شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأفلام قد أعدت دون أية تغيرات

يجب أن

:حفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من 15-25 مئوية ورطوبة نسبية من 20-40%

To be Kept away from Dust in Dry Cool place of 15-25- c and relative humidity 20-40%

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

جامعة عين شمس
كلية الهندسة

دراسة تصادم المنشآت أثناء الزلازل

رسالة مقدمة من

مهندس / خالد زكى سليمان سيد
ماجستير الهندسة المدنية (إنشاءات)

للحصول على

درجة دكتوراه الفلسفة فى الهندسة المدنية

(إنشاءات)

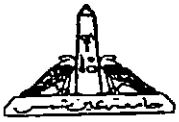
تحت إشراف

أ.د. أمين صالح على
أستاذ الهندسة الإنشائية
جامعة عين شمس

أ.د. محمد محمد عتابى
أستاذ الهندسة الإنشائية
جامعة عين شمس

أم. د. عصام أحمد الكردى
أستاذ مساعد الهندسة الإنشائية
جامعة الإسكندرية

القاهرة - ١٩٩٩



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

A STUDY ON POUNDING OF BUILDINGS DURING EARTHQUAKES

BY
ENG. KHALED ZAKY SOLIMAN SAYED
M.Sc. ENG.

A Thesis
Submitted in fulfilment for the
requirements of the Degree of Doctor
of philosophy in Civil Engineering
(Structures)

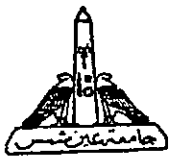
Supervised by

Dr. Amin Saleh Aly
Prof. of struct. Engrg.
Ain Shams University

Dr. M.M.H. Attabi
Prof. of struct. Engrg.
Ain Shams University

Dr. Essam El-Kordi
Assoc.Prof. of struct. Engrg.
Alexandria University

CAIRO - 1999



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

APPROVAL SHEET

Thesis: Doctor of philosophy in civil engineering (Structures)

Student name: KHALED ZAKY SOLIMAN SAYED.
Thesis title : A STUDY ON POUNDING OF BUILDINGS DURING EARTHQUAKES.

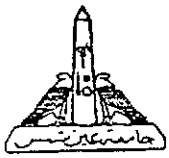
Examiners committee: **Signature**

Dr. Mohamed Ezzat Sobaih
Prof. of Structural Engineering,
Faculty of Engineering,
Cairo University.

Dr. Hassan Ibrahim Hegab
Prof. of Structural Engineering,
Faculty of Engineering,
Ain Shams University.

Dr. Amin Saleh Aly
Prof. of Structural Engineering,
Faculty of Engineering,
Ain Shams University.

Date : 25 / 2 / 1999



ABSTRACT

Soliman, Khaled Zaky, "A study on pounding of building during earthquakes". Unpublished Doctor of philosophy dissertation Structural Engrg. Dept., Faculty of Engrg., Ain Shams University, 1999.

The purpose of this dissertation is to provide valuable information to structural engineers, as well as to the Egyptian code committee about considering the pounding between adjacent buildings during earthquakes, in the design process. Therefore, the main objectives of this thesis are:

1. Developing a formula for estimating the gap element stiffness.
2. Developing a new spectra analysis to avoid pounding during earthquakes, i.e. , to recommend the minimum required gap between adjacent buildings to preclude pounding.
3. Investigating the proper method for strengthening the existing adjacent buildings for mitigating the effect of pounding in future earthquakes.
4. Applying the pounding phenomena in treating historical minarets, as a new application. The yield surface interaction for the non-reinforced masonry element is developed. The validity of **PC-ANSR** program is extended to treat the masonry element.

The nonlinear dynamic analysis programs, such as, **PC-ANSR** & **DRAIN-2DX**, statistical program such as, **SPSSWIN** and few developed programs are used to conduct this dissertation

The developed formula predicts the gap element stiffness with an accuracy of about 94% for regular buildings. The estimated gap distance, from the developed spectra analysis for earthquake pounding, is found in agreement with the exact solution. To preclude pounding for existing adjacent buildings, the ratio of their fundamental time periods as well as, the ratio of their heights should be considered during strengthening them.

The developed method for treating the non-reinforced masonry element is found in agreement with the **BS. 5268** specification. It was also found that the negligence of the effect of pounding leads to non-conservative design of the minarets, especially for the parts above the pounding location.

Key words: Pounding; Earthquakes; Gap element; Impact; Reliability; Minarets; Strengthening; Stiffness

ACKNOWLEDGEMENTS

The author wishes to record his sincere appreciation to his advisor, Professor Amin Saleh Aly, for his valuable guidance and helpful suggestions during the course of this research. The author gratefully acknowledges the endless support provided by Professor Mohammed Mohammed Attabi during the course of this research. The author also thanks Associate Professor Essam Ahmed El-Kordi for his helpful suggestions throughout the course of the work.

Much credit and gratitude must be extended to both Professor Andre Filiatrault (Ecole Polytechnique Institution- Quebec-Montreal - Canada), who sent to the author some recent valuable researches, and Structural Engineer Bruce Maison (Impell Corporation, San Roman, California, USA), who sent to the author the **PC-ANSR** program and some valuable researches free of charge. The author sends his thanks to both of them for the unlimited help and assistance in achievement of this research.

Finally, thanks are due to the author's wife, who supported and encouraged him during the research.

STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Doctor of Philosophy in Civil Engineering (Civil Engineering – Structurs).

The work included in this thesis was carried out by the author in the Department of Structural Engineering, Ain Shams University, from April 1994 to November 1998.

No part of this thesis has been submitted for a degree or qualification at any other University or Institution.

Date :29 / 11 / 1998.
Signature : Khaled Zaky Soliman
Name :Khaled Zaky Soliman.