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Re-adaptation of Malay House Thermal Comfort Design Elements into Modern Building Elements – Case Study of Selangor Traditional Malay House & Low Energy Building in Malaysia

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Abstract: The traditional Malay house is one of the richest components of Malay's cultural heritage in Malaysia. Generally, the traditional Malay house is a reflection of the Malay community's way of living. With greater global awareness of the environment and a renewed perspective on contemporary Malaysian architecture, architects and designers are once again looking for tropical solutions in building design. One of the main characteristics of traditional Malay house 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 buildings. The purpose is therefore to study the thermal comfort design elements such as building orientation, interior layout space, natural ventilation and lighting, window designs, and stack effect on the roof design. The investigation was carried out through observations, interviews and some research visits. A comprehensive research was accomplished on the adaptation of Malay house architecture elements with selected the Selangor traditional Malay house as the key study and one modern building which is the Ministry of Energy, Green Technology & Water (MEGTW) building, Putrajaya. This study attempts to have recorded information for those who are interested and for the future generation because the traditional Malay house was evolved by the Malays over generations, adapting to their needs, culture and environment. This study is crucial to revive the awareness in the understanding and appreciation of the technique of thermal comfort design elements of traditional Malay house adapted into modern building design.

Key words: Design elements; Green building; Thermal comfort; Traditional Malay house.

INTRODUCTION

The purpose of this study is to investigate the re-adaptation of Malay house on thermal comfort design elements in Selangor traditional Malay house into low energy buildings in Malaysia which is the MEGTW building in Putrajaya. The elements such as building orientation, interior layout space, natural ventilation and lighting, window designs, and stack effect on the roof design will be discussed in this paper. This process of identifying the thermal comfort design elements is crucial to understand how the vernacular architecture was built in deep understanding of Malaysian equatorial climate and how Malaysian designers and architects nowadays re-adapted the thermal comfort design elements into new modern building in order to maintain the thermal comfort of the building occupants.

Traditional Malay House: The traditional Malay house is one of the richest components of Malaysia's cultural heritage. A house was designed and built by the users themselves – the Malays in Malaysia – according to their own needs and with a good understanding of nature and environment, incorporating and reflecting their way of life and culture [1, 2]. Furthermore, the design and the construction process in terms of energy efficiency, the indoor environmental qualities, sustainable site planning, the materials and resources used have always been essential aspects related to traditional Malay architectural practice. The Malay house is a perfect vernacular architecture in the past that is environmentally sustainable [2].

Traditional Malay houses have thermal comfort elements such as the use of local materials, the house orientation, high pitch roof-as stack effect function also as solar shading devices, raise on stilts-to capture high-velocity of air movement, and plenty of windows and openings-to allow more natural lighting and natural ventilation. The successful designs of the traditional Malay house in relation to the environmental aspects have made one wonder that Malay people in the past seemed to understand bioclimatic design more compared to the recent building development [3].

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Low Energy Building: On October 18, 2005 the Prime Minister of Malaysia has stated on the strategy to counter oil prices spiraling with some efforts to be undertaken to encourage more buildings to use the low Therefore, the Ministry of Energy, Green Technology and Water (MEGTW) building was designed and built by the government with technical input on Energy Efficiency from DANIDA (Danish International Development Assistance) starting in March 2002 and was completed in September 2004. This building is a National Demonstration project and it's aimed to promoting energy efficiency (EE) in buildings, and the project is part of a wider program aimed at developing the capacity of the Malaysian building industry in EE building design [6]. After the construction was completed, the MEGTW has demonstrated integration of the best energy efficiency measures towards achieving the overall best cost-effective building.

Malaysian Climate: Malaysia is situated in the equatorial region, the climate characteristics are uniform temperature, high humidity and copious rainfall. Winds are generally light. Proximity to the sea and an equatorial location generate a warm and humid climate, which is constant throughout the year [4]. The Malaysian climate can be classified as warm-humid equatorial, characterized by high temperatures and humidity. Air temperature averages between 22 and 32 degree Celsius with small annual and diurnal ranges [1].

Today, the Malaysian Meteorological Department (MMD) under the Ministry of Science, Technology and Innovation (MOSTI) has claimed that the average air temperature in most cities in Malaysia has increased. In two decades, the average air temperature has increased from the minimum of 22 degree to 24 degree and the maximum of the air temperature had reached 34 degree Celsius [5]. This result shows that Malaysian climate has been changing starting from 1990 until 2010. Therefore, architects and designers in this country should learn from ancestors and re-adapt the thermal comfort design elements from traditional Malay house as an important element that should be considered in designing modern building in Malaysia.

METHOD

Site Observation: Site observation provides the primary data for the study since it is first hand information gained through this analysis. This research first observed the Selangor traditional Malay house to study about the thermal comfort design element of the house. For example the house orientation, how the Malays arrange the interior layout space, how they design the fenestration to gain more natural ventilation and lighting, the windows design, and stack effect on the roof design.

The researcher takes photo of the selected area of Malay house which are the *anjung*, main house (*rumah ibu*), *selang* and the kitchen area. Next, the researcher stays in the house for one whole day to feel energy office concept where the premium is on saving energy. Malaysian government wants their MEGTW new building to be a showcase building for energy efficiency and low environmental impact. and experience living in the house and gather data and fill the observation cards.

The second case study is the Ministry of Energy, Green Technology and Water (MEGTW) Building at Putrajaya as the 1st modern low energy building in Malaysia. This case study observed the thermal comfort design elements in modern building which were re-adapted from the traditional Malay house. The exploration and photograph analysis also observed the orientation of the building, office space division and the interior spatial layout plan. The researcher also obtained the measured drawing of the building from the authority.

The researcher repeated the process of observation in this building similar to what had been done in the first case study. However, the spaces were totally different but the thermal comfort design elements still have been adapted into this building.

Interviewing the Experts: For this study, the semi-structured interview was conducted to get first hand data about the thermal comfort design elements of traditional Malay house and low energy building which is MEGTW building. A complete set of questionnaire was sent to the experts before the interview session. Assoc. Prof. Tajuddin Haji Ismail, lecturer in UiTM Shah Alam was chosen as the expert in traditional Malay house design and Mr. Amir Shaiful Razain Abu Zaini, assistant manager of Human Resource Department in Ministry of Energy, Green Technology and Water was interviewed as representative of the MEGTW building.

RESULTS AND DISCUSSION

The discussion based on the similarities of traditional Malay house on thermal comfort elements that were re-adapted into low energy building in Malaysia which is the Ministry of Energy, Green Technology and Water (MEGTW) building. The elements are orientation of building, interior layout space, window design and solar shading device, also the stack effect and cross effect of natural air ventilation into building space.

Building Orientation: Fig. 1(a) and 1(b) show that the main entrance of traditional Malay house was oriented to facing the East. For religious reason, most of the traditional Malay house faces Mecca (i.e. in an east-west direction) [1]. This orientation can minimize the number of areas exposed to direct solar radiation during the day and hence, reduce the heat gain in the building. This orientation was also for cultural purposes which are minimal light in the morning in concern of the occupant's dignity whereas it will gain more light in the evening so that it can reduce the artificial light usage at that particular time. This intelligent guideline was practiced in traditional Malay house construction all over the country in precedent times.

Fig. 1: a) Façade of the Selangor traditional Malay house

Fig. 1: b) House orientation of the Selangor traditional Malay house

As opposed to traditional Malay houses, the MEGTW building was oriented so that the main entrance faces the south. The reason is to reduce heat gain during the day. In planning of MEGTW building, plenty of windows were built to face north and south rather than to face east and west as shown in Fig. 2(a) and 2(b). This is also an intelligent design which can reduce the sun heat from sunrise and sunset. Even though this design does not reflect the design of traditional Malay house, but the idea to reduce the heat gain during the morning was obviously the same.

Fig. 2: a) Main entrance of the MEGTW building, Putrajaya

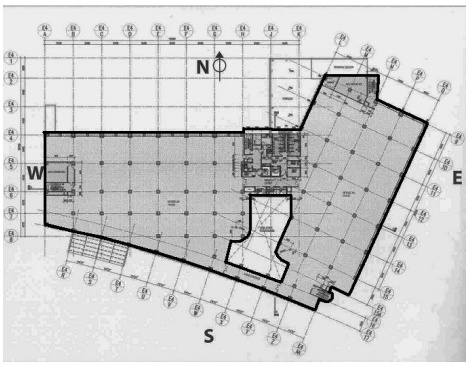

Fig. 2: b) Main entrance of the MEGTW building, Putrajaya

Interior Layout Planning: The interior layout was designed to respect the Malay culture and social relation between the occupant and the guest (Fig. 3). The main entrance of traditional Malay house was designed to face the East-West. The front portion of the house which was *serambi* and *anjung* was the area to greet the male guest. Its design has openness with no wall constructed here. The important space to greet the guest was loaded with sunlight in the morning. The main house which is *rumah ibu* was designed with minimal partition to allow the natural lighting and ventilation flow into the whole interior spaces. The *rumah tengah* and *rumah dapur* is a space to greet female guest and as the place for food preparation [7].

Fig. 3: Interior layout planning of the Selangor traditional Malay house

The architect of MEGTW building has learnt from the master builder of traditional Malay house about the interior planning. The interior planning of MEGTW building was designed based on the importance of space and electrical usage. Fig. 4 shows the main space such as general office and working area was designed to face the source of natural lighting whereby it is located near the windows and the glass wall that faces the atrium skylight. The unimportant space that is infrequently used such as the meeting room, storage area and staff pantry was located in the core area of the building. This layout design can reduce the electrical and artificial light consumption during the day.

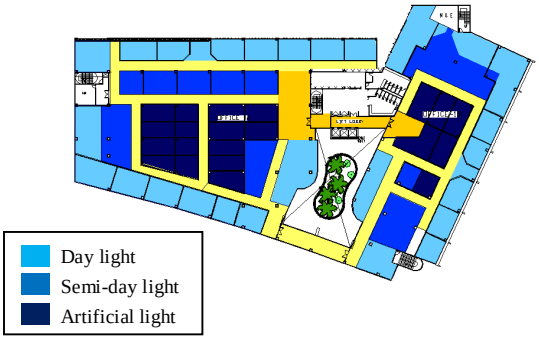

Fig. 4: Interior layout planning of the MEGTW building

Windows Design and Solar Shading Device: The traditional Malay house was designed to respect the climate of Malaysia so the master builders designed the houses with plenty of windows, pitch roof and hollow carving as fenestration design in order to gain more natural light as well as the solar shading device [8]. It also created privacy conditions for the occupant. Natural lighting illuminated the house in every angle of interior space because of plenty of windows and openings. Meanwhile in the afternoon, the roof and fenestration design shades also reduced the glare from sunlight [Fig. 5(a), 5(b)].

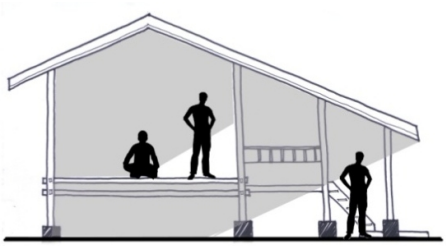

Fig. 5: a) Cross sectional of the Selangor traditional Malay house

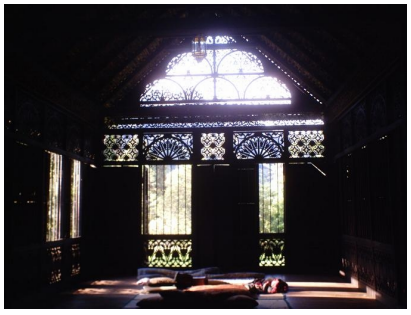

Fig. 5: b) Fenestration design of the Selangor traditional Malay house

The MEGTW building adapted the idea of fenestration design of traditional Malay house by building plenty of windows around the building façade. However, a lot of windows were built facing north and south so that the windows will gain optimum natural light. A few of windows were built in the east and west façade to reduce the heat gain from the sunlight.

Fig. 6(a) and 6(b) show the windows design of the MEGTW building. The architect designed the punch-hole windows with light shelves to gain more light into the interior space. The punched-hole or egg-crete type of window is used as a solar shading device during the afternoon in order to reduce heat from direct sunlight as well as to avoid glare for the occupants. Furthermore, the architect used window glazing glass in order to reduce the sun heat. Research from The Energy Department of MEGTW showed that the visible light transmission coefficient of 63.1% and 57% shade was better than the existing building shading devices [6, 9].

Fig. 6: a) Window design of the MEGTW building

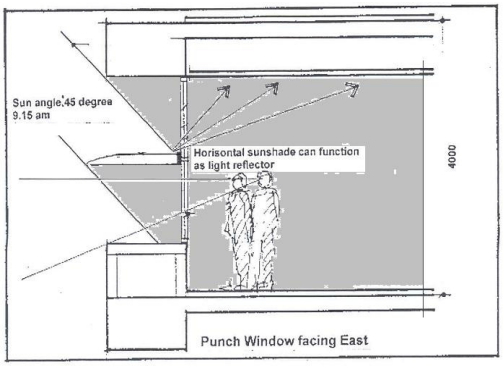

Fig. 6: b) Cross sectional of the window

The Stack Effect and Cross Effect of Natural Ventilation: The traditional Malay house was perfectly designed to fit the local climate with plenty of windows to achieve maximum air flow in order to cool the entire house [3]. Cross effect of natural ventilation that flow into the house will provide good thermal comfort to the occupant. The open interior space with minimal partition allows good ventilation in the Malay house and the fully open-able windows can allow the natural ventilation at the body level [2]. The fenestration design with hollow wood carving will let more natural ventilation flow into the interior spaces. The roof design can trap hot air and push through the air vent design under the roof. This intelligent design can decrease the heat in the interior space (Fig. 7).

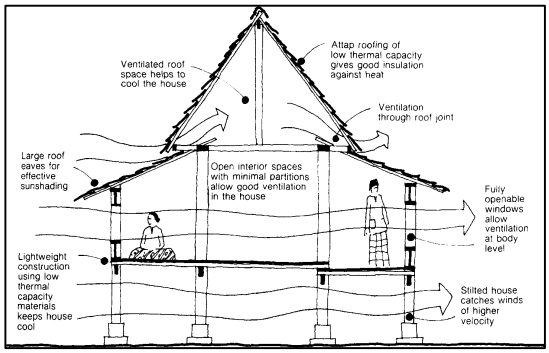

Fig. 7: Natural ventilation and stack effect diagram of Selangor traditional Malay house

The MEGTW building was designed with open atrium in the centre of the ground floor area that have void up to the fifth level of the building. The atrium designed with the solar chimney which re-adapted the idea of stack effect roof design in Malay house can reduce the hot air in the main area of the building.

As shown in Fig. 8, the thermal flue stack at the atrium pushes off the hot air out from the building through the air vent in the solar chimney. It also allows natural light into the interior office space as well as reduces the glare with the use of 50% transparency canvas as shading device in the afternoon.

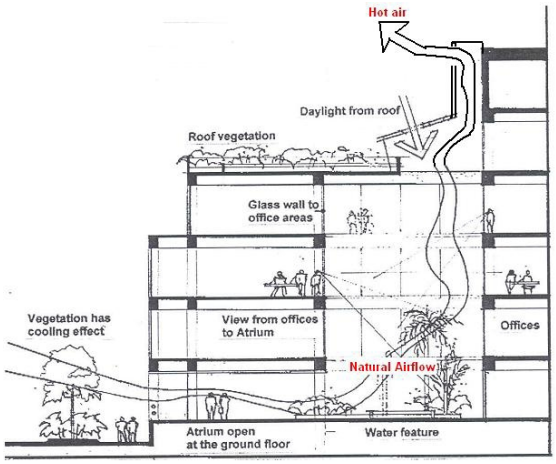

Fig. 8: Natural ventilation and stack effect diagram of MEGTW building

CONCLUSION

The Malays have a very intelligent technology and created the design elements in order to build a traditional Malay house suitable to the climate of Malaysia. From the investigation of this study, there are similarities between the thermal comfort design elements of traditional Malay house and low energy building in Malaysia. The architect and designer of the MEGTW have re-adapted the Malay house's thermal comfort elements into the development of low energy buildings in Malaysia. The thermal comfort elements that have been re-adapted are the consideration of building orientation, fenestration design, the application of natural lighting system and natural air ventilation system and the arrangement of interior spaces.

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