بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

MONA MAGHRABY

Ain Shams University
Faculty of Engineering
Department of Structural Engineering

Investigation of the Bearing Capacity of Strip Footings on Sedimentary Jointed Rocks

A THESIS
Submitted in Partial Fulfillment of the Requirements of the Degree of
MASTER OF SCIENCE IN CIVIL ENGINEERING

Submitted by

Ayat Raafat Awad Khairy Al Sayed
B.Sc. in Civil Engineering – Structural Engineering (2013)
Faculty of Engineering – Ain Shams University

Supervised by

Dr. Hesham Mohamed Helmy
Associate Professor of Geotechnical Engineering
Structural Engineering Department
Faculty of Engineering
Ain Shams University

Dr. Mohamed Maher Tawfik
Assistant Professor of Geotechnical Engineering,
Structural Engineering Department
Faculty of Engineering
Ain Shams University

October – 2019

Ain Shams University
Faculty of Engineering
Department of Structural Engineering

Name : Ayat Raafat Awad Khairy Al Sayed
Thesis : Investigation of the Bearing Capacity of Strip Footings on Sedimentary Jointed Rocks
Degree : Master of Science in Civil Engineering (Structural)

EXAMINERS COMMITTEE

Name and Affiliation	Signature
Prof. Dr. Mostafa Diaa Al-Deen Abu Keifa Professor of Geotechnical Engineering , Faculty of Engineering Cairo University **Prof. Dr. Mona Mostafa Eid** Professor of Geotechnical Engineering , Faculty of Engineering Ain Shams University **Dr. Hesham Mohamed Helmy** Associate Professor of Geotechnical Engineering, Faculty of Engineering Ain Shams University	

Date: / / 2019

Ain Shams University
Faculty of Engineering
Department of Structural Engineering

Name : Ayat Raafat Awad Khairy Al Sayed
Thesis : Investigation of the Bearing Capacity of Strip Footings on Sedimentary Jointed Rocks
Degree : Master of Science in Civil Engineering (Structural)

SUPERVISORS COMMITTEE

Name and Affiliation	**Signature**
Dr. Hesham Mohamed Helmy Associate Professor of Geotechnical Engineering Faculty of Engineering Ain Shams University	
Dr. Mohamed Maher Tawfik Assistant Professor of Geotechnical Engineering Faculty of Engineering Ain Shams University	

Date: / / 2019

Postgraduate Studies
Authorization stamp: The thesis is authorized at / / 2019

College Board approval
/ / 2019

University Board approval
/ / 2019

Curriculum Vitae

Name:	Ayat Raafat Awad Khairy Al Sayed
Date of Birth:	13 November 1989
Place of Birth:	Egypt
Nationality:	Egyptian
University Degree:	B.Sc. in Civil Engineering, Faculty of Engineering, Ain Shams University, 2013
Current Job:	Geotechnical Engineer

Declaration

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Civil Engineering (Structural Engineering). The work included in this thesis was carried out by the author in the Department of Structural Engineering, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

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

Name: Ayat Raafat Awad Khairy Al Sayed

Signature:

Date:

(To my mother, might you be proud)

Acknowledgment

I wish to express my gratitude to Dr. Hisham Mohamed Helmy , Associate Professor of Geotechnical Engineering in the Structural Engineering Department, Ain Shams University and Dr. Mohamed Maher Tawfik Assistance Professor in the Structural Engineering Department, Ain Shams University for their kind supervision, sincere assistance and valuable guidance during the preparation of this thesis.

This thesis could not have been completed without the most significant supports and love from my family and my friends throughout the study.

Abstract

Although the bearing capacity term is well known among the geotechnical engineers, when it comes to non-homogenous formation contains several features like the jointed rock, this term becomes a little harder to adequately estimated. The main feature highlighted in the jointed sedimentary rocks is how it formed in nature and how this formation caused weak planes implanted inside the rock mass. These weak planes are known as faults, beddings, and joints, which are weak shearing zones subjected to loading.

The loading direction concerning the joint orientation (dip angles), had a considerable effect on the bearing capacity of the whole mass, this effect can accurately be represented only when the rock mass studied as discrete formation, i.e., the intact rock and the joints separately simulated with their individual parameters. Also, the spacing between these joint what makes the rock behaves either as a sound rock when the spacing is widely spread within the mass or behaves as fracture material when the spacing is closed then, more joints exist under the footing.

To study the latter mentioned parameters, available results from the plate load test performed in the Bakhtiary Dam in Iran were utilized to investigate the Bearing Capacity of strip footings on a Limestone formation. A numerical model was developed using the finite element method to simulate and validate the Plate load test performed in the dam site. The numerical model was formed as a discrete model.

The predicted ratio between the shear strength parameters (cohesion), the modulus of elasticity of the intact rock, and the discontinuities gives a reasonable agreement with the measured field settlements and the results from

the numerical model. This result implemented in the parametric study along with different ratios to compare it with an analytical BC. The analytical approach's parameters were based on empirical rating system (RMR) as it is a simple system to use among engineers. Other approaches depended on the unconfined compressive strength (qu), which is similar to the Mohr Columb original solving method.

A further parametric study had been carried out with this different strength and stiffness ratios, to show the effect of these ratios with presence of inclined joints (30 and 45 degrees) on the allowable bearing capacity of the rock mass, also studied the effect of (S/B) joint spacing with respect to the footing width by changing the strip footing width. All the parameters stated above studied with their effect on the allowable bearing capacity and represented on bearing capacity – RMR curves mention the variant parameters.

Also, a study had carried out with constant famous number among engineers, 0.50 MPa (5.00 Kg/cm^2) as allowable BC when shallow foundation lies on rock mass, implementing the different stiffness and cohesion ratios between intact blocks and joint, settlement – RMR curve was plotted.

Also, studying the differential settlement under the footings of one structure located on different rock conditions had carried out in this study.

Keywords: Sedimentary Rocks; Jointed Rock; Bearing Capacity; Finite Elements in rock mass; Mohr-Coulomb Criterion; Joint dip angles.

TABLE OF CONTENTS