بسم الله الرحمن الرحيم

شبكة المعلومـــــات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون آية تغيرات

يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of
15 – 25c and relative humidity 20-40 %

بعض الـوثـــائق

الأصـلية تـالفـــة

MENOUFIA UNIVERSITY
FACULTY OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT

SOIL SUCTION AND ANALYSIS OF RAFT FOUNDATION RESTING ON EXPANSIVE SOILS

By

Eng. Basuony Metwaly Abdel-Aziz El-Garhy
B.Sc. in Civil Engineering, 1989
M.Sc. in Geotechnical Engineering, 1993

A Thesis Submitted to Menoufia University

in Partial Fulfillment of the Requirements for

the Degree of

DOCTOR OF PHILOSOPHY IN ENGINEERING

STRUCTURAL ENGINEERING

IN THE FIELD OF SOIL MECHANICS AND FOUNDATIONS

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Mohsen Kirawy

(1999)

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(1999)

STATEMENT

This Thesis is submitted to the department of Civil Engineering, Faculty of Engineering, Menoufia University for the award of Ph.D.

Thesis Title:

Soil Suction and Analysis of Raft Foundation Resting on Expansive Soils

The work included in this thesis has been carried out by the author in the department of Civil Engineering, Faculty of Engineering, Menoufia University in cooperation with the department of Civil Engineering, Ohio University, U.S.A.

No part of this thesis has been submitted to any other university or institute for the award of a degree or qualification

Author's Name: Basuony Metwaly Abed El-Aziz El-Garhy
Signature : Basuony El-Garhy
Date : 26/1/1999

The above statement has been signed by the thesis author.

Supervisor

Head of the department

ABSTRACT

This study introduces a practical and simple solution for two major problems: (1) predicting moisture movement and estimating the associated volume changes in expansive soils, and (2) analysis of the interaction between a raft foundation and the movements in the supporting expansive soils. The solution of these problems are accomplished through the development of two computer models.

A three-dimensional moisture diffusion and volume change model named SUCH has been developed. The model SUCH is able to predict the distribution of soil suction and the resulting volume changes in expansive soils with respect to time under a covered area (i.e., raft foundation or pavements) when the supporting soil mass is subjected to different edge conditions that commonly cause moisture changes (i.e., climate, trees, or ponded water). The model SUCH has been validated against field data at four test sites in different countries (i.e., United States, Saudi Arabia, and Australia) with widely varying climatic and soil conditions. In each of these widely divergent sites, the moisture diffusion and volume change model SUCH was shown to be valid. Using the new model SUCH, a method for calculating the edge moisture variation distance is developed. The results of the model analysis showed that different moisture barrier systems and the sand cushion technique can be used to minimize the moisture and volume changes in the supporting expansive soils. The model can also show the effect of either trees or ponded water located adjacent to the foundation, either of which can cause excessive moisture and volume changes in the supporting expansive soils.

A soil-structure interaction model called SLAB97 based on the finite element method has been developed for calculating the structural design parameters (i.e., moments, shears, and deflections) in the raft foundation resting on expansive soils. The new model SLAB97 requires only a statement of the initial soil suction conditions in the soil mass and the changes in the boundary conditions to predict the response of the raft foundations to these changes in the boundary conditions. The model SLAB97 overcomes

the major shortcoming present in all existing design procedures, namely the estimation of the distorted mound shape. The model SLAB97 is capable of estimating the distorted mound shape by considering the changes of soil suction distribution throughout the supporting expansive soil mass and the resulting volume changes (shrink/heave) with respect to time under a set of different edge conditions that commonly cause moisture changes (e.g., climate, trees, and ponded water). Most importantly, the user of the SLAB97 does not need to prescribe the edge moisture variation distance and the maximum differential movements as input values, as well as the locations of points not in contact and the amount of the initial gap between the raft foundation and the subgrade at these points. However, it does require an estimation of the worst expected boundary conditions which may cause the worst soil suction distribution through the soil mass under the raft foundations during the lifetime of the structure. The new design methods introduced in this study appears to be an improvement on all other design methods presently available for design of raft foundation resting on expansive soils.

The new model SLAB97 provides guidance for minimizing the structural design parameters (moments, shears, and deflections) in the raft foundation resting on expansive soils by using different moisture barrier systems. The results of the model analysis showed that either trees or ponded water located adjacent to the raft foundation can cause an increase in the structural design parameters. Also, the superstructure load pattern is considered an important parameter governing the values and the distribution of the structural design parameters in the raft foundation resting on expansive soils.

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TABLE OF CONTENTS