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Faculty of Engineering

ANALYSIS OF SHEAR WALLS IN FRAMED STRUCTURES

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الله

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Abstract

The thesis deals with the analysis of shear walls with openings subjected to lateral loads. The finite element method is used for the analysis as it is a powerful tool of illustrating the internal action in all wall elements as well as the details of wall deformation efficiently.
A comprehensive finite element computer package is used for the analysis, the package includes the elements necessary to accurately simulate the shear wall whatever is its geometry. Both symmetrical and unsymmetrical curtailed shear walls with openings are investigated.
A comprehensive parametric study on these walls is performed concerning many parameters such as: shear wall breadth, opening width, soil modulus of elasticity, curtailment length, and raft foundation thickness. The results indicating the wall drift, the distribution of stresses under the wall foundation and the internal forces in lintel beams are drawn. The results of the study are analysed, discussed and useful recommendations regarding the analysis and design of curtailed shear walls with openings are stated.

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INTRODUCTION

INTRODUCTION

The accumulation of residential and business establishments at the central zones of main cities, together with the increasing cost of land, requires the vertical extension of the constructed buildings for social and economical reasons.

Such high rise buildings may be defined as those in which the effect of the lateral forces, such as wind and earthquake, are more dominant than the gravity forces, thus necessitating careful study of the design and stability of the structures.

Since the late nineteenth century when the first skyscrapers were built, the main aim of structural engineers and architects has been to achieve efficient and economical structural systems for various ranges and heights of buildings going all the way up as well as 100 stories.

Advanced researches on building materials such as reinforced concrete and structural steel allowed for an efficient use of these materials in choosing an economical method of building tall structures.

The process of choosing the structural system for tall buildings depends on many aspects, one of them may include the foundation considerations. For example, tall buildings having rock soil available near the ground level, is considered to have stable foundation, for this case the structural system or materials are not affected. The structural system also depends upon the overall proportions of the tower, the height to width ratio accompanied with the floor area ratio of the building. Climatic conditions including the wind effects and the seismic zone in which the structure lies, is of utmost importance. The structural system considering the floors deflections, wind, earthquake sway must be in coordination with the architectural, structural and mechanical system requirements.

The available choices of reinforced concrete structural systems are:

a) traditional beam column framing, which may or may not be simulated by flat slabs or waffle constructions, this system can be suitable up to 20 stories.

b) shear wall systems in the direction of lateral forces and continuous shear walls up to 150 stories

c) shear wall frame interaction where shear walls interact with beam-column or slab-column type of framing, suitable for up to 70 stories.

d) framed-tube created by closely spaced exterior columns tied at each floor with deep spandrel beams simulating a hollow tube with perforated holes (window openings) suitable up to 60 stories

e) tube in tube system where an exterior closely spaced column and spandrel beams creates an exterior tube interacting with an interior tube made by shear walls enclosing the surface core, suitable up to 100 stories.

f) modular tube system where an exterior closely spaced column spandreled tube is stiffened by walls or grid walls dividing the tube into two or more smaller tubes within the boundary of the overall building.

Another available choice of structural systems is the structural steel systems (frames and trusses) or a composite structural system for example a concrete exterior framed tube accompanied with a steel interior framing.

The structural system studied in this thesis is the reinforced concrete system shear walls. In general shear walls are considered so rigid in their own plane so as to resist almost all the lateral loads imposed on the structure. They are well suited for constructions in earthquake areas and one of its main advantages is the low reinforcing steel content.