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"Effect of the Rigidity of Super-Structure on Contact Stress"

A Thesis

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Of Master of Science in Civil Engineering – Structural Department

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ABSTRACT

"Effect of the Rigidity of Super-Structure on Contact Stress"

Ain Shams University – Faculty of Engineering

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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 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.

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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