CHAPTER 1.0

Introduction

Architecture in the twentieth century has been characterised by an emphasis on technology to the exclusion of other values to provide thermal comfort for its inhabitants. Modern designers and developers when designing and constructing buildings, they tend to emphasise building aesthetics and profit rather than thermal comfort of the users. Therefore, problem of too hot, too humid and even dark often occurred in modern buildings.

> *"The Modern Malaysian House is generally the epitome of the declining inhabitable indoor and outdoor environment. Due to economic reasons, the high cost of building materials, room dimensions was much smaller than those of the Colonial House, ceilings much lower..."* (AbdulMalik, 1994)

In Malaysia which is hot and humid throughout the year, air conditioning has largely used by almost every household. Studies done by Kubota (2006) showed that air conditioning used the highest energy consumption in a building. Increased energy consumption due to rapid urbanisation is a major concern in most developing countries. Thus, it is important to find passive cooling means that can reduce the need for air conditioning in this hot humid country.

Studies done by Watson (1983) showed that openings in a hot humid climate play a major role in determining the thermal comfort of the occupants as their locations and sizes determine the ventilation conditions of the buildings. Windows fulfil many

functions in buildings, such as providing visual and auditory contact with the outdoors, views to attractive scenery, induce natural ventilation, and day lighting.

There are three main issues in window design for hot and humid climate; uneven horizontal luminance distribution, glare and high solar heat gain as per stated in studies done by Sullivan (1986). Besides that, window design is one of the factors which affect the building energy consumption for lamps and air conditioning (ASHRAE, 1985). Ideally, a window should let in desirable daylight and prevent the unwanted solar radiation energy (infrared heat) that causes overheating to the interior spaces. On the contrary, for aesthetics purposes, large windows are designed causing overheating in buildings. Some buildings have mitigated solar exposure by applying solar control films and external shading devices to existing windows in order to reduce unwanted solar heat. *"These conventional films may block unwanted heat, but they also block desired visible light and change the appearance of the building."* (ASHRAE, 1985) Previous studies on natural ventilation to achieve thermal comfort for housing in Malaysia suggested that

> *"…different types of rooms had an impact on the thermal comfort. Although bungalow-type of houses is generally more spacious in terms of size it must be noted that all four sides of this type of house are directly exposed to the outdoors. This contributes to the higher indoor temperatures recorded as compared to houses with two or three sides exposed to solar radiation."* (Ahmed, Zain-Ahmed and Abdul Rahman, 2000)

Different types of building will require different number and sizes of windows. The number of windows needs to be controlled as windows not only allow ventilation and daylight but also will bring in heat at the same time.

The surveys on natural ventilation and daylighting for housing in Malaysia have been carried out by many local researchers. One of the surveys which has been conducted by AbdulMalik(1999) showed that indoor comfort could not be achieved without the mechanical aids. There is also statement stated that it is necessary to have mechanical ventilation system to cool the building,

> *"... wind in Malaysia for natural thermal comfort cannot be depended upon because of its characteristic behavior in that it is unpredictable. As a result air conditioning, fan and misting fountain were resorted to.."*
> (Martin, 1980).

Several researchers attempted to clarify the above argument (e.g. Zain-Ahmed, 2000; AbdulMalik, 1999 and more). There have been similar studies regarding daylighting performance of the integrated daylighting and ventilation system for buildings in the tropics. The above studies are an excellent source of information for understanding the natural ventilation in different types of houses. However, it was stated that although contemporary house types have shown that good thermal comfort in hot, humid climates, it could not achieved with natural cooling and ventilation alone.

> *"New innovative techniques or mechanical means need to be introduced for cooling, dehumidification and to increase and induce air movement..."*(Zain-Ahmed, 2000).

Traditional architecture sets an example for modern architecture on how the physical comfort was achieved by passive means, without energy consumption. Indoor spaces, doors, windows were planned and oriented to take maximum advantage of the climate. The role of trees, vegetation and water around the building in determining the thermal comfort was well appreciated. However, it was noted that opening design of houses has received less attention when passive cooling techniques were introduced in the literatures. There are also several similar studies on natural ventilation and day lighting in Malaysia conducted by AbdulMalik, (1999) Ahmad (2004) which focused on achieving thermal comfort using passive means but not windows as provider to thermal comfort.

A proper building design should manage to minimise heat gain of buildings, and consequently reduce the application of cooling systems. Therefore, the application of passive cooling system on a building in hot humid climate required an appropriate design for that climate.

"Façade design and ventilation are key elements to a successful strategy." (Allard, 1998) For tropical regions, where the air temperature and relative humidity are generally high, the effectiveness of natural ventilation is questionable. Therefore, this study on the impact of urban microclimate to the indoor thermal comfort, the day lighting performance and the effectiveness of window design of the British Colonial residences in Kuala Lumpur is significant. The result promotes suggestion on how to optimise window designs for urban residences. This study has targeted on high ceiling, single storey buildings among British Colonial residences in Kuala Lumpur. The investigation of the natural ventilation and day lighting component were reported here

focusing on the evaluation of the effectiveness of windows designs and their optimum performance.

The study showed the result of the window designs performance, the user's response on the indoor thermal comfort performance of selected colonial residential buildings. The result of window and wall ratio, internal air temperature and the level of day lighting on an overcast day were analysed and correlated, based on field measurement and simulation test were conducted on selected building which has the most critical urban setting for selected days.

1.1 Research Issue

British Colonial residences in Kuala Lumpur were designed with climatic responsive design.

> *"During the British period, residences had been constructed to house the British officials. These buildings have borrowed the western tradition, particularly in the style and method of construction with, of course, adaptations to the local climate."* (Ghafar, 1997, pp.45).

Openings especially windows of British Colonial residences would have contributed to make this type of building to become more climatic responsive. However, current users/occupants of the houses are dissatisfied with the indoor comfort level and resorted to install air condition as in order to cool the interiors. *"Additional air condition will affect the tangible cultural heritage which is considered worthy of preserving for the future as these buildings survives from the past is often unique and irreplaceable."*

(Raikar, 1999) On the other hand, due to city development, many of these old buildings had been replaced by high rise buildings. The initial survey showed there is a tendency to conserve some of this building type in order to retain the collective character and memory of places.

1.2 Problem Statement

Providing thermal comfort is the basic requirement of a building. In modern buildings, this is usually accomplished with the help of mechanical cooling rather than considering use the climatic factors and other natural processes to satisfy our comfort requirements.

Previously, local population used to know how to adapt to various conditions of tropical climate. Some of the practical ways in managing these climatic constraints exist in traditional buildings. "*... new buildings and constructions often do not adapt to local context and climate. As a consequence, indigenous know-how and experience is lost in many areas."* (Raikar, 1999) There is issue of whether to conserve these old buildings which are in the past it was considered responsive to climate but by observing the current urban scenario the building performance especially the windows design becomes questionable.

The heritage buildings in Malaysia are examples of a sensitive approach as to energy conscious building which achieves for indoor comfort conditions. The concepts used in the heritage buildings should be rediscovered and reapplied to comply with the present requirements of passive design in architecture.

"Window is the most basic element that need to be considered seriously in order to achieve thermal comfort in a building." (Chand, 1986) This study aims to investigate the various window designs applied in British Colonial residential building in Malaysia in tackling the adversities of the climate.

1.3 Objectives

The objectives of this research are:

- To evaluate the effectiveness of the window design of British Colonial Residences for improved indoor thermal, day lighting and ventilation condition in the urban climate of Kuala Lumpur

- To evaluate the impact of urban microclimate on the indoor thermal comfort and daylight performance of British Colonial Residences in Kuala Lumpur

1.4 Significance of Study

This study aims to preserve the British colonial residences in Kuala Lumpur by utilising the natural environment, namely natural ventilation and day lighting.

1.5 Scope of Study

The study focuses on the effects of different design on windows, under naturally ventilated conditions, with reference to several zones in selected bungalows. These design variables are limited to:

a. Selected residences based on the availability of measured drawings in Resource Centre and CORE (Centre for Conservation Studies and Records)

b. Case study in Kuala Lumpur due to the most significant urban changes through development throughout these 20 years. Consequently, climate in Kuala Lumpur also has a drastic changes compared to other cities in Malaysia.

1.6 Research Limitation

Due to time constraint, this study was conducted using five (5) colonial residential buildings located in Kuala Lumpur. The five houses selected for window to wall ratio calculation are all government properties and one of the houses: the Badan Warisan Malaysia is a recognisable conservation non-government organisation which conserves and promotes to public for preserving, restoring and conserving heritage buildings in Malaysia. Residences that have been chosen are either converted into offices (which are open only during working hour, from 8am – 6pm, such as JKR 989 and JKR 511) or abandoned (which is closed all the time, such as JKR 1331). Among the five houses, only one building which is Badan Warisan Malaysia was selected to fulfil the field measurement and simulation test as this building has the most critical urban setting compared to the other buildings. As a result of limited measuring instruments in laboratory and complicated procedures introduced by Badan Warisan Malaysia, the measurements were conducted on limited days.

Simulation software-AIOLOS and bioclimatic graph were derived for Western countries; there will be a deviation when it applied in tropical countries.

1.7 Research Problem

Among the selected British Colonial houses which were investigated- JKR 511 and JKR 989 had been converted from houses into offices. The function for some of the rooms in the residences had been changed. Office staff occupied JKR 989 during field measurement and simulation test.