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Improvement in subgrade soil of flexible pavement using Geosynthetics

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Abstract— **Highways, expressways and different urban and rural roads in India have the most usual problem of formation of localized depression, settlement, potholes, ruts, cracks and settlement due to unexpected non uniform settlement of soil especially during rainy season. They are formed or occurred due to poor or insufficient bearing capacity of the subgrade in saturated condition. The subgrade soil mostly capitulate lower CBR value which ranges from 2-5%. Using CBR method of pavement design the whole thickness of pavement will increase exponentially with a decrease inside the CBR fee of subgrade soil which successively increases the fee of construction. So, it's been attempted to apply the geosynthetics cloth for growing the bearing ability of the subgrade. Laboratory and simulated field CBR tests are performed on soil samples with and without the inclusion of geosynthetics layer and additionally via varying the location of it inside the mildew. Use of geosynthetics raises the CBR value of the subgrade and thereby reduces the pavement thickness. The purpose for the use of those geosynthetics that they may be exceptionally resistant to biological action and wear and tear due to natural factors. They are durable and after studying literature review from previous researches, so further working ahead to open new opportunities in this field of civil engineering. This study will have a positive impact on cost as it will reduce the Project maintenance cost of the road. This study will discuss in detail the procedure and its successful applications.**

Keywords— Geogrids, CBR Value, Flexible Pavement, Sub grade.

I. Introduction

One of the biggest problems engineers face in building highways in the plains and coastal areas of India is the presence of soft / loose soil at low levels. Roads built on this loose soil require high concentrations of granular material leading to high construction costs. Further attempts to decrease thickness of paved layer to build the economy will lead to premature vandalization to road which will cause the road to be repaired shortly after construction. This situation may be even worse if it is exacerbated by poor water supply or lack of it. Some regions of India are located in a rain-fed area with limited water supply and a weak subgrade. This is the main cause of poor road conditions in those provinces.

If you look at the poor road conditions in some provinces of India geosynthetic use is considered for road construction to improve road performance. A geosynthetic made of polymers is preferred for this purpose.

Geosynthetics made from polymeric materials is becoming known as one of most flexible building materials used with soil, rock, earth, or other soil engineering materials as an integrated part of man-made projects such as retaining walls, road fencing and construction, benefits due to its presence. Paved roads one of areas where geosynthetic use increases momentum. When geosynthetic is used on pavements or other structures, it needs to carry out more than one function such as isolating, solidifying, draining, filtering, and preventing liquid. Many different types of geosynthetics are manufactured in the industry where one can choose geosynthetic depending on the task to be done geosynthetics. Their choice to perform one or more tasks depends on the physical, mechanical and hydraulic properties of geosynthetics.

II. Objective

The overall objective of this study is to investigate different geosynthetics and their applications in flexible pavement construction. The broad objectives of the study can be listed as follows:

1. To reduce the thickness of flexible pavement.
2. To determine the CBR value using geosynthetics at different depth in construction of flexible pavement.

III. Properties of Materials Used

The soil used in the present study is locally available soil taken near to Yamuna. The engineering and index properties such as specific gravity, Atterberg's limits, compaction characteristics etc. of the particular soil selected for this study were determined in the laboratory as per IS 2720. The physical properties of the soil obtained are given in Table 1.

Properties	Test Value
C_u	2.20
C_c	1.51
D_{10}	0.08 mm
D_{60}	0.20 mm
D_{30}	0.15 mm
G	2.65
OMC	14%
MDD γ_d, gm/cc	1.65
Soil type	SP-SM
Liquid limit	Non plastic
Plastic limit	Non plastic
K	7.5×10^{-4} cm/ sec

Table 1: Subgrade Soil Properties

Parameter	Results
Mass per unit area	1140 gm / m^2
Thickness (mm)	Thickness in stress 2 kPa 8.50 20kPa 7.37 200 kPa 5.40
Puncture resistance (CBR Push through)	On single layer 1.5 KN Double layer 3.0 KN Triple layer 4.5 KN
Strain at failure	60%
Initial tangent modulus	55 KN/m

Table 2: Physical Properties of coir mat

IV. METHODOLOGY

CBR tests are performed (both immersed and un-immersed conditions) using soil-only samples and a horizontal surface of the coir mat in a different location up. CBR tests are performed in different sizes mould to get the effect of confinement. The CBR test was performed on a model test bed. At this point it is an important aspect of test results it should be noted. In Agra, usually one of the chief aspects of road damage is water. It's high, high the status of the water table. So, roads usually have to work on a submissive state. Results show CBR value for coir mat reinforced subgrade when submerged in water shows approximate twice the unconfirmed CBR value (without coir mat) under the aforementioned condition. This works under-line the special importance of coil reinforcement in road construction in Agra.

Test on soil desired:

- Standard Proctar Compaction Test
- Liquid Limit
- Plastic Limit
- Grain size distribution
- CBR Test
- Specific Gravity Test

During testing the coir mat is planted in depth one cm, two cm, three cm and four cm from top of soil in the middle layer at instance. In Table 4, noted that high CBR values are found in the coir mat area for one cm. CBR values then decrease in coir mat space two cm and three cm and four cm. In all kinds of mold, the CBR value at a position of 4.0cm is approximately same for unreinforced soil. So, it ends with lowering the coir mat spot will have a reduced effect an increase in ground CBR values. The best locality is near up. This, effect is justified by the following explanation. The reason for the high CBR values of the coir mat depth at 1.0cm can be excused in two ways. First given instance of coir mat at a point of one cm has high confinement in granular subgrade soil used in it the CBR mould has another coir mat position. So there CBR observed value is measured very high.

V. TEST RESULTS

I have done various test to compare bearing capacity of soil with geonet and without geonet of subgrade of soil. Some of the important results are as under:

Placing of Coir mat from top, cm	Unsoaked D/d=2 CBR	3	4	5	α
No coir mat	8.7	5.8	4.9	4.0	4.0
1	20.4	9.5	8.8	7.5	7.6
2	16.4	7.0	6.6	5.9	5.5
3	13.5	6.2	6.0	4.8	4.8
4	9.0	5.7	5.4	4.5	4.6
	Soaked				
No Coir mat	4.4	2.3	3.0	2.4	
1	8.7	7.0	5.9	5.0	
2	6.4	5.9	4.7	4.3	
3	6.0	4.5	4.2	4.1	
4	5.0	4.0	3.7	3.0	

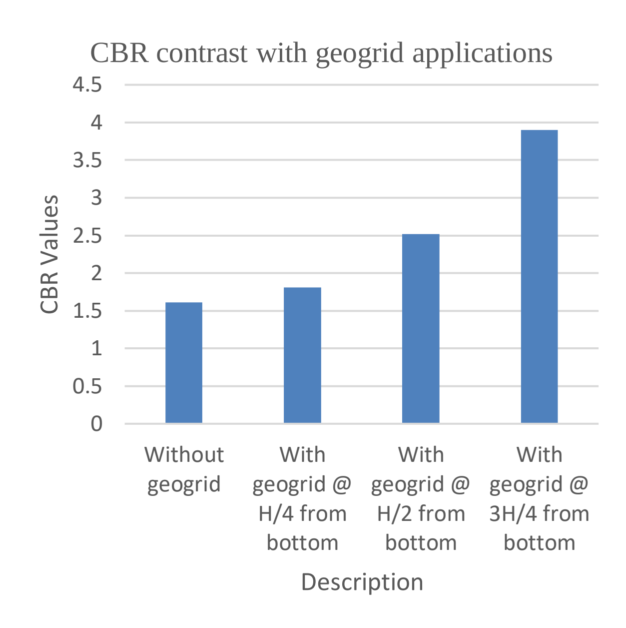
Table 3: CBR test results

ds	**% s**
1.0	76%
2.0	43%
3.0	30%
4.0	18%

Table 4: Strain developed in coir mat

IRC (CBR Method)	**With Coir Mat at 1.0cm from Top** CBR_s: 7%	**Without Coir Mat** CBR_s :2%
Pavement thickness required in (mm)	365	650

Table 5: Thickness of pavement required



Description	**CBR value**
Without geogrid	1.65
With geogrid @H/2 depth from bottom	1.81
With geogrid @H/2 distance from bottom	2.52
With geogrid @3H/4 distance from bottom	3.90

Table 6: Variation of CBR value at different depths

Thickness (mm)	**Without geogrid**	**With geogrid @ H/4 from bottom**
GSB	NA	300
G. BASE	NA	250
DBM	NA	110
BC	NA	50
Total pavement thickness(mm)	Stabilization required	710

Table 7: Thickness of pavement vs geogrid application

VI. CONCLUSION

The main objective of this study was to reduce the cost of flexible pavement construction using coir geotextiles in subgrade reinforcement and side road protection is very effective. It is also recommended to build additional test tracks using coir geotextiles of different distances under different soil conditions in order to further test their performance. When geogrid is used in subgrade of flexible pavement it not only decreases the pavement thickness but also increase the life of pavement. The following conclusions are drawn from this study:-

i. From the CBR test results it is recognized that CBR value of soil has improved to 63% in the unsoaked state and up-to 190% for soaked condition where coir mat position is present at 1cm from the top.

ii. The fact that in a wet environment the installation coir mat improved CBR almost twice after detection especially in the province of Agra which has high rainfall in rainy season, high-water table conditions specially, near Yamuna areas and roads performance get worst in a drenched state.
iii. From the design features it is evident that thickness of flexible pavement can be reduced to almost 75% if the coir mat is placed above the subgrade i.e., with coir mat pavement has thickness of 36.5 cm against 65 cm when we do not use coir mat in the subgrade of flexible pavement.
iv. The CBR results on subgrade soil without geogrid (1.65%) shows that it requires more stabilization which means it require more materials for compaction which ultimately results in increasing cost of pavement but when we test subgrade soil with geogrid then it shows higher CBR value (3.90%) at a depth of 3H/4 from the bottom which means geogrid not only provided stability but also pavement will require less thickness as compared to thickness required in pavement without geogrid.

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References

[1] ASTM C150, 2007. Standard Specification for Portland Cement. ASTM C150-07. West Conshohocken, PA. Doi: 10.1520/C0150-07.
[2] Consoli, N.C., Prietto, P.D.M., Ulbrich, L.A., 1998. Journal of Geotechnical and Geo-environmental Engineering.124 (12), 1211–1214.
[3] Gray, D.H., Ohashi, H., 1983. Mechanics of fibre reinforcement in sand. Journal of Geotechnical Engineering 109 (3), 335–353.
[4] Maher, M.H., Gray, D.H., 1990. Static response of sands reinforced with randomly distributed fibres. ASCE 116 (11)1661–1677.
[5] Consoli C, Casagrande et. Al. Plate load test on fibre reinforced soil. J Geotech Geo-environment Eng. ASCE 2003; 129:951–5.
[6] Consoli, N.C., Casagrande, M.D.T., Prietto, P.D.M., Thome, A., 2003b. Plate load test on fibre-reinforced soil. Journal of Geotechnical and Geo-environmental Engineering 129 (10), 951–955.
[7] Consoli, N.C., Vendruscolo, M.A., Prietto, P.D.M., 2003a. Journal of Geotechnical and Geo-environmental Engineering, ASCE129 (1), 96–101.
[8] Consoli, et. Al G.S., 2002. Engineering behaviour of a sand reinforced with plastic waste. Journal of Geotechnical and Geo-environmental Engineering128 (6), 462–472.
[9] Tang, C., Shi, B., Gao, W., Chen, W., Cai, Y., 2007. Geotextiles and Geomembranes 25 (3), 194–202.
[10] Maheshwari V. Performance of fibre reinforced clayey soil. EJGE 2011; 16:1067–87.

BIOGRAPHIES

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