

Review Article

POTENTIAL APPLICATION OF THE MODULAR SYSTEM IN TRADITIONAL MALAY HOUSE IN MODERN CONSTRUCTION INDUSTRY

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Received: 06.11.2019

Revised: 08.12.2019

Accepted: 10.01.2020

Abstract

Modular system allows many advantages in construction process and final production. Some of the lists are cost-effectiveness in terms of time consuming in site, labour, product materials and many more. The quality of modular system also can be monitored wisely as it develop in factory in mass production according to the design. Therefore there are possible to reduce risk in of non-functional components and create standardization of each component and interface. This paper proposes the implementation of modular system integrated with the traditional Malay house components potentially the non-structural components such as wall, window and staircase. The traditional Malay house system is basically a modular system in terms of measurement, panel dismantle-reassemble method, expandable and moveable as well. The issues of modular using the traditional human measurement will be analysed using observation and site visit and analysis. Details of traditional Malay housing components will be analysed and the suitable components for modular system will be selected. The system that will be generated can be applied to the housing development in Malaysia and meantime preserving the aesthetic elements of the traditional Malay house. The outcome of this paper will create a conceptual of modular housing system implemented of traditional housing components in building environment.

Keywords: Modular, housing, traditional, systems, Malay

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DOI: <http://dx.doi.org/10.31838/jcr.07.02.147>

INTRODUCTION

According to Department of National Heritage there are issues regarding the heritage buildings preservation in Malaysia where many monumental and historical buildings cannot be preserved due to the limitation of the implementation of the traditional human measurement system like fathoms and inch to the width and cross-legged or stand for height or girth armful of poles (www.jwn.gov.my). Besides, the main problem for conservation of traditional wooden buildings is the lack of skilled craftsmen in the art of traditional carpentry and joinery work, especially for conservation of timber as the species are decreasing. As the problem regarding the preservation of the aesthetic aspects of the traditional buildings especially the traditional Malay house is relatively unsolved, this research proposes the implementation of modular system integrated with the traditional Malay house components. The traditional Malay house system is basically a modular system in terms of measurement, panel dismantle-reassemble method, expandable and moveable as well. Therefore, the main concept of modular system is already met while the issue of modular using the traditional human measurement will be analysed deeply in this paper. The system that will be generated can be applied to the housing development in Malaysia and meantime preserving the aesthetic elements of the traditional Malay

house. The outcome of this paper will create a conceptual of modular housing system implemented of traditional housing components in building environment.

THEORETICAL RESEARCH AND METHODOLOGY

The theoretical system of the traditional Malay house has included the adaptation of socio-cultural hierarchy; the roles of the women, the human measurement scale system and also the natural environment surrounding (Lim Jee Yuan, 1991). Amos Rapoport (1969) also argues that there are two aspects that determine the house form and function;

Modifying Factors of House Form (factors that directly affect form)

Socio-cultural factors and house form (factors that indirectly affect form. It affect socio-cultural aspects first and later architecture)

As relate to this research, Materials, Construction and Technology are fall under the First Aspect that determine the house form and function. These three elements (materials, construction, and technology) are defining to one another in forming the architecture of the house (Figure 1).

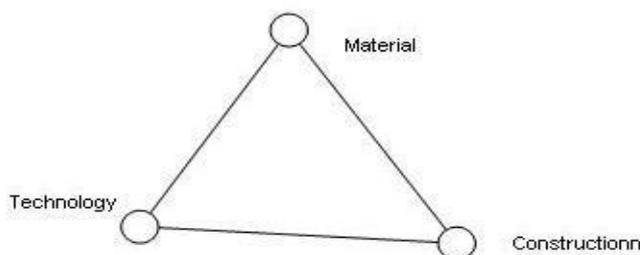


Figure 1: The defining elements of Modifying Factors of House Form (Amos Rapoport, 1969)

The theoretical framework taken from the human scale measurement implemented in traditional Malay house system

will be conjoined with the defining elements as above. Modularisation of the components will be reviewed in order to select the potential components for the conceptual modular traditional Malay house suitable for current housing industry. Several interviews have been made with the architects and consultants regarding potential modular system as such Industrial Building System (IBS) using traditional measurement and components.

MODULARISATION IN INDUSTRIAL BUILDING SYSTEM (IBS)

IBS (Industrial Building System) is defined as a construction technique in which components are manufactured in a controlled environment (on or off site), transported, positioned and assembled into a structure with minimal additional site work (Hamid et al., 2008; CIDB, 2007; CIDB, 2005 and CIDB, 2003). The rising sustainability awareness around the globe has put the construction industry under immense pressure to improve project efficiency and deliverables. Industrialised Building System (IBS) has the potential to promote sustainability development and green construction. This may be achieved from a controlled production environment, minimization of construction waste, extensive usage of energy efficient building material, a safer and more stable work environment, and possibly better investment for long term project economy (Mohd Idrus Din, Noraini Bahri, Mohd Azmi Dzulkifly, et. Al, 2015). Therefore, the prefabricated housing is defined here as the manufacture of whole houses, or significant housing components, offsite in a factory setting prior to installation or assembly onsite. This is a promising innovation with a clear relationship to more environmentally friendly building practices (Hampson & Brandon, 2004). The concepts of prefabrication and simplification of tasks applied to the construction sector are not new, having been discussed extensively since the 1950's (Branson, Eishennawy, Swart, and Chandra, 1990).

Modular system is mainly comes from the subsystems and functions of modules that interconnected in construction. Modular system can be developed in manufacturer in order to produce complex product according to the design and desire. There are three main aspects that can be determined within modular design: firstly, product architecture, which specifies the modules and functions of the system. Secondly, the modules (components, subsystems or mechanisms) that interact and execute the functions: and finally, the interfaces that define the connections and communications between them

(Martins, Oliveira & Relvas, 2005). In current construction industry, modular system is applicable as the industrial design have to provide reliable and capable demand in innovation, quality, diversity and speed from the consumers or clients. As stated by the Kamrani and Salhieh (2000) that the success of the enterprises is now based on the capability and ability to answer rapidly to the consumer's demands and in the use of technological innovations. Innovation in architectural development has been introduced since the world of digital media and computerized in drafting where the prefabricated in building materials and components in mass production become realistic. Modular system allows many advantages in construction process and final production. Some of the lists are cost-effective in terms of time consuming in site, labour, product materials and many more. The quality of modular system also can be monitored wisely as it develop in factory in mass production according to the design. Thus, it is possible to reduce risk in of non-functional components and create standardization of each component and interface.

TRADITIONAL MALAY HOUSE MODULAR SYSTEM

Traditional Malay house is respected as a cultural and social representation of Malay race whereby it resemble the indigenous technology wise upon the climate, human scale and social needs. As stated in Amos Rapoport (1979) that local architecture fulfilling the local social and cultural needs, provided setting for certain activities; and also separate domain and differentiate between spaces and genders. Malays were believed adapted the analogy of crafting the boat into the construction of their house as cited by Phillip Gibbs (1987).

The Malays were a seafaring people and the carpenters who built their houses also built their boats. There are thus many boat analogies used in the house. The word for the posts of the house is 'tiang', which is also the word for the mast of the boat. The word for the flooring is 'lantai', which is also the word for the boat's floor. The word for the equilateral triangle gable-end is 'tebar layar' which signifies the sail of the boat. (p. 22)

Malays used the traditional human measurement scale and proportion in constructing a house and honoured woman as the house manager and therefore named the space as *rumah ibu* or the core part of the house. Traditionally, Malays used their body parts in measurement system such as fathoms and inch to the width and cross-legged or stand for height or girth armful of poles (Figure 2).

Figure 2: Human measurement scale applied in traditional construction (Abdul Halim Nasir & Wan Hashim Wan Teh, 1994)

The traditional Malay house applied a modular system where the spaces can be extended and also dismantle-reassemble. Figure 3 below shows the implementation of the extension system.

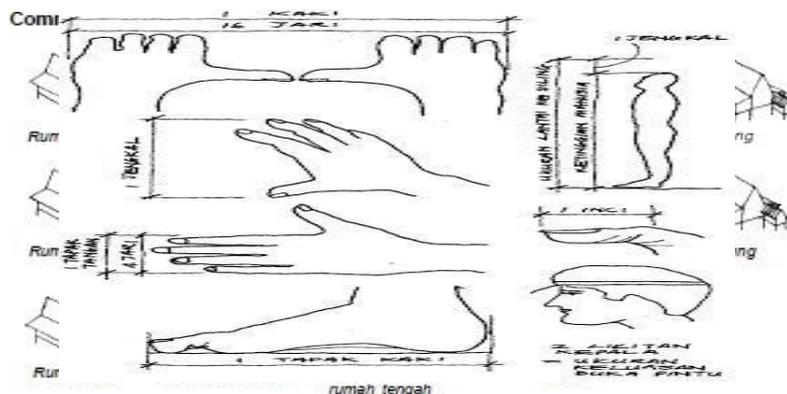


Figure 3: Examples of expandable spaces from the core space or rumah ibu (Lim Jee Yuan, 1987)

The spatial extension and expandable of the house parts are known as modular system where the components of the house coordinated to attach to another part proportionally. Killman

(1994) has stated that the indigenous traditional method construction the traditional Malay house is near-perfect solutions to the control of climate, multi-functional use of

spaces, flexibility in design and a sophisticated prefabricated system which can extend the house with the growing needs of the family. In social, Malays chose to expand the core part due to the addition of the family members or hierarchy in the society. As the social activities may increase in a house, the spatial needs also expanded due to demand of the members. Modular system in traditional Malay house was begin at the core part. It applied

nail-less jointing system such as dowel joint, bridle joint, finger joint, tongue and groove, mortise and tenon; and more. These jointing ease the carpenters and Malays to dismantle and reassemble the house either to move the house or to expand the components. Table 1 and Figure 4 show the basic components of the traditional Malay house .

Table 1: The components in basic traditional Malay house construction system

No	Component	Definition
1	<i>Tiang gantung</i>	Pillars
2	<i>Susoh</i>	Edges to support cross floor-beams
3	<i>Rasok</i>	Cross-beams from pillar to pillar
4	<i>Gelegar</i>	Girders/joist
5	<i>Jeriau</i>	Split laths, just below the floor proper
6	<i>Lantai</i>	Floor
7	<i>Tunjuk langit</i>	King post
8	<i>Tulang bumbong</i>	Roof-ridge
9	<i>Kasau jantan</i>	Main rafters
10	<i>Tutup tiang</i>	Beam across top of pillars
11	<i>Alang pandak</i>	Short cross-beam
12	<i>Bendul</i>	Beam at threshold
13	<i>Gulong-gulong</i>	Rollers/purlin
14	<i>Kasau betina</i>	Subsidiary rafters
15	<i>Jenang</i>	Uprights of door
16	<i>Tutup jenang</i>	Lintel
17	<i>Belebas</i>	Main horizontal and vertical laths for fixing atap wall
18	<i>Jerejak</i>	Thinner perpendicular laths for ditto
19	<i>Pekukian atap</i>	A lath holding down the lowest part of the atap roof
20	<i>Atap</i>	Palm-leaf thatch
21	<i>Perabong</i>	Double row of atap protecting the roof-ridge
22	<i>Alang panjang</i>	Low cross-beams
23	<i>Chuchoran atap</i>	Lowest edge of palm-leaf roof

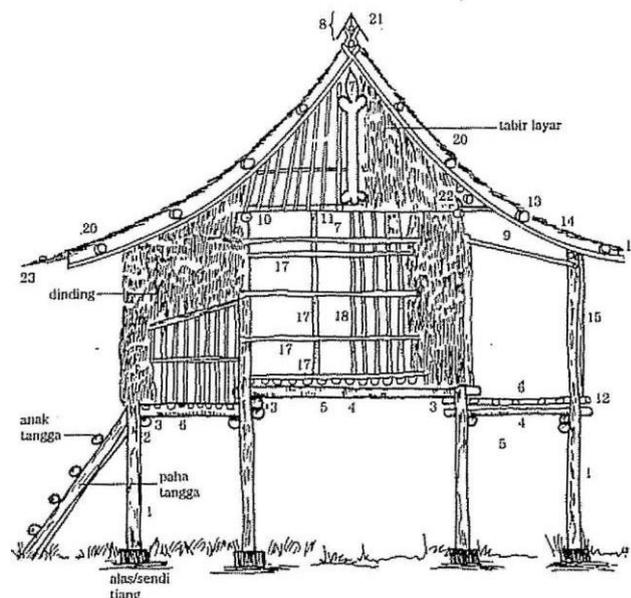


Figure 4: The basic traditional Malay house (Rumah Perak) (Yaakub Idrus, 1966)

Many researchers emphasized the uniqueness of modularisation implemented in constructing the traditional Malay house (Zainol, Al-Mamun and Permarupan (2013);

Ismail and Ahmad (2006); Husli (2011); Lim (1987); Gibbs (1987)). Connection between components applied variety nail-less jointing system create defect less on the component and

prolong the used of the component specifically timber component.

THE CONCEPTUAL MODULAR SYSTEM

As Malaysia is already adapted the modular system of prefabricated housing construction, it is a potential implementation the method and technology towards the integration of the aesthetical characteristics and the components of the traditional Malay house. However, the core material of the traditional Malay house which is timber creates high maintenance in repairing the defect due to the weather and insects, and decreasing the number of skilled craftsmen limits the construction of the traditional Malay house.

Considering timber as the material for traditional house, the

craftsmanship such as carving and details are possible to craft compared to concrete or brick. However, there is possible opportunity that traditional house style would be selected as IBS housing industry. The traditional Malay House System is classified into The uniqueness of the traditional Malay house can be adapted by selecting the suitable component that represent the aesthetic of traditional craftsmanship such as the girders, floor, column, beams, and wall. Housing industry may contribute to the national identity in implementing the traditional components of housing system in mass construction of modular house although using other materials than timber. Terengganu State Museum is one of the example of the application of traditional elements with aesthetic value on the concrete wall (Figure 5).



Figure 5: Example of concrete wall with traditional aesthetic elements applied at Terengganu State Museum

Regards to the possibility in constructing the housing industry with IBS and implementing traditional Malay components, the measurement respected to human body can be applied as well

as traditionally the craft and carves are measured according to the traditional method of scale.

Tabel 2: Example of traditional Malay components for modular system for housing industry

<p>Elements :</p> <ul style="list-style-type: none"> a) Stair b) Girders c) Beams 	<p>Elements :</p> <ul style="list-style-type: none"> a) Wall (<i>janda berhias</i>) b) Opening carvings 	<p>Elements :</p> <ul style="list-style-type: none"> a) Gabled-end (<i>tebar layar</i>) b) Lath

CONCLUSION

There is high potential of implementation the traditional Malay house of modular system in current housing industry particularly as the IBS is already produce in Malaysia. The conceptual modular traditional Malay housing system will enhance the issue of identity of the traditional Malay house in future development. Replacing the timber as the main material from the traditional Malay house to alternative material such as cemented-fibre and precast-concrete may consistent the aesthetical value and identity of Malay house.

ACKNOWLEDGEMENT

This paper is sponsored under SGJP-USM - R/MYRA/A12.00/00554A/002/2017/000480. Thank you to Universiti Malaysia Kelantan for the opportunity and contribution.

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