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Case Studies

# A Conceptual Paper on the Effective Approach of Maintenance Practices for the Low-Cost Low-Rise Residential Buildings in the Northern Region, Malaysia

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## Abstract

This research focuses on improving maintenance strategies for Malaysia's low-cost, low-rise residential buildings. Challenges include poor construction quality, reliance on corrective maintenance, and insufficient financial resources due to inefficient fee collection. These issues increase breakdowns, higher costs, and reduced building performance. The study aims to enhance the appropriate building maintenance planning in low-cost, low-rise residential buildings by assessing building conditions, identifying challenges, and recommending solutions. A mixed-method approach involves building condition assessments, resident and management surveys, and expert interviews to gather comprehensive insights. The findings will emphasise the importance of better construction practices, adequate funding, and improved stakeholder communication to ensure effective maintenance.



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## 1. Introduction

Building maintenance is "work undertaken to keep, restore or improve every part of a building, its services and surrounds, to a currently accepted standard, and to sustain the utility and value of the building" [1,2]. The objectives of building maintenance are to ensure that the buildings and their associated services are in a safe condition, that the buildings are fit for use, and that the condition of the building meets all statutory requirements [1,2]. Furthermore, maintenance aims to carry out the necessary work to maintain the value of the physical assets of the building stock and to uphold the quality of the building.

In Malaysia, many challenges arise in maintaining low-cost, low-rise residential buildings. One of the challenges is that the building management failed to implement preventive maintenance, which can lead to major issues affecting the performance and longevity of the building [1]. In addition to corrective

maintenance, preventive maintenance was introduced to mitigate the risks of breakdowns and prevent unexpected breakdown costs. This strategy is called time-based maintenance, scheduled maintenance or cyclic maintenance. Preventive maintenance tasks are performed in accordance with a predetermined plan at regular, fixed intervals, which may be based, for example, on operating time [3].

Another challenge to maintaining low-cost, low-rise residential buildings is that they are built in low-quality conditions [4,5]. The facilities constructed during the initial planning and construction phase greatly affect the damage that occurs and the future maintenance costs. Developers, along with the design and construction teams, need to be actively involved from the start, during pre-planning, design, and construction, because their knowledge is crucial for ensuring the overall quality of the building, which impacts its long-term costs [1]. This involvement can help improve record-keeping and reduce challenges for management teams in creating effective maintenance plans, supported by complete information about the facilities and warranties. Effective maintenance management can be greatly improved by ensuring quality during construction [1].

Moreover, a significant challenge facing building maintenance practices in Malaysia is the lack of adequate funds allocation [6]. Property developers often struggle to collect maintenance fees from building occupants, who are dissatisfied with the condition of their buildings [7]. As a result, many maintenance organisations face financial shortfalls, preventing them from running effective maintenance operations [1]. Sufficient financial resources are important for maintenance organisations to function effectively [6]. Without good financial maintenance operations, innovation, and improvement efforts cannot proceed as planned [8]. It is important to have enough budget set aside for maintenance to keep up with the growing need for building care and ensure upkeep practices can last over time [8]. Inefficient collection of maintenance fees negatively impacts the management body's ability to acquire necessary resources.

This research focuses on the maintenance practices of low-cost, low-rise residential buildings in Malaysia. The study will be conducted in Penang. The five different types of areas around Penang will be chosen to take 5 samples of low-cost, low-rise residential buildings, which will be inspected to conduct research. It aims to identify the current condition of these buildings by conducting a Building Condition Assessment (BCA). Then, the challenges faced in their maintenance will be analysed by distributing the questionnaire to occupants and the property manager. Lastly, recommend solutions for improvement on maintenance by conducting an interview session with a professional.

## 2. Literature Reviews

### 2.1. Building Defects

Building defects are problems that can seriously affect a building's safety and lifespan. These defects can happen due to mistakes made during the design phase or damage from natural disasters. Research shows that poor design, low-quality workmanship, and not following construction standards are major causes of these issues [9]. Building defects can lead to dissatisfaction among tenants and reduce the building's overall value and usability. The deterioration of building parts can worsen when environmental factors, like harmful chemicals, are present. As noted in previous studies, various factors such as mechanical forces, radiation, temperature changes, and biological processes can change the materials used in buildings, making them weaker over time. These outside forces and poor construction practices create conditions that allow building defects to grow. Another cause of building defects is soil settlement, which occurs when the ground under a building shifts or sinks [10,11].

### 2.2. Building Condition Assessment (BCA)

Building Condition Assessment (BCA) is a systematic approach that plays a critical role in improving asset management knowledge and monitoring, ultimately enhancing asset information management. Building condition assessment is a physical inspection and diagnosis of building health [12]. Building condition assessment is generally conducted to assess the current state of a building and estimate the extent of its deterioration. The primary aim of BCA is to minimise financial and capital costs throughout a building's lifecycle while maximising asset value for all stakeholders involved [13]. This focuses on effective asset management and the significance of understanding asset conditions in developing effective maintenance and investment strategies, particularly in commercial buildings [12].

### 2.3. Low Rise Building

Low-rise buildings are typically defined as structures with a limited number of floors, often ranging between one and four stories. They are distinct from high-rise buildings, which are taller and more complex in terms of design, structure, and services. Low-rise buildings are widely used for residential, commercial, and institutional purposes due to their relatively simple construction and lower construction costs. In the context of residential buildings, low-rise structures are commonly used in suburban areas where space is available, and construction density is low [14,15].

### 2.4. Low-cost Residential Building

Low-cost residential buildings are housing solutions designed to provide affordable shelter to lower-income households [16]. These buildings are typically characterised by basic construction standards, simplified design, and cost-effective materials to ensure affordability. In many developing countries, including Malaysia, low-cost residential buildings are essential to national housing strategies aimed at addressing the housing shortage and providing decent living conditions to vulnerable populations [15,17].

### 2.5. Construction Practice in Low-Cost Low Rise Residential Building

Low-cost residential buildings are constructed similarly to other houses in strength, structure, and foundation. However, these homes are designed to be more affordable, accessible, and easier to build. Their development focuses on reducing costs using locally sourced materials and implementing strategies to lower maintenance expenses [14]. Maximising the use of space in low-cost, low-rise residential buildings also improves energy efficiency, as these homes generally lack complex mechanical systems or advanced technologies [14]. Proper building maintenance is crucial for managing life cycle costs, ensuring that various components of the building function well, extending its operational life, and supporting sustainable development [14].

## 3. Methodology

This concept of improving the maintenance practices of low-cost, low-rise residential buildings in Penang, a highly urbanised and economically significant state in Malaysia. Penang is located on the northwest coast of Peninsular Malaysia, comprising Penang Island, where the capital George Town is situated, and Seberang Perai on the mainland, connected by the Penang Bridge and the Second Penang Bridge. With its strategic location and status as one of Malaysia's most developed economic hubs, Penang boasts the highest GDP per capita among the states. It is the country's leading exporter, generating over RM447 billion in exports in 2023.

### 3.1. Data Collection

#### 3.1.1. Understanding and Solving Maintenance Challenges in Low-Cost, Low-Rise Residential Buildings

The research aims to look at the challenges of maintaining low-cost, low-rise residential buildings and explore ways to improve their upkeep. To do this, three key approaches will be used: assessing the physical condition of buildings, gathering feedback from residents and property managers, and seeking expert advice on better maintenance practices.

#### 3.1.2. Checking the Condition of Buildings

In order to understand the current state of these buildings, a Building Condition Assessment (BCA) will be used. This means inspecting important parts of the buildings, such as walls, roofs, plumbing, and electrical systems, to see if there are any visible problems. By recording these issues, we can get a clear picture of what needs to be fixed and how serious the issues are.

#### 3.1.3. Hearing from Residents and Property Managers

Since residents and property managers experience these issues first-hand, their opinions are important. A semi-structured questionnaire will ask them about common problems, such as how often repairs are done, financial difficulties, and whether they are satisfied with the current maintenance. Their responses will help us understand the biggest challenges in keeping these buildings in good condition.

#### 3.1.4. Learning from Maintenance Experts

We will also talk to experts like engineers and property managers to find the best ways to improve maintenance. Their knowledge and experience will help us discover practical and long-lasting solutions to the problems identified. These expert insights will guide recommendations for better maintenance practices that can improve living conditions for residents.

## 4. Data Analysis

The data analysis will be conducted in three phases based on the research objectives. Qualitative and quantitative methods will be used to analyse the findings.

For the first objective, the condition of low-cost, low-rise residential buildings will be assessed through Building Condition Assessment (BCA). The data collected from field observations (see Table 1–4) will be quantified using a condition rating system to evaluate the state of various building components.

A semi-structured questionnaire will be developed and distributed to occupants and building managers of low-cost, low-rise residential buildings to achieve the second objective. The questionnaire is designed to capture a comprehensive understanding of the challenges involved in maintaining these buildings. It will consist of closed-ended questions to gather quantitative data and qualitative insights. The closed-ended questions will focus on specific aspects such as common maintenance problems, the frequency and urgency of repairs, satisfaction with current maintenance practices, and perceptions of the effectiveness of building management systems.

The answers to the closed-ended questions will be entered into SPSS for analysis. Descriptive statistics will be used to summarise the data. For example, frequency distribution will show how often certain maintenance issues are reported. This could reveal that cracks in the walls or plumbing issues

are the most common problems. The mean, median, and standard deviation will be calculated to understand satisfaction levels with maintenance or the frequency of repairs. Cross-tabulation will be used to compare different groups, such as comparing maintenance problems reported by residents versus property managers, or how issues differ based on the age of the buildings.

**Table 1: Scale of Condition Assessment.**

| Condition | Scale Value | Description (Value) |
|---|---|---|
| 1 | New / As New | Minor Servicing |
| 2 | Fair | Minor Repair |
| 3 | Poor | Major Repair / Replacement |
| 4 | Very Poor | Malfunction |
| 5 | Dilapidated | Damage / Missing |

**Table 2: Scale of Priority Assessment.**

| Priority | Scale Value | Description (Value) |
|---|---|---|
| Normal | 1 | Functional; cosmetic / slight defect, need to touch-up and service. |
| Routine | 2 | Minor defects; can lead to major defects in the long run if unattended. |
| Urgent | 3 | Serious defects; already expanded, function to an unacceptable standard. |
| Emergency | 4 | Element / structure does not function at all; or Risk that can lead to fatality and/or injury. |

**Table 3: Condition Survey Protocol (CPS) 1 Matrix.**

| No. | Type | Matrix | Score | Colour Code |
|---|---|---|---|---|
| 1. | Minor | Plan Maintenance (Non-Compliance-CAT 3) | 1 to 4 | |
| 2. | Quite Significant | Condition Monitoring (Non-Compliance-CAT 2) | 5 to 12 | |
| 3. | Serious Attention | Serious Attention (Non-Compliance-CAT 1) | 13 to 20 | |

**Table 4: Overall Building Rating.**

| No. | Building Rating | Score |
|---|---|---|
| 1. | Good (Compliance) | 1 to 4 |
| 2. | Fair (Observation) | 5 to 12 |
| 3. | Dilapidated (Non-Compliance) | 13 to 20 |

For the third objective, in-depth interviews will be conducted with key stakeholders such as property managers, building contractors, and local authorities. These stakeholders will provide valuable qualitative data about potential solutions for improving building maintenance. The interviews will focus on gathering insights into their challenges in maintaining low-cost, low-rise residential buildings and their suggestions for improving the maintenance process. The semi-structured interviews will allow for open-ended questions while ensuring that important topics are covered.

The interviews will be recorded with the consent of the participants and later transcribed to ensure all details are captured accurately. After transcribing the interviews, the data will be analysed using thematic analysis. This process involves reviewing the interview transcripts and identifying recurring themes, such as better communication between management bodies and building occupants, the importance of regular maintenance schedules, or the role of funding in maintaining buildings. Thematic analysis will help organise the data into meaningful categories, making it easier to identify common patterns and insights the interviewees share.

## 5. Conclusions

This study uses a systematic research process to investigate effective maintenance practices for low-cost, low-rise residential buildings in Penang, Malaysia. The research process is divided into three stages: preliminary research, data collection and analysis, and evaluation and recommendations. The study employs a mixed-methods approach, incorporating Building Condition Assessments (BCA), questionnaires, interviews, and observations to collect and analyse qualitative and quantitative data.

The study population includes diverse stakeholders, such as residents, building managers, maintenance personnel, and experts. By focusing on a stratified random sampling of residents and purposive sampling of experts, the research ensures comprehensive insights into the challenges and potential solutions for maintaining these critical housing structures. The geographic focus on Penang is justified by its unique demographic, economic, and urbanisation challenges, making it a representative case study for low-cost housing issues in Malaysia.

This study aims to recommend solutions for improving the maintenance level in low-cost, low-rise residential buildings by integrating perspectives from multiple stakeholders and applying both pragmatic and systematic methodologies.

## Declaration of Conflict of Interest

The authors declared no conflict of interest with any other party in the publication of the current work.

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