Climatic design of the traditional Malay house to meet the requirements of modern living

Kamarul Syahril Kamal, Lilawati Abdul Wahab and Asmalia Che Ahmad

University Technology Mara, Perak, Malaysia

ABSTRACT: Repeated calls for a distinct tropical architecture are being made based on the simple reason that the weather in tropical countries, such as Malaysia, is vastly different from that of countries in Europe and North America where the majority of today’s architectural innovations and movements originate. Until the advent of air conditioning, all buildings in Malaysia has been designed with particular regard to local tropical climatic conditions. With greater global awareness of the environment and a renewed perspective on contemporary Malaysian architecture, architects are once again looking for tropical solutions in building design. One of the main characteristics of vernacular houses is that they are designed with a deep understanding and respect for nature, but this design-with-nature approach is no longer found in the modern houses. This paper intends merely to focus on various ways in which the traditional Malay house can be easily adapted and improved to meet the requirements of modern living because the traditional Malay house is best reflected by the climatic design of the house itself. The traditional Malay house is an important source for the creation of a Malaysian identity in architecture because it reflects and expresses the way of life of its users and was evolved by the Malays over generations adapting to their needs, culture and environment.

Conference theme: Architecture and the environment.
Keywords: Tropical climate, traditional Malay house, building design, modern house.

INTRODUCTION

The traditional Malay house is a timber house raised on stilts. It is basically a post and lintel structure with wooden or bamboo walls. Set in a middle of a large compound, the traditional Malay house not only reflects the creative and aesthetic skills of the Malays, but also meets their socioeconomic, cultural and environmental needs. The basic design of the traditional Malay house and its construction methods give it great flexibility so that extensions to the house can be carried whenever necessary. (Nasir 1985), A distinctive feature of the vernacular Malay house is its height and/or steeply sloping roof with gables at both ends. The roof is covered with a lightweight and excellent thermal insulator made from the fronds of the local palm trees, which holds little heat during the day and cools down at night. The gables are fitted with screens, which provide protection from driving rain while allowing ventilation. Windows are plentiful, lining the walls and providing good ventilation and views for the house. This quality of openness is also reflected by the large open interior spaces with minimal partitions. Another distinctive feature is the practice of raising the house on posts above the ground. (e.g. Fig. 1)

Since many early settlements were built along rivers and the coastline, the raised floor construction was an ideal solution for coping with ground dampness in the hot and humid tropical climate and also with the heavy rains that frequently resulted in flash floods. In settlements that were built within the thick rainforest, the raised floor system also allowed the house to be ventilated through cracks in the raised floor. Traditional Malay houses have at least two entrance by steps, the main entrance at the front for visitors and males and the one at the back mostly for women and children. One of the most congenial of the traditional Malay house is its openness.

The house is divided into areas, rather than rooms, for various social and household activities. A noticeable feature in the traditional house is the absence of portions or solid ceiling-height walls separating the three main areas - the veranda, main house and kitchen - which are formed by slight floor level changes and the positioning of doorways to separate the different areas. From a distance, the traditional Malay house seems to merge naturally with the environment.

Figure 1: The basic design of the traditional Malay house

1. CHANGES, THREATS AND CONSTRAINTS OF THE TRADITIONAL MALAY HOUSE

Following World War II, a large number of new towns were created in Malaysia to support a growing and increasingly urban based population. Since then, the traditional Malay house is undergoing many changes and is faced with constant treats against its continued existence. Economic and socio cultural values promoted by modern development are making a strong impact on
the Malay house forms. Large scale housing estates of repetitive single and double storey link modern houses created suburban centers and township. Since the late 1970s, housing developments have mushroomed in all parts of the country. Even though the design and planning of houses built in many townsships across the country are fairly standard and similar, the typologies are not necessarily moulded by the local socio-economic, cultural and the environmental needs of a typical Malaysian family. The status of the traditional Malay house is being lowered and traditional Malay house forms are being vulgarized and replaced by modern housing. The deep designs of the typical units of modern houses often result in a lack of adequate daylight and natural ventilation in the inner spaces. Appropriate local building materials and the coherent and holistic design principles of the traditional Malay house form are being replaced and disintegrated by modern influences. The use of modern building materials like zins, asbestos, cement, bricks and louver windows have significantly changed the traditional Malay house forms. Zinc and asbestos are replacing the attap roofs, creating very hot and cold interiors in the daytime and night respectively and very noisy interiors when it rains. These modern roofing materials are unsuitable for the traditional Malay house because of their high thermal conductivity and the low roofs of the traditional Malay houses have no ceilings. The use of cement and bricks has also significantly changed the traditional Malay house forms where the kitchen have been dropped from the raised platforms on stilts to the ground level. This has created new additions and changed the scale of the buildings. Such extensions change the proportions, scale and character of the house creating a more solid looking house, uncharacteristic compared to the traditional Malay house which is light and airy. The louver windows have replaced the fully openable full length wooden windows in many traditional Malay houses. The louver windows create a barrier which destroys the quality of openness for ventilation and views in the traditional Malay house. The louver windows have also closed the bottom of the traditional full length windows, making it less efficient in ventilations. The While house forms should change to fit the changing needs of the users, modern changes in the Malay house form are disruptive and inappropriate because such changes are often imposed from external sources and are not understood by the local communities. These changes are often irrelevant to and disregard local socio-economic, cultural and the environmental conditions. The modern housing development projects reflects the continued existence of the traditional Malay house.

2. MALAYSIAN CLIMATE AND THE ENVIRONMENT

The climate of Malaysia referring to Yuan (1987:68) can be classified as warm-humid equatorial, characterized by high temperatures and humidity. Air temperature averages within 22 and 32 degree Celsius with small

![Figure 2: The external environment of the traditional Malay house](source: Yuan 1987)
annual and diurnal ranges. It is continually near but seldom exceeds normal skin temperature. Humidity is high throughout the year, averaging about 75% or more. With heavy clouds covering the high water vapour content in the air, direct solar radiation is filtered. The high humidity also accelerates rotting, rusting and the growth of algae and mould. The winds are generally of low-variable speed. Strong winds can occur with the rains. Rainfall is also high throughout the year averaging 250 to 300 cm annually. Rains become more intense with the monsoons. Vegetation growth is sometimes difficult to control under the good conditions of air, moderate heat and high rainfall. Air flowing across any surface is subject to frictional effects. Wind spreads are higher with increasing heights and are lower near the ground where there are many obstructions. The relatively high percentages of reflected solar radiation from the sea, sky and beach make glare controls in houses necessary. Occasional strong winds which occur during monsoon seasons may pose serious hazards to houses and the settlers. (e.g. Fig. 2)

2.1. Thermal comfort requirements

The main causes of climatic stress in Malaysia according to Yuan (1987:70) are "...high temperatures, solar radiation, humidity and glare". Therefore, to achieve climatic comfort in the modern Malaysian houses, these factors must be controlled besides the control of rain, floods and occasional strong winds. For thermal comfort, heat gain by the body from the environment through solar radiation or warm air must be minimized to constant body temperature of around 37 degree Celsius. Heat loss through conduction, radiation and convection is negligible in the climate because the air temperatures are continually near the body temperature. Direct and indirect solar radiation, hot air, together with conduction and radiation from the building fabric are also the main sources of heat gain to the body. Thus, to achieve some degree of thermal comfort, the saturated air envelope around the body must be removed. In most modern buildings where high thermal capacity material such as bricks and concrete are used, the heat absorbed within the building fabric which is radiated to the interiors of the buildings causes great discomfort. From the above discussion, it is clear that to achieve thermal comfort in the warm humid climate, solar heat gain by the building and human body must be minimized while heat dissipation from the body must be maximized by ventilation and evaporative cooling. The deep understanding of such thermal comfort requirements and the nature of the Malaysian climate is reflected in the climate adaptation of the traditional Malay house discussed in the following sections. (e.g. Fig. 3)

3. THE DESIGN REQUIREMENT FOR CLIMATIC CONTROL

From the previous explanation of the climatic characteristics of Malaysia, it is obvious that to attain optional climatic control, a modern house design in Malaysia referring to (Nasir, 1985) should provide the following points;

i. Allow adequate ventilation for cooling and reducing humidity.
ii. Use building materials with low thermal capacity so that little heat is transmitted into the house.
iii. Control direct solar radiation.
iv. Control glare from the open sky and surrounding.
vi. Ensure adequate natural vegetation in the surroundings to provide a cooler environment.

If modern house was designed and built by taking above points much into account. As a result, it is a very appropriate modern house form suited specially to the vagaries of the tropical climate of Malaysia. Indeed it is much more suited to the local climate rather than the modern western-style brick houses which are living in today. There are numerous features in the traditional Malay house that are geared towards providing effective ventilation. The quantity of openness reflects the importance given to ventilation in the design of the traditional Malay house. The elongated structure with minimal partitions in the interior will allow easy passage of air and cross ventilation. Its large roof and low windows tends to be under lighted. This gives a physiological effect of coolness as strong light is often mentally associated with heat. Indirect sources of light are the best forms of natural lighting for the climates as they minimize heat gain and glare. Direct sunlight should not be used for day lighting as it is accompanied by thermal radiation. It can be concluded that the traditional

Building Materials

- Traditional Malay houses use lightweight construction of wood and other natural materials. The lightweight construction of low thermal capacity holds little heat and cools adequately at night. The attic roof is an excellent thermal insulator. Glazed areas are seldom found in the traditional Malay house.

- Modern housing estate houses use bricks, tiles, concrete and other materials of high thermal capacity. These materials store up heat and radiate it into the house, causing considerable discomfort. Glazed areas are usually abundant in these houses.

Layout

- Traditional Malay houses are randomly arranged. This ensures that wind velocity in the houses in the latter path of the wind will not be substantially reduced.
- Rigid patterns in the arrangement of housing estates houses create barriers that block the passage of wind to the houses in the latter path of the wind.

Ventilation of Roof Spaces

- Roof spaces in the traditional Malay house are properly ventilated by the provision of ventilation points and panels in the roof construction.
- Roof spaces in the housing estate house are blocked by trapped air instead of being ventilated. Such construction requires a high ceiling to be effective.

Vegetation

- The use of coconut trees and other tall trees in the kampong not only provides good shade but also does not block the passage of winds at the house level.
- Often, because of the limited size of the compounds of the housing estate house and the need to provide privacy, only hedges and small trees are planted. Thus the passage of winds at the house level is often reduced considerably.

Figure 3: Climatic design of the traditional Malay house

Source: Yuan 1987

Figure 4a: Comparison of climatic design with modern houses
Malay house uses mainly ventilation and solar radiation control devices to provide climatic comfort for the house. These are the most effective means for climatic comfort in a house in the warm and humid Malaysian climate and environment.

3.1. Comparison of climatic design with modern houses

To fully demonstrate the effectiveness and value of the climatic design of the traditional Malay house, it would be best to compare its climatic design with that of the modern houses. The modern housing estate of a typical brick and tile is chosen for this comparison. This house form imposed with little adaptations to the Malaysian conditions has led to very uncomfortable living conditions in many Malaysian homes nowadays. Such uncomfortable conditions are mainly caused by various factors. Such factors which affect climatic design adversely will be clearly reflected when we compare the climatic design of the modern housing estate and the traditional Malay house. The design, layout, the use of materials, ventilation, solar radiation, lighting and glare of both house types are discussed in detail as follow. (e.g. Fig. 4abc)

4. RECOMMENDATION OF THE NEW DESIGN

The basic tenet of tropical architecture is finding various ways and means of reacting to and/or harnessing the local tropical climate for improved living conditions. The passive approach to tropical architecture entails keeping unwanted climate elements, such as heat and rain, out while encouraging more of the good elements, such as natural ventilation and lighting. The more active approach to tropical architecture, however, attempts to harness certain climates elements for energy and increased efficiency. The passive response to tropical architecture has been practiced for centuries and is, today, slowly making a comeback in modern residential design. The recommendation of the new design to meet the requirement of modern living according to Fee (1998:124) must follow these concepts;

i. The basic concept demands that direct sunshine and heat be kept out, as is the rain, therefore roofs are often steeply pitched to facilitate water drainage and to provide a large, ventilated roof space below which allows warm air to dissipate and the building to keep cool where gaps between wooden slats under the roof eaves can allow air to enter.

ii. Large and wide overhangs roof eaves are essential for protecting windows from sun and rain from entering, offer shading, and reduce unwanted glare.

iii. Gaps between overlapping roof eaves or flat cutout patterns above the window encourage natural ventilation.

iv. Maximizing natural ventilation in a building is essential and can be accomplished by a variety of methods, like building a house on stilts so that wind speed increases with altitude, or incorporating openings in the walls of tall buildings can encourage airflow.

v. The use of large windows and air vents in the roof or walls has a similar effect, but designs must also prevent rain from entering.

vi. Orienting a particular building towards the direction of the prevailing wind is important where the airflow can be increased by arranging houses in random order as opposed to the regular patterns seen in most housing estates which trap air and prevent adequate ventilation.

vii. Rooms with outside walls and a large roof space will remain cooler than other rooms by designing large open spaces within the house and minimizing the number of room partitions which encourages air flow and cooling as in the absence of internal walls means increased cross ventilations.

Figure 4b: Comparison of climatic design with modern houses

Source: Yuan 1987
viii. The choice of construction materials is also paramount to tropical architecture, modern building design, particularly high-rise building, may severely limit that choice. Timber is not only abundant locally but also possesses low thermal mass, meaning that less heat is retained and transmitted into the building. Bricks, concrete and glass, on the other hand, tends to radiate heat into building. A good example of the tropical design for modern residential housing adapting all the traditional Malay house concepts was the ‘Salingar house’ designed by Architect Jimmy Lim that received the coveted Aga Khan Award for Architecture in 1998 as shown below. (e.g. Fig. 5)

Figure 5: Tropical ‘Salingar house’ design for modern residential housing

CONCLUSION

From the comparison and examples as discussed earlier, it can be seen that modern housing estate houses in Malaysia are not only badly designed climatically, but they usually go against the basic requirements for thermal comfort. The characteristic as discuss earlier found in many modern houses making them very uncomfortable to live in. Besides the use of unsuitable building materials in the environment, social and economic pressure has also contributed to the adverse urban climate. With high density living, more areas are paved and less left for trees and greenery. Higher building costs and profit motivation have also cut the necessary large roof eaves short, made open shady verandas disappear and lowered ceiling heights. The need for greater security and privacy in the urban areas has led to house designs which are more closed, thus reducing ventilations. Modern bulky furniture and finishes also make the house warmer as they store up heat and make the house stuffy and crowded. The way modern housing estates are developed makes the housing estate barren of vegetation. Residents have to suffer the intense heat absorbed and stored in the barren environment. The use of the traditional Malay house form as a source for Malaysian identity in the modern contexts is both difficult and tricky and the present approaches used have largely failed for many reasons. Due to lack of understanding of the traditional Malay house, the approaches toward the use of the traditional Malay house form for the creation of Malaysian identity have been superficial and uncreative. Most of these approaches have taken the traditional Malay house into completely new socio-economic and cultural contexts. Many of them are set in the urban setting and applied to modern institutional, commercial and public buildings instead of the housing unit. As a solution, clearly lessons can be drawn from the climatic design of the traditional Malay house for housing in the modern context. Wooden houses and lightweight construction can be promoted in the suburban areas in the housing estates where densities are not so high to suit the environment.

REFERENCES