CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Wind Engineering is best described as the rational treatment of interaction between wind in the atmospheric boundary layer and man and his works on the surface of earth (Cermak, 1975). It comprises a synthesis of knowledge from fluid mechanics, meteorology, structural mechanics, physiology and the like. Although aerodynamics is of central importance, most applications are non-aeronautical in nature. As far as structural engineering is concerned, the evaluation of wind-induced pressure loads on building surfaces, primary and secondary structural systems, and the consequent along wind, across wind and torsional response are clearly the most important applications. Good knowledge of fluid and structural mechanics is the fundamental background necessary for the understanding of details of interaction between wind flow and civil engineering structures or buildings.

The unsteady character of the wind regime, particularly in urban areas, combined with the additional unsteadiness generated by the separated flow after the wind impacts on a building generates highly fluctuating pressures depending on the flow characteristics and the building configuration. Naturally, the wind-induced pressure regime is more complex than the wind flow regime, so its evaluation becomes more cumbersome and analytical techniques fail in most cases. Consequently, boundary layer wind tunnels simulating atmospheric flows have been used and continue to use extensively for the evaluation of wind loads on buildings. Computational approaches have progressed through the last decade but they are still at a level that hesitation prevails when their results are suggested for use in practical applications.
Local winds have minimal influence on primary and secondary circulations but, regardless, they may have high intensity. Thunderstorms, caused heavy precipitation (like wall jets) and tornadoes, which are the most powerful winds causing maximum damage, belong in this category.

Malaysia is located near the equator. In general, the wind climate is dominated by the two monsoon seasons and the inter-monsoon thunderstorms. The northeastern monsoon blows from December to March, usually accompanied by heavy rains. Around June to September, there blows the southwestern monsoon which is slightly tranquil. Thunderstorms frequently occur during the inter-monsoon periods. Although thunderstorms are localized phenomena, they often produce significant strong and gusty surface winds. These winds from thunderstorms are relatively stronger and more turbulent than those of monsoon winds. (Choi, 1999) Unlike in cyclone prone region, the thunderstorms in Malaysia occurs in micro scale (Yusoff, 2005). Despite their small size and short duration of thunderstorm which is about 15 to 30 minutes. Every thunderstorm produces lightning which has the potential to kill people. Heavy rain from thunderstorms can lead to flash flooding and landslides. Strong winds and hail are also dangers associated with some thunderstorms.

Currently in Malaysia, a wind-related disaster is not being given priority due to lack of expertise and awareness among the Malaysian. Incidences of damaged houses have been reported in daily Newspapers. From the reported news, it is observed that most of the damage occurs in northern region on peninsular Malaysia. The climate change in the world has resulted in significant increasing in the numbers of incidences of freak wind storm in Malaysia. It is of vital that study be carried out to under the characteristics of such freak wind storm. Damage due to wind occurs due to lack of concern regarding wind effect to building structure. Moreover most codes of practice do not reflect much the structural system and materials used in Malaysia practice. It is clearly shown that repeated type of damage occurs at different places in Malaysia. However, no concrete measure has been seen to be taken to address such potential dangerous hazard.
Frictional effects play an important role for wind near the ground surface. Stathopoulos (2007) reported that ground obstructions slow down the movement of air close to the ground surface causing reduction in wind speed. Thus, the mean wind speed may change in direction slightly with height, as well as magnitude (Holmes, 2001). Recently, Computational Fluid Dynamics (CFD) has become a powerful tool for the study of airflow through and around structures in built-up areas. CFD enables to see results almost immediately and allows exploring the effect of different wind speed and direction. CFD techniques may be used for determination of wind effects where Standards are sometimes not directly or as easily applicable, for instance when designing tall buildings and non-conventional structures. (Mendis et.al, 2007).

High-rise buildings are particularly influential to wind effects. Therefore, information regarding the wind flow pattern can be important for architects and engineers. However, with the advent of computational analysis using advanced modeling techniques like CFD, it is made possible to simulate the same condition in a virtual environment. CFD allows designers to analyze a full domain of the model and presents the results of analysis in an easy to understand graphical way.

Methods for reflecting directional wind characteristics have been proposed by Cook and Holmes. Matsui et al. has examined the effects of directional wind characteristics and the orientations of structures on wind loads on the basis of the Holmes method. It is important to decide the directional characteristics of strong winds at a construction site in order to achieve a resilient wind-resistant design. Wind load in structural engineering can be defined as the natural horizontal load produced by air and it is the most important element because wind load has a great deal of influence on building design and the design of other kinds of civil engineering structures. Usually structure members fail because of inadequate consideration given to wind action at the design stage. In practice, it has been found useful to start with a reference wind speed based on statistical analysis of wind speed records obtained at meteorological stations throughout the country or near to the area of study.