

EXPLORING ALTERNATIVE MATERIALS FOR BAMBOO PANEL WALLS IN THE CONSERVATION OF THE IHSANIAH ISKANDARIAH MOSQUE: A CONCEPT PAPER

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ABSTRACT

The Ihsaniah Iskandariah Mosque, Kuala Dal, Perak, serves as a symbol of Malaysia's cultural identity, making its preservation crucial for future generations. Despite previous conservation efforts, sections of the mosque's bamboo panel walls have suffered deterioration. The climate and environmental conditions in Malaysia, including high humidity and rainfall, pose challenges to the longevity of traditional materials like bamboo. To address this challenge, there is a need to explore alternative materials that offer enhanced durability, weather resistance, and sustainability. Researching alternative materials represents a proactive step towards preserving our cultural heritage. It not only fortifies the structural integrity of iconic landmarks like the Ihsaniah Iskandariah Mosque but also mitigates the environmental footprint of conservation efforts. Moreover, this endeavour catalyses adaptation strategies for climate change, propelling us toward a future where heritage conservation seamlessly aligns with sustainable development goals. This paper emphasizes the importance of collaborative research efforts in developing innovative solutions for conservation, ultimately safeguarding Malaysia's cultural heritage for future



generations and promoting cultural tourism. Research on these alternative materials needs to be conducted, and the findings will assist the National Heritage Department in making decisions regarding the replacement of the mosque's bamboo panel walls.

Keywords: *Bamboo Panel Wall, Conservation, Mosque, Perak*

INTRODUCTION

The Old Mosque Kuala Dal, located in Padang Rengas, Kuala Kangsar, Perak Darul Ridzuan, Malaysia, stands as a cherished symbol of historical and cultural significance. Constructed with traditional "kelarai" bamboo strips, both the structure and wall panels of the mosque exemplify Malaysia's rich architectural heritage. Many historical artifacts that constitute cultural heritage are made of wood, highlighting not only the material's availability and ease of use but also its inherent beauty, often accentuated by human craftsmanship (Hunt, 2012). Additionally, wood is a renewable resource; after one tree is harvested, another can grow to take its place.

While kelarai offers a traditional and sustainable option for wall construction, it presents various challenges under different climatic conditions. This deterioration is primarily due to the inherent susceptibility of traditional materials like bamboo to climate variations, including erratic rainfall patterns and temperature fluctuations. Despite conservation efforts undertaken in 2008 by the Department of National Heritage, sections of the mosque's walls have suffered considerable damage over time. In response to this challenge, there is a pressing need to explore alternative materials for the conservation of the mosque. The primary objective of this research is to identify and assess alternative materials that can effectively replace the damaged bamboo panel walls while maintaining the architectural integrity and aesthetic value of the mosque. The research will also consider the durability and weather resistance of the selected materials to ensure their long-term suitability.

Researching alternative materials represents a proactive step toward preserving our cultural heritage (Shahrul Yani Said et al., 2016). It fortifies the structural integrity of iconic landmarks like the Ihsaniah Iskandariah

Mosque and mitigates the environmental footprint of conservation efforts. Moreover, this endeavour catalyses adaptation strategies for climate change, propelling us toward a future where heritage conservation seamlessly aligns with sustainable development goals.

This proposed research aims to contribute to the preservation of Malaysia's cultural heritage and support the efforts of the Department of National Heritage in conserving historical landmarks. Additionally, the findings may have broader implications for similar conservation projects globally, benefiting local communities and the tourism sector. Ultimately, the research will assist the Department of National Heritage in making informed decisions regarding the replacement of the mosque's bamboo panel walls, ensuring the continued preservation and appreciation of this cultural treasure.

HISTORY OF IHSANIAH ISKANDARIAH MOSQUE

The Ihsaniah Iskandariah Mosque, also known as the Old Mosque of Kg Kuala Dal, is an architectural and historical gem located in Padang Rengas, Kuala Kangsar, Perak Darul Ridzuan. This mosque, which dates back to the early 20th century, is not only a symbol of Malaysia's cultural heritage but also a significant tourist attraction in Perak. According to Harun et al. (2008), the mosque was commissioned by Sultan Idris Murshidul'adzam Shah, the 28th Sultan of Perak, and was completed in 1936. It was named after his father, Sultan Iskandar Shah, and his son, Sultan Iskandar Shah II, reflecting its deep royal connections. The uniqueness of this mosque can be seen in its architectural design, which resembles a birdcage and is built mainly out of wood. Harian Metro (2016) states that the uniqueness of this two-story mosque lies in its entire walls made of woven bamboo called "tepus walls". The fine artistry of the arabesque-influenced hand-woven kelarai motifs on the mosque's walls adds aesthetic value to the building, making it a major attraction for onlookers. There are 20 two-leaved windows adorned with carvings of "direct hole, not pierced" motifs of bean sprouts, crescent moons, and stars. The mosque's roof is also very unique as it does not have any eaves, making it look like a flat roof unaffected by the roof of the Kenangan Palace. This mosque was not used in 1976, after a new mosque known as Al-Wahidiah Mosque was built (Department of National

Heritage, 2024). The mosque's walls are composed of two types: bamboo panel walls and wooden panel walls. The upper-level walls are entirely made of bamboo panelling, while the lower-level walls consist of a combination of bamboo and wooden panels.

The Al-Wahidiah Mosque was built on the same site to accommodate the needs of the original mosque, which were insufficient. With the presence of the new mosque, the Ihsaniah Mosque is only utilized when necessary, especially during festive seasons and ceremonies. Over time, the function of the Ihsaniah Mosque has diminished, and until now it has been left unused and vacated since 1976 without any specific activities. The condition of the mosque, as shown in Figure 1, shows the effect of deterioration over time. Currently, the mosque only serves as a subject of study for architects, carvers, and kelarai weavers.



Figure 1. The Condition of the Mosque after being Vacated in 1976

Source: Department of National Heritage, (2024)

Recognizing the mosque's historical and architectural significance, the Department of National Heritage undertook extensive conservation work in December 2008. The conservation efforts included a wide range of activities to restore and preserve the mosque's structural and aesthetic integrity. During the 2008 conservation, efforts were made to replace these walls using materials identical to the originals, ensuring that the new bamboo panels matched the traditional weaving motifs, patterns, and dimensions precisely. Key aspects of the work included repairing the roof and structural framework, conducting termite prevention treatments, and restoring walls, panels, doors, and windows. These efforts were meticulously executed

to maintain the mosque's authenticity, architectural beauty, and intricate carvings as shown in Figure 2.



Figure 2. After conservation work in the year 2009

Source: Department of National Heritage, (2024)

Despite these comprehensive conservation efforts, nearly 15 years later, as shown in Figure 3, it was discovered that the bamboo panel walls had deteriorated and required replacement. Bamboo, being an organic material, is particularly vulnerable to environmental factors such as humidity, rainfall, and temperature fluctuations, leading to its degradation over time. The Department of National Heritage, acknowledging the need for more durable materials, has initiated a search for suitable alternatives to replace the bamboo panels. This search aims to find materials that can withstand environmental challenges while preserving the mosque's historical and aesthetic values.



Figure 3. Current condition of the kelarai walls of Ihsaniah Iskandariah Mosque, Padang Rengas

Source: Researcher (2024)

THE NEED TO EXPLORE ALTERNATIVE MATERIALS FOR KELARAI PANEL WALLS

In traditional Malay homes, notably those along the western coast of peninsular Malaysia, particularly in the state of Perak, kelarai wall panels are frequently used as external walls and interior separators. Because of its durability, bertam (*Engeissonatritis*), pelupuh, rumbia, and split bamboo are usually used to make these walls (Afzanizam Muhammad et al, 2012). After the materials are split and planed, they are submerged in mud to preserve them. Additionally, some panels have several colour paint jobs.

Preserving the original materials and structural systems is a major goal in the restoration of old wooden buildings. However, preserving the original historical elements during the repair of an endangered structure is a challenging and costly task (Arif Sarwo Wibowo, 2015). Therefore there is a need to research alternative materials for the conservation of the Old Mosque Kuala Dal arises of several critical factors. Researching alternative materials for the conservation of the Old Mosque Kuala Dal is imperative to address existing challenges, leverage technological advancements, and ensure the sustainable preservation of this iconic heritage site.

PRESERVATION OF CULTURAL HERITAGE

In many historic districts, an urban conservation programme is implemented as part of heritage-led revitalization to preserve the local atmosphere (Shahrul Yani Said et al., 2016). The Old Mosque Kuala Dal, with its unique architecture and historical significance, stands as a testament to Malaysia's rich cultural heritage. Additionally, cultural tourism fosters greater appreciation and understanding of diverse cultural traditions, promoting tolerance and dialogue across different communities (Arif Sarwo Wibowo, 2015). These sites serve as valuable windows into the past, offering visitors insight into the rich history and cultural significance of the region. By safeguarding these landmarks, we not only protect our collective heritage but also create opportunities for cultural exchange and tourism-driven economic growth (Samadi & Mohd Yunus, 2012).

TOURISM PROMOTION

The preservation of cultural heritage sites like the Old Mosque Kuala Dal is essential for promoting regional tourism and supporting local economies. The influx of tourists brings with it opportunities for job creation, entrepreneurship, and infrastructure development, all of which contribute to the socio-economic development of the surrounding communities. By maintaining the mosque's aesthetic appeal and structural integrity, and uplifting the image of the place to its former glory, we can continue to attract visitors from far and wide, thereby stimulating economic growth and fostering cultural exchange (Shahrul Yani Said et al., 2016).

DETERIORATION OF BAMBOO PANEL WALLS

Despite previous conservation efforts, sections of the mosque's bamboo panel walls have deteriorated over time. This highlights the need to explore alternative materials that offer greater durability and longevity to ensure the continued preservation of the mosque. Identifying materials that can better withstand environmental stresses will help maintain the mosque's structural and visual integrity. Durable materials reduce the need for frequent repairs and replacements, leading to more sustainable conservation practices.

ENVIRONMENTAL FACTORS

Deformations and distortions naturally occur in buildings with predominantly strong wooden structures due to atmospheric conditions. Many issues with wooden artifacts stem from changes in their dimensions caused by fluctuations in moisture content, primarily influenced by the relative humidity of the surrounding air (Hunt, 2012). Air temperature is significant because it helps regulate relative humidity, creating an interdependent relationship between temperature, relative humidity, and water vapor pressure (the actual amount of water vapor in the air, which varies with location, season, weather, and local conditions). The climate and environmental conditions in Malaysia, including high humidity and heavy rainfall, pose challenges to the longevity of traditional materials like bamboo.

In addition to that, with the changing climatic patterns, including fluctuations in rainfall and temperature, there is a growing need to adapt conservation practices accordingly. Exploring alternative materials that can withstand varying environmental conditions is essential for ensuring the long-term sustainability of conservation efforts. Climate-resilient materials will help protect the mosque from the adverse effects of climate change. Materials that are more resistant to moisture and temperature fluctuations will enhance the mosque's resilience against environmental wear and tear.

TECHNOLOGICAL ADVANCEMENTS

Because of its natural substance exposed to the elements and agents of degradation, wood can biodegrade therefore one of the reason timber buildings are not as durable as concrete ones. The ability of moisture content to cause shrinkage and swelling causes the jointing of timber structures to fail after a given amount of time (Afzanizam Muhammad et al, 2012). Advances in material science and technology present opportunities to discover innovative solutions for conservation. Exploring alternative materials that leverage these advancements may offer superior performance and longevity compared to traditional materials. Utilizing cutting-edge technology can lead to more effective and sustainable conservation strategies.

COMMUNITY ENGAGEMENT

According to Arif Sarwo Wibowo (2015), one of the most crucial aspects of early-stage conservation work is the self-awareness of both the communities and the government in preserving a building as part of the national heritage and culture. Even when the significance and value of maintaining the original structure are recognized, many individuals lack the budget or access to expert assistance. Engaging local communities in conservation efforts fosters a sense of ownership and pride in cultural heritage. Researching alternative materials provides an opportunity to involve community stakeholders in decision-making processes and ensure their perspectives are considered. Involving the community helps in building a collective responsibility toward heritage preservation.

DEFECTS OF KELARAI PANEL WALLS

Kelarai, a traditional woven bamboo mat, has been used to adorn the walls of palaces and Malay houses in the past. It is also commonly used in Malaysia for wall construction due to its sustainability and aesthetic appeal. Made by intricately weaving thin bamboo strips together, kelarai creates a durable and flexible material suitable for walls, ceilings, and furniture. While in other places, such weaving is made from bertam materials and referred to as tepas. Kelarai or tupas creations are stronger, firmer, and rougher, suitable for their function as room dividers.

The Malay community uses weaving techniques and kelarai to produce several items used in their daily lives such as mengkuang mats, stalls, baskets, and walls (Ahmad Zakaria et al., 2018). Mohd Aripin and Muhammad (2017) stated that the weaving technique known as kelarai is not only for decorating walls but also functions from the perspective of good air circulation

However, despite these advantages, kelarai panels exhibit several defects, especially under adverse climatic conditions. One significant drawback of kelarai is its vulnerability to environmental factors. While bamboo panels generally perform well in hardness tests, they are prone to dents and damage from high humidity. Consequently, the lifespan of kelarai panels is notably shorter than that of other materials like plywood, making them less ideal for long-term use in certain climates.

Several specific defects associated with kelarai panels are predominantly due to climatic influences. Peeling paint is a major issue, arising from prolonged exposure to varying weather conditions, particularly moisture and water. This problem is often exacerbated by leaks from plumbing or roofing issues that allow water to seep behind the paint. Additionally, inadequate surface preparation before painting, such as not cleaning or priming the panels properly, can result in poor paint adhesion, leading to peeling. Factors such as painting over dirty or contaminated surfaces and using incompatible paint types also contribute to this issue. Furthermore, exposure to direct sunlight can cause the paint to dry out prematurely and peel off.

Changes in humidity, temperature, and moisture levels can also lead to warping and discoloration of the materials used in kelarai walls. Split bamboo, bertam, rumbia, and pelupuh are particularly susceptible to these changes, significantly affecting the panels' durability and appearance over time. Continuous exposure to various weather conditions accelerates the deterioration of kelarai materials, with high humidity, fluctuating temperatures, and moisture contributing to the weakening and breakdown of bamboo and other natural fibers used in these panels (Hunt, 2012). Moreover, bamboo and similar organic materials are prone to termite infestations. Without proper treatment and regular maintenance, termites can severely damage the structural integrity of kelarai walls (Afzanizam Muhammad et al, 2012). Additionally, rapid heating or uneven temperature distribution can cause minor cracks in kelarai panels, compromising their aesthetic appeal and reducing their overall strength and durability.

To mitigate these climate-related defects and ensure the longevity of kelarai wall panels, proper maintenance and preservation techniques are essential (Bredenoord, 2024). Regular inspections, timely treatments of materials, and immediate repairs are crucial to preventing severe damage. Ensuring proper surface preparation before painting and using suitable paint types can also enhance the durability and appearance of kelarai panels. The causes of peeling paint on kelarai wall panels include moisture and water exposure, improper surface preparation, exposure to direct sunlight, use of incompatible paint types, thick paint application, and the natural aging and deterioration of paint over time. Each of these factors can significantly impact the integrity and longevity of kelarai walls, necessitating proactive measures to address and prevent these issues.

FIBERS WALL PANEL AS ALTERNATIVE MATERIALS FOR BAMBOO PANEL WALLS

Fiber-based wall panels, utilizing natural fibers such as jute, sisal, and coir, present a sustainable alternative to traditional bamboo panels for wall construction. These fibers, when combined with binders like cement or resin, create strong, lightweight panels that are often more affordable and easier to install than bamboo. Fiber wall panels offer superior resistance to water, fire, impact, stains, and bacteria compared to kelarai, which is

vulnerable to moisture and water damage. This durability ensures that fiber panels maintain their structural integrity and appearance over a longer period. Unlike kelarai, fiber wall panels are easy to clean and maintain, with no grout lines that can discolor or stain over time. They require minimal upkeep and can be simply wiped with a soft cloth, reducing the need for frequent painting or repairs.

Over time, fiber wall panels prove to be more cost-effective than kelarai. Their low maintenance requirements and the ability to replace individual panels if damaged contribute to long-term savings. Fiber wall panels come in a variety of finishes and designs, making them suitable for diverse interior design styles. This versatility allows for greater customization to match aesthetic preferences. Being lighter than kelarai, fiber wall panels reduce the dead load on structures, potentially lowering construction costs and making installation easier. Additionally, fiber wall panels often feature fire-resistant and anti-termite properties, which are crucial for enhancing the safety and durability of building constructions, especially in regions prone to termite infestations. The ease of installation for fiber wall panels, with options available for direct installation services, reduces labor costs and construction time, making them a practical choice for modern building projects. Many suppliers of fiber wall panels offer warranties, providing assurance of the product's quality and durability and adding to the long-term value proposition of these panels.

However, there are some disadvantages to consider. Fiber wall panels may lack the natural aesthetic appeal of kelarai, which is valued for its use of natural materials like bamboo, bertam, rumbia, and pelupuh. This can be a significant drawback for projects aiming to preserve traditional looks. Fiber wall panels can also be more expensive upfront compared to kelarai, particularly if they incorporate high-quality materials or specific design features. Additionally, while generally durable, some fiber wall panels may not be as long-lasting as kelarai, and they can be sensitive to moisture if not properly sealed, leading to potential warping or discoloration. Installation of fiber wall panels can sometimes be complex, requiring specialized techniques or tools, which can add to the overall project cost. Furthermore, fiber wall panels may offer limited customization options compared to kelarai, which can be custom-made with specific materials and designs to suit individual project needs. Lastly, the production process for fiber wall

panels can have a higher environmental impact compared to kelarai, which is often made from sustainable, locally sourced materials.

DISCUSSION

The comparison between kelarai wall panels and fiber wall panels provides valuable insights into their respective strengths and weaknesses. Kelarai panels, woven from split bamboo, bertam, rumbia, and pelupuh, are lauded for their affordability and accessibility, making them a popular choice for wall construction, especially in traditional Malay architecture (Ahmad Zakaria et al., 2018). Their use of natural materials aligns well with sustainability goals and budget-conscious projects. However, despite their aesthetic appeal and historical significance, kelarai panels exhibit notable vulnerabilities, particularly in adverse climatic conditions.

One significant drawback of kelarai panels is their susceptibility to environmental factors, such as moisture and termites. While bamboo panels excel in hardness tests, they are prone to dents and damage in high-humidity environments, leading to a shorter lifespan compared to alternative materials like plywood. The climatic sensitivity of kelarai panels is further exacerbated by issues such as peeling paint, warping, discoloration, and termite infestations, all of which compromise their structural integrity and aesthetic appeal over time (Bredenoord, 2024).

In contrast, fiber wall panels offer enhanced durability and performance, thanks to their composition of natural fibers like jute, sisal, and coir, combined with binders like cement or resin. These panels boast superior resistance to water, fire, impact, stains, and bacteria, ensuring their longevity and structural integrity in various environmental conditions. Additionally, fiber panels require minimal maintenance, offer versatile design options, and can even feature fire-resistant and anti-termite properties, addressing key concerns associated with kelarai panels.

However, despite their advantages, fiber wall panels present some drawbacks. These include higher upfront costs, limited customization options, potential moisture sensitivity, and a higher environmental impact associated with their production process. These factors may deter consumers,

particularly those with budget constraints or a preference for traditional aesthetics.

CONCLUSION

In conservation efforts for structures like the Old Mosque Kuala Dal, the choice between kelarai and fiber wall panels requires a critical analysis of project requirements, budget considerations, and sustainability goals. While kelarai panels hold cultural significance and are more accessible economically, they may necessitate more frequent maintenance and repair, especially in climates prone to moisture and termite infestations. Fiber wall panels, on the other hand, offer superior durability and performance but come at a higher initial cost and may lack the natural aesthetic appeal of kelarai. Ultimately, the choice between kelarai and fiber wall panels hinges on a careful assessment of project requirements, budget constraints, and sustainability goals. For endeavors like the preservation of the Old Mosque Kuala Dal, striking a balance between cost-effectiveness and long-term performance is paramount. By weighing the advantages and limitations of each option, stakeholders can make informed decisions that prioritize both economic viability and structural integrity.

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AUTHOR CONTRIBUTIONS

All authors contributed to the design of the research and the write-up. All authors have read and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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