Malaysian Journal of Sustainable Environment
Vol.12.No.2 (2025) 121-146
doi: 10.24191/myse.v12i2.1659

DEFECTS AND DILAPIDATION OF BRITISH COLONIAL BUILDINGS IN NEGERI SEMBILAN, MALAYSIA

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Received: 27 November 2024
Accepted: 13 February 2025
Published: 31 August 2025

ABSTRACT

Colonial buildings in Malaysia play a pivotal role in revealing the nation's rich history. The advent of British colonisation in the early 19th century not only reshaped the political landscape but also left a lasting imprint on the architectural heritage of the era. However, the passage of time has posed significant challenges to the structural integrity of these heritage structures, with defects progressively compromising their stability. This paper aims to identify specific flaws in two colonial buildings in Negeri Sembilan and propose effective solutions to prevent their deterioration. These buildings were selected as case studies because colonial architecture in Negeri Sembilan has received less attention compared to other prominent Malaysian states, despite the rich collection of British colonial architecture in Seremban. By employing a comprehensive methodology that includes observational studies of these buildings with varied functions and historical contexts, along with interviews with building owners and government officials, this research provides valuable insights into the accumulated defects and strategies for mitigation. The primary causes of these defects were identified as environmental factors, with high humidity, rain exposure, and natural aging being significant contributors. This study underscores the urgent need for systematic maintenance and highlights the importance of conserving these architectural gems, officially recognised as part of our national heritage. Serving as a call to action, this research advocates for

collective efforts to ensure the preservation and enduring existence of these invaluable historical assets.

Keywords: *Defects and dilapidation, Colonial architecture, British colonisation, Malaysian heritage, Historical preservation*

INTRODUCTION

The colonial era in Malaysia witnessed successive colonisation by Portuguese, Dutch, and British powers, each leaving an enduring mark on Malaysia's architectural landscape (UNESCO World Heritage Centre, 2024). This period gave rise to colonial buildings that significantly enrich the nation's cultural fabric. Colonial architecture, shaped under foreign influences, characterised structures constructed between the 17th and 20th centuries (Ahmad, 1994; Sanusi et al., 2020). These buildings profoundly impacted Malaysia's architectural style, moulding its built environment and reflecting their multifaceted roles in the socio-economic and administrative fabric of the region.

Previous research has primarily focused on colonial buildings in prominent Malaysian states such as Melaka, Penang, Perak, Kuala Lumpur, and Selangor (Al-Obaidi et al., 2017; Asif et al., 2019; Dai & Zhou, 2019; Zwain & Bahauddin, 2019; Awang et al., 2020; Chau et al., 2020; Mamat & Aziz, 2020; Sanusi et al., 2020; Rashid et al., 2021; Rahim et al., 2022; Bujang et al., 2023; Ibrahim et al., 2023). However, colonial architecture in Negeri Sembilan has received comparatively less attention, despite the significant presence of British colonial architecture in the state.

Seremban, the capital of Negeri Sembilan, boasts various types of British colonial buildings, including government buildings, residences, educational institutions, and transportation hubs. Despite limited research on Negeri Sembilan's colonial buildings, their significance should not be underestimated, particularly as some are officially designated as "Heritage" under the National Heritage Act 2005 (Act 645). These structures, featuring distinctive British colonial elements such as bay windows, expansive porches, and decorative plasterwork, are unfortunately prone to defects over time.

The primary goal of this research is to thoroughly evaluate the structural integrity of colonial buildings in Negeri Sembilan. To achieve this, the study aims to (1) identify key common defects affecting these buildings and (2) formulate recommendations to mitigate the impact of these defects. Addressing common defects and proposing effective solutions are crucial for preserving the state's rich historical and architectural heritage, boosting tourism revenue, and supporting the local economy.

The Negeri Sembilan State Government has announced several initiatives to preserve its historical buildings, including collaborations with federal agencies, local governments, and non-governmental organisations on restoration projects. However, the effectiveness and extent to which these initiatives have been realised remain uncertain. While these efforts are promising, their actual success in attracting tourists and enhancing cultural pride needs to be critically assessed.

DEFECTS AND DILAPIDATION IN HERITAGE BUILDINGS

The term "defects" refers to the degradation of building characteristics and services, resulting in a decline below satisfactory quality levels in meeting users' requirements (Johar et al., 2013; Alauddin et al., 2018). According to Merriam-Webster (2024), "dilapidation" denotes the decay, deterioration, or partial ruin of a structure, particularly due to neglect or misuse. Numerous heritage structures face significant challenges due to these defects, a predicament exacerbated by insufficient treatment and management by occupants or property owners themselves (Hanafi et al., 2018).

The impact of building defects extends to various aspects, including aesthetics, comfort, and occupant safety. Building structures are particularly vulnerable to environmental conditions and changes resulting from human errors in design. Heritage buildings, when exposed to environmental conditions over extended periods, are prone to developing defects. Commonly affected elements in heritage buildings, such as roofs, walls, floors, ceilings, toilets, doors, and windows, compromise these structures' aesthetic value (Mansor et al., 2012).

Many heritage buildings suffer from serious defects and deterioration due to inadequate legislative measures regarding maintenance and management. This deficiency leads to poor upkeep practices, ultimately threatening their existence (Zolkafli et al., 2018). Failure to maintain heritage buildings properly can lead to bigger issues, highlighting the necessity for proactive maintenance measures.

The issue of defects and dilapidation in heritage buildings has long been a prominent concern in building preservation. A study by Ramli et al. (2021) highlights buildings' vulnerability to weather and moisture, compromising structural integrity and necessitating robust maintenance practices. Rectifying such issues requires substantial labour and dedication to address each defect, ultimately restoring the building to optimal condition.

This phenomenon can manifest in either the structural or non-structural elements of architectural edifices (Hanafi et al., 2018). Significant deficiencies within the structural components, particularly those responsible for bearing loads, can pose safety hazards to occupants. Although defects in non-structural elements are generally less severe than structural defects, maintenance is necessary to optimise functionality.

In the meantime, adaptive reuse may be suggested for abandoned buildings that are dilapidated and have no active use. Retrofitting is considered a viable solution to address building vacancy issues (Rashid & Heath, 2024). If the government cannot afford to conserve these abandoned buildings, investors can take over the properties for the benefit of the entire community.

METHODOLOGY

This research adopts a qualitative methodology to investigate defects and dilapidation in colonial buildings. The qualitative approach provides comprehensive insights into the nature, causes, and consequences of these issues through detailed observational studies and expert interviews. The study examines two designated "Heritage Sites" under the National Heritage Act 2005 (Act 645): the District Office and Survey Department Building, and the Seremban Railway Station, both located in Seremban, Negeri Sembilan

(Jabatan Warisan Negara, 2024). These case study buildings were selected due to their historical, architectural, and functional significance, as well as the distinct preservation challenges, they present. Despite the focus on a limited number of case studies, the findings are intended to contribute to a broader understanding of similar issues affecting colonial buildings.

Observational methods are critical for researching defects and dilapidation in heritage buildings. Through visual inspection, researchers identified and documented issues such as cracks, deterioration, and water damage, enabling an assessment of the extent of the damage and the prioritisation of areas requiring immediate attention. This study utilises observational methods adapted from Hanafi et al. (2018), focusing on 10 key building components: the roof, exterior walls, interior walls, doors and windows, columns and beams, ceiling, floor, stairs, apron, and services (see Table 1).

Table 1. Summary of Common Defects in Colonial Buildings in Malaysia

No.	Building Component	Common Defect
1	Roof	Missing or broken tiles
		Timber structural decay
		Mouldy surfaces
		Dampness on ceiling boards
		Biological growth
2	Exterior Walls	Dampness (rising or falling)
		Crumbled plaster
		Peeling paint
		Mouldy surfaces
4	Interior Walls	Dampness (rising or falling)
		Cracks
		Peeling paint
		Mouldy surfaces
		Burned traces
		Biological growth
4	Doors and Windows	Holed partitions
		Decayed timber frame
		Missing panel
		Broken glass

		Cracked glass
		Faded paint
		Peeling paint
		Equipment falling out of place
5	Columns and Beams	Dampness (rising or falling)
		Crumbled plaster
		Peeling paint
		Cracking of beams
		Mouldy surfaces
		Biological growth
6	Ceiling	Cracks
		Mouldy surfaces
		Missing panel
		Peeling paint
7	Floor	Missing or broken tiles
		Damaged timber floor
		Water stains
		Damp surface or puddle
		Decayed timber floor
8	Stairs	Cracks
		Moss
		Damaged handrails
		Mouldy surfaces
		Peeling paint
		Biological growth
9	Apron	Cracks
		Moss
10	Services	Damaged rainwater downpipe cover
		Dysfunctional electrical appliances
		Dysfunctional wiring system

Source: Adapted from Hanafi et al. (2018)

Interviews are integral to researching defects and dilapidation in heritage buildings. They are designed to obtain detailed insights into the historical context, ownership, maintenance practices, and underlying causes of identified defects. This qualitative data complements observational studies, providing a comprehensive understanding of the building's

condition and informing effective preservation strategies. Personnel from the Negeri Sembilan Museum Board (LMNS) and the Negeri Sembilan Public Works Department (JKR Negeri Sembilan) were interviewed regarding the District Office and Survey Department Building, while insights concerning the Seremban Railway Station were gathered from personnel at Malayan Railways Limited (KTMB) and the Malaysia Public Works Department (JKR Malaysia).

The findings are subjected to a comparative analysis, examining the defects and their causes across the two case study buildings. This analysis elucidates the similarities and differences in defect types, underlying causes, and recommended solutions within their respective contexts.

Case Study 1: District Office and Survey Department Building

The District Office and Survey Department Building, constructed in 1912 in the Neo-Renaissance architectural style, is located at Jalan Dato' Abdul Kadir, Seremban, Negeri Sembilan (see Figures 1, 2, 3, and 4). This structure is owned by the Negeri Sembilan Government Secretary's Office (PSUKNS) and managed by the Negeri Sembilan Museum Board (LMNS). The building, which features two floors, has experienced several functional transformations over its history. Originally serving as the District Office and Survey Department building during the British colonial era, it remained in this role until the department relocated to a new facility in Seremban 2 around 2005. Subsequently, the building was adapted for use by the Malaysian Handicraft Development Corporation, Negeri Sembilan Branch, which operated there from 2007 to 2017 before relocating to Kuala Pilah. As of the time of the fieldwork, the building is vacant and not in use.

Figure 1. District Office and Survey Department Building (Case Study 1)
Source: Author, 2025

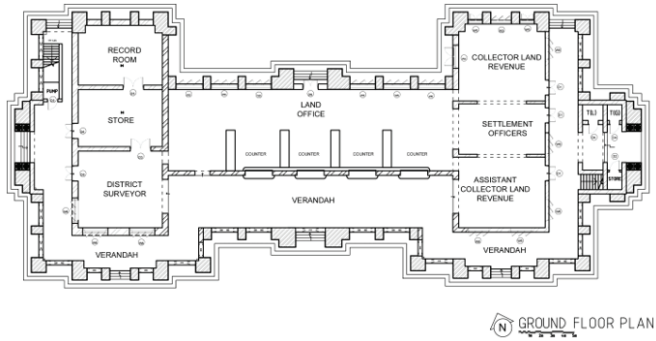

Figure 2. Ground Floor Plan of Case Study 1

Source: Author, 2025

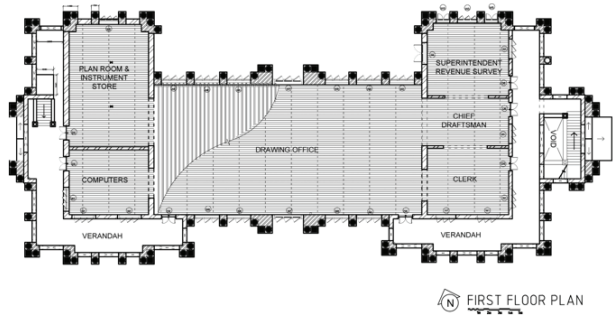

Figure 3. First floor plan of Case Study 1

Source: Author, 2025

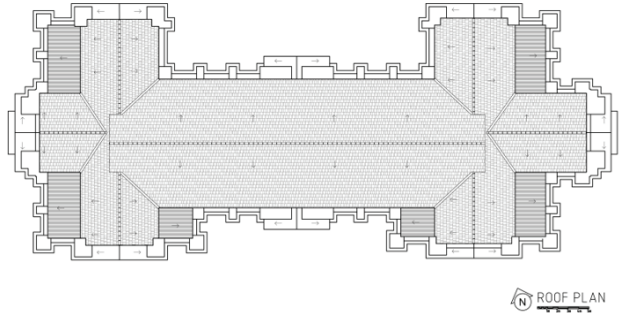

Figure 4. Roof plan of Case Study 1

Source: Author, 2025

Case Study 2: Seremban Railway Station

The Seremban Railway Station, constructed in 1910 in the Neo-Mughal architectural style, is situated at Jalan Tuanku Antah, Seremban, Negeri Sembilan (see Figures 5, 6, and 7). Owned by Malayan Railways Limited (KTMB), the station's construction cost was RM26,000. Initially operated by various railway companies, it was managed by the Malayan Railway Administration from 1948. The station facilitated intercity train services and goods transport. Between February and April 1994, it underwent significant remodelling to accommodate the KTM Komuter services, including platform elevation for enhanced accessibility. The station functioned as the southern terminus of the KTM Komuter's Rawang-Seremban Line until 2011, and briefly resumed this role in 2015. In January 2024, construction of a new station building was scheduled to commence, with completion anticipated by January 2026. As of the time of this study, the building remained an active public transportation hub for Seremban and its surrounding areas.

Figure 5. Seremban Railway Station (Case Study 2)

Source: Author, 2025

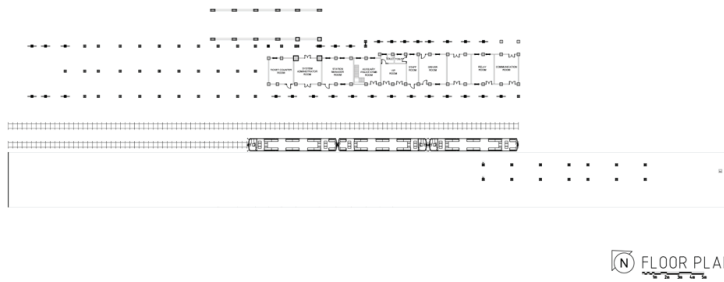

Figure 6. Floor Plan of Case Study 2

Source: Author, 2025

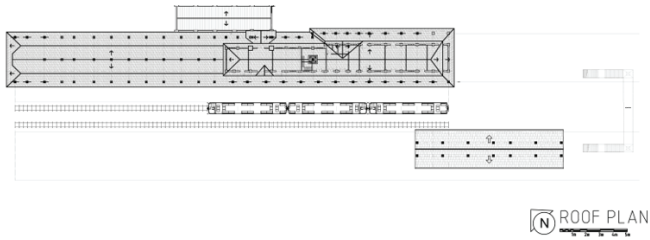

Figure 7. Roof Plan of Case Study 2

Source: Author, 2025

RESULT AND DISCUSSION

The building components observed in this research include the roof, exterior walls, interior walls, doors and windows, columns and beams, ceiling, floor, stairs, apron, and services (see Table 1). A meticulous examination of these components has provided a detailed exposition of identified defects and dilapidations. The findings for each case study buildings are systematically presented, with building plans indicating the locations of defects (as shown in Figures 8, 9, and 10 for the District Office and Survey Department building, and Figures 11 and 12 for the Seremban Railway Station), supported by detailed descriptions of the types and causes of defects, along with recommended solutions. These recommendations are informed by a thorough literature review and insights from interviews with government officials specialising in heritage conservation. This analysis offers a comprehensive elucidation of the observed structural challenges.

Case Study 1: District Office and Survey Department Building

Over the years, the District Office and Survey Department building (referred to as Case Study 1) has undergone several functional changes. During the fieldwork, the building was found to be in a highly dilapidated and abandoned state (see Figures 8, 9, and 10), having been uninhabited and unmaintained since 2017, when it last served as the office for the Malaysian Handicraft Development Corporation, Negeri Sembilan Branch. A proposal exists to rehabilitate the building and repurpose it as the Negeri Sembilan Visual Art Gallery; however, this plan is currently awaiting funding allocation from the Negeri Sembilan State Government.

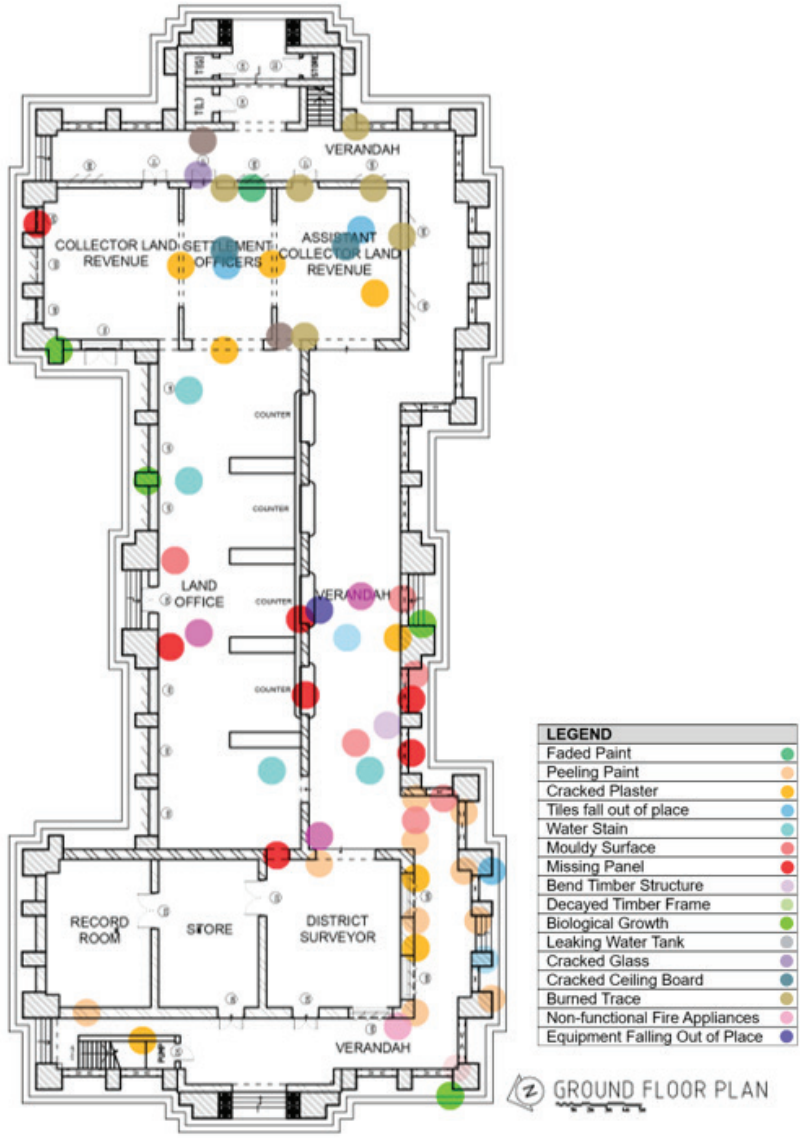

Figure 8. Common Defects in the Ground-floor Area of Case Study 1
Source: Author, 2025

Figure 9. Common Defects in the First-floor Area of Case Study 1
Source: Author, 2025

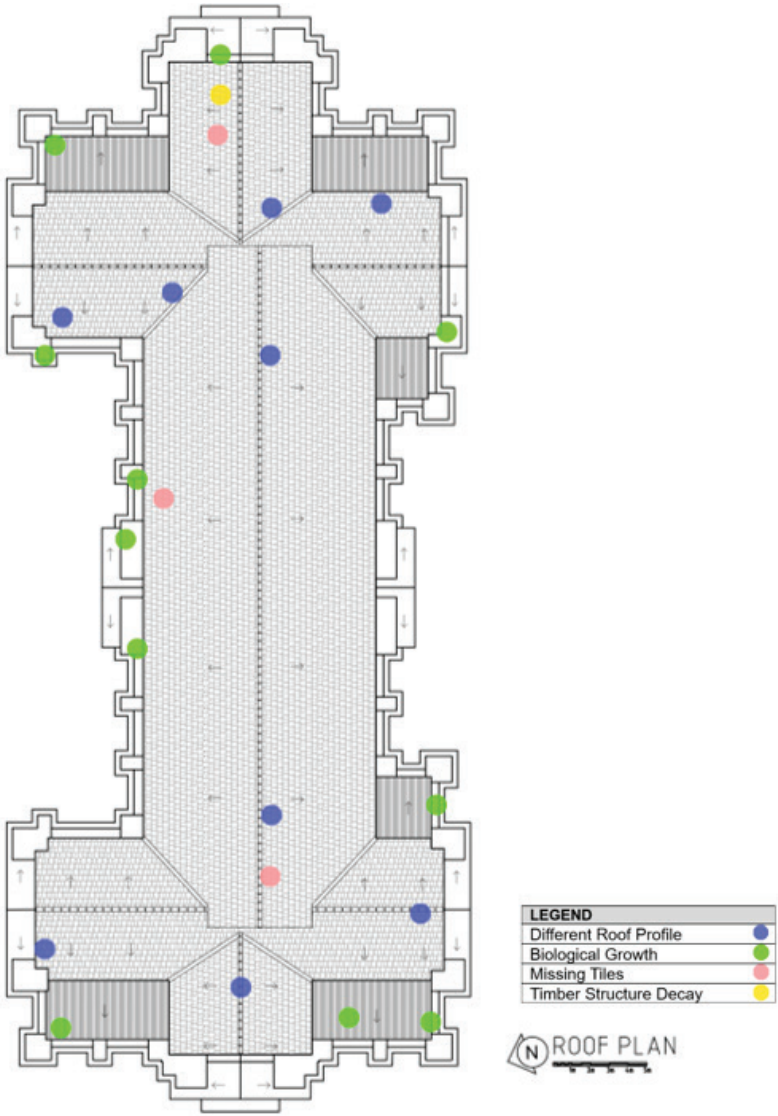

Figure 10. Common defects in the roof area of Case Study 1
Source: Author, 2025

Types of Defects

Case Study 1 displays a variety of defects primarily resulting from neglect and environmental conditions. The roof is notably affected by missing or broken tiles, timber structural decay, and mouldy surfaces. The exterior walls experience issues such as dampness, crumbled plaster, peeling paint, and mould. Interior walls show dampness, cracks, peeling paint, mould, burned traces, and holed partitions. Additional problems include decayed timber frames, missing panels, and broken glass in doors, as well as peeling paint on windows. Columns and beams are compromised by dampness, crumbled plaster, peeling paint, and mould, while the floor has missing or broken tiles, water stains, damp surfaces, and decayed timber. The stairs exhibit cracks, moss, damaged handrails, and mouldy surfaces, and the apron suffers from cracks and moss. Services are affected by damaged rainwater downpipe covers and dysfunctional electrical appliances and wiring systems.

Causes of Defects

The causes of defects in Case Study 1 are multifaceted. High humidity and exposure to rain significantly contribute to issues such as mould growth, damp walls, and peeling paint. Vandalism has exacerbated the deterioration through timber structural decay and burned traces on interior walls. Additionally, neglect and inadequate maintenance have critically impacted the integrity of timber frames, plaster, and services. Problems with floors and stairs are further compounded by improper installation and ongoing exposure to environmental elements.

Recommended Solutions

To address these defects, several measures were recommended. Regular inspections and maintenance are essential for early detection and remediation of issues. Implementing damp-proof courses and sealing roofs and windows can effectively manage moisture ingress. Utilisation of high-quality materials, such as treated timber for structural elements and durable tiles for roofing and flooring, is advised. Maintaining proper drainage systems is crucial to prevent water accumulation. Anti-mould treatments and enhanced security measures to deter vandalism are also important. Specific repairs should include replacing missing tiles, fixing leaks, and repairing or replacing damaged structural components.

Case Study 2: Seremban Railway Station

Although the physical condition of the Seremban Railway Station (referred to as Case Study 2) is slightly dilapidated due to a lack of maintenance by Malayan Railways Limited (KTMB) (see Figures 11 and 12), it is in better condition than the District Office and Survey Department building (Case Study 1) because it is still actively used. The station remains operational, providing KTM Intercity services and serving as a hub for transporting goods, with no plans to alter its current function in the foreseeable future.

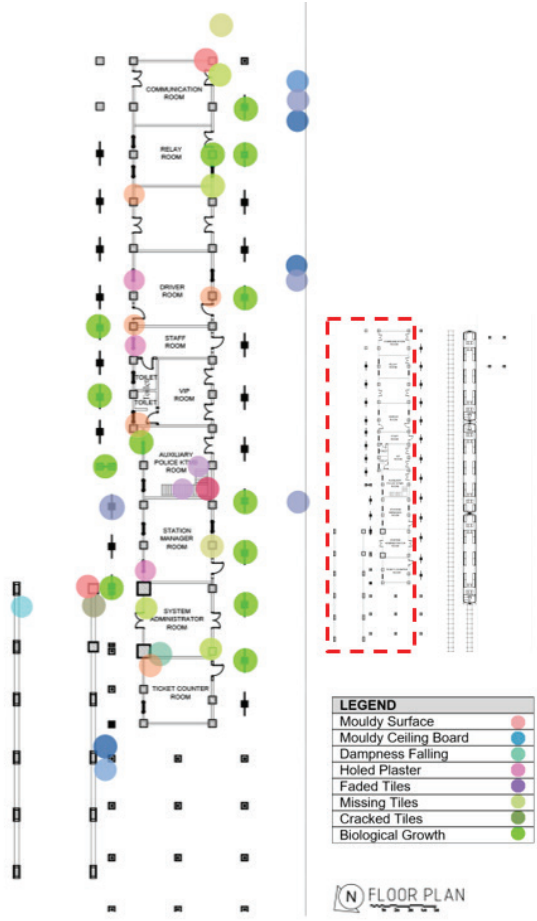

Figure 11. Common Defects in the Ground-floor Area of Case Study 2
Source: Author, 2025

Figure 12. Common Defects in the Roof Area of Case Study 2
Source: Author, 2025

Types of Defects

Case Study 2 presents a range of defects primarily attributable to maintenance challenges. The roof exhibits missing or broken tiles, faded tile surfaces, mould attacks, biological growth, and issues with rainwater downpipes. The exterior walls are affected by dampness, cracked bricks, peeling paint, and flaking plaster. Interior walls show cracks, whereas doors and windows generally remain intact. Columns and beams are afflicted by peeling paint, cracks, and insect damage. The ceiling displays dampness, cracks, missing panels, mouldy surfaces, and holed plaster. Floors are characterised by standing water, uplifted tiles, and cracked tiles. Similar issues were observed in the stairs and apron, including standing water, uplifted tiles, and cracked tiles. Additionally, services suffer from poor air-conditioning unit installation, leading to leaks and mould growth.

Causes of Defects

The causes of defects in Case Study 2 are predominantly environmental. High humidity, rainfall, and exposure to intense sunlight contribute to issues such as faded tiles, mould growth, and damp walls. Maintenance challenges, including temporary repairs and inadequate installation, further exacerbate these problems. Additionally, natural aging contributes to defects like cracked bricks and tiles. Although evidence of vandalism is less prevalent compared to Case Study 1, maintenance-related issues are notably more pronounced.

Recommended Solutions

To address these defects, several recommendations were proposed. Implementing consistent maintenance practices is crucial to preventing recurrence of issues. Regular inspection and cleaning of roof tiles, application of anti-mould treatments, and the use of appropriate materials for repairs are essential. Installing new damp-proof courses and ensuring proper sealing of cracks and gaps will help prevent moisture ingress. Replacing damaged components with high-quality materials, such as bricks, tiles, and timber, is recommended. Effective drainage systems should be maintained to avoid standing water and uplifted tiles. Regular maintenance checks on air-conditioning units and other services are necessary to prevent leaks and subsequent mould growth. Specific repairs should include replacing missing roof tiles, recoating faded tiles, fixing leaks, and repairing damaged structural elements.

Synthesis of Research Objective 1

The first research objective is to identify key common defects affecting colonial buildings in Negeri Sembilan. The defects identified in both Case Study 1 and Case Study 2 are largely driven by environmental factors, including high humidity, rain exposure, and natural aging. A detailed account of these key common defects is presented in Table 2. These findings illustrate the susceptibility of British colonial buildings in Negeri Sembilan to moisture-related issues and emphasise the importance of implementing regular maintenance and repair strategies to mitigate the adverse effects of the tropical climate.

Table 2. Key Common Defects in Case Study 1 and Case Study 2

No.	Key Common Defect	Description
1	Roof Defects	Missing or broken tiles and biological growths like mould are prevalent in both buildings. These are due to intense winds, heavy rainfall, and humidity, which are characteristics of the Malaysian climate.
2	Wall Defects	Both buildings suffer from dampness, peeling paint, and mould on exterior and interior walls, caused by moisture infiltration and high humidity levels.
3	Ceiling Defects	Mouldy surfaces and cracks were found in the ceilings of both buildings, attributable to prolonged water exposure and high humidity.
4	Floor Defects	Issues such as standing water, uplifted tiles, and cracked tiles are common, resulting from improper installation, clogged drainage, and temperature fluctuations.
5	Biological Growth	Both structures exhibit biological growth, including mould and plants, particularly in areas with persistent moisture issues.

Source: Author, 2025

The defects observed in Case Study 1 and Case Study 2 demonstrate significant differences in their nature and underlying causes. As outlined in Table 3, Case Study 1, which has suffered from neglect and vandalism, displays severe issues including missing roof tiles, extensive mould growth, and considerable structural damage across various building components. In contrast, Case Study 2, which faces challenges related to maintenance and environmental conditions, shows defects such as faded roof tiles, cracked bricks, and uplifted tiles with standing water. The primary causes

of defects in Case Study 1 are high humidity and vandalism, whereas defects in Case Study 2 are largely attributed to inadequate maintenance and natural aging. These variations highlight the influence of maintenance practices and environmental factors on the preservation and deterioration of colonial buildings.

Table 3. Differences in Defects between Case Study 1 and Case Study 2

No.	Building Component	Case Study 1	Case Study 2
1	Roof	Exhibits significant issues such as missing or broken tiles, timber structural decay, and mouldy surfaces, primarily due to high humidity, rain exposure, and vandalism.	Shows missing or broken tiles, faded tile surfaces, and mould attacks, primarily influenced by high humidity, rain, intense sunlight, and maintenance challenges.
2	Exterior Walls	Affected by dampness, crumbled plaster, peeling paint, and mould, with issues driven by high humidity, rain exposure, and neglect.	Features dampness, cracked bricks, peeling paint, and flaking plaster, caused by high humidity, rain, intense sunlight, and maintenance problems.
3	Interior Walls	Display dampness, cracks, peeling paint, mould, burned traces, and holed partitions, with damage caused by high humidity, rain exposure, and vandalism.	Show cracked walls, with defects attributed to high humidity and natural aging, and less impact from vandalism.
4	Doors and Windows	Contain decayed timber frames, missing panels, broken glass, and peeling paint, primarily due to vandalism and neglect.	Generally show no significant defects, with fewer maintenance issues compared to Case Study 1.
5	Columns and Beams	Suffer from dampness, crumbled plaster, peeling paint, and mould, resulting from high humidity, rain exposure, and neglect.	Exhibit peeling paint, cracks, and insect attacks, primarily due to high humidity, environmental exposure, and insect infestation.
6	Ceiling	Not specifically detailed.	Displays dampness, cracks, missing panels, mouldy surfaces, and holed plaster, influenced by high humidity and maintenance challenges.

7	Floor	Features missing or broken tiles, water stains, damp surfaces, and decayed timber, with defects caused by high humidity, rain exposure, and improper installation.	Shows standing water, uplifted tiles, and cracked tiles, due to high humidity, rain, and maintenance issues.
8	Stairs	Exhibit cracks, moss, damaged handrails, and mouldy surfaces, with issues caused by high humidity, rain exposure, and neglect.	Display standing water, uplifted tiles, and cracked tiles, with problems mainly due to high humidity and maintenance challenges.
9	Apron	Affected by cracks and moss, driven by high humidity and rain exposure.	Shows standing water, uplifted tiles, and cracked tiles, with maintenance challenges exacerbating the condition.
10	Services	Include damaged rainwater downpipe covers and dysfunctional electrical appliances, primarily due to poor maintenance and improper installation.	Feature poor installation of air-conditioning units leading to leaks and mould growth, exacerbated by maintenance issues.

Source: Author, 2025

Synthesis of Research Objective 2

The second research objective is to formulate recommendations aimed at mitigating the impact of key common defects found in colonial buildings in Negeri Sembilan. Based on the identified key common defects, the proposed recommendations to address these issues are detailed in Table 4.

Table 4. Recommended Solutions to Mitigate the Impact of Key Common Defects in Case Study 1 and Case Study 2

No.	Recommended Solution	Description
1	Regular Inspection and Maintenance	Implement routine inspections to detect early signs of defects such as missing tiles, dampness, and mould growth. Scheduled maintenance can prevent minor issues from escalating into significant problems.
2	Moisture Control	Install damp-proofing courses on walls and ensure proper sealing of roofs and windows to prevent moisture ingress. Use moisture-resistant materials in high-humidity areas to reduce the risk of mould and biological growth.

3	Quality Material Replacement	Replace damaged or decayed materials with high-quality, durable alternatives. For example, use treated timber for structural elements and high-grade tiles for roofs and floors to enhance longevity and resistance to environmental stressors.
4	Proper Drainage Systems	Ensure efficient drainage systems around and within the buildings to prevent water accumulation and standing puddles. Regularly clean and maintain gutters and downpipes to avoid blockages and water damage.
5	Anti-Mould Treatments	Apply anti-mould treatments on vulnerable surfaces, such as roofs, ceilings, and walls, to inhibit mould growth. This can include the use of chemical solutions, low-pressure water sprays, and specialised paints that resist mould formation.
6	Vandalism Prevention	For buildings like Case Study 1, where vandalism contributes to structural decay, implementing security measures such as surveillance systems and restricted access can help protect the property from further damage.

Source: Author, 2025

By implementing these recommendations, the maintenance and preservation of British colonial buildings in Negeri Sembilan can be substantially enhanced, thereby extending their lifespan and preserving their historical value. Regular maintenance, high-quality repairs, and preventive measures are essential to mitigate the impact of key common defects and ensure the sustainable conservation of these heritage structures.

CONCLUSIONS

This research examined defects and deterioration in British colonial buildings in Negeri Sembilan, Malaysia, specifically analysing the District Office and Survey Department building (Case Study 1), and the Seremban Railway Station (Case Study 2). Through a detailed comparative analysis, key findings regarding common defects, their causes, and recommended solutions have been identified.

Both case study buildings display common defects such as missing or broken roof tiles, mould growth, damp walls and ceilings, and issues with floors, including standing water and cracked tiles. These issues are primarily attributed to high humidity, rain exposure, and natural aging,

which are prevalent in Malaysia's tropical climate. The frequent occurrence of biological growth and peeling paint further underscores the buildings' susceptibility to moisture-related problems.

Environmental factors particularly high humidity and rain exposure were found to be the primary causes of these defects. For Case Study 1, vandalism and neglect significantly contributed to structural decay and fire damage, whereas such issues were less prominent in Case Study 2. The defects in Case Study 2 were more closely linked to ongoing maintenance challenges, indicating a need for improved upkeep strategies.

To address these defects, the study recommends a multifaceted approach, including regular inspections and maintenance, the installation of moisture control systems, the use of high-quality replacement materials, the implementation of effective drainage systems, and the application of anti-mould treatments. Additionally, measures to prevent vandalism are crucial for preserving the structural integrity and historical value of these buildings.

Collectively, these strategies facilitate early identification and remediation of defects, mitigate water-related damage, ensure the durability of repairs, maintain a dry and stable environment, reduce decay, and protect historical features. By implementing these comprehensive measures, the longevity and continued contribution of these colonial buildings to cultural heritage can be ensured.

In conclusion, the study features the need for systematic and ongoing conservation efforts to protect British colonial buildings in Malaysia. Implementing the recommended solutions and proactive maintenance can help preserve these heritage structures' longevity and historical significance. Preserving colonial-era buildings is vital for cultural and historical reasons, as they embody significant aspects of Malaysia's architectural evolution and historical narrative.

The findings offer valuable guidance for conservation practitioners, policymakers, and heritage managers involved in maintaining colonial-era architecture in tropical climates. Continued research and monitoring are essential to adapt recommendations to evolving environmental conditions and advancements in conservation technology. Expanding research to

include a broader range of case studies or building types would further validate and enhance these findings, providing a more comprehensive understanding of defects in colonial architecture.

ACKNOWLEDGEMENT

This research is supported by the Universiti Sains Islam Malaysia (USIM) through the USIM Research Grant 2022 (PPPI/FKAB/0122/USIM/12422).

FUNDING

This research is funded by the Universiti Sains Islam Malaysia (USIM) through the USIM Research Grant 2022 (PPPI/FKAB/0122/USIM/12422).

AUTHOR CONTRIBUTIONS

The author and all co-authors collaborated throughout the entire process of data collection, research design, and execution. They collectively commented on the outcomes, engaging in discussions and analyses to achieve the best possible results. Each author has made significant contributions to the writing of the paper.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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