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Ain Shams University
Faculty of Engineering
Structural Engineering Department

Finite Element Modeling of Lateral Loads Resisting R.C. Cores of Irregular Shapes

By
Akram Mostafa Fetoh Abdelmaksod

Thesis

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
In
Structural Engineering

Supervised by

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STATEMENT

This thesis is submitted to Ain Shams University for the degree of Doctor of Philosophy in Civil Engineering (Structural Engineering).

The work included in this thesis was carried out by the author in the Department of Structural Engineering, Faculty of Engineering, Ain-Shams University, From February 2017 to December 2019.

No part of this thesis has submitted for a degree or a qualification at any other university or institute.

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ABSRTACT

Analysis of tall buildings under the effect of lateral loads is commonly performed using highly sophisticated commercial software finite element analysis packages. Reinforced concrete cores are among the structural elements used extensively to resist lateral loads. In order to account for concrete cracking, the design of these cores is performed using interaction diagrams, based on the relevant code idealization of the strain diagram throughout the section height. This idealization does not differentiate between cores of regular and irregular shapes. In addition, the torsional movements of these cores are not considered in computation of their ultimate capacity.

In this research, an extensive study is conducted to investigate the actual structural behavior of cores of different section shapes, through the development of highly accurate nonlinear finite element analysis models, taking into account steel yield, and concrete cracking.

A parametric study was conducted to assess the actual structural behavior of symmetric and un-symmetric core shapes, taking into consideration several factors including effect of various degrees of torsional movements on the overall section capacity, width to thickness ratios for walls of R.C. cores, and the steel to concrete ratio. The analysis results are compared to those obtained for the same sections using commonly used commercial software packages, and the differences are highlighted. The overall conclusions reached are used to make important recommendations regarding the “reduction factors” which need to be applied to the common interaction diagram design procedure, in case of cores of irregular sections in order to give designers a more realistic and accurate estimate of the core’s ultimate carrying capacity.

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