Green concepts through shape-grammar – the language of intermediate spaces in traditional Malay houses

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Abstract

The traditional Malay houses (TMH) can be seen as an embodiment of a true implementation of green architecture through its design efficiency and moderation in the use of resources throughout the lifecycle of the houses. This paper describes the relationship of green architecture to the language of the intermediate spaces of the TMH as part of the general analysis of traditional Malay houses from the sustainability or "green" perspective. The research is conducted by examining the shape grammar descriptions of the intermediate spaces and relating them with the green concept from design to construction stages. From the design perspective, the intermediate spaces introduce efficient natural ventilation and lighting to the main house, while from the construction perspective, the development of the intermediate spaces promote efficient and timely use of timber materials in its construction.

Keywords: Green architecture, intermediate spaces, traditional Malay houses

1. 0 Introduction

The traditional Malay houses (TMH) have been the subject of interest to many researchers of vernacular architecture. The houses provide a glimpse of the lifestyle of the Malays in the 18-19th century and represent the local cultural heritage. The houses were built by master carpenters and builders. Due to the wooden materials used in the construction of these houses, many are no longer usable and some have been left unattended. With the concern of preserving the local cultural heritage, many efforts have been made by architects and enthusiasts to document these houses. The objectives of the studies range from efforts in documenting the built structures in order to prevent the information from being lost after the structures have deteriorated or destroyed, to preservation of the original structures through restoration and transplanting the structures to another area. The combined documented collections have exceeded well over 200 sets of measured drawings (Zulkifli, 2006; Raja Nafida, 2006; Supyan, 2006). A more simplified approach to represent the information regarding TMH built forms has been developed in order to recreate the TMH in a digital form. The newly developed generation approach is seen as a promising method in capturing the inherent forms of the TMH and representing the forms in a formal way (Said and Embi, 2007a, 2007b and 2008; Embi and Said, 2008).

The traditional Malay houses (TMH) can be seen as an embodiment of a true implementation of green architecture through its vernacular development. The TMH can be systematically described through the use of shape grammar. Previous studies have covered the major forms of TMH which include the main house or "rumah ibu" and the kitchen or "rumahdapur". Recently, the study has been extended to include a detailed description of the intermediate spaces of TMH. This paper describes the relationship of green architecture to the language of the intermediate spaces of the TMH as part of the general analysis of traditional Malay houses from the sustainability or "green" perspective. The research is conducted by examining the shape grammar descriptions of the intermediate spaces and relating them with the green concept from design to construction stages.

2.0 TMH and Green Design

The concept of green architecture entails several elements such as minimizing harmful effects of buildings or structure on the environment and enhancing efficiency and moderation in the use of resources throughout the lifecycle of the buildings. Among others, resources such as energy, material, and development space play a key role in a successful implementation of the concept. The traditional Malay houses (TMH) can be seen as an embodiment of a true implementation of green architecture through its vernacular development. The TMH can be systematically described through the use of shape grammar. Previous studies have covered the major forms of TMH which include the main house or "rumah ibu" and the kitchen or "rumah dapur". Recently, the study has been extended to include a detailed description of the intermediate spaces of TMH.

The proposed green design framework ties together the typology and topology of TMH in order to accurately capture the green concept of living in TMH. Typological studies and topological formalisms are the few approaches that utilize the geometrical representations. Types can be defined as a concept which describes a group of objects characterized by the same formal structure such as social activity, building construction, and abstract geometry. The typological approach employs a systematic analysis of buildings along with many physical attributes including, entrance, parti, circulation, massing, symmetry, rhythm, and the likes. The analysis uses simple drawings to represent abstract concept of an architectural work since the attributes being studied can be represented graphically.

2.1 Green Design Concept from TMH Design Language

The main living spaces of the TMH comprise of the core space under the gable roof as well as the adjacent spaces to the left and right of this space, housed under the skillion roofs. For the purpose of studying the development of spaces in the TMH, we defined the TMH spaces as rectangles bounded by the main posts and the floor joist, as shown in Figure 1. The width of the rectangles is bounded by the distance between any adjacent two posts and the height of the rectangle is bounded by the height of the shortest post. Hence, the height of the space may be limited by the roof joist in the case of "rumah ibu" space and by the extent of the post for the "serambi samanaik" and "serambi gantung" areas.

Further to the above main living spaces, additional spaces may be defined for the TMH to represent the adjoining spaces to the "serambi gantung" or "serambi samanaik" or the "rumah ibu" space. These adjoining spaces are formed from the joining of several units for which the spaces are called a "selang" (an intermediary space) or a courtyard. The skillion roofs of the basic units are usually extended to provide some shade for these adjoining spaces, but rain would typically fall through. Towards the rear of the house, an open platform could be formed called the "pelantar" or "jemuran". The "pelantar" serves as a place for washing and drying of kitchen utensils as well as a place for preparation of food. Towards the front, an entrance space called the "rumah tangga" (stair house) or "beranda" (verandah) could also be formed to serve as an entry space for the house. The "rumahtangga" space is typically smaller as it does not extend across the depth of the "serambi" spaces. The width of this space, however, could be larger than the width of the "serambi" spaces. Hence, these additional spaces are less consistent in their dimensions than the three major living spaces in TMH. In more recent development of the TMH houses, the "selang" space is roofed, sometimes forming another gabled roof by itself, or by joining the eaves of the opposing skillion roofs with a roof gutter (Figure 2).

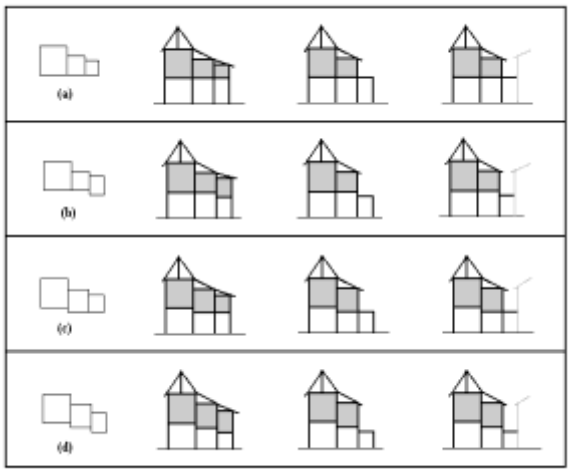


Figure 1: A single-unit house with extension towards the rear.

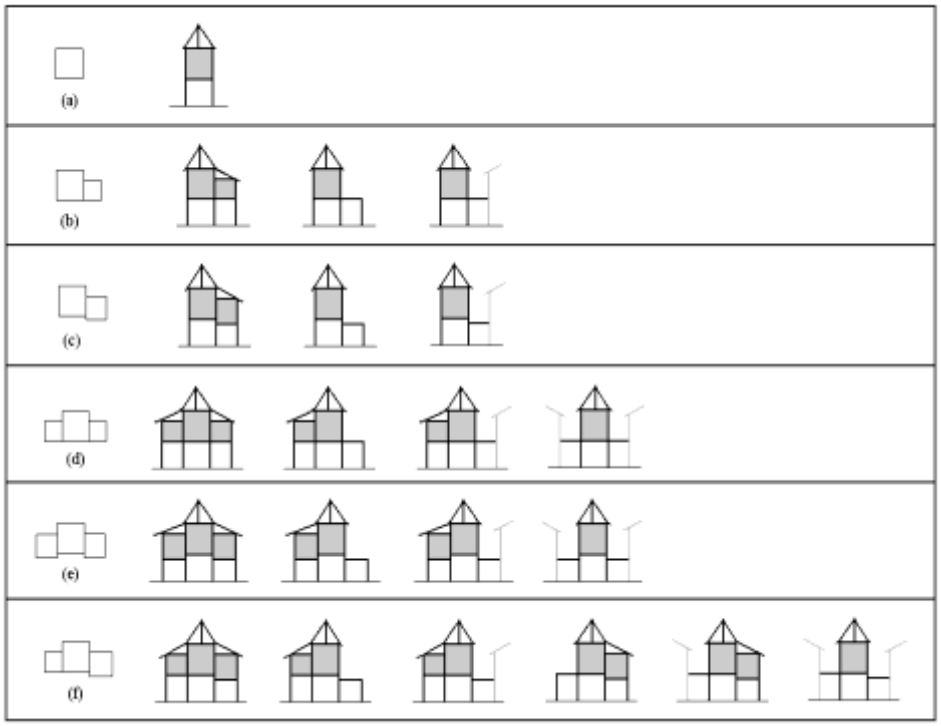


Figure 2: Variation of forms of a single-unit house independently or in conjunction with other units, where a space without roof and wall becomes a "selang" or a "pelantar".

From the design perspective, the intermediate spaces introduce efficient natural ventilation and lighting to the main house, both from the front (relating to "anjung" and "serambi") as well as to the middle (relating to "selang") and to the rear section (relating to "pelantar"). It is interesting to note that in a restricted exploration of the spaces in TMH using only the three main living spaces as possible spaces, a total of nine basic forms are observable. The nine basic shapes are thought to be sufficient to represent the general forms of the TMH, as described in Said and Embi (2008). In this study, the living spaces are redefined as spaces that could be formed without any wall and roof to depict intermediate spaces. The intermediate spaces or "selang" is one of the key contributors to the green embodiments of TMH.

2.2 Green Design Concept from TMH Construction Language

In Figure 3, the main living spaces of the TMH are represented by geometrical lines. The number of timber materials and dimensions of the spaces were measured from a sample of 13 TMH representatives obtained from the collections of measured drawings and the literatures on TMH from all the four regions of the peninsula of Malaysia (Said 2011). The average ratios of the main living spaces are shown in Table 4.1. It is assumed that this ratio is maintained as further spaces are added to the left or right of the main living spaces. This assumption is justified by the requirements on the angle of the skillion roof for the adjacent spaces of the "rumah ibu". As further spaces are added, the angle of the skillion roof cannot be steeper than the previous angle and a gentler sloping of the skillion roof is expected. The limiting angle of the skillion roof is, however, near horizontal, as these would prevent a quick rain water runoff from the roof, defeating the strong environmental compatibility features of the house forms. Hence, the spaces of the TMH were observed to rarely extend beyond a fourth space but extend to another connecting single unit.

In addition to the ratio of the key dimensions, the ratios of the height of the "tunjuklangit" (kingpost) to the length of the "alangpendek" (roof joist) and that of the length of the "alangpendek" to the width of the "rumahibu" (core space) are also tabulated. The arc tangent of the height of the king post to half of the length of the roof joist is 54.5 degrees, which is the average angle of the gable roof. These almost standard design dimensions of TMH promote the reduction of wasteful materials as the construction can already be envisaged even from the raw material extraction stages. From the construction perspective, the development of the TMH promotes efficient use of timber materials in its construction as well as in managing the timely utilization of the material as the space grew

in its form and functions.

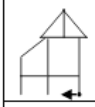
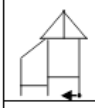
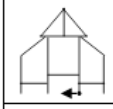
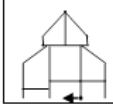
Structure	No. of Space	No. of Tiang	No. of Rasuk	House Type
	1	2	1	Rumah Bujang
	2	3	1	Rumah Ibu with Kelek Anak
	2	3	1	Rumah Ibu with Serambi Gantung
	2	3	2	Rumah Ibu with Serambi Rumah Dangau
	2	3	2	Rumah Ibu with Serambi Gantung
	3	4	1	Rumah Kutai Rumah Tiang 12 Terengganu, Kelantan
	3	4	2	Rumah Melaka Rumah N. Sembilan
	3	4	1	Rumah Tengah or Belakang
	3	4	3	Rumah Melayu Perak lama
	3	4	2	Rumah Melaka & Rumah N. Sembilan Berloteng

Figure 3: The minimum amount of timber materials required to construct the basic form.

Table 1: Average ratio of the critical dimension of TMH.

Parameters	Values
Height to width of *rumahibu* space	1:1.1
Height to width of *serambisamanaik* space	1:1.3
Height to width of *serambigantung* space	1:1.1
Floor level drop	1:0.1
Height of *rumahibu* space to height of *serambisamanaik* space	1:0.6
Height of *rumahibu* space to height of *serambigantung* space	1:0.7
Length of *alangpendek* (roof joist) to height of *tunjuklangit* (king post)	1:0.7
Width of *rumahibu* space to length of *alangpendek* (roof joist)	1:1.3

One other key aspect of TMH construction is on the direction of the houses. The decision on direction is critical in the generation of the Malay houses since certain spatial elements in the traditional Malay houses are directional dependent. For example, the "rumah dapur" (kitchen house) is always designated to be at the rear-most section or unit of the house while the "serambi gantung" (hanging veranda) is always at the front section of the house. The directions of the houses were also related to the surrounding environment from the façade point of view as well as direction of sunrise and sunset.

In TMH, the "rasuk pendek" (short floor joist) connects the two posts with a mortised joint. The height of the "rasuk pendek" indicates the available height of the rumah ibu as well as the "kolong" (space beneath the floor). The typical height of the floor level above the ground level is 1.2 – 2.0 m. The space beneath the floor is usually used as temporary storage and temporary poultry rearing area. The choice of height reflected the ease at which adult Malays can walk underneath the floor. This height also promotes cross ventilation for the spaces beneath the living spaces. The exchange of air between the living spaces and the spaces underneath promotes natural ventilation in the living spaces. The "serambi gantung" (hanging veranda) area, with the preferred floor arrangement at a lower level than the floor level of the core space is another example of a green living space. The height of the floor level of the "serambi gantung" area from the ground level is between 1 – 1.2 m. This living space is usually open and without solid wall and connects directly to the "rumah ibu". It provided a great source of lighting and ventilation for the "rumahibu", due to its frontal location. The roof element of TMH is known as the "bumbung panjang". In some cases, the "tiang gantung" (hanging post) is used in the construction. The use of "tiang gantung" may also indicate the presence of a "loteng" (attic). With the absence of the "tianggantung", the length of the "alang pendek" (roof tie girt) and the "tunjak langit" (kingpost) determines the angle of the roof. The documented angle of the roof, θ is in the range of 45-57 degrees. The steep angle of the roof serves to expedite rain water flowing as well as providing stack effect to efficiently remove heat from the "rumah ibu".

3.0 Discussions and Conclusions

The above analysis has demonstrated the robustness of the design and construction of the TMH in light of green or sustainable design. From the design perspective, the intermediate spaces introduce efficient natural ventilation and lighting to the main house, both from the front (relating to "anjung" and "serambi") as well as to the middle (relating to "selang") and to the rear section (relating to "pelantar"). From the construction perspective, the development of the living and intermediate spaces promote efficient use of timber materials in its construction as well as in managing the timely utilization of the material as the TMH grew in its size and units.

4. 0 Acknowledgement

The authors would like to acknowledge the financial support from MOHE through the grant No. 600-RMI/FRGS 5/3 (121/2012).

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