider several issues during the design phase, such as the climatic, environment, local culture and many more. According to Olanrewaju, *et al.* (2015), buildings are exposed to the sunlight, rain, wind, and humidity. The responsibility of the designer is to design the building correctly and selecting the appropriate material to be constructed to reduce the time and cost of the maintenance work in the future. For example, a flat roof might inappropriate to be constructed in the tropical countries such as Malaysia due to the heavy rainfalls and high humidity, and it will be resulting in the high amount of maintenance cost.

2.4 Post Occupancy Evaluation (POE)

In recent years, Malaysia has experienced an incredible rise in the population and urbanisation. Former Housing and Local Government Minister Zuraid Kamaruddin stated that 386,340 affordable housing units are planned, while 181,211 units are currently under development (New Straits Times, 2020). PPR is one of the affordable housing programmes introduced by the Malaysian government to assist low-income groups and squatters. Safety performance and physical environment of the housing are always the concern for the residents. Therefore, the environmental and quality issues become an important aspect to emphasise when developing low-cost housing projects (Nurhayati, *et al.*, 2015).

POE, is a method to demonstrate the significant aspects of the evaluation, while the main consideration is to define the building and the participation required from the occupants such as feedback (Husin, *et al.*, 2015). As indicated by Chohan *et al.* (2010), related to the relationship between the satisfaction of the occupants with architectural aspects of housing, the majority of researchers agreed on the significance of resolving problems with design defects, building maintenance, and satisfaction of the occupants. Besides, the finding conducted

by Mohit and Azim (2012) supported that the satisfaction of the residents more influenced by the services provides, such as maintenance, availability of public facilities and so on.

2.4.1 Building Performance

Building performance has a closely integrated with the users, as the users will measure the performance levels of the building which might impact on the customer satisfaction level and building occupancy rates. A building which fulfils the requirements of comfort, healthy, safe and high-quality able to attract building users and impact the supply and demand of building stock. Therefore, building performance is crucial in ensuring that the high-quality assets can achieve the satisfaction and requirements of the users (Wahab & Kamuruzzaman, 2011).

PPR is aimed to provide affordable housing for the low-income groups and improve living condition. However, PPR has labelled as poor maintenance, high vandalism and crime rates. Thus, building performance plays a main role in serve as a measurement to monitor the operation and condition of the building and act as a guideline for further improvements (She, Aini, & Zyed, 2022).

The aspects that will be analysed in the building performance by POE technique are the condition, performance in term of maintenance, and safety of the building. This is to ensure that the building overall has meet the requirements and satisfaction of the residents.

2.4.2 Physical Environment

The physical environment describes the circumstances and external factors in people's life that affect their health (Live Well San Diego, 2014). The physical environment of the neighbourhood, including its air quality, noise levels, interior amenities, and other factors, has a substantial impact on the residents' well-being and health (Live Well San Diego, 2014). Therefore, the physical environment has an impact on the level of satisfaction of the occupants based on their opinions, perceptions, and evaluations of environmental elements including building density, design, and location (Nurhayati, *et al.*, 2015).

According to the analysis by Nurhayati, *et al.* (2015), dwelling unit features are one of the main factors that influence the physical environment of the community. For instance, the size of the living room, the size and number of bedrooms, size of toilets and bathrooms. As stated by The Sun Daily (2023), the children living in PPR are unhappy and stressed as they do not have enough spaces and facilities for them to study and play; in resulting they faced mental problems. Hence, the designer plays a crucial role in ensuring the size of the dwelling unit fix the residents' requirements. Moving forward, the analysis by Mohit, Ibrahim, and Rashid (2010), figured out that the social environment received the lowest satisfaction from the occupants. This is due to the location of the public low-cost housing being far away from the hospital, LRT stations, and public library. Most of the residents prefer to shorten the traveling time to the public goods and workplace (Said and Juanil, 2013). Furthermore, a study by Sulaiman, Hasan, and Jamaluddin (2016) indicated that most of the occupants are unsatisfied with the services of refuse disposal and becomes

a major issue among the occupants as lead to affect the occupants' quality of living life. Thus, the physical environment is vital to provide a quality living life to the occupants.

In physical condition, there are several elements that will be analysed by using the POE technique. For example, the exterior finishes, interior finishes, quality of the material used, quality of the workmanship, satisfaction on the dwelling size and services of the management. Inadequate material selection can cause to building deterioration over time. For example, using non-waterproof resistant wall finishes as external finishes can increase the wear and tear on the walls. Moreover, the lack of preventive maintenance, such as the delay of sealing cracks detected can lead to water infiltration, in resulting brings the damages to the walls and foundations over the time.

2.4.3 Safety Performance

The safety performance assessment is one of the significant conditions for judgment in the satisfaction of the functionality and the requirements of occupants. (Husin, *et al.*, 2015). As stated by The Star (July 23, 2009), the occupants of low-cost housing in Desa Mentari, Petaling Jaya, expressed safety concerns and complained about holes beneath concrete slabs, uneven ground, and the roof's failure. These indicated that the poor design, poor workmanship and inappropriate material selection are the factors causing to the building failure. Besides, Goh and Yahaya (2011) indicated that when adjustable louvered windows are installed, there is a risk that the glass panes' catches are malfunctioning and will fall from the higher floor, leading to safety concerns for the occupants. Therefore, the lack of the preventive maintenance by the management is the factor that leading the residents' concern and worries on the issues.

2.5 Strategies to Improve Building Maintenance

The involvement of each relevant stakeholder, including the building owners, tenants, maintenance team, and many more plays an integral role to share the responsibility for solving these challenging issues to foster a harmonious living environment for PPR's residents. An excellent maintenance practice can affect the satisfactory of the residents, in resulting creating a harmonious living environment to the residents (Masyatul, 2013).

2.5.1 Regular Training in Construction Industry

According to Waziri (2016), to achieve the project's goals, the construction labours must be knowledgeable and skilled when performing the construction works. Therefore, outstanding training is necessary for having high-quality construction. This is due to the labours can improve their construction knowledge when attending the training. All parties involved in the construction process, including the clients, must receive ongoing training on the job site to share information and reduce construction defects (Dantew and Enday, 2019).

2.5.2 Involvement of the Organisation's Maintenance Experts

The involvement of maintenance departments is one of the strategies to improve building maintenance. The activities covered by the maintenance departments are cleaning services, repairs, planned maintenance and corrective

maintenance (She, Aini, and Zyed, 2022). The maintenance departments should create a method for evaluating the building that establishes the minimal criteria standards at which various buildings should be maintained (Awol, Adugna, and Mosisa, 2016). An excellent building maintenance practice able to maintain the building at the initial stage and effectively serves its purpose (Masyatul, 2013).

The maintenance departments can conduct maintenance operation plan, which to identify the maintenance activities to carry out in a timely manner (Awg and Amin, 2013). This action will bring a huge confidential to the residents. Next, a Post Occupancy Evaluation (POE) can be carried out to evaluate and review on the requirements and expectations from the residents.

2.5.3 Strict Supervision

In construction industry, it is often suffering from the poor performance in terms of delays, cost overruns and poor-quality projects (Dalibi, 2016). A poor-quality project can affect the performance, profitability, and the reputation of the organisation involved (Dalibi, 2016). For example, a poor-quality activity can lead to costly rework or building failure, in resulting to project delays, cost overruns, and injuries. Such poor-quality project is linked to the poor supervision. Therefore, a strict supervision on construction sites is a vital criterion to enhance the quality of the projects (Razak, *et al.*, 2010).

Firstly, Public Works Department (PWD) plays an important role in monitoring and inspecting construction activities during the construction stage to ensure strict compliance with the design and specifications (Tan and Md Azree, 2013).

Construction industry is a labour-intensive, which the quality of the building is depends on the performance of the workmen (Dalibi, 2016). Within the construction site, the implementation of strict supervision plays a vital element. The quality of the building is depending on the performance in the construction site. Nevertheless, contractors or subcontractors should engage in daily oversight so that any issue related to the quality of labour can be found and fixed immediately (Hassan, *et al.*, 2016). The inability of supervisors in planning of work and miscommunication are linked to the poor-quality project delivery (Dalibi, 2016). Therefore, it is crucial to have experienced and well-trained site supervisors to monitor and inspect during the construction stage.

2.5.4 Proper Communication Among Parties

Communication is the key to leading a project to success. For instance, a supervisor has to deliver a message or information to the workers, so, the workers will carry out the work correctly when received the correct message. If one of the parties delivers or receives the wrong messages, it will lead to negative consequences such as construction failure. Therefore, a proper communication between individuals and organisations to increase the quality of design, workmanship, and construction (Danitew and Enday, 2019).

2.5.5 Proper Construction Management

Construction management is knowns as the comprehensive planning, coordinating, and oversight of a construction project from inception to completion. The main categories will

be investigated are cost, scope, schedule, safety, and risk management (Go Codes, 2023).

A project cost budget is important as it covers from the start to end of the project, such as labour cost, plant and machinery, material and equipment (Go Codes, 2023). However, construction industry is complex as it may consist of some unpredictable concerns such as increasing price of raw materials, extreme weather, and unforeseen diseases. Therefore, a proper construction management can help in reducing the risk by control budget, scheduling, and problem solving (Go Codes, 2023).

Also, the quality of workmanship can be improved by proper construction management (Dantew and Enday, 2019). A main contractor or site supervisor has responsible to manage, organise and lead the work. The proper construction management can directly affect the productivity of the labours (Meor Hasan, *et al.*, 2016). For instance, if a main contractor or site supervisor failed to control and lead the project, the issue regarding the quality of the project will occur.

2.5.6 Proper Manpower Management

Construction productivity primarily depends on human effort and performance (Meor Hasan, *et al.*, 2016). A proper manpower management able to ensure the cost-effective of a project (Majumdar, 2023). Manpower management ensure that the appropriate workers are placed in the appropriate roles, based on their skills and knowledges. If a project consists of improper manpower management such as insufficient numbers of workers, it may cause the work to be in a rush and result in poor quality of the project (Dantew and Enday, 2019). For example, the contractor has to keep track of the workload done every day, to ensure that the manpower management is sufficient. Also, manpower management helps in controlling project's cost. This is due to a proper manpower management can avoid hiring over workers, which can cause in increasing of labour cost (Majumdar, 2023). Hence, proper manpower management is crucial in a construction project to ensure the cost-effective of a project.

3.0 METHODOLOGY

A quantitative research approach has been chosen to fulfil the research objectives of this research. The central focus of this research is to enhance the building maintenance of PPR, ultimately fostering a harmonious living environment for its occupants. Within the confines of this study, an exploration into the requirements, expectations, and satisfaction of PPR's occupants is intended. According to Pajo (2018), the utilisation of extensive samples can be used to reflect the perceptions of broader populations. A huge portion of opinions and viewpoints from respondents becomes imperative to bolster the precision of information. Consequently, a quantitative research methodology is chosen due to its capacity for extensive data compared to the qualitative research method. Moreover, its efficiency in gathering data is particularly pertinent given the time constraints in this study. A questionnaire survey is distributed among PPR's occupants in Kuala Lumpur. Subsequently, the data collected will undergo rigorous examination through the Statistical Package for Social Science (SPSS) software tool.

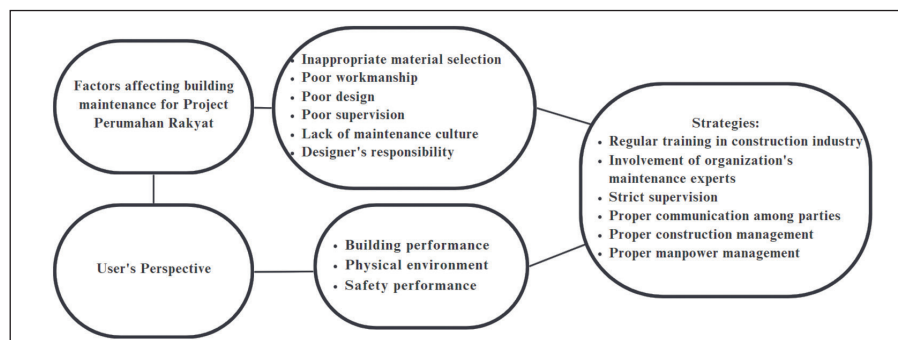


Figure 2: Theoretical framework of the study

since it takes less time to complete for respondents. Additionally, respondents can complete the online survey on a mobile device, laptop, or tablet with no time or geographical restrictions. The higher the sample size, the higher the reliability of this study. Figure 3 illustrates the information about the PPR in Kuala Lumpur comes with the sample size.

3.4 Data Analysis using SPSS

Data analysis helps solve search-related issues by using numbers and facts

3.1 Theoretical Framework

This study reviewed the critical factors that affect residential building maintenance for PPR. The utilisation of Post Occupancy Evaluation (POE), valuable insight into the effectiveness and efficiency of the maintenance practices from the perspectives of the users can be gained. Figure 2 illustrates the theoretical framework of this study.

3.2 Data Collection

A large amount of information is required to be gathered when implementing a quantitative research method. To come up with an accurate result, being careful in collecting data and information is necessary. In this study, the online distribution of questionnaire surveys is more appropriate to gather a huge portion of responses in a short time. The target population is the occupants who live in PPR, Kuala Lumpur.

3.3 Questionnaire Distribution

The questionnaire surveys were distributed electronically through social media such as email, Facebook, WhatsApp to the occupants who live in PPR, Kuala Lumpur. Online surveys typically have greater response rates than paper surveys

No.	Housing Projects	Total No. of Units	Total No. of Blocks	Handover Year	Sample Size(s)
1	PPR Pekan Batu	632	2	2002	20
2	PPR Desa Petaling	632	2	2002	20
3	PPR Pudu Hulu	948	3	2003	30
4	PPR Seri Anggerik	316	1	2003	20
5	PPR Seri Alam	660	5	2004	30
6	PPR Salak Selatan	632	2	2004	20
7	PPR Laksamana & PPR Perkasa	1,620	5	2005	30
8	PPR Seri Semarak	1,580	5	2005	30
9	PPR Kg Limau	632	2	2005	20
10	PPR Kg Muhibbah	2,844	9	2006	30
11	PPR Raya Permai	1,264	4	2006	30
12	PPR Seri Malaysia	632	2	2007	20
13	PPR Kg Baru Air Panas	2,528	8	2007	30
14	PPR Pantai Ria	1,264	4	2007	30
15	PPR Pekan Kepong	948	3	2010	20
TOTAL		17,132	57	-	380

Figure 3: Information on PPR, Kuala Lumpur

(Ashiwadam, 2020). Consequently, the researchers were able to understand the relevance of the research-based technique, including statistical significance related to the research topic, and to gain a greater understanding of data analysis. The data collected from the questionnaire were interpreted and further analysed by using SPSS software. Moreover, the statistical tests that will be used in this chapter include Cronbach's Alpha Reliability method and Measures of Central Tendency.

4.0 RESULTS AND DISCUSSION

In this section, the relative results from the findings of the factors affecting residential building maintenance for PPR from the user's perspective in Kuala Lumpur are presented. Besides, a Post Occupancy Evaluation (POE) regarding on building performance, physical environment, and safety performance is reviewed among PPR's residents. Also, the strategies for improving building maintenance are evaluated from the respondents based on responses. The data were collected through an online questionnaire survey and will be analysed using Statistical Package for Social Science (SPSS) software.

4.1 Descriptive Analysis

Total of 380 sets of respondents is received through social media such as email, WhatsApp, and Facebook. The target respondents are the residents who live in PPR, Kuala Lumpur. The details of the respondents are summarised and tabulated in the Table 1.

4.2 Cronbach's Alpha Reliability Test

A total of 380 respondents' feedback was calculated and analysed by Statistical Package for Social Science (SPSS) accordingly. Table 2 shows the result of reliability test obtained for the factors, POE, and strategies were 0.906, 0.962, and 0.901. According to the Cronbach's Alpha, the greater the value is, the more reliable the sample is. Therefore, the Cronbach's Alpha value of obtained in Table 4.2 are excellent result because the values are ranged beyond 0.900. Hence, the data collected are highly reliable to be used for analysis.

4.3 Mean Ranking

The mean values are analysed by using the Statistical Package for Social Science (SPSS) software. After that, the relative ranking of each item is arranged by following the individual mean scores. The mean score and ranking are computed and presented in Tables 3, 4, 5, 6, and 7.

Table 1: Demographic of respondents

	Percentage (%)	Respondent (N=165)
Gender		
Male	52	197
Female	48	183
Age Range		
21-30 years	35	134
31-40 years	31	116
41-50 years	23	86
51-60 years	8	32
Above 60 years	3	12
Marital Status		
Single	44	168
Married	38	143
Divorced	18	69
Number of Family Members Living with the Respondent		
1-2	38	144
3-5	25	132
Above 5	27	104
Period Living in PPR of Respondent		
Less than 1 year	11	41
2-5 years	19	71
6-10 years	51	194
11-15 years	15	58
More than 15 years	4	16
Satisfaction Level of Respondents with the Building Maintenance in PPR		
Very Unsatisfied	5	19
Unsatisfied	6	22
Neutral	9	33
Satisfied	48	184
Very Satisfied	32	122

Table 2: Cronbach's Alpha Value of Reliability Test

Sections	Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
Factors affecting residential building maintenance	0.906	0.916	6
Post Occupancy Evaluation (POE)	0.962	0.962	50
Strategies to improve in building maintenance	0.901	0.905	6

Table 3: Mean Ranking of Factors Affecting Residential Building Maintenance

Code	Factors	Means	Ranking
F1	Inappropriate Material Selection	4.28	1
F2	Poor Workmanship	4.22	2
F3	Poor Design	4.19	3
F4	Lack of Maintenance Culture	4.15	4
F5	Designer's Responsibility	4.08	5
F6	Poor Supervision	3.95	6

4.3.1 Factors Affecting Residential Building Maintenance

Table 3 present the mean ranking of the factors that affect the residential building maintenance, and the level of agreement based on the perspectives of residents who living in PPR, Kuala Lumpur. The highest mean ranking indicates that the respondents believed that a factor is more likely to affect the building maintenance.

As shown in Table 4.3, the factor with the highest mean ranking of 4.28 was 'Inappropriate material selection (F1)', which most of the respondents strongly agreed was a major factor in affecting building maintenance. According to Ofori, Duodu, and Bonney (2015), poor quality of material will lead to failure of materials, which require replacement or more maintenance work in the future. Supported by Islam, *et al.* (2021), the appropriate material during the design phase is able to reduce the needs of maintenance in the future. Therefore, the selection of material during the construction stage is important to minimise the maintenance work in the future.

The second-highest mean ranking was 'Poor workmanship (F2)', with a mean value of 4.22. In the construction industry, skilled workers are important in performing a good quality of work (Ofori, Duodu, and Bonney, 2015). This is because skilled workers able to perform the work based on their skills and past experiences. It helps reduce the work time span, minimising cost and improving the quality of work. In comparison, unskilled workers required to spend more time in training, and additional money.

The lowest mean ranking among the factors was 'Poor supervision (F6)', which has a mean value of 3.95. The quality of the supervision depends on the skill of site supervisor (Dalibi, 2016). This is because the site supervisor is responsible for controlling and planning the construction work. As a site supervisor, communication is an essential skill which can affect the performance of construction (Hong, Wee, and Omar, 2021). For example, if the site supervisor gives insufficient information and instructions to the site workers, it will affect the progress of the construction performance. However, this key factor might not be the first priority among the residents based on the analysis result above.

Table 4: Mean Ranking of Post Occupancy Evaluation (Building Performance)

Code	Building Performance	Means	Ranking
A1	I agree that the building provides a sense of safety.	4.12	1
A3	I agree that the overall performance of the building, in terms of maintenance services, is good.	4.04	2
A2	I agree that the condition of the building, both inside and outside, is good.	3.94	3

4.3.2 Post Occupancy Evaluation (POE)

Table 4 indicates the mean ranking of building performance in Post Occupancy Evaluation. Most of the respondents agreed that the building provides a sense of safety, which has a mean value of 4.12. However, there is a mean value of 3.94 of the respondents agreed the condition of the building, both inside and outside is good.

Table 5 showed the mean ranking of physical condition in the Post Occupancy Evaluation. The highest mean ranking value is 4.18, which indicated that the majority of the respondents satisfied the internal floor finishes of the building. The second highest mean ranking value is 4.17, which most of the respondents satisfied on the internal ceiling finishes of the building. While the third highest mean ranking value is 4.16, which is the quality of the ceiling finishes material.

Table 5: Mean Ranking of Post Occupancy Evaluation (Physical Condition)

Code	Physical Condition	Means	Ranking
B6	I agree that the interior finishes (floor finishes) of the building are good.	4.18	1
B4	I agree that the interior finishes (ceiling finishes) of the building are good.	4.17	2
B7	I agree that the quality of ceiling finishes material is good.	4.16	3

Table 6 shows the mean ranking of the safety performance in Post Occupancy Evaluation. Most of the respondents were satisfied on the functionality and responsiveness of the fire alarms in the building, which showed a mean value of 4.09. The second-highest of the mean ranking value is 4.08, which most of the respondents were satisfied on the lighting system in the stairwells and lobby area.

Table 6: Mean Ranking of Post Occupancy Evaluation (Safety Performance)

Code	Physical Condition	Means	Ranking
C21	I agree that the functionality and responsiveness of fire alarms in the building is good.	4.09	1
C18	I agree that the lighting system in the stairwells area is good.	4.08	2
C16	I agree that the lighting system in the lobby area is good.	4.08	2

4.3.3 Strategies to Improve Building Maintenance

Table 7 provided the mean scores and ranking of the strategies to improve building maintenance. A higher mean score represented that the strategies are effective in improving building maintenance from the perspective of the respondents.

Based on Table 7, the highest mean ranking is 'Regular training in construction industry (S1)', with a mean value of 4.29. Hanuashdh, Jailani, and Rahman (2021) outlined that work performance might be affected by the lack of training. For instance, a supervisor who lacks knowledge in controlling the maintenance operational framework will lead to a poor-quality maintenance outcome. In contrast, a skilled team able to perform a professional level of work, which produce a good quality of work.

The second-highest mean ranking is 'Involvement of organisation's maintenance experts (S2)', with a mean value of 4.23. According to Rodrigues, *et al.* (2018), the lack of preventive maintenance will fasten the deterioration of buildings. The organisation's maintenance experts play an important role in conducting preventive maintenance, such

as, checking on the functionality of rainwater gutters, lighting system in the common area, servicing mechanical and electrical installation. Therefore, the restoration or major repair can be avoided or postponed. Besides, the collaboration of the organisation's maintenance experts between stakeholders is important to ensure that the building maintenance to success (Au-Yong, *et al.*, 2017).

The lowest mean ranking among the strategies was 'Strict supervision (S6)', with a mean value of 3.98. According to Hong, Wee, and Omar (2021), a strict supervision able to ensure the quality of building. It helps to increase the disciplinary and adapt good practices of the construction workers in the work. Hence, strict supervision during the construction stage can minimise the delivery of poor-quality of work. However, based on the analysis results above, most of the residents might not consider that strict supervision able to help in improving building maintenance. This is due to the strict supervision might bring drawbacks such as decreased morale of the workers which can lead to a decrease in productivity.

Table 7: Mean Ranking of Strategies to Improve Building Maintenance

Code	Strategies	Means	Ranking
S1	Regular training in construction industry	4.29	1
S2	Involvement of organisation's maintenance experts	4.23	2
S3	Proper communication among parties	4.22	3
S4	Proper construction management	4.20	4
S5	Proper manpower management	4.07	5
S6	Strict supervision	3.98	6

3.0 CONCLUSIONS

The aim of this research study is to enhance the building maintenance of PPR, which provide a harmonious living environment for the residents. However, the poor building maintenance still practices in Malaysia and lead to the increasing of building deterioration. Therefore, the research objectives such as factors that affect building maintenance, Post Occupancy Evaluation (POE), and the strategies to improve building maintenance are successfully achieved and reviewed.

The research contributes to the developers and contractors who engaged in construction industry. In this research, the factors affecting to the building maintenance had been identified, which provides a valuable information for the professionals. The developers and contractors can implement the strategies to improve the building maintenance. Moreover, this research has significant implications to local government bodies. Therefore, the local government may aware to the factors affecting to the building maintenance of PPR. A comprehensive understanding of the factors affecting building maintenance provides local governments with the tools to formulate policies and allocate resources. Hence, this research study enables local government bodies to take specific actions in improving the building maintenance and enhancing the quality of the PPR's residents.

There are several limitations are identified. Firstly, time constraint is one of the limitations faced by the research studies. Therefore, the study is restricted to conduct the data collection in Kuala Lumpur due to the time constraints. This led to the research study having a smaller sample size because of a lower number of data collection. As a result, the outcomes obtained may cause to inaccurate to represent the PPR's residents of whole Malaysia. Next, the data collection method implemented in this research is quantitative method. The quantitative method only provides numerical descriptions rather than comprehensive elaboration as compared to qualitative method. However, some of the respondents may provide simplistic answers to the questionnaire without thoroughly analysing the questions. Thus, this may lead to inaccuracies in the data collection.

There are a several recommendations suggested to solve these limitations. Firstly, lengthen the period for data collection. Therefore, the rate of respondents will increase and the data analysed will be more accuracy. Besides, expanding the research scope able to produce a higher accuracy and reliability result. Instead of restricting the study to Kuala Lumpur, the research should broaden the research area to the whole Malaysian state. This is important because the residents in other PPR may offer a different perspective on the building maintenance. As a result, expanding the research scope to include various Malaysian states will contribute to a more accurate and reliable research study. Also, a mixed research method is suggested to be implemented for the future studies to enhance the reliability and accuracy of data collection. A qualitative method, such as face-to-face interviews, able to facilitate in-depth and comprehensive explanations from respondents. This approach is able to mitigate the risk of simplistic answers encountered in questionnaire survey and increasing the confidence level in this research. ■

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PROFILE



KAI WEN KHOR is a graduate with a Bachelor's Degree in Quantity Surveying with Honours from Universiti Tunku Abdul Rahman (UTAR), completed in 2024. She is committed to continuous learning and actively engages with the latest developments in the construction field. Her dedication to the field fuels her ambition to make meaningful contributions to the built environment.

Email address: khorkw01@gmail.com