AIN SHAMS UNIVERSITY

Faculty of Engineering

ANALYSIS OF PILE-RAFT-SOIL INTERACTION

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A Thesis

Submitted in partial fulfillment for the

requirements of the degree of Master of Science

in Structural Engineering

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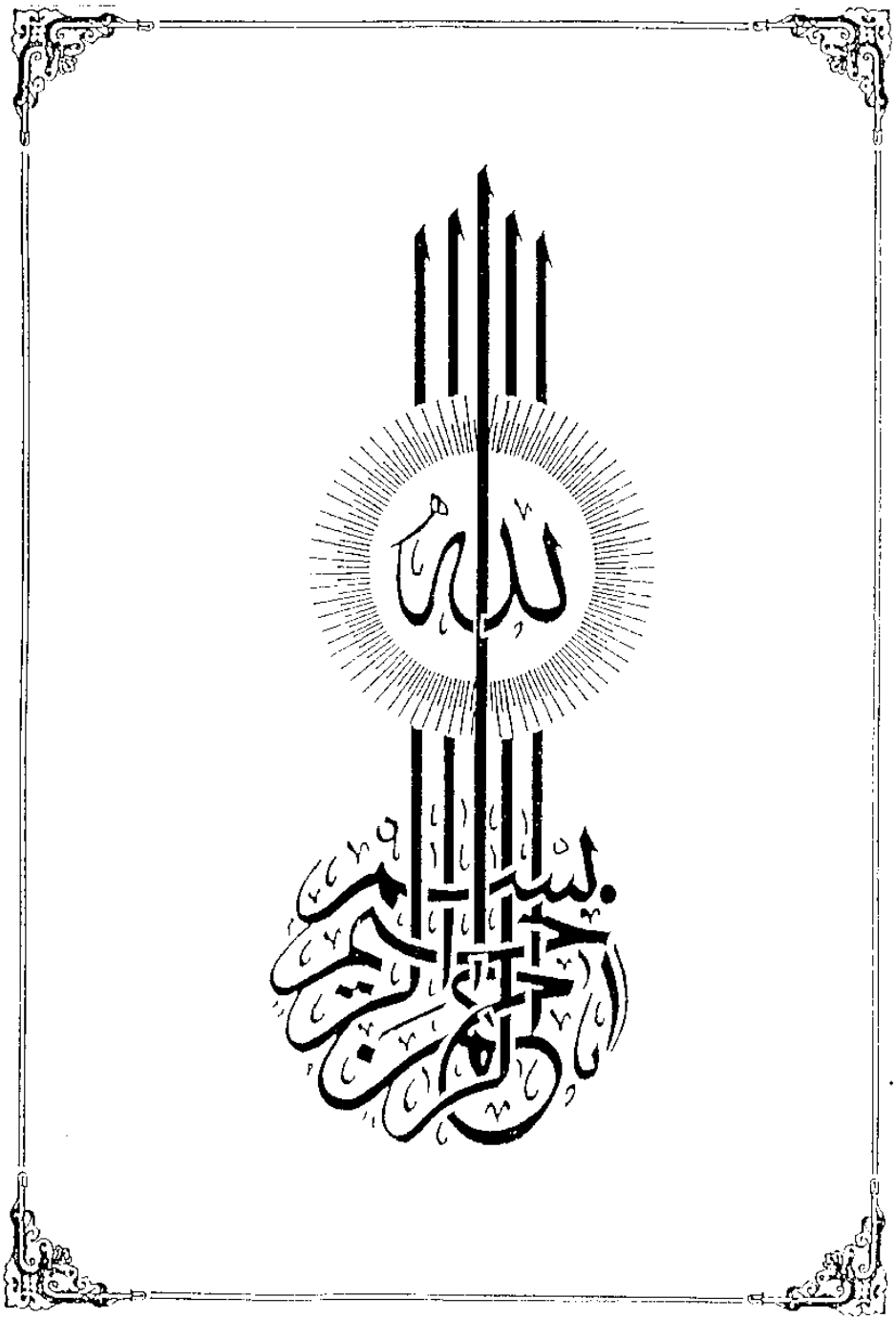
Cairo-1989

بسم الله الرحمن الرحيم

IN THE NAME OF GOD, THE MOST GRACIOUS,
THE MOST MERCIFUL.

Praise be to God, who guide us hitherto, and
we could not have been guided if He has not guided us.

And blessing, peace be upon the most honoured, Mohammed Bin
Abdullah, may God be gracious on his kins and companions.



STATEMENT

This dissertaion is submitted to Ain Shams University for the degree of Master of Science in Structural Engineering.

The work included in this thesis was carried out by the author in the Department of Structural Eng., Ain Shams University, from September 1985, to February 1989.

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

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ACKNOWLEDGEMENTS

I wish to express my cordial gratitude and deep thanks to Prof. Dr. Farouk El-Kadi, Professor of Geotechnical Eng., Faculty of Engineering, Ain Shams University, for his stimulating supervision, contact advice and constructive criticism which made the completion of this work possible.

I am greatly indebted to Dr. Fathalla El-Nahhas, Associate Professor of Geotechnical Eng., Faculty of Engineering, Ain Shams University, for his diligent and continuous work on reviewing the computational process and logic of this thesis. Also, for generating many ideas and extensive suggestions for the various chapters which improved the content of this thesis.

Grateful thanks are due to the author's mother and sister for their encourgement and patience. Thanks are also due to the author's friends and in particular, Eng. Hany Shawky for his assistance.

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NOTATIONS

The following notations are those generally used in the presented work. Other notations required for the purpose of analysis are mentioned in their appropriate places.

a : pile radius

Ap : pile cross sectional area.

Bx,By : Dimensions of the soil element in the X and Y directions respectively.

C : depth of point load from surface

[DEFL]: the raft deflection matrix

Ep : Young's modulus of pile material

Es : the soil modulus of elasticity

{F} : the load vector for vertical loads at the various nodes

{F}e : nodal point forces vector of the element

{Fz}e : the shear forces at the different element nodes

G : soil shear modulus

[Ipp] : pile - pile interaction square matrix in order Np

[Ips] : pile - soil surface interaction matrix in order Np by Ns

[Isp] : soil surface - pile interaction matrix in order Ns by Np

[Iss] : soil - soil interaction square matrix in order Ns

I_{ij} : vertical displacement factor for element i due to shear stress at element j

I_{ib} : vertical displacement factor for element i due to unit stress at the base

I_{bb} : vertical displacement factor for the base due to unit stress at the base

I_{bj} : vertical displacement factor for the base due to shear stress at element j of pile shaft.

[I] : the unit matrix of order (n+1) by (n+1)

[Is] : n+1 square matrix of soil displacement factors

$[K]_e$: the element stiffness matrix

$[K_{ww}]_e$, $[K_{wo}]_e$, $[K_{ow}]_e$, $[K_{oo}]_e$: the partitions stiffness matrices given in Appendix (D).

L : total length of pile

{M} : the load vector for moments at the various nodes

$\{M_E\}_e$: the moments in the X & Y directions at the element nodes

Mx,My : the moment of all load components along the Y and X axis respectively

Np : number of pile elements.

Ns : number of soil elements.

P : value of the load

{P} : the load vector of external applied vertical loads at the nodes in order (Np+Ns)

P_t : Total applied load

Ps : Load taken directly by the soil in direct contact with the soil

P_i : the vertical shear on the pile periphery at element i

pR_i : the displacement of the pile at element i

pR_{i-1}, pR_i, pR_{i+1} : the displacements of the midpoints of elements i-1, i, i+1, respectively.

[pI] : n+1 square matrix of coefficient for pile action.

{Q} : the vector of the unknown reactions in order (Np+Ns)

R_g : Pile group settlement with rigid pile cap

R_r : Raft settlement without piles

Rs : Single pile settlement

q_i : the normal stress in the pile at element i

{q}e : nodal point displacement vector of the element

S : the spacing between the two piles

{St} : the total settlement vector

[SETT]: influence factors matrix of order (Np+Ns)

sRij : vertical displacement at i due to stress p_j at j

sRi : vertical displacement at i

sRb : vertical displacement at the base

{sR} : soil displacement vector

[sI] : the soil coefficient matrix of order (n+1) by (n+1)

sRip : settlement of single pile

sRzp : settlement factor of two identically, equally loaded piles

spRj : the settlement factor at soil surface point j due to embedded concentrated load Pi at segment i

ssI(i,i): the influence settlement factor for the soil surface element due to its own unit stress

$Sred_i$: the reduced settlement at point i

St_i : absolute settlement at point i

Sp_i : absolute settlement of plane of supports at point i

{Sr} : the reduced settlement vector in order (Np+Ns)

[SRED]: the reduced settlement coefficients square matrix (Np+Ns) by (Np+Ns)

T : Pile cap thickness

(T/d)u: Pile cap to diameter ratio shared the load equally among the individual piles in the group.

{Wz}e : the vertical displacement at the element nodes

{W}, {θ} : the displacements at the various nodes

Z : depth of required point to calculate settlement at it

Z_p : pile element height ($Z_p=L/n$)

zI_{ij}, zI_{ib}, zI_{bj}, zI_{bb} : are the soil coefficient factors for the effect of the second pile on the first

δz : value of settlement

ν : poisson's ratio for soil

$\{\theta\}_e$: the rotations in the X & Y directions at the element nodes

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