

THE UTILISATION OF TIMBER MATERIAL FOR MODERN RESIDENTIAL PROJECT CONSTRUCTION

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ABSTRACT

Purpose – The construction materials play a part in determining the tenants' true comfort. The construction material has an impact on the vision of a structure since it deals with the building's façade. Timber is a great insulating material that helps to maintain room temperature compared to other materials. Timber helps to reduce heat and the associated energy requirements. However, few studies have investigated timber as the appropriate response to design materials to reduce climatic discomfort in tropical weather. This paper is to investigate the characteristics of timber that has been used in traditional houses that address the climatic issue for modern residential projects.

Design/methodology/approach – A quantitative questionnaire survey has been employed on 30 respondents living in timber modern houses in Johor Bahru. Descriptive statistical analysis was carried out in pie charts to determine the level of agreement in the suitability of the construction material, thermal comfort, low thermal conductivity, and awareness of climatic response.

Findings – The findings show that nearly half of the respondents have found the construction material to be suitable, where low thermal conductivity factors contribute to climatic issues. Also, most of the respondents have rated neutral in using timber material for thermal comfort. Over half of the respondents tend to agree that an awareness of climatic response plays a significant role in designing a modern residential project.

Research limitations/ implications – As the preliminary part of ongoing research, this study is limited to a quantitative study. Further research could employ a qualitative approach to develop a full understanding of the characteristics of timber, and how timber as the selected material that is used in the traditional house can solve the climatic issues for modern residential projects in Malaysia.

Keywords: Climate, Modern Residential, Thermal Comfort, Timber Construction

INTRODUCTION

Climate is the long-term shift of the average weather patterns in a particular place. Climatic change means any systematic change over the decades or more in the long-term of climate variables data such as temperature, precipitation, pressure, or wind. Malaysia's climate may be categorised as warm-humid equatorial, with high temperatures and humidity characteristics (Jamaludin et al., 2015; Daghigh, 2015). Therefore, the selection of building materials has a significant impact on the local climate. The use of timber in the selection of building materials has been hailed as an eco-friendly material in construction (Victoria et al., 2017; Md Noh et al., 2016). This is mainly because of its thermal characteristics, structural qualities and costs, and the construction elements of a building. The climate factor is one of the main considerations in the selection of an appropriate material. Thus, the selected building material should suit the climate (Hemali, 2019). This research focuses on how timber may be easily deployed and adjusted to meet the needs of modern living in terms of climatic issues- as a building material that is used by traditional Malay homes (Kamarul et al, 2004). This study aims to investigate the climatic issue due to lessen thermal comfort of modern construction materials. Correspondingly, this issue is related to the selection of suitable materials that can be used for modern residential projects. Thus, it is important to study the construction material of timber characteristics and how timber as a traditional construction material can be implemented for modern architecture residential projects to solve climatic issues.

LITERATURE REVIEW

History of Timber Construction Material

Timber was utilised for constructing buildings and shelters as a building material. Timber has initially been utilised in the construction of relatively big urban buildings rather than being considered as acceptable primarily for large and small buildings, which are often well isolated from neighbouring buildings (Svatoš-Ražnjević et al, 2020). Timber might be one of the oldest and low-tech materials, yet it is still the favourite material of architects across the world. This material has been used throughout human history and has given people a wide variety of construction items and building materials. New building materials, i.e., concrete and steel, were brought to the fore by modernisation and technology in the construction sector and in the effort to decrease costs. History reveals that timber has been present as a building material aside from stone since the ancient times. Notably, timber is the major building material, even though it has steadily decreased and replaced by today's concrete (Mat Lazim Z. et al, 1986; Mohd. Zulkifli G., 1989).

Timber is one of the earliest building materials that is utilised by humanity as a background of Malaysian architecture. Malaysia, with its abundance of wood, where 90 per cent of its timber have been used for various functions: from the imposing and well-built wood palaces for the Sultans to the most modest and semi-permanent buildings. Although timber has many positive properties, such as its availability, strength, and flexibility, it is rapidly declining owing to environmental conditions and natural factors. Correspondingly, many timber houses are attacked and destroyed by fire as well as termites. Thus, the reliance on timber has made way for construction materials such as reinforced concrete in the twentieth century (Law, 1985).

The Malay home was historically utilised as an architectural basis for palaces and religious buildings in Malaysia. Although the structural structure and essential concepts have remained very constant, the Malay houses have experienced dramatic modifications over the years. Due to climate change and cultural variables, diversity in construction forms and spatial expression occurs (Wong, 1995).

Local Context of Traditional and Modern Construction in Malaysia

Malaysia is comprised of 14 states with different cultures, religions, and ethnicities. All states have their own religious rituals and cultural customs. Diverse cultural practices have led to different types of architecture with their respective significance and symbolic character behind each feature. Notably, one of the primary characteristics of traditional buildings is the in-depth knowledge of their design and a respect for nature. The traditional Malay home may readily be changed and enhanced to the current living conditions, as the traditional Malay house best reflects the climate of the house itself (Nasir and Teh, 2011; Kamarul et al., 2004). The deep shape of the modern houses' typical components sometimes results in an interior environment that lacks sufficient sunlight and natural ventilation. Appropriate materials for local construction are replaced and dissolved by contemporary forces albeit the retaining of cohesive and integral design principles of the traditional Malay home and shape (Nasir and Teh, 2011; Kamarul et al., 2004).

As the primary sources of heat gain to the building envelopes are the direct and indirect sun radiation, hot air, conductivity, and radiation from the construction material, therefore, the saturated air surplus surrounding the body must be eliminated to ensure some degree of thermal comfort. The heat that is absorbed within the material of the structure which is radiated into the interior of the buildings causes considerable discomfort in most modern buildings, where high thermal capacity materials such as bricks and cement have been utilised. The solar heat gain of the buildings must be limited if thermal comfort is to be achieved in a warm wet environment, while ventilation and evaporative cooling must increase the thrust from the body (Kubota and Toe, 2015; Kamarul et al., 2004). A new Malaysian house design should provide adequate ventilation to control the climate problem (Kubota and Toe, 2015; Nasir and Wan Teh, 1994). The design should ensure cooling and humidity reduction, utilise low-thermal building materials to ensure the house is conveyed with little heat, control direct solar radiation, control the clearing out of and around the open sky and provide a cooler environment. To develop and construct a

modern house, the design needs to take into consideration the local climate factor (Kubota and Toe, 2015; Kamarul et al., 2004). The selection of suitable construction materials according to the local climate is an important factor to achieve comfort; this allows people to feel comfortable when they are in a house that has features that are suitable for the climate in a particular location. Without the appropriate construction material, the overall building performance will be affected in terms of thermal conductivity, thermal comfort, and greater energy consumption.

METHODOLOGY

The population based on this study showed a total number of 30 respondents living in modern timber houses in Johor Bahru. The demographic background was captured in the study. Male and female respondents yielded equal results of 50 per cent or 15 respondents. A quantitative questionnaire survey gathered relevant information regarding the characteristics of timber used in traditional houses, and to study timber to solve the climatic issues for modern residential projects. The questionnaire measures four items that were related to the construction material that was used in modern residential projects—selection of suitable construction material, thermal comfort, thermal conductivity, and the importance of studying timber characteristics. The questionnaire design employed a five-point Likert scale which ranges from 1= “Strongly Disagree” to 5= “Strongly Agree”. However, the data collection for this study faced several limitations. The questionnaire could result in distribution errors. On the other hand, the sample of the study is rather small and limited to the selected modern timber residential houses, hence, the findings do not represent a larger population.

FINDINGS AND DISCUSSION

The data collected from this study were analysed in descriptive statistics. The question of the use of timber in solving the climatic issue for modern residential projects was discussed in the following:

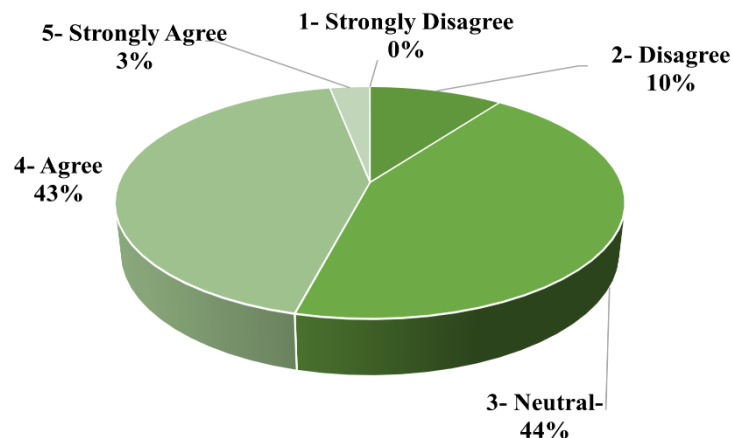


Figure 1 Selection of suitable construction material in local area that could reduce climatic issue

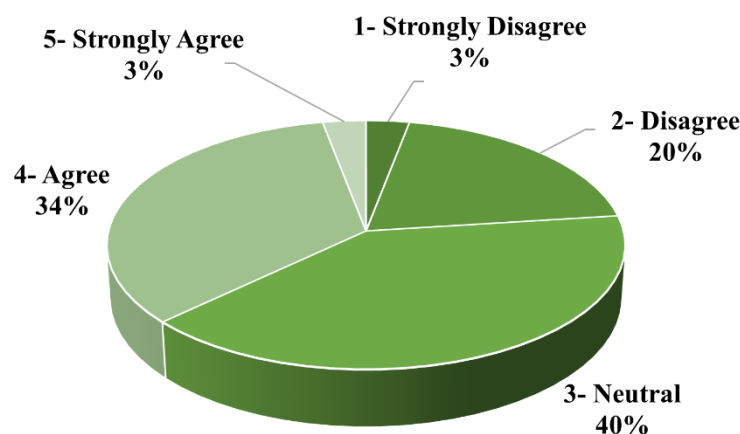


Figure 2 Using timber as the main building material helps with the comfort of occupants

Based on the survey, **Figure 1** shows the suitability of the selection of construction materials in the local area that could reduce the climatic issue. A large number of respondents rate Neutral (44%) responses in the selection of a construction material that is important to reduce the climatic issue that occurs in Malaysia. This was followed by the respondents who rated Agree (43%), Disagree (10%), Strongly Agree (3%), and Strongly Disagree (0%). The finding shows that the selection of construction materials may not be the only distinguishing factor in reducing the climatic issue but could be a contributing factor.

On the other hand, **Figure 2** indicates the use of timber as the main building material helps to make a difference in the comfort of the occupants. Most respondents scored Neutral (40%) response to the findings, and there are also respondents who Agree (34%), Disagree (20%), Strongly Agree (3%), and Strongly Disagree (3%). The data suggests that the respondents are more inclined towards the agreement scales- whereby using timber helps them with their indoor comfort level.

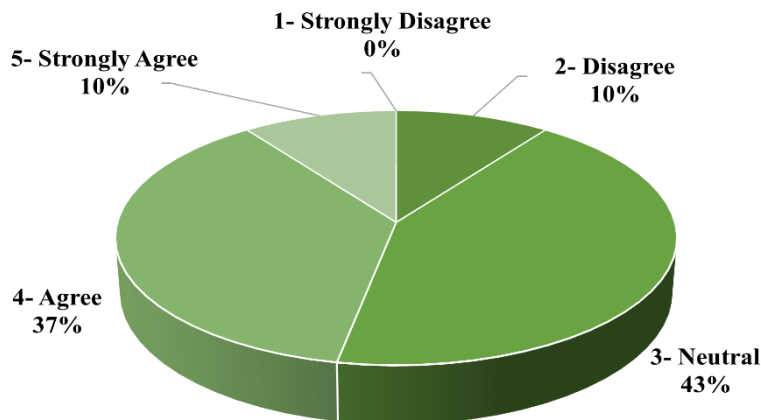


Figure 3 Low thermal conductivity on timber characteristics protect from direct heat radiation

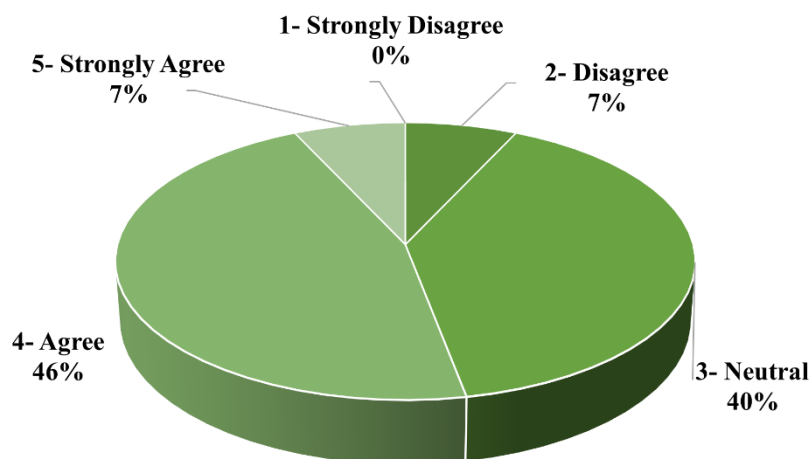


Figure 4 The importance of studying timber characteristics in the effort of reducing climatic issue in Malaysia

The characteristic feature of low thermal conductivity becomes an important factor in determining the comfort of the occupants of the house. This factor becomes the yardstick of whether the timber has such characteristic features or not. This is to identify whether the timber can provide a long period of

time to reach high temperatures. The findings that are related to thermal conductivity are in **Figure 3**. A majority of the respondents provided neutral (43.3%) responses about whether thermal conductivity is one of the main factors in determining comfort in a construction. This was followed by an agreed (37%) response, strongly agree (10%), and disagree (10%). The result suggests that the respondents tend to agree that timber characteristics contribute to lower thermal conductivity.

Finally in **Figure 4**, The data obtained found that the respondents who scored on the Agree scale had the highest (46%) as to whether it was necessary to study timber characteristics in reducing the problem of climatic issues, especially in the construction industry in Malaysia. The remaining scales that the respondents have scored are Neutral (7%), followed by Strongly Agree (7%) and Disagree (7%). From the results, most of the respondents are inclined towards the agreement scale, that there is a need to study extensively the relationship of timber characteristics in reducing the climatic issue.

Based on the findings of four of the items measured, the selection of suitable construction material and low thermal conductivity of timber characteristics could potentially reduce the climatic issue. This differs from the study of Kubota and Toe (2015) that the indoor air temperatures of traditional Malay houses are higher than the outdoor temperatures, but have better solar heat control due to the passive design of the houses. Conversely, Chinese shophouses have better indoor air temperatures due to the adjacent atrium-like courtyard that helps to cool the indoor environment, however, the outdoor temperature is higher due to the surrounding urban heat island. Another study also indicates that timber construction is extremely lightweight and has a low thermal mass that consequently leads to a lack of thermal comfort, especially in summertime (Albatici et al, 2017). This indicates that the use of construction material and timber characteristics may not solely be the factor in reducing climatic issues but also take into account the external environmental condition and the design of the construction.

Furthermore, using only timber material to help with the comfort of the occupant may not be sufficient as the finding would suggest. Although timber material may be more lightweight than modern material (i.e., brick and cement) but other contributing factors such as the design, and location of buildings with the surrounding external environment play a significant role in influencing the thermal comfort of the occupants themselves. Finally, there is a need to extensively study the relationship of timber characteristics and how it could influence the effort of reducing climatic issues.

CONCLUSIONS

The output of this research is to highlight the significance of using timber as a common construction material in designing modern residential projects. As the sample size is small and limited to a selective area in Johor Bharu, additional studies can be performed in the future for a larger sample size and similar studies in the different states in Malaysia.

This study was conducted to obtain detailed information on timber characteristic features. Several characteristic features of timber have been shortlisted in this study. Among the best features of timber that make it suitable and relevant throughout the ages is its low thermal conductivity. It is based on the highest percentage which has been rated by the respondents. Several questions have been listed in studying how timber can be used as a construction material to solve the climatic issues for modern residential projects. Low thermal conductivity is one of the main factors why timber is a suitable material to use in Malaysia. Timber is a material that has low thermal conductivity and can provide comfort to the occupants when it is exposed to direct radiation. However, using only timber as the construction material may not be enough to reduce the climatic issue. Other contributing factors such as design, location, and the surrounding external environment play an important role in the effort to control the microclimatic of the indoor environment. Further study could look into the relationship between timber characteristics in modern residential projects and the factors that could reduce the climatic issues in Malaysia.

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