CBR Characteristics of Soils Stabilised with Geogrid

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Abstract

Soil Reinforcement is an effective and reliable technique for improving the strength and stability of soil. Geogrids are used to stabilize and improve the strength and characteristics of soil. Black cotton soil, marine clay soil and Kuttanadan clay soil are the different types of soil involved in this paper. These soils are not used for any construction purposes. The implementation of geogrids will enable the usage of these soils in construction. Laboratory tests were conducted on soil specimen with geogrids in one or more layers. Strength tests are to be conducted on the above mentioned soils. This paper focuses on the variation of strength of three types of soil by using geogrids.

Keywords - *Soil Reinforcement, Geogrids, Black Cotton Soil, Marine Clay Soil, Kuttanadan Clay Soil.*

I. INTRODUCTION

A. General

Soil reinforcement technology is given the utmost importance in present days to adopt weak soils into competent stable ground for different civil engineering applications. The need for land is increasing day by day so it is very important to monitor strength of the soil to meet the demands of increasing population. Soil reinforcement is a highly effective and reliable technique for improving the strength and stability of soil. Geogrids are recommended for the separation function because of their low cost, coefficient of friction, elongation and drape to confirm to any surface, effective filtering even after elongation, abrasion and puncture resistance, and their high coefficient of permeability. They can be reclaimed and reused. This project aims to study the effectiveness of natural Geogrid in stabilizing clay.

B. Materials

Materials used: Black Cotton Clay soil, Kuttanadan Clay Soil, Marine Clayey Soil collected from different districts of Kerala. Geogrid H_2M_9 from Alappuzha District.

II. EXPERIMENTAL PROGRAMME

Three types of clayey soils were selected for this study. The index properties were determined. Important physical properties are given in Table No. 1

Table 1 - Physical Properties Of Clayey Soils

PROPERTIES	BLACK COTTON SOIL	MARINE CLAYEY SOIL	KUTTANADAN CLAYEY SOIL
FREE SWELL INDEX	36.26%	41.66%	46.15%
Specific Gravity	2.6	2.62	2.59
LIQUID LIMIT	47.5%	43.91%	57.64%
Plastic Limit	27.66%	22.22%	25%
Plasticity Index	19.84%	21.69%	32.64%
Optimum Moisture Content	14.15%	17%	19%
Max Dry Density	1.78g/cc	1.4g/cc	1.35g/cc
Unconfined Compressive Strength	210.3kN/m^2	179.05kN/m^2	165.71kN/m^2
California Bearing Ratio	3.13%	4.47%	2.23%

From the above tests conducted and from IS 2720 it is clear the soil requires stabilization because of high swell index, high plasticity index, low UCC value and low CBR value. Hence proper stabilisation methods are to be adopted to increase the CBR value to increase the bearing capacity of soils.

One type of geogrid was used to reinforce the clayey soil. The type of coir geogrid that is used for our study is H_2M_9.

Various properties of geogrid considered for this study are given in Table 2.

Table 2 - Properties Of Geogrid

Properties	H_2M_9
Minimum Weight gms/m^2	900
Warp Ends Per dm	13
Weft picks per dm	7
Density kg/sq.m	0.9
Mesh opening mm	5*10
Tensile strength kN/m^2	10.49

Fig.1 H_2M_9 Geogrid

A. *Major Experimental Program*

Geogrid are used to strengthen weak soil, however the position of installation of geogrids shows variation in the strength. The geogrids placed at different height show different strength. The depth at which geogrids shows maximum strength is called optimum depth. The optimum depth is therefore very crucial to obtain maximum strength.

For the optimum depth determination various tests are conducted by placing geogrids at different height of the sample. The depths are 0.2H, 0.4H, 0.6H and 0.8H where H is the height of the sample from the top. The geogrid can be said to efficient only when it shows maximum efficiency. The pictorial representation of geogrid placement at different levels is shown below.

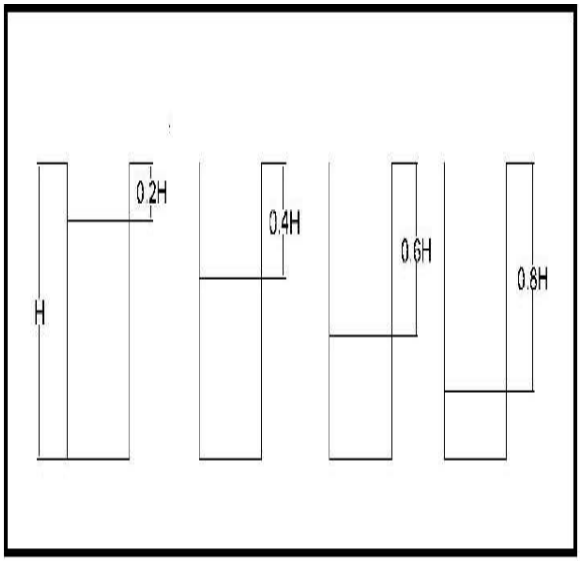


Fig.2 Shows The Arrangement Of Geogrids Placed At 0.2h, 0.4h, 0.6h And 0.8h Respectively

III. PERFORMANCE EVALUATION

The CBR test can be carried out by mixing the soils at optimum moisture content. In order to determine the OMC value, standard proctor test has to be carried out for soil reinforced at 0.2h, 0.4h, 0.6h and 0.8h from the top.

A. *Standard Proctor Test*

1) *OMC For Black Cotton Clayey Soil*

HEIGHT	OMC	MAX DRY DENSITY (g/cc)
0.2H	15%	1.77
0.4H	16.5%	1.7
0.6H	17.2%	1.62
0.8H	18.18%	1.68

2) *OMC For Kuttanadan Clayey Soil*

HEIGHT	OMC	MAX DRY DENSITY (g/cc)
0.2H	17.8%	1.76
0.4H	18.4%	1.7
0.6H	20.2%	1.66
0.8H	21%	1.6

3) OMC For Marine Clayey Soil

HEIGHT	OMC	MAX DRY DENSITY (g/cc)

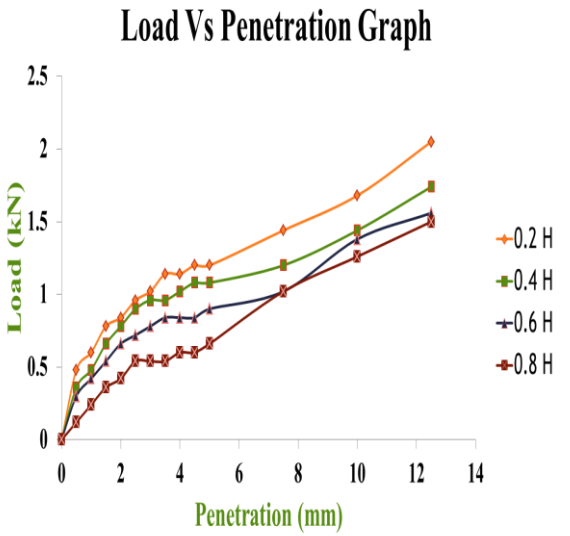
0.2H	19.9%	1.72
0.4H	22.3%	1.69
0.6H	23.6%	1.65
0.8H	24.67%	1.6

These moisture contents are adopted for the conduction of California bearing ratio test. The moisture content has increased after reinforcement which is evident from table .After the addition of geogrids the OMC increased it is because of the water absorbing compounds inside the geogrids.

B. California Bearing Ratio Test

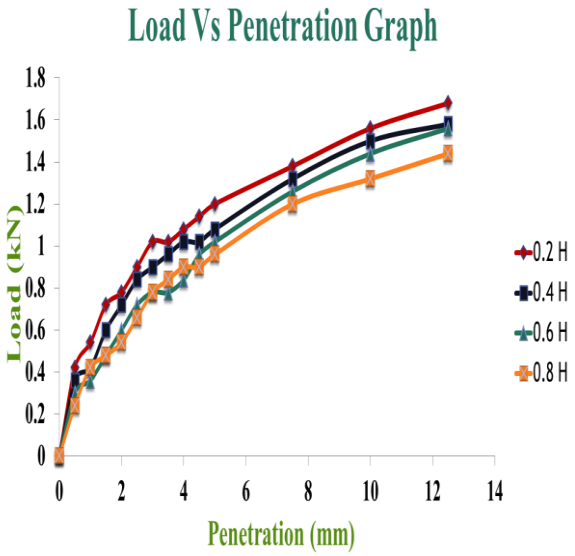
The CBR value is defined as the resistance offered by the soil against the penetration of 50 mm dia plunger penetrating at the rate of 1.25mm/min.

1) CBR Of Black Cotton Clay Soil



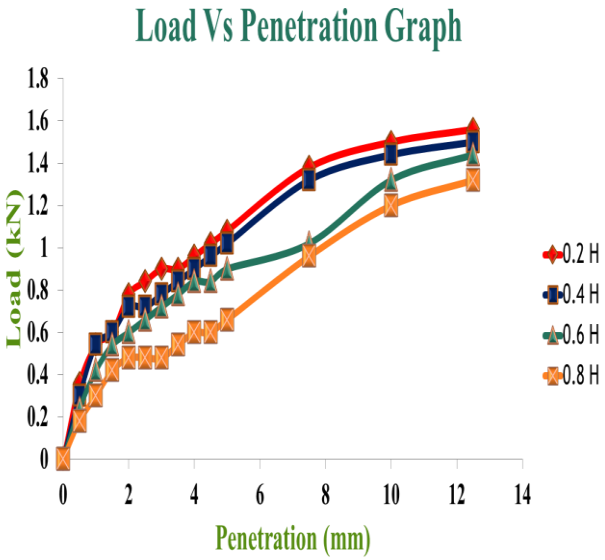
HEIGHT	CBR VALUE
0.2H	7.15%
0.4H	6.7%
0.6H	5.36%
0.8H	4.02%

2) CBR Of Kuttanadan Clayey Soil



HEIGHT	CBR VALUE
0.2H	6.7%
0.4H	6.26%
0.6H	5.36%
0.8H	4.91%

3) CBR Of Marine Clayey Soil

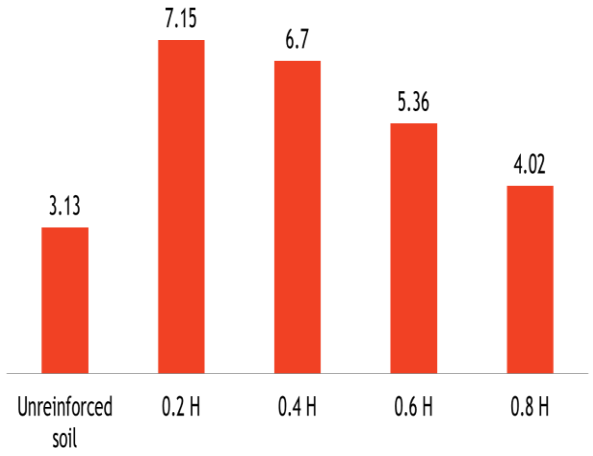


HEIGHT	CBR VALUES
0.2H	5.81%
0.4H	5.36%
0.6H	4.47%
0.8H	3.57%

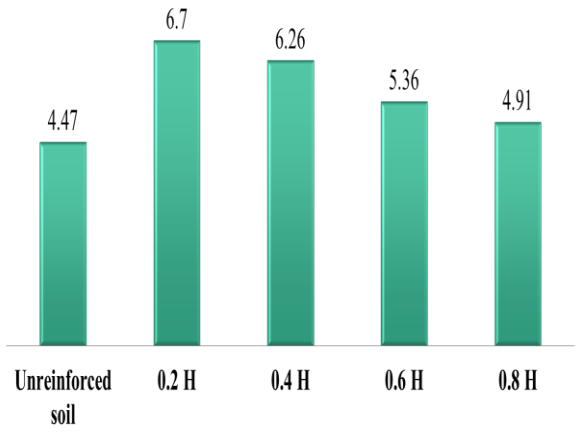
IV. COMPARATIVE STUDY

A. *Comparing The CBR Characteristics Of Soils Before And After Stabilising*

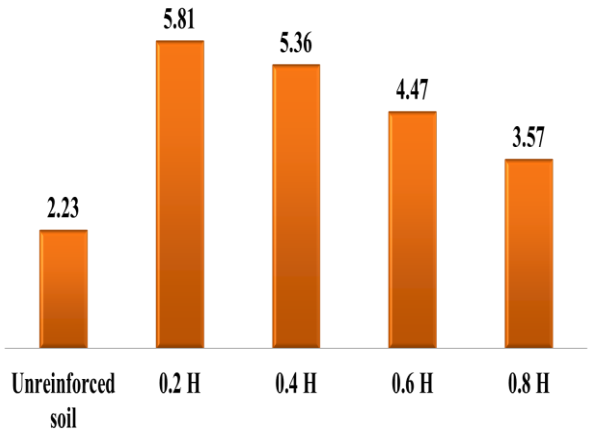
1) *Black Cotton Clay Soil*



2) *Kuttanadan Clayey Soil*



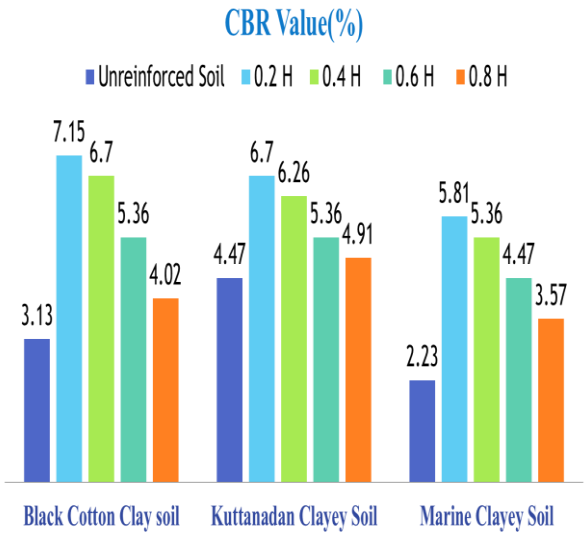
3) *Marine Clayey Soil*



B. *Inference*

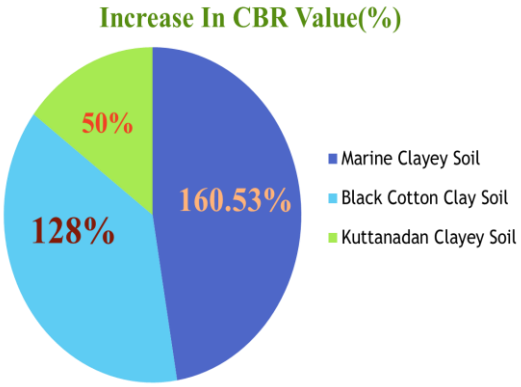
- The unreinforced black cotton clay soil, kuttanadan clayey soil and marine clayey soil could only show a very less CBR value.
- The impregnated Geogrid could improve the CBR value.
- However this increase in the CBR value is more when Geogrid was placed at the top layer.

V. RESULTS AND DISCUSSIONS



- ❖ The CBR values of all the soils got hired up in a considerable amount when Geogrid is placed.
- ❖ Increase in CBR value indicates increase in bearing capacity of soils.
- ❖ Hence it is clear that the soil can be effectively stabilised by the inclusion of Geogrid.

- The highest increase in the CBR value was achieved when geo-grid was placed at 20% depth from the top of the specimen.



- The CBR of a soil increases by 50-200% when it is reinforced with a single layer of Geogrid.

VI. CONCLUSIONS

This project is the outcome of the extensive laboratory research work carried out to explore the possibility of utilizing H_2M_9 Geogrid, a natural eco-friendly material. Experiments were done to study the CBR characteristics of soils stabilized with H_2M_9 Geogrid. This was accomplished by performing elaborate laboratory investigations in different aspects. The main focus was to conduct systematic work on the use of H2M9 Geogrid, a coir product, so that new methods of application can be evolved which will pave way for the growth of traditional coir industry.

- The CBR value of soil is found to increase with the inclusion of Geogrid.
- The highest increase in the CBR value was achieved when geo-grid was placed at 20% depth from the top of the specimen.
- The CBR of soil increases by 50-200% when it is reinforced with Geogrid. The amount of improvement depends upon the type of soil and position of geo-grid.
- The CBR of the Geogrid reinforced soil depends on the strength of soil, properties of Geogrid and the placement depth of Geogrid.

Hence it can be concluded that Geogrid stabilized soils are structurally strong compared to unreinforced soils.

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