Ain Shams University
Faculty of Engineering
Department of Structural Engineering

"Effect of polypropylene fibers inclusion on the mechanical behavior of clayey soil"

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

Submitted by

Mostafa Said Yousef Khalil
B.Sc. in Civil Engineering 2011
Ain Shams University – Faculty of Engineering

Supervised by

Prof. Mohamed Monier Sayed
Professor of Geotechnical Engineering
Structural Engineering Department
Faculty of Engineering
Ain Shams University

Dr. Abdullah Mohamed Galaa
Assistant Researcher Professor
Foundation and Soil mechanics Institute
Housing and Building Research Center

Ain Shams University
Faculty of Engineering
Department of Structural Engineering

"Effect of polypropylene fibers inclusion on the mechanical behavior of clayey soil"

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

Submitted by

Mostafa Said Yousef Khalil
B.Sc. in Civil Engineering 2011
Ain Shams University – Faculty of Engineering

Supervised by

Prof. Mohamed Monier Sayed
Professor of Geotechnical Engineering
Structural Engineering Department
Faculty of Engineering
Ain Shams University

Dr. Abdullah Mohamed Galaa
Assistant Researcher Professor
Foundation and Soil mechanics Institute
Housing and Building Research Center

Researcher Data

Name : Mostafa Said Yousef Khalil

Date of birth : 28/9/1988

Place of birth : Cairo – Egypt

Last academic degree : B.Sc. in Civil Engineering – Ain Shams University 2011

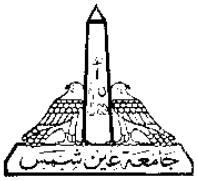
University issued the degree : Faculty of Engineering - Ain Shams University

Date of issued degree : 2019.

Current job : Civil Engineer, Housing and Building Research Center

Signature

Eng. / Mostafa Said Yousef Khalil



AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Structural

[Title]

by

Mostafa Said Yousef Khalil

Master of Science in Civil Engineering

(Structural Engineering)

Faculty of Engineering, Ain Shams University, 2018

Examiners' Committee

Name and Affiliation	**Signature**
Prof. Khaled Mohamed El-Zahaby Structural , Housing and Building Research Center.	…….
Prof. Ali Abdel-Fattah Structural , Ain Shams University.	…….
Prof. Mohamed Moneir Sayed Structural , Ain Shams University.	…….

Date:21 April 2019

Statement

This thesis is submitted as a partial fulfillment of Master of Science in Civil Engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

Eng. Mostafa Said Yousef Khalil

Signature

……..……

Date:21 April 2019

Abstract of M.Sc. Thesis

Mostafa Said Yousef Khalil, Effect of polypropylene fibers inclusion on the mechanical behavior of clayey soil, Master of Engineering Science Thesis, Ain Shams University, 2019

Clays are used in various applications that require increasing its bearing capacity and enhancing its resistance to cracking due to the environmental conditions. The effect of polypropylene fibers (PPF) inclusion on unconfined compressive strength and resistance to cracking under multiple wetting-drying cycles is investigated in this study. An experimental program is carried out to study the effect of the inclusion of randomly-distributed short fibers on the compressive strength and the resistance to cracking of clayey soils. Specimens of unreinforced kaolinite clay as well as reinforced clay with 0.5% and 1.0% PPF are utilized in the study.

The use of polypropylene fibers is the most commonly used for reinforcement of soils, due to its low cost and the ease of mixing with the clay soil.

A laboratory testing program was carried out in this research to achieve this goal. The purpose of the program is to evaluate the effect of the fiber content in clay soils on both their resistance to unconfined compression and cracks. These properties were studied using modified Proctor tests, unconfined compression, and cracking testing.

The study also aims to study the possibility of using fibers-reinforced clay soil as an alternative to geotextile reinforced clay soil. Therefore, the optimum percentage of fiber has been studied. Test samples were prepared with different percentages of fiber (0.5%, and 1%). A comparison was presented between using the optimum percentage of fibers and the number of geotextile layers.

The study presents methods for preparing samples for fiber-reinforced clay soil by preparing molds for testing of fiber-reinforced soil using the unconfined compression tests. Soil resistance and behavior were evaluated under the influence of loads through the results of laboratory tests. The results show that the inclusion of fibers enhances the unconfined compressive strength (UCS) up to a certain fibers content after which UCS decreases. The inclusion of fibers is found to significantly reduce the stiffness of the soil, increase the ductility and increase the post-peak strength of the soil. Clay reinforced with random reinforcement elements (PPF) exhibited larger UCS than those reinforced with one and two layers of systematical-reinforcement (non-woven geotextile). Desiccation cracking is quantified through calculating Cracking Intensity Factor (CIF) values. Specimens reinforced with 0.5% PPF exhibit the largest resistance to desiccation cracking. The resistance to cracking increases with fibers content up to certain fibers content after which such resistance decreases. Moreover, multiple wetting and drying reduce the effectiveness of fibers inclusion to reduce desiccation cracking.

Keywords: Fiber-reinforced clay, Un-confined compression, Desiccation cracking, Wetting and drying cycles, CIF.

Acknowledgement

I would like to express my gratitude and respect to my supervisor and teacher, Prof. Mohamed Morsy, for his support and aids throughout this research. I am also thankful to my co-supervisor, Dr. Abdullah Mohamed Galaa, for his efforts and advice throughout this research. Working with Prof. Mohamed Morsy and Dr. Abdullah Mohamed Galaa has been a great learning experience.

I also want to thank the staff of Housing and Building National Research Center (HBRC) for giving me the opportunity to do part of the experimental work in the Geotechnical Engineering Laboratory.

I would like to thank my colleagues and the technical staff of the Geotechnical Engineering Laboratory for their support.

I am also very thankful to my family and my friends for their continuous support and love.

Table of Contents

Chapter (3) Experimental Testing Program

List of Figures