RESEARCH IN MANAGEMENT OF TECHNOLOGY AND BUSINESS
e-ISSN: 2773-5044

RMTB

Vol. 6 No. 2 (2025) 926-945
https://publisher.uthm.edu.my/periodicals/index.php/rmtb

Study on the Maintenance Level of Heritage Buildings in Sandakan, Sabah

Pang Shao Dong[1], Indera Syahrul Mat Radzuan[1,2]*, Zarina Shamsudin[1,2] , Nur Yuhanis Ismon[1,2]

[1] *Department of Real Estate Management, Faculty of Technology Management & Business, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, MALAYSIA*
[2] *Malaysian Real Estate Institute (MyREI), Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, MALAYSIA*

*Corresponding Author: syahrul@uthm.edu.my
DOI: https://doi.org/10.30880/rmtb.2025.06.02.072

Article Info

Received: 30 September 2025
Accepted: 1 November 2025
Available online: 1 December 2025

Keywords

Maintenance Practices, Maintenance Level, Maintenance Impact, Heritage Buildings

Abstract

This research analyses the current maintenance level on heritage buildings and the maintenance impacts on heritage buildings. There are six heritage buildings within the Sandakan Heritage Trail that have been selected as the case study. While two methods adopted in this research to collect data in which the qualitative and quantitative. The triangulation method was used to ensure the reliability and validity of the findings by cross-verifying data from these multiple sources. Thought interviews with related individuals or parties, surveys on visitors and the heritage buildings observation, the data collected for analysis purposes. The findings is to determine the currents maintenance level and evaluate the maintenance impacts on heritage buildings in Sandakan, Sabah.

1. Introduction

Preserving heritage buildings is important for maintaining cultural identity and historical significance. This research is to examines maintenance practices and impacts in preserving heritage buildings, focusing on the Sandakan Heritage Trail in Sabah, Malaysia. The evaluation of maintenance levels and the impact in this study aimed to offer insights for effective heritage conservation. The adoption of suitable methodology allows research to contribute to the outcome which meets the objectives. The findings also contribute to the broader field of heritage preservation which offering recommendations for improving maintenance practices and ensuring the longevity of Malaysia's cultural heritage.

1.1 Research Background

The Sandakan is well-known for its great history and for its collection of heritage structures which are mostly inspired by British colonial architecture and World War II (Tan, 2013). The heritage buildings and buildings include the Agnes Newton Keith Home, The Parish of St Michael, Masjid Jamek, Sam Sing Kung Chinese Temple and more that can attract the tourism. One well-known tourist destination that provides a path through several historical and cultural landmarks is the Sandakan Heritage Trail which officially launched on June 21, 2003 (Chong, 2021). Among these stops are seven historically significant 18th-century buildings that survived the attack during World War II. Given the abundance of heritage buildings, it is essential to conduct proper maintenance to preserve their current state and historical significance. In the perspective of Goussos (2022), heritage buildings are vital elements of a country's cultural legacy. Therefore, heritage buildings require protection and preservation through proper maintenance but there is a need to preserve both history and

contemporary relevance. A result of research from Zolkafli et al. (2019) also mentioned the necessity of regularly and properly maintaining heritage buildings to retain their original value.

Recently, an article by Bavani M (2024) mentioned the government's efforts in maintaining heritage buildings by providing tax benefits to building owners. This highlights that the government is still striving to improve the maintenance management system, while the significant financial support provided is important. The organisation's commitment to maintaining and protecting these culturally and historically important structures are also needed. At the same year, a repair incentive in RM6.48 million was awarded by the George Town World Heritage Incorporated (GTWHI) for the purpose of restoration and preservation of the heritage building (Imran, 2024) This indicates that the dedication of all related parties involved in safeguarding heritage buildings are employing their own strategies to achieve this goal. Research from Hosseini et al. (2021) indicates that the designation of World Heritage Buildings (WHSs) positively impacts tourism demand in developing countries, where that study suggest that the WHS branding can serve as an effective promotional tool to attract tourists. This study also highlights the need for proper maintenance of heritage buildings to preserve their current state and historical significance

Moreover, the sustainability of the heritage tourism industry should come with effective maintenance and management practices in enhancing heritage sites for tourism (Thirunavukkrasu & Radzuan, 2021). According to Raja & Miswan (2008), a significant challenge in the maintenance industry is the lack of comprehensive data on maintenance activities in Malaysia with some organisations failing to collect such data. Therefore, it is important to assess the maintenance level of heritage buildings, establish a baseline which enables informed decision-making for subsequent maintenance efforts. This initial step is important for determining the appropriate actions needed to preserve these heritage buildings effectively.

1.2 Problem Statements

Sodangi et al. (2013) highlighted the importance of information management, where information and other related documentation of maintenance management are important. It also suggested that the inspections and condition surveys allow the researchers to understand and identify the any issues that may arise. This is an essential way and the very first step for developing effective maintenance strategies and ensuring the long-term preservation of these buildings. This idea was also supported by the research of Syahmi et al. (2022), where the lack of record keeping caused low performance in maintenance, especially the immediate maintenance, which required a quick response time. Recently, the Sandakan Heritage Trail reprinted 10,000 updated maps, indicating ongoing maintenance efforts. However, there are other news reports by Chong (2022) with photographic evidence showcasing the Batu Sapi Heritage Park in Karamunting, once a well-known tourist destination in Sandakan. The park features a rock formation resembling a three-legged buffalo, located just meters away from the beach. However, the news highlighted the apparent failure of maintenance for this heritage site in Sandakan. This raises questions about the level of maintenance, its impact and the necessary requirements that need to be addressed.

Furthermore, in the context of maintaining heritage buildings, the goal is to preserve their original historical value while making improvements, and this maintenance should come with professional and proper management to carry out the actions. However, according to an article by Maketab (2023), the trail is maintained by a team of volunteers, who work closely with Sandakan Municipal Council, Sabah Tourism and Tourism Malaysia. Thereof, the study need to focus on the examination maintenance level of the heritage site in Sandakan, Sabah. In the economic perspective, the significance of heritage buildings in attracting tourism cannot be overstated. Mazi Aljohani & Ah Choy (2021) conducted a study that revealed the substantial positive impact of heritage tourism on Sabah, Malaysia's local community, especially in terms of economic and cultural benefits. Their study highlights the importance of protecting historic buildings by making sure that the characteristics that make these locations attractive are not put at risk by an increase in visitors is a significant problem in the field of cultural tourism.

In 2023, an article by AWANI (2023) stated that domestic tourism has also seen a strong rebound with 54.5 million visitors recorded. These figures indicate that the Malaysia's tourism sector is slowly recovery form the pandemic era, and it is highlighting its resilience and potential for growth in the tourism sector. When the visitor increases, there is the concern that where the heritage buildings may encounter challenges like vandalism, looting, and overcrowding due to tourism which could endanger their unique cultural or historical values. The issues in the heritage buildings can negatively affect the satisfaction levels of tourists visiting these buildings (Syed Mohamad et al., 2023). One of the challenges arises from how maintenance minimises the harm caused by these issues when heritage buildings are open to the public for visits and the impacts.

1.3 Research Questions

(i) What is the maintenance level of heritage buildings in Sandakan, Sabah?
(ii) What are the maintenance impacts on heritage buildings in Sandakan Sabah?

1.4 Research Objective

(i) What is the maintenance level of heritage buildings in Sandakan, Sabah?
(ii) What are the maintenance impacts on heritage buildings in Sandakan, Sabah?

1.4.1 Sub Section Headings

Sub-section headings should also be in the same style as the headings, numbered 1.1, 1.2, etc, and left justified, with second and subsequent lines indented.

1.5 Scope of the Study

This research focuses on heritage buildings within Sandakan, Sabah, Malaysia. Specifically, it examines six historical and cultural landmarks along the Sandakan Heritage Trail, which are the Masjid Jamik, Agnes Keith's House, Goddess of Mercy Chinese Temple, St. Michael and All Angels Church, Sam Sing Kung Chinese Temple and Wisma Warisan. The study employed a combination of qualitative and quantitative methods, including interviews, surveys and observations. Maintenance levels are assessed based on standards through the interview and observation in the stakeholder perception, and other relevant criteria.

1.6 File Naming and Delivery

The study's importance arises from its potential to provide insightful information about the maintenance level in heritage buildings and the impacts of maintenance. It offered a thorough evaluation of the condition of the heritage buildings by assessing the present maintenance level, which can guide future conservation efforts. This information is beneficial to stakeholders, including the maintenance professionals, government authorities, investors, researchers, and others involved in heritage building management, as it can inform decision-making and improve the overall preservation and sustainable management of these cultural assets. The findings of this study are answered with research questions and reach the objectives.

2. Literature Review

2.1 Heritage Buiding Maintenance

In Malaysia, heritage buildings are defined and protected under the National Heritage Act 2005 (Act 645). According to Section 2 of the Act, a heritage site is any site, building, or structure of historical, cultural, architectural, or archaeological significance and designated as such under the Act. Nevertheless, Sabah has its own regulations pertaining to this subject, the State Heritage Enactment 2017 which essentially defines the same things as the National Heritage Act (2005). The maintenance of heritage buildings is a critical aspect of heritage conservation and management, ensuring that these buildings retain their cultural, historical, and architectural significance for future generations. One aspect of heritage buildings maintenance is its aim to preserve the physical integrity of heritage building and it refers to the actions taken to protect and conserve the physical elements of a heritage building such as floor, window, door, and mores building structures.

This idea was support by Rahman et al. (2012) where their research highlighted the importance of on-going maintenance is preserving the heritage buildings. Effective maintenance often involves the participation of local communities and stakeholders. Community engagement can help foster a sense of ownership and responsibility towards the heritage building. Thus, the research of Isa et al. (2011), it suggests that conservation in heritage building management is about finding a balance between preserving the building's original character and making necessary improvements to meet current standards. This ensures the site remains authentic and culturally significant while also ensuring that it is safe and comfortable for the public. Regular monitoring and inspection are essential components of heritage building maintenance. Continuous assessment of the building's condition helps identify potential issues early, allowing for timely intervention before significant damage occurs. Feilden & Jokilehto (1998) describe maintenance as including all practical and technical approaches necessary to ensure the building's condition remains true to its original state without degrading its value and significance. This progressive and continuous process is crucial for prolonging the lifespan of heritage buildings.

2.2 Maintenance Management System

In terms of recognising and acknowledging the maintenance management system of heritage buildings is fundamental steps. Therefore, an evaluation of maintenance management system in a heritage building managements allow the research to understanding the physical condition of buildings. This evaluation maintenance management system's quality is crucial for ensuring the effectiveness and efficiency of preservation efforts. According to the findings of Ibni & Othuman (2012), effective maintenance of heritage

buildings requires balancing costs, selecting appropriate materials, employing skilled professionals, and establishing a clear management structure with defined roles and communication channels.

More, standardised procedures ensure consistency and quality, while prioritising safety and maintains the comfort of occupants and compliance with health and safety regulations. Heritage Building Maintenance Management (HBMM) which is an approach to preserving and managing historical buildings which involves a systematic practices and strategies to maintain, repair, and conserve heritage structures to ensure their longevity and continued use (Adegoriola et al., 2022). When related to maintenance measurement, HBMM involves assessing the current condition of a heritage building and determining the appropriate maintenance actions needed to preserve its integrity and historical significance. This assessment includes evaluating the building's structural stability, identifying areas of deterioration or damage and developing a maintenance plan to address these issues (Adegoriola et al., 2022). This approach provides a framework for measuring and managing maintenance in heritage buildings effectively.

2.3 Measurement of the Maintenance

The measurement of maintenance levels involves evaluating the physical condition of heritage building, the effectiveness of maintenance activities and the resources allocated. The data is an important element as it serves as the input for all measurements before generating the final output. In the research of the Madaraez (2012), it expresses that comprehensive data collection is necessary for the process of measuring maintenance levels accurately in real estate. The accuracy of data can help in comparing and analysing the performance of different facilities, leading to better maintenance strategies and more efficient resource use. This indicated that the necessary of development of survey to gather data on maintenance practices with the outcome. In other research which conduce by Bello et al. (2020), the measurements are only focus on qualitative aspects which is an understanding the management and maintenance practices of properties through interviews, analysis of the properties' characteristics and usage. They have developed their own methods and criteria for gathering which are used to analysing data related to subject study, particularly in terms of maintenance and management. The research only appears that the research methodology includes both qualitative and quantitative approaches.

2.3.1 Development and Application of Measurement Tool

In many research studies, researchers often developing their own measurement tools to ensure that the instruments function as the context specific. This will align with their unique research objectives, and capable of capturing the precise constructs under investigation (Abdullah & Raman, 2000). One of the examples in the study on maintenance management practices in heritage buildings, the researchers created a semi-structured interview form, and a Likert scale questionnaire tailored specifically to assess maintenance management systems and staff satisfaction in heritage buildings (Syahmi et al., 2022). This approach enhances the validity and reliability of their measurements, ensuring that the data collected is both relevant and accurate. Noor et al. (2019) utilised a combination of qualitative and quantitative approaches to assess the maintenance needs of Balai Zaharah in Johor Bahru. The research has adopted a visual inspection conducted which focuses on architectural and structural elements, with defects rated based on condition and maintenance priority. The maintenance priority ratings were classified from very good to very critical, indicating the severity of each defect. This building condition rating utilises an inspection scale ranging from one to five, with each number corresponding to specific characteristics and descriptions that represent the building's condition. This method simplifies the analysis and understanding of the building's state by using numerical values as indicators of the maintenance level. The analysis involved assessing the building's functionality, security, maintainability, and sustainability based on identified defects. Data were recorded in building condition schedules and defect sheets, with photographs illustrating the defects. The overall building rating was determined by the total marks from the matrix analysis divided by the total number of defects. The study's findings and methodologies provide valuable insights into the maintenance needs of heritage buildings and can guide future conservation efforts

2.3.2 Standardised Guidelines for Evaluating Heritage Buiding Conditions

Observation and inspection provide firsthand information essential for evaluating a building's condition. Clear descriptions and guidelines are necessary to distinguish between acceptable and problematic conditions ensuring that the assessment is both accurate and reliable. More, measurements should come with standardised criteria and detailed descriptions as every building is unique in terms of its design, construction materials and historical significance. According to Jasme et al. (2014) having clear guidelines and descriptions allows for more accurate evaluations, ensuring that heritage buildings are assessed not only for their physical condition but also for the preservation of their authenticity. This standardised approach not only facilitates the evaluation of building conditions but also allows for more accurate comparisons across studies. It ensures that evaluators have a common understanding of what constitutes a particular level of deterioration or preservation. In the study by Jasme et al. (2014) the initial phase of building investigation involves a comprehensive analysis of its

structure. This includes a detailed assessment of individual components such as the roof, forecourt, and both the external and internal parts of the building. When considering building components, it is essential to reference the "Heritage Building Conservation Needs Statement: User Manual" from (Jabatan Kerja Raya (2019). This manual outlines the specific maintenance needs and standards for various building elements, including the roof, windows, doors, ceilings, floors, stairs, and railings, guiding effective maintenance practices.

2.4 Maintenance Impacts on Heritage Buiding

2.4.1 Positive Impacts on Heritage Buiding

On the positive side, regular and effective maintenance is crucial for prolonging the lifespan of heritage buildings. Numerous studies have mentioned this beneficial outcome when carrying out the maintenance activities. Such consistent maintenance practices help to maintain the building's physical integrity, ensuring that it remains true to its original state without losing its historical significance (Feilden & Jokilehto, 1998). Preserving the building's authenticity and cultural significance is one of the maintenance objectives when coming into the heritage building maintenance. This was supported by the research Isa et al. (2011) where the maintenance is ensuring the historical value of the building. Another positive maintenance outcome is to reduce the need for extensive and costly repairs for the building in the future (Lazarus, 2007). These extensive costs come from the action needed to take to repair and replace the buildings material or structure. Maintenance helps identify and address minor issues early, before they worsen.

Moreover, In the maintenance management perspective, costs saving is always an organisation's objective when carrying out the maintenance activities. These activities can be influencing maintenance costs, including human factors, tools and equipment, spare parts and materials, funds allocation, and available information (Mong et al., 2018). The preservation and maintenance of heritage buildings are important not only for conserving their historical and cultural significance but also for enhancing visitor experience. Like religious buildings, heritage buildings attract a diverse range of visitors driven by both cultural and recreational interests. Just as effective tourism management is crucial for religious buildings (Adegoriola et al., 2021; Collins, 2020) proper maintenance of heritage buildings plays a critical role in shaping visitor experience. When a building is well-maintained, visitors are more likely to have a positive experience as the structure's authenticity is preserved, and their expectations are met. In the research of Pande & Shi (2023) have shown that the service and facility of the religious heritage buildings have a huge correlation with visitor experience. The visitor in religious heritage buildings will also focus on the functional of the building such that the maintenance will play an important role.

2.4.2 Negative Impacts on Heritage Buildings

Unlike regular properties, heritage buildings hold unique historical value and maintenance activities can potentially alter their original state. This concern has also been highlighted by Feilden and Jokilehto (1998) noted that maintaining heritage buildings presents greater challenges compared to modern structures, as the need to preserve their authenticity and historical integrity often conflicts with the necessity of repairs and upkeep. Using modern materials or incorrect restoration techniques can alter the original appearance and structure of heritage buildings, compromising their authenticity Feilden (2003). When maintenance only focus on replacing traditional materials with modern equivalents may compromise the authenticity of the structure, as new materials may not blend well with the original architecture. Some of those traditional maintenance which need chemical treatments or cleaning agents that are not eco-friendly can lead to pollution, which in turn exacerbates environmental conditions that favour microbial growth. This creates a feedback loop where maintenance efforts intended to preserve the building end up contributing to its deterioration Hermans (1998) In a biodeterioration perspective, a traditional cleaning method that use harsh chemicals such as sodium hypochlorite (bleach) or hydrochloric acid to remove stains and biological growth on stone surfaces can cause harmful environmental effects.

Maintenance can bring the negative impact which can damage the original building structure by adopt with incorporate material. Moreover, an over-restoration maintenance practice, where the attempt to "improve" or modernise a heritage building results in the loss of significant historical features. This can include the removal of original architectural elements, decorative features, or finishes that are seen as outdated or impractical. Over-restoration may also involve extensive reconstruction using new materials that do not accurately reflect the original building's craftsmanship or aesthetic, erasing its historical context. In such cases, rather than preserving the building's heritage, restoration efforts can unintentionally lead to the erasure of its historical identity.

3. Research Methodology

3.1 Research Design

According to Igwenagu (2016), research should start with identifying the problem, followed by formulating a hypothesis, outlining testable consequences, evaluating the hypothesis, and presenting the outcomes. Each step logically follows the previous one, creating a structured pathway that transforms an existing problem into new knowledge. This research design involves five stages which is defining the problem and objectives, conducting a comprehensive literature review to understand the current state of knowledge and identify gaps, systematically collecting data using mixed methods (qualitative and quantitative), analysing the data with appropriate statistical methods to draw conclusions and contribute to the existing body of knowledge and summarising the study's major findings where emphasising the significance and implications which offering valuable insight (refer to Appendix A).

3.2 Data Collection

The use of mixed methods, which combine the qualitative and quantitative methods to collect the available data. The data collection methods used to collect data in this study are observation, interviews and surveys. Data collection involves interviews and observations to assess the current maintenance level of these buildings.

3.2.1 Observation

Physical inspections using standardised checklists to gather data on the current maintenance levels, which focus on the external and internal of the building, and the three systems, which are the mechanical systems, electrical systems, and plumbing system, were conducted (Table 1). While a 5-point scoring system is used to evaluate the condition of each building element during inspections, where the scoring system ranges from 1 (Very Poor) to 5 (Excellent), was adopted (Table 2). The average or mean was adopted in these cases to ensure a fair comparison and standardise the evaluation, as the number of building elements assessed varies between the buildings.

Table 1 *Inspection Focus*

Element	Inspection Focus (Check For)
Exterior Walls	Cracks, bulging, water damage, efflorescence, peeling paint and mortar damage.
Roof	Missing or damaged tiles, leaks, water pooling, sagging, flashing and gutter condition.
Windows	Glass condition, frame wear, rot, warping, and operational functionality.
Doors	Frame, panel, hardware condition, alignment, and smooth operation.
Gutters and Downspouts	Blockages, leaks, rust, damage, secure attachment and proper water redirection.
External Paint	Peeling, cracking, fading, blistering, and protection of underlying materials.
Interior Walls	Cracks, moisture damage, peeling paint, structural movement, condition of decorative elements.
Ceiling	Cracks, water stains, sagging, structural issues, mold, mildew, condition of decorative features.
Flooring	Uneven surfaces, cracks, loose and damaged tiles, water damage, condition of historical features.
Structural Elements	Settling, cracking, deterioration, foundation condition, signs of stress or failure.
Mechanical Systems	Condition and functionality of HVAC systems, leaks, rust, unusual noises and operational inefficiencies.
Electrical Systems	Outdated wiring, faulty outlets and switches, condition of circuit breakers compliance with safety codes.
Plumbing Systems	Leaks, corrosion, blockages, condition of pipes and fixtures proper drainage.

Table 2 *Building Component Condition Assessment Scale (Oversavation)*

Score	Description
1 (Very Poor)	The element is in extremely poor condition, with major structural damage, non-functional systems, or severe deterioration. Immediate action is required.
2 (Poor)	The element is in poor condition, with noticeable issues that require prompt repair. While functional, the element is far from optimal and may present problems soon.
3 (Fair)	The element is in fair condition, showing signs of wear or minor issues. Regular maintenance is recommended to maintain functionality.
4 (Good)	The element is in good condition with only minor cosmetic issues. It functions well and

	requires minimal maintenance.
5 (Excellent)	The element is in excellent condition, fully operational with no visible damage or wear. Regular maintenance has kept it in top condition.

3.2.2 Interview

Interview the building manager to evaluate maintenance practices to gain insights into the maintenance management. The evaluation of the management and maintenance practices for heritage buildings, based on six key criteria: management, maintenance activity evaluation, skilled workers and expertise, resource management, use of technology and expected outcomes. More interviews with relevant stakeholders were conducted to gather additional insights and detailed information. The interview questions for stakeholders focus on the role, responsibility, and relationships involved in maintenance activities, aiming to understand their involvement, decision-making processes, and the interaction with building maintenance management.

3.2.3 Surveys

Surveys measured user satisfaction and evaluated the impact of maintenance, where the feedback focuses on user experiences and satisfaction with maintenance effectiveness. This allows respondents to express their level of agreement or satisfaction with different statements and is employed to gather data to achieve the second objective of assessing the impacts of maintenance. The Likert-Type Scale Response Anchors by Vagias (2006) were adopted for this purpose, which ensures a standardised and reliable approach to measuring perceptions and attitudes. The survey is structured into four sections, which are demographic information, visitor experience and satisfaction, positive impacts of maintenance, and negative impacts.

3.3 Data Analysis

The data derived from observation, interviews and surveys are analysed using statistical techniques to identify patterns and insights. Content analysis focuses on interviews and observations related to the condition of heritage buildings, breaking down content into manageable units. The adoption of transcription converts audio recordings of interviews into written text, facilitating detailed analysis. Next, the thematic analysis helps to identify common themes from stakeholder interviews, aiding in the development of informed recommendations for maintenance practices. Descriptive statistics by calculating the mean score of data points to provide a central value that represents the overall building's condition and maintenance management, and summarise data using Excel, aiding in visualisation. The triangulation was adopted in the findings by cross-verifying data from multiple sources, which enhances the credibility and validity of conclusions and recommendations regarding heritage building maintenance in Sandakan, Sabah.

4. Results and Discussion

4.1 Maintenance Level of Heritage Building

The result of the assessment of the heritage buildings is considered good preservation and well-maintenance, with an average point above 4 (Table 3). According to Table 4, the overall score is derived from the sum of the external, internal, system, structural components, and other elements assessed using a Likert scale ranging from 1 to 5. As a result, there are two heritage buildings with a rating of excellent, which are Agnes Keith's House 4.73) and St. Michael's (4.73) and All Angels Church (4.69). The lowest average compared to the others is for Sandakan Jamek Mosque (4.13), which is closely followed by the Goddess of Mercy Temple (4.14). The Sam Sing Kung Temple (4.20) and Wisam Warisan (4.23) are in good condition. Overall, a rating scale of 4, which shows that the building is in good condition with only minor issues or wear. It also indicates that the building functions well and requires minimal maintenance to perform to reach excellent condition. The rates of excellence in buildings show that the buildings are well-maintained and fully operational.

Table 3 *Average Score Rating Scale*

Average Score	Rating
1.00 – 1.49	Very Poor
1.50 – 2.00	Poor
2.50 – 3.00	Fair
3.00 – 4.49	Good
4.50 – 5.00	Excellent

Table 4 *Overall Maintenance Level Analysis of Heritage Buildings*

Elements	Sandakan Jamek Mosque	Agnes Keith's House	Goddess of Mercy Temple	St. Michael's and All Angels Church	Sam Sing Kung Temple	Wisma Warisan
External of the Building	22	24	16	22	19	22
Internal of the Building	15	20	16	20	17	14
Systems and Structural Components	13	15	13	14	14	14
Other Notable Element	12	12	13	5	13	5
Overall	62	71	58	61	63	55
Number of Elements	15	15	14	13	15	13
Average	4.13	4.73	4.14	4.69	4.20	4.23
Rate	Good	Excellent	Good	Excellent	Good	Good

4.2 Evaluation of Management, Maintenance Practices and Stakeholders' Comments

4.2.1 Management and Maintenance Practices

The evaluation of the management and maintenance practices for heritage buildings, based on six key criteria that have been explained, which include the management, maintenance activity evaluation, skilled workers and expertise, resource management, use of technology, and expected outcomes. The average score to keep the fairness is assessed by assessing the total scores, the number of questions fulfilled and the average rating (Table 5). As a result in Table 6, the R2 have achieved the highest total score of 66 with all questions fulfilled and 4.71 average scores. This reflects the strong management and maintenance practices in all areas, especially in the maintenance activities and expertise of the workers. However, R4 is closely followed by the total score of 62 and the average score of 4.4. In contrast, R3 have recorded the lowest score of 37 with the average score of 3.36, which indicates that there are challenges in multiple areas in terms of management. This might also be due to the absence of an organisational structure within the heritage building. R1 achieved a total score of 60 with an average of 4.29, indicating generally strong management and maintenance practices. R5 scored 43 with an average of 3.31, reflecting a more critical view of the practices. All respondents, except R6, met the expected outcome score of 4, which shows that the majority achieved management and maintenance goals to a satisfactory level.

Table 5 *Respondents information*

Respondent ID	Role	Years of Experience	Affiliation
R1	Building Manager	5	Masjid Jamik (Town Mosque)
R2	Building Manager	3	Agnes Keith's House
R3	Owner	-	Goddess of Mercy Chinese Temple
R4	Maintenance Manager	20	St. Michael and All Angels Church
R5	Building Manager	20	Sam Sing Kung Chinese Temple
R6	Building Manager	6	Wisma Warisan
R7	Heritage Building Founder	30	Historical Society
R8	Local Authority Representative	6	Sandakan City Council

Table 6 *Overview of Management and Maintenance Practices*

Sub Section	R1	R2	R3	R4	R5	R6
Management	9	9	4	9	7	9
Maintenance Activity Evaluation	17	19	11	18	12	14
Skill Workers and Expertise	9	12	6	10	7	10
Resource Management	12	12	7	12	8	11
Use of Technology	9	10	5	9	5	9
Expected outcome	4	4	4	4	4	2
Total	60	66	37	62	43	55
Question Fulfilled	14	14	11	14	13	14
Average	4.29	4.71	3.36	4.43	3.31	3.93

4.2.2 Stakeholder's Comments

In terms of the role and experience, R7, who is the founder of the Sandakan Heritage Trails program, has 21 years of experience leading a non-governmental organisation with nine volunteers, which focuses on raising awareness and promoting the heritage as tourism products. The creation of the trails is driven by preservation motivation as R7 demanded to raise awareness of the next generation. On the other hand, R8 is the urban designer in the Sandakan town council with three years of experience and roles as building manager of Wisma Warisan. Both respondents have assisted in the field of maintenance responsibilities by finding funding sources and highlighting the need for funding. This function also highlighted budget allocation for maintenance activities, where the respondents are not directly involved but instead provided the funding resource. These incidents are similar to the monitoring and maintenance that is delegated to each heritage building. R7 and R8 have served as team leaders, the head of an NGO with 9 volunteers (R7) and the head of the urban planning department in Sandakan Town Council (R8). However, both representatives have limited authority towards for each individual heritage building but only provide suggestions.

Despite the different roles of stakeholders, both respondents contribute to preservation efforts. The public engagement of R7 initiatives aims to build awareness, while R8 is focused on policy development to control the maintenance activities within the heritage buildings. In such a way, the contribution of the program that raises awareness and promotes the consistent maintenance is the main objective. In the opinion of both stakeholders, the maintenance activities face challenges due to the low awareness, lack of funding and policies. Moreover, there is a communication gap between the heritage building's manager and stakeholders. In this case, R7 rated the maintenance condition as poor in terms of management, while R8 considered it fair. The R7 have suggested strong involvement in heritage building maintenance, and this involvement should be enforced under the framework of policies, as R8 mentioned. Additionally, the impacts of the heritage trials are beneficial toward the tourism sectors due to the opinion of both stakeholders. However, R8 highlighted that the impact has no significant effect on broader economic growth, particularly in terms of the city's development. Overall, the primary challenge to advancing the preservation of heritage buildings is influenced by the perception and awareness of the current community. This highlights the need for effective policies to establish better control and support preservation efforts (refer to Appendix B).

4.3 Evaluation of Maintenance Impacts on Heritage Builidngs

4.3.1 Demographic Profiles

Demographic profile from the survey which included 83 respondents which 47 individuals are males, and 36 individuals are female. In term of race, the majority are Chinese (59 respondents), followed by 13 respondents which are identifying as "other races and 11 Malay respondents. As the results of Chinese race as dominated respondent, the Buddhism have the highest record number of respondents as 44 individuals, followed by Christianity (20 respondents) and Islam (18 respondents). Notably, there are 1 respondent identifying as other religion which reflecting Sabah's diverse racial and religious landscape. The age distribution revealed that the largest group was aged 18 to 25 years old which making up as 36 individuals which reflecting a younger demographic. There are 15 respondents in a group of 36 to 45 age group which making it the second-largest category, followed by 14 respondents aged 46 to 55 and 13 respondents aged 26 to 35. Only one respondent was aged 66 to 75, and none were aged 17 or younger or above 76. Regarding educational, most respondents held a bachelor's degree (27 respondents) and diploma or pre-university (26 respondents). It followed by secondary education which represents 23 respondents, and a smaller proportion of respondents had master's degree (5 respondents). The level of vocational, technical education and primary education both record 1 respondent, while there are no respondents had a doctorate education level.

Students and private sector employees formed the largest group, accounting for 25 and 20 individuals. The number of respondents recorded is the same for both self-employed individuals and government employees, with 17 respondents in each category. There are 4 respondents without jobs which including 1 retired individual and 3 unemployed respondents. Most of the respondents have 21 to 30 years of residence in Sandakan, Sabah (24 respondents), followed by 22 respondents' residence for 11 to 20 years. This was followed by the respondents who live for 31 to 40 years in Sandakan. There are 4 respondents who have lived in the area for less than one year, and the number of respondents is the same as the number of respondents's area for 1 to 5 years. The least represented categories were those who had lived in the area for 6 to 10 years (3 respondents). The other 7 and 8 respondents were residents for 41 to 50 50 years and above (refer to Appendix C).

4.3.2 Positive Impacts of Maintenance

A significant majority of respondents agree or strongly agree that regular maintenance activities, such as structural repairs and restoration work are prolonging the life of these buildings (Figure 1). This statement was supported by 34 respondents who strongly agree and 27 respondents who agree. In contrast, only a small number (4 respondents) disagreed, and 1 respondent strongly disagreed, while 17 respondents had a neutral opinion. In terms of targeted maintenance efforts, maintenance activities that focus on preserving original materials and ensuring historical accuracy in repairs are believed to increase the historical value of heritage buildings. This is shared by 68 respondents, of whom 44 strongly agree and 24 agree, with only 3 respondents expressing disagreement. The other 12 respondents have a neutral mind on this statement.

There were 27 respondents who agreed and 35 who strongly agreed that the maintenance of heritage buildings reduces costly repair with minimal disagreement (3), while none of the responses strongly disagreed on this matter. Only 18 were unsure about the statement. Furthermore, seventy respondents agree (23) or strongly agree (47) that specific maintenance tasks, such as cleaning and repairing, improve their experience when visiting these heritage buildings. However, there is a small portion of respondents (2) who disagree and neutral (11) on this matter. Lastly, the attractiveness of heritage buildings to visitors is perceived to increase due to maintenance efforts, with 70 respondents in agreement, which recorded the highest strong agreement (48) compared to the impact of others, and only 4 respondents disagreed with this. Overall, the trend of positive impact showed an agreement on the impacts and only a few disagreements. The data underscores the importance of regular and targeted maintenance in preserving the structural integrity, historical value and visitor appeal of heritage buildings.

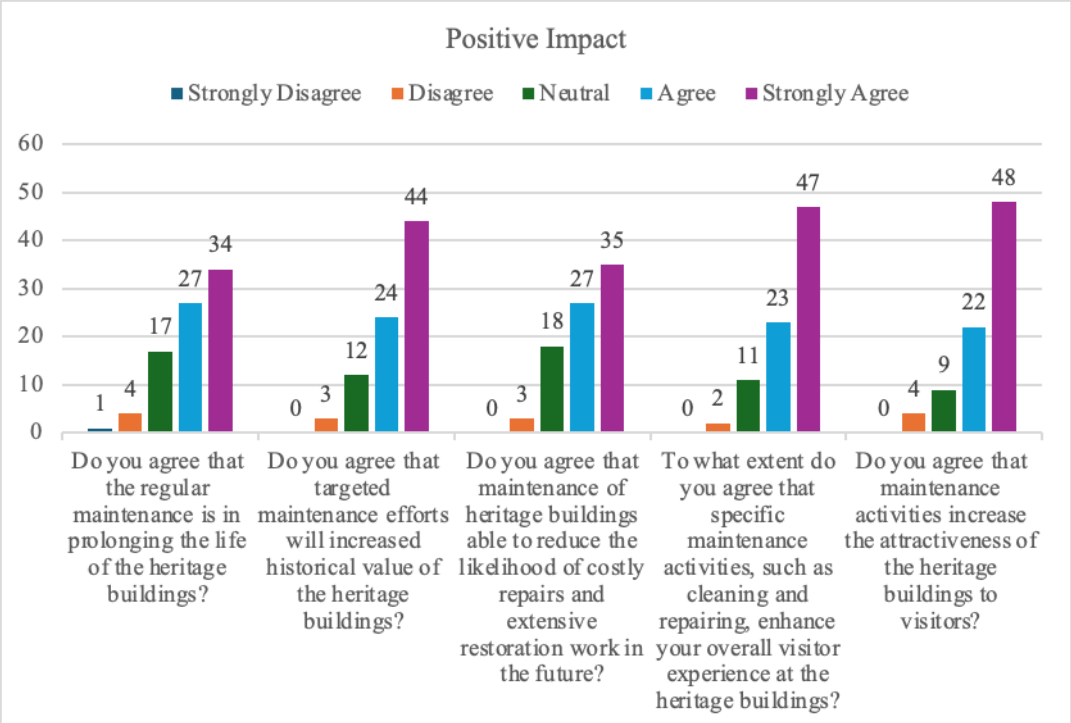


Figure 1 *Positive Impact of Heritage Buildings Maintenance*

4.3.3 Negative Impacts of Maintenance

Based on Figure 2, regarding the negative impact which maintenance causes loss of authenticity, 33 respondents support, 21 respondents agree, and 12 respondents strongly agree. However, 33 respondents were neutral

about the statement that the use of modern materials and alterations to original structures result in the loss of authenticity, while 15 disagreed and 2 strongly disagreed. Additionally, the use of incorporated or old materials and traditional methods in maintenance work is perceived to make heritage buildings more vulnerable to environmental factors such as weathering and pollution. This view was shared by 17 respondents who agreed and 14 who strongly agreed, while 34 respondents remained neutral. This statement was received 16 disagreement and 2 strongly disagreement.

Furthermore, respondents have 25 agreement and 13 strongly agreement of opinion on the over-restoration practices and the use of incorporated materials are seen as potentially damaging to the original building structure. However, there are 30 respondents were neutral and 15 disagree with this statement. Overall, most of the respondents have neutral on these statements and a notable presence of disagreement opinion on this negative impacts. The highest concern is seen in negative impacts where over-restoration and structural damage are significant worries.

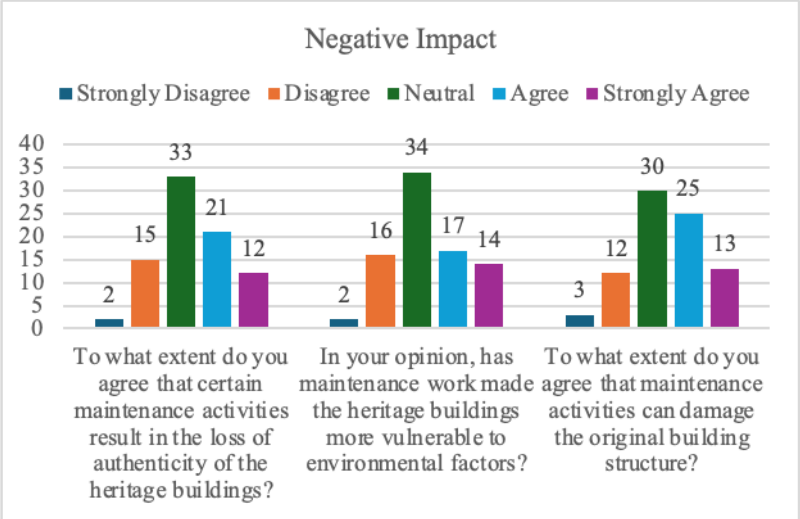


Figure 2 *Negative Impact of Heritage Buildings Maintenance*

4.4 Satisfaction Level with the Heritage Buildings

4.4.1 Frequency of Visits

Among the six heritage buildings, there are 58 respondents who never visit the Sandakan Jamek Mosques, while 14 respondents visit the mosques rarely, less than once a year. There are 7 respondents who visit the mosques 1 to 3 times per year, and 3 respondents visit monthly, while a small number (1) always visit. Agnes Keith's House shows a more balanced distribution, with the 45 respondents visiting less than once a year, followed by a group of respondents (14) who visit 1 to 3 times yearly. There are fewer respondents in the categories of often and always visiting the buildings. However, there are still 22 respondents never visited Agnes Keith's House.

Out of the respondents, 24 rarely visit the Goddess of Mercy Temple, while 23 visit it sometimes. Fewer respondents (3) often visit, and none of the respondents visit the temple weekly. Nonetheless, there are 33 respondents have never visited. St. Michael's and All Angels Church showed a group of frequent visitors with 30 respondents visiting weekly or more often, followed by 28 who visit sometimes. Only a small number (2) visit often, and 4 respondents rarely visit.

Sam Sing Kung Temple shows a similar trend to Sandakan Jamek Mosques, but with 33 respondents never visiting, 25 visiting rarely, and 19 visiting sometimes. However, a small number of respondents visit the temple often or always. Lastly, Wisma Warisan has a considerable number of frequent visitors, with 38 respondents visiting less than once a year, followed by 15 visiting sometimes, and 2 visiting rarely. Only 28 respondents have never visited this site (refer to Appendix D).

4.4.2 Invalid Data

The data validation summary provides an overview of the responses collected from 83 participants, categorised into valid and invalid data (Table 7). A total of 29 responses (approximately 35%) were deemed due to response validity bias. In contrast, 54 responses (about 65%) were validated as complete, consistent, and reliable for use in the evaluation level of satisfaction. This breakdown ensures the integrity of the analysis by focusing solely on accurate and usable data, providing a clear representation of the respondents' insights. In the case of Masjid Jamek, 58 respondents reported they had never visited the buildings, while only 38 marked "Not Applicable" for

satisfaction, which indicated that a gap of 23 respondents rated their satisfaction despite having no firsthand experience with the buildings. This incident highlighted that some respondents may have provided satisfaction ratings based on assumptions, second-hand information, or misunderstood the survey question.

Table 7 *Data Validation Summary*

Data	Number
Invalid Data	29
Valid Data	54
Total Respondents	83

4.4.3 Satisfaction with Preservation and Maintenance

At Sandakan Jamek Mosque, most of the respondents (11) have moderately satisfied levels of satisfaction, and 10 were slightly satisfied. A smaller number of respondents expressed being very satisfied (1), not at all satisfied (1) and extremely satisfied with the preservation and maintenance of the buildings. Agnes Keith's House shows a large portion of respondents (20) indicating moderately satisfied, followed by 17 respondents who were very satisfied with the preservation and maintenance, and 1 respondent was extremely satisfied. In contrast, there were 7 respondents who were slightly satisfied, and no respondents reported as not satisfied at all.

The Goddess of Mercy Temple demonstrates a concentration of responses in moderately satisfied (11), with 12 respondents very satisfied and 1 extremely satisfied. A smaller group was slightly satisfied (4), while no respondents reported being not at all satisfied. This situation was like St. Michael's and All Angels Church, where there was no respondent being unsatisfied at all, and low respondents (1) reported being slightly satisfied. However, 23 respondents were very satisfied, which records the highest among the six buildings, followed by 2 respondents who were extremely satisfied.

For Sam Sing Kung Temple, most respondents (12) selected moderately satisfied, with 11 reporting very satisfied and 2 respondents reporting extremely satisfied. A lower number was recorded for slightly satisfied (4). Despite this, Wisma Warisan displayed a trend with 14 moderately satisfied, 4 very satisfied, and none extremely satisfied reported. 19 respondents expressed that they were slightly satisfied, and 1 was unsatisfied at all, which records the highest among the six buildings.

In the matter of not applicable, the highest number recorded was 30 respondents in Sandakan Jamek Mosque, followed by 26 and 25 respondents in the Goddess of Mercy Temple and Sam Sing Kung Temple. St. Michael's and All Angels Church reported that 17 respondents were not applicable to this. In the case of Agnes Keith's House, there are 9 not applicable, which is lower than Wisma Warisan (16). This result was influenced by the frequency of visiting where the respondent had never visited the heritage buildings (refer to Appendix E).

4.4.4 Satisfaction with Functional and Usability

At Sandakan Jamek Mosque, most respondents were moderately satisfied (14), slightly satisfied (4) and very satisfied (4). A very small number, which only 1 respondent reported for level of satisfaction at not satisfied at all, while only 1 respondent expressed extreme satisfaction. Regarding the functional and usability of Agnes Keith's House, most respondents expressed moderate satisfaction, followed by 19 very satisfied, 18 slightly satisfied, and 1 extremely satisfied. However, there were 4 respondents who were slightly satisfied.

Moderate satisfaction was expressed by 12 respondents regarding the functionality and usability of the Goddess of Mercy Temple. In addition, 10 respondents indicated they were very satisfied. There was 1 respondent who was extremely satisfied, in contrast to 4 respondents who had slight satisfaction. The usability and functionality of the St. Michael's and All Angels Church garnered moderate satisfaction from 20 respondents, extremely satisfied from 4 respondents, and only 10 were slightly satisfied. Among the respondents, 4 expressed a high level of satisfaction, which is the highest recorded for heritage buildings, and there were no reports of dissatisfaction.

For Sam Sing Kung Temple, 13 respondents reported being moderately satisfied, and 9 respondents reported being very satisfied due to the functionality and usability of the building. The categories of slightly satisfied and extremely satisfied each recorded 4 and 3 respondents, while no respondent reported being unsatisfied. 17 respondents indicated they were moderately satisfied, while 15 respondents were slightly satisfied with the functionality and usability of Wisma Warisan. A small proportion of respondents were very satisfied (5), and one respondent expressed dissatisfaction. In the case of not applicable, it was influenced by the frequency of visiting where the respondent had never visited the heritage buildings (refer to Appendix F).

4.5 Triangulation of Findings

4.5.1 Sandakan Jamek Mosque

As a result of the inspection, Sandakan Jamek Mosque and have average scores of 4.13 which are the lowest among the buildings assessed. This result indicates that an improvement in management and maintenance practices is needed as the average scores for management and maintenance practices are 4.29. The practice such as the lack of in-house training and the quarterly routine maintenance schedule have negatively impacted the maintenance outcomes. However, the data showed that most respondents were moderately satisfied with the in term of preservation, maintenance, functional and usability of the mosque which the buildings meeting the basic expectations of users.

4.5.2 Agnes Keith's House

The observational data for Agnes Keith's House have the highest average score (4.73) compared to others heritage buildings, indicating that the building is well-preserved and maintained. This high score reflects effective management and maintenance practices (4.71). The building manager (R2) mentioned that the maintenance is managed by formal government committees which ensure a high level of coordination and effectiveness. This have strengthened the suggestion and opinion by R7 where a strong government in term of building management. Survey data showed high levels of satisfaction among respondents and most respondents were moderately to very satisfied with the building's maintenance, while a significant number were extremely satisfied with many expressing that the preservation and usability of Agnes Keith's House were excellent. This aligns with the observational and interview data confirming the effectiveness of the current maintenance practices.

4.5.3 Goddess of Mercy Temple

In contract of Agnes Keith's House, this heritage building has the lowest average score with score of 4.14. Interview data indicated that the temple relies solely on outsourced maintenance and manage by owner without organisation, which may contribute to its lower scores. The owner (R3) mentioned issues such as insufficient and difficult to reach quality materials affects to the maintenance activities. For instance, the inaccessibility and high cost of unique roof tiles require a larger budget for maintenance compared to other heritage buildings. More, stakeholders highlighted the challenges of maintaining the heritage due to limited resources and the absence of a structured management framework. In such cases, the involvement of stakeholders in maintenance activities is provided financial support to address maintenance issues as highlighted during the interview sessions.

4.5.4 St. Michael and All Angels Church

St. Michael and All Angels Church received an excellent rating with an average score of 4.69 from the observational data, which the highest average score after Agnes Keith's House. These results indicate effective management and maintenance practice (4.43) been adopted into the heritage buildings. This was confirmed by interview data with R4 reporting very effective management and frequent maintenance activities weekly. Regarding resource allocation, the managers stated that it is more than sufficient to support maintenance activities. The survey data showed high levels of satisfaction among respondents with many expressing that the church's preservation and usability were excellent. These results are aligned with the heritage buildings conditions.

4.5.5 Sum Sing Kung Chinese Temple

Sum Sing Kung Chinese Temple indicated a good average score of 4.20 in building condition assessment, and 3.31 of management and maintenance practices. Since both buildings share similarities, the results are nearly identical. The scores are comparable to those of the Goddess of Mercy Temple, highlighting maintenance challenges such as financial constraints and difficulties in obtaining quality materials for maintenance. However, this temple benefits from having an organisation that sets it apart. Survey data showed that respondents were generally satisfied with the temple's preservation and maintenance which is similar to the Goddess of Mercy Temple.

4.5.6 Wisma Warisan

Wisma Warisan received average score of 4.23 from the observational data indicating good but not exceptional maintenance practices (3.93). Interview data indicated that most of the other heritage buildings have met the expected outcomes, but Wisma Warisan has rarely achieved this. This is attributed to insufficient resources and

the occasional frequency of in-house worker training among other factors maintenance. Stakeholders highlighted the need for better resource management and more frequent maintenance activities. The building's proximity to modern buildings makes accessing quality materials easier, but financial constraints and limited skilled labour impact the overall maintenance quality. More, the survey data showed that respondents were slightly satisfied with the building's preservation and maintenance, this reflects a need for more frequent maintenance activities to maintain its good condition. In these results, having an organisation is beneficial but government organisations often manage multiple heritage buildings, which may result in Wisma Warisan not being prioritised in terms of funding or attention compared to other buildings. Additionally, the building is busy and serves as a functional government institution which could further impact its maintenance focus.

4.5.7 General Analysis and Conclusion

The condition of the building is influenced by management and maintenance practices, which in turn affect visitor experiences. In the stakeholder comments, R7 and R8 had differing opinions, R7 expressed that maintenance especially in management, was poor, while R8 had a fair opinion. According to the interview data, maintenance responsibilities are primarily assigned to individual owners or managers of each building. This highlights several challenges faced by heritage buildings, including a lack of standardisation, limited resources, and coordination issues. As R7 pointed out, unclear role definitions further exacerbate these difficulties. Furthermore, stakeholders highlighted low awareness, which is evident from the lower frequency of visits, as the six buildings recorded a high number of respondents who have never visited the buildings.

Regarding the six heritage buildings, Agnes Keith's House and St. Michael and All Angels Church achieved high scores in both observational assessments and user satisfaction. However, buildings like the Goddess of Mercy Temple and Sam Sing Kung Chinese Temple faced challenges related to financial constraints, limited access to quality materials, and the absence of structured management. These issues were reflected in their lower scores and moderate satisfaction levels. Wisma Warisan, despite being managed by a formal government organisation, showed mixed results. Overall, targeted improvements in resource allocation, training, and stakeholder collaboration are essential to ensure the sustainability of heritage buildings. More, enhance management frameworks and prioritising underperforming buildings, such as Wisma Warisan, which can significantly improve preservation efforts and align maintenance practices with desired outcomes.

5. Conclusion

The objective has been successfully accomplished by collecting comprehensive data and analysed. Buildings like Agnes Keith's House and St. Michael's Church demonstrated effective frameworks and resource allocation, achieving high preservation levels. Conversely, buildings like Wisma Warisan and the Goddess of Mercy Temple faced challenges due to limited resources and insufficient training. Survey data revealed moderate satisfaction levels, with low community awareness affecting visitation rates. While maintenance practices have positively contributed to the building's longevity and usability, concerns like loss of authenticity and over-restoration were viewed with a neutral stance. Interview results highlighted the need for clear policies, better communication and more.

The study emphasises the importance of structured management, frequent maintenance, and stakeholder collaboration. Policies are needed to standardise practices, allocate resources, and improve public awareness. Future research should explore advanced technologies and broader cultural contexts to enhance heritage preservation efforts. This study evaluated maintenance levels and impacts on six heritage buildings, highlighting the role of effective management and stakeholder involvement. While some buildings demonstrated strong preservation efforts, others faced significant challenges. The findings underscore the need for targeted improvements to ensure the sustainability and cultural significance of heritage buildings. The study was limited to six buildings, with data reflecting local perspectives. Recommendations include implementing structured management frameworks, increasing public awareness, and enforcing policies for standardised maintenance practices. Future research should explore innovative techniques and policy impacts on heritage preservation.

Acknowledge

The authors would like to thanks the Department of Real Estate Management and the Faculty of Technology, Universiti Tun Hussein Onn Malaysia, for supporting this paper for publication

Conflict of Interest

There is no conflict of interests regarding the publication of the paper

Authors' contribution

The authors confirm their contribution to the paper as follows: ***study conception and design***: Pang Shao Dong, Indera Syahrul Mat Radzuan, Zarina Shamsudin, Nur Yuhanis Ismon; *data collection*: Pang Shao Dong, Indera Syahrul Mat Radzuan; ***analysis and interpretation of results***: Pang Shao Dong, Indera Syahrul Mat Radzuan ;***draft manuscript preparation***: Pang Shao Dong, Indera Syahrul Mat Radzuan, Zarina Shamsudin, Nur Yuhanis Ismon. All authors reviewed the results and approved the final version of the manuscript.

References

Abdullah, S. H., & Raman, S. (2000). Quantitative and Qualitative Research Method: Some Strengths and Weakness. *Jurnal Pendidik Dan Pendidikan*.

Adegoriola, M. I., Lai, J. H. K., Chan, E. H., & Darko, A. (2021). Heritage building maintenance management (HBMM): A bibliometric-qualitative analysis of literature. *Journal of Building Engineering*, *42*, 102416. https://doi.org/https://doi.org/10.1016/j.jobe.2021.102416

Adegoriola, M. I., Lai, J. H., Yung, E. H., & Chan, E. H. (2022). Conceptualizing the identification of critical success factors for heritage building maintenance management (HBMM). *IOP Conference Series: Earth and Environmental Science*, *1101*(6), 62017. https://doi.org/10.1088/1755-1315/1101/6/062017

AWANI. (2023). *Are we doing enough to preserve our heritage sites?* Astro Awani. https://www.astroawani.com/berita-malaysia/columnist-are-we-doing-enough-preserve-our-heritage-sites-440417

Bavani M. (2024). *'Tax relief for heritage building owners can reduce maintenance burden.'* The Star. https://www.thestar.com.my/metro/metro-news/2024/05/02/tax-relief-for-heritage-building-owners-can-reduce-maintenance-burden

Bello, H., Ayob, M. F., & Sarkawi, A. A. (2020). Preliminary Study on the Maintenance Level of Waqf Properties: Federal Territory, Kuala Lumpur. *UMRAN - Journal of Islamic and Civilizational Studies*, *7*(3), 87–97. https://doi.org/10.11113/UMRAN2020.7N3.443

Chong, R. (2021). *Sandakan Heritage Trail – rekindling Sandakan's history with a walk*. The Vibes. https://www.thevibes.com/articles/culture/39881/sandakan-heritage-trail-rekindling-sandakans-history-with-a-walk

Chong, R. (2022). *What happened to Batu Sapi Heritage Park? | Malaysia | The Vibes*. The Vibes. https://www.thevibes.com/articles/news/60492/what-happened-to-batu-sapi-heritage-park

Collins-Kreiner, N. (2020). A review of research into religion and tourism Launching the Annals of Tourism Research Curated Collection on religion and tourism. *Annals of Tourism Research*, *82*, 102892. https://doi.org/10.1016/J.ANNALS.2020.102892

Feilden, B. M. (2003). *Conservation of Historic Buildings: Vol. Third edition*. Architectural Press.

Feilden, B. M., & Jokilehto, J. (1998). *Management Guidelines For World Cultural Heritage Sites*. ICCROM.

Hermans, M. H. (1998). *Sustainable Building Maintenance*.

Hosseini, K., Stefaniec, A., & Hosseini, S. P. (2021). World Heritage Sites in developing countries: Assessing impacts and handling complexities toward sustainable tourism. *Journal of Destination Marketing & Management*, *20*, 100616. https://doi.org/10.1016/j.jdmm.2021.100616

Ibni Hashim, N., & Othuman Mydin, A. (2012). Maintenance Management System of Administration Heritage Building in Malaysia. *International Journal Of Engineering*.

Igwenagu, C. (2016). Fundamentals of research methodology and data collection. *LAP Lambert Academic Publishing*.

Imran Hilmy. (2024). *RM6.48mil repair funds for heritage buildings*. The Star. https://www.thestar.com.my/metro/metro-news/2024/05/04/rm648mil-repair-funds-for-heritage-buildings

Jabatan Kerja Raya. (2019). *Heritage Building Conservation Need Statement*.

Jasme, N., M.A., O., & Md Sani, N. (2014). Investigation of Adaptive Reuse of Heritage Buildings in Penang. *SHS Web of Conferences*, *11*. https://doi.org/10.1051/shsconf/20141101007

Lazarus, D. (2007). Maintenance of heritage architecture: Implementation and practice. *WIT Transactions on the Built Environment*, *95*, 319–328. https://doi.org/10.2495/STR070301

Madaraez, L. R. (2012). Measurement of operation and maintenance practices for corporate property management. *Pollack Periodica*, *7*, 117–126. https://doi.org/10.1556/Pollack.7.2012.3.12

Maketab, H. (2023). *The Sandakan Heritage Trail in Sabah is a must-do for history buffs*. The Star. https://www.thestar.com.my/lifestyle/travel/2023/11/11/the-sandakan-heritage-trail-in-sabah-is-a-must-do-for-history-buffs

Mazi Aljohani, N., & Ah Choy, E. (2021). *Impact of Heritage Tourism on Local Community in Sabah, Malaysia* (Vol. 18, Issue 5).

Mohd Noor, S., Shing Mei, C., Syahrizal Ibrahim, I., Nabilah Sarbini, N., Hanim Osman, M., & Azeyah Khiyon, N. (2019). Heritage building condition assessment: a case study from Johor Bahru, Malaysia. *IOP Conference Series: Earth and Environmental Science*, *220*(1), 012024. https://doi.org/10.1088/1755-1315/220/1/012024

Mohd-Isa, A. F., Zainal-Abidin, Z., & Hashim, A. E. (2011). Built Heritage Maintenance: A Malaysian Perspectives. *Procedia Engineering*, *20*, 213–221. https://doi.org/10.1016/J.PROENG.2011.11.158

Mong, S. G., Mohamad, S., & Misnan, M. S. (2018). Key Strategies to Overcome Cost Overruns Issues in Building Maintenance Management. *International Journal of Engineering and Technology(UAE)*, *7*, 269–273. https://doi.org/10.14419/ijet.v7i2.29.13330

National Heritage Act (2005).

Pande, K., & Shi, F. (2023). Managing visitor experience at religious heritage sites. *Journal of Destination Marketing & Management*, *29*, 100800. https://doi.org/10.1016/J.JDMM.2023.100800

Rahman, A., Akasah, Z., & Zuraidi, S. (2012). The Importance of On-Going Maintenance in Preserving the Heritage Listed Buildings. *International Journal on Advanced Science, Engineering and Information Technology*, *2*. https://doi.org/10.18517/ijaseit.2.2.184

Raja Marzyani, R. M., & Miswan Abdul Hakim, M. (2008, May). *Identifying Maintenance Issues in Malaysia*.

Sodangi, M., Khamidi, Dr. M. F., & Idrus, A. (2013). Maintenance management challenges for heritage buildings used as royal museums in Malaysia. *Journal of Applied Sciences and Environmental Sustainability*, *1*, 23–28.

Syahmi, M., Effandi, E. M., Ashraf, M., & Rahman, A. (2022). A Study on Maintenance Management Practices for the Conservation of Heritage Museum Buildings in Malacca. *Progress in Engineering Application and Technology*, *3*(2), 231–242. https://doi.org/10.30880/peat.2022.03.02.023

Syed Mohamad, S. B. H., Abdul Rahman, M. A., Suratkon, A., & Shahrin, F. (2023). Tourists' Perspectives on Condition of Heritage Buildings and Resiliency of the Heritage Tourism Industry in Melaka. *International Journal of Sustainable Construction Engineering and Technology*, *14*(2), 250–255. https://publisher.uthm.edu.my/ojs/index.php/IJSCET/article/view/14026

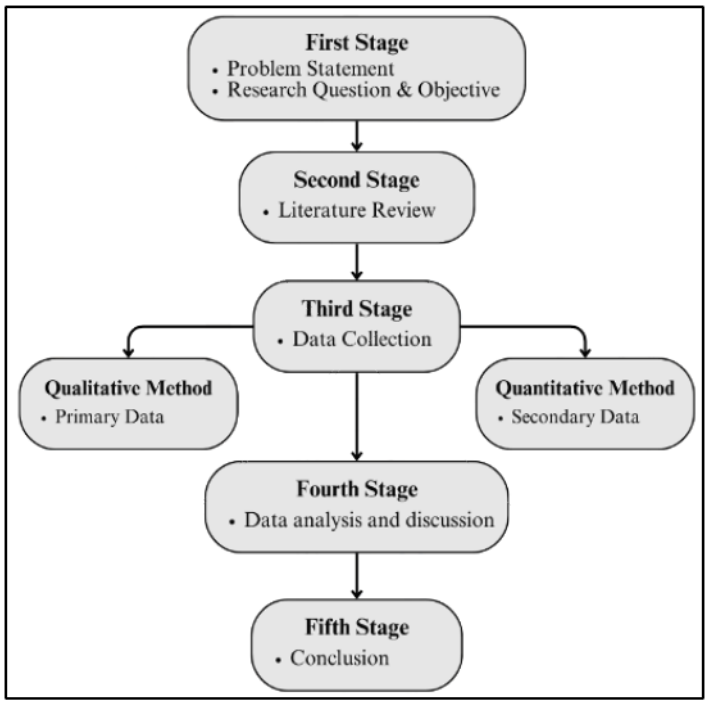
Tan, H. H. (2013). *Sandakan: Steeped in history and eco-attractions*. The Jakarta Post. https://www.thejakartapost.com/news/2013/03/10/sandakan-steeped-history-and-eco-attractions.html

Thirunavukkrasu, P., & Mat Radzuan, I. S. (2021). Significance of Conserving Built Heritage on Commercial Property : A Case Study Of Little India, Kuala Lumpur. *Research in Management of Technology and Business*, *2*(2), 867–880. https://penerbit.uthm.edu.my/periodicals/index.php/rmtb/article/view/5057

Vagias, W. M. (2006). Likert-Type Scale Response Anchors. In *Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management*.

Zolkafli, U. K., Zakaria, N., Mohammad Mazlan, A., & Ali, A. S. (2019). Maintenance work for heritage buildings in Malaysia: owners' perspectives. *International Journal of Building Pathology and Adaptation*, *31*(1), 186–195. https://doi.org/10.1108/IJBPA-07-2018-0062.

Appendix A



Flow Chart of the Research Design

Appendix B

Stakeholder Comments on Heritage Building Maintenance

Theme	Sub-Theme	R7 Code	R8 Code
Role and Experience	Experience and Position	Heritage program founder with 21 years of experience.	Urban designer in Sandakan town council with 3 years of experience.
Maintenance Responsibilities	Funding Support	Assists with funding and sponsorship when needed.	Responsible only for Wisma Warisan, no additional responsibilities for other buildings.
Decision-Making Authority	Team Leadership	Heads an NGO with 9 volunteers (Sandakan Heritage Trails).	Collaborates with urban planning and development control departments.
Monitoring Building Condition	Advisory Role	Provides suggestions but lacks monitoring authority.	Only monitors Wisma Warisan; no role in privately owned buildings.
Budget Management	Resource Allocation	Secures sponsorship and funding when required.	Budget responsibility falls on individual owners or managers of each building.
Stakeholder Engagement	Community Awareness	Focuses on raising awareness among younger generations through activities like heritage walks.	Collaborates with community groups and push the need for policy control.
Inspiration for Heritage Trail	Preservation Motivation	Desire to protect local culture and educate future generations.	NA
Contribution of Program	Preservation and Tourism	Raises awareness but notes that management efforts depend on individual buildings.	Promotes consistent maintenance and facilitates tourism-based funding.
Challenges	Communication and Funding	Role definition, communication gaps and lack of cooperation.	Communication issues, lack of policies and funding challenges including negative comments.

Current Maintenance Level	Condition Assessment	Generally poor, especially in management, though some improvements noted.	Fair, some sites need improvement, others are well-preserved.
Suggested Improvements	Awareness and Policies	Believes good communication is the key to solving problems.	Suggests increasing awareness among owners and younger generations with policies as a guide.
Supportive Policies	Policy Needs	Notes that no policies exist.	Confirms absence of policies.
Impact of Heritage Trail	Tourism Benefits	Boosts tourism and attracts foreign visitors, particularly Europeans.	Supports tourism but notes no impact on broader economic growth.
Public Engagement Changes	Awareness Levels	Public engagement is still low which shown the importance of awareness.	Notes no change in awareness and believes it remains low.
Additional Suggestions	Government Involvement	Suggested for stronger government involvement in heritage building maintenance.	No additional suggestions provide

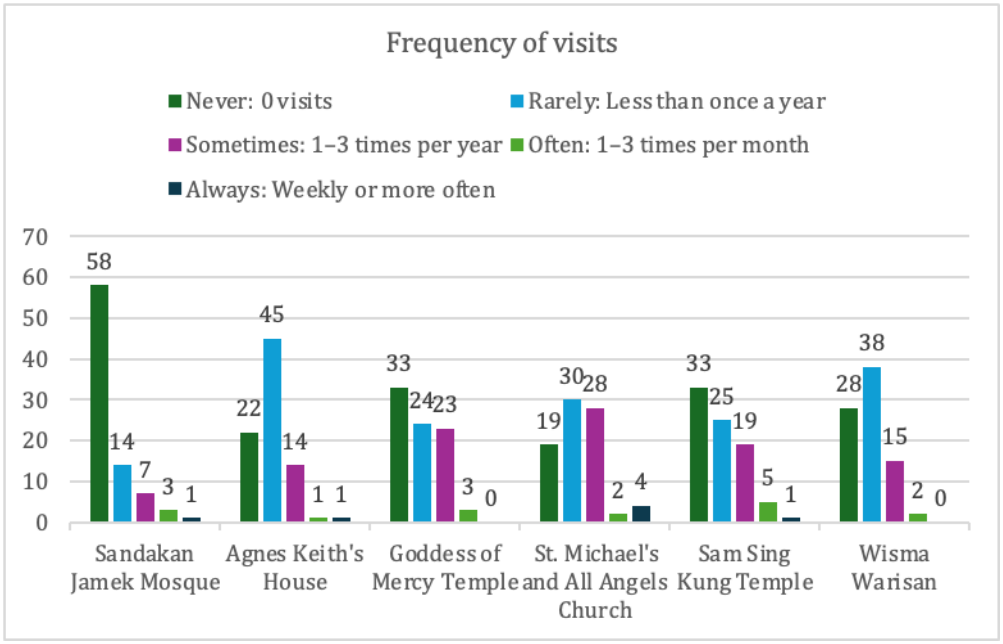
Appendix C

Demographic profile

Category	**Type**	**Number of Respondents**	**Percentage (%)**
Gender	Male	47	56.6
	Female	36	43.4
Race	Malay	11	13.3
	Chinese	59	71.1
	India	0	0
	Other	13	15.6
Religion	Islam	18	21.7
	Christianity	20	24.1
	Buddhism	44	53
	Hinduism	0	0
	Other	1	1.2
Ages	17 and under	0	0
	18 - 25	36	43.4
	26 - 35	13	15.7
	36 - 45	15	18.1
	46 - 55	14	16.9
	56 - 65	4	4.8
	66 - 75	1	1.2
	76 and above	0	0
Education	Primary education	1	1.2
	Secondary education	23	27.7
	Vocational/Technical education	1	1.2
	Diploma/Pre-university	26	31.3
	Bachelor's degree	27	32.5
	Master's degree	5	6
	Doctorate/Ph.D.	0	0
Occupations	Student	25	30.1
	Unemployed	3	3.6
	Self-employed	17	20.5
	Government employee	17	20.5
	Private sector employee	20	24.1
	Retired	1	1.2
	Other	0	0
Length of Residence	Less than 1 year	4	4.8

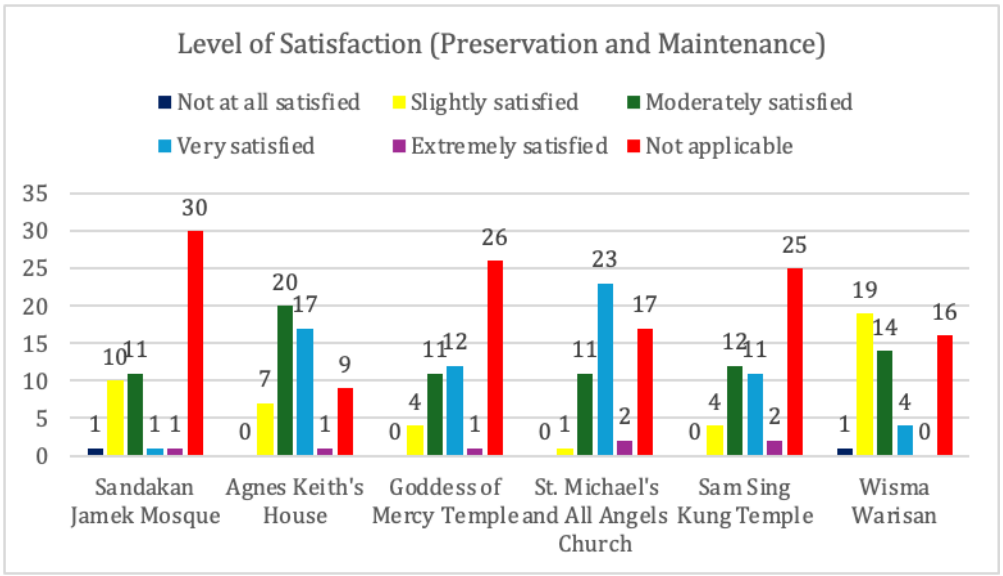
	1 - 5 years	4	4.8
	6 - 10 years	3	3.6
	11 - 20 years	22	26.5
	21 - 30 years	24	28.9
	31 - 40 years	11	13.3
	41 - 50 years	7	8.4
	More than 50 years	8	9.6

Appendix D



Frequency of Visits

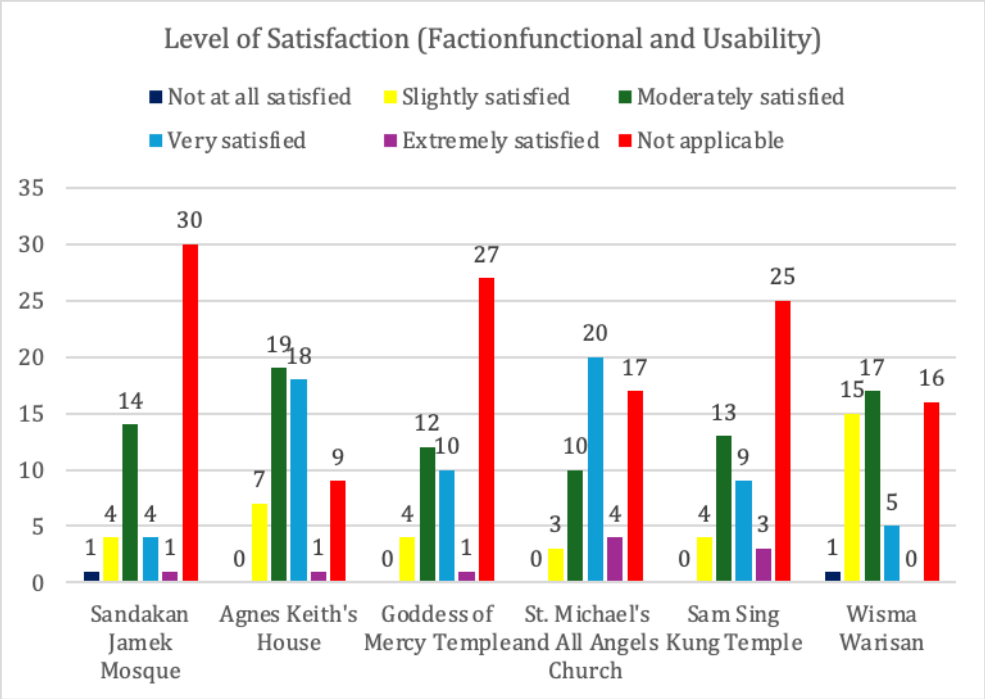
Appendix E



Level of Satisfaction with Preservation and Maintenance of Heritage Buildings

Research in Management of Technology and Business Vol. 6 No. 2 (2025) p. 926-945

Appendix F



Level of Satisfaction with Functional and Usability of Heritage Buildings