

Laboratory Study of Adding Glass Fiber on Unconfined Shear Strength and Mechanical Properties of Cohesive Soil due to Different Water Contents

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Abstract

One method for rehabilitation of weak and problematic soil properties is rehabilitation by using physical added material such as fibers. In this paper, effect of glass fiber on rehabilitation of clay soil mechanical properties are studied. The main goal of this paper is evaluation of how added glass fiber to clay soil can affect engineering properties of soil, particularly unconfined compression strength and elasticity modulus of reinforced soil. In this research five different composition of soil and glass fiber (0.5 to 2.5) per cent with 11, 13 and 15 per cent water content are used. In order to study the effect of water content and glass fiber, unconfined compression tests have been done on clay soil reinforced by fiber glass and unreinforced clay soil. Obtained results in this research show that adding glass fiber to clay increases highly unconfined compression strength and elasticity modulus of the reinforced clay. Increasing fiber glass and water content, increases failure strain and makes difference in failure situation of the reinforced clay. Increasing water content in samples, increases ductility and failure strain of reinforced clay and decreases unconfined compression strength and elasticity modulus.

Keywords: *Glass Fiber, Unconfined Shear Strength, Cohesive Soil, Water Content*

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Extended Abstract:

1. Introduction

In 2005, Ghazavi and Amelsakhi studied the effect of waste tires on sand and investigated the optimization of tire chip dimensions in an environmental geotechnical research using a large direct shear test of 30 x 30 cm. The results showed that the dimensions of tires have optimal dimensions for which the maximum shear strength of reinforced sand is obtained (Ghazavi and Amelsakhi, 2005a). In another study, Ghazavi and Amelsakhi investigated the optimization of the chip dimensions of worn tires in sandy soil based on the CBR test results (Ghazavi and Amelsakhi, 2005b). Ahmed et al evaluated the effects of adding recycled glass fiber on improving the resistance parameters of different types of soils. The results showed that the addition of these fibers has caused a significant increase in the values of shear resistance and internal friction angles of soils (Ahmad et al., 2012)

2. Materials and methods

The glass fibers used in this study are ordinary type E, which is usually used for weapon applications in general and general mode. In this research, E-type glass fibers with an average length of 6 mm have been used to reinforce sticky soil. It should be noted that the reason for using this length of fibers in the research is the possibility of using this length of fibers inside the mold and spreading it randomly and having a greater effect on sticky soil. For coarse-grained soils, the length of the fibers will be different. The reason for using this type of fiber in this research is the common nature of this type of fiber. In other words, the goal is to apply common materials in the industry. Obviously, there are other types of fibers that can be used by researchers in similar researches.

In order to investigate the effects of adding glass fibers with uniform distribution in cohesive soil and also the effect of moisture changes in natural cohesive soil samples and reinforced with glass fibers on the properties of cohesive soil, unconfined compressive strength tests on 4 A group of clay samples was made. These groups include one natural cohesive soil group without reinforcing materials and three groups of reinforced cohesive soils with five different percentages of glass fibers in three different moisture values

3. Tests results

The lowest and highest values of unconfined compressive strength were obtained for the natural cohesive soil sample with 15% moisture content and the reinforced cohesive soil sample with 1% fiber content at 11% moisture content, with values of 273 and 1543 kPa, respectively. The maximum value of compressive strength of cohesive soil samples reinforced with 1% of glass fibers at humidity of 11, 13 and 15% has been obtained as 1543, 1128 and 573 kilopascals, respectively.

4. Conclusion

The optimum percentage of glass fibers in cohesive soil to achieve the highest amount of unconfined compressive strength for all moisture percentage values of 11, 13 and 15%, the value of 1% by weight has been obtained. It can be stated that this obtained percentage is the optimal value for the desired conditions in this research. The maximum value of compressive strength of cohesive soil samples reinforced with 1% of glass fibers at humidity of 11, 13 and 15% has been obtained as

1543, 1128 and 573 kilopascals, respectively. As it can be seen, the increase in sample humidity has resulted in a decrease in unconfined compressive strength. The lowest and highest values of unconfined compressive strength were obtained for the natural cohesive soil sample with 15% moisture content and the reinforced cohesive soil sample with 1% fiber content at 11% moisture content, respectively, with values of 273 and 1543 kilopascals.

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