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Effect of Bitumen Coated Jute Geogrid Reinforcement on Cohesive Soil

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***Abstract*— The loads coming on the structures are transferred directly to the earth. The stability of the structure depends upon the strength of the soil on which it is constructed. In case of soft soils, the properties have to be improved for better performance under the action of loads. Geosynthetics have been widely used in soil reinforcement. Fibre reinforced soil exhibits greater extensibility and small losses of post peak strength i.e., greater ductility in the composite material compared to the unreinforced soil. The main aim of the study is to investigate and evaluate the effects of jute reinforcement in the form of geogrids. The variation in CBR values with jute geogrid layers placed at equal vertical spacing within the soil at different combinations such as 1 layer, 2 layers, 3 layers and 4 layers were studied under both soaked and unsoaked conditions. In order to reduce the rate of degradation of jute, the jute geotextile was coated with bitumen. The variation in tensile strength of jute geogrid with and without bitumen coating were also studied Further, these results were compared with that of unreinforced soil. Also, the durability study of the jute geogrid with and without bitumen coating was conducted.**

Keywords*— *Cohesive soil , Reinforcement, Jute Geogrid, Bitumen, CBR , Tensile Strength, Durability

I. INTRODUCTION

The primary purpose of reinforcing a soil mass is to improve its stability by increasing its bearing capacity and tensile strength, and by reducing settlement and lateral deformation. Conventional reinforcing methods make use of continuous inclusions of strips, sheets, bars, fabrics or grids into the soil mass. Reinforcement may be classified into two major categories: (a) ideally inextensible inclusions (metal strips and bars) and (b) ideally extensible (naturally and synthetic fibres, plant roots and polymeric fabrics).

The construction of fibre reinforced soil is easily achieved by simply mixing soil with fibres as in case of other stabilizing admixtures like cement, lime, calcium sulphate, fly ash and silica fume. Fibre reinforced soil behaves as a composite material in which fibres of relatively high tensile strength are embedded in a matrix of soil. Shear stresses in the soil mobilize the tensile resistance in fibres, which in turn imparts greater strength to the soil.

Generally, the high tensile strength and extendibility of the added fibres help to effectively reduce the compressibility and brittleness of the parent soil, which is generally superior to traditional soil improvement approaches such as using cement. Fibre reinforced soil exhibits greater extensibility and small losses of post peak strength i.e., greater ductility in the composite material compared to the unreinforced soil or soil reinforced with high modulus inclusions.

The orientation of reinforcement in a particular direction may result in anisotropy of the soil mass that could result in a decrease of directional strength. But the primary advantages of randomly distributed fibres are the absence of potential planes of weakness that can develop parallel to oriented reinforcement.

II. OBJECTIVES

- To make comparative assessment of CBR (soaked and unsoaked) of soil reinforced with bitumen coated and uncoated jute geogrids.
- To study the variation in tensile strength of jute geogrid with and without bitumen
- To conduct the durability study of uncoated and bitumen coated jute geogrid

III. MATERIALS AND METHODOLOGY

The soil was collected from Thonnakkal region and jute was purchased from Kolkata. Bitumen was used for coating the jute fibres. The initial properties of soil were tested and the physical properties of jute were obtained from the manufacturer. The properties of bitumen were also determined.

The initial properties of Thonnakkal soil is given in Table 1.

TABLE 1.INITIAL PROPERTIES OF THONNAKKAL SOIL

Soil property	Value obtained
Natural water content (%)	28.04
Liquid limit (%)	47
Plastic limit (%)	28
Shrinkage limit (%)	25
Plasticity index (%)	19
Specific gravity	2.57
OMC (%)	29.37
Maximum drydensity(kN/m^3)	15.2
Percentage sand (%)	10%
Percentage silt (%)	52 %
Percentage clay (%)	38 %
IS Soil Classification	MI

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The particle size distribution curve of soil is shown in Figure. 1.

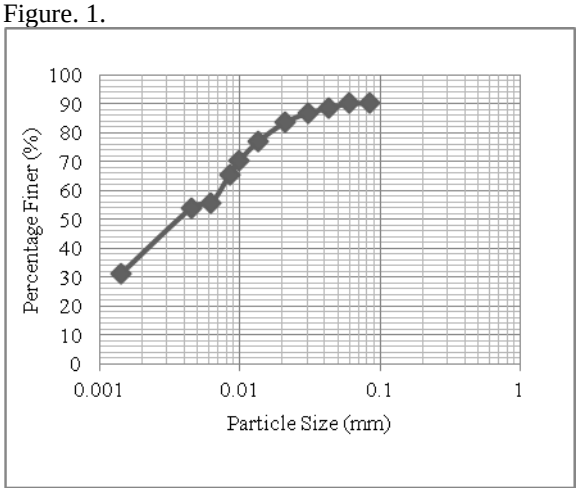

Fig.1 Particle size distribution curve of soil

The physical properties of jute fibre are given in Table 2.

TABLE 2. PHYSICAL PROPERTIES OF JUTE FIBRES

Jute fibre property	Value obtained
Specific gravity	1.29
Density (kN/m^3)	13
Micro-Fibril Angle (degree)	8.1
Cellulose/Lignin Content (%)	61 /12
Tenacity (MN/m^2)	525
Elongation (%)	1.1

The properties of bitumen used for coating the jute fibre are given in Table 3.

TABLE 3. PROPERTIES OF BITUMEN

Property at 25^O C	Value
Grade	A 80/100
Specific gravity	1.03
Penetration (mm)	90
Softening point (ºC)	46
Ductility (cm)	100
Flash point (ºC)	225

Here, California Bearing Ratio test as per IS 2720: (Part 16) 1987 is used for evaluating the suitability of subgrade. In order to compare the effect of bitumen coating on the strength characteristics of jute geogrid with time , the tensile property of bitumen coated jute geogrid were studied as per IS 1969 (Part 1) : 2009. The test specimen was 50 mm wide and 200mm long. It was clamped centrally so that its longitudinal centre- line passes through the centre point of the front edges of the jaws. The movable clamp was moved and the test specimen was extended to the point of rupture. The maximum force at rupture was noted. The test was conducted for both uncoated and bitumen coated jute geogrid. The durability study of uncoated and bitumen coated jute geogrid were also conducted

IV. RESULTS AND DISCUSSION

The CBR test was conducted for unreinforced and jute geogrid [with and without bitumen coating] reinforced soil and the load penetration curve was plotted as shown in Figure 2, Figure 3, Figure 4and Figure 5. The tests were carried under both soaked and unsoaked conditions.

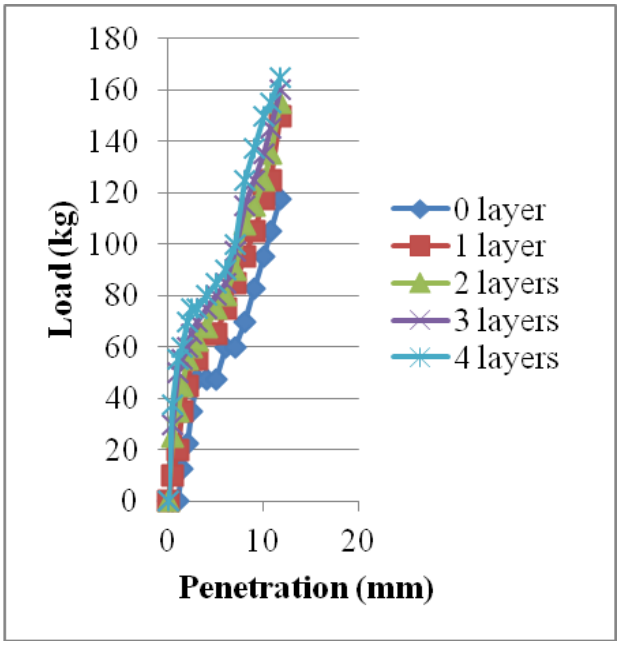

Fig.. 2 Load penetration curves plotted by varying the number of uncoated jute geogrid layers (unsoaked CBR test)

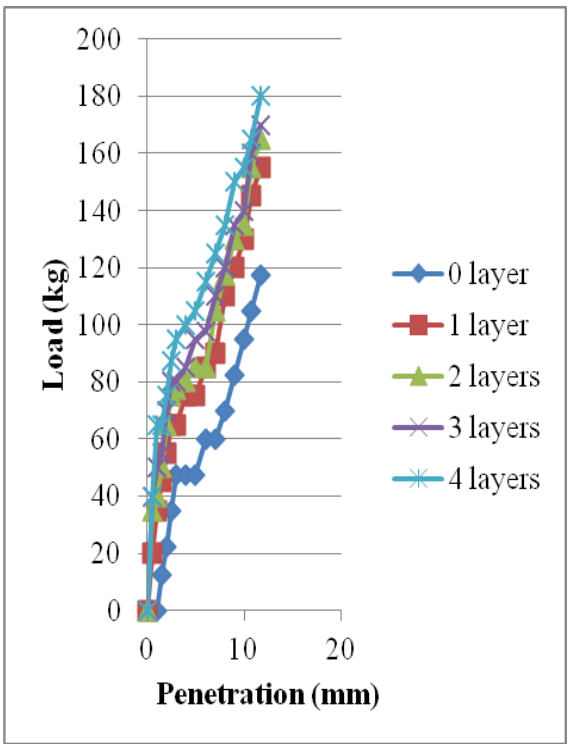

Fig. 3 Load penetration curves plotted by varying the number of bitumen coated jute geogrid layers (unsoaked CBR test)

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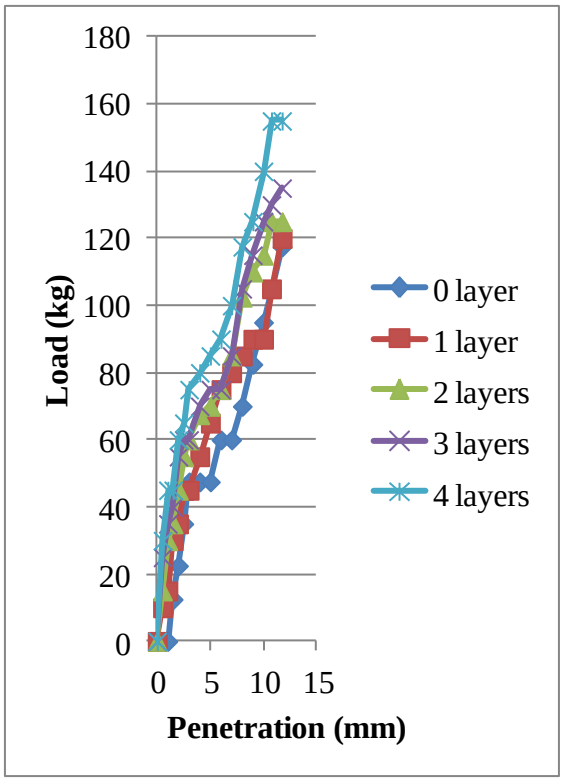

Fig. 4 Load penetration curves for different number of uncoated jute geogrid layers (soaked CBR test)

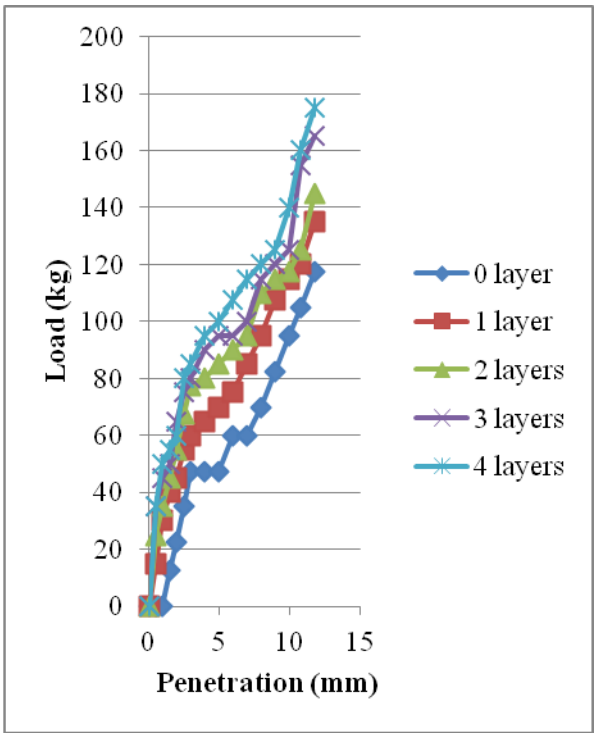

Fig. 5 Load penetration curves for different number of bitumen coated jute geogrid

It is observed that in general, there is marked influence in results due to the presence of jute geogrid reinforcement within the soil on its CBR characteristics and the CBR value is observed to be higher in all cases of reinforced soil specimens compared to that of unreinforced specimen. CBR value has increased from 1.05 to 3.94 for uncoated jute geogrid reinforced soil specimen and further to 4.08 for bitumen coated jute geogrid reinforced soil specimen. Further, it is observed that the extent of improvement in the CBR value depends upon the increase in the number of layers. It is because of the improved redistribution of load provided by the reinforcement placed. The load carrying capacity of soil increases and the immediate settlement decreases with the inclusion of jute geogrid layers in soil. The jute geogrid acts as an interlock or a bond which transfers the stress from the soil to the reinforcing elements by mobilising the tensile strength of the reinforcing elements which results into decrease in tensile strain and improvement in the load carrying capacity of reinforced soil. The soil reinforcement using bitumen coated jute fibres has given a much higher CBR value. This increment in the CBR value is attained due to the stiffness provided by the bitumen coating.

In the unsoaked CBR tests, there is marked influence due to the presence of jute geogrid reinforcement within the soil on its CBR characteristics (soaked condition). CBR (soaked) value is observed to be lower in all cases compared to that of CBR (unsoaked) value. The soaked CBR value showed a decreasing trend than that of the unsoaked CBR value because the water molecules tends to fill the voids upon saturation. Due to softening of soil particles, the bearing capacity of soil decreases. The CBR value has increased from 0.98 to 3.24 for uncoated jute geogrid reinforced soil specimen and further to 3.81 for bitumen coated jute geogrid reinforced soil specimen which indicates the effect of jute reinforcement even under soaked conditions. The soil reinforcement using bitumen coated jute fibres has given a much higher CBR value, under soaked condition also. This increment in the CBR value is attained due to the stiffness provided by the bitumen coating which is quite effective even under soaked condition.

In case of the bitumen coated jute geogrid also, the strength improvement was proven to increase with increasing number of coated jute geogrid layers. Here, the added advantage of bitumen was seen in the deterioration characteristics of the jute geogrid. Thus it was necessary to analyse the effect of the bitumen coated fibres on the shear strength parameters and stress strain characteristics of reinforced soil. For that, the triaxial tests of reinforced soil with 4 layers (showed substantial increase) of bitumen coated jute geogrids at 1 day, 7 days, 14 days and 28 days were studied. The shear strength parameters of the triaxial specimens of bitumen coated jute (4 layers) reinforced soil with time is given in Table 4.

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TABLE 4 SHEAR STRENGTH PARAMETERS OF THE TRIAXIAL SPECIMENS OF BITUMEN COATED JUTE (4 LAYERS) REINFORCED SOIL WITH TIME

No. of days	c (kPa)	ϕ (degrees)	% increase (c)	% increase (ϕ)
0	19.7	26	-	-
1	19.9	26	1.0	-
7	20.4	26.5	2.5	1.9
14	21.3	27	7.1	3.8
28	22.6	28	13.6	7.7

The tensile property study of uncoated and bitumen coated jute geogrid were conducted and
Table 5 shows Maximum force at rupture of jute geogrids

TABLE 5 MAXIMUM FORCE AT RUPTURE OF JUTE GEOGRIDS

No. of days	Maximum force at rupture (N)	
	Uncoated jute geogrid	*Bitumen coated jute geogrid*
1	500	500
7	500	600
14	500	700
28	500	900

It was observed that there is improvement in strength characteristics with increase in the number of days when the soil was reinforced with bitumen coated jute geogrid layers.The bituminous coating and the jute geogrid acts together as a single unit which helps to activate the mobilization of the membrane action and lateral confinement of interface. The bitumen coating held by the jute geogrid mesh imparts confining effect and better interlocking compared to uncoated jute geogrid. It was observed that the maximum force at rupture increases with time in case of bitumen coated jute geogrid compared to that of uncoated jute geogrid. At 28 days, the maximum force at rupture was found out to be 900N which was only 500N in case of uncoated jute geogrid. With time, hardening of the bitumen occurs which imparts better stiffness to the jute geogrid layers. As a result, the strength of soil reinforced with bitumen coated jute geogrid also increases with time. The study thus shows the suitability of bitumen coating, both as a deterioration reducing element for jute geogrid and also as a strength imparting factor.

V. CONCLUSIONS

- CBR (unsoaked) value has increased 275% for uncoated jute geogrid reinforced soil and 289% for bitumen coated jute geogrid reinforced soil.
- CBR (soaked) value has increased 231% for uncoated jute geogrid reinforced soil and 289% for bitumen coated jute geogrid reinforced soil.
- The study on the effect of bitumen coated jute fibre reinforcement with time also shows increment in the shear strength parameters and stiffness modulus.
- The maximum load at rupture increased 80% for bitumen coated jute geogrid than uncoated jute geogrid at 28 days.

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REFERENCES

[1] Arvind, “Significance of geotextile in unpaved roads with special reference to stress analysis”, International Journal of Erath Science and Engineering,Vol. 6, 2013,pp: 251-268.

[2] BarnaliGhosh, Dr. V. Ramesh, Rajarajeswari B. Vibhuti,“Improvement of soil characteristics using Geo-textile”, International Journal of Science and Technology Research, Vol.3, 2014,pp:1278-1286.

[3] Dipa Ray, “Study on alkali coated jute fibres”, International Journal of Engineering and Technology” Vol.5,2001,pp: 95-103.

[4] Dr. Dixit M. S. and Dr. Patil K. A., “Effect of Reinforcement on Bearing Capacity and Settlement of Sand”, Electronic Journal for Geotechnical Engineering, Vol.19,2014,pp:1034-1046.

[5] Donald H. Gray, A.M. andTalal Al-Refaeai, “Behaviour of fabric versus fibre reinforced sand”, ASCE ,1986,pp: 804-820.

[6] H. P. Singh and M. Bagra, “Improvement in CBR value of soil reinforced with jute fiber”, International Journal of Innovative Research in Science, Engineering and Technology. Vol. 2, pp:3447-3451.

[7] IS 1969 (Part 1) : 2009 Indian Standard methods of test for textiles —Tensile properties of fabrics determination of maximum force and elongation at Maximum Force method Part 1 ,Third revision, New Delhi.

[8] IS 2720 (Part 11) : 1993 Indian Standard methods of test for soils part 11, Determination of the shear strength parameters of a specimen tested in unconsolidated undrained triaxial compression without the measurement of pore water pressure, First Revision, BIS New Delhi.

[9] IS 2720: (Part 16) 1987 Indian Standard methods of test for soils part 16, Laboratory determination of CBR, Second Revision, New Delhi.