

Reshaping History: Modernising Heritage Timber Buildings through Adaptive Reuse - Lessons from Istana Jahar

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Abstract. This study examines the modernisation of heritage timber buildings through adaptive reuse, focusing on the case of Istana Jahar. It aims to explore the challenges and opportunities of integrating modern building services like electricity, air-conditioning, and water plumbing into these historical structures while preserving their significance. The central research problem involves finding strategies to balance introducing modern services with preserving authenticity. The study uses a mixed-methods approach involving qualitative analysis of historical records, architectural documentation, and site visits. By analysing Istana Jahar's historical context, architectural features, and current state, it assesses how modern building services can be incorporated with minimal impact on the building's historic fabric. The findings reveal best practices for integrating modern building services while maintaining historical authenticity. The study identifies trends in Istana Jahar's adaptation to modern needs, emphasising the need for a careful balance between heritage preservation and contemporary functionality. The conclusions drawn from this case offer context-specific recommendations for adaptive reuse of similar heritage timber buildings. Drawing lessons from Istana Jahar demonstrates how heritage timber buildings can be thoughtfully modernised while preserving their cultural and architectural integrity, reshaping history, and safeguarding our built heritage for future generations.

1 Introduction

Heritage timber buildings hold immense historical and cultural significance in Malaysia, with mosques, traditional Malay houses, and palaces reflecting the country's rich architectural heritage. However, these invaluable treasures are facing numerous challenges that threaten their existence. Factors such as floods, abandonment, lack of maintenance, and fire have

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resulted in the loss of a significant number of traditional houses, mosques, and palaces over the years. Nonetheless, there have been a few instances where heritage timber buildings have been successfully reused, albeit with a change in their original function.

Adaptive reuse of heritage buildings is often driven by the necessity to ensure their continuous utilisation and preservation [1]. These old timber buildings were initially designed to cater to climatic conditions and specific functional requirements. However, when repurposing these buildings, various considerations must be considered to accommodate modern technological needs, including electricity, air conditioning, and plumbing. Adapting these buildings to new functions can save them from abandonment or demolition, offering a fresh lease of life.

The practice of adaptive reuse is not unique to Malaysia. However, it is a global trend, particularly regarding notable architecture that remains well-maintained, possesses flexible spaces, and carries historical significance. While some of these buildings may be transformed into museums, the majority undergo restorations to preserve their material values while accommodating new functions. Concerning the new function and following the criterion that the best use for a building is that it was created when it becomes obsolete for different reasons. It is clear that if the new function of the building is very similar to the original one, that conversion has more chances of success with less intervention [2]. On the contrary, if the programme is very different, a more severe intervention on the building's general structure will be needed, and the result could be critical for preserving and enhancing its identity [3]. However, if the program diverges significantly, more substantial structural modifications may be necessary, potentially posing challenges to protecting the building's identity [3].

Existing heritage buildings naturally undergo degradation over time, rendering them unsuitable for their original purposes. Enhancing these buildings' conditions or adapting them to new functions is also necessary. Building conservation has emerged as a growing concern, although its widespread application in Malaysia is relatively recent [1]. The principles of conservation and rehabilitation used in Malaysia are influenced by international charters such as ICOMOS' Venice Charter and Burra Charter. Building conservation involves physically preserving a structure and safeguarding the historical information it encapsulates [4].

In Malaysia, listed buildings are subject to special considerations. Listed building consent is required for any modifications that may impact the character of a building recognised as having particular architectural or historic interest. It is crucial to note that once a building is listed, the protection extends to the entire structure, regardless of its grading. This comprehensive protection is governed by the National Heritage Act 2005 (Act 645). These conservation measures aim to ensure the preservation and recognition of Malaysia's architectural heritage.

Given the importance of heritage timber buildings and the need for their adaptive reuse, this study seeks to explore the transformative process of modernising these structures while preserving their historical significance. Drawing lessons from the remarkable case study of Istana Jahar, the research will delve into the challenges and opportunities associated with integrating modern building services while maintaining the authenticity and integrity of these architectural gems.

2 Literature Review

The existing literature has discussed the modernisation of heritage buildings and the challenges associated with integrating modern building services while preserving their historical significance. Scholars and experts emphasise the importance of conserving heritage buildings as they serve as tangible links to past eras, reflecting the lifestyle and culture of the people who inhabited them. Rather than demolishing these structures, sustaining them and

providing new functions can offer valuable insights to future generations about their cultural heritage [5].

When adapting heritage buildings for different functions, it is crucial to ensure that the new use respects and preserves the architectural character and originality of the structure, which requires careful decision-making and a professional approach to selecting the appropriate function that aligns with the cultural significance of the building [6]. The adaptive reuse process presents significant challenges for designers, as it introduces new regulatory conditions and requires a comprehensive analysis of the building's heritage values, physical characteristics, and potential.

A fundamental problem in adaptive reuse projects is the tendency to make arbitrary decisions regarding the new function without conducting an in-depth analysis. The selection of the new use should be based on analytic and scientific methods to ensure the most appropriate strategy for the adaptive reuse project [1]. Without a thorough analysis, heritage buildings may eventually fall into disuse or experience negative impacts on their originality due to social and economic factors. Given the substantial investment in conserving heritage buildings, it is essential to pursue economically, socially, and physically sustainable approaches in adaptive reuse projects [6].

Various theories and frameworks have been developed to guide the adaptive reuse process and strike a balance between tradition and innovation. These frameworks emphasise the importance of understanding heritage buildings' cultural significance and historical context while considering contemporary needs and functions [5]. By incorporating these theories and frameworks into the decision-making process, designers can ensure that adaptive reuse projects respect the existing building's historical context and add a contemporary layer without compromising its character.

3 Methodology

A mixed-methods approach is adopted to address the research problem and achieve the study's objectives, combining qualitative analysis of historical records, architectural documentation, and immersive site visits. This methodology provides a comprehensive understanding of the transformative process of modernising heritage timber buildings through adaptive reuse, with Istana Jahar serving as a remarkable case study.

The qualitative analysis of historical records forms a crucial component of the methodology. Historical documents, including archival records, photographs, and written accounts, are examined to gain insights into the historical context and significance of Istana Jahar. This analysis provides a foundation for understanding the building's original purpose, construction techniques, and cultural value.

Architectural documentation plays a vital role in capturing the unique features and design elements of Istana Jahar. Detailed documentation, including measured drawings, plans, and elevations, is examined to understand the building's architectural composition. This documentation helps identify the distinctive elements that contribute to the heritage value of Istana Jahar and informs the modernisation process.

Immersive site visits are conducted to gather firsthand information and experience the building in its physical context. Through site visits, the researchers can observe and analyse the existing conditions of Istana Jahar, including the state of preservation, structural integrity, and any previous modifications. This direct engagement with the building allows for a deeper understanding of its historical fabric and provides insights into potential challenges and opportunities for modernisation [7].

The selected mixed-methods approach is justified by its ability to capture diverse perspectives and sources of information. A comprehensive understanding of Istana Jahar and its transformation through adaptive reuse can be achieved by combining historical analysis,

architectural documentation, and immersive site visits. The qualitative nature of the methodology allows for a nuanced exploration of the challenges and opportunities associated with integrating modern building services while preserving the building's historical significance.

Istana Jahar, the chosen case study site, holds significant historical and architectural value in Malaysia. It is a heritage timber building that exemplifies the traditional Malay architecture of the region. The case study site's selection is based on its unique characteristics, historical significance, and successful adaptation to modern needs. Istana Jahar provides a rich context for examining the balance between tradition and innovation in modernising heritage timber buildings.

The historical and architectural significance of Istana Jahar lies in its cultural importance and architectural features, such as its intricate woodwork, traditional design elements, and historical context. By thoroughly analysing Istana Jahar, the study aims to extract lessons and insights that can be applied to similar heritage buildings undergoing adaptive reuse.

4 Historical Context and Architectural Features of Istana Jahar

Istana Jahar, originally a single-storey timber building, has undergone radical transformations throughout its history to adapt to the evolving needs of the ruling Sultan and changing circumstances. The building is part of a lineage of royal palaces in Kelantan, including Istana Balai Besar and Istana Tengku Sri Akar. The fusion of traditional Kelantanese architecture and European influences in Istana Jahar's current form raises questions about its original influence and the impact of European colonisation on its architecture.

The architectural features of Istana Jahar reveal a blend of Kelantanese and European styles. While the roof forms, wall panels, and ornamentation belong to traditional Kelantanese architecture, the presence of wrought iron spiral staircases, iron railings, and a semi-octagonal porch indicates the influence of Georgian architecture, representing foreign design elements. The building now stands as a double-storey masonry structure, showcasing a combination of these architectural influences.

Currently, Istana Jahar serves as the Kelantan Royal Tradition and Customs Museum. However, its original function as a residence palace for at least two Sultans of Kelantan suggests the presence of facilities and services required for their daily routines and activities [8].

The historical background of Istana Jahar can be traced by examining the chronicles of events in Kelantan's history. Significant changes in the building's architecture and function occurred during the different reigns of the Sultans. The construction of Istana Jahar began in 1887–1889, during the reign of Sultan Muhammad II, as a single-story timber building. Subsequent renovations and additions transformed it into a double-story timber building (1900–1905) and a double-story masonry structure with a semi-octagonal porch (1905–1920) following the visit of the Siamese emperor in 1905. Further renovations in 1965 converted the palace into offices and the Kelantan State Museum, and in 1990, it underwent an additional renovation to house the Royal Tradition and Customs Museums.



Fig. 1. Adaptation of Istana Jahar through various functions before its transformation into a museum.

5 Integrating Modern Building Services while Preserving Historical Authenticity

Integrating modern building services into heritage timber buildings while preserving historical authenticity presents a unique challenge in architectural conservation. Incorporating modern building services, including mechanical and electrical services, including electricity, air-conditioning systems, and water plumbing, requires careful consideration to minimise the impact on the historic fabric of the buildings. Introducing new wiring, ductwork, and plumbing may require alterations to the building's structural elements, potentially leading to the displacement or removal of original materials. This process can alter the building's spatial layout, aesthetics, and material composition, compromising its historical authenticity and visual coherence. Developers encounter various regulatory, financial, and physical challenges when embarking on adaptive reuse projects. Heritage buildings, in particular, often lack modern mechanical and electrical systems that conform to current standards [9].

Conversely, zoning by-laws include provisions that govern building use, size, height, density, and location; occasionally, variances or waivers may be sought to circumvent specific building code requirements [10]. Additionally, within the profession, there is a recurring difficulty in sourcing adequately skilled and experienced individuals to engage in adaptive reuse endeavours [11]. A case study examining the compatibility assessment of new uses for heritage buildings, focusing on the Alexandria National Museum in Egypt, revealed an impressive 80% approval rate among professionals for efficiently adapting mechanical, electrical, and acoustic systems and fire safety measures [2].

This analysis explores strategies for seamlessly integrating these modern building services while preserving the historical integrity of heritage timber buildings. One approach to minimising the impact on historical fabric is carefully selecting and implementing modern building services. For example, the installation of electricity should be done discreetly, with wiring and outlets strategically placed to avoid disrupting or damaging the original architectural elements. Concealing ductwork and vents is crucial when integrating air-conditioning systems, ensuring that the spatial qualities and aesthetics of the heritage building are preserved.

Architects who played a pioneering role in the development of the modern movement found Viollet-le-Duc's architectural theory to be of great significance as it facilitated their departure from the constraints of historical precedents and the theoretical traditions of earlier

architectural styles. Viollet-le-Duc's concepts concerning preserving old structures have assumed renewed importance and provided valuable insights for patrons and builders. Instead of concealing novel features, ancient masters recognised the necessity of integrating them harmoniously, even transforming these new requirements into decorative elements. Notably, installing central heating systems, air-conditioning, and air handling units received particular attention and care, not intending to hide them but to showcase their utilisation as new works of art at the forefront of architectural innovation [12].

Using sustainable materials and techniques is critical in achieving a harmonious integration of functionality and historical authenticity. By employing materials that mimic the appearance and characteristics of traditional elements, such as heritage-style fixtures and fittings, it is possible to blend modern plumbing systems seamlessly into the building's historic fabric. This approach helps to maintain architectural integrity while providing the necessary building services for contemporary use [3].

In striking a balance between preserving cultural heritage and meeting contemporary needs, it is essential to consider the significance of the building and its cultural value. The cultural heritage of a timber building lies not only in its physical fabric but also in its historical context, craftsmanship, and cultural symbolism. Therefore, any modifications or additions should respect the building's heritage value and contribute to its continued significance.

An example of a retrofitted building in the Chinese context is the Lui Seng Chun, located in Hong Kong, which exemplifies a retrofit process applied to a traditional Chinese architectural type known as "Tong-Lau," or the shop house. Initially constructed in the 1930s, the building underwent retrofitting to meet contemporary safety standards, necessitating the addition of a new staircase and fire protection measures. Furthermore, modern accessibility concerns were addressed by installing a new elevator, ensuring inclusivity for disabled individuals. Additional mechanical installations were incorporated into the structure in pursuit of enhanced functionality. In the broader context of historic building retrofitting, a delicate equilibrium must be achieved, encompassing considerations for preserving the building's heritage value, accommodating the functional requisites of the new purpose and fostering social benefits stemming from this adaptive transformation [13].

Integrating modern building services into heritage buildings lacks specifically outlined requirements, except for the stipulations in the Uniform Building By-Law (UBBL), which necessitates compliance with building services and fire regulations. Consequently, the practices employed by other countries serve as valuable references, such as the Tasmanian Heritage Council's Practice Note 16, which emphasises that the most effective approach to preserving historic heritage sites lies in ensuring their continuous use. Installing new services and building services in these heritage places can open up opportunities for ongoing utilisation. However, when updating services and facilities in such contexts, certain principles must be considered, encompassing the installation of water tanks, heating and gas systems, satellite dishes and antennae, air-conditioning, and other relevant features. While these updates can present challenges, finding solutions that have minimal impact on the site's heritage values is possible. It is crucial to approach any modifications with the utmost care, aiming to minimise intrusion or adverse effects on the building's heritage value and distinctive characteristics. Additionally, the ability to reverse or undo the changes made for new services and equipment is highly desirable, considering that today's building services will likely be improved in the future (Tasmanian Heritage Council, Practice Note 16).

6 Integrating Modern Services for Istana Jahar as a Museum: Requirements and Recommendations

Several modern services have been adopted in transforming Istana Jahar into a museum while preserving the building's heritage value. This analysis will focus on the requirements and

recommendations for integrating modern building services such as air-conditioning systems, electricity and fittings, fire safety measures, and water plumbing.

6.1 Air conditioning system

In regions with warm temperatures, installing air-conditioning systems becomes necessary to meet modern building requirements in heritage buildings. However, several factors should be carefully evaluated before implementing such procedures. The cooler and drier air produced by air-conditioners may lead to shrinkage of building materials, and condensation on surfaces or within the fabric could potentially promote mould growth, impacting the building's integrity. Additionally, the installation process of air conditioners should be undertaken with sensitivity, avoiding haphazard placement that could adversely affect the visual appearance of the heritage building [1]. The extensive use of air conditioning in different activities must also be addressed from the perspective of thermal comfort [14] since they have significantly impeded the move towards passive design.

To address these concerns, the Singapore Urban Redevelopment Authority (URA) (1998) has established guidelines for installing air-conditioning units in heritage buildings. Recommendations include avoiding window air-condensing units to preserve the façade's integrity and opting for compact units with the least visible impact on the building's design. The specific location of the air-conditioning units should be tailored to the building's typology and the nature of the project. Additionally, direct expansion split air-conditioning systems should be seamlessly integrated into the interior of the building, with concealed or sensitively installed ducting to minimise visual obtrusion. The aim is to ensure that the air-conditioning systems harmonise with the architectural elements and maintain the building's visual authenticity (URA, 1998).

For Istana Jahar, preserving its original aesthetics is essential while providing a controlled climate for exhibits and visitor comfort. Concealing ductwork and vents and carefully selecting air conditioning units that blend with the interior design will aid in achieving this balance. By adhering to these recommendations, Istana Jahar can benefit from modern climate control while safeguarding its architectural heritage.



Fig. 2., 3 and 4. The improperly placed outdoor air-conditioning units compromised the aesthetic and historical integrity of Istana Jahar.

6.2 Electricity and fittings

Integrating electricity and fittings is another vital aspect of adapting modern services. Lighting fixtures, electrical outlets, and other electrical requirements must be installed discreetly to avoid disrupting the building's historic fabric. It is recommended to carefully plan the placement of electrical outlets and wiring to minimise their visibility and impact on the historical fabric. Historical-style fittings, such as switches and sockets that mimic the design of the period, can be used to maintain the aesthetic coherence of the museum.



Fig. 5., and 6. Incorporating historical-style fittings to preserve aesthetic coherence in the museum.

6.3 Fire safety

According to Stewart Kidd, challenges often arise when additional staircases for means of escape are required in heritage buildings. Incorporating fire precautions "hardware," such as exit notices, emergency lighting, fire detection, warning, and suppression equipment, can also pose a dilemma. Balancing the necessity to provide adequate fire safety measures while preserving the building's architectural and historical character presents a potential conflict of interest. When fire safety improvements entail alterations to the building, a careful and sympathetic design approach becomes crucial to minimise any adverse impact on its heritage attributes [15]. Kidd proposes a set of principles to guide fire protection improvements in heritage buildings, emphasising minimal intervention to minimise disruption and damage during installation, maintenance, and potential removal. Reversibility is encouraged, promoting a 'plugin, plug out philosophy' for changes made to heritage or listed buildings. Furthermore, any work undertaken should be essential, with justification based on a detailed fire risk assessment. Sensitivity to the building's appearance and fabric is crucial when installing fire protection devices and systems to safeguard the heritage values they are meant to protect [16,17].

Compliance with fire safety regulations is imperative for Istana Jahar to function as a public space. This necessitates installing fire detection systems, emergency lighting, emergency exits, and fire extinguishers. While implementing these fire safety measures, it is essential to discreetly integrate them and design them to minimise their visual impact, thereby preserving the building's significant heritage value. Collaboration with fire safety experts is recommended to develop a comprehensive fire safety plan that meets contemporary requirements while preserving Istana Jahar's historical fabric.



Fig. 7., and 8. Emergency staircases provide direct access from the first floor of Istana Jahar to the outdoor area.



Fig. 9. Inappropriate water tank tower impairs the aesthetic appeal of the building.

6.4 Water tank and plumbing system

Incorporating water tanks and plumbing systems into heritage buildings necessitates adherence to specific guidelines and recommendations outlined by the Tasmanian Heritage Council. According to these guidelines, installing a water tank on a heritage building is best achieved by situating it to the side or rear of the structure, as this approach is generally deemed more suitable for such sensitive contexts. Bladder and underground systems may also be viable alternatives for consideration. However, locating the tank where it becomes visible from the front boundary is generally discouraged, except in cases where the material and size of the tank are compatible with the overall aesthetics of the building. For rural and regional properties, incorporating water tanks may be viewed as a traditional element, thereby offering greater flexibility in terms of placement.

Nevertheless, careful consideration should be given to factors like the colour and materials of the tank, as they can significantly impact the appropriateness of its positioning. In urban settings, the water tank's location, colour, size, and construction can influence the character and heritage value of the surroundings. As such, plastic and fibreglass tanks are often discouraged due to their artificial appearance unless suitable screening can effectively mitigate their visual impact.

For the transformation of Istana Jahar into a museum, implementing modern water plumbing systems becomes imperative to cater to visitor building services, such as restrooms and sinks. It is essential to employ sustainable materials and techniques that emulate traditional elements to maintain the historical authenticity of the building. Utilising heritage-style fixtures and fittings can further facilitate the seamless integration of modern plumbing systems. However, it is crucial to address concerns related to the location and design of the water tank tower. Inappropriate positioning may result in an unsightly view, mainly if the plumbing system around the water tank needs to be more organised and unsealed. Hence, careful attention must be given to ensure that modern water infrastructure is installed in a manner that preserves the architectural heritage and aesthetics of the esteemed heritage building.

6.5 Rainwater downpipe system

Installing a rainwater downpipe system is necessary to manage rainwater runoff from the roof. This system should be carefully designed and positioned to minimise its impact on the exterior appearance of the building. Traditional-style downpipes and rainwater harvesting techniques can be employed to maintain the visual integrity of Istana Jahar while incorporating modern functionality.

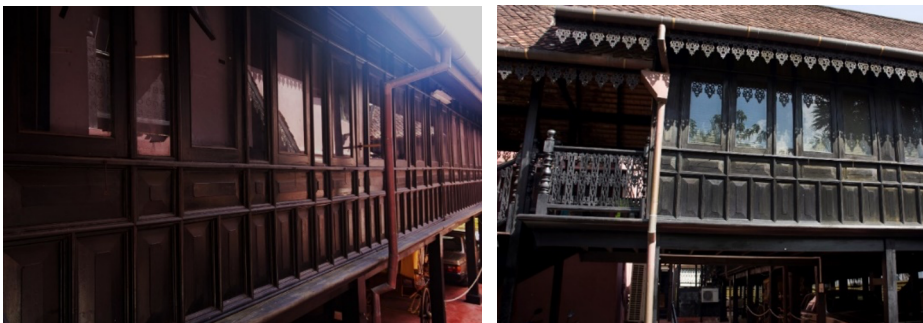


Fig. 10., and 11 . Rainwater downpipe system at Istana Jahar effectively manages runoff while preserving the building's exterior aesthetics using traditional-style downpipes and rainwater harvesting techniques.

7 Requirements and Recommendations

When integrating modern services for Istana Jahar as a museum, several considerations should be considered to preserve the building's heritage value. Installing a rainwater downpipe system is necessary to manage rainwater runoff from the roof. Traditional-style downpipes and rainwater harvesting techniques should be employed to minimise their impact on the building's exterior appearance. This approach maintains the visual integrity of Istana Jahar while incorporating modern functionality.

In terms of water plumbing, the installation of water tanks is often required. Water tanks should be located on the side or rear of the structure to maintain the historical aesthetics of the building. Bladder and underground systems may be viable alternatives. Attention should be given to the colour and materials of the tank, as plastic and fibreglass tanks may be visually inappropriate. The tank's scale, colour, materials and support structure should be carefully considered to ensure their appropriateness and compatibility with the urban setting.

Incorporating air-conditioning systems presents challenges in preserving the building's fabric and appearance. The cooler and drier air produced by air-conditioning systems may cause shrinkage of building materials and potential condensation issues. Careful consideration should be given to installing air-conditioning units to mitigate these risks. The guidelines provided by the Singapore Urban Redevelopment Authority suggest using compact units that are least visible from the exterior. Window-type units should be avoided, and split air-conditioning systems should be integrated with the building's interior while concealing ducting to minimise visual impact.

When installing internal elements such as equipment and cabling, care should be taken to avoid detracting from significant elements of the building. Dropped ceilings that compromise the proportions of a room or conceal important historic features should be avoided. Intake grilles should be placed in less visible spaces, and unobtrusive grilles should be used in formal or significant areas to maintain the building's aesthetic integrity.

Considering fire safety requirements, alterations to the building should be minimal and sympathetic to the architectural and historic character of Istana Jahar. The principles of minimal intervention, reversibility, and essentiality should be followed. Fire protection measures should be installed with sensitivity to the overall appearance of the building, ensuring they have the minimum impact on the fabric while providing appropriate levels of safety. Compliance with legal requirements, such as listed building consent, planning permission, building standards, fire regulations, and certification, is essential.

By implementing these recommendations, Istana Jahar can successfully adapt modern services while preserving its heritage value as a museum. The careful integration of these services ensures the functionality of the building while respecting its historical and architectural significance, allowing future generations to appreciate and understand its cultural heritage.

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