AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

TOWARDS A CONSISTENT SEISMIC DESIGN EGYPTIAN CODE

By

Eng.Safinaz Saeed Khalifa
B. Sc, Civil Engineering – Zagazig University 1994
M.Sc. Ain Shams University 2005

A Thesis
Submitted In Partial Fulfilment For The Requirement Of Degree Of
Ph.D. In Structural Engineering

Supervised by

Prof. Dr. Amin Saleh Aly	**Prof. Dr. Essam Ahmed El Kordi**
(Prof. of Structural Engineering	(Prof of Structural Engineering
Ain Shams university)	Alexandria university)

Cairo 2013

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EXAMINATION COMMITTEE

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Title of thesis :- **TOWARDS A CONSISTENT SEISMIC DESIGN EGYPTIAN CODE**

Degree :- **Doctor of Philosophy**

Committee:-

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Date : ……/……../ 2013

STATEMENT

This dissertation is submitted to Ain Shams University in partial fulfilment for the requirements of the degree of Doctor of Philosophy in structural engineering.

The work included in the thesis was carried out by the author in the structural engineering department, ain shams university.

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

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AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Structural engineering department

Abstract of the Ph.D. thesis submitted by **Eng. Safinaz Saeed Khalifa**

Title of thesis :- TOWARDS A CONSISTENT SEISMIC DESIGN EGYPTIAN CODE

Supervisors

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ABSTRACT

Several Egyptian codes of practice have been published in Egypt during the past two decades, for example “The Regulation of Earthquake – Resistant Design of Building in Egypt” [ESEE 1988], “The Egyptian Code for Load and Forces“ [ECLF 1993] released in 1993, “the Egyptian Code of Practicf for Loads and Forces” [ECLF 2003] released in January 2003, forwarded by the [ECLF 2008]. Great inconsistencies (variances) were observed among the different Egyptian seismic codes and the international current well known seismic building codes namely the Eurocode [EC8:2003] and the international building code [IBC 2009] concerning the absolute values of the calculated base shear forces obtained by the considered seismic codes, in addition to great difference concerning the method of determining the

equivalent static base shear forces and the parameters constituting the presented equations.

The thesis presents a parametric study followed by an analytical study concerning nine residential moment–resisting frame reinforced concrete structure buildings (models), with a regular configuration and regular stiffness in plan and elevation. The buildings are assessed according to the regulations of the ECLF 2008. The chosen case studies represent the mid-rise up to the level of high-rise multistory building used in Egypt from the structural system, ductility requirements, occupancy and use aspect. Also, the models undergo the precautions recommended by the ECLF 1993 (the total height of the building does not exceed 100m. and also does not exceed five times the dimension in the direction of the earthquake excitation) , so that the equivalent static method of analysis could be applicable. The considered models are being split into 3 groups as three heights are considered governing the range of mid-rise up to high–rise multi storey buildings (45m, 60m, 90m). The three groups are divided into three categories, each category is concerned with a specified factor K (geometrical aspect ratio) which is the ratio between the total height of the building (H) to the dimension (b) in the direction of excitation (K=3, 4, 5). The study undergoes the implementation for the equivalent static method for determining the equivalent static base shear value according to the six seismic building codes under consideration. In order to obtain a reasonable and realistic comparison, common conditions are presented, such as the same type of soil, the same type of foundation, and the same ductility considered (D.C.M). The Peak Ground Acceleration PGA considered is 0.3g. is Then the three dimensional dynamic response spectrum method of analysis is applied to obtain the actual dynamic base shear values by using the SAP200 software program for structural analysis. Then the analytical study is presented through the regression analysis by using the (IBM SPSS V.20) software program.

The current study presents more consistent equations for the determination of the fundamental natural time period concerning the mid-rise up to high rise regular MRF RC buildings. The study gives the allowance for the implementation of the equivalent static method of analysis for heights exceeding the height limitation presented in the EC8:2003, the ECLF 2008 and the Euro code EC8:2003. The study also presents new seismic factors such as KD which governs the relationships among the absolute actual dynamic base shear forces in the different seismic codes presented in addition to the factor R0 that represents the relationship between the equivalent static base shear forces and their corresponding actual dynamic base shear forces in each seismic code presented. Finally the thesis presents a more consistent and economic base shear values in comparison to the current seismic codes considered.

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