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HOMEOWNERS' AND ARCHITECTS' PERSPECTIVES ON WOOD AND WOOD PRODUCTS AS PREFERRED MATERIAL FOR BUILDING CONSTRUCTION IN MALAYSIA

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By

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The Malaysian construction industry is one of the driving forces of the country's economy. The construction sector accounted for 10.1% of the country's Gross Domestic Product (GDP) in 2018. However, the consumption of wood and wood products in the construction sector accounted for only 18% of the total materials cost incurred by the construction sector in 2018. Therefore, it is important to determine the main reasons that deter homeowners and architects from using wood and wood products in the buildings. In this respect, the objective of this study was to determine the preferences of homeowners and architects for wood and wood products for specific applications in buildings, and to assess the attributes that influenced its utilization in building construction. The study was conducted through a questionnaire survey of 137 practicing architects throughout Malaysia, with a matching number of 137 homeowners. The response rate for the questionnaire survey was 31% or 43 respondents from each category. The application of wood and wood products by architects was focused primarily on non-structural applications rather than structural applications. It was found that cost, customer demand, durability, natural beauty, availability, ease of design, and workability were primary considerations for architects in specifying wood and wood products in building construction. A factor analysis of the results showed that building regulations, material quality and beauty, customer demand, and design and assembly were the primary determinants that influence architects specifying and using wood and wood products in building construction. It was apparent that the use of wood and wood products in building construction in Malaysia has the potential to be further increased through advertising and marketing in the material among the general public, as well as architects and specifiers. Generally, homeowners and architects were sensitive to the cost of construction which predetermined their preference for using wood and wood products. Other factors that were taken into consideration in specifying wood and wood products for building construction include durability, fire resistance and

environmental friendliness. The study also showed that in order to increase the use of wood and wood products in building construction in Malaysia, the local councils should consider enforcing a minimum quantity of wood and wood products to be used in the building, before approval is given.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PERSPEKTIF PEMILIK RUMAH DAN ARKITEK MENGENAI KAYU DAN PRODUK KAYU SEBAGAI BAHAN PILIHAN UNTUK PEMBINAAN BANGUNAN DI MALAYSIA

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Industri pembinaan Malaysia adalah salah satu daya penggerak ekonomi negara. Sektor pembinaan menyumbang 10.1% daripada Keluaran Dalam Negara Kasar (KDNK) negara pada tahun 2018. Walau bagaimanapun, penggunaan kayu dan produk kayu dalam sektor pembinaan menyumbang hanya 18% daripada jumlah kos bahan yang ditanggung oleh sektor pembinaan pada tahun 2018. Oleh itu, adalah penting untuk menentukan sebab-sebab utama yang menghalang pemilik rumah dan arkitek daripada menggunakan produk kayu dan kayu di bangunan. Dalam kaitan ini, objektif kajian ini adalah untuk menentukan keutamaan pemilik rumah dan arkitek bagi produk kayu dan kayu untuk aplikasi khusus dalam bangunan, dan menilai ciri-ciri yang mempengaruhi pemanfaatannya dalam sektor pembinaan di Malaysia. Kajian ini dijalankan melalui kaji selidik soal selidik 137 pengamal arkitek di seluruh Malaysia, dengan jumlah yang hampir sama dengan 137 pemilik rumah. Kadar respons untuk soal selidik adalah 31% atau 43 responden dari setiap kategori. Penerapan produk kayu dan kayu oleh arkitek tertumpu terutamanya pada aplikasi bukan struktur dan bukannya aplikasi struktur. Didapati kos, permintaan pelanggan, ketahanan, kecantikan semula jadi, ketersediaan, kemudahan reka bentuk, dan kebolehpasaran adalah pertimbangan utama bagi arkitek dalam menentukan produk kayu dan kayu dalam pembinaan bangunan. Analisis faktor keputusan menunjukkan bahawa peraturan bangunan, kualiti bahan dan keindahan, permintaan pelanggan, dan reka bentuk dan perhimpunan adalah penentu utama yang mempengaruhi arkitek yang menentukan dan menggunakan produk kayu dan kayu dalam pembinaan bangunan. Adalah jelas bahawa penggunaan kayu dan produk kayu dalam pembinaan bangunan di Malaysia berpotensi untuk ditingkatkan lagi melalui pengiklanan dan pemasaran bahan di kalangan masyarakat umum, serta arkitek dan penentu. Secara amnya, pemilik rumah dan arkitek sensitif terhadap kos pembinaan yang telah ditentukan terlebih dahulu untuk menggunakan kayu dan produk kayu. Faktor lain yang diambil kira dalam menentukan kayu dan

produk kayu untuk pembinaan bangunan termasuk ketahanan, kebakaran dan keramahan alam sekitar. Kajian itu juga menunjukkan bahawa untuk meningkatkan penggunaan kayu dan produk kayu dalam pembinaan bangunan di Malaysia, majlis-majlis tempatan mesti menguatkuasakan kuantiti minimum kayu dan produk kayu untuk digunakan di dalam bangunan, sebelum kelulusan diberikan.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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This is to confirm that:

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CHAPTER 1

INTRODUCTION

1.1 General Background

The Malaysian construction industry is one of the driving forces of the country's economy. The construction sector accounted for 10.1% of the country's Gross Domestic Product (GDP) in 2016 (Bank Negara, 2017). Inevitably the construction sector is an important wealth generator apart from improving the life of Malaysians through the government's socio-economic policies for development. Further, the construction industry also created job opportunities for 800,000 people in 2017. The sector, which requires a large workforce, in the form of general labor, designers, artisans, skilled worker, contractors, architects, etc. has remained an important job creating sector in the country for many years (Ibrahim et al., 2010). The construction industry also creates spillover effects to the other economic and service sectors including manufacturing and banking. Therefore, many industries are involved in the construction sector and each industry has its own role in making the construction sector a success.

Generally, the Malaysian construction industry constitutes 4 categories of construction types. First are the commercial buildings, which are the buildings used for commercial purposes. Examples of commercial buildings include government buildings, schools, private offices, warehouses and hospitals government buildings, schools, private workplaces, distribution centers and hospitals. Second is the residential buildings, which are constructed based on the demand of the citizens Second is the residential buildings, which are developed dependent on the interest of the residents of the country to have living spaces and homes in certain areas. Private or public developers construct residential buildings in areas of high population and demand. This will encourage people to purchase the houses, and at the same time will increase the economic activities in the surrounding area, as well as the growth of the construction sector. Thirdly is the heavy engineering & infrastructure construction, which involves substantial designing and foundation development, and takes a long time to complete. Examples of such constructions are highways, airport and bridges (Ibrahim et al., 2010). The last type of construction is the industrial buildings which are industrial structures. In Malaysia however, this type of construction is less compared to the other types of constructions under taken by the private sector. According to (Cheah, 2017; Ratnasingam et al., 2018), commercial buildings is the most constructed (35%-40%), followed by residential (30%-35%), then infrastructure (20%-25%) and finally industrial buildings (5%-10%).

The Malaysian construction industry is supervised and guided by the Construction Industry Development Board (CIDB). CIDB is a statutory body established under the Act of Parliament, viz. Act 520 Lembaga Pembangunan

Industri Pembinaan Malaysia (1994). The objective of the CIDB is to develop and promote the construction industry as a target industry for the national economy, contributing sector to the national economy. The CIDB ensures the construction industry meets the quality requirement of the customers and guarantees excellent development structures and works (Chua and Oh, 2011; Ratnasingam et al., 2018).

1.2 Wood as a Construction Material

Wood is one of the oldest materials that has been utilized for construction. However, wood is less prominent compared to all other building material and this fact is broadly acknowledged by architects, designers and consultants as well as owners of projects. Generally, in comparison to the popularity of steel and concrete, which are the two are key components in building construction, wood has a lesser presence. Despite this scenario, wood and wood products manufacturers and suppliers in Malaysia have completed an incredibly great job and have broken new deals in the country, as wood items by and large, have gained wide application and inclusion, in term functionality and aesthetically (Hannon et al., 1978; Ab Latib et al., 2019).

It must be recognized that building development planning without the experts' inputs usually causes damage to the environment, expending numerous materials from the earth, and the production of all these building materials also take up a great deal of power and vitality. That includes from delivery of the building materials, annihilating works, earthworks, to building and working the building which has farfetched effects on the environment. Thus, it is important to ensure sustainable building materials such as wood, are used for construction purposes.

1.3 Wood as a Sustainable Material

Despite its limited popularity, wood has numerous favorable circumstances where it is appropriate for building construction. One essential point to feature is that tree can have thousands years of life, and consequently, the wood derived from the tree has supportability which is unquestionably not uncertain, which makes it proper to be utilized for building materials (Mohmoudkelaye et al., 2018; Ratnasingam et al., 2018). Furthermore, timber is one of the most sustainable material on the earth, and appropriate replantation and management can ensure its sustainability as a building material. Government efforts to control deforestation must be actualized to guarantee, what is harvested is replenished through replanting activities, which is called "controlled deforestation" (Ratnasingam et al., 2018; Ab Latib and Ratnasingam, 2019).

Wood resources in Malaysia undergo various degrees of processing to change from the raw wood material state from trees, to be remanufactured into products, a stark contrast to other building materials. Nevertheless, wood has unrivaled advantages, which include its high heat resistance which in turn afford a cooling effect. This will lower the cost of the building operation due to the diminished requirement for climate control system. Furthermore, wood resources can be used as wooden entryway, wooden floor, wooden windows or wooden roof board that permit the augmentation of warmth protection in the buildings. In some instances, it is possible to introduce wood as a light-weight building material (Ramage et al., 2017).

Generally, there are numerous enquiries from building designers and architects in Malaysia about the wide choices of wood materials available and those that have some unique characteristics have an added appeal to be used in buildings (Ratnasingam and Chung, 2016). Non-toxic wood-based materials have some informal advantages as demonstrated by its ability to tidy up the air, kill the bacteria, dust and dirt (Nathan, 2018; Ab Latib and Ratnasingam, 2019).

Using wood materials can also lessen the carbon dioxide emission and return oxygen required by humans, to the environment. Wood also helps with forestalling concoction of vapor spillage into the buildings, which increase its wellbeing level when in contact with vapor (Huang et al., 2018).

Wood material is a carbon –sink, since wood stores a large amount of carbon and inputs positively the global climate change phenomenon. Using wood materials in construction and in buildings reduces the carbon footprint of the construction sector. With a wide-variety of wood species in Malaysia, building designers, architects and homeowners have a wide choice of material to choose from (Collins et al., 2016; Ratnasingam et al., 2018).

Wood-based building materials also have a high load bearing limit, and when treated with waterproofing and termite-treatment, makes it suitable for use as open air materials since it can withstand abnormal state of dead load, dynamic load, water and biological pests. Previously, wooden houses were the common sight in many provincial zones in Malaysia, however at the present day, wood is used commonly as façade, column, segment, roof, fencing and other limited applications (Nathan, 2018; Ab Latib et al., 2019). As a characteristically green building material, wood has such high diversity, which includes pressed wood, overlaid timber, timber section, square to round wood and etc., which can be tailor-made to suit the building.

Moreover, wood can be machined into any desired structure that is favored by the building designer and architect, particularly facade that requires unlimited conceivable outcomes. Since thousand years ago, humans have built multiple-storied buildings using wood. Numerous compositional buildings also used wood

as the key building material around the world. From platform to facade, furniture material, connect, lobby, divider, floor to numerous different kinds of utilization; wood as a material offers the best choices for use as structural and internal materials (Bysheim and Nyrud, 2008).

Its cost viability, ecological benevolent, stylishly satisfying, solid, high rigidity, flexible, strong, structure agreeable, high accessibility are among the many advantages that can be derived from wood and wood products (Ahmad et al., 2018).

1.4 Problem Statement

The exports of wood and wood products from Malaysia are significant as shown in Table 1.1, reaching an average of RM22.0 billion per year. Further, the domestic consumption of wood and wood products has also been increasing annually (Table 1.1) (Collins et al., 2016; Ab Latib et al., 2019). Despite, such export and domestic consumption figures, the consumption of wood and wood products in the construction sector accounted for only 18% of the total materials cost incurred by the construction sector in year 2018 (Ratnasingam et al., 2018; Ab Latib et al., 2019).

Table 1.1: Export and Domestic Consumption Value

All Types of Wood and Wood Products	Export (RM billion)	Domestic Consumption (RM billion)
2016	22.1	16.3
2017	23.1	17.9
2018	22.2	18.1

Although, Malaysia is a major tropical wood and wood products producer in the world, apart from Indonesia, Thailand and Burma (Ratnasingam et al., 2018), nevertheless, the level of consumption of wood and wood products in the construction sector is relatively low. Wood and wood products utilization in building construction is often associated with furniture and other value-added wood products, which is non-structural in application. Ironically, wooden construction structures in Malaysia is considered cheap, apart from being perceived as substandard, of low social status and unsafe. The use of laminated wood structures and laminated boards is one of the approaches to solve the issue of lack of sturdiness, but it is not widely used in Malaysia. It must be stated that laminated wood products provide a choice to the building designers and architects to meet the requirements of the structural design. As it is in Malaysia, most construction structures uses wood in the form of sawn timber and plywood only (Ratnasingam and Chung, 2016; Cheah, 2017).

The argument that the supply of timber from the natural forests in country is on the decline (Table 1.2) and therefore, does not encourage the use of wood and wood products in the construction sector is weak. This is against the background that the forest resources in Malaysia is sustainably managed as per the Sustainable Forest Management (SFM) system, and the wood and wood products manufactured from this resource is one of the most environmental-friendly material available. It is a acknowledge fact that the use of wood and wood products in building construction will lower the carbon-footprint and also serve to reduce the effects of global climate change (Ononiwu and Nwanya, 2016).

Table 1.2: Supply Timber in Peninsular Malaysia

Natural Forest Log Production	Million Cubic Metres (m^3)
2013	4.08
2014	4.11
2015	4.34
2016	4.45
2017	3.81

The reasons for the declining use of wood and wood products in building construction in the present day construction industry, compared to the many traditional wooden houses constructed during the last century is a subject that has not been well reported and is worth investigating.

In this respect, the main research question of this study is to examine the trends in wood and wood products utilization in building construction in Malaysia (Figure 1.1).

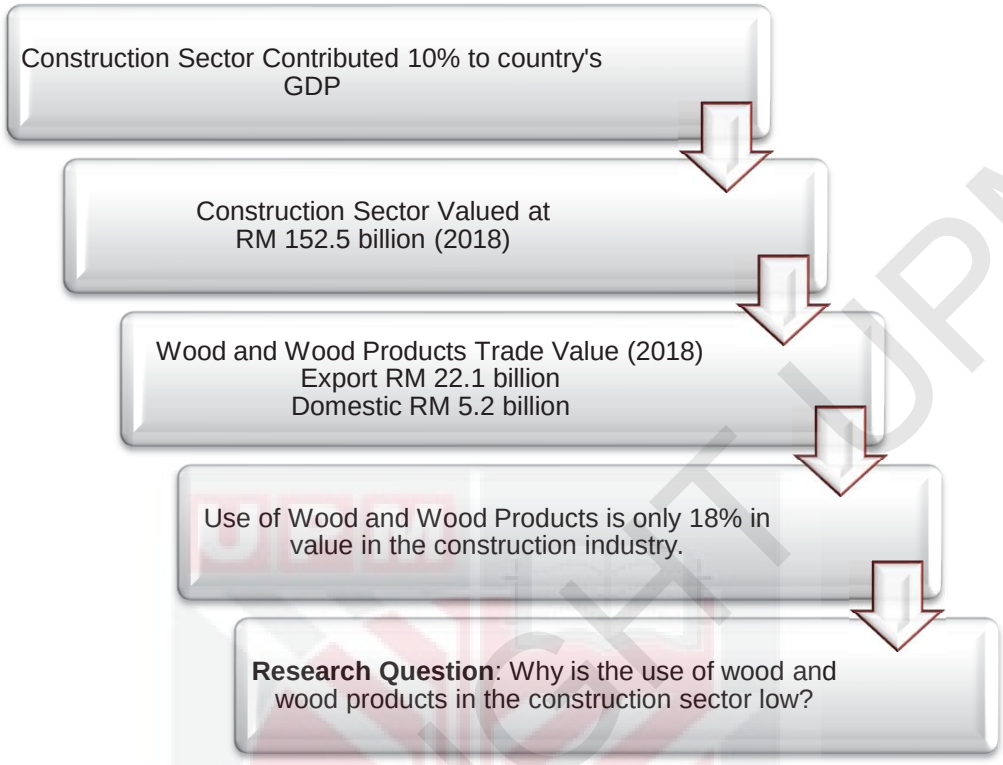

Figure 1.1: Research Frameworks

1.5 Objectives

Therefore, the general objective of this study was to analyze the extent of wood utilization in the construction sector in Malaysia.
While the specific objectives of this study were:

i. to determine the factors influencing architects' and homeowners' decision for specifying wood and wood products for construction purposed,
ii. to investigate the perspectives of architects' and homeowners' towards wood as a preferred material, and
iii. to make recommendations on possible ways to encourage wood and wood products use as a construction material.

1.6 Scope and Limitations

A study of this nature should ideally be cross country, covering all building professionals as well as homeowners. Unfortunately, due to such wide scope and also after discussion with several industry experts, this study focused on:

i. The architects' and homeowners' perspective on wood and wood products usage in the construction sector,
ii. The perception, awareness and knowledge of architects' and homeowners' perspective on wood and wood products usage in the construction industry,
iii. The factors and preferences for using wood and wood products in the construction industry, and
iv. The issues with respect to improving wood and wood products usage in the construction industry in Malaysia.

The respondents were confined to stand-alone building architects and homeowners, such as bungalows and semi-detached homes in densely populated areas throughout Peninsular Malaysia. This is attributed to the fact that this sector accounts for the highest possibility of wood use in buildings as suggested by the Persatuan Arkitek Malaysia (PAM).

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