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WELCOME SPEECH FROM THE CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

بسم الله الرحمن الرحيم السلام

عليكم ورحمة الله وبركاته

Greetings to all,

It is with great pleasure that I welcome you to the 17th RISM International Surveying Conference for Undergraduates (ISCU 2025), themed *"Embracing Construction Revolution 4.0: Transforming Malaysia's Built Environment."* On behalf of the Royal Institution of Surveyors Malaysia (RISM), I also wish to express our sincere appreciation to Universiti Teknologi MARA (UiTM), Perak Campus, for graciously hosting this significant event.

As we navigate the era of the Fourth Industrial Revolution (IR4.0)—or in our context, Construction Revolution 4.0 (CR4.0)—we are witnessing transformative advancements across the global construction sector. Technologies such as Building Information Modelling (BIM), the Internet of Things (IoT), artificial intelligence (AI), robotics, big data analytics, and cloud computing are redefining the way we build, manage, and interact with our built environment. For Malaysia, embracing CR4.0 is a strategic imperative to achieve our socio-economic and environmental goals.

This conference serves as a vital platform to unite surveying undergraduates from various disciplines, fostering critical dialogue on industry challenges, enhancing professional networking, and preparing a new generation of talent for the rapidly evolving construction landscape. It is also an opportunity for employers to engage with and inspire our future professionals.

I would like to extend my heartfelt thanks to all industry speakers, paper presenters, judges, and participants for their time, contributions, and support in making ISCU 2025 a success. I also commend the organising committee for curating a meaningful and dynamic conference experience.

May the knowledge gained, connections formed, and ideas exchanged during this event inspire all participants to lead and innovate in their future endeavours.

Wishing everyone a productive and memorable conference.

Prof. Ts Sr Dr. Adi Irfan Bin Che Ani'
Chairman, Universities' Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM CO-CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

Bismillahirrahmanirrahim.

السلام عليكم ورحمة الله وبركاته and greetings to all.

It is my great pleasure to welcome everyone to the 17th International Surveyor Conference for Undergraduates (ISCU 2025), proudly hosted by Universiti Teknologi MARA (UiTM) Perak Branch in collaboration with the Royal Institution of Surveyors Malaysia (RISM). This event is a meaningful platform for students in the built environment to share ideas, showcase innovations, and build professional networks. We are honoured by your presence and enthusiastic participation, with 135 accepted papers and 78 poster presentations this year.

UiTM Perak, home to the College of Built Environment, has long been a hub for academic excellence in architecture, planning, and surveying. Our commitment remains strong in nurturing competent graduates who meet industry demands and contribute to nation-building.

While you're here, we invite you to experience the heritage and culture of Perak Tengah from the architectural richness of Rumah Kutai to the historical towns of Pasir Salak, Bota, and Kampung Gajah.

To all presenters and winners, congratulations on your achievements. Let your work today be a catalyst for future success and academic growth. We hope this conference will inspire you to explore new ideas, foster collaboration, and make lasting memories.

My deepest thanks to the Royal Institution of Surveyors Malaysia (RISM) and the organising committee for making this event a success.

We hope your experience here will be rewarding and unforgettable.

Thank you. Selamat datang dan selamat berjaya.

Associates Professor Dr. Nur Hisham Ibrahim, *PMP*
Co-Chairman, Universities' Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM THE PROJECT DIRECTOR

RISM 17th International Surveying Conference for Undergraduates 2025

Alhamdulillah, all praise to Allah S.W.T. for His guidance and blessings in making the RISM 17th International Surveying Conference for Undergraduates (ISCU) 2025 a reality.

It is with great honour and gratitude that I welcome all participants, guests, academicians, and industry professionals to this prestigious event, proudly organized under the Royal Institution of Surveyors Malaysia (RISM). This 17th edition of ISCU stands as a proud testament to our collective dedication toward academic excellence, professional collaboration, and youth empowerment in the field of surveying.

I extend my heartfelt appreciation to RISM for its unwavering support, to the hardworking ISCU 2025 Organising Committee, and to all 16 partnering universities across Malaysia for their commitment and contributions. Your efforts have shaped this conference into a dynamic platform for knowledge exchange, innovation, and professional growth.

To the academicians and practitioners present, your insights are invaluable in bridging the gap between academic theory and real-world practice. To our undergraduate participants, your passion, curiosity, and commitment are the very foundation of our future. May this conference not only deepen your academic journey but also ignite a spirit of leadership, integrity, and sustainable thinking.

Let this gathering serve as more than an academic milestone. May it foster lifelong networks, inspire transformative ideas, and chart new directions in our shared professional journey.

Wishing everyone a rewarding and inspiring conference experience.

Sr Dr. Nurul Fadzila Zahari
Project Director
RISM 17th ISCU 2025

EXPLORING THE INTEGRATION OF GREEN BUILDING ELEMENTS INTO HERITAGE CONSERVATION IN GEORGETOWN WORLD HERITAGE SITE: COMMON PRACTICES, CHALLENGES AND STRATEGIES

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ABSTRACT

Heritage buildings hold significant architectural and cultural values. It requires conservation efforts that balance preservation with sustainability. As urban sustainability gains global attention, integrating green elements into heritage conservation has become essential. However, limited acknowledgement on this effort poses challenges, leading to missed opportunities for environmental benefits. This study focuses of Georgetown, Penang, a UNESCO World Heritage Site known for its sustainability initiatives. It aims to develop a framework for integrating green elements into heritage conservation. A qualitative research design was employed, involving a rigorous literature review of 32 peer-reviewed articles. This study seeks to identify the green elements incorporated into heritage building conservation, investigate the challenges associated with their implementation and examine significant strategies for effective integration. The proposed conceptual framework outlines three key components, serving as a foundational approach for further empirical investigation. This study seeks to contribute to policy development and industry best practice to ensure eco-conscious heritage building preservation for future generations.

Keywords: Heritage Conservation, Heritage Site, Green Building Element, Georgetown

I. INTRODUCTION

Heritage buildings are significant remnants of the past, embodying architectural, historical, and cultural values that are essential for community identity and are inherited by future generations (Al-Sakkaf et al., 2020; Norazman et al., 2023). There are various research that have been done emphasizing the importance of preserving the authenticity of heritage site to preserve their historical, cultural and architectural elements (Abdul Aziz, 2021; Al-Sakkaf et al., 2020; Husa & Harun, 2023; Mat Hasan et al., 2022). In striving for a balanced approach to heritage site management, emphasis has also been placed on ensuring heritage conservation activities comply with sustainable and environmental practices (Teoh, 2021). Pedersen et. al (2024) in their research highlight the development and evaluation of advanced energy-efficient technologies for improving the building performance, at the same time identify the challenges and solution facing during energy upgrading and preservation. Similarly, Panakaduwa et. Al (2024), highlight the advanced energy-efficient technologies for retrofitting buildings, addressing the challenges and proposed solutions to balance sustainability and architectural integrity. Additionally, Pintossi et. Al (2023) highlights the significance of addressing issues like gentrification and climate change, incorporating urban history protection into sustainable development, and suggesting tactics for creative governance and community engagement. These studies highlight international perspectives on environmental and historical preservation, offering valuable insight into balancing sustainability with cultural heritage. In Malaysia, apart from Melaka, Georgetown in Penang is also a UNESCO World Heritage Site, designated in 2008. The city boasts nearly 5000 heritage buildings (UNESCO World Heritage Centre, n.d.). Beyond its historical significance, Georgetown has embraced sustainability initiatives that align with global trends in heritage conservation and environmental stewardship (Alauddin et al., 2022; Bagheri et al., 2022). This also aligns with the vision of Penang 2030 which emphasizes the integration of environmental sustainability within heritage conservation. The initiatives aim to enhance urban liveability while balancing heritage preservation with modern development (Teoh, 2021).

While sustainable practices are increasingly adopted for new development projects, their implementation in heritage conservation remains limited. One of the key challenges is the low number of heritage buildings certified under Malaysia Green Building Index (GBI), even though many projects incorporate green features without formally receiving formal recognition (Green Building Index, 2025). The lack of acknowledgment and promotion of sustainable effort in heritage conservation raises concerns about missed opportunities for environmental benefits (Alauddin et al., 2022; Pedersen et al., 2024). Without a clear understanding of how green elements can be integrated into heritage conservation and what challenges hinder the process, finding balance between heritage preservation with sustainability can become difficult (Abdul Aziz, 2021; Alauddin et al., 2022; Lidelöw et al., 2019). This study aims to bridge this gap by proposing a conceptual framework that better integrates these two aspects. Accordingly, this study has three key objectives; to identify green building elements in heritage conservation, to explore the challenges associated with their implementation and to develop strategies for effectively integrating sustainability into heritage conservation projects. The findings are significant to address the research gap while supporting the national effort and Penang's vision for environmentally responsible urban conservation.

II. LITERATURE REVIEW

Heritage Building VS Heritage Buildings Conservation

A. Heritage Building and its Characteristics

Heritage buildings encompass structures, artifacts and areas of historical and architectural significance. It serves as tangible links to the past and reflects the cultural identities of the communities (Al-Sakkaf et al., 2020). Norazman et. al (2023) further define heritage buildings on their architectural, aesthetic, historical and cultural importance, emphasizing their role in preserving the identity and history of local community. One of the defining characteristics of heritage buildings is their distinctive architectural features, which embody the design trends and construction technique (Al-Sakkaf et al., 2020; Husa & Harun, 2023). For example, buildings from the colonial era may have classical columns and symmetrical designs, whereas Art Deco buildings may feature geometric shapes and vibrant colors (Shehata et al., 2024). Beyond their architectural significance, heritage buildings hold immense cultural values, representing the social, cultural and economic norms of the periods which they were built (Al-Sakkaf et al., 2020). Religious structures, such as mosques, temples and churches, symbolize spiritual beliefs and practice while traditional marketplace and community centers reflect the social interactions and economic activities of their time (Al-Sakkaf et al., 2020). Another key characteristic of heritage buildings is their construction materials and techniques, which are often influenced by the local geographical and environmental context (Mat Hasan et al., 2022). The common material for heritage building is timber with example Malacca Sultanate Palace buildings which built in 15th century; brick with example St. Paul's Church which built in 1521; stone with example Kek Lok Si Temple which built in 1891 (Mat Hasan et al., 2022).

B. Conservation of Heritage Buildings

Heritage buildings need various of strategy to conserving historical, cultural and architectural buildings (Alauddin et al., 2022; Husa & Harun, 2023; Norazman et al., 2023). The type of conservation can be divides into four which are strategies: restoration and repair, adaptive reuse, maintenance, and retrofitting or rehabilitation. This study highlights on adaptive reuse and restoration. These two strategies are emphasized for their complementary roles in heritage conservation, restoration ensure the preservation of historical authenticity, while the adaptive reuse integrating modern urban framework such as technology to ensure their continued relevance and utility, at the same time can reach green element idea (Alauddin et al., 2022; Harun, 2011; Vafaie et al., 2023). By focusing these, it is important to balance the historical conservation with contemporary socio-economic and environmental demands.

Georgetown World Heritage Site VS Green Heritage Conservation

A. Overview of GWTHS

George Town World Heritage Site (GTWHS), located in Penang, Malaysia, is a UNESCO World Heritage Site inscribed in 2008 under the world heritage list number 1223 with the tittle "Melaka and George Town, Historic Cities of the Straits of Malacca" (UNESCO World Heritage Centre, n.d.). As a historic business port, George Town drew a diverse population, including Malays, Chinese, Indians, and Europeans, resulting in a distinct urban landscape that combines colonial architecture, traditional shophouses, and religious sites of several faiths. Today, George Town is a thriving living heritage site that combines modern urban life with historical and cultural

preservation. Conservation measures include stringent rules, adaptive reuse of heritage structures, and community involvement (UNESCO World Heritage Centre, n.d.). GTWHI has been actively involved in conservation projects, community engagement, and educational programs to address these challenges such as urbanization and development. A cooperative strategy involving local communities, stakeholders, and international organizations is necessary for GTWHS to continue grow sustainable and recognized as worldwide (George Town World Heritage Incorporated, 2024).

B. Green Heritage Conservation

Green buildings are structures that minimize their negative effects on the environment while functionally, safety, and reliably utilizing eco-friendly technologies like low-carbon systems and renewable energy (Yin et al., 2024). The United States Environmental Protection Agency (2024) defines as an approach to building, operating, and maintaining structures throughout their whole life cycle that is resource-efficient and environmentally conscious. Addition, ecosystem protection, carbon footprint reduction, and the encouragement of sustainable activities are some goals that green heritage conservation aims to achieve while preserving historical and cultural characteristics (Shehata et al., 2024).

In Malaysia, several strategies have been introduced to promote green heritage conservation. The Green Technology Master Plan (2017-2030) aims to develop a low-carbon and resource efficient economy while also embarking on a green growth journey, including sector building (Ministry of Energy, Green Technology and Water (KeTTHA), 2017). Additionally, Malaysia has adopted the Green Building Index (GBI), a widely recognized measure for encouraging sustainability in the built environment. The GBI encourages green design, construction, and operation of buildings, including heritage structures (Green Building Index, 2025).

In George Town, a UNESCO World Heritage Site, here is some example of Penang strategies which incorporate green element into conservation. Two notable examples are Penang Town Hall and Hotel Penaga. Penang Town Hall, constructed by two British Army engineers, Captain Innes and Satterthwaite. At present, it is categorized as a Category 1 Building by UNESCO World Heritage Site. incorporated green building elements like energy-efficient LED lighting, high-efficiency air conditioners, natural illumination, low-flush toilets, leak detection systems, and performance monitoring systems (Green Quarter, 2020; Hassan & Abdul Nasir, 2017). Similarly, Hotel Penaga, a heritage boutique hotel from the 1920s renovated by architect Hijjas and environmentalist Angela, achieved a GOLD GBI CERTIFICATE (GBI-NRNC-0003(RVA1)) with a score of 76 marks (Dewiyana et al., 2016; Ng et al., 2021). Key building element include solar panels, energy-efficient air conditioning, LED lighting, natural ventilation, rainwater harvesting systems, and the use of reusable materials (Dewiyana et al., 2016).

C. Importance of Incorporating Green in Heritage Conservation

The integration of green practices in heritage conservation is essential for promoting environmental sustainability and carbon emission. It contributes to a more sustainable built environment (Shehata et al., 2024). Additionally, incorporating green building elements enhances visitor experiences and increases the attractiveness of heritage sites. Conservation efforts that integrate sustainable building method are often perceived as more responsible and appealing, thereby drawing a broader audience and boosting tourism (Hassan & Abdul Nasir, 2017). Furthermore, the integration of green building elements allows heritage structures to merge with modern sustainable design while maintaining their historical essence. An example of this approach is the Penang Town Hall, here conservation efforts have successfully combined traditional architectural features with contemporary green technology, thereby enhancing the buildings' functionality while preserving its cultural identity (Hassan & Abdul Nasir, 2017; Shehata et al., 2024). However, while adopting sustainable technology and heritage conservation, it is crucial to maintain a balance between modernization and historical authenticity to ensure that the heritage value of these structures remains intact (Shehata et al., 2024).

D. Principles of Green Building Element Conservation

i) Energy Efficiency (EE)

Energy Efficiency (EE) is capacity to accomplish the same goal or task by using less energy (US Department of Energy, n.d.). Gupta & Chakraborty (2021) define EE as the minimization of energy consumption by means of resources optimization to generate comfortable living conditions inside a building. Using energy-efficient technologies will help to drastically lower energy consumption in the framework of heritage preservation (Gupta & Chakraborty, 2021). This is especially important since improving energy-efficient and supporting energy conservation in heritage building will help to decrease carbon dioxide emissions, so supporting more sustainable

conservation practices (Lidelöw et al., 2019; Min et al., 2022).

ii) Indoor Environment Quality (IEQ)

IEQ, encompasses factors such as air quality, lighting, thermal comfort, and ergonomics, all of which impact to resident health, comfort and well-being (U.S. Green Building Council, 2014). Based on Kang, Y. (2024) understanding IEQ is calculated by several environmental elements, such thermal comfort (TC), indoor air quality (IAQ), acoustic comfort, and visual comfort. Thermal transmittance of walls, window specs, airtightness, indoor temperature, and humidity are all often measured using the definition from Indoor Thermal Environmental Analysis (Kang et al., 2024). It can be accomplished by utilizing areas that are completely naturally ventilated, installing air conditioners and mechanical ventilation, setting up an automated indoor temperature system, and managing humidity and moisture.

iii) Sustainable Site Planning and Management (SM)

SM is the design approach to minimize the environmental impact of development project while maximizing social and economic benefits (Archi-Monarch, 2023). Moreover, SM is characterized as a sustainability approach that focuses on safeguarding natural resources while minimizing negative environmental impacts. This idea can be implemented through facility evaluations (such as examining roofs, windows, HVAC systems, and plumbing), energy and erosion management, and the use of renewable energy sources for heating and cooling (Alauddin et al., 2022).

iv) Materials and Resources (MR)

Materials and Resources (MR) are those with suitable performance, durability, low maintenance demands, and low energy use during manufacturing and usage (Tazmeen & Mir, 2024). Green element building conservation depends on the use of sustainable materials since they direct effect environmental impact of projects. This can achieved by using long-lasting materials with little environmental effect (Tazmeen & Mir, 2024). Another incorporation of reusing and recycling methods, which might extend the life of heritage buildings and reduce the need of fresh building materials (Tam & Hao, 2019). Particularly in the preservation of heritage buildings, this method significantly lower waste, so lessening environmental impact of construction activities (Alauddin et al., 2022).

E. Challenges in Maintaining Authenticity and Green Value in Heritage Conservation

The main challenges to include green building elements into heritage conservation are regulatory constraints, lack of skilled workers in heritage conservation practice and structural limitations.

i) Regulatory Constraints

The incorporation of eco-friendly construction components into legacy preservation is typically limited by numerous conservation projects tied to heritage rules worldwide, which impose tight standards that must be obeyed (Azizan et al., 2020; Conejos et al., 2019). This suggests that strict adherence to heritage preservation regulations may hinder the adoption of energy-efficient improvements, as stakeholders fear potential repercussions for altering original elements (Azizan et al., 2020; Conejos et al., 2019). Moreover, there is a deficiency of explicit guidelines on and comprehension of how to integrate the green building aspect into heritage conservation amid the regulatory constraints, but many individuals are still deterred from engaging in this endeavor due to regulations, licensing prerequisites, and complexity (Conejos et al., 2019).

ii) Lack of skilled workers in Heritage Conservation Practice

An additional major obstacle to successful integration is the lack of skilled professionals who possess expertise in both heritage conservation and green building design practices (Azizan et al., 2020). The present situation shows a significant lack of expertise, especially in heritage conservation, making the incorporation of green building design practices more difficult. Studies emphasize the challenges encountered in integrating green building elements into heritage preservation because of a shortage of skilled experts (Azizan et al., 2020; Harun, 2011).

iii) Structural Limitations

Structural limitations present another challenge to integrating green building elements in the conservation of heritage. Many heritage buildings, including Penang Town Hall, were constructed using traditional materials and techniques that may not support the integration of modern green technologies without compromising their structural integrity (Azizan et al., 2020). Additionally, the structural limitations of older buildings may restrict the practicality of incorporating specific green technologies.

F. Common Strategies to Incorporate Green Building Elements in Heritage Conservation

Common strategies to incorporate green building elements in heritage conservation is summarized in Table 1.0, emphasizing stakeholder awareness, flexible regulations, training, adaptive reuse and expert collaboration.

Table 1.0 Common Strategies Implement in Heritage Conservation (Conejos et al., 2019; Harun, 2011; Hassan & Abdul Nasir, 2017; Leijonhufvud et al., 2024; Mekonnen et al., 2022; Shehata et al., 2024)

Solution	Description
Stakeholder Involvement and Awareness	Implementing awareness initiatives to inform stakeholders about the advantages of incorporating green technologies into heritage preservation.
Adaptable Regulatory Frameworks	Creating more adaptable regulatory frameworks that facilitate the incorporation of green technologies without compromising.
Training and Education Initiatives	The architects, engineers and artisans with the necessary abilities to handle the difficulties if integrating green technologies into heritage structure, these programs should concentrate on them.
Adaptive Reuse Strategies	Examining adaptive reuse methods can create chances to transform current buildings while integrating contemporary sustainable technologies.
Collaboration with Conservation Experts	Engaging conservation specialists during the planning and execution stages of green building integration can guarantee that any changes to the structure adhere to best practices for preserving heritage.

Conceptual Framework

The conceptual framework for this study examines the integration of green building elements into heritage conservation, structured around three key components. As shown in Figure 1.0, the first components identifies green building elements that align with heritage conservation, ensuring sustainability without compromising structural integrity (Pintossi et al., 2023). The second component examines the challenges associated with implementing these elements, particularly in Georgetown, where balancing sustainability with heritage preservation presents practical difficulties (Azizan et al., 2020). Understanding these challenges, aligns with the vision of Penang 2030 (Penang State Government, 2023). The third component focuses on strategies for sustainable heritage conservation, aiming to bridge the gap between sustainability and heritage preservation. As noted by Vardopoulos (2019), developing effective strategies is essential for ensuring that conservation effort aligns with modern sustainability principles. This approach presents the way forward and requires in-depth exploration (Vardopoulos, 2019).

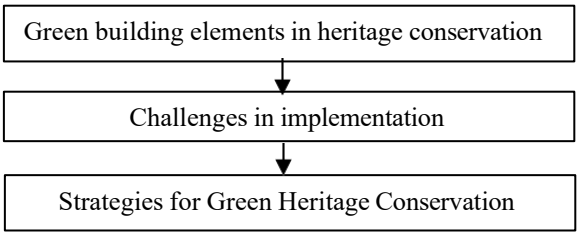

Figure 1.0 Conceptual Framework

III. METHODOLOGY

This study employs qualitative research design and follows a systematic research process. The identification of research issues and gaps was conducted through a comprehensive review of 32 peer-reviewed articles published between 2019 until 2025 from several databases. The literature search focused on exploring the integration of

green building principles into heritage conservation. Further analysis centered on the Georgetown World Heritage Site which served as the scope of refining the research gap. Insight from the literature review were synthesized to develop a structured conceptual framework. The outcomes of this study are explicitly aligned with Penang's 2030 sustainability objectives.

CONCLUSION

This study emphasizes on the importance of integrating green building elements into heritage conservation, to achieve a balance between sustainability and cultural preservation. By examining international perspectives and focusing on Georgetown Penang, a UNESCO World Heritage Site with strong sustainability initiatives, this study highlights the important of aligning conservation efforts with environmental responsibility. The proposed conceptual framework outlines three key components; that is identifying green building elements, addressing challenges in their implementation and formulating effective strategies for sustainable heritage conservation. While this paper serves as a foundational study, further research will be conducted to validate and refine the research through empirical investigation. By aligning with Penang's 2030 sustainability vision, this study aims to contribute to policy development and industry best practices, ensuring that heritage sites can serve as models of eco-conscious preservation for future generations.

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