Effect of Geotexile and Coir Geocell on CBR Strength of Subgrade Soil

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Abstract:- Nowadays it is a big challenge for civil engineers to do construction in poor soil with high loads. Such weak soil can be improved by different ground improvement techniques. Soil reinforcement is one of the most popular ground improvement techniques and this technique is used in this study. In this study the feasibitly of the soil as a subgrade material for pavement construction. A series of model tests has been carried out to develop an understanding of the influence of the geotextile and geocell on the subgrade soil. Geotextiles used here are two nonwoven geosynthetics, woven coir geotextile and geocell prepared from coir geotextile. The geocells mattresses were prepared by placing the coir strips in transverse and diagonal directions with joints at the connections. The performance of geotextiles and geocell is obtained based on the CBR load –penetration relation. Soaked and unsoaked CBR test are conducted with geotextiles and geocell.CBR value shows that the strength of soil is improved with the inclusion of geotextiles and geocell.

Keywords:- *Geosynthatics, coir geotexiles, geocells, CBR.*

I. INTRODUCTION

Nowadays innovative ground improvement techniques practiced all over the world. Mainly used method is reinforcement with geotextiles, geomembranes and geocells. They offer the advantages such as environmental sensitivity, space saving, material availability, technical superiority, higher cost saving and less construction time .The fundamental properties, such as tensile strength, filtering, water permeability and drainage can be improved by inserting geotexitles between subbase and base material. The strength and rigidity of pavement structures, which often fail when before their design life and geosynthetics reinforcement is the best method to improve such properties of pavements. Efforts are made in this direction in the present study.

In this study a series of CBR tests were conducted with geotextiles and geocells of different type as reinforcement to soil proposed to be used as subgrade material for pavement construction and the results of test were analysised and compared.

II. OBJECTIVES

- To determine engineering properties of soil.
- Evaluate the influence of geotextiles and geocell.
- To compare the CBR values of geotextile and geocell.
- To study the cost effectiveness.

III. SCOPE

The scope of present study is limited to, investigation of influence of reinforcement of locally available poor soil as a sustainable subgrade for construction.. The geotextiles and geocell could fulfill the functions as reinforcement material. Therefore in this study we are attempting to improve the strength of locally available weak soil by using geotextiles and geocells and evaluate the influence of geotextiles and geocell on CBR value.

IV. LITERATURE REVIEW

Until recently, few studies have reported on the effect of geotextile and coir geocells behavior. Huang (2004) prepared a study which concentrates on the effect of input wheel load and output stress or stain that is produced in the pavement. The advantages of mechanistic methods are the improvement in the reliability of a design, the ability to predict the types of distress, and the feasibility to extrapolate from limited field. It must be noted that the Geocell material can be selected based on the field requirements. And Emersleben and Meyer (2008) in his journal paper, describes about the surface deflection and vertical pressure on the subgrade which can be reduced by the use of geocells. The effect of geocells shows that performance improved as the height to diameter ratio was increased. The use of geocells not only reduced the amount of material required, but it also improved the speed of construction.

V. METHODOLOGY

A. Collection and Characterization of materials

The materials used in this study are soil and non woven geotexile, coir geotextile and geocell.

- *Soil*

Locally available soil is used for the present study. The summary of the index and engineering parameters of the tests done in the accordance with the respective Indian Standard Specifications. Based on the tests done, the soil is classified as MI.

PROPERTIES	VALUES
Specific gravity	2.4
Percentage of gravel (%)	21.7
Percentage of sand (%)	75.7
Percentage of clay and slit (%)	2.6
Dry density (gm/cm^3)	1.48
Optimum moisture content (%)	20
Uniformity coefficient	9.47
Coefficient of curvature	0.75
Liquid limit, W_L (%)	41
Plastic limit (%)	25
Plastic Index, Ip (%)	16

Table 1. Propertise of soil

B. Nonwoven geosynthetics

Non-woven geosynthetics collected from Gayatri polymers and geosynthatics Bangalore. It is manufactured from short staple fiber or continuous filament yarn. It will have mechanical inter-locking and chemical bonding with the polymer type used. Hence it will derive its propertises. Nonwoven geotextiles are classified into different grades like F-22, F-32, and F-46 etc. Nonwoven fabrics provide specific functions such as absorbency, liquid repellence, resilience, stretch, softness, strength, flame retardancy, wash ability, cushioning, thermal insulation, acoustic insulation, filtration, use as a bacterial barrier and sterility. Fabrics are created using these specific properties which are very useful and economical. It can also have the texture and strength of a woven fabric and can be as bulky as the thickest padding.

PROPERTIES	VALUES
Weight	275g/m^2
Thickness at 2kPa(kN/m)	1.4
Elongation at break	50%
Permeability	0.03mm
Pore size	75 micron
Tensile strength	19 KN/m
Dynamic cone drop	75mm
Price	140/sqm

Table 2 Properties of geosynthetics F-46

PROPERTIES	VALUES
Weight	175g/m^2
Thickness at 2kPa(kN/m)	0.9
Elongation at break	45%
Permeability	0.04mm
Pore size	85 micron
Tensile strength	12 KN/m
Dynamic cone drop	85mm
Price	120/sqm

Table 3. Properties of geosynthetics F-32

C. Coir geotextile

Brown coloured coir fibre is obtained from fully riped coconut. They are very strong and highly resistant to abrasion. Coir collected from coir board. It is protected from ultra violet component of sunlight, while processing. Woven coir geotextiles are available in different mesh opening ranging from 3 to 25mm. Coir has the heights tensile strength of any natural fibre and it is also very long lasting life.

PROPERTIES	VALUES
Mass/unit area (gm/m^2)	717.52
Thickness at 20 kpa(mm)	6.77
Puncture resistance(mm)	26
Tensile strength Dry(kN/m)	8.76
Tensile strength wet(kN/m)	7.66
Shear strength (kg/cm^2)	0.32
Permeability (lit/m^3/min)	11940
Price	70/sqm

Table 4. Properties of coir geotextile

D. Geocell

Geocells were fabricated from coir geotextiles with the aim of providing an additional confinement to the soil. The geocells mattresses were prepared by coir geotexiles 4 numbers of size 6cm X 6cm by placing them in transverse and diagonal directions by using with threads. They are 3D, honey comb like structures with interconnected cells. The soil is confined within these cells, thereby acting as a rigid base, reducing excessive settlements and preventing shear failure. Geocells are widely used in construction for erosion control, soil stabilization on flat ground and steep slopes, channel protection, and structural reinforcement for load support and earth retention.

F. California Bearing Ratio

California Bearing Ratio test was done as per IS specification. For this, the test specimens were prepared by compacting in 5 layers by giving 56 blows for each layer. The CBR tests were conducted with single layer nonwoven geotexile and double, three layer of reinforcement. The material is placed in such a way that while testing to remains in one third depth of the mould [14].Samples is molded at its

optimum moisture content and was tested for soaked and unsoaked CBR strength.

VI. RESULTS AND DISCUSSIONS

The results of different tests performed in this study are presented in this section. The variation of different test parameters is analyzed and relevant observations are made.

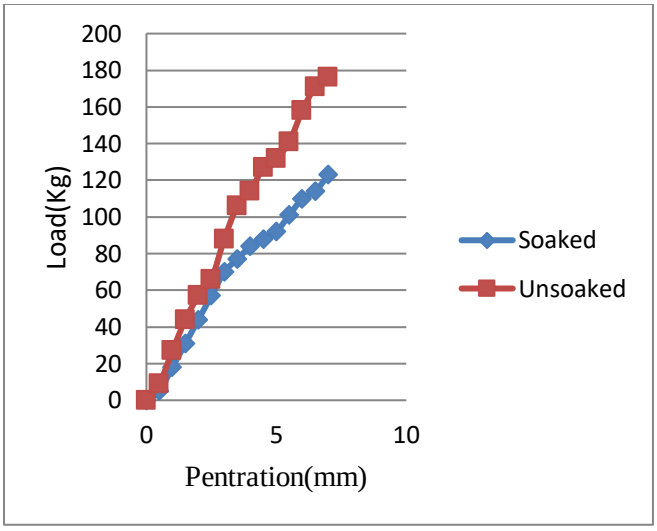

Fig 1:- CBR curves for soaked and unsoaked soil alone

SL NO	STATE	CBR VALUE UNSOAKED	CBR VALUE SOAKED
1	Soil	6.42%	4.17%
2	Soil+ geotextile (F-46)	7.25%	6.42%
3	Soil+ geotextile(F-32)	6.86%	5.1%
4	Soil+ coir geotextile (one layer)	6.61%	4.47%
5	Soil+ coir geotextile (two layer)	6.71%	4.72%
6	Soil+ coir geotextile(3 layer)	7.23%	5.10%
7	Soil+ geotextile (F -32)+ Coir (3 layer)	8.65%	8.24%
8	Soil+ geocell(3)	9.25%	8.71%
9	Soil+ geocell(4)	11.12%	10.82%

Table 5. Shows variation of CBR value with different geotextiles and geocell.

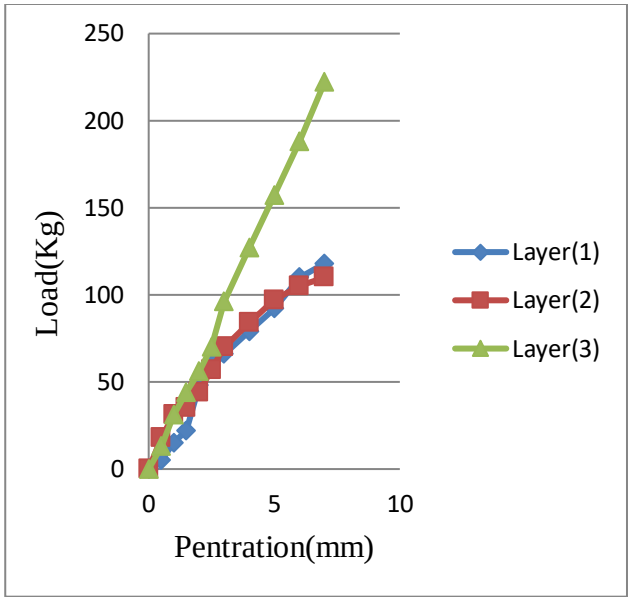

Fig 2:- CBR curves for coir geotexiles

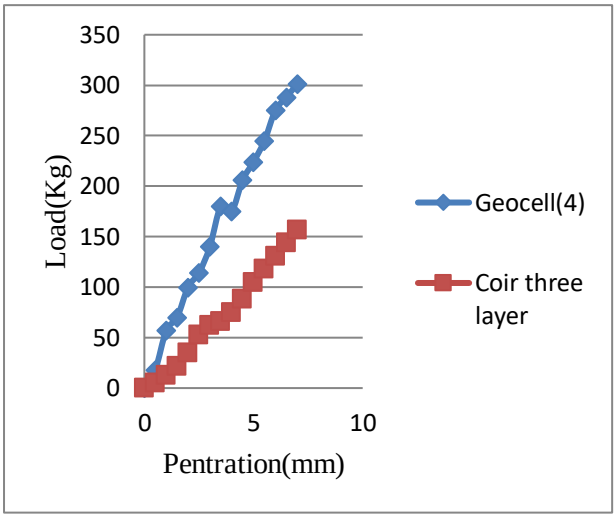

Fig 3:- CBR curves for coir geotexiles

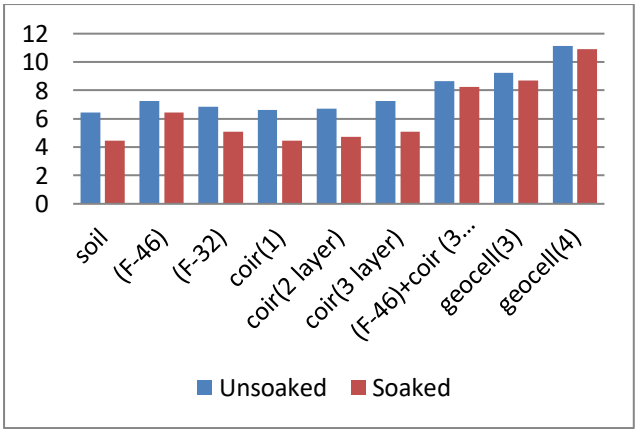

Fig 4:- Variation of CBR value for soaked and unsoaked tests

Sl No	Type	Cost of materials for laying for 1 sqm subgrade of geotexile
1	Geotextile (F-46)	140
2	Geotextile(F-32)	120
3	Coir geotextile (one layer)	70
4	Coir geotextile (two layer)	140
5	Coir geotextile (two layer)	210
6	Geotextile (F -32)+ Coir (3 layer)	350
7	Geocell(3)	130
8	Geocell(4)	150

Table 6. Cost effectiveness of different geotexitles

From the results, CBR Value of synthetic geotextile is higher than natural coir geotextile for single layer. For coir geocell CBR value increases by 159%. The value of geotextile of F-46 is 6.42% which is greater than that of geotextile F-32 is 5.1%, it shows F-46 had better performance than F-32 .It may so because tensile strength of F-46 is greater than F-32.

Coir geocell provide greater CBR value than the combination of geotextiles. Considering the CBR values of geocell found to be cost effective. The coir products are eco-friendly and they are natural products of India considering use of them will be economical.

VII. CONCLUSION

Soil used in the present study was reinforced with geotextiles and geocells of different type and CBR tests were conducted in soaked and unsoaked conditions. From the results of tests the following conclusions were obtained.

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- CBR Value of synthetic geotextile was higher than natural coir geotextile for single layer.
- CBR value of fabric geotextile of F-46 is 6.42 % and of fabric geotextile F-32 is 5.1%.Hence the performance of F-46 is better than F-32.
- Coir geocell provide greater CBR value than the combination of geotextiles.
- Numbers of geocells provided at an area has an effect on CBR value.
  For coir geocell type (II), CBR value increases by 159%.

Analyzing the cost of different types of geotexile reinforcement, geocells are
found to be cost effective.

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