EVALUATION OF CODE REQUIRED SEPARATION DISTANCE BETWEEN ADJACENT R.C FLAT SLAB MID-RISE BUILDINGS

By

Hosam Eldin Mohamed Gamal Mahmoud

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Structural Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

EVALUATION OF CODE REQUIRED SEPARATION DISTANCE BETWEEN ADJACENT R.C FLAT SLAB MID-RISE BUILDINGS

By
Hosam Eldin Mohamed Gamal Mahmoud

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Structural Engineering

Under the Supervision of

Prof. Dr. Walid Abdellatif Attia

Professor of Structural Analysis and Mechanics, Faculty of Engineering, Cairo University

Prof. Dr. Ahmed H. Ahmed Amer

Professor of Structural Analysis and Mechanics, Faculty of Engineering, Cairo University

Dr. Mostafa M. Abdelwahab ElSayed

Assistant Professor of Structural Analysis and Mechanics, Faculty of Engineering, Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

EVALUATION OF CODE REQUIRED SEPARATION DISTANCE BETWEEN ADJACENT R.C FLAT SLAB MID-RISE BUILDINGS

By
Hosam Eldin Mohamed Gamal Mahmoud

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Structural Engineering

Approved by the
Examining Committee

_____
Prof. Dr. Walid Abdellatif Attia (Thesis Main Advisor)

_____
Prof. Dr. Ahmed H. Ahmed Amer (Thesis Advisor)

_____
Prof. Dr. Sherif Ahmed Mourad (Internal Examiner)

_____
Prof. Dr. Hatem Hamdi Gheth (External Examiner)
Professor at Housing& Building Research Center

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

Engineer's Name: Hosam Eldin Mohamed Gamal Mahmoud
Date of Birth: 17/2/1991
Nationality: Egyptian
E-mail: Hosam.m.gamal@gmail.com
Phone: 01118978356
Address: 8 Momtaz street, Omrania, Giza

Registration Date: 01/03/2013
Awarding Date: --/--/2018
Degree: Master of Science
Department: Structural Engineering

Supervisors:

Prof. Dr. Walid Abdellatif Attia
Prof. Dr. Ahmed H. Ahmed Amer
Dr. Mostafa M. Abdelwahab ElSayed

Examiners:

Prof. Dr. Walid Abdellatif Attia (Thesis main advisor)
Prof. Dr. Ahmed H. Ahmed Amer (Thesis advisor)
Prof. Dr. Sherif Ahmed Mourad (Internal examiner)
Prof. Dr. Hatem Hamdi Gheth (External examiner)
Professor at Housing& Building Research Center

Title of Thesis:

EVALUATION OF CODE REQUIRED SEPARATION DISTANCE BETWEEN ADJACENT R.C FLAT SLAB MID-RISE BUILDINGS

Key Words:
Performance evaluation; Pounding; Gap distance; Fragility curves; Code requirement

Summary:

Recent and past earthquake damages have proven that buildings can undergo significant structural damage under intense ground shakes. One of the possible factors that may lead to structural damage is the seismic pounding phenomenon, where adjacent buildings with insufficient gap distance may collide with each other leading to excessive shear forces and moments. As pounding may cause fatal outcomes, evaluation of code requirements for the gap distance between adjacent buildings is addressed in this thesis. A parametric study on the inelastic response of flat slab buildings under seismic action is carried out. In addition, the study evaluates the requirements of Egyptian Code of Practice regarding separation distance between adjacent mid-rise flat slab buildings. In this study, typical RC flat slab buildings, with three heights, represents residential buildings designed in accordance with the Egyptian Standards are analyzed using nonlinear time history analysis. Ten different earthquake records with 6 different peak ground accelerations varying from 0.15g to 0.7g are considered herein in order to simulate constructing the same buildings in different locations with different earthquake intensity. In this regard, fragility curves, which illustrate the relation between the peak ground acceleration and the probability of certain damage occurrence, are established for the concerned buildings considering different damage states. Then, more than 350 nonlinear pounding scenarios between adjacent buildings are studied and compared with Egyptian Code of Practice requirements, clarifying the need to adjust the Egyptian Code to prevent all pounding probabilities, especially for smaller earthquake intensities less than 0.3g.

Acknowledgements

I truly thank my fiancée, my near future wife, Nermin Ali for her continuous encouragement, help and support. Without her I would have never done any of this, I would have surrendered to the stress; may Allah bless her now and always.

My father and mother really helped, endured too much stress and supported me to the end. I shall thank my cousins especially Momen Mostafa and Nour Wael for letting me access their laptops to perform the analysis.

Special thanks to Dr. Ahmed Hassan Amer for helping me and advising me. Also, I learned a lot from Dr. Mostafa Abdelwahab Elsayed, in academic and social fields; An amazing doctor and an awesome friend. He helped me, worked with me and supported me a lot, more than I can count.

I shall never forget Dr. Abdelmeguid Khafagi, head of bridge 7 department at Arab Consulting Engineers (ACE) for his support and for accepting condition about leaving work early. I learned most of my knowledge from him and I am still learning.

Dedication

To my fiancée,
To my mother and father,
To my grandmother,
To my entire family.

Table of Contents

List of Tables

List of Figures