CHAPTER 1

INTRODUCTION

1.1 GENERAL

High-rise buildings have always been a key construction development over the years in keeping pace with the increasing demand of human population. This in turn had shifted the attention of engineers and designers in looking into various possible way of building or constructing the safe sound structure. Typical high-rise building can be categorized as reinforced concrete frame or steel frame.

Rapid advancement in the field of construction had given a platform for steel construction to develop at enlarging scale. Steel frame, for instance is a structure in which the weight is carried by steel skeleton or framework, as it is opposite to wall support system. It was true enough that steel frame has many advantages compared to ordinary reinforced concrete frame in terms of faster time of erection, better quality control, design flexibility, sustainability, and lesser weight than RC structures which in turn requires lighter foundation, and occupies less space which can be designed for larger span/column free spaces. Basically, the mechanism of loads distribution for both steel frame and reinforced concrete frame are similar, in which load from the beam was transferred to column, and finally to the foundation. Steel frame particularly function well under high lateral (wind) loading, because of its ductility, and that’s make it preferable in high-rise structure. More than that, steel frame has capability to bend without breaking and absorb the energy acting on it. Steel frames were able to carry the weight of more floors, so walls became simply cladding for the purpose of insulating and adorning the building.
On the other hand, the construction of braced steel frame structure has become equally important in construction industry as it will resist the lateral forces that might act on the structure. Braced steel frame is well known in Malaysia in the context of high-rise structure. Generally, this frame exists under the provision of bracing elements that was aimed to provide stability and resist wind loads. Bracing is an element used to support and strengthen various part of a building and it will usually provide lateral stability for columns and beams. Steel braced frame with lateral bracing is very common in high-rise construction and has advantages in terms of simplicity and economical construction.

Typically, there are four types of bracing that are used in practice, which includes X-bracing, Inverted V-bracing, K-bracing and diagonal bracing. Each of these bracing provides has different strength on the structural integrity of steel frame. Similarly, each of these bracing types can be used either on one bay or multiple bays. Therefore, there are plenty of ways in which to brace a building. For this study, multitude of these combinations were modeled and analyzed to determine the appropriate bracing type and layout for 30-stories steel frame building subjected to wind load.

1.2 PROBLEM STATEMENT

A very significant parameter that influences the limits of today’s high rise construction is the wind loading, and yet one of the biggest concerns is to deal with the lateral drift. Over the years, numerous studies have been conducted on the issue of lateral drift on the structure that was deemed the biggest threat to high-rise construction due to wind loading and any serviceability issues that may arise from this lateral movement. Engineers and designers faced a hardest task when designing high-rise structure subjected to substantial wind forces which has lead them to address the issue in the early stage of design development. Building is about to face severe damages if too much of drift takes place on the building under lateral loading. According to Ho and Schierle (1990), excessive lateral drift on building can cause significant damage on secondary systems, such as partitions, curtain walls and structure’s interior walls, which in turn will generate secondary column stress due to P-delta moments that can also
induce problem on column stability. Basically, there are three paramount perspectives in regards to drift and lateral stability, which are structural stability, architectural integrity and potential damage to various non-structural components and lastly human comfort during and after the building experiences the motions. Thus, in buildings over approximately 30-stories, the bracing technique becomes a vital part of the design. Providing bracing to the steel frame could reduce the lateral drift of the structure and thus lead to safer building to the users. However, choosing the correct bracing type and its’ appropriate orientations in frame structure is of utmost importance in order to generate fruitful results of resisting the lateral forces.

1.3 OBJECTIVES OF STUDY

The objectives of this study are:

i. To study the effect of different bracing type on the lateral drift of 30-stories steel frame building.

ii. To analyze the effect of varying the position of bracing prior to minimization of lateral drift of 30-stories steel frame building.

iii. To compare the effect of pin connection only to a combination of pin-moment connection in reducing the lateral drift of 30-stories steel frame building.

1.4 SCOPE OF STUDY

The scope of this study was related to the design of steel frame structures with different bracing technique and its’ orientations on frame structure using Eurocode 3 of ANSYS. The general information regarding the steel frame was shown in Table 1. The structural integrity of 30-stories steel frame building to take on drift control with different bracing types and layouts was discussed in detail. Illustrated in Figure 1.1, four types of bracing were used throughout this course of study, which includes X-bracing, Inverted-V-bracing, K-bracing and single diagonal bracing. Moreover, each of the bracing system was tested using 21 different models, at which each model will have different bracing location prior to lateral drift minimization, as shown in Figure 1.2 (for