Ain Shams University
Faculty of Engineering
Structural Engineering Department

Numerical Modelling of Concrete Diaphragm Walls

By

Ahmed Hosny Mohamed Abdel-Rahman
B. Sc. Civil Eng. - Hon. (1989)
Ain Shams University

A Thesis

Submitted in Partial Fulfillment for
the Requirements of the Degree of Master of Science
in Civil Engineering

624.1934
A-H

Supervised By

Prof. Dr. Fathalla Mohamed El-Nahhas
Prof. of Soil Mechanics and Foundation Engineering
Ain Shams University

Dr. Ali Abdel-Fattah Ali
Assist. Prof. of Soil Mech. and Found.
Ain Shams University

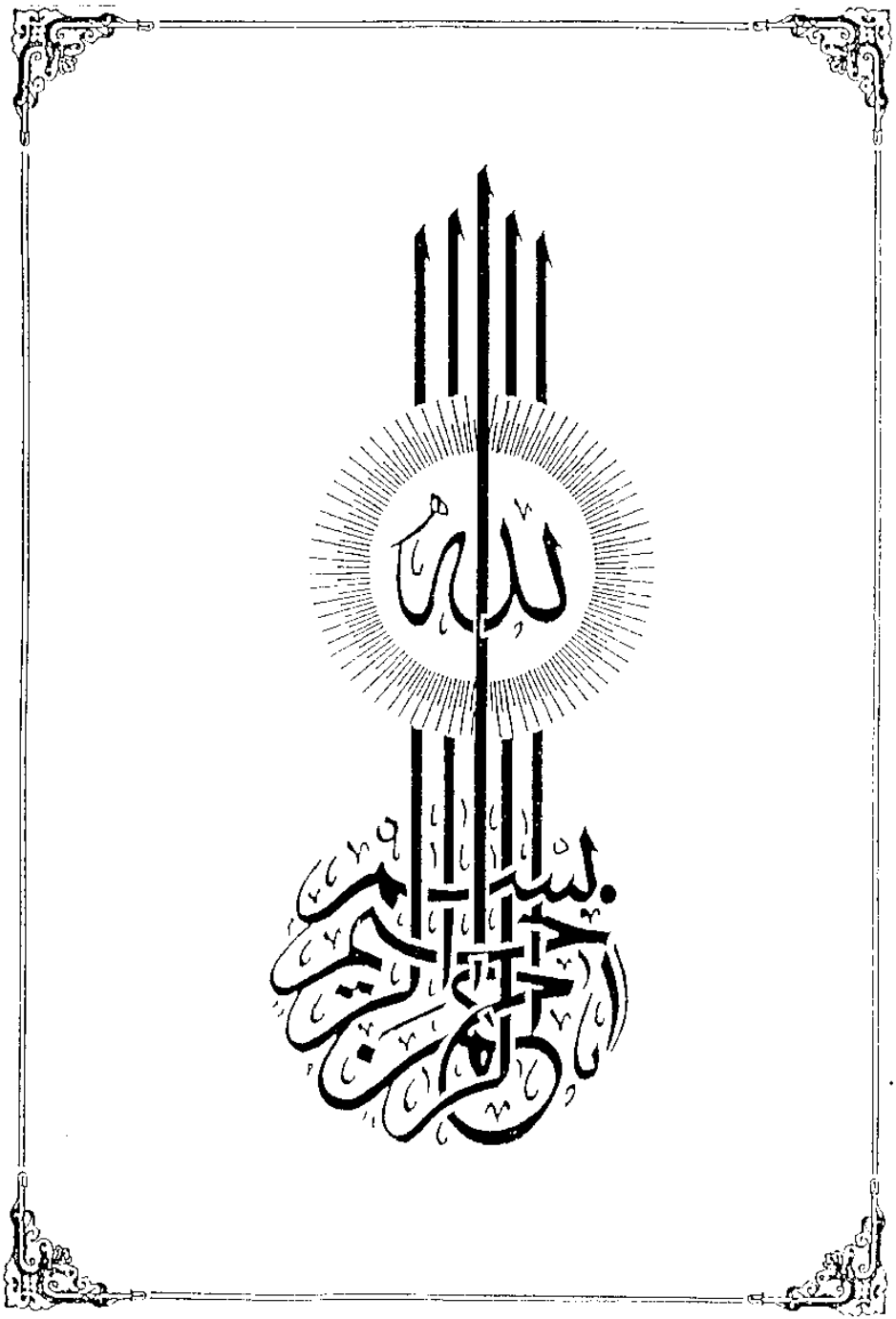
Dr. Mohamed Adel El-Gammal
Researcher in Eng. Research Inst.
National Research Center

Cairo - 1993

Central Library - Ain Shams University

بسم الله الرحمن الرحيم

Central Library - Ain Shams University

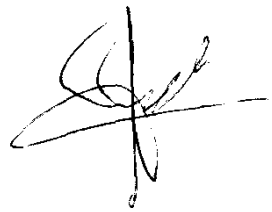


Central Library - Ain Shams University

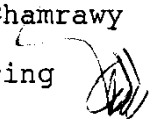
EXAMINER COMMITTEE

Name, Title, Affiliation — Signature

1. Prof. Dr. Farouk I. El-Kadi
   Prof. of Geotech. Engineering
   Ain Shams University



2. Prof. Dr. Moustafa K. El-Ghamrawy
   Prof. of Geotech. Engineering
   El-Azhar University



3. Prof. Dr. Fathalla M. El-Nahhas
   Prof. of Geotech. Engineering
   Ain Shams University

Date: / /1993

Central Library - Ain Shams University

STATEMENT

This dissertation is submitted to Ain Shams University for the degree of M. Sc. in Civil Engineering.

This work included in the thesis was carried out by the author in the department of Structural Engineering, Ain Shams University, from April, 1992 to June 1993.

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

Date : 1993

Signature:.....

Name :Ahmed Hosny Mohamed Abdel-Rahman

Central Library - Ain Shams University

ACKNOWLEDGMENTS

I wish to express my thanks and appreciation to Prof. Dr. Fathalla El-Nahhas for his supervision, guidance and both technical and moral support through this research. I also wish to express my deep gratitude to Dr. Ali Abdel-Fatah for his encouragement, invaluable advices and guidance during each stage of this research. Many thanks go to Dr. Adel El-Gammal for his continuous helpful discussions for every part of this thesis.

My utmost gratitude is for Dr. Mohamed Sheta for his encouragement, enormous help and sincere advices that gave me the strength to finish this work. Special thanks should go to Dr. Ashraf Abdel-hy for his friendship and helpfull technical support. Finally, I wish to dedicate this work to my family for giving me the suitable atmosphere during the time spent on this study.

Central Library - Ain Shams University

Ain Shams University
Faculty of Engineering
Structural Engineering Department

Abstract for the M. Sc. thesis submitted by

Eng. Ahmed Hosny Mohamed Abdel-Rahman

Title of the Thesis: **Numerical Modelling of Concrete Diaphragm Walls**

Supervisors : **1. Prof. Dr. Fathalla Mohamed El-Nahhas**
2. Dr. Ali Abdel-Fattah Ali
3. Dr. Mohamed Adel Ghareb El-Gammal

Registration Date : 10/12/1990
Examination Date : 4/9/1993

ABSTRACT :

Implementation of subway systems became one of the effective solutions to overcome some of the enviromental problems which face man's life sepecially in large highly populated cities.

Construction of subway stations and tunnels using the cut-and-cover technique employing reinforced concrete diaphragm walls is considered one of the most effective methods for controlling ground movements with minor effects on the adjacent existing structures. Analysis of such braced walls is considered one of the most sophisticated soil-structure interaction problems.

This research proposes a numerical modelling for analysis of diaphragm walls during the different construction stages of tunnels and subway stations. The associated variations in the soil stress field and deformations were investigated. In order to carry out such analysis, a computer program was specially upgraded using the Fortran language. Eight-node isoparametric finite elements were used to simulate the soil continuum and the diaphragm wall, the nonlinear stress-strain behaviour of the soil employing modified Duncan model (1984) were utilized. Spring type interface elements were also introduced to model the soil-diaphragm wall contact surface.

This thesis presents a comparative study between results of the nonlinear finite element analysis and the field measurements which had been compiled during construction of the Greater Cairo Underground Metro, Phase 1. Also, results of the analysis were compared with the predicted values from the commonly used empirical design rules of such walls.

An extensive parametric study was also carried out to evaluate the sensitivity of the utilized numerical model and the effect of different factors concerning the soil-wall interaction on the behaviour of the diaphragm wall and the associated soil deformations and stress field.

Key words: *Diaphragm walls, tunnels, braced excavation, nonlinear analysis, Fortran, Finite element, eight node element, interface elements, unloading increments.*

Central Library - Ain Shams University

TABLE OF CONTENTS

CHAPTER **PAGE**

Central Library - Ain Shams University

Central Library - Ain Shams University

Central Library - Ain Shams University

Central Library - Ain Shams University

Central Library - Ain Shams University

LIST OF FIGURES

Central Library - Ain Shams University

Central Library - Ain Shams University

Central Library - Ain Shams University