Preliminary Survey and Defects Analysis of Traditional Timber Mosques in Malaysia

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Abstract: - This paper presents the results of a preliminary condition survey analysis on defects and deterioration in traditional timber mosques. In conservation practice, it is crucial to understand the type and cause of defects in order to use this information during the improvement stage. In addition, repairs are dependent on the survey findings of building conditions. A total of 52 mosques, particularly those designed with traditional vernacular architecture, have been chosen for this study to identify the common problems and causes of timber defects in buildings. Most defects are found on the roof, as a result of dampness. Overall, the building conditions are good, with most defects relating to the aesthetic effects. Lack of routine maintenance is the primary cause of building defects.

Key-Words: - building conservation, building survey, building defects, condition survey, defects in wood, mosque

1 Introduction

Like other countries in the world, Malaysia is rich with a legacy of historic buildings, which showcase outstanding craftsmanship and architectural quality. These possess impressive historical features and preserve a heritage of workmanship from the past. Although Malaysia is a popular country experiencing rapid development, it still has its cultural properties, such as *Sultan Abdul Samad's* building, *Masjid Jamek* in Kuala Lumpur, *Tengkera* Mosque in Malacca and various statues. These old buildings, still standing, clearly show the unique architectural heritage and inestimable worth of historic buildings (Ahmad, 1997; Kamal, 2007). Along with other historic buildings, traditional mosques have long been known for their unique style and historic contributions to the nation. Sadly, these old mosques are affected by defects and deterioration agents that cause them to degenerate. This, in turn, causes them to be neglected.

Conservation, the preservation and maintenance of heritage buildings to prevent them from being destroyed, protect the authenticity of cultural properties and preserve both the aesthetic and historical values of the buildings (Harun, 2005; Ali et al., 2009), has long been practiced in some countries and has become important for the conservation of natural resources (Ahmad, 1994). Conservation in Malaysia has become a new revolution across the nation (Ali et al., 2009; Che-Ani et al., 2009). Awareness in our society is essential, thus it has become a responsibility of each of us to sustain our heritage and maintain the continuity of history lest the past fade forever.

2 Definition and Importance of Conservation

Conservation is a practice which emphasizes the importance of preserving cultural properties. It is generally understood for its efforts to extend the life of objects of cultural and natural importance. Conservation undertakes two initiatives: to care for and safeguard the object from destruction, decay and unintentional changes (Harun, 2005, Fielden 2000) and to manage change when it is necessary (Orbasli, 2008).

According to Fielden (2000), conservation is a practice that requires technical and scientific knowledge of how decay occurs and how to eliminate it. The definition broadens from technical aspects to dynamic planning the management process to prolong the life of historic buildings.

Building conservation is important for its contributions in various sectors and communities, as it preserves historical evidence of what has once been. According to Powell (1994), a heritage building contains explicit and implicit historical values; while in Orbasli (2008), heritage buildings are an important part of the built environment in which history and cultural evidence can be found by exploring them. The emphases of conservation are categorised as below:

2.1 Restore and Appreciate the Uniqueness of a Cultural Heritage

Each historic building has its own uniqueness that is clearly seen, from an architectural point of view, regarding its origin of materials, settings, layout and cultural landscape. A built environment is not complete without the contribution of historic buildings because they are an intrinsic part of this type of environment (Orbasli, 2008). The architectural style of a building is one medium that tells its origin or influences, creating an appreciation for the historical value within a cultural property. Cultural properties are of historic significance because they are strong evidence a past era and indicate historical events that once occurred (Ahmad, 1994).

Historical buildings are well known for their beauty in architectural design, impressive workmanship and construction. Presently, historic buildings are still used in commercial sectors or are privately owned. According to Orbasli (2008), in a time of increasing environmental consciousness, existing buildings are important resources that, with sufficient care, can continue to be used for a very long time. In fact, the interest, from the architectural standpoint, is to show the evidence of past civilisation's refined art, craftsmanship and construction technology (Kamal et al., 2007; Che-Ani et al., 2008 and Che-Ani et al., 2009). Young (1991), Orbasli (2008) and Ali & Rahmat (2009) extend their view to technical aspects because creativity and technological innovation are important factors in understanding these buildings.

2.2 Maintain Image and Identity of a Historic City

Historic buildings contain the valued identity of a place. According to Idid (1996), identity is a variation of images of places used to distinguish one from another. One component that creates identity in a town or place is the old existing buildings. Acting as documents of the past, historic buildings are an important source of historical materials, much like the paper and parchment used by historians. Therefore, it is important to conserve and preserve historic buildings because they provide a sense of identity and continuity in a fast-changing world (Kamal et al., 2008). The uniqueness of a townscape is of cultural significance; if it vanishes, it can never be replaced (Idid, 1996).

2.3 Understand Psychological Value of Historic Buildings

An historic building creates psychological emotion and nostalgia, particularly for those who have sentimental value for the old buildings. The situation creates a close relationship between a historic building and human psychology. Ahmad (1998a) relates two psychological approaches to conserving historic buildings: sensitivity for historical and aesthetic value and emotional bonds to the historic buildings. An historic building provides a symbol for a society its cultural identity and heritage, representative of a particular time. An understanding of the period when the building was built can be formed. Aspects such as daily life, environment, architecture and building technology can be uncovered through the observation and assessment of historic buildings.

One can feel a nostalgic interest when an important event happened which created an emotional psychology (Kamal et al., 2007). When seeing a historic building, it triggers memories of historical events that can only happen once. For example, Stadium Merdeka in Kuala Lumpur is a priceless building that was witness to the moment when Malaysia gained its independence. A psychological value is in the effects of sensitivity and emotional reactions that arise when seeing such a piece of memorable evidence.

2.4 Retain History and Beliefs

Heritage has a broad definition. It can be a pattern of life, cultural settlement or system of traditional beliefs. Old buildings and monuments can tell their own history and events, such as when these structures witnessed to the existence of a civilisation still being researched. Some historic buildings and monuments are still used as palaces and places of worship; some are preserved as a part of a monumental heritage, such as statues and ruins (Harun, 2005).

Young (1991) stated that belief is one of the factors that caused the development of civilisations. Hence, history and beliefs are well related, thereby explaining why conservation of historic evidence is important.. Pyramids, the Inca City and monuments, such as Borobudur, give strong evidence that belief has been at the centre of the development of civilisations. Buildings, monuments and tombs have been built for the purpose of worship. Tangible evidence of the remnants of past civilisations requires preservation and conservation for history to be passed on to new generations. It is interesting and fascinating when ancient buildings prove that superior technology was used during their construction; we still wonder about this and continue to do research. The contribution of heritage buildings to educational development is undeniable because it is the only tangible evidence that exists for any future research regarding historical and cultural studies.

2.5 Preserve Architectural Continuity and the Importance of Architecture in the Tourism Industry

Building conservation is seen as part of the effort to preserve remnants of civilisations because architectural heritage is clearly evidence that shows the continuity of built environment. According to Antoniou (1981), conservation is an activity that involves the improvement of quality in environmental planning. It is the management of limited resources, such as historic buildings and places, where the main objective is to ensure continued use. This can be further explained: building conservation does not just restore the building, but prolongs its function as well. It is best viewed as reusing the past and improves for economically used.

The preservation of historic buildings and monuments has been proven to boost the economy in a region (Che-Ani et al., 2008 and Ali et al., 2009). Ahmad (1998b) highlights the identity and environment seen in historic buildings through the transformation of architecture. These form part of cultural tourism, which contributes to the economy of a country. Another reason for conservation arises from a desire to promote national identity (Orbasli, 2008). Cultural diversity and unique architectural styles are introduced to visitors through heritage tourism activities, which stimulate economies in particular regions.

3 Traditional Mosque Architecture in Malaysia

Mosque refers to *'Mezquita'*, the word from Spanish that means "*Muslim house of worship*" (Merriam Webster, 2008). Islam has been growing by significantly l, especially after the past of Prophet Muhammad SAW. In Southeast Asia, Islam was adhered to by most in the Malay Archipelago. This is made apparent through signs of trade and evidence shown by the existence of tombs and mosques in the region.

During the early period of Islam in Malaysia, mosque architecture is simple and does not possess the clear features, such as large domes and decorated calligraphy from those in the Middle East.Many mosques of the traditional architectural style were built to hold prayers and other activities associated with the teachings and dissemination of Islam. The architectural styles and building materials of mosques built during the 15th century were similar to that of traditional Malay houses. According to Ahmad (1999a), there are two types of architectural styles under the vernacular mosque category, namely the traditional and regionally influenced, which are differentiated by the design of the roof. The traditional mosques usually reflect the strong influences of the Malay houses, the people's way of life and their environment. The roof generally has a long gable. Conversely, vernacular mosques with regional influence distinguished by their two- or three-tiered roofs with decorative ridges and clay tiles. The regional influences seen in the mosques in Malaysia are similar to the old mosques built in many parts of Indonesia. The architectural style of the traditional mosque mainly reflects the environment, which can be seen through the building construction (Ahmad, 1999a). Some of the building's features, which were built in response to the warm and humid climate conditions, are pitched roofs to enable rain water to run off quickly and many openings, including louvered windows, fanlights and carved panels to allow natural cross ventilation of air. Another design feature is the stilts on which mosques were built to raise them above ground level to avoid floods. The use of stilts also serves the purposes of providing ventilation and comfort, in addition to being a safety precaution in response to the environment (Nasir & Teh, 1997 and Rasdi et al., 2004).

3.1 Triple-Stacked Pyramidal Roofs

The design of the earliest mosques in Malaysia is the three-stacked pyramidal roof mosque. According to Rasdi (2000), the form was detected in the design of the *Kampung Laut* mosque (Figure 1) and *Kampung Tuan* mosque, both built between the 16th and 17th centuries. The form is distinguished by several layers in a pyramidal arrangement, and it is understood that some areas in Indonesia called the roof design a '*joglo* roof" because its design was taken from the traditional Javanese house (Nasir, 1995 and Budi, 2004). The roof is arranged by stacking one above the other with ornamental features installed on top called '*mahkota atap'* (Nasir, 1995).

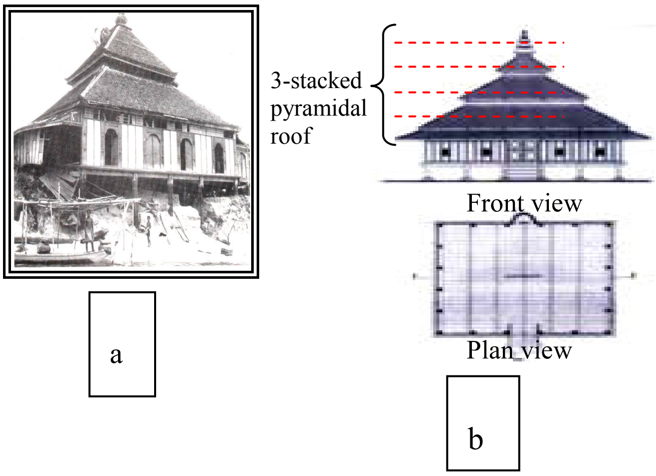

Figure 1: (a) *Kampung Laut* mosque before being restored to *Nilam Puri,* (b) Building plan of *Kampung Laut* mosque (National Archives & Rasdi 2007).

3.2 Double-Stacked Pyramidal Roofs

Another form distinguished as a traditional mosque is the double-stacked pyramidal roof. This form was used in the construction of the *Papan* mosque in *Perak* and the *Lenggeng* mosque in *Negeri Sembilan* (Figure 2), which are both said to be built between the 18th and 19th centuries (Nasir, 1995). The construction is the same as the triple-stacked roof, but instead only uses a double-layered roof.

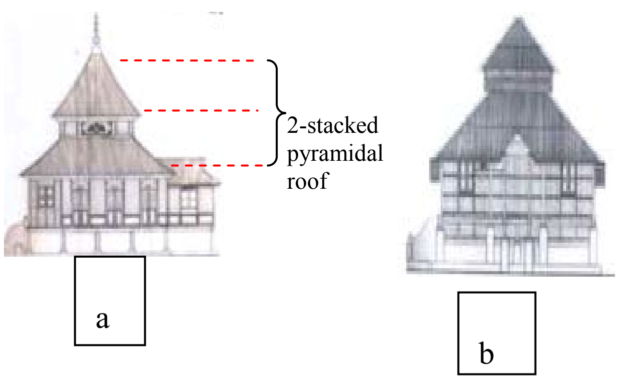

Figure 2: (a) *Lenggeng* mosque in Negeri Sembilan (b) *Papan* mosque in Perak Board (source from Rasdi 2007).

3.3 Gable Roof Form

The form used is almost the same seen in traditional local houses. In this design, there are two types, using single- or double-layer roofs. The roof is long and straight and at the ends there are vertical walls with a triangle shape acting as gable roofs (Figure 4). This form can be seen in the construction of the *Tok Pulai Condong* mosque (Figure 3), the *Langgar* mosque in Kelantan (Figure 4) and the *Sunan Bonang* mosques in Java, Indonesia (Nasir, 1995).

Figure 3: *Old Tok Pulai Condong* mosque, *Pulai Condong*, in *Kelantan*.

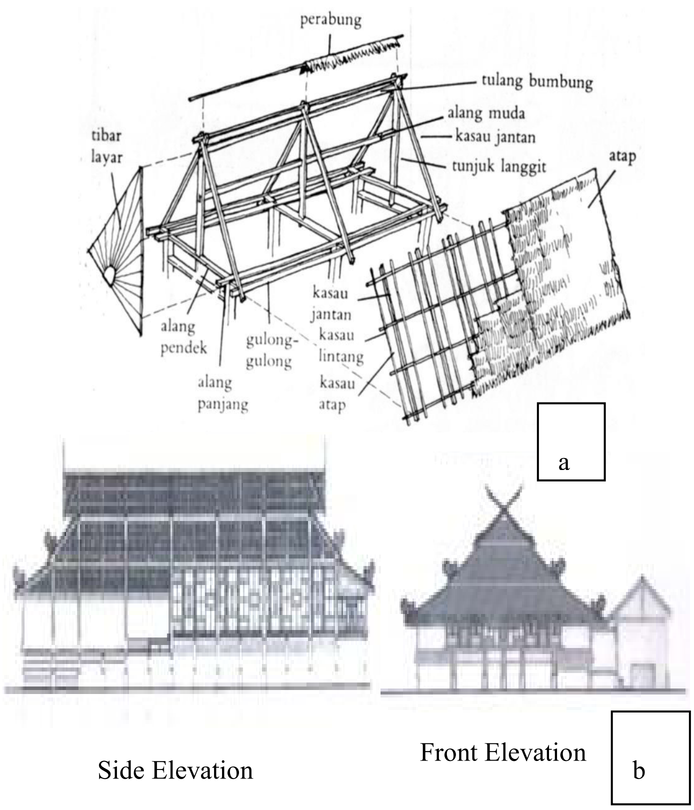

Figure 4: (a) The gable roof form of traditional houses in Malaysia. (b) The *Langgar* mosque using two layers of the long gable roof (Lim, 1987 and Chen, 1998).

4 Defects and Deterioration in Timber Buildings

Defects and deterioration are common problems in any built structure. Various defects are more common in an old structure (Ransom, 1981). As in BS 3811 (Code of Practice, British Standard 1984) defects are defined as the deterioration of building features and services to unsatisfactory quality levels of requirement users. According to Burden (2004), defects refer to an improper condition that affects the structure, leading to failures or low performance and utilisation of a heritage building. Consequently, it not only results in an aesthetically unsatisfactory appearance, intervention for users' safety may be required (Che-Ani et al., 2011).

Wood is one of most popular materials for both structural and non-structural parts in the construction industry and is widely used. When timber is used as a structural material in buildings, it is still part of the carbon cycle and therefore is liable to be broken down by fungi and animals. However, this cycle can be stopped by careful attention to building design and maintenance, and through the use of wood preservatives (Coggins, 1980).

Generally, there are four major groups for wood deterioration agents: biological, physical, mechanical and chemical (Figure 5). Some of the agents are significantly less destructive and usually result only in causing dissatisfaction in aesthetical value. It has been noted that biological agents and moisture problems cause common defects and can cause serious wood deterioration.

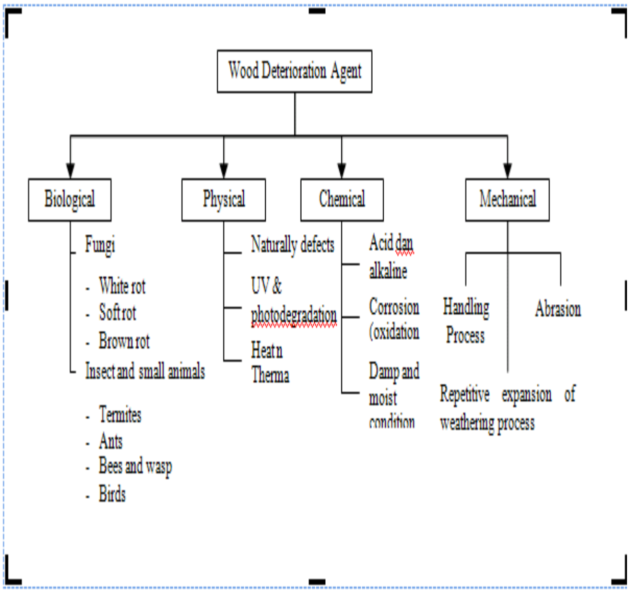

Figure 5: Agents of decay and deterioration in wood.

4.1 Biological agents

Biological agents are well known for their disastrous attacks. They are categorised under two types: fungi, and insects and small animals. Soft rot, brown rot and white rot are typically grouped into fungi, while animals and insects of concern are generally beetles, termites, ants, bees and birds.

Fungi attacks can be seen in wood with high exposure to moisture conditions (Coggins, 1980; Mohammad & Wan Mat, 1991). Timber that is at or below 20% moisture content is immune to fungal attack; above this level, with a temperature below 30°C, timber is at high risk (Che-Ani et al., 2008). Timber used by the end user typically has 15% moisture content and will lose its strength if it exceeds this percentage (Mohammad & Wan Mat, 1991).

Fungi are a group of organisms in the plant category that can cause decay and discolouration of cellulose material, such as wood (Ridout, 2000). Unlike plants, they do not synthesise food as they live by acquiring lignin and carbohydrate components from other organic materials to use as energy. Soft rot attacks damp wood and penetrates slowly from the surface. It attacks the cellulose and hemiselulosa of a wood causing defects, often in the form of a chequered pattern, and softens when touched (Weaver, 1997, Bawyer & Haygreen 2007). The attack turns the wood into a dark brown colour, similar to the brown rot attack (Brian Flannigan, 2001). The most common sites for soft rot in buildings are wooden windowsills and areas where water drips from the roof continuously and wets wooden materials.

The white rot decay attacks lignin leaving a white cellulose residue that frequently has black lines through it and feels spongy. According to Weaver (1997), the fungi prefer hardwood, but are sometimes found in softwood. Brown rot fungi are divided into two types known as dry rot and wet rot. Fungi of this group attack wood and leave dark brown effects. The brown rot fungi are also commonly known as dry rot fungi (Ridout, 2000). This type of fungi can live in a dry wood, with no air circulation, and quickly reproduces in a wooden structure (Zakaria, 2005). They can produce water through their own metabolic processes and can then transport this water to the wood. In this way, they can help maintain the necessary moisture content for attacks to be sustained. Since the attack causes the wood to rot, it shrinks and splits into cubical pieces slightly turning a darker colour. Serpula lacrymans are the most common in its species (Desch, 1983; Ashurst, 1989 and Weaver, 1997).

As for wet rot, it is likely to attack very wet wood with an average moisture content between 40-50% (Weaver, 1997). In some areas, it is known as 'cellar rot'. The attacked wood has a very dark brown or black appearance and cracks predominantly along the grain. It can be found on very damp timber where a leaking problem exists along with inadequate ventilation, such as skirting against a wall affected by rising dampness and window and door frames that have long been exposed to damp conditions. Wet rot is easy to identify as the wood will be very damp, cracked, dark in colour and will shrink. The wood will crumble or will be very soft and pulpy when prodded with a sharp implement, such as a screwdriver.

Beetles, termites, bees, wasps, and small birds also cause defects. Insects, particularly termites and wood destroying beetles, are well known for causing disastrous losses in timber buildings. Subterranean termites are often the cause of severe damages to wooden structures and in some cases, to concrete foundations, particularly by species from tropical regions (Tan, 2009). In the early stage, it is difficult to identify the termites' attack since it begins out of sight.. The effects of termite attacks are generally detected by the hollow-sound heard when tapping the wood on the surface (Kamal, 2007). Insects such as ants and bees generally do not consume wood cells, instead they attack to breed and build nests. Carpenter ants (Camponotus Ferrugineus) make holes in wood to build colonies and can be detected through a fine wood dust and small holes found on the wood surface. While bee attacks are distinguished by a large hole approximately 10mm in diameter found on the surface, birds cause defects through nesting and, as is common with woodpeckers, creating holes in timber buildings. Sparrows and swallows, unlike woodpeckers, bring moisture and aesthetic defects with their droppings (Ridout, 2000).

4.2 Physical Agents

Physical agents refer to imperfections and aesthetical defects in wood itself. Basically, it was naturally born, known for its hollow, knots and cracked features before consumed by users. Photodegradation and continuous exposure to UV rays are catalysts for defects that bleach and pale out the woods' natural colour, while thermal defects cause chequered surfaces results of a high temperature conditions, such as heat and fire (Ridout, 2000).

4.3 Chemical Agents

Defects by chemical agents cause physically coarse conditions and brittleness. Acid makes the wood brittle and wood fibres become disassociated. The end result is a mass of sharpened filaments detectable on the surface. These defects can usually be found in industrial areas with high pollution. Exposure to alkaline environments has even more severe results: lignin and hemicelluloses are degraded and the timber loses strength and is softened through high concentrations of alkaline (Ridout, 2000). The rate and impact of defects are dependent on the period of exposure, concentration of the chemical and stimulation by temperature; these defects can lead to a serious deterioration.

Dampness is one of the main agents that cause severe defects in buildings, and it has been noted that most the buildings in Malaysia are subject to this problem (Mohammad & Wan Mat, 1991). Moisture accelerates the decay process and wood becomes structurally weak if exposed to a high level of moisture. Water seeps into the wood, thus allowing decay agents such as fungi to reproduce in wood cells. The state of defects depends on the moisture level, the rate of moisture absorption and stimulation from the environment, such as rain, wind and sunlight (Mohammad & Wan Mat, 1991). The higher is the humidity, the greater are the defects in any wooden structure.

4.4 Mechanical Agents

Defects in this category are commonly caused by mechanical friction during handling and processing, such as cutting and drying. The combined effects of light, wind and water movement produce stresses resulting in small surface checks and cracks (Ridout 2000). Erosion takes place due to the weathering process and results in greater cracks and coarse conditions on the surface (Desch, 1983).

5 Condition Survey of Wood Defects in Traditional Timber Mosque

5.1 Methodology

An important stage in conservation practice is the condition survey, used to identify defects and material deterioration in old historic buildings. The investigation is crucial as it is closely linked to the reparation stage, wherein any improvement should be based on the building's defects and overall state. In this research, a condition survey was conducted to identify the extent of defects in old, traditional mosques in Malaysia, which includes the identification of the common locations, types and causes of wood defects. The aim of the survey is to have specific knowledge associated with the defects, particularly in historic timber buildings, to determine the locations, types and causes of wood defects so that specification can be carried out to overcome the problems.

Several criteria were set in conducting the survey. A list of subject buildings were collected from literatures, archives and electronic documents from government agencies, such as the Department of National Heritage, Department of Malaysian Islamic Development (JAKIM), Museum Association of Malaysia (PERZIM) and Penang Heritage Trust. The selection was based on these criteria:

1. A mosque; defined as a building which served as a Muslim house of worship;
2. At least 50 years old;
3. Traditional design with vernacular architecture;
4. Minimum of 50% of building materials from wood, or were once built from wood; and
5. Of historical value and must contribute to heritage property.

Based on these criteria, 52 mosques were identified (Table 1). Renovations and alterations had been found in some of the selected buildings, and these were structurally maintained. Alterations were noted for some building elements, but some buildings continue to use original material on the roof structure, pillars, doors, windows, stairs and walls. To allow for ease in analysis, each building was grouped by location and year of construction. The building ages were clustered into groups containing 50-year increments, as shown in Table 1.

Table 1: Location and year built.

State	1559-1608	1609-1658	1659-1708	1709-1758	1759-1808	1809-1858	1859-1908	1909-1958	1959-2009
Negeri Sembilan			1					4	
Pahang							2	1	
Melaka		1		4	1	2	4	15	1
Terengganu							1		
Kelantan				1		1	1	1	
Perak							2	3	
Pulau Pinang				1				2	
Selangor								1	
Kedah					1			1	

Several items were listed to obtain necessary information: the building's name, year built, location, current usage, summary of the current condition and maintenance history. The survey was carried out room-by-room and all wood defects were noted and recorded on the condition survey form. The analysis was made element-by-element: the columns, beams, walls, floors, windows, doors, roof and stairs. The analysis can be referred to in the next section.

5.2 Findings and Discussion

The results from the condition survey are analysed and summarised in the pie chart. As Figure 6 shows, 53% of buildings surveyed are located in Malacca. Most of the mosques in Malacca still retain the original design of traditional architecture, although some have experienced alterations and renovations. Other buildings are located in Perak (10%), Negeri Sembilan (9%), Kelantan (8%), Pahang and Penang (6%).

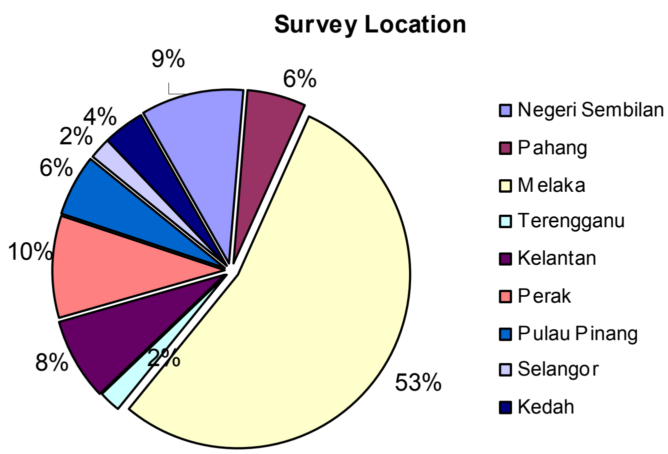

Figure 6: Location of survey

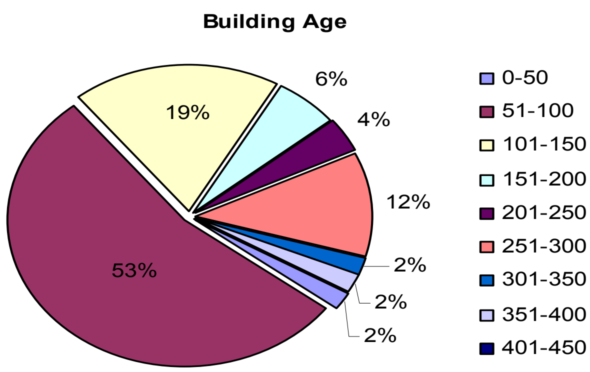

Figure 7: Percentage of building age of the survey

Figure 7 illustrates the analysis of building ages. Survey shows 53% are aged between 51-100 years, followed with group 101-150 years (19%), 251-300 years (12%), 151-200 years (6%) and 201-250 years (4%). Mosques built between 1909 and 1958 were the most common due to demolition or replacement of older buildings. Most of the buildings (90%) are in good condition (Figure 8). Maintenance factors have been identified for these results. Meanwhile, a total of 85% are in use, 15% are under repair and the rest are abandoned (Figure 9). It only 33% retained to maintain wood as the primary building material (Figure 10).

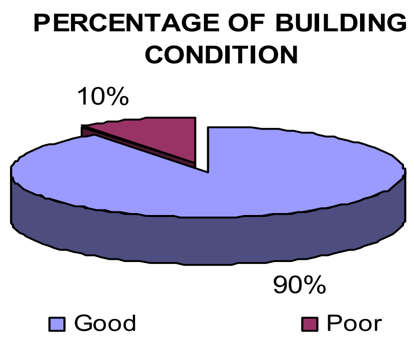

Figure 8: Percentage of building condition

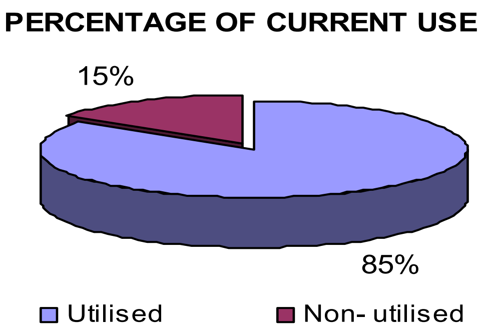

Figure 9: Percentage of building in use

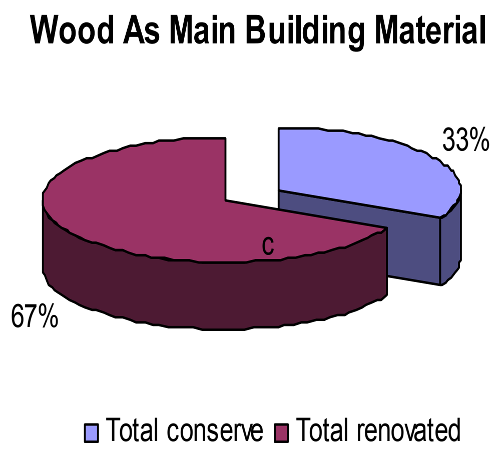

Figure 10: Percentage of retain wood in building

nost found on roof with 34% from the total survey, followed by wall (24%), column (14%), windows (10%), doors (8%) and stairs(4%). Defects on floor and beams are respectively contributing 4% and 2% in the survey.

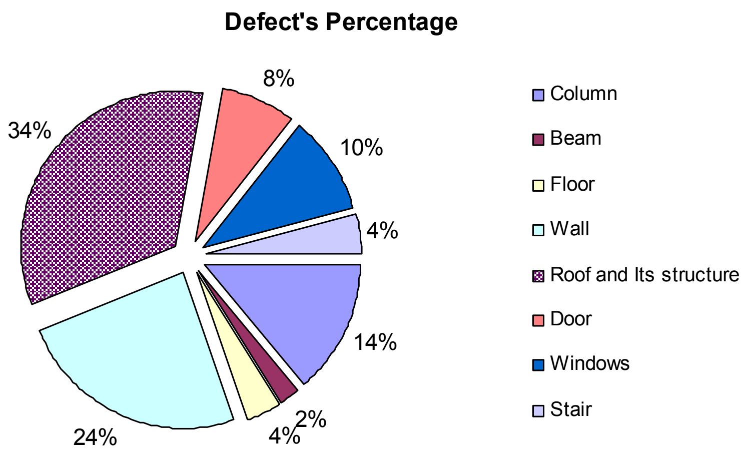

Figure 11: Percentage of defects in building element

Table 2 shows the breakdown of defects in each element found in the survey. Defects in column are mostly caused by mechanical factor. 52% are to cause on aesthetical defects, while 21% are caused by ants, nest in fissure and moist location. The defects are generally decrease on the aesthetic point, yet structurally are in sound condition. Unlike the defects found on the beams, its respectively caused by environmental agents, mechanical action and the presence of insects such as ants and beetles. The rest is cracks and the presence of moisture. It is noted that not many defects can be found as no specific route available for the inspection and overall structure are in good condition.

Few defects were identified in the floor inspection. Those present are the result of mechanical factors, environment, and insects. Blistering paint, an aesthetic defect, accounts for 33% of the damage found, followed by the presence of ant colonies (23%), termites and environmental agents (15%). As in walls, the defects are mostly due to mechanical agents that cause paint blistering (28%), followed by the presence of ant colonies (15%), damp condition and minor cracks (13%). The presence of small plants, fungi, termites and beetles had been noted, which give a small number of defects to this element.

Table 2: Findings and percentage of wood defects in traditional timber mosque

DEFECTS	FUNGI	a) Soft Roy	b) White Rot	c) Dry Brown Rot	d) Wet Brown Rot	e) Stain Mold	Insects and Birds	a) Termites	b) Beetles	c) Ants	d) Bees and Wasp	e) Small Birds	a) UV rays	b) Small plant, lichen	a) Acids and Alkaline	b) Dampness and Moisture	Cracks (Mechanical)	Paint Blistering (Mechanical)	Gutters and Rainwater Pipes	Missing and Broken Parts	FREQUENCY (NO)	PERCENTAGE (%)
ELEMENT																						
COLUMN		0	0	0	0	3		1	3	12	4	0	2	0	0	0	3	23			51	14
Percentage (%)		0	0	0	0	6		2	6	24	8	0	4	0	0	0	6	45				
BEAM		0	0	0	0	0		0	2	2	0	0	1	0	0	1	1	1			8	2
Percentage (%)		0	0	0	0	0		0	25	25	0	0	13	0	0	13	13	13				
FLOOR		0	0	0	0	0		2	0	3	0	0	2	0	0	1	0	5			13	4
Percentage (%)		0	0	0	0	0		15	0	23	0	0	15	0	0	8	0	38				
WALL		1	0	0	0	4		5	3	13	2	0	6	7	0	11	11	25			88	24
Percentage (%)		1	0	0	0	5		6	3	15	2	0	7	8	0	13	13	28				
ROOF		0	0	1	3	6		0	3	4	1	6	9	5	1	30	4	21	17	13	124	34
Percentage (%)		0	0	1	2	5		0	2	3	1	5	7	4	1	24	3	17	14	10		
DOOR		0	0	0	0	0		0	0	5	0	0	2	0	0	0	16	5			28	8
Percentage (%)		0	0	0	0	0		0	0	18	0	0	7	0	0	0	57	18				
WINDOW		0	0	0	0	1		1	2	10	3	0	1	0	0	1	5	14			38	10
Percentage (%)		0	0	0	0	3		3	5	26	8	0	3	0	0	3	13	37				
STAIR		1	0	1	0	0		1	0	2	0	0	2	0	0	1	3	4			15	4
Percentage (%)		7	0	7	0	0		7	0	13	0	0	13	0	0	7	20	27				
TOTAL		2	0	2	3	14		10	13	51	10	6	25	12	1	45	43	98	17	13	365	100

Roofs with defects were found to be aesthetically affected, but structurally sound. The most common defects clearly show the presence of dampness caused by broken tiles, gutters and ineffective rainwater systems, mechanical agents that cause blistering and coarse surface conditions and a small presence of biological agents. In doors, cracks, blistering paint and the presence of ant colony are commonly found. The presence of a small number of insects was noted in the windows. As for stairs, this element only contributes a small number to the overall defects, where most of it had been repaired and changed materially. Defects in stairs are mostly caused by mechanical factors such as blistering paint and cracks, and the presence of small numbers of insects.

6 Conclusion

This preliminary survey gives an overview of the current conditions of old traditional mosques, particularly those made from timber. The importance of the study is that it can be used to formulate a framework of appropriate repairs of defects. From the findings, it can be seen that almost all traditional mosques in the survey are in a good state. Defects can be found in minimal numbers and are less destructive to the building structures. Most defects had undergone minor repairs. Some of the buildings had been conserved to keep the uniqueness of traditional architecture and maintain utilisation as a Muslim house of worship. The roof has been identified as the most common place for defects, specifically suffering from dampness-related problems caused by ineffective roof parts. Lack of maintenance and repair was the major factor in the worst of these defects Thus, early preventive measures are important to minimise the risk of damage or failure. The best remedy is one accurately to defects. The understanding of building defects is, therefore, an essential key for good repair practice, particularly in the conservation of historic buildings.

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