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Environmental Prospective of Passive Architecture Design Strategies in Terrace Houses

Wan Rahmah Mohd Zaki^{*}, Abdul Hadi Nawawi & Sabarinah Sh.Ahmad

Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, Shah Alam, Malaysia

Abstract

Conventional terraced houses in Malaysia have deep floor plans which limit natural cross ventilation. Inevitably, certain rooms are subject to solar gain and cause thermal discomfort to occupants who then dependent on mechanical cooling; thus incur high operational energy cost. This paper advocates Passive Architecture (PA) terraced house which design strategies create natural thermal comfort for occupants. The indoor thermal comfort in the two hypothetical schemes, i.e., conventional and PA terraced houses is simulated. The result shows that PA terraced house has a definite environmental prospective to house owner/occupant and offer a positive returns to the developer.

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Keywords: Passive architecture; orientation; ventilation; and indoor environment.

1. Introduction

Malaysia is located between 1oN and 7oN of the Equator and experiences daily diurnal temperature between 24 and 36oC (Meteorology Department of Malaysia, 2009). In such a hot and humid climate, mechanical ventilation or mechanical cooling is important in order to maintain comfortable indoor conditions. However, these appliances, particularly mechanical cooling system requires substantial

^{*} Corresponding author. Tel.: +6 019 2151 021.

E-mail address: warazaki@yahoo.com.

amount of operational energy, mainly electricity. A study carried out by the Centre for Environment, Technology & Development, Malaysia (CETDEM, 2006) found that an average local urban household used 44% of the total monthly electricity consumption for mechanical cooling.

Sh. Ahmad (2004) in her study on thermal comfort in residential apartments affirmed the indoor thermal comfort zone for Kuala Lumpur, Malaysia is between 23.6 and 28.6oC. Rationally, when the indoor air temperature is in these ranges, occupant would not require mechanical cooling. This is particularly possible at night, when the external air temperature drops to about 24oC. On the contrary, Kubota & Toe (2008) reported the use of mechanical cooling in houses, specifically air conditioning system is on the rise, from 13,000 households in 1970 to 229,000 households in 1990; and leaped to 775,000 households in 2000; and most houses left the system running throughout the night time. It is believed that indoor thermal discomfort happens at night due to poor house design that traps heat and solar gain during daytime and radiates it indoor at night time.

The objective of this paper is to describe the features of Passive Architecture (PA) design strategies for terraced houses and to prove that PA terraced house offers natural thermal comfort as long as possible which makes mechanical cooling at that time, unnecessary.

2. Literature Review

Passive Architecture (PA) is a term coined to describe buildings designed to be responsive to the local climatic conditions such that comfortable indoor condition is created naturally, for as long as possible (Zaki et al., 2007). The terminology is expressed as ‘passive’ to portray a defensive or protective approach of house design in shielding occupants from the local climate elements; and ‘architecture’ place this responsibility to the Architect being the ‘Principal Submitting Person’ in the Uniform Building By-Law and the profession is obligated to create good building design (Zaki et al., 2008). Fundamentally, in hot and humid tropics such as Malaysia, PA design strategies aim to avoid heat from the sun, promote natural cross ventilation from the prevailing wind and ensure daylight into the building. In the local context, it is observed that the traditional Malay house exemplifies physical attributes (e.g.: raised floor, louvered windows, large overhangs, etc.) that give the desirable effect (i.e., cool house) propagates by PA design strategies (Fig. 1).



Fig. 1. Typical Traditional Malay House

However, modern houses have evolved to be far from the vernacular ones. Nonetheless, many experts have deliberated on the critical PA design strategies for modern houses in the tropical countries.

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