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Faculty of Engineering and Quantity Surveying

INVESTIGATION ON THE EFFECT OF COMPACTION AND COMPRESSIVE STRENGTH OF CLAYEY SOIL USING GLASS FIBER

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SUPERVISOR'S DECLARATION

This project report Investigation on the effect of Compaction and Compressive Strength of Clayey Soil using Glass Fiber is prepared and submitted by Ibrahim Abubaker I12000565 as partial fulfillment of the requirement of Bachelor of Engineering (HONS) in Civil Engineering, INTI International University.

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Supervisor

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ABSTRACT

Construction or roads and other civil engineering structures on a loose or soft soil is risky due to its high compressibility, low shear strength, and high permeability. In such situations, it is general practice to modify the soil properties by blending with different materials such as lime, cement and fly ash or by reinforcing the soil. The soil that was used for this research was classified as clay soil and the stabilizer used is Glass fiber.

The optimum moisture content of the clay with and without glass fiber was found. Clay with glass fiber had higher Optimum moisture content compared to the virgin soil. Virgin soil OMC was 13.7% and soil with Glass fiber 1%, 2.5%, 4% and 5% had 14%, 14.9%, 15.9% and 16.3% of OMC. Whereas the dry density of the soil increase as the glass fiber was added into the soil. Dry Density of virgin soil was 1.87 g/cm^3 and for soil with glass fiber 1%, 2.5%, 4% and 5% had 1.84 g/cm^3, 1.77 g/cm^3, 1.76 g/cm^3 and 1.72 g/cm^3. The compressive strength was also tested and soil with glass fiber showed decent increase in stress compared to the virgin soil. Compressive Stress for virgin soil was 396.24 and for soil with Glass fiber 1%, 2.5%, 4% and 5% was tested to be 539.34, 732.54, 840.69 and 886.20. It can be concluded that glass fiber can be used on construction sites as a mode of soil stabilizer and to improve its strength.

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CHAPTER 1

INTRODUCTION

1.1 General

Soil has its own scientific analysis in construction materials with regards to its abilities on dealing with forces. Soil is the oldest engineering material and it is one of the most complex field for engineers to the point that when it comes to design for the safety factor. In the infrastructure field, soil is the first thing to consider before progressing with any of the developments on that particular area. It has been the main objective of engineers to study the soil and its properties to build a strong base that can hold the structure firmly for a longer period of time and for the safety of people that will be occupying the structure for various purposes of their need. Reinforcement of soil is wide field of research since decades and in recent times it has been put into more concentration because of the revolution in infrastructure design and because of the trend of building taller buildings. To follow up with safety and materialistic demands soil study should be done to its finest. As well as the engineers have to come up with a plan to be cost effective.

In soil reinforcement, there are multiple cases where soil with shallow depth may not be of good quality, and to construct subterranean foundations it may be costly. As well as there are many cases where the soil may not be of good quality even at larger depths and it may not be feasible to replace the soil entirely. Lastly, there are situation in which underground construction that may include underground air base, bunkers for military purposes and subways for transportation of civilians, in these particular situations the soil needs to be able to support or take the overlaying pressure of unsupported walls. In all of the above-mentioned scenarios it is necessary to reinforce the soil and to improve its strength with appropriate materials so that it can provide highest efficiency of its own purpose.

In modern era of construction, focusing on clayey soil it is very important to come up with a solution of improve the strength of soil. There are many researches done with various methods to improve the strength of clay in past and are already been applied. One of them is by using Glass fiber. Glass fiber which is also known as fiber glass. Fiberglass is light in weight and very strong material. Comparing the strength properties of fiber glass with carbon fiber, carbon fiber has higher strength. Glass fibers are less brittle and less expansive then carbon fiber. Glass fiber can easily be formed using molding process. When it comes to the usage of glass fiber, glass fibers are the most oldest and most familiar in performance. It's been manufactured since 1930s (Kiron,2017).

1.2 Statement of the Problem

Areas of construction that are governed by the area of clay soil that mainly consists of silty soil and clayey soil commonly present problems related to geotechnical engineering due to the individualities of such type of soil which are generally low in hydraulic conductivity, low shear strength and highly compressible. Such properties of soil may cause insufficient bearing capacity of the soil to upkeep the foundation, that have high potential of settlement in post construction and instability of the slope respectively.

For example, in any construction area that contains clay soil or soft soil may require deep foundation instead of shallow foundation due to its poor condition of engineering properties, that may lead to a hype in cost of the project. To overcome such circumstances, soil improvement can be taken into consideration so that the shear strength of the soil can be improved.

Other than that, pavement distortion (alteration of original shape) and rutting (reoccurring period) are also some of the major issues that commonly occur on the road due to irregular or excessive settlement of the clay soil underneath due to its characteristics that is highly compressible.

So, this research journal is being conducted to study on the characteristics of the clayey soil and the effect on compaction of soil reinforced by glass fiber. The effectiveness of this glass fiber to enhance the unconfined compressive strength of the soil is also to be examined.

1.3 Research Objective

The objective of this research is to explore on the influence on compaction and strength characteristics considering clayey soil stabilized with Glass fiber.

The Objectives are as follows:

-To determine the engineering properties of clayey soil and soil classification.

-To determine the effect on optimum moisture content and maximum dry density of soil reinforced at different percentage of Glass fiber.

-The determine the effectiveness of unconfined compressive strength of clayey soil by using glass fiber.

1.4 Scope of Study

To achieve the objectives of the study, several experimental works need to be conducted. To complete the research soil sample will be collected from Klang. Tests such as sieve analysis for particle size distribution, atterberg limit to get liquid limit, plastic limit, plasticity index and shrinkage limit was conducted. Determination of engineering properties and classification of soil will be conducted. The soil sample will undergo proctor test in determining the maximum dry density and optimum moisture content at dissimilar percentage of soil reinforcement used. Glass fiber was used for soil reinforcement at 1%, 2.5%, 4% and 5% at length of 0.5cm. Maximum dry density and optimum moisture content of untreated soil will be used as basis in preparing soil sample.

1.5 Significance of Study

To ensure the stability of the structure built, the strength of the substructure plays major role in engineering filed. The compressive strength of soil always become a major consideration such as for road construction, slope stability and embankment protection. Excessive settlements occur in soils that have low shear strength especially for weak soil which are generally highly compressible and low in hydraulic conductivity.

There are many methods available to improve the strength of the soil such as chemical stabilization, soil reinforcement, grouting and surcharge in a combination with vertical drain. To keep the research environment friendly and cost effective natural materials are the best source to stabilize the clay soil. Which may highly reduce the risk that may damage the environment and glass fiber is easy to find in Malaysia.

Glass fibers are light weighted, extremely strong and robust material. These fibers are among the most versatile industrial material known today. The glass fiber used in this study was locally available.

CHAPTER 2

LITERATURE REVIEW

2.1 Brief History

Since centuries the modification of soils has been implemented. For instance, the Mesopotamians and Romans individually discovered that it is feasible to boost the capacity of pathways to transfer activity by intermingling feeble soil with a considerable operator like pulverized limestone or calcium (Ellaby, 2010). Arbitrarily arranged fiber incorporations in the soils on the other hand goes about as plant establishes in regular means. Which prompt the quality of soil and dependability or characteristic inclines. Along these lines, it's been over 5000 years that the idea of fiber reinforcement was perceived (Sridhar *et.al*, 2017).

Numerous cases of strengthening the soil like Great Wall of China, ziggurats of Babylon, and so on (Hossain *et.al*, 2015). In the cutting-edge history of soil adjustment, idea and rule of soil fortification was primarily created. The presentation of fortifying components in a dirt mass expands the shear protection of the medium (Sridhar *et.al*, 2017). Thusly, endeavors for utilizing stringy ingredients, as simulation of the past, were begun. From the time of this development, about 4000 structures have been worked in beyond than 37 nations so far utilizing the idea of earth support (Aggarwal *et.al*, 2010).

At first, polyester fibers already staple fibers inputted to the geotechnical building marketplace under the conventional brand of "Texsol". Utilized as a part of retaining walls and slant assurances. Notwithstanding, unsystematically dispersed fiber-strengthened soils, recognized as short fiber soil composites, of late pulled in mounting consideration in numerous geotechnical designing applications, in logical research condition, as well as at official genuine field (Shukla *et.al*, 2017). Engineered staple filaments have been utilized as a part of soil since

the late 1980s, when the underlying examinations utilizing polymeric strands were directed (li, 2005).

2.2 Soil Characteristics

About 7 soil attributes which are utilized for characterization of the soil. Composition, color, texture, structure, soil water, organic matter and chemistry. Each is portrayed quickly underneath (Asekeen, 2017).

2.2.1 Composition

Arrangement of the soil is divided into four important classes: Inorganic Material, water, air and natural materials. Compound that is not driven from meat or plants and carbons particles are missing. The amount of water or air atoms which are present in soil will equally choose the arrangements. Meat or plant sources are natural materials and these sources do include carbon atoms.

2.2.2 Color

To classify the soil based on the colour, the best way to do so is to look at the shade of it. Soils that are high in nature are usually darker in colour. Such soil types are used for plantation and cultivation purposes. Typically, clayey soil is found in yellow, orange or red in colour which has high amount of iron.

2.2.3 Texture

Texture of soil is found by the feel of it and by and large alludes to clay, sand and silt substance. Researchers decide the qualities of soil by a surface triangle, with this research can