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Heritage Building Maintenance Practices: The Case of Muzium Diraja Kedah (MDK)

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Abstract

Maintaining heritage buildings requires a well-structured maintenance management system to ensure their continued usability and cultural significance. The Muzium Diraja (MDK) in Alor Setar, Kedah, an important historical landmark, faces several maintenance-related challenges, including financial constraints, limited access to original building materials, and a constrained maintenance budget, which affect the effectiveness of ongoing maintenance activities. This study investigates the current maintenance practices adopted at the museum using a qualitative case study methodology. Information was obtained through in-depth interviews with seven key personnel selected through purposive sampling, representing conservation, development, monument-related agencies, and the Public Works Department (JKR). The analysis identifies critical weaknesses in several key aspects of maintenance management, including organizational structure, asset management, maintenance strategies, workforce capabilities, financial provision, and documentation practices. Based on these findings, the study proposes targeted improvement measures, including the adoption of a structured maintenance management system, the implementation of proactive and planned maintenance strategies, the enhancement of technical skills among maintenance personnel, sufficient financial allocation, and systematic record-keeping. These measures are intended to support the sustainable preservation of the Muzium Diraja Kedah and safeguard its heritage value for future generations.

1. Introduction

Maintenance is a fundamental requirement for all building types; however, it is particularly critical for museum buildings, as they serve a dual role in supporting daily operations and safeguarding their historical and cultural significance. Museums function as key institutions for shaping collective identity and reinforcing a sense of belonging within communities. In the context of heritage museums, the buildings themselves act as repositories of cultural memory, housing artifacts, documents, and narratives that reflect a nation's historical development. Beyond their educational function, museums contribute to cultural awareness, heritage appreciation, tourism, and community engagement.

Heritage buildings, such as the Muzium Diraja Kedah (MDK), play a vital role in communicating the nation's historical narrative and serve as valuable resources for academic research and public learning. Their architectural form and spatial design often reflect the socio-cultural and technological context of the period in which they were

constructed, further enhancing their heritage value. Consequently, preserving such buildings is essential to ensure that their cultural significance and historical narratives remain accessible to future generations. Proper and systematic maintenance enables museums to remain functional, safe, and visually appealing, while continuing to operate as meaningful cultural landmarks and tourist attractions.

Effective maintenance management has been widely recognized as a critical contributor to organizational performance, particularly through improvements in operational efficiency, service quality, and asset longevity [1];[2];[3]. Achieving high standards in maintenance practice requires strategic management approaches that align maintenance planning with user needs, institutional objectives, and available resources. In Malaysia, however, building maintenance is frequently carried out on a conditional basis, largely dependent on budget availability rather than actual maintenance requirements. This reactive maintenance approach often results in delayed interventions, which can lead to physical deterioration, reduced functionality, and declining user satisfaction. Over time, such practices may render buildings less attractive or even unfit for their intended purpose, thereby diminishing their overall value to both users and the broader community.

As custodians of cultural heritage, museums are responsible not only for preserving collections but also for maintaining the historic buildings that house them. These structures represent significant architectural heritage and embody cultural and historical values that cannot be replaced once lost [4]. Without appropriate maintenance and conservation measures, heritage buildings are vulnerable to progressive deterioration, which may ultimately result in irreversible damage and the loss of cultural assets [5];[6]. Regular and planned maintenance is therefore a core element of effective conservation practice and should be implemented proactively rather than only in response to visible defects or urgent failures [7].

In this context, this study aims to examine the existing maintenance practices implemented at Muzium Diraja Kedah (MDK). The focus is on identifying gaps, weaknesses, and limitations associated with the prevailing reactive maintenance approach. By critically analyzing current practices, the study seeks to propose practical recommendations for improving maintenance planning, organization, and management. Ultimately, the findings are intended to support the development of a more systematic and efficient maintenance management framework that ensures the long-term preservation, functionality, and sustainability of the museum and its heritage assets.

2. Literature Review

2.1 Preventive Maintenance in Heritage Buildings

Preventive maintenance is widely recognised as a fundamental strategy for the effective conservation of heritage buildings. A proactive maintenance framework focuses on early detection of defects and scheduled interventions, which help to improve safety, extend asset lifespan, and reduce long-term maintenance costs. Previous studies emphasise that preventive maintenance is the most effective conservation approach for heritage buildings, regardless of whether the elements involved are architectural, structural, mechanical, or landscape-related, as early intervention minimises deterioration and avoids major corrective work.

Compared to reactive or complaint-based maintenance, preventive maintenance offers significant advantages, particularly for historic buildings with ageing materials and unique construction techniques. Reactive maintenance often addresses defects only after they have occurred, which can lead to secondary damage and increased repair costs. Recent empirical studies provide strong evidence that systematic preventive maintenance significantly improves the performance of heritage buildings. For example, [8] demonstrated that planned maintenance programmes in historic buildings reduced unplanned failures and emergency repairs by enabling early defect detection and timely interventions. Similarly, [9] found that preventive maintenance improves budget predictability by allowing maintenance costs to be forecast more accurately, thereby reducing sudden financial pressures on facility management organisations.

In the context of heritage conservation, [10] reported that preventive maintenance strategies contribute directly to sustainable conservation outcomes by slowing material deterioration and preserving original building fabric. More recently, [11] showed that heritage facilities adopting structured maintenance planning experienced lower lifecycle costs and better long-term asset conditions compared to those relying on reactive maintenance approaches. Collectively, these studies confirm that systematic preventive maintenance not only reduces unexpected breakdowns but also supports financial efficiency and sustainable heritage conservation practices. Therefore, adopting a structured preventive maintenance approach is essential to ensure the long-term preservation and functionality of heritage buildings.

2.2 Heritage Buildings and Tourism Value

Heritage buildings play a significant role in cultural preservation and tourism development, as they attract both local and international visitors due to their historical importance, architectural uniqueness, and strong cultural identity [12]. These buildings serve as tangible links to the past, contributing to the public's understanding of

history, traditions, and national identity. In Malaysia, heritage tourism makes a substantial contribution to national revenue while reinforcing social identity and cultural continuity across generations [13];[14].

Recent studies indicate that the physical condition and maintenance quality of heritage buildings significantly influence tourists' perception and behavior. Well-maintained heritage sites are generally more attractive, safer, and more comfortable, leading to higher visitor satisfaction and a greater likelihood of repeat visits [15]. Conversely, visible deterioration and poor maintenance can negatively affect visitor experience, reduce destination attractiveness, and weaken tourism potential [16].

Viewing heritage buildings as tourism assets underscores the importance of effective maintenance strategies in preserving both their physical condition and aesthetic quality. Maintenance activities should therefore not be regarded solely as technical tasks, but as strategic investments that support cultural sustainability and long-term economic growth. Maintaining high standards in the conservation and management of heritage buildings is essential for achieving sustainable tourism objectives and ensuring that cultural assets continue to serve as long-term socio-economic and cultural resources [17].

2.3 Overview of Muzium Diraja Kedah

The Muzium Diraja Kedah, or Kedah Royal Museum, stands as one of Malaysia's most significant heritage landmarks. Originally known as Istana Kota Setar, the building was constructed in 1735 during the reign of Sultan Muhammad Jiwa Zainal Adilin Mu'azzam Shah I, the 19th Sultan of Kedah (1710–1778). Serving both as a royal residence and the administrative center of the Kedah Sultanate, the palace played a pivotal role in the state's governance and cultural history. In 1983, the building was restored and repurposed as a royal museum to commemorate the Silver Jubilee of His Majesty Sultan Abdul Halim Mu'adzam Shah's reign. Officially opened on 25 July 1983, the museum has since embodied Kedah's enduring royal and cultural legacy, preserving its historical significance for future generations.

The preservation and upkeep of the MDK are vital not only to maintain its functionality but also to protect its architectural authenticity and historical significance. According to [18], the conservation of heritage buildings must integrate sustainable management practices that address both structural maintenance and the protection of cultural significance. Their study highlights that consistent maintenance planning and stakeholder involvement are essential to prolong the lifespan of Malaysia's historical buildings while maintaining their aesthetic and cultural integrity. Similarly, [19] and [20] emphasized that continuous and preventive maintenance play a critical role in reducing deterioration risks and ensuring long-term preservation outcomes.

Moreover, effective conservation contributes directly to sustainable tourism and cultural continuity. [21] emphasizes that the proper care and management of heritage sites enhance their educational, economic, and cultural importance, making them valuable resources for local and national development. Therefore, taking care of the Muzium Diraja Kedah is not only about keeping the building safe. It also demonstrates Malaysia's strong commitment to preserving its cultural heritage and promoting sustainable heritage tourism.

2.4 Maintenance Management Challenges in Heritage Museums

Preventive maintenance is crucial for protecting heritage buildings, yet many museums continue to struggle with its effective management. Heritage sites are often managed by several government agencies, which creates complicated procedures and slows down decision-making. It has been noted that overlapping duties and weak coordination often delay responses to maintenance problems, leading to faster deterioration [18]. At Muzium Diraja Kedah, maintenance is handled by different authorities. This system can slow the release of funds or approval for repairs. When damage occurs, the need for multiple approvals often postpones urgent work, putting both the building and its collections at risk. Studies show that such governance issues encourage reactive maintenance, where repairs are only performed after visible damage has occurred [22]; [23].

Reactive maintenance is unsuitable for heritage sites because older materials and construction methods need careful handling. [19] and [24] found that frequent unplanned repairs increase costs, cause repeated problems, and reduce historical authenticity. Without a planned system, heritage assets like MDK face ongoing deterioration and higher long-term expenses.

MDK, built in 1735, is almost 300 years old and represents Malaysia's royal architectural heritage. [23] stresses that preserving such buildings requires constant monitoring, proper records, and regular care, not just repairs after damage. Limited budgets exacerbate this challenge, as large restoration projects often consume most available funds [25]; [18].

A systematic maintenance plan that carefully balances cost, time, and preservation is essential for sustaining heritage buildings. Effective management, adequate financial support, and a thorough understanding of the building's materials and performance are critical factors [21];[26]. Through proactive and well-organized maintenance practices, heritage museums such as Muzium Diraja Kedah (MDK) can safeguard their architectural integrity and cultural significance, ensuring that these assets remain preserved for future generations.

3. Methodology

This study adopted a qualitative case study approach to explore maintenance management practices at the MDK. The case study method was chosen because it allows an in-depth examination of real-world issues within their natural context and supports the development of practical insights [26].

A purposive sampling technique was used to identify respondents with relevant experience and expertise in heritage building maintenance. This non-probability sampling method enables researchers to select participants who can provide rich and detailed information related to the research objectives [27].

A total of seven respondents participated in the study. They included three staff members from the Conservation Department of MDK, one representative from the Development Department of Muzium Negeri Kedah, two staff members from the Monument Department of Muzium Padi Negeri Kedah, and one technical staff member from the Public Works Department (PWD), Kedah. These individuals were selected based on their professional roles, technical knowledge, and involvement in maintenance and conservation work.

Unstructured interviews were the main data collection method. Each interview lasted between 45 minutes and one hour and was conducted at the respondents' workplaces. All interviews were audio-recorded with the participants' consent and subsequently transcribed for analysis. Relevant documents, including maintenance policies, guidelines, and reports, were also reviewed to support the findings. The collected information was then coded and analyzed thematically to identify common themes and insights related to maintenance management practices at Muzium Diraja Kedah.

4. Results and Discussion

This section presents the study's findings, focusing on key elements of maintenance management at MDK. Each element is critically examined to assess the effectiveness of current practices and identify areas that require improvement.

4.1 Current Practices of Maintenance Management

4.1.1 Maintenance Organization

Maintenance at MDK is overseen by Muzium Negeri Kedah (MNK), which employs 57 staff members to manage all museums across the state. The organization is structured into several units, including administration, finance, conservation, development, and public relations. At MDK, the Conservation Unit is responsible for daily upkeep, while the Development Unit manages larger repair and restoration projects.

Findings reveal that the maintenance team lacks sufficient personnel, resulting in reduced operational efficiency and slower response times. Shortages in technical expertise and manpower are widely recognized as recurring challenges in heritage building management [28]. Adequate staffing and skill development are therefore essential to ensure effective maintenance and preservation of the museum's facilities.

4.1.2 Maintenance Approach

The maintenance practices at MDK primarily rely on a corrective or reactive approach, where repairs are undertaken only after visible defects or failures occur. Routine cleaning and basic upkeep are performed by the Conservation Unit on a scheduled basis. However, preventive or planned maintenance is rarely implemented, leaving the museum vulnerable to recurring damage and higher long-term repair costs.

This reactive approach is not ideal for heritage buildings, as older materials and traditional construction techniques require timely interventions to prevent deterioration. Studies by [19] and [23] emphasize that unplanned maintenance increases costs, accelerates material decay, and compromises the authenticity of heritage assets. To ensure the museum's sustainability, a systematic preventive maintenance strategy should be developed in accordance with heritage conservation principles recommended by [21].

4.1.3 Maintenance Budget

According to the MNK operational guidelines, maintenance funding is allocated based on the assessed condition of each museum building. Financial resources for MDK are primarily provided by the Lembaga Muzium Negeri Kedah, while smaller expenses are managed internally.

Interview findings indicate that repair works costing less than RM20,000 can be executed directly through indent procedures, whereas projects exceeding this threshold require a formal quotation process. For larger maintenance or restoration efforts, the Development Unit must prepare a proposal and seek approval from higher management. Respondents emphasized that sufficient financial backing is crucial for timely maintenance, as delays in budget approval frequently led to prolonged deterioration. This observation is consistent with [25], who identified limited financial allocation as a major obstacle to effective heritage building maintenance in Malaysia.

4.1.4 Maintenance Record

MDK keeps detailed documentation of all preservation, restoration, and maintenance activities as part of its heritage management responsibilities. These records include work logs, inspection reports, and photographic evidence that capture the condition of both artifacts and structural components.

Maintaining accurate and up-to-date records is essential to ensure that future maintenance adheres to recognized conservation standards and supports long-term planning [29];[18]. Photographs, in particular, provide a valuable tool for tracking physical changes and detecting early signs of deterioration. A well-structured record-keeping system is therefore a key element of sustainable conservation management.

4.1.5 Maintenance Personnel

At MDK, maintenance responsibilities are shared between in-house staff and external contractors, depending on the complexity of the work. Routine activities such as cleaning and minor repairs are managed internally by the Conservation Unit, usually involving a small team of two to five workers. More specialized tasks, including structural restoration, electrical systems, or landscaping, require coordination with MNK, which appoints licensed contractors through a formal procurement process.

Findings indicate that the limited technical expertise of internal staff often leads to dependence on external contractors. This reliance can raise costs and extend repair timelines. [28] have noted that the shortage of skilled maintenance personnel is a persistent challenge in Malaysian heritage management, underscoring the importance of targeted training programs and better resource allocation to strengthen in-house capacity.

4.2 Recommendations for Improving Maintenance Management

The following recommendations are proposed to strengthen maintenance practices at the MDK, ensuring the sustainable preservation of its heritage assets and enhancing operational efficiency. These suggestions are derived from the study's findings and are reinforced by evidence from similar research in the conservation literature.

4.2.1 Systematic Maintenance Management

A systematic maintenance management system should be implemented to improve the scheduling, monitoring, and documentation of all maintenance activities. Maintenance tasks, including minor repairs, should be carried out regularly and recorded in a structured format to support planning and budgeting. Establishing a centralized maintenance log will provide a reliable reference for decision-making and resource allocation.

According to [18], systematic maintenance enhances efficiency and ensures that heritage structures receive timely care, reducing the risk of deterioration. Likewise, [21] recommends proactive management systems to ensure conservation efforts align with international standards and sustainability goals.

4.2.2 Planned and Preventive Maintenance

A planned maintenance program is essential for the sustainable preservation of Muzium Diraja Kedah (MDK). Preventive maintenance activities such as regular inspections, cleaning, and minor repairs should be conducted at fixed intervals to detect early signs of deterioration before they become severe. Routine maintenance should occur on a daily or weekly basis, while comprehensive inspections should be conducted at least twice a year to assess the condition of mechanical, electrical, and structural systems.

Research consistently highlights the advantages of proactive maintenance. Studies show that structured systems enhance operational efficiency, reduce repair costs, and support the sustainable management of heritage buildings [18]. Well-organized schedules also help maintain structural integrity while balancing conservation priorities with financial considerations [30]. Preventive approaches further contribute to long-term sustainability by minimizing environmental and economic impacts [31]. Regular inspection-based maintenance has been found to improve decision-making and extend the lifespan of heritage assets [32]. By implementing a planned and well-documented maintenance strategy, MDK can preserve both its functional performance and cultural significance for future generations.

4.2.3 Skilled Personnel and Training

Effective maintenance management in heritage buildings relies heavily on the presence of skilled and qualified personnel. Staff must possess both technical expertise and a solid understanding of conservation principles to ensure that interventions are appropriate, sustainable, and aligned with heritage standards. Management should appoint experienced personnel to oversee operations and ensure compliance with established conservation and safety requirements.

Ongoing training and capacity-building initiatives are essential for strengthening staff competencies in maintenance planning, preventive conservation, and the application of modern diagnostic tools. Previous studies

have highlighted that investing in human capital significantly improves the performance and sustainability of heritage maintenance systems [24];[18]. Similarly, [31] stresses that workforce development enhances decision-making, safety, and long-term efficiency. Literature further supports this view, showing that continuous professional training enables organizations to adapt to evolving conservation technologies and management practices, ultimately leading to better preservation outcomes [33];[34].

By cultivating a skilled and knowledgeable workforce, MDK can enhance the quality of its maintenance activities, reduce its reliance on external contractors, and ensure the long-term protection of its cultural heritage.

4.2.4 Budget Allocation and Financial Planning

A consistent and well-structured annual budget is fundamental to effective maintenance management. The museum's administration should establish a funding plan that prioritizes maintenance requirements according to building condition, material age, and level of use. Interview findings revealed that respondents considered training costs for existing staff, such as participation in maintenance courses, part of the budget allocation, thereby contributing to more efficient museum maintenance practices.

Financial planning must also anticipate economic fluctuations and unforeseen emergencies to ensure resilience. Recent studies emphasize that insufficient financial allocation remains a major barrier to the maintenance of heritage buildings in Malaysia [35]. Ensuring adequate funding and timely budget approval is therefore critical to prevent delays in repair work and reducing overall maintenance costs.

4.2.5 Documentation and Record

Proper documentation and record management should be integral components of the museum's maintenance system. All maintenance activities—such as inspections, repairs, and restoration works—must be systematically recorded in organized databases or maintenance logs to ensure accuracy and traceability. During the interviews, respondents emphasized the importance of maintaining detailed records for every maintenance activity and submitting them to supervisors. Several participants also suggested establishing a dedicated documentation system to track ongoing tasks and update completed work regularly. Conducting routine audits and monitoring was recommended to verify that documentation remains complete, reliable, and aligned with conservation requirements.

Such practices not only help identify recurring issues and strengthen accountability but also provide valuable data for long-term planning. As emphasized by [36], the importance of systematic documentation and monitoring in the maintenance of heritage buildings is a critical reference for future conservation strategies.

4.2.6 Compliance with Standards and Regulation

Compliance with standards and regulations is essential for the effective maintenance and preservation of heritage buildings. Adhering to approved procedures ensures that repair and conservation works are conducted safely, efficiently, and in line with heritage protection principles [37], [38]. Acting promptly when repairs are required is equally important for preventing further deterioration and maintaining the museum's overall quality and appearance [39].

Interview findings support this view. All participants agreed that immediate repairs help protect and maintain the museum's heritage. They also emphasized that all maintenance activities should adhere to established standards, particularly those related to visitor safety. One participant emphasized that repair work must comply with regulations established by authorities, such as the Public Works Department (PWD), to prevent further deterioration and ensure long-term effectiveness.

Overall, strict adherence to maintenance standards guarantees that conservation work is performed responsibly and sustainably. It enables museums to protect their cultural assets while meeting safety and regulatory requirements, thereby supporting both operational efficiency and heritage conservation goals.

5. Conclusion

This study provides an evaluation of maintenance management practices at Muzium Diraja Kedah (MDK), focusing on assessing current procedures and identifying strategies for improvement. The proposed recommendations aim to enhance the museum's long-term sustainability, ensuring the effective preservation of its cultural, historical, and physical assets.

The findings offer valuable guidance not only for MDK but also for other state institutions such as Muzium Negeri Kedah (MNK) and Muzium Padi Negeri Kedah (MPNK). Collectively, these insights provide a practical framework for enhancing maintenance planning, optimizing resource allocation, and advancing preventive conservation practices.

By implementing the suggested measures, museums in Kedah may enhance operational efficiency, optimize maintenance resources, and provide visitors with safer and more welcoming environments. These improvements

are expected to enhance preservation outcomes and foster more sustainable management practices, thereby ensuring the long-term protection and resilience of heritage museum buildings in Malaysia.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors are responsible for the study conception, research design, data collection, data analysis, result interpretation and manuscript drafting.

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