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“Effect of the Rigidity of Super-Structure on Contact Stress”

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BY

Hany Farouk Shehata Saleh

B. Sc. Civil Engineering 2007 – Higher Institute of Engineering – Shorouk Academy

Under the Supervision of

Prof. Dr. Farouk I. K. Elkadi

Professor of Geotechnical Engineering
Department of Structural Engineering
Faculty of Engineering
Ain Shams University

Prof. Dr. Yasser M. El-Mossallamy

Professor of Geotechnical Engineering
Department of Structural Engineering
Faculty of Engineering
Ain Shams University

Assc.Prof.Dr. Hesham A. Mahdy

Associate Professor of Geotechnical Engineering
Head of Civil and Project Management Department
Faculty of Engineering
Future University

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Prof. Dr. Yasser M. El-Mossallamy

Assoc. Prof. Dr. Hesham A. Mahdy

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ABSTRACT

“Effect of the Rigidity of Super-Structure on Contact Stress”

Ain Shams University – Faculty of Engineering

Civil Engineering Department

By / Eng. Hany Farouk Shehata

This Thesis presents a study on the effect of the super-structure rigidity on the contact stress, the corresponding differential settlement between strip footings, and the distribution of subgrade reaction modulus of isolated footings.

In order to achieve this aim; a numerical analysis using two dimensional finite element software program (PLAXIS 2D PACKAGE version 8.20 professional) was carried out on six models; three of them were used to show the effect of the frame's slab thickness, frame rigidity, and number of frame bays on the contact stress and the differential settlement; and two of them were used to show the effect of soil model and frame rigidity with variable load level on the differential settlement, while the last one is to investigate the effect of soil model on the modulus of subgrade reaction (K_s).

The models prove that the super-structure rigidity and the soil modeling have a significant effect on the contact stress, the corresponding differential settlement, and modulus of subgrade reaction (K_s). For average stress under footing less than 0.35 of the ultimate stress, the structural analysis can be performed by structural finite element program considering the modulus of subgrade reaction

(K_s) under footing resulted from geotechnical finite element program. For average stress under footing greater than 0.35 of ultimate stress, the structural analysis should be performed by geotechnical finite element program that can model the super-structure. Because the greatest difference between the resulted normal forces in walls from geotechnical finite element program, can lead to inappropriate design.

STATEMENT

This Thesis 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 author in the department of Structural engineering, Ain Shams University, From July 2009 until July 2013.

No part of this thesis has been submitted for a degree or a qualification.

Date:

Signature:

Name: Hany Farouk Shehata

LIST OF CONTENTS

| <u>TITLE</u> | <u>Page</u> |
|---|--------------------|
| ACKNOWLEDGEMENT..... | I |
| ABSTRACT..... | II |
| LIST OF CONTENTS..... | IV |
| LIST OF TABLES..... | VII |
| LIST OF FIGURES..... | VIII |
| LIST OF SYMBOLS..... | XIII |
| CHAPTER (1): INTRODUCTION | 1 |
| 1.1 Problem Statement | 1 |
| 1.2 Objectives | 1 |
| 1.3 Thesis Organization | 2 |
| CHAPTER (2): LITERATURE REVIEW | |
| 2.1 Introduction | 3 |
| 2.2 Soil Structure Interaction of Shallow Foundations..... | 3 |
| 2.2.1. Conventional analysis | 4 |
| 2.2.2. Subgrade Reaction theory | 6 |
| 2.2.2.1 Winkler model | 6 |
| 2.2.2.2 Filonenko-Borodich model..... | 7 |
| 2.2.2.3 Hetenyi Foundation..... | 7 |
| 2.2.2.4 Pasternak | 7 |
| 2.2.2.5 Further Simplification Models for Winkler... | 8 |
| 2.2.3. Methods based on elastic theory..... | 10 |
| 2.2.4. Methods based on elasto-plastic constitutive law | 17 |
| CHAPTER (3): FINITE ELEMENT MODELING | |
| 3.1 Introduction..... | 23 |
| 3.2 Finite element solution | 23 |

| | |
|---|----|
| 3.3 Soil models | 25 |
| 3.3.1 Linear Elastic | 25 |
| 3.3.2 Mohr-Coulomb | 25 |
| 3.4: Model Verification | 27 |
| 3.4.1: Linear Elastic model Verification | 27 |
| 3.4.2: Mohr-Coulomb model Verification..... | 32 |
| 3.4.2.1 PLAXIS Solution..... | 32 |
| 3.3.2.2 Solution by Egyptian code for foundation design (EC2001)..... | 34 |
| 3.5: Methodology and modeling | 34 |
| CHAPTER (4): ANALYSIS AND DISCUSSION | |
| 4.1 Introduction..... | 38 |
| 4.2 Effect of slab location with different thicknesses on contact stress and differential settlement | 38 |
| 4.2.1 Modeling | 38 |
| 4.2.1.1 One storey frame model | 40 |
| 4.2.1.2 Semmel slab model | 41 |
| 4.2.2 Results and discussions | 41 |
| 4.2.2.1 Differential settlement..... | 41 |
| 4.2.2.2 Contact stress | 47 |
| 4.3 Effect of the frame rigidity on the contact stress and differential settlement | 52 |
| 4.3.1 Modeling | 52 |
| 4.3.2 Results and discussions | 54 |
| 4.3.2.1 Differential settlement..... | 54 |
| 4.3.2.2 Contact stress | 61 |
| 4.4 Effect of number of frame bays on the contact stress and differential settlement | 65 |

| | |
|--|-----------|
| 4.4.1 Modeling | 65 |
| 4.4.2 Results and discussions | 66 |
| 4.4.2.1 Differential settlement | 66 |
| 4.4.2.2 Contact stress | 69 |
| 4.5 Effect of Length of Frame Bays on the Differential Settlement | 72 |
| 4.5.1 Modeling | 72 |
| 4.5.2 Results and discussions | 73 |
| 4.5.2.1 Differential settlement | 73 |
| 4.6 Effect of soil model and load level on the differential Settlement | 76 |
| 4.6.1 Modeling | 76 |
| 4.6.2 Results and discussions | 77 |
| 4.7 Effect of frame floors rigidity with variable load level and soil model on the differential settlement | 80 |
| 4.7.1 Modeling | 80 |
| 4.7.2 Results and discussions | 81 |
| 4.8 Effect of soil model on the modulus of subgrade reaction (K_s)..... | 90 |
| 4.8.1 Modeling | 90 |
| 4.8.2 Results and discussions | 91 |
| CHAPTER (5): CONCLUSIONS AND RECOMMENDATIONS | |
| 5.1 Introduction..... | 95 |
| 5.2 Conclusion | 95 |
| 5.3 Recommendations for Future Studies..... | 97 |
| REFERENCES..... | XV |

LIST OF TABLES

| <u>TITLE</u> | <u>Page</u> |
|---|-------------------------------|
| CHAPTER (2): LITERATURE REVIEW | |
| Table (2.1): The Summary of the literature review about the effect of the soil structure interaction on contact stress..... | 18, 19, 20, 21and 22 |
| CHAPTER (3): LITERATURE REVIEW | |
| Table (3.1): the research models..... | 36 |
| Table (3.2): Model dimensions and parameters..... | 37 |
| CHAPTER (4): ANALYSIS AND DISCUSSIONS | |
| Table (4-1): Walls normal force at different thickness of the slab taken from one storey frame with hinged walls model | 43 |
| Table (4-2): Values of the dimensionless differential settlement between the corner and inner footings at different thickness of the slab for model (1)..... | 45 |
| Table (4.3): Values of K_f for different equivalent slab thickness and the differential settlement for model (2) | 56 |
| Table (4.4): illustrates values of normal force in walls (NF) and the percentage of difference (Δ %) for the corner and inner walls resulted from PLAXIS and SAP2000 with K_s resulted from PLAXIS..... | 93 |
| Table (4.5): illustrates values of normal force in walls (NF) and the percentage of difference (Δ %) for the corner and inner walls resulted from PLAXIS and SAP2000 with traditional way for calculating K_s | 94 |

LIST OF FIGURES

| <u>TITLE</u> | <u>Page</u> |
|---|-------------|
| CHAPTER (2): LITERATURE REVIEW | |
| Figure (2-1): Rectilinear contact pressure distribution..... | 5 |
| Figure (2-2): The soil as infinite number of springs..... | 6 |
| Figure (2-3): Filonenko-Borodich Foundation Model..... | 7 |
| Figure (2-4): Pasternak Foundation Model..... | 8 |
| Figure (2-5): Analysis of continuous beam after Amer (1983)..... | 10 |
| Figure (2-6): Analysis based on Boussinisque's assumptions..... | 11 |
| Figure (2-7): Three moment equation method (Ohde)..... | 12 |
| Figure (2-8): Deflection method suggested by El-Kadi (1967)..... | 14 |
| Figure (2-9): Illustration for theoretical and damped settlement after El-Kadi (1978)..... | 16 |
| CHAPTER (3): FINITE ELEMENT MODELING | |
| Figure (3-1): Distribution of nodes and stress points in interface elements and their connection to soil elements. (PLAXIS Manual, 2008)..... | 24 |
| Figure (3-2): Elastic perfect plastic model. (Brinkgreve (2005))..... | 25 |
| Figure (3-3): Strip slab on elastic foundation subjected to uniform area load | 27 |
| Figure (3-4): Relation between the maximum vertical settlement and distance (Z) times of breadth of beam | 28 |
| Figure (3-5): Relation between the maximum vertical settlement and distance (L) times of breadth of beam | 28 |
| Figure (3-6): Generated finite element mesh, linear elastic verification..... | 29 |
| Figure (3-7): Finite element solution for contact stress under foundations with different rigidities..... | 30 |
| Figure (3-8): Numerical solution for contact stress under foundations with different rigidities, after F. El-Kadi, 1967..... | 31 |
| Figure (3-9): Generated finite element mesh, Mohr-Coulomb Verification..... | 32 |
| Figure (3-10): Load-Displacement relation for verifying Mohr-Coulomb model... | 33 |
| CHAPTER (4): ANALYSIS AND DISCUSSIONS | |
| Figure (4-1): One storey frame model..... | 39 |
| Figure (4-2): Semmel slab Model..... | 39 |

| | |
|---|----|
| Figure (4-3): Generated finite element mesh for one storey frame model..... | 40 |
| Figure (4-4): Generated finite element meshes for semmel slab model..... | 41 |
| Figure (4-5): Settlement ratio under foundations for different slab thicknesses for one storey frame with fixed walls model..... | 42 |
| Figure (4-6): Settlement ratio under footings for different slab thicknesses for one storey frame with hinged walls model..... | 43 |
| Figure (4-7): Settlement ratio under foundations for different slab thicknesses for semmel slab model..... | 44 |
| Figure (4-8): The relation between the dimensionless differential settlement and the slab thicknesses for model (1) | 45 |
| Figure (4-9): The distribution of the dimensionless contact stress under the inner footing for model (1), slab thickness 100 cm..... | 48 |
| Figure (4-10): The distribution of the dimensionless contact stress under the outer footing for model (1), slab thickness 100 cm..... | 48 |
| Figure (4-11): The relation between the average contact stress under the inner footing and the slab thicknesses for model (1) | 49 |
| Figure (4-12): The relation between the average contact stress under the outer footing and the slab thicknesses for model (1) | 49 |
| Figure (4-13): Dimensionless contact stress under outer footing for different slab thicknesses of the slab for semmel slab model..... | 50 |
| Figure (4-14): Equivalent Slab Model, model (2) | 52 |
| Figure (4-15): Typical Multi-Floor Model, model (2) | 53 |
| Figure (4-16): Settlement ratio under foundations for all thicknesses of the slab for equivalent slab model, model (2) | 54 |
| Figure (4-17): Settlement ratio under foundations for different multi storey models, model (2) | 55 |
| Figure (4-18): The relation between the differential settlements with the floors number for model (2) | 55 |
| Figure (4-19): The relation between the differential settlements with K_f for model (2) | 57 |

| | |
|---|----|
| Figure (4-20): The relation between the dimensionless differential settlements with K_f for model (2) | 57 |
| Figure (4-21): The relation between the dimensionless factor (F) with number of floors, for model (2) | 58 |
| Figure (4-22): The relation between the dimensionless differential settlements with the number of floors for model (2) | 59 |
| Figure (4-23): The measurements of the dimensionless differential settlement for Stud-Hochhaus (II) in Germany..... | 59 |
| Figure (4-24): The distribution of the dimensionless contact stress under the inner footing for model (2), for 8 floors..... | 61 |
| Figure (4-25): The distribution of the dimensionless contact stress under the outer footing for model (2), for 8 floors..... | 61 |
| Figure (4-26): The relation between average contact stresses under inner footing with the number of floors for model (2) | 62 |
| Figure (4-27): The relation between average contact stresses under outer footing with the number of floors for model (2) | 62 |
| Figure (4-28): The relation between average contact stresses under inner footing with K_f for model (2)..... | 63 |
| Figure (4-29): The relation between average contact stresses under outer footing with K_f for model (2) | 63 |
| Figure (4-30): Typical model of three-bay frames, model (3)..... | 65 |
| Figure (4-31): Settlement ratio under foundations for different slab thicknesses, model (3) | 66 |
| Figure (4-32): The relation between the differential settlements with number of floors for model (3) | 67 |
| Figure (4-33): The relation between the differential settlements with K_f for model (3) | 67 |
| Figure (4-34): The relation between the dimensionless differential settlements with K_f for model (3) | 68 |
| Figure (4-35): Dimensionless Contact Stress " q " = (Contact Stress / P_{sm}) under the outer footing for multi-floor model, for model (3) | 69 |

| | |
|---|----|
| Figure (4-36): Dimensionless Contact Stress “ q ” = (Contact Stress / P_{sm}) under the inner footing for multi-floor model, for model (3) | 69 |
| Figure (4-37): The relation between average contact stresses under inner footing with the number of floors, for model (3) | 70 |
| Figure (4-38): The relation between average contact stresses under outer footing with the number of floors, for model (3) | 70 |
| Figure (4.39): Typical model of three-bay frames, for model (4) | 72 |
| Figure (4.40): Settlement ratio under foundations for different floors, Three- Bay Models, for model (4)..... | 73 |
| Figure (4.41): The relation between the differential settlements with number of floors for model (4) | 74 |
| Figure (4.42): The relation between the differential settlements with K_f for model (4) | 74 |
| Figure (4.43): The relation between the dimensionless differential settlements with K_f for model (4) | 75 |
| Figure (4-44): Model of linear elastic and Mohr coulomb constitutive laws, for model (5) | 76 |
| Figure (4-45): Settlement ratio under foundations for different load levels for linear elastic model, for model (5)..... | 77 |
| Figure (4-46): Settlement ratio under foundations for different load levels for Mohr-coulomb model, for model (5)..... | 78 |
| Figure (4-47): The relation between the differential settlements with the average stress under inner footing (as % of ultimate stress)..... | 79 |
| Figure (4-48): model (6) | 80 |
| Figure (4-49): Dimensionless settlement under foundations with load level of 5KN/m ² for linear and Mohr coulomb models, for model (6)..... | 81 |
| Figure (4-50) Dimensionless settlement under foundations with load level of 10KN/m ² for linear and Mohr coulomb models, model (6)..... | 82 |
| Figure (4-51): Dimensionless settlement under foundations with load level of 20KN/m ² for linear and Mohr coulomb models, for model (6)..... | 83 |
| Figure (4-52): Dimensionless settlement under foundations with load level of 30KN/m ² for linear and Mohr coulomb models, for model (6) | 84 |

| | |
|---|----|
| Figure (4-53): Dimensionless settlement under foundations with load level of 40KN/m ² for linear and Mohr coulomb models, for model (6) | 85 |
| Figure (4-54): Dimensionless settlement under foundations with load level of 60KN/m ² for linear and Mohr coulomb models, for model (6) | 86 |
| Figure (4-55): Dimensionless settlement under foundations with load level of 120KN/m ² for linear and Mohr coulomb models, for model (6) | 87 |
| Figure (4-56): The relation between the differential settlements at different load level and different slab thickness with K_f for model (6). | 88 |
| Figure (4-57): Model of linear elastic and Mohr coulomb constitutive laws, model (7)..... | 90 |
| Figure (4-58): Model of linear elastic and Mohr coulomb constitutive laws, model (7)..... | 91 |
| Figure (4-59): The relation between K_s and width of the inner footing for model (7)..... | 91 |
| Figure (4-60): The relation between λ and width of the inner footing for model (7) | 92 |
| Figure (4-61): The relation between λ and width of the inner footing for model (7) | 92 |

LIST OF SYMBOLS

Δ = Unitless differential settlement under foundations.

Δ_E = The variance in wall load resulted from PLAXIS and SAP2000 for elastic soil model.

Δ_P = The variance in wall load resulted from PLAXIS and SAP2000 for plastic soil model.

Δ_s = The differential settlement under foundations.

A = The length of division of the beam.

b = Width of foundation.

c = Settlement at the edge of the foundations.

C = The cohesion of the soil.

D = Flexural rigidity of the foundation.

d_s = Depth of compressible layer.

E = Modulus of elasticity of the material of foundation.

E_c = Modulus of elasticity of the concrete.

E_s = Modulus of elasticity of the soil.

e_x, e_y = Coordinates of the resultant force with respect to X, Y axes respectively.

f = Size or shape factor for foundation on a particular type of soil.

I = Moment of inertia of the foundation.

I_x, I_y = Moment of inertia of the foundation with respect to X, Y axes respectively.

K = Relative factor of rigidity of foundation soil system.

K_f = The relative factor of rigidity of frame-soil system.

K_s = The coefficient of subgrade reaction.

L = Total length of the beam.

L_s = The distance between the middle point of corner foundation to the middle point of inner foundation