AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

EFFECT OF RIGIDITY OF SUPERSTRUCTURE ON CONTACT PRESSURE

BY

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STATEMENT

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

The work included in this thesis was carried out by the author in the Department of Structural Engineering, Ain Shams University, from December 1981 to September 1988.

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

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To My Dear Rana...

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EFFECT OF RIGIDITY OF SUPERSTRUCTURE

ON CONTACT PRESSURE

M.Sc. Thesis in Civil Engineering

DEPT. OF Structural Eng., Ain Shams University

By

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ABSTRACT

Interaction of structures founded on isolated footings is greatly dependent on the rigidity of two elements, tie beams and overall rigidity of superstructure. Review of previous studies indicated that there is a lack of simple design methods and researches concerning evaluation of the real effect of tie beams for resisting differential settlements and consequently the benefits of utilizing tie beams in shallow foundations.

This thesis presents a parametric study for investigating the effect of rigidity of tie beams and superstructure on the calculated values of differential settlement of supports and consequently, their effect on the magnitude of applied contact pressure beneath foundation.

A BASIC computer program was specially coded and used on a microcomputer for this investigation. It was concluded that the rigidity of tie beams and superstructure has a major effect on minimizing the differential settlements between footings and also affects the contact pressure.

An analytical procedure is presented and can be used to calculate settlement, differential settlement and contact pressure, taking into consideration the effect of rigidity of superstructure elements.

KEY WORDS : Isolated footings, Tie beams, Semelles, Rigidity of superstructure, Contact pressure, BASIC, TURBO BASIC, CAD, Parametric study, Differential settlement.

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NOTATIONS

The following notations are those generally used in this thesis; other notations required for the purpose of the analysis will be mentioned following their appearance.

SYMBOL	REPRESENTS
P_{am}	: Average contact pressure.
E_s	: Young's modulus of elasticity of soil.
E_c	: Young's modulus of elasticity of foundation material.
S_o	: Original settlement without tie beams.
C_i	: Settlement influence coefficient.
D_s	: Depth of compressible layer of soil.
a & b`	: Dimensions of a footing.
S	: Damped settlement.
S^*	: Settlement Coefficient.
L	: Total length of tie beam.
C_b	: Coefficient of subgrade reaction.
σ	: Allowable contact pressure.
A	: Area of footing.
I_c	: Moment of inertia of cross section.
h	: Height of floor.
d	: Depth of tie beam.
b	: Breadth of tie beam.
ΔS	: Damped differential settlement.
ΔS_o	: Original differential settlement with no tie beam.
ΔS_t	: Theoretical differential settlement neglecting the

effect of adjacent footings.

ΔS_{cb} : Differential settlement choosing Winker's assumptions.

ΔS_{max} : Maximum differential settlement between any two points.

R.F. % : R.F. = $(\Delta S/\Delta S_o)\%$.

R.P. % : R.P. = (1 - R.F.)%.

$\Delta \sigma$ % : Percentage of variability of σ.

ΔS_1 : Damped differential settlement for first span.

ΔS_2 : Damped differential settlement for second span.

M or B.M. : Bending moment acting on tie beam.

n : Number of footings.

K_m : Relative rigidity factor.

m : Bending moment factor.

m_1 : Another bending moment factor.

n - 1 : Number of spans.

C.P. : Allowable contact pressure.

ΔR : Variability of reactions.

R.A.M. : Random access memory of computer.

R.O.M. : Read only memory of computer.

UNITS

The following units are used:

SYMBOL	UNITS
P_{sm}, σ	kg/cm^2
E_s	kg/cm^2
E_c	t/cm^2
σ	$Pa = 0.1\ kg/cm^2$
S	mm
Δ S	mm
h	m
L	m
D_s	m
a, b, b`, d	m
B.M.	t.m

INTRODUCTION

CHAPTER (1)

INTRODUCTION

1.1 General:

Design of foundation must satisfy two essential deformation requirements, namely, the total settlement of the structure is limited to a tolerably small amount (depending on the type of superstructure) and the differential settlement of the various parts of the structure is minimized as much as possible to eliminate any structural damage. In several cases the minimization of differential settlement, is considered more important than limitations on uniform overall settlement.

In order to limit settlements, it may become necessary to use deep foundations to transmit the load to deeper, firmer layers.

However, if satisfactory soil directly underlies the structure, shallow foundations can be designed taking into account the deformation constrains.

Settlement of a structure is the result of the deformation of the supporting subsoil. It may be evidence of elastic deformation, volume change due to a reduction of the water content (consolidation) or general shear movement, or other factors as collapse of structural arrangements of soil particles (Scott, 1981).

Limiting the total settlement of a structure is frequently used as an indirect means of controlling the amount of differential settlement. For instance the Canadian Foundation