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Efficiency of Geo - Fabrics inthe Construction of Pavements on Highly Compressible Clayey Soil

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***Abstract* - Design and construction of pavements on highly compressible clayey subgrades pose lot of problems due to its low load carrying capacity. The technique used to improve the properties of such soils is to reinforce with geo-fabrics like coir and synthetic woven geotextile (TFI-3300, TFI-3600). Among this the synthetic woven geotextile proves to be better and gives promising results. The materials are placed in four layers (top,h/6,2h/6,3h/6). The influence of varied number of reinforcing layers on CBR values is investigated along with cost efficiency and percentage of reinforcement obtained. The results are analyzed effectively by introducing a non-dimensional factor known as Strength Benefit Ratio (SBR). It is found that both CBR and SBR values increases with increase in number of reinforcing layers. Based on the favourable results obtained, it can be concluded that highly compressible soil can be successfully stabilized and maintained using woven synthetic geo-fabrics TFI-3600.**

Keywords* - *Clayey soil, California Bearing Ratio, Strength Benefit Ratio, Synthetic Geo-textiles, Coir.

1. INTRODUCTION

The long term performance of any construction project depends on the stability of the underlying soil. Stabilized soil is, in general, a composite material that results from combination and optimization of properties in individual constituent materials. The major classifications are mechanical stabilization, hydraulic stabilization, physical & chemical stabilization and stabilization by inclusion and confinement. The material used for stabilization in this project is coir and synthetic woven geotextile. Geotextiles are permeable fabric which when used in association with soil, have the ability to separate, filter, reinforce, protect or drain. Geotextiles are of two types. They are woven and non-woven geotextiles.

2. OBJECTIVES

- To compare between natural and synthetic geotextiles and to determine the percentage increase in reinforcement.
- To determine the suitable material for the soil samples collected.
- To study the subgrade strength characteristics of stabilized clayey soil by studying the variations of California Bearing Ratio (CBR) values.

3. LITERATURE

D. NEERAJA et. al. (2012) in their project "To study the influence of geo-fabrics in the construction of pavements on expansive clayey subgrades" came to the conclusion that the CBR value increases with increase in number of reinforcing layers. CBR value is high from one layer to two layers in case of natural fabrics and CBR value is high from three to four layers in case of synthetic fabric.

MESHRAM .K et. al. (2013) "To improve the performance of roads on poor subgrade soil using coir geotextiles" concluded that utilization of non-conventional material like coir geotextile in construction of roads can provide cost effective and eco-friendly solution for road and help to solve geotechnical problems.

M.S.DIXIT et. al. (2012) "To assess the improvement in strength and stability characteristics by using geotextiles" concluded that the value of OMC increase with increase in geo-synthetic woven content. CBR value is found to be more for soil reinforced with geotextiles.

TAPAS DASGUPTA (2014) "To assess the usefulness of jute geotextile as soil reinforcement" came to conclusion that the geotextile contributes towards better road performance. Unit cost is low for jute geotextile.

SAXENA .N (2014) "To study the effect of geo-grid reinforcement on soil" concluded that Geo-grid reinforced soil is stronger and stiffer and gives more strength than the equivalent soil without geo-grid reinforcement. Maintaining the same thickness of the pavement, the designed life can be increased substantially with the inclusion of geo-grid layer.

4. MATERIALS & PROPERTIES

4.1 Soil

The soil used for this project is obtained from Kecherry near Thrissur and is taken from a depth of 2-3 m from the ground level. The soil is dried firstly in atmospheric condition and then in oven for about 24 hours and sieved

through 4.75 mm and 425 micron sieve. Specific gravity, Atterberg limits, Hydrometer test, proctor test, CBR test etc are done. From these results the soil is classified as CH soil according to Indian Standard Classification System i.e. clayey soil of high compressibility.

4.2 Coir

The natural woven coir geotextile is obtained from coir mills of Alappuzha, which is of the category H2M8. The material is placed in the CBR mould in four layers (top,h/6,2h/6,3h/6) by cutting it in circular pieces of 15 cm diameter inorder to fit into it.

4.3 Synthetic woven geotextiles

The synthetic woven geotextile used is TFI-3300, TFI-3600 which is obtained from Tech-fab India, Mumbai. These materials are separately kept in four different layers as that of coir and the CBR value is found out.

Table 1. Properties of clayey soil

Properties	Values
Specific gravity	2.71
Particle size distribution a) Gravel (%) b) Sand (%) c) Silt (%) d) Clay (%)	 0 24 27 49
Liquid limit (%)	68
Plastic limit (%)	23.14
Plasticity index (%)	44.86
Shrinkage limit (%)	19.49
Soil classification	CH
Maximum dry density (g/cc)	1.78
Optimum moisture content (%)	19.14
CBR (%)	1.79

5. RESULTS AND DISCUSSION

The results are analyzed using a non- dimensional factor called Strength Benefit Ratio (SBR). It is the percentage increase in CBR value of reinforced soil when compared to that of un-reinforced soil.

$$SBR = (CBR_{(Reinforced)} - CBR_{(Unreinforced)}) x100 / CBR_{(Reinforced)}$$

In the preliminary test the CBR value of unreinforced clayey soil is 1.79%. These values prove that the soil need to be reinforced inorder to withstand heavy load. So the reinforcement is done using coir and synthetic geotextile. The figures 1, 2 & 3 show the load penetration curve of clayey soil with coir, TFI-3300 & TFI-3600 in one, two, three and four layer respectively. The materials are arranged in the order of top, h/6, 2h/6 and 3h/6 depth. The tables 2 & 3 shows the CBR and SBR values for one, two, three and four layers respectively. It is found that the CBR value is maximum for TFI-3600 than other geo-fabrics chosen when four layers are adopted. Similarly SBR value also increases and is maximum for TFI-3600. This is because of the high tensile strength of the synthetic geotextile. The maximum SBR value of coir, TFI-3300, TFI-3600 for four layers are 275%, 338% & 550% respectively

Fig 1: Load penetration curve of clayey soil with coir for different no: of reinforcing layers

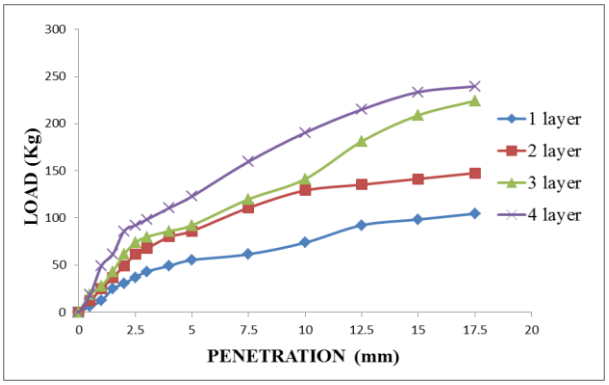

Fig 2: Load penetration curve of clayey soil with TFI-3300 for different no: of reinforcing layers

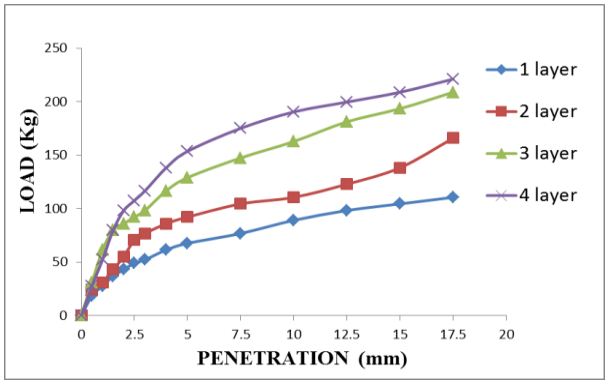

Fig 3: Load penetration curve of clayey soil with TFI-3600 for different no: of reinforcing layers

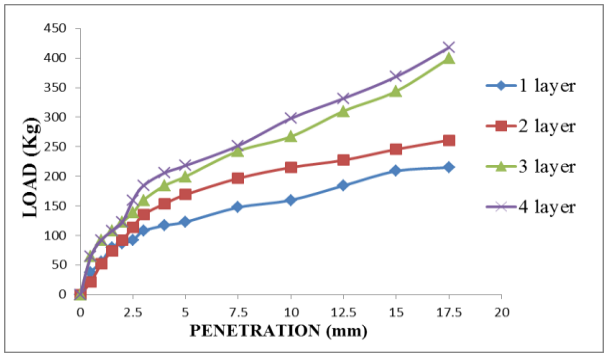

Table 2. CBR values of coir, TFI-3300, TFI-3600 for different layers

Materials	CBR unreinforced	One layer	Two layer	Three layer	Four layer
COIR	1.79	2.69	4.48	5.37	6.72
TFI-3300	1.79	3.58	5.15	6.72	7.84
TFI-3600	1.79	6.72	8.29	10.08	11.65

Table 3. SBR values of coir, TFI-3300, TFI-3600 for different layers

Material	SBR values (%)			
	One layer	Two layer	Three layer	Four layer
COIR	50	150	200	275
TFI-3300	100	187	275	338
TFI-3600	275	363	463	550

6. CONCLUSIONS

The CBR value increases as the number of reinforcing layer increases and is maximum for four layers for all geo-textilles used (TFI-3300, TFI-3600). From the results it is found that the maximum obtained CBR value for coir, TI-3300, TFI-3600 are 6.72%, 7.84%, 11.65% respectively for four layer reinforcement. The SBR value of coir, TFI-3300, TFI-3600 for four layers are 275%, 338%, 550% respectively. Considering all these results it is found that the maximum CBR and SBR value is for TFI-3600 when arranged in four layers i.e. 11.65% and 550% respectively. This proves that TFI-3600 is more efficient than TFI-3300 and coir. This is mainly due to the high tensile strength of the synthetic geo-textile especially TFI-3600 and is found to be much more efficient than the natural geo-textile coir for highly compressible clayey soil. Using this material in subgrade construction proves to be economic by providing more load carrying capacity and less maintenance. It is not possible to increase the number of reinforcing layer more than four because if increased beyond four numbers it does-not prove to be economic while giving more bearing capacity.

7. REFERENCES

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