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Adaptation of Traditional Malay Wall Element in Modular System

Siti Aisyah Muhammad*
Faculty of Architecture and Ekistics, Universiti Malaysia Kelantan, 16300 Bachok, Kelantan, Malaysia

Original Research Article

***Corresponding author**
Siti Aisyah Muhammad

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Abstract: Preservation of the aesthetical aspects of the traditional buildings especially the traditional Malay house is relatively unsolved due to the limitation of the material used specifically the timber. The traditional Malay house system is basically a modular system in terms of measurement, panel dismantle-reassemble method, expandable and moveable as well. 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 is develop in factory in mass production according to the design. This paper proposes the adaptation of modular system in modern housing that integrated with the traditional Malay house component specifically the non-structural component such as the wall system. The issues of modular using the traditional components will be analysed using observation and site visit and analysis. The system generated can be applied to the housing development in Malaysia and in the meantime preserving the aesthetic elements of the traditional Malay house. The outcome of this paper will acknowledge a concept of modular housing system adapting the traditional wall element in building environment, and appreciating the aesthetic value of the traditional Malay house as well.

Keywords: House, wall, built environment, traditional, IBS, Malay house.

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 adaptation 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 the conservation of timber as the species are decreasing (Figure-1).

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 adaptation 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 thoroughly in this paper. The system that will be generated can be applied to the housing development in Malaysia and in the mean time preserving the aesthetic elements of the traditional Malay house. The pbjective of this paper is to deliver the potential adaptation of the concept of modular housing system using traditional Malay house wall technique and aethetic yet adapted current building material such as cement fiber or IBS.

MATERIALS AND METHODS

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 [1]. Amos Rapoport [2] also argues that there are two aspects that determine the house form and function;

1. Modifying Factors of House
   Form (factors that directly affect form)
2. Socio-cultural factors and house form (factors that indirectly affect form. It affects socio-cultural aspects first and later architecture)

Fig-1: Example of abandoned Malay traditional house
Source: http://rumahmelakawarisanmelayu.blogspot.my/2014/08/

As related to this research, Materials, Construction and Technology fall under the First Aspect that determines the house form and function. These three elements (materials, construction, and technology) are defining one another in forming the architecture of the house (Figure-2).

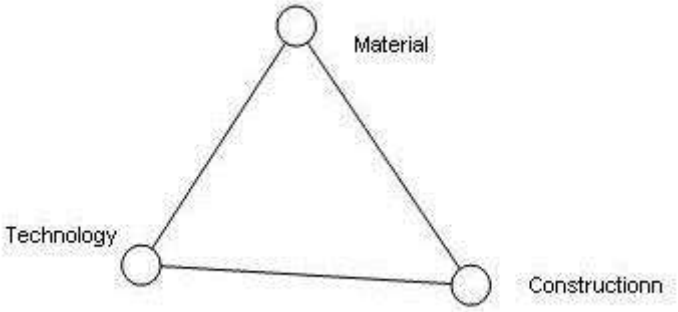


Fig-2: The defining elements of Modifying Factors of House Form [2]

The theoretical framework taken from the human scale measurement implemented in traditional Malay house system will be conjoined with the defining elements 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.

Modularization 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 [3-6]. 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 [7]. 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 [8]. The concepts of prefabrication and simplification of tasks applied to the construction sector are not new, having been discussed extensively since the 1950's [9].

Modular system mainly comes from the subsystems and functions of modules that are 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 [10]. In current construction industry, modular system is applicable as the industrial design has to provide reliable and capable demand in innovaion, quality, diversity and speed from the consumers or clients. As stated by the Kamrani and

Salhieh [11] 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, labours, product materials and many more. The quality of modular system also can be monitored wisely as it is developed in factory in mass production according to the design. Thus, it is posible to reduce risk of non-functional components and create standardization of each component and interface.

Fig-3: Wall panel in IBS system

Source: http://www.utusan.com.my/sains-teknologi/teknologi/kaedah-ibs-jimat-cepat-dan-berkualiti-1.28239

Traditional Malay House Modular System

Traditional Malay house is respected as a cultural and social representation of Malay race whereby it resembles the indigenous technology wise upon the climate, human scale and social needs. As stated in Amos Rapoport [12] 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 [13].

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 use 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 use 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-4).

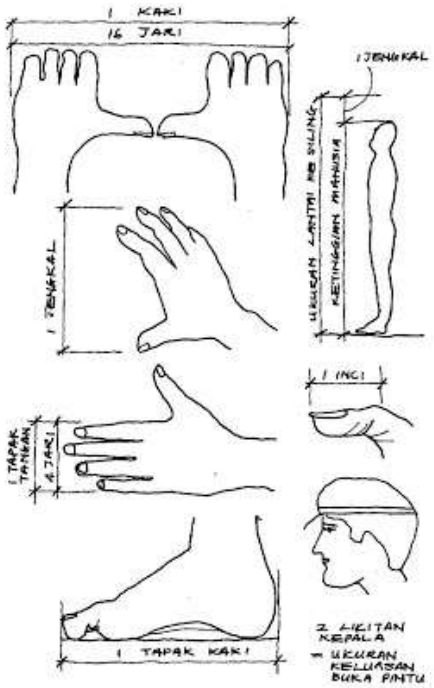


Fig-4: Human measurement scale applied in traditional construction [14]

The traditional Malay house applied a modular system where the spaces can be extended and also dismantle-reassemble. Figure-5 shows the adaptation of the extension system.

The spatial extension and expandable of the house parts are known as modular system where the components of the house are coordinated to attach to another part proportionally. Killman [15] 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 choose 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.

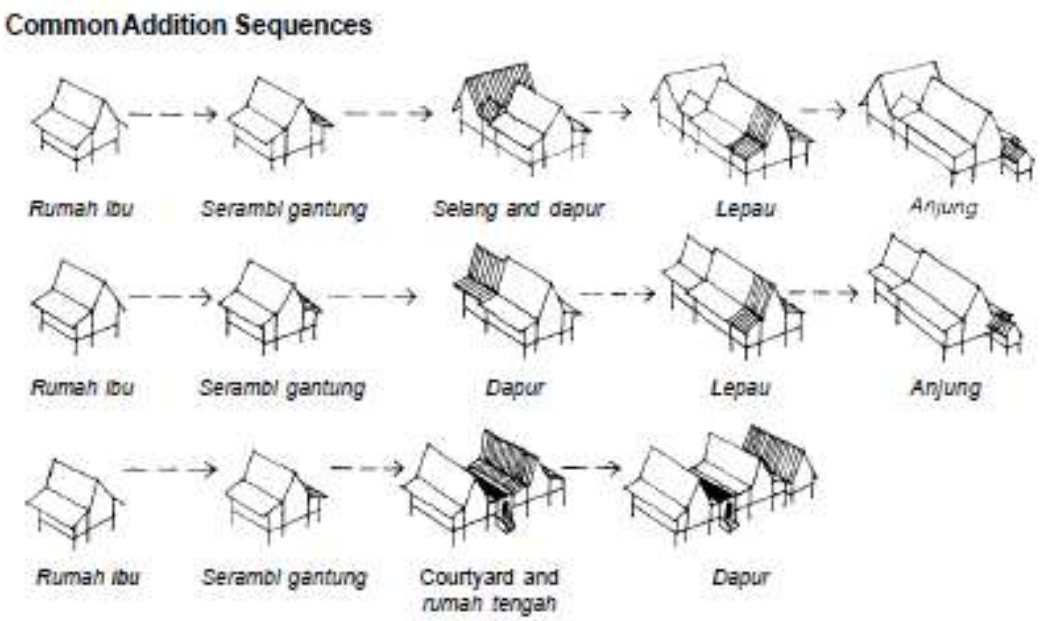


Fig-5: Examples of expandable spaces from the core space or *rumah ibu* [1]

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

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

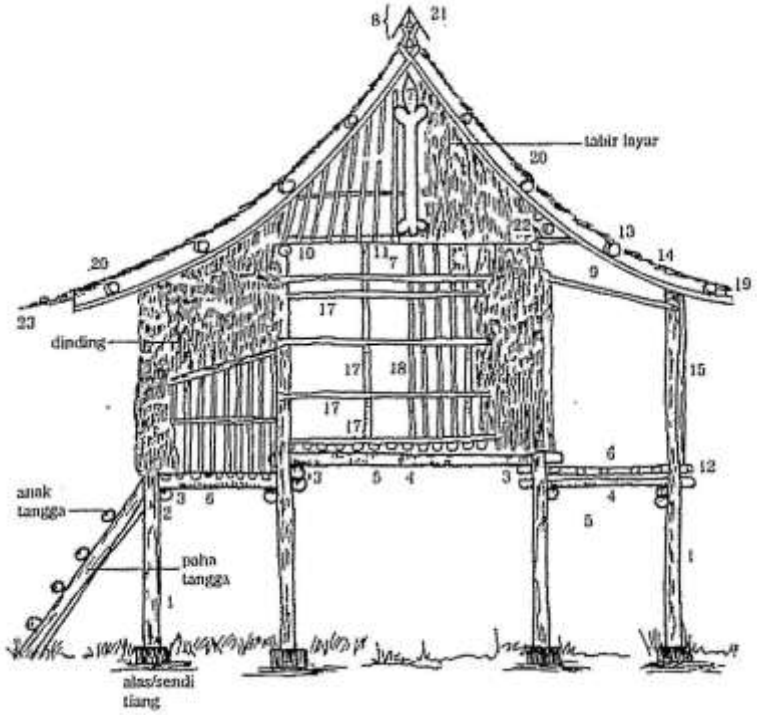


Fig-6: The basic traditional Malay house (Rumah Perak) [20]

Modular system in traditional Malay house begins at the core part. It applies 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. Figure-6 and Table-1 show the basic components of the traditional Malay house.

Many researchers emphasized the uniqueness of modularisation implemented in constructing the traditional Malay house [16-18, 1, 13. Connection

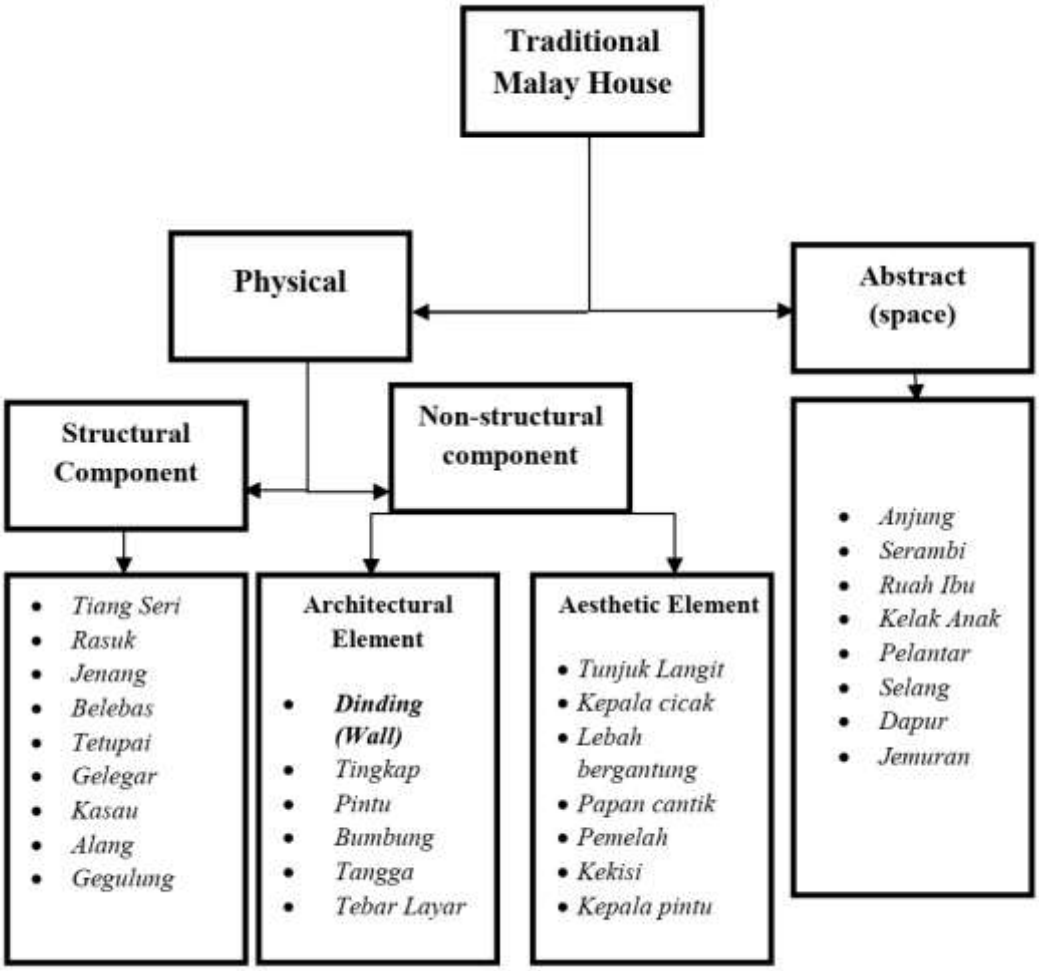
between components applies variety nail-less jointing system creating less defect less on the component and prolonging the use of the component specifically timber component.

RESULTS AND DISCUSSION

Traditional Wall System in Modular Concept

According to the finding by Nur Shuhada and Shahril Khairi [19], the traditional Malay house components divided to two main categories which are, Physical and Abstract (Space) (Figure-8). The Physical category consists of Structural and Non-structural component. Wall is clustered in Non-structural component that comply the architectural element of the traditional Malay house system. Wall is potentionally adapt the modular system as wall in traditional Malay house can be dismantle and reassemble at any location.

Table-2: Types of wall in traditional Malay house



There are three types of wall acknowledge in traditional Malay House; *Dinding Tindih Kasih*, *Dinding Janda Berhias* and *Dinding Kelarai I* (Table-2).

Adaptation of Conceptual Modular System

As Malaysia has already adapted the modular system of prefabricated housing development, it is a potential adaptation of 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 craftmen limits the construction of the traditional Malay house. Current industry has shown that cement fiber can be implemented as wall system. Abundant manufacturer provide the options of design and dimensions for example PRIMA FIBER Cement Board, SHERA Board and American fiber. The wall panel produced by these company basically applied *Dinding Tindih Kasih.* Figure 9 shows the section of *Dinding Tindih Kasih* and Figure 10 shows the used of cement fiber in construction.

		
Dinding Tindih Kasih	*Dinding Janda Berhias*	*Dinding Kelarai*

Fig-8: Wall as part of the architectural elements in traditional Malay house system [19]

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 uniqueness of the traditional Malay house can be adapted by selecting the suitable component that represents the aesthetic of traditional craftsmanship such as the girders, floor, column, beams, and walls. 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-11).

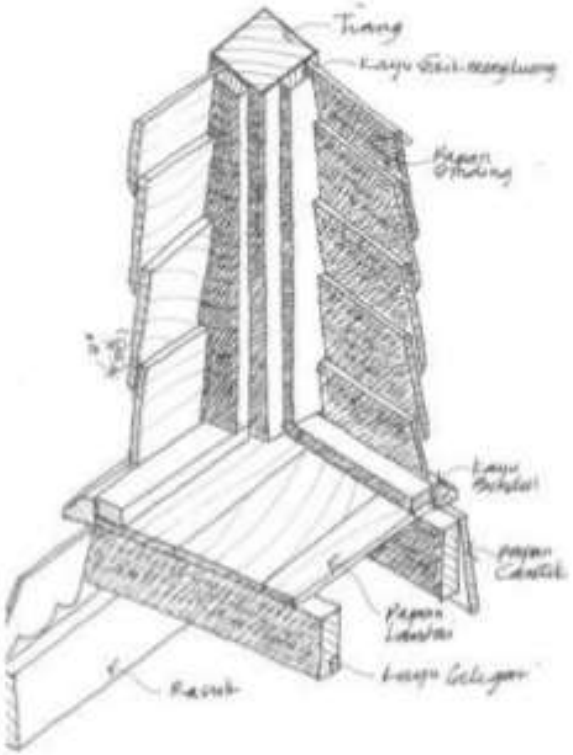


Fig-9: Sectional joint of *Dinding Tindih Kasih*

Fig-10: Cement-fiber wall panel used at Darul Hadith (DAHAN), Kubang Kerian, Kelantan

Fig-11: Example of concrete wall with traditional aethetic elements applied at Terengganu State Museum

CONCLUSION

There is a high potential for adaptation the traditional Malay house of modular system in current housing industry particularly as the IBS has already been produced in Malaysia. The conceptual modular traditional Malay housing system will enhance the issue of identity of the traditional Malay house in future development. Some element from the traditional Malay house has proved that it can be developed and constructed. There are many non-structural elements such as the roof eave, ridge cap, window shutter and baluster with the malay indegenous design can be developed in IBS to sustain the aesthetical and identity of the housing development in Malaysia.

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