

# ASSESSMENT OF BUILDING DEFECTS OF TRADITIONAL TIMBER HOUSES IN PENANG, MALAYSIA

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## Graphical abstract



## Abstract

Traditional timber houses is one of historical heritage building in Malaysian built environment which needs to be maintain because it is diminishing by time. Timber construction is once widely used in construction industry especially used in many historic building. However most of them are fail to be maintained thus many building defects can be found on traditional timber house. Surveys were conducted in three traditional timber houses in Balik Pulau, Penang. The data collected were analysed using Building Rating System (BARIS) to specify the overall condition of the building good; fair or dilapidated. All the three traditional timber houses are in fair condition which are in acceptable condition but need repair works to maintain.

**Keywords:** Building defects, traditional houses, timber construction, building maintenance

## Abstrak

Rumah kayu tradisional adalah salah satu bangunan warisan sejarah dalam alam bina Malaysia yang perlu dikekalkan kerana ia semakin lupus dek peredaran zaman. Pembinaan kayu digunakan secara meluas dalam industri pembinaan terutamanya yang digunakan dalam bangunan bersejarah. Walau bagaimanapun, kebanyakan daripada bangunan ini gagal untuk dikekalkan kerana terdapat banyak kecacatan bangunan pada rumah kayu tradisional. Kajian ini telah dijalankan di tiga buah rumah kayu tradisional di Balik Pulau, Pulau Pinang. Data yang dikumpul dianalisis dengan menggunakan Sistem Penilaian Bangunan (BARIS) untuk menentukan keadaan keseluruhan bangunan itu sama ada baik; sederhana atau usang. Ketiga-tiga buah rumah kayu tradisional berada dalam keadaan yang sederhana dan boleh diterima tetapi perlu kerja-kerja pembaikan untuk mengekalkannya.

**Kata kunci:** Keusangan bangunan, rumah tradisional, pembinaan kayu, penenggaraan bangunan

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## 1.0 INTRODUCTION

In early century in Malaysia, timber is popular material used to build houses. Traditional timber houses one of the significant heritage building in built environment in Malaysia. The components of traditional timber houses are well adapted to Malaysian climate while the space division is suit Malaysian culture. Villagers built the house themselves and designed it aesthetically. However,

traditional timber houses at present are diminishing and their existing are neglected. Many traditional timber houses are not well-maintain result to timber defects and decaying.

Timber used for building must be strong and durable to endure force that will acting on them. There are many types of timber in Malaysia that are popular for construction purpose. The species usually used is like, Chengal, Merbau, Balau, Kempas, Meranti and other species that have good strength

and durability that can be used for a long period. Durability rating for Malaysian timber ([1] are shown in Table 1.

**Table 1** Durability rating for Malaysian timber

No	Durability	Period
1	Very durable	More than 10 years
2	Durable	5 – 10 years
3	Moderately durable	2 – 5 years
4	Non-durable	Less than 2 years

A building condition assessment identified as the best method in order to carry out the survey of a building. Assessment of building condition method has also proven its effectiveness as has been done in Balai Besar Conservation Project, Alor Setar Kedah. The method can provide a good initial information, especially on the physical condition of the building, as well as overall building condition [2].

The common building defects found in all three houses are deterioration (rot), insect attacks, discoloration, and scaling. The problem arises due to no particular maintenance are carried in professional approach. Typically, defects related to timber in tropical country because of moisture effect and biological attack, such as termites, beetles, and borers. These defects are mainly caused by the timber in service being subjected to environmental exposure ([3]. A continuous exposure to these environmental agents and pests without proper preventive measures will rapidly dilapidated buildings [2]. Understandings towards timber defects are necessary to run repair works.

A timber defect is generally an imperfection, which either weakens the wood greatly or makes the wood unsuitable to work with for the purpose it is to be used [3] and the effects of defects and deterioration or otherwise commonly referred to as damages and failures in the quality, function, use and beauty, in buildings are dependent on the surrounding conditions and time [4]. Basically, timber defects classified into two main groups; natural defects and condition defects. Natural defects are the natural properties of the timber such as knots, shakes, twisted, rupture, wane, presence of sap woods, sloping grains and resin pockets. Meanwhile, condition defects are weather (moisture) related defects, blue and discoloration.

Therefore, maintenance works should be done from time to time to prevent further major defects occurs in the house. Preventive action is require in order to keep the building maintain. One of way is by using high quality of timber. A high quality of timber can help to prolong the lifespan of the building. Beside, a treatment must be done when a defect occurs, so a major defect can be inhibited. A repair works from a professional is recommended. Other than that, a protection must be used against insect since Malaysia's climate is hot humid temperature, many biological agent can attack timber in a building. Last

but not least, a preservative timber is crucial to repel moisture problem in timber. In this research, proper recommendations are given for the defects occurs at the house to cure the problems. Further information will be discussed in the following section.

## 2.0 METHODOLOGY

A preliminary study is done in order to fulfil the research objectives and complement to the research title. After get know the scope and objective of the study, a literature review are done. Literature reviews are compromises of all the data regarding the research in details. Then primary data are collected through assessment of building condition in three houses in Balik Pulau as case studies. Qualitative approach is used in this research because all the data are collected by site survey. During the survey visual inspection is used and some tools as shown in Table 2.

**Table 2** Tools for visual inspection

No	Tools / Instrument	Description
1	Camera	Zoom in and out to focus on the subject properly
2	Moisture meter	Identifying the surface and internal moisture content of the timber element
3	Thermo Hygrometer	Indication of temperature
4	Laser Distance	Measure the dimension for horizontal and vertical, also at an angle

The data is analysed using Building Rating System (BARIS) where the entire defect will be calculated by the number of score divided by number of defects. The overall condition of the house can be rated good; fair or dilapidated. After that, recommendation will be given to handle the defect problems.

## 3.0 RESULTS AND DISCUSSION

### 3.1 Traditional Timber House One, Kampung Perlis

When the survey was conducted, the average temperature inside the house shown is 36.58 degree Celsius. This means the thermal surrounding is quite high. Proceed with the analysis, the result of the condition of the house are shown below. Based on the result, the highest number of defects for this house is deterioration; dry rot mostly. Other than that, termites nest also found in first floor in the house.

Figures 1 and 2 show deterioration of timber window frame and timber underneath floor slab. There is no excess moisture detect from the laser

moisture. The moisture location 1 (Figure 1) is 7.8 while moisture content for location 2 (Figure 2) is 10.4.



**Figure 1** Deterioration of timber window frame



**Figure 2** Decay of timber underneath floor slab



**Figure 3** Termites attack on beams at 1<sup>st</sup> floor



**Figure 4** Insect attack from beetles on timber roof section

Figure 3 shows termite's effect all over the beam on the first floor. Figure 4 shows insect attack from beetles on timber roof section. All the four examples are out of twelve defects found in the timber house. The result from BARIS, it is specify the timber house one is in FAIR condition with total score 5. No serious defect is found. Only cosmetic defect and minor defects are required repaired works

### 3.2 Traditional Timber House Two, Kampung Perlis

At this house, the average temperature recorded is 32.15 degree Celsius. The surrounding temperature is normal. Four examples of defects found in this house are shown below. After analysis has been done, deterioration; dry rot and wet rot are found to be the highest total number of defects in this house. Further explanation will be discussed below.



**Figure 5** Deterioration of timber



**Figure 6** Scaling of painting at column area

Figure 5 shows deterioration of timber. It has low presence of moisture content with 10.1. Figure 6 shows scaling of painting at the column. This picture is taken outside of the house. Last but not least, Figure 7 shows discoloration on timber. The colour of the timber is fading and uneven. The total defects found in this traditional timber house two is eighteen. There is one serious defect should be taken urgent repair work. Overall condition for this house is FAIR with total score of 6.



**Figure 7** Discolouration of timber

### 3.3 Traditional Timber House Three, Kampung Sg Pinang

The average temperature surrounding when conducting survey at this house shows 34.52 degree Celsius. The thermal condition is normal. After analysis has been done, it is found that the most type of defect found is deterioration.



**Figure 8** Deterioration of timber beam



**Figure 9** Termites nest on the column area

Figure 8 shows deterioration of timber beam inside the house. The defect located at the hall of the house. Most of the hall's beams are decaying. The moisture test shows the moisture presence for is 11.4. Figure 9 shows termites nest which was found on the column area. Figure 10 shows discoloration of timber wall. The picture is taken outside of the house. While Figure 11 shows warping of timber partition which also taken outside of the house. The four examples of defect shown above are out of fifteen defects all together that can be traced in traditional timber house three. The overall condition of the house is FAIR which need some maintenance services. The total score for the house is 6.



Figure 10 Discoloration of timber wall



Figure 11 Warping of timber partition

All the three houses mostly have the same common building defects. They are deterioration of timber; consist of wet rot and dry rot, termite attacks, insect attacks; such as beetles and borers, scaling of painting, discoloration of timber, corrosion on metal sheet, and warping of timber. The most defect can be found in all houses is deterioration of timber. This is because tropical climate in Malaysia is hot humid temperature makes timber easy to decay. The presence of moisture and continuous exposure to UV rays on timber can weaken the timber. Other than weather factor, biological agent also comes to be the cause of the building defects found on the houses. For instance is insect attacks that easily attract to timber materials; termites, beetles and borers. These three insects can harm the timber and in critical cases the timber will devastated. Other than that, wrong used of timber is also contributes to factor of timber defect. There are some types of timber are well-known with their strength and durability; Chengal and Balau will endure fungal and insect attack for many years while others such as Jelutong and Rubberwood are highly susceptible to decay ([5]. Besides, other cause is human factor which means vandalism from the users. There are some recommendations for maintenance and repair works which is importance to prolong the lives of the timber house and prevent further serious defect.

Refer the following Table 3. While defect description for all houses are shown in Table 4.

Table 3 Recommendations for maintenance and repair works

Defects	Remedies
Deterioration; wet rot and dry rot	For the devastated part of timber, replacing with a new quality timber is a must. Repair work can use epoxy. Preservatives for timber is recommended to prevent same defect occurs
Discoloration	Paint the surface to prevent affected by chemical reaction and UV rays
Scaling	Clean the old paint with scrapper and repaint with new weatherproof paint.
Insect attack	For the devastated part of timber, replacing with a new quality timber is a must. Repair work can use epoxy. Used of pest control is recommended to prevent same defect occurs
Termites attack	For the devastated part of timber, replacing with a new quality timber is a must. Repair work can use epoxy. For the termites attack, soil condition for the building must be preventing with anti-termites is recommended
Warping	For the devastated part of timber, replacing with a new quality timber is a must.

Table 4 Defect description for all houses

Building Condition	Description
Functional, only cosmetic defect	<ul style="list-style-type: none"> <li>All building element a best condition</li> <li>Minor stage of defects and damage</li> <li>Repairing work-not immediate</li> <li>Building is safe for occupant</li> </ul>
Minor defect, but can lead to serious defect if left unattended	<ul style="list-style-type: none"> <li>Some parts of building element have damages</li> <li>Defects and damages varied of major and minor</li> <li>Repairing work-immediate</li> <li>Building is safe for occupant</li> </ul>
Serious defect, cannot function to an acceptable standard	<ul style="list-style-type: none"> <li>Building element has damage almost entirely</li> <li>Defects and damages are serious</li> <li>Repairing work-immediate</li> <li>Building is unsafe for occupant</li> </ul>

### 5.0 CONCLUSION

This preliminary survey gives an overview of the current conditions of traditional house, particularly those made from timber. The purpose of this research is to find the best repair works for the defects occur in the house. From the findings, it can be conclude that all the traditional timber house in this study are in fair condition. They are still in acceptable condition but need some strategies for repair works and actions. All the defects are mostly cosmetic and minor defects. Only a few major defects are found in all three houses. The repair works are suggested to maintain the houses. The repair works need the damage timber to be replaced with a new quality timber.

Preventive action need to be taken is by using quality timber, painting and use anti-insect substance for insect attacks. 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.

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