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REINFORCEMENT OF KAOILINITIC SOIL USING COIR FIBRE GEOTEXTILE

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Abstract

Abstract — Soil stabilization has become a major issue in construction engineering and the researches regarding the effectiveness of using natural waste are rapidly increasing. Soil reinforcement is an effective and reliable technique for improving strength and stability of soils.Successful use of geosynthetics is ensured in a given geotechnical application, as it is not only compatible but effective in improving the soil properties when appropriately placed.The natural geotextiles can be used as separator, reinforcement and drainage layer for unpaved and paved road sections.
In this work the performance of woven geotextile, interfaced between soft subgrade is carried out experimentally using California Bearing Ratio (CBR) and Model Footing Test. In order to evaluate the performance, the load-penetration relation of soft subgrade and soft subgrade-geotextile for woven geotextile are obtained. Comparison of the above obtained values shows that the performance is improved with the inclusion of woven geotextile.
Keywords: Coir Geotextiles, CBR Test, Model Footing

1. Introduction

The less amount of land is available for construction because of increasing the urbanisation and modernizations. Owing to this, construction of structures these days is being carried on land having weak or soft soils. Now stability of any structure depends on the properties of soil. Using land having soft soil for construction leads to various ground improvement techniques such as soil stabilization and soil reinforcement. The process of improving engineering properties of soil and thus making it more stable is called soil stabilization. There are various methods for soil stabilization like mechanical stabilization, cement stabilization, lime stabilization, bituminous stabilization, chemical stabilization, thermal stabilization, electrical stabilization, stabilization by grouting etc. In the present work, detailed study on the effect of using a natural material such as coir on subgrade soil is being considered to improve properties. Soil stabilization is of great importance in road construction. Long term performance of pavement structures often depends on the stability of the underlying soils.
In the case of geotechnical engineering the idea of inserting geotextile in a soil mass in order to improve its mechanical behaviour has become very popular. The concept of earth reinforcement is an ancient technique demonstrated abundantly in nature by animals, birds, and the action of tree roots. These reinforcements resists tensile stress developed within the soil mass thereby restricting shear failure. Reinforcement interacts with the soil through friction and adhesion. The practicing engineers are employing this technique for stabilization of thin soil layers, repairing failed slopes, soil strengthen around the footings and earth retaining structures. The inclusion of geotextile increases strength parameters of the soil as in case of reinforced concrete construction.

2. OBJECTIVE

- To increase the bearing capacity and shearing strength of the soil.
- Economical and gainful utilization of locally available coir fibre.
- To study the load settlement behaviour of coir geotextile reinforced and unreinforced soil in the laboratory.
- To locate the ideal position of coir geotextile in subgrade soil.

3. SCOPE

- Coir geotextile improves soil properties.
- Easily and cheaply available material.
- Weak soil can hence be used for construction.

4. METHODOLOGY

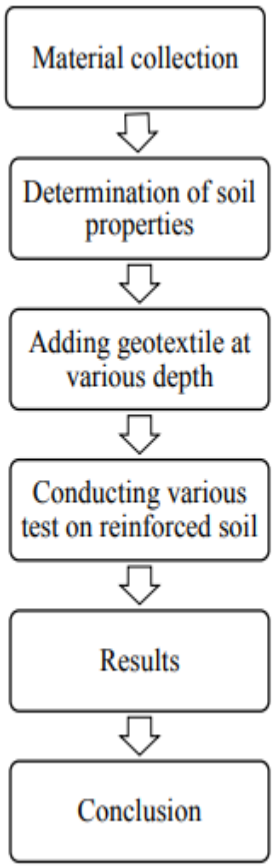

Figure 1. Methodology

5. COIR GEOTEXTILES

Coir is an abundantly available and renewable resource, which is more durable than jute as its lignin content is more. The biggest advantage of coir geotextile is its availability, economic price range, and eco compatibility. It can be tailor made as per end users technical requirements like porometry, permittivity, strength etc. The uses of coir geotextile in improving the bearing capacity of soil and erosion control are well established. The effects of placement position and stiffness of

geotextile on the performance of reinforced section were examined, by using two types of geotextiles- one is woven and other one is nonwoven.

Figure 2 . Woven Geotextiles

The advantages of coir geotextiles are the initial strength, stiffness and hydraulic properties of coir reinforcement are almost comparable to those of similar products made from polymer materials. They are of very low raw material price. By chemical treatment and polymer coating, the life of coir products can be improved. It can be laid on any surface owing to its flexibility and hence it is useful for geotechnical purpose. Coir fibres are environmental friendly, biodegradable and aesthetically pleasing and easy to install and follows the contour the soil surface.

6. LABORATORY TESTS

6.1 General Properties

The basic properties of soil sample were tested before starting the major test. Here the general properties such as specific gravity, particle size distribution, compaction, Atterberg limits, unconfined compressive strength etc. were determined.

6.2 Test Results

Table 1. Basic Soil Properties

Properties	Values
Specific Gravity	2.57
Liquid Limit	44%
Plastic Limit	29%
Shrinkage Limit	24%
Percentage Silt	80%
Percentage Clay	18%
Optimum Moisture Content	24%
Maximum Dry Density	1.15g/cc
Unconfined Compressive Strength	3.644kg/cm2
Shear Strength	1.822kg/cm2
Normal Stress at Failure	1.822kg/cm2
Angle of Internal Friction	0

6.3 California Bearing Ratio Test Results

It is the of the force per unit area required to be penetrate a soil mass with a circular plunger of 50mm diameter at the rate of 1.25mm per minute to that required for corresponding penetration of a standard material. The test was conducted for unreinforced soil and also for reinforced soil by placing the geotextile at B/4 depth, B/2depth and 3B/4 depth respectively.

Table 2. CBR Test Results

Soil	CBR at 2.5mm penetration	CBR at 5mm penetration
Unreinforced Soil	2.2%	3.2%
3B/4	3.3%	4.3%
B/2	3.5%	4.9%
B/4	4.4%	6.5%

6.4 Modal Footing Test Results

Model footing test on the fibre reinforced soil were conducted to investigate the pressure settlement behavior of randomly distributed fibre reinforced soil and effect of fibre content on the bearing capacity of the randomly distributed fibre reinforced soil. The value of load settlement curve for reinforced soil, when the geotextile is kept at a depth of 25mm (B/4) is above than that of the 50mm (B/2), 100mm (B) and unreinforced soil.

6.5 Plate Load Test Results

Plate load is the test for determining the ultimate bearing capacity of soil and settlement of foundation under the loads for clayey and sandy soil. Plot a load penetration curve for unreinforced soil. 28 7. The test procedure is repeated for reinforced soil by placing geotextile at various depths such as B/4, B/2 and B.

6.6 Graphical Representation of CBR test

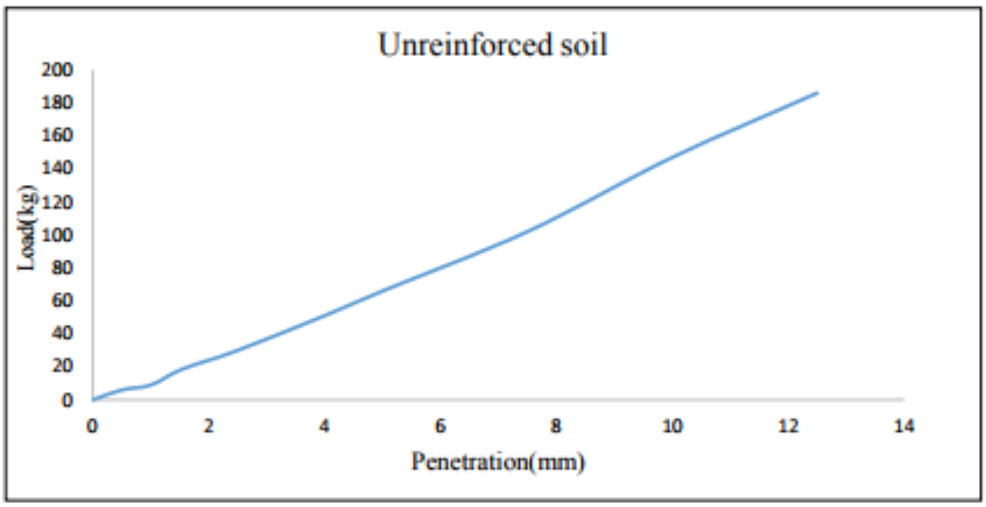

Figure 3 . Load Penetration Curve For Unreinforced Soil

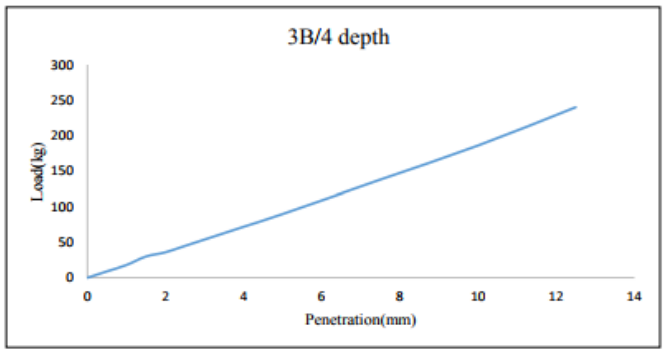

Figure 4 . Load Penetration Curve For 3B/4 Depth

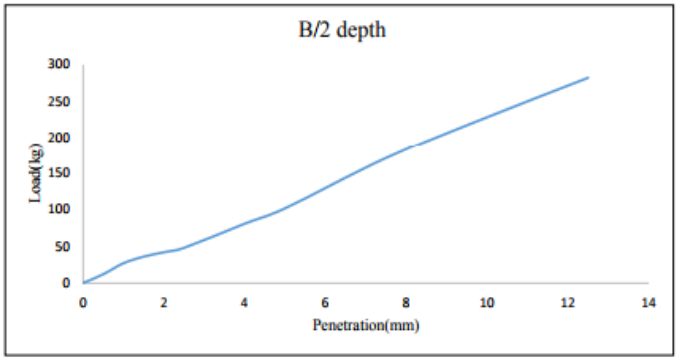

Figure 5. Load Penetration Curve For 3B/4 Depth

6.7 Model Footing Test

Model footing test on the fibre reinforced soil were conducted to investigate the pressure settlement behavior of randomly distributed fibre reinforced soil and effect of fibre content on the bearing capacity of the randomly distributed fibre reinforced soil.

6.8 Graphical Representation of Model Footing Test

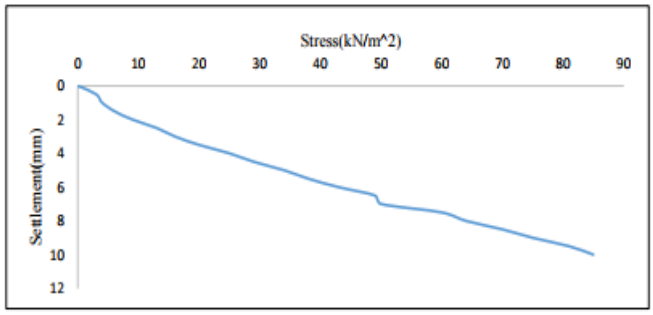

Figure 7 .Graph between stress and settlement for unreinforced soil

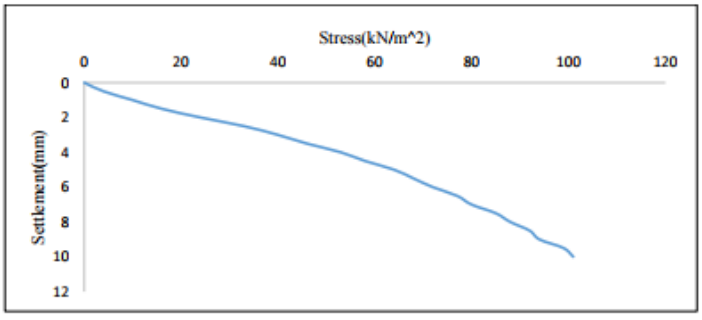

Figure 8.Graph between stress and settlement for reinforced soil at B depth

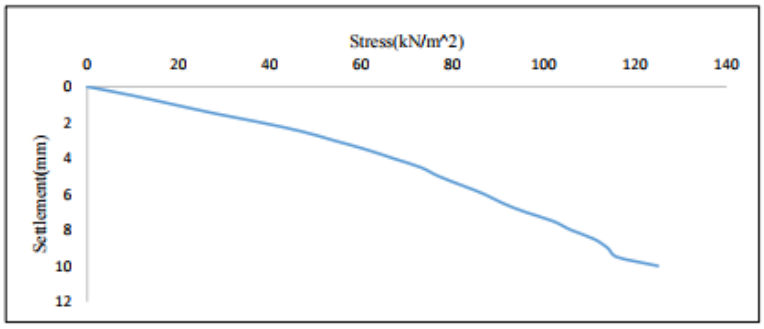

Figure 9. Graph between stress and settlement for reinforced soil at B/2 depth

The stress carried by the soil reinforced with geotextile is more than the unreinforced soil. Also from the above observation and graph it is clear that the maximum stress is carried when the geotextile is kept at a distance of B/4 from the top where B is the width of the footing used.

7. CONCLUSIONS

This work was done to assess the effect of coir geotextiles on the performance of kaolinitic soil.CBR and model footing were conducted by placing geotextiles at different depths. The maximum value of CBR was obtained when the geotextile was placed at B/4 depth from the surface, where B is the height of the cylinder used. In the case of model footing test, the maximum stress was carried when the geotextile was placed at B/4 depth from the surface of the tank, where B is the width of the footing used to transfer the load. In the plate load test the maximum load was carried when the geotextile was placed at B/4 depth, where B is the width of the plate used for transferring the load. The test results reveals that there is improvement in the strength of kaolinitic soil. This helps to find application for using geotextiles to improve the bearing capacity of soil especially in the construction of pavements. It makes the construction of pavements economical by reducing the depth of wearing courses. This also helps in construction of buildings economically in clayey soil areas thereby reducing the maintenance cost of buildings.

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