

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Historical Background:

For the structural engineer the major difference between low and high-rise buildings is the influence of the wind forces on the behavior of the structural elements. Generally, it can be stated that a high-rise building structure is one in which the horizontal loads are an important factor in the structural design. In terms of lateral deflections a high-rise concrete building is one in which the structure, sized for gravity loads only, will exceed the allowable sway due to additional applied lateral loads. This allowable drift is set by the code of practice. If the combined horizontal and vertical load cause excessive bending moments and shear forces the structural system must be augmented by additional bracing elements these could take several forms [12].

The first high-rise buildings were constructed in the United States in the 1880s, had been largely for commercial and residential purpose. They arose in urban areas where increased land prices and great population densities created a demand for buildings that rose vertically rather than spread horizontally, thus occupying less precious land area. High-rise buildings were made practicable by the use of steel structural frames and glass exterior sheathing. By the mid-20th century, such buildings had become a standard feature of the architectural landscape most countries in the world. The feasibility and desirability of high-rise structures have always depended on the available materials, the level of construction technology, and the state of development of the services necessary for the use of the building. As a result, significant advances have occurred from time to time with advent of a new material, construction facility, or form of service. With the rapidly increasing number of masonry high-rise buildings in North America toward the end of the nineteenth century, the limit of this form of

construction became apparent in 1891 in the 16 story Monadnock Building in Chicago. With the space in its lower floors largely occupied by walls of over 2m thick, it was the last high-rise building in the city for which massive load-bearing masonry walls were employed. The new material allowed the development of lightweight skeletal structures, permitting buildings of greater height and with larger interior open spaces and windows, although the early wrought-iron frame structures still employed load-bearing masonry façade walls. The first high-rise building totally supported by a metal frame was the eleven story Home Insurance Building in Chicago in 1883. Two years later, in the same city, diagonal bracings were introduced in the façade frames of the 20 story Masonic Temple to form vertical trusses, the forerunner of modern shear wall and braced frame construction [1].

High-rise buildings subjected to gravitational loads of permanent and temporary addition to the lateral loads resulting from the movement of wind or earthquakes. Fire are the primary consideration in the design process, the design considerations for fire prevention and protection, smoke control and fire fighting[1].

Modern high-rise buildings of the framed tube system exhibit a considerable of shear-lag with consequential reduction in structural efficiency. Despite this drawback, framed-tube are widely accepted as an economical system for high-rise buildings over a wide range of building heights. This is because in the framed tube system the lateral load resisting elements are placed on the outer perimeter. The tube comprises closely spaced columns that are connected at each floor level by deep spandrel beams. Such buildings are usually equipped with service cores, which many house the lifts, emergency stairways, electrical and mechanical zones and other services. These cores referred to as the internal tubes are often designed to provide added lateral stiffness to the building, they also interact with each other as well as with the external tube. Framed tube structures with multiple internal tubes, or tubes in tube structures, are widely

used due to their high stiffness in resisting lateral loads and the availability of the internal tubes in supporting the vertical loads [11].

### **1.2 Research Problem:**

This study is very important. Because designers lately rely heavily on computer analysis when designing. Computer analysis results should always in practice be checked safety ensured and fulfillment of the economical aspect.

### **1.3 Objectives of Study:**

This study aims to achieving the following objectives:

- 1- To indentify the various structural systems which are used in buildings.
- 2- To indentify the special consideration in the design of high-rise buildings by using American Standard for framed tube system.
- 3- To analyze the high-rise buildings using linear elastic methods according to approximate methods.
- 4- To analyze and design framed tube system by using computer program (ETABS 9.5.0)
- 5- To compare the analysis results obtained using approximate methods and computer program for structure under gravity and lateral loads.

### **1.4 Methodology of Study:**

To achieve the above objectives the research uses the following methodology:

- Collect information on high-rise buildings from the available references, internet and previous researches.
- Taking the wind reports from previous researches that were conducted to the wind loads.
- Using ETABS program in the analysis of the building and then compare the results with the results of manual analysis.

### **1.5 Research Hypothesis:**

- 1- The material of the structure and the structural components are linearly elastic.
- 2- Only the primary structural components are considered and nonstructural components are assumed to be negligible and conservative.
- 3- Floor slabs are assumed to be rigid in plane.
- 4- Component stiffness of relatively small magnitude are assumed negligible.
- 5- Deformations that are relatively small, and of little influence, are neglected.
- 6- The effects of cracking in reinforced concrete members due to flexural tensile stresses are assumed represent able by a reduced moment of inertia.

### **1.6 Outlines of Thesis:**

This study consists of six chapters, the contents of these chapters are as presented below:

Chapter One : Introduction, historical background, research problem, objectives, methodology, hypothesis and outlines of thesis.

Chapter Two: Literature Review, loading, lateral resisting system, modeling for analysis, high-rise behavior and approximate analysis methods.

Chapter Three: Manual Analysis and Design, description of case study, analysis results and design results.

Chapter Four: Analytical Modeling of Framed Tube, linear static analysis, structure system model and symmetrical structure systems.

Chapter Five: Analysis and Discussion of Results.

Chapter Six: Conclusions and Recommendations.