UNIVERSITI TEKNOLOGI MARA

A CLIMATE RESPONSIVE APPROACH FOR THERMAL COMFORT IN MALAYSIAN BUILDINGS

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In the name of Allah, the Most Beneficent and the Most Merciful

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ABSTRACT

Climate has been recognized as one the major factors which influences energy consumption in buildings. Malaysia is a hot and humid country and the climate of Malaysia imposes thermal pressure on buildings due to thermal difference between the desired internal temperature and extremes of the external temperature. The building envelop is to protect from the extreme temperature while the optimum set point for air conditioning system will avoid energy wastage. Adaptive thermal comfort model shows that human thermal comfort is dependent on the average external ambient temperature, thus the monthly average temperature is required for determining the thermal comfort set point temperature. Managing and controlling the heat from the ambient external condition to the thermally comfortable internal condition requires knowledge on the external climate condition, the desired internal thermal comfort condition and the interfacing building envelope behavior.

This thesis which analyses the various external climate parameters for seven typical locations in Malaysia, uses adaptive thermal comfort model to recommend optimum design temperature as guideline, either for air conditioning control parameters or natural ventilation. The temperature design guideline is classified into maximum preferred thermal comfort, thermal comfort and acceptable thermal comfort. Psychrometric analysis is a very useful tool, developed in this thesis using Visual Basic for analyzing the climate with reference to the thermal comfort zone. It gives the moist air properties extra information, such as enthalpy and humidity ratio, which are very relevant to when estimating the amount of heat and water that is needed to be extracted for thermal comfort in buildings. Design tools were also developed to simulate the influence of solar radiation on building envelope under transient dynamic condition. These design tools are very significant in facilitating the understanding of thermal behavior and proper design condition for energy efficiency and thermal comfort.

CHAPTER 1

INTRODUCTION

One of the objectives of Malaysian energy policy is to promote the efficient utilization of energy and to discourage wasteful and non-productive patterns of energy consumption [1]. The need for energy efficiency on Malaysian building and the prospect for climate responsive approach to achieve thermal comfort inspire this study on energy efficiency and thermal comfort.

In 1983 the United Nations appointed an international commission to propose strategies for “sustainable development”- way to improve human well-being in the short-term without threatening the local and global environment in the long term. The Commission was chaired by Norwegian Prime-Minister Gro Harlem Brundtland, and its report “Our Common Future”, published in 1987 was widely known as “The Brundtland Report”. The report defined sustainable development as "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [2]. This energy efficiency studies in building is inline with the spirit of the sustainable development agenda.

Climate, which has a major effect on building energy consumption, will be analyzed in this thesis. The process of identifying, understanding, managing and controlling climatic influences at the building site is the most critical part of building design. Energy utilization depends on climate. If the external climate is already comfortable then there is no need for conditioning. In this condition, no cooling or heating is required and therefore no energy is required for conditioning. On the other hand, if the external climate is hot and not comfortable, there is a need for conditioning. Thus, energy is required for conditioning. The energy for conditioning is dependent on the temperature difference between the external condition and the desired internal condition and the physical properties of the wall separating the two. Similar building in different climate