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ADDITION OF RBI-81 WITH GEOTEXTILES IN SUBGRADE TO STRENGTHEN SOIL FOR BITUMINOUS PAVEMENTS

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Abstract

In the past 20 years, many new road improvement techniques have revolved around the use of geosynthetics. In India, most of the flexible pavements are need to be constructed over weak sub-grade having low modulus values. The California bearing ratio (CBR) of these sub-grade soils has very low, resulting in more thickness of the road crust. Replacing of these existing weak sub-grade soil may not be good option, thus it is required to stabilize these weak sub-grade soil with suitable stabilizer.

Geosynthetics have been found to be a cost effective alternative to improve the weak sub-grade soils in adverse locations. In this study, firstly the various properties of soil sample like grain size analysis, liquid limit, plastic limit, plasticity index & identification of soil has been evaluated and then CBR values of these soils have been improved using geotextiles. Non-Woven geotextiles are placed at different layers of various soil samples, and then a series of California Bearing Ratio (CBR) tests were conducted to evaluate the strength of the subgrade soil. It was observed that the CBR value increases, when the non-woven geotextile are placed at different layers of various soil sample. From this study, single layer of non-woven geotextiles is introduced at the depth of 0.85H from the bottom of the mould shows better performance than those samples with the geotextiles layer are placed at other depths.

In this study, the flexible pavement have been designed for both fatigue and rutting life of 100MSA at 90% and 80% reliability, when the non-woven geotextile are placed at three different depths of subgrade soil samples. The critical strain value for both fatigue and rutting life are analysed by programme IITPAVE software and are less than the allowable strain values as computed by IRC: 37-2012.

Keywords— Geotextiles , RBI-81

I INTRODUCTION

This Flexible pavements are generally intended to have multiple layers, including the bitumen layer, surface course, aggregate base layer, aggregate subbase layer and sub grade soil. The superiority and life of pavement are really affected by the type of sub-grade, sub-base and base course layers. Subgrade soil are the bottom most layer of the pavement whether it is rigid or flexible. The function of subgrade is to provide sufficient support to the road crust and also to support the traffic in the form of foundation. Sometimes the soil present underneath the surface consist of various locally available soil materials which are soft and do not posses adequate strength to support the traffic in the form of foundation structure.

The sub grade strength is mostly expressed in terms of California Bearing Ratio (CBR). Weaker the strength of sub grade soil requires more thickness of road crust, while stronger subgrade requires less thickness of each pavement layers. The exact design strategies are given by the Indian Road Congress of the pavement layers that based upon the subgrade soil strength, that mainly depend on the California Bearing Ratio value of the soil sample soaked for four days. With the value of CBR of soil are known, the suitable thickness of the road crust required above the subgrade of soil for different traffic conditions is determined using the design charts, proposed by IRC-37-2012.

At time the soil subgrad is removed and replaced or its characteristics are improved. By adding cement lime or excessive aggregates. But this method is very costly and also time consuming. Geosynthetics on the other hand are cost effective and prove to be a better alternative for improving the weak subgrade soils in adverse location.

Geosynthetics are the products, where at least one material is made from synthetic or natural polymer in nature , in the form of sheet or 3 dimensions structure.

There are two types of geotextiles used for engineering purposes, which are woven and non voven fabric. Non voven geotextiles fabric is more stretchers than the voven geotextiles. The non voven geotextiles looks like a felt fabric; That is an arrangements of fibres either oriented or randomly patterned in sheet form

II EXPERIMENTAL INVESTIGATION

2.1 *Material used*

A brief description of the materials and methods used in this investigation is given as following.

Three soil sample A, B & C was collected from three different locations. Sample A was collected from Poonch region whereas; Sample B and C were collected from Jammu district. The required properties of soil samples A, B and C were determined as shown in below tables. Sample A is clayey in nature, sample B is silty sand and sample A is a granular soil using grain size analysis.

2.2 ***Properties of Soil Sample A***

S.No.	Tests	Properties	Description	Relevent IS Codes
1.	Grain Size Analysis	Fines, < 75µ (%)	53.7	IS 2720 Part IV
		Sand (%)	46.3	IS 2720 Part IV
2.	Compaction Test	MDD (kN/m^3)	18.5	IS 2720 Part VIII
		OMC (%)	14%	IS 2720 Part VIII
3.	Casagrande Tests	Liquid Limit (%)	32.5	IS 2720 Part V
		Plastic Limit (%)	20	IS 2720 Part V
		Plasticity Index (%)	12.5	IS 2720 Part V
		Flow Index	29	IS 2720 Part V
		Toughness Index	0.68	IS 2720 Part V
4.		Classification	CL (Clay and silt with low compressibility	IS 1498-2007

2.3 Properties of Soil Sample B

S.No.	Tests	Properties	Description	Relevent IS Codes
1.	Grain Size Analysis	Fines, < 75μ (%)	12.1	IS 2720 Part IV
		Sand (%)	87.90	IS 2720 Part IV
		Effective size (D_{10}) (mm)	0.055	IS 2720 Part IV
		D_{30} (mm)	0.208	IS 2720 Part IV
		D_{60} (mm)	0.432	IS 2720 Part IV
		Uniformity coefficient, C_u	7.85	IS 2720 Part IV
		Coefficient of curvature, C_c	1.82	IS 2720 Part IV
2.	Compaction Test	MDD(kN/m^3)	18.82	IS 2720 Part VIII
		OMC (%)	13.1	IS 2720 Part VIII
3.		Classification	Silty Sand	IS 1498-2007

2.4 Properties of Soil Sample C

S.No.	Tests	Properties	Description	Relevent IS Codes
1.	Grain Size Analysis	Fines, < 75μ (%)	0	IS 2720 Part IV
		Sand (%)	100	IS 2720 Part IV
		Effective size (D_{10}) (mm)	0.053	IS 2720 Part IV
		D_{30} (mm)	0.10	IS 2720 Part IV
		D_{60} (mm)	0.490	IS 2720 Part IV
		Uniformity coefficient, C_u	9.24	IS 2720 Part IV
		Coefficient of curvature, C_c	0.385	IS 2720 Part IV
2.	Compaction Test	MDD (kN/m^3)	19.81	IS 2720 Part VIII
		OMC (%)	11	IS 2720 Part VIII
3.		Classification	Sand	IS 1498-2007

2.5 Properties of Geotextiles:

S. No.	Description	Properties
1	Type of Geotextiles	Non-Woven
2	Type of fiber	Polypropylene
3	Pore size	less than 75 microns
4	Grab Tensile strength	570 N
5	Puncturing strength	180 N
6	Grab Elongation	50%
7	Permittivity	1 sec^{-1}
8	Water Permeability	20.4 lit/ m^2/ sec

Chemical composition of RBI Grade 81

S.No	***Properties***	***Description***
1	Calcium Oxide (CaO)	50-60%
2	Silicon dioxide (SiO2)	15-20%
3	Sodium oxide(SO_2)	10-15%
4	Aluminium trioxide (Al_2O_3)	5-10%
5	Iron trioxide (Fe_2 O_3)	0-2%
6	Magnesium Oxide (MgO)	0-1%
7	Fibers (Poly propylene)	0-1%
8	Additives	0-4%

III. METHODOLOGY

1. California Bearing Ratio

CBR test were conducted on Sample A, B and C with reinforced and unreinforced with a one layer of non-woven geotextile at different depth under soaked condition. Geotextiles are placed in single layer at three different heights from above such that 1/3H (0.33H), 2/3H (0.66H) and 0.85H from the bottom of the mould for all the samples

IV RESULTS AND DISCUSSION

CBR test was conducted on various samples and the result obtainted were as follows

Load Penetration curves for unreinforced sample A

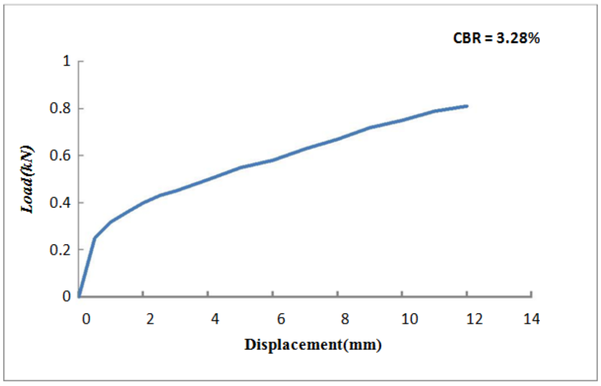


Figure: Load Penetration curves for unreinforced sample A

Load Penetration curves for Geotextile layer placed at 1/3 from the bottom of thr mould in sample B

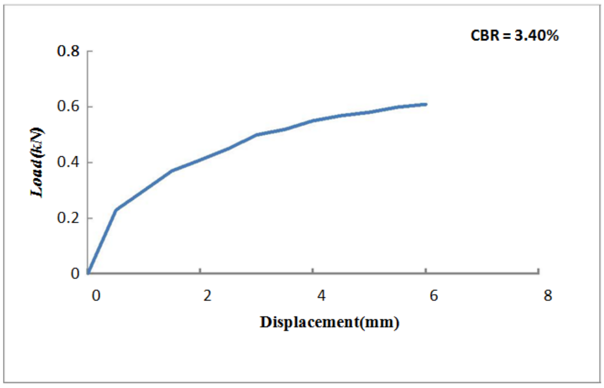
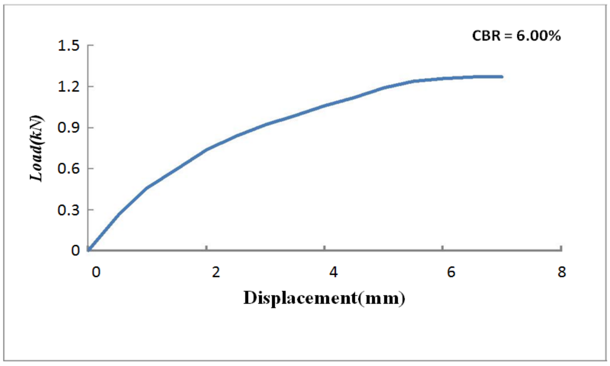


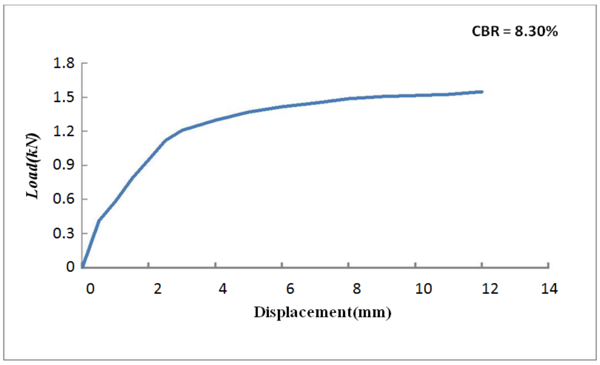
Figure: Load Penetration curves for Geotextile layer placed 1/3 from the bottom of mould in sample A

Load Penetration curves for Geotextile layer placed at 0.15 at 2/3 from the bottom of the mould in sample



Load Penetration curves for Geotextile layer placed at 2/3 from the bottom of the mould in sample A

Load Penetration curves for Geotextile layer placed at 0.15H from the top of the mould in sample A



Load Penetration curves for Geotextile layer placed at 0.15H from the top of the mould in sample A

Load Penetration curves for unreinforced Sample B:

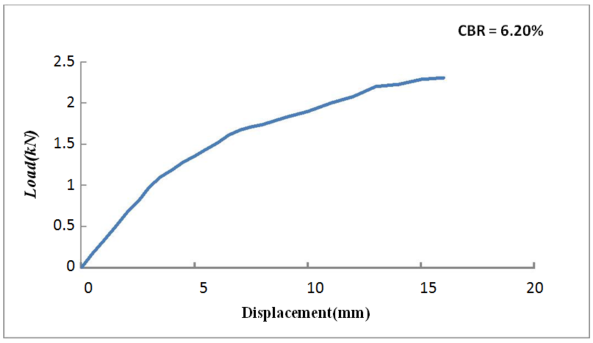


Figure: Load Penetration curves for unreinforced Sample B

Load Penetration curves for Geotextile layer placed from the bottom of the mould in sample B

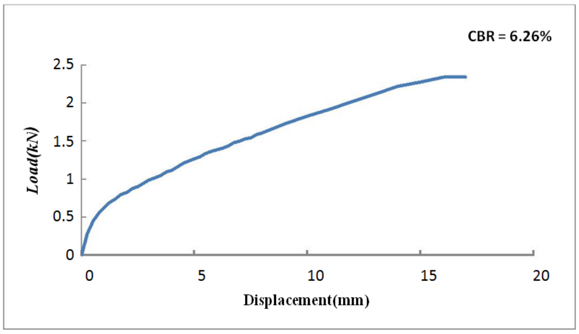


Figure: Load Penetration curves for Geotextile layer placed at 1/3 from the bottom of the mould in sample B

Table: CBR values of Sample A, B & C with and without geotextiles

S. No.	Samples	Soil without Geotextiles (%)	Soil with Geotextiles at different depths (%) from the base of the mould		
			0.33H	0.66H	0.85H
1	A	3.28	3.40	6.00	8.30
2	B	6.20	6.26	9.82	12.01
3	C	11.9	12.30	18.72	21.2

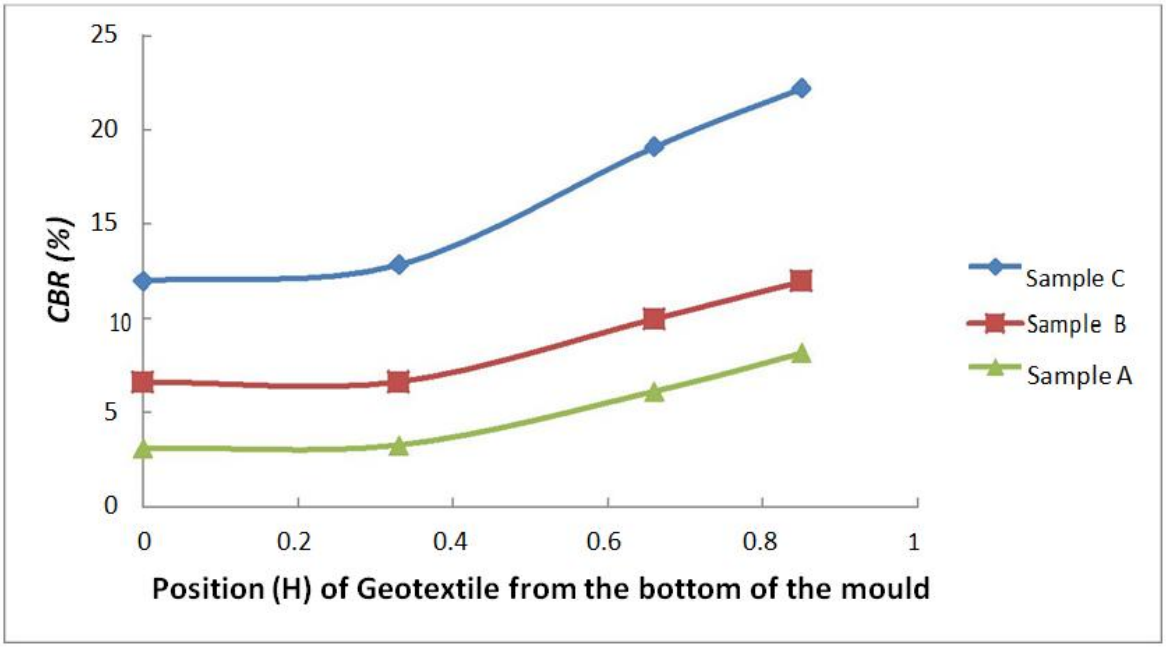


Figure:Representation of results when single layer of geotextile are placed at different position in sample A, B and C

Table : CBR values of Sample A, B & C with and with RBI-81

Sample	CBR value without RBI-81	CBR value RBI-81 (2%)	CBR value RBI-81 (4%)	CBR value RBI-81 (6%)
A	**3.28**	**4.6%**	**5.2%**	**5.8%**
B	**6.9**	**6.8%**	**9.6%**	**10.2%**
C	**11.09**	**12.3%**	**15.2%**	**17.6%**

V.CONCLUSION

Based on the experimental results of this study the following conclusions are drawn:-

1) In weak & soft subgrade soil, non-woven geotextiles increases the penetration resistance resulting in higher value of CBR, when the geotextiles are placed at varying depths
2) The percentage increase in the CBR value is 161%, 80.27% and 85.05%, when the geotextiles are placed at 0.85H from the bottom of the mould in single layer in sample A, B and C under soaked condition.
3) Sandy soil with geotextiles can be used as sub-base material in the pavement design, as its CBR value is 22.23%, as according to IRC 37-2012, the minimum value of CBR for subbase material used in bituminous pavement is 20%. This type of application can lead to lot of savings in the aggregate consumed for the WBM / WMM layers construction and can thus lead to development of sustainable and green highways

VI REFERENCES

[1] A.K.Choudhary, K.S.Gill and J.N.Jha (2011), Improvement in CBR values of expansive soil sub-grades using geo-synthetics. Proceedings of Indian Geotechnical Conference, Kochi. J-233: pp.569-572

[2] Archana Muraleedharan (2016), Behaviour of geo-grid reinforced silty sand. Techno Journal of Engineering and research. 1(1): pp.1-4

Amin C., Hamid N. (2011), CBR Test on Reinforced Soil, Pan-Am CGS Geotechnical Conference, Kochi

[3] Charles Anum, Nana Yaw, Richter Opoku (2014), Effect of geogrid Reinforced subgrade on layer thickness & design of low volume bituminous sealed road pavements. International Research Journal. 3(7): pp.59-67

[4] Dr. D.S.V.Prasad and Dr M. Anjan Kumar (2010), Behaviour of reinforced sub bases on expansive soil sub-grade. Global Journal of Researches in Engineering. 10(1): pp.1-8

[5] Dr. P. Senthil Kumar, and R. Rajkumar (2012), Effect of Geotextile on CBR Strength of Unpaved Road with Soft Sub grade. Electronic Journal of Geotechnical Engineering. 17(1): pp.1355-1363

[6] Hossein Moayedi Sina Kazemian, Arun Prasad, Bujang B. K. Huat (2009), Effect of Geo-grid Reinforcement Location in Paved Road Improvement. Electronic Journal of Geotechnical Engineering. Vol. 14: pp.1-11

IS: 2720-Part iv (2006) Grain size analysis, Bureau of Indian Standard, New Delhi, India.

IS: 2720-Part v (1985) Determination of Liquid limit & Plastic limit, Bureau of Indian Standard, New Delhi, India.

[7] IS: 2720-Part viii (1995) Determination of Water content, Bureau of Indian Standard, New Delhi, India

IS: 2720-Part xvi (2002) Determination of CBR, Bureau of Indian Standard, New-Delhi, India

[8] IRC: 37-2012, “ Guidelines for design of flexible pavement”