CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Wind-related disaster had become significant impacts in our society which responsible for the tremendous physical destruction, loss of life, injury and economic damage. The severity and increased frequency of wind-related disaster events over the past few years in Malaysia has shifted the attention from several researchers towards to investigate the effect of wind effect on building structure in Malaysia. On June 13th 2013, a severe thunderstorm hits Penang which lasted for about an hour. In this tragedy, the lightning arrestor pole together with several accompanying structure, the fin-shaped wall attached to a 21-storey UMNO Tower Penang came crashing down during a thunderstorm, crushing vehicles, killing two and five were severely injured. Therefore this study was carried out to investigate the effect of wind speed and direction to the building tower.

Wind occurs due to the existence of different level of atmospheric pressure. When a difference in atmospheric pressure exists, air under high pressure will moves towards area of lower pressure, which in turn resulting in wind of various speeds. The greater the difference in pressure, the faster the air flows. Liu, (1991) stated that, building or structures deflect winds causing a change in wind speed and direction around the buildings or structures Wind has a very dynamic, unsteady flow pattern in the environment (Vasan & Stathopoulos, 2012). Due to this point, not every point on a building or structure in the path of flow has the same velocity. These characteristics can be reflected in the velocity distributions on the building surface in the path of flow.
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.

Figure 1.1 Example of result obtained from CFD analysis
Matsui et al. (2003) 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. Structural member fails 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.

1.2 PROBLEM STATEMENT

Design and orientation of building or structure did not consider the repeatable load effect to the building which at some point could contribute to the structural damage or failure. All of the standards provide the value of coefficients specifically for orthogonal wind directions and regular-shaped buildings. The standards do not apply to buildings or structures that are of unusual shape or location. Furthermore, the scope of MS 1553:2002 is limited to a small range of geometries and structures for which the wind loading does not control the design.

1.3 OBJECTIVES OF STUDY

In any research, there are some objectives to be achieved. In this research, the objectives are:

i. To investigate the effect of building orientation and shape to the wind characteristics.

ii. To simulate the building against variation of wind speed and direction by using Computational Fluid Dynamics