conference proceeding

UNIVERSITI TEKNOLOGI MARA

SIMPOSIUM NUSANTARA 9

THE 9TH REGIONAL SYMPOSIUM OF THE MALAY ARCHIPELAGO

Revisit Islamic Civilization and Built Environment In The Malay World

11 & 12 December 2012
Al-Khawarizmi Lecture Hall
UiTM(Perak)

Organized by:
Centre for Knowledge & Understanding of Tropical Architecture & Interior (KUTAI)
Centre for Islamic Thought & Understanding (CITU)
Faculty of Architecture, Planning & Surveying (FSPU)
Universiti Teknologi MARA (Perak)
http://perak.uitm.edu.my/simpora9

KUTAI FSPU

The 9th Regional Symposium of The Malay Archipelago 2012 (SIMPOSIUM NUSANTARA 9 2012)
11-12 Decsember 2012, Perak, MALAYSIA

PAPER CODE : ST516

ADAPTIVE REUSE OF HERITAGE TIMBER BUILDING: THE NEED OF MODERN TECHNOLOGY

Juliza Mohamad
Faculty of Creative Technology and Heritage, Universiti Malaysia Kelantan, Malaysia
juliza@umk.edu.my.

Abstract

This article is about a study on adaptive reuse of heritage timber building in consideration of technical aspects. In Malaysia, it is estimated that there are only a few numbers of heritage timber building such as palace, mosque and Malay traditional houses left. Some of the heritage timber buildings were damaged because of lack of maintenance and few were abandoned, and there were also few buildings were burnt down. A few numbers of heritage timber buildings were converted their function into a new function. The characteristics of heritage timber buildings which were built to response with the climatic conditions need to be adjusted to adapt new modern technology in consider to fulfil the requirement for a new function. The aim of this paper is to find solution on how to adapt then new requirement, i.e. new modern technology such as electricity, air-conditioning system and water plumbing system to the heritage timber buildings which have been converted into another building function to make the building well functioned without giving the negative impact to the old buildings.

Keywords: Adaptive reuse; timber building; modern technology; heritage; building function.

1. Introduction

In Malaysia. in general, heritage buildings such as mosques, traditional Malay houses and palaces are largely made of wood. Wood as a building material has unique characteristics and sensitivity. To this day, Malaysia lost very large number of traditional houses, mosques and palaces which were destroyed by the floods, being abandoned, lack of maintenance, and fire. However, there are few numbers of heritage timber building was reused again by changing the original function of the building. Adaptive reuse of the buildings is usually stimulated by the need to ensure that building have a continuing use. Characteristics of the old timber buildings were constructed by taking into account climatic conditions and the functioning of a building. By changing the original function of the building, many things need to be considered to meet the need of modern technology such as electricity, air conditioning and plumbing. When a building or a site loses its original function, it is possible to save it from abandonment or demolition by adapting it to a new use. This is a current practice worldwide, particularly in the case of remarkable architecture that remains in good conditions, where spaces are flexible and the settlement is of special interest. Some of them are transformed into museums of themselves, but most of them suffer a renovation based on parameters that preserve their material values with more or less success in order to host a new function. Concerning the new function and following the criterion that the best use for a building is that for which it was created, when, due to different reasons, it becomes obsolete, 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. 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 then be quite critical for the preservation and enhancement of its identity. Existing buildings are subjected to processes of degradation with time, which leads to a situation in which in which they became not able to fulfil the purpose for which they have been built. Sometimes, there is also the need to improve the conditions offered by the existing buildings or to adapt them to new functions.

Building conservation has long been of concern, although its popular application is relatively recent in origin, particularly in Malaysia. In Malaysia, the conservation and rehabilitation principles which are used are similar to as outlined in ICOMOS', Venice and Burra Charter. (Syed Abdul Haris Syed Mustapa, 2009). According to A. Ghaffar Ahmad (1994), in Malaysia, the practice of building conservation is considered new in the local architectural scene. Adrian Phillips (2010) wrote that building conservation involves carefully identifying what is most important about the buildings and taking care not only in the preservation of their physical fabric, but in the wealth of historical information embodied in it. Where buildings are listed, permission known as listed building consent is needed for

works that affect the character of the building as a building of special architectural or historic interest. It should be noted that once a building is listed, the listing extends to the whole building (irrespective of its grading). (Nicholas Doggett, 2007).

2. Heritage

Cambridge Advance Learner's Dictionary (2008) defines the word 'heritage' as features belonging to the culture of a particular society, such as traditions, languages or buildings, which still exist from the past and which have a historical importance. In the context of heritage building, Kamal and Harun (2002) gave the definition of the heritage building as buildings which were built in the past which have high historical and architectural values and require continuous care and protection to preserve their historical, architectural, aesthetic, archaeological, spiritual, social, political and economic values. In other words, heritage buildings are expected to have an indefinite life span, signifying that they should be preserved for as long as possible. Feilden (1982) also stated that heritage buildings differ from modern buildings because they are anticipated to last forever. He also described heritage buildings as buildings that for various reasons society has decided shall be preserved for as long as possible. In Malaysia, the efforts to preserve the heritage buildings are supported by various acts and legislations. There are few acts in Malaysia are relating to the heritage and conservation of the buildings. They are Town and Country Planning Act 1976 (Act 172), Antiquities Act 1976 (Act 168), Street, Drainage & Building Act 1974 (Act 133), Local Government Act 1976 (Act 171), Malacca Enactment No.6 of 1988 and Johore Enactment No.7 of 1988. The latest act is National Heritage Act 2005 (Act 645) which is most complete act produce by government in order to protect national heritage items. The current conservation or rehabilitation practice in Malaysia also is based on what outlined in ICOMOS, Burra Charter and Venice Charter. But unfortunately, there are relatively no sufficient and specific legislations or guidelines for timber heritage building conservation.

3. Adaptive Reuse

Adaptive reuse is concerned with converting buildings into other, more effective and efficient uses. (Douglas, 2006). He stated that more effective here means that the adapted property serves the client's requirements better and gives the building an extended useful life. For example, this may be because the building's appearance is not in keeping with the corporate image of the company. An adaptation scheme in such circumstances would focus on refurbishing the property internally as well externally. Effectiveness therefore relates to the degree to which the building satisfies the business or social needs of the occupiers. More efficient, on the other hand, is related to the performance aspects of the building. It means that its spatial and technical characteristics are enhanced or are in keeping with the needs of the user. The layout of a building, for instance, may require reconfiguration to make it suit new or modified living or working practices. Burra Charter (1999) defined adaptation as modifying a place to suit the existing use or a proposed use. Adaptive reuse refers to a change in the main function of the building, whilst maintaining its original form and character. Douglas (2006) wrote that adaptive reuse therefore is about overcoming obsolescence and redundancy in buildings. It is also about ensuring the long-term future of buildings threatened by dilapidation, vacancy and eventual demolition. Ideally, of course, it requires a relatively flexible, responsive and viable building. Potentially most types of building can be adapted to another use. It is not only the number of buildings available for conversion that limits the range of possibilities, but also their location and form of construction. (Douglas, 2006). The Department of the Environment and Heritage, Commonwealth of Australia in its booklet publication; Adaptive Reuse – Preserving Our Past, Building Our Future (2004) stated that the most successful built heritage adaptive reuse projects are those that best respect and retain the building's heritage significance and add a contemporary layer that provides value for the future. Sometimes, adaptive reuse is the only way that the building's fabric will be properly cared for, revealed or interpreted, while making better use of the building itself. Where a building can no longer function with its original use, a new use through adaptation may be the only way to preserve its heritage significance (Department of the Environment and Heritage, Australia, 2004). The department also wrote that some state agencies are making policies to manage change, including adaptation, when assessing development of heritage places. Such policies contain standard criteria to help ensure that an adaptive reuse project has minimal impact on a building's heritage values, such as;

- discouraging "façadism"—that is, gutting the building and retaining its façade
- requiring new work to be recognizable as contemporary, rather than a poor imitation of the original historic style of the building and
- seeking a new use for the building that is compatible with its original use.

4. Typology of Heritage Timber Buildings

Traditional Malay architecture employs sophisticated architectural processes ideally suited to tropical conditions such as structures built on stilts, which allow cross-ventilating breeze beneath the dwelling to cool the house whilst mitigating the effects of the occasional flood. High-pitched roofs and large windows not only allow cross-ventilation but are also carved with intricate organic designs.

4.1. Traditional Malay Palaces in Malaysia.

In days of yore, the Malay palace not only functioned as the official residence of the sultans but also played an important role in society as a centre of learning, administration and culture. It was the palace which played patronage to artisans and craftsmen as well as issued orders pertaining to the administration of the state which flowed down the hierarchy of Bendahara, Temenggung and Laksamana. During feudal times, the Malay rulers invested great effort and pride in the construction of their wooden palaces, which were often sited near river mouths to observe ships coming from the sea. The friezes, wall panels and even windows were embellished with intricate carvings. However, over the years, even the hardest of timbers succumbed to the ravages of flooding and termites. As a result, only less than a dozen wooden places are still standing today. One of the most unique traditional palace in the country is the Istana Kenangan, which stands a top Bukit Chandan *(Chandan Hill)* in Kuala Kangsar. It is uniqueness stems from its bamboo walls, which gave it the original name of Istana Tepas. It was built in 1926 during the reign of Sultan Iskandar Shah by Haji Suffian and his sons Zainal Abidin and Ismail from Penang who took a year to complete the building without using any nails or architectural plans. The outstanding characteristic of this palace is the repeated use of the polygonal design. The whole structure of the palace, in fact, consists of several interconnected polygonal buildings, and its end tower supports a polygonal roof. Sixty pillars support this beautiful palace, which is a testimony to the artistry and skills of the Malay craftsmen. Today, Istana Kenangan functions as the Royal Museum, which brings back evocative memories of the past lifestyle of the Perak royalty with its displays of medals, old photographs and artifacts.

Photo 1: Istana Seri Menanti Negeri Sembilan is currently a museum.
Source: http://www.hbp.usm.my/malayarchi/

In Kota Bahru, the Istana Jahar is decorated with carved panels and wooden fretwork. Its Balai Penghadapan has a pentagon-shaped balcony supported by columns. Located at Jalan Sultan, Kota Bharu, the palace has been converted into the Museum of Royal Customs. Istana Jahar is possibly the most splendid and refined wooden palace in Kelantan. Its elegant proportions and artistic embellishments easily mark it out as a state heritage building. The the Museum of Royal Customs; is a fine old wooden palace dating back to 1887. This beautiful palace is adorned with intricately carved wooden panels, showcasing Kelantan's good wood craftsmanship.

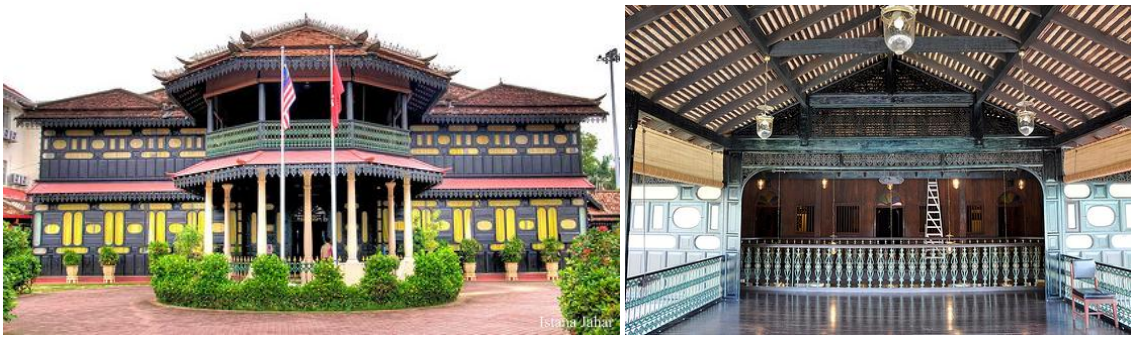

Photo 2 (a) Front view of the Istana Jahar and (b) Pentagon-shaped balcony of the museum.

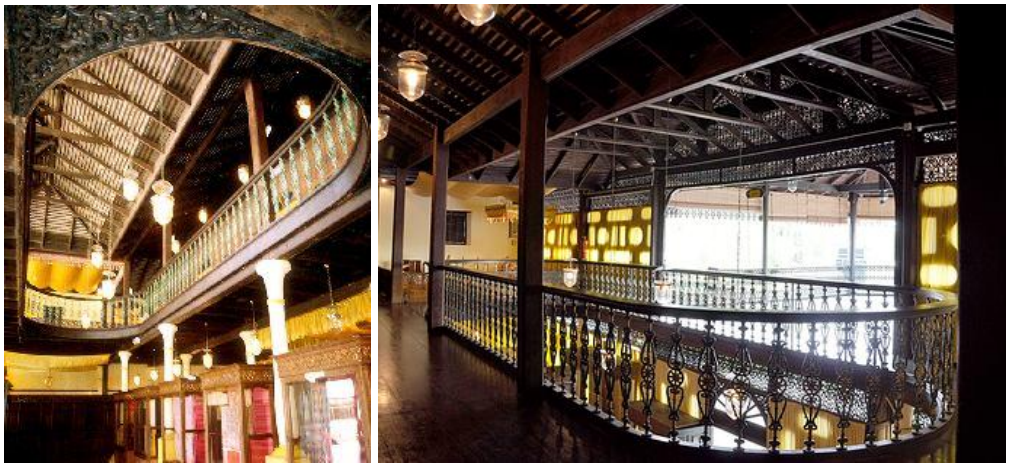

Photo 3 (a) and (b): Internal views of Istana Jahar.
Source: www.kelantan.muzium.net/

Istana Balai Besar, or the Palace with the Great Hall, is one of the oldest palaces in Malaysia. Located on the east coast of the Malay Peninsula in Kota Bharu, this palace was the residence of the local northern Malay Sultanate. Sultan Muhammad II (1839-1886) built Istana Balai Besar in the early 1840s when he decided to move to the province of Kelantan from the island of Saba, where the royal palace was threatened by natural erosion. (Jacques, 1991). Fee (1998) wrote that the palace complex set the prototype for subsequent palaces on the east coast, which consist of six areas: the porch *(anjung),* the audience hall *(balai besar),* the main house *(rumah ibu),* the middle house *(rumah tengah),* the kitchen area *(rumah dapur)* and the verandah *(jemuran basah).* At the Istana Balai Besar, the private apartments are quite modest in relation to the audience hall designated as the sultan's reception area. However, these lesser pavilions are for the most part raised above the ground on piles, as was common regional practice, whereas the audience hall was uniquely built on the ground. The audience hall itself is spanned by a tripartite roof of various inclinations supported by columns. Until the 1980s, the entire timber structure was whitewashed but for some light green detailing found on the exterior walls and the gates of the high wooden fortress-like wall which surround the complex. In the 1980s however, the Malaysian Department of Museums and Antiquities replaced some of the timber from the fortress wall which had been damaged by flooding and repainted the wall and gates a dark brown with gold detailing. Much of the original decoration is found in the woodwork itself, including designed paneling and embossed piercing, or tebuk timbul, found in the interior. (Fee, 1998).

Photo 4: View of Istana Balai Besar.
Source:http://archnet.org/library/images/oneimage.jsp?location_id=9232&image_id=47616

Photo 5 (a) and (b): Detail of *'Janda berhias'* wall panel.
Source:http://archnet.org/library/images/oneimage.jsp?location_id=9232&image_id=47616

4.2. Traditional Malay House.

The traditional Malay house is a timber house raised on stilts. It is basically a post-and-lintel structure with wooden or bamboo walls and a thatched roof. Windows are plentiful, lining the walls and providing good ventilation and views for the house. This quality of openness is also reflected by the large open interior spaces with minimal partitions.Raja Bahrin Shah (1988) posits that Kelantan and Terengganu traditional timber houses are appreciated for two reasons. First, its building forms are efficiently designed to suit local climate condition and timber-based construction materials. Second, the embellishments in forms of intricate carvings on various panels are found in integral with the architecture of the houses. *Rumah perabung lima* (five-ridged roof house) and *rumah bujang berserambi/berselasar* (verandah house) were the most common types of houses found in Kelantan and Terengganu. *Rumah perabung lima* is characterized by the a hipped roof. *Rumah perabung lima* is a type of house with pyramidal roof and it was the first type of house with the roof form introduced in Kelantan (Abdul Halim and Wan Hashim, 1996). *Rumah bujang berserambi* or *rumah bumbung panjang* also was the most common type of house found in Terengganu. One of the dominant features for this type of house is a long single-ridged roof with two gable ends. The two ends of the long roof have curved frames known as *pemeleh* fixed to the roof edge. The term of *pemeleh* is used to refer to the decorative frames for the gable ends of the roof (Abdul Halim and Wan Hashim, 1996).

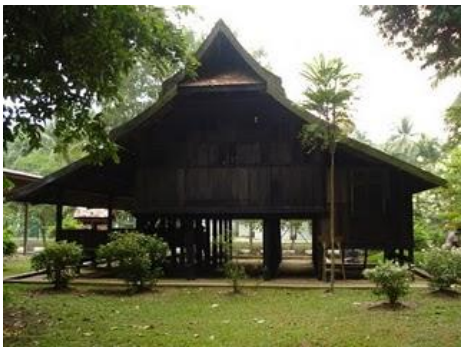

Photo 6: Example of *Rumah bujang berserambi* or *rumah bumbung panjang* which can be found in Terengganu.
Source: Rumah Bujang Berserambi Berselasar from http://rumahkayutradisional.blogspot.com/2010_08_01_archive. html

4.3. Traditional Timber Mosque.

Same as the traditional Malay house, the construction of the traditional timber mosque is basically use mortise and tenon system. Masjid Kampung Laut, arguably the oldest mosque in the country, still serves its primary purpose as a house of worship as it survives yet another century. While it continues to draw the Muslim faithful, researchers and history and architecture students also come here to unlock and get insights into the vast history and knowledge found within its walls. Nik Imran (2000) wrote that it was built in the 1400s by a group of seafaring missionaries plying the Jawa, Pattani and Brunei sea routes, the all-timber mosque is, by most accounts, a living museum. It has survived two big floods the first in 1926, known as *Bah Air Merah*, and another in 1966. The second flood severely damaged the building when a portion of the mosque close to the river was swept away by flood waters. Some of its stilts were left dangling in the air when the ground underneath was washed away by the flood. The construction materials of mosque are timber, lime mortar and clay roof tiles. The material used to construct roof ridges and duck tails is lime mortar. The primary material is timber. All structural components are from this material. The primary structural components like columns and beams are made from *Chengal*. The other timber type material construction is *Merbau* especially used for floor and wall panels (Mohd. Akib, 2003). Kampung Laut Old Mosque is one of the best examples that illustrate a modular system in curtain wooden wall construction. Each module is overlapped with wood panel as the perimeters. The layout of these wooden boards applies interlocking system. The local master builders call this wall as *'janda berhias'*. The function of wood panels is to conceal the line joints of the wooden boards. The dimension of the wooden board is a rectangular shape with 2:1 ratio, a size about 0.6×0.3 m. The thickness of the wooden board is 15 mm. The width of the panel is 75 mm. Similar interlocking modular boards are used in window's and door's construction.(Hassan, 2010)

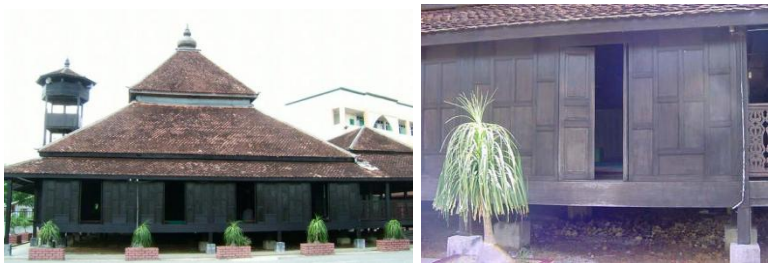

Photo 7 (a) Side view of Kampung Laut Old Mosque and (b) Modular wall's partition named *'Janda Berhias'.*
Source: http://shw.raykinzoku.fotopages.com/6972632.html and *http://tuengr.com/V02/027-052.pdf*

Mulong Old Mosque is listed as one of the heritage buildings in this country. The Mulong Old Mosque is very special, not only because its beautiful and unique design but also because of its history. The building was formerly the throne room (Balairong Seri) of the palace of Raja Dewa Tuan Zainal Abidin (1897-1945), the prince of Kelantan´s Sultan Muhammad III. The palace is currently known as Istana Balai Besar. The location of this palace is in Kota Bharu, close to Istana Jahar. The mosque is representative of architectural styles that reflect most of the characteristics of traditional local architecture. The architectural styles like those of local houses and buildings of that era are influenced by a number of factors such as the climatic conditions, the availability of building materials, the ethnic background and local craftsmanship. As expected of a building that used to be part of a palace, the architecture is delicate. The building itself was made of *Chengal* wood. It was including the structural frame and the wall panel which also known as *'Janda Berhias'* wall panel. The *Red Meranti* (Shorea spp) timber was used mainly for the window frames and flooring. *'Nyatoh* (Sapotaceae spp) timber was used for the window panels. During the restoration works, the same species of timber (seasoned and treated) was used to replace any rotting flooring, window frames and panels.

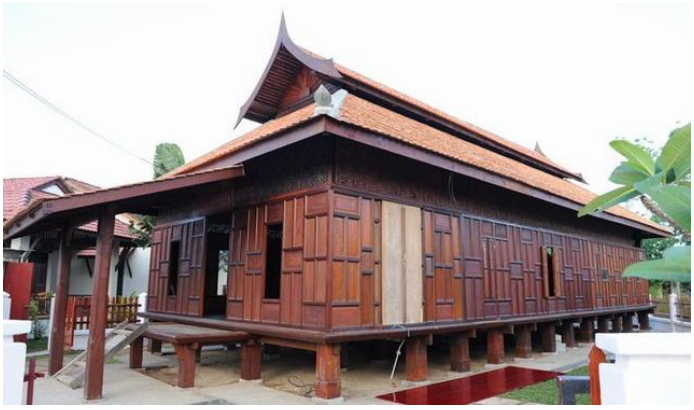

Photo 8: Perspective view of Mulong Old Mosque.
Source: Photos of Masjid Lama Mulong by Shaari from http://imageevent.com/jassabtr/masjidmulongkelantan?n=0&z=2&c=3&x=0&m=16& =0&p=13

Photo 9 (a) and (b): Exposed roof structure. The roof structure is made of high quality *Chengal* wood. The exposed roof structure shows the beauty and uniqueness of Malay traditional building construction.
Source: Field Study, 2011

5. Installing Modern Services on Heritage Buildings

According to Tasmanian Heritage Council in its Practice Note 16, the best way to preserve historic heritage places is to ensure their continued use. Installing new services and technologies in heritage places may increase opportunities for the ongoing use of the place. There are principles to consider when updating services and facilities in heritage places. It is including installing water tanks, heating and gas installations, satellite dishes and antennae, air-conditioning and others. Such updates can be challenging but in many cases it is possible to find a solution with minimal impact on the heritage values of a place. The work may affect the significance and values of the buildings. A guiding principle is that any work should be undertaken with the least intrusion or impact on building's heritage value or features. The ability to undo the changes that are made for new services and equipment is highly desirable as today's technology will undoubtedly be improved in the future. (Tasmanian Heritage Council, Practice Note 16).

Other considerations are that:

- The appearance, including scale, form, colors and reflectivity of a new element does not detract from the character of the place;
- The installation (including any metering devices) should not be visible from the principal vistas of the place;
- The operation and servicing of equipment, including vibration, airflow and condensation, will not damage significant fabric;
- Mounting devices and associated cabling and wiring will not damage significant fabric; and;
- The building fabrics will not be affected by trenching for conduits.

5.1. Water tank

Traditionally, tanks were placed towards the rear of the building to reduce the visual impact. The guidelines and suggestions made by the Tasmanian Heritage Council for installing water tank on heritage building is by locating a water tank either to the side or rear of the building will in most cases be a suitable solution for heritage places. Bladder and underground systems may be another option. Locating the tank in a position where it will be visible from the front boundary is generally not considered sympathetic, depending on the material and size. For rural and regional properties, the use of tanks may be considered a traditional element and as such provide more opportunities for placement. However, consideration should be given to the color and materials of the tank. The scale, color and materials of the tank and its support will affect appropriateness of placement. In the urban setting, location, color, size and construction of the tank may impact on the character and heritage value of the place. Plastic and fiberglass tanks are frequently inappropriate because of their artificial colour and texture, although the visual impact of a plastic tank may be minimized to an acceptable degree by screening.

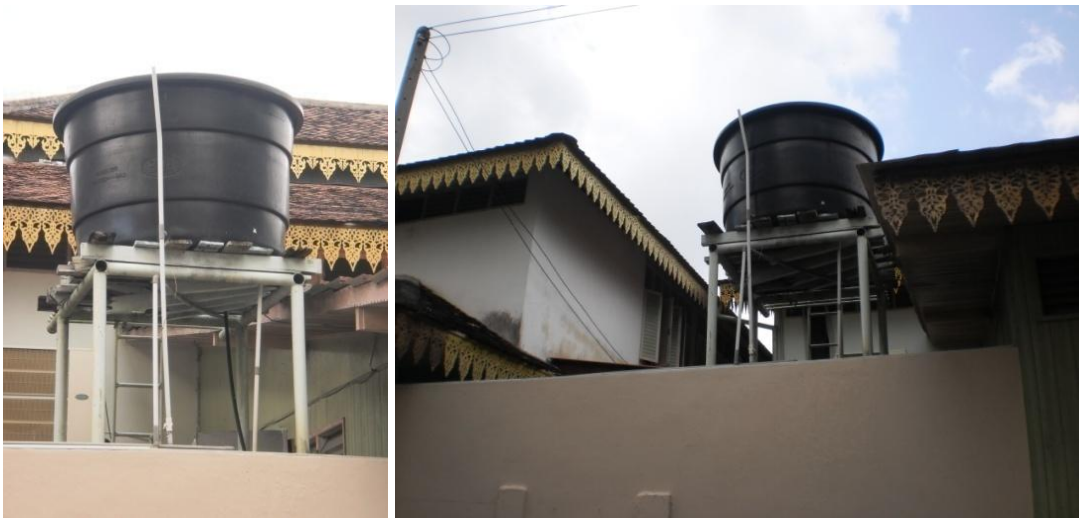

Photo 10 (a) and (b): The water tank which is located at the rear of the building at Kelantan Islamic Museum reduces the visual impact of the building but the choice of tank's material is inappropriate because of its color and the structure of the tank's stand is also not blend to the building character.
Source: Field Study, 2011.

5.2. Air-conditioning System

According to A. Ghaffar (2004) almost all of the heritage buildings were built without air-conditioning systems. Where people have to contend with warm temperatures, the need to install air-conditioning systems to meet modern building requirements seems necessary. Subject to the building function, structures and the effects on building fabric, one should consider several factors before installing air-conditioning units in heritage buildings. The cooler and drier air produced by the air-conditioning systems may cause shrinkage of building materials. There may also be a possibility of condensation either on the surfaces or within the structure of the fabric, eventually allowing the build-up of mould. Moreover, it may be difficult installing the air conditioners as evidenced by how units were haphazardly placed on windows or the front façade of some heritage buildings. Such poor practices have gravely affected the appearance of these heritage buildings. (A. Ghaffar, 2004). Singapore Urban Redevelopment Authority (URA) (1998) set a few guidelines of installing the air-conditioning unit. Window air-condensing units should not be used as they mar façade of the conservation building. Air-conditioning units should be as compact as possible. Whilst catering to the need of the users, their possible visual impact on the building design should be taken into consideration. They should be located such that they are least visible from the exterior. The specific location will depend on the building typology and nature of the project. Window type units should not be used as they would mar facades. Direct expansion, split air-conditioning systems should be well be integrated with the interior of the building. The ducting from the condensing units should preferably be concealed or sensitively installed so that it is

not visually obvious. The ducting from the compressor units is well concealed within the casing which has been painted to blend with the wall of the rear service block. (URA, 1998).

5.3. Maximizing Energy and Water Efficiencies in New Work to Existing Building

Where new work is proposed to an existing heritage building, energy efficiency and water sustainability measures should form an important part of the design process. (Rowe, 2009). Consideration could be given to:

- Orientation: the location of the new work and the orientation of windows and other openings to maximize passive heating and cooling.
- Proposed construction materials: the energy ratings of the building materials proposed and how these materials may enhance both the energy efficiencies and heritage values of the place.
- Shading devices for the new work: the design of screens, awnings, window hoods, verandas or porches where they will not have any adverse impact on the significance of the heritage building.
- Proposed energy efficiency of heating and cooling systems.
- Additional water consumption and water saving measures as a result of the new work
- Where electrical cabling is required, its layout should ensure minimal impact on significant building fabric.

5.4. Internal Elements

According to Tasmanian Heritage Council, care should be given to ensure that placement of the internal element does not detract from significant elements of the building.
Care should be taken to:

- Avoid installing a dropped ceiling to hide equipment where this destroys the proportions of the room or conceals important historic features;
- Position cabling appropriately, dependent on wall construction; and
- Place intake grilles in less visible spaces and use unobtrusive grilles for formal or significant spaces.

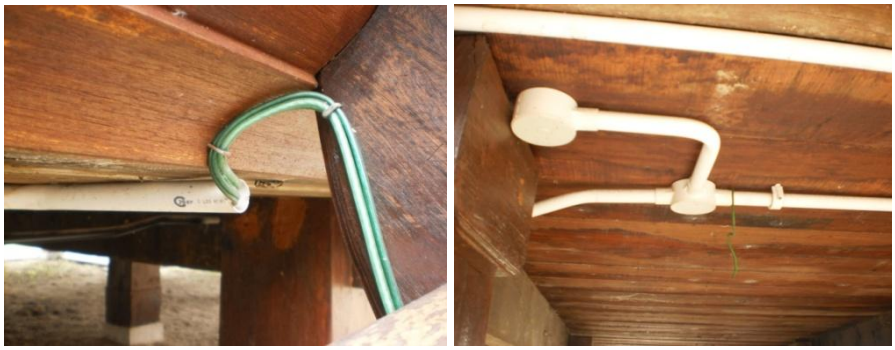

Photo 11 (a) and (b): The trenching of electrical conduits for power point is laid underneath the floor board to avoid visibility of the trenching conduit (Mulong Old Mosque).
Source: Field Study, 2011

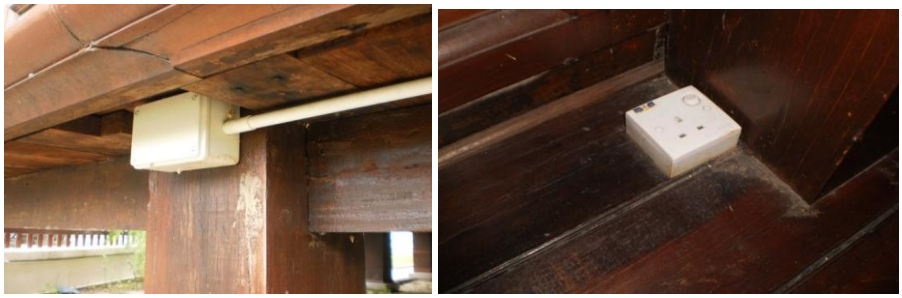

Photo 12 (a) The distribution board installed underneath the floor board. (Mulong Old Mosque) and (b) The power point is installed on the floor surface. (Mulong Old Mosque).
Source: Field Study, 2011

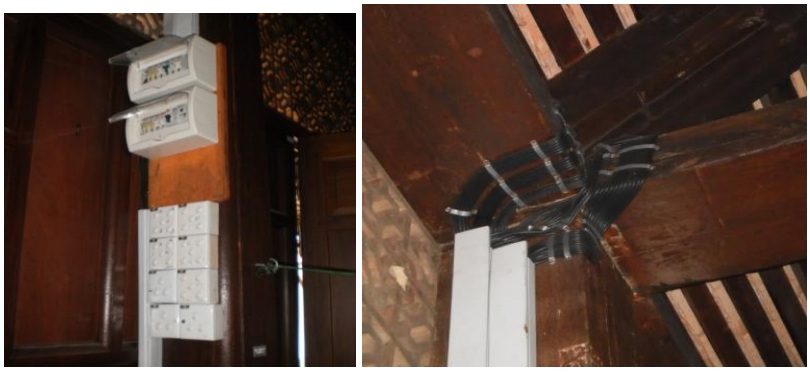

Photo 13 (a) The electrical fittings' switches is placed at one place. (Mulong Old Mosque) and (b) The electrical trenching conduits for electrical fittings are laid on the top of roof beam. (Mulong Old Mosque).
Source: Field Study, 2011

5.5 Fire Protection System

The following is a list of the minimum requirements for general fire protection in conservation buildings by Singapore Urban Redevelopment Authority (URA) (1998). Additional fire safety provisions may be imposed by relevant authority depending on the assessment of the fire risk involved.

- Fire extinguisher - Fire extinguisher should be provided, installed and clearly marked according to Bomba requirements.
- Hosereels – These should be located within the building and near the exit doorways or other locations acceptable to the Bomba requirements.
- Exit Signs – Exit signs and lights should be appropriately located to provide clear indication of the exit points.
- Fire Alarm System - Generally for shophouses not exceeding 3 storeys and/or an amalgamation of not more than 2 shophouses units, the manual alarm system complete with detectors and call points must be provided. For multi-occupancy, the fire alarm panel can be located within the compartmented staircase at the first storey next to the five-footway. For single occupancy, the fire alarm panel is not necessary.

According to Stewart Kidd (2003), the difficulties will often arise when additional staircases for means of escape are required. The incongruity of fire precautions "hardware" such as exit notices, emergency lighting, fire detection, warning and suppression equipment is another facet of this problem. There may thus be a conflict of interests between, on the one hand, the need to provide adequate fire safety and, on the other, the need to preserve the architectural and historic character of the building. When fire precautions involving alterations to the building cannot be avoided, careful and sympathetic design is needed to minimise the impact these have on the architectural and historic character of the building. In some cases, a more satisfactory approach will be to avoid the circumstances that bring about the requirements for alterations. In this regard, Kidd (2001, 2005) suggested that all fire protection improvements for heritage buildings should follow the following principles:

- Minimal Intervention: Any changes to a listed or heritage building must cause as little impact on the building and its fabric as possible. Any work undertaken to improve compartmentation, or to provide fire detection or suppression, should not cause unnecessary disruption or damage during installation, maintenance or eventual removal.
- Reversibility: Any changes to a heritage or listed building should wherever possible be reversible, i.e. adopting a 'plug in, plug out philosophy'.
- Essential: Only the minimum amount of work necessary to achieve the stated objective(s) should be undertaken and all the work should be justified and informed by a detailed fire risk assessment.
- Sensitive: Fire protection devices, equipment and systems should be installed with due consideration to the overall appearance of the building as well as having the minimum impact on the fabric of the building which they are intended to protect.

- Appropriate: The fire protection measures adopted must be appropriate to the level of risk- for example there may be little point in providing a full automatic sprinkler system for a location which is sparsely furnished and where there is little or no fuel load.
- Legal Compliance: The fact that certain fire protection measures are required by law does not overrule the need to comply with other legal requirements (listed building consent, planning permission, building standards, fire regulations and certification).

CONCLUSION

There are not many timber buildings left in Malaysia. Based on the study of timber building's typology, the author concluded that these types of buildings should be conserved due to their architectural uniqueness and aesthetical value and also the historical significance. A schedule of on-going maintenance will ensure that the historic building is in a good state of repair. The manual of routine maintenance should outline the recommended procedures and the frequency at which each should be carried out. Owners should also keep an up-to-date log of repairs and note all deteriorated conditions. Routine maintenance of fire safety equipment must be done at regular intervals. It is highly recommended due to timber building is highly risky to fire attack. This should include the scheduled inspection of the fire safety equipments such as fire extinguishers, hosereels, exit signs and fire alarm systems. If there is damage as a result of the new systems to building fabric, immediate repair should be carried out before it become worse. Continuous monitoring should be taken to make sure the repair is well done. The repair should be done carefully to avoid damages to the existing fabric of the conservation buildings. The heritage timber building to be conserved shall be restored in accordance with the proposed conservation guidelines. All original structural and architectural elements shall be retained and restored. In the event that such as elements have to be repaired or replaced, their features shall be retained. No building or structure shall be altered or demolished if there is a conceivable way of preserving it in its original or current condition. When upgrading and adapting a heritage timber building to new uses, the existing structure should be retained by strengthening and repairing structural elements. Any alteration or strengthening to structural elements should be done in the most sympathetic and unobtrusive way, using original methods and materials wherever possible. The restoration and adaptation of heritage timber buildings to new uses require understanding of the behavior of traditional timber buildings, traditional timber building construction methods and how the buildings hold themselves together by the intricate interaction of the various elements. Replacement of any structural and architectural components, if any, shall follow the original design and materials. New installation and addition shall not drastically affect the intrinsic character of the timber building.

REFERENCES

Abdul Halim Nasir and Wan Hashim Wan Teh (1996). *The Traditional Malay House*. Shah Alam: Fajar Bakti Sdn. Bhd

Adrian Phillips**,** Surveyor of the Fabric (2011). *Buildings;What is building conservation?* Retrieved from http://www.hrp.org.uk/learninganddiscovery/caringforthepalaces/whatisconservation/buildingconservation.aspx

Ahmad, A. G. (1994). *Building Maintenance*. Retrieved July 23, 2010 from http://www.hbp.usm.my/conservation/ SeminarPaper/maintenance.html

A Ghafar Ahmad (1994). *Why Buildings Decay*. Retrieved Nov.19, 2010 from http://www.hbp.usm.my/conservation/SeminarPaper/DECAY.html

A Ghafar Ahmad (2004). Majalah Akitek, Volume 16, Issue 1, First Quarter. *Understanding Common Building Defects : The Dilapidation Survey Report.*

Ahmad Sanusi Hassan (2010). *Kampung Laut's Old Mosque in Malaysia: Its Influence from Chinese Building Construction*. School of Housing, Building and Planning, Universiti Sains Malaysia.

Cambridge Advance Learner's Dictionary (2008) 3rd edition. Cambridge.

Chen Voon Fee (1998). *The Encyclopedia of Malaysia, Volume 5: Architecture*. Archipelago Press.

David Rowe (2009). Technical Leaflet : *Heritage Buildings and Sustainability*. Heritage Council of Victoria, Department of Planning and Community Development. Retrieved May. 14, 2012 from http://www.dpcd.vic.gov.au/__data/assets/pdf_file/0003/44859/Sustainability_Heritage_tech_-leaflet.pdf

Department of the Environment and Heritage, Commonwealth of Australia, (2004). *Adaptive Reuse – Preserving our past, building our future.* Pirion, Australia.

Dumarcay, Jacques (1991). *The Palaces of South-East Asia: Architecture and Customs.* Oxford: Oxford University Press.

Fielden, B.M. (2000) *Conservation of Historic Buildings*. Oxford: Architectural Press.

Feilden, B. (1982). *Conservation of Historic Buildings*. Oxford: Butterworth

ICOMOS Australia (1999). *The Burra Charter, International Council on Monuments and Sites Australia.*

James Douglas (2006). *Building Adaptation : Second Edition*. Butterworth-Heinemann.

Kamal, K.S & Ahmad, A.G. (2007). *Pendekatan dalam Kerja Pemuliharaan Bangunan Bersejarah di Malaysia: Satu Tinjauan Umum.* Post Graduate Research Colloquium, Penang, Malaysia.

Kamal, S.K. and Harun, S.N. (2002). *Building Research Methodology in the Conservation of the Historic Buildings in Malaysia.* Proceedings of the International Symposium Building Research and the Sustainability of the Built Environment in the Tropics, University Tarumanagara, Jakarta, Indonesia. 14-15 October.

Kidd, S. (2005) *TAN 28: Fire Safety Management in Heritage Buildings*. Edinburgh: Historic Scotland.

Kidd, S. (2001) *TAN 22: Fire Risk Management in Heritage Buildings.* Edinburgh: Historic Scotland.

Mohd. Akib, S. (2003). *Kampung Laut's Old Mosque.* Kota Bharu: Kelantan State Museum Corporation.

Nicholas Doggett (2007) *Heritage Protection in Britain.* Retrieved Dec. 12, 2010 from http://www.buildingconservation.com/articles/heritageprotection/heritageprotection.htm

Nik Imran Abdullah (2000). *Mosque that is a living museum; Its history continues to fascinate researchers.* Reprinted from the New Straits Times, Monday June 5, 2000. Retrieved April 11, 2011 from http://www.malaysian-museums.org/article9.htm

Raja Bahrin Raja Ahmad Shah. (1988). *The Terengganu Timber Malay House*. Kuala Lumpur: Badan Warisan Malaysia.

Syed Abdul Haris Syed Mustapa, Kamarul Syahri Kamal and Mohamad Zaki Zainul (2009). *Rehabilitation of Heritage Buildings in Malaysia.* Retrieved Jan. 23, 2011 from http://lukisanterukur.wordpress.com/2009/01/29/rehabilitation-of-heritage-buildings-in-malaysia/

Singapore Urban Redevelopment Authority (URA) (1998). *Conservation Guidelines: Technical Supplement : Understanding Mechanical and Electrical Services*.

Tasmanian Heritage Council. *Practice Note 16: Installing Modern Services on Heritage Buildings.*

The Department of the Environment and Heritage, Commonwealth of Australia (2004). *Adaptive Reuse – Preserving Our Past, Building Our Future.*