NUMERICAL INVESTIGATION OF THE SOIL REPLACEMENT EFFECTIVENESS IN SWELLING CLAYS

By

Dalia Abdel Moneim Ali Mohamed Abo-Rageh

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
in
Civil Engineering - Public Works

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:
Numerical investigation of the soil replacement effectiveness in swelling clays

Key Words:
Expansive soil; replacement soil; swelling pressure; heave; differential heave

Summary
The first part of the present thesis concerns with performing a numerical simulation of the swelling pressure test to evaluate the effect of SWCC shape on the swelling pressure. The second part concerns with performing a simulation of the replacement method to evaluate its effectiveness on the heave. The effect of the building stiffness on the swelling deformation was also studied. The impact of increasing the building stiffness of the first two stories of the building on the swelling deformation was also studied. The influence of the replacement soil depth and the building stiffness on the differential upward movement in different stories of a building was investigated. The ABAQUS software and Regina clay are used in this analysis. The present results show that the swelling pressure increases with decreasing the initial water content and increasing the initial soil suction. Higher replacement soil stiffness increases the differential heave between footings. Accordingly, a replacement layer with low stiffness is more suitable from heave point of view. Moreover, higher building stiffness tangibly reduces the differential heave between footings. The replacement soil thickness can be reduced by increasing the building stiffness. Increasing the building stiffness of the first two levels of a building can significantly reduce the differential heave. Replacement soils with high permeability produce higher heave compared to those with low permeability. However, they result in lower differential heave compared to the low permeability replacement soils.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Dalia Abdel Moneim Ali Date: / / 2019

Signature:

Dedication

I dedicate this work
To my dear husband,
Sameh Shaaban
To my dear children,
Aseel Sameh and Ahmed Sameh
To my parents,
Abdel Moneim Ali and Mervat Mohamed

Thank you all for your support during all these years.

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Cairo, 2019

Dalia Abdel Moneim

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