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A Comparative Study on Dry Density and CBR Value on Soils Using Jute as a Reinforcing Material

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ABSTRACT

Randomly distributed fibre reinforcement technique has successfully been used in a variety of applications such as slope stabilization, road sub-grade and sub-base etc. This is a relatively simple technique for ground improvement and has tremendous potential as a cost effective solution to many geotechnical problems. Keeping this in view the present study was taken up. In this study, soil was taken from a slope in the BGSBU campus. Three samples each from Top, Middle and Bottom portion of the slope were taken and characterized as "CL" (Clayey soil with low plasticity). A series of Proctor tests were carried out on the three samples with and without jute fibre. The percentages of jute fibre by dry weight of soil was taken as 0.5%, 1%, 1.5% and 2% and they were randomly mixed with the soil. The dry density and Optimum Moisture Content of soil corresponding to each fibre content was determined in Geo-Technical Engineering Laboratory of BGSBU. Proctor test results indicate that on inclusion of jute fibre, the dry density decreases and optimum moisture content increases up to jute percentage of 1% and after that the trend reverses in both the parameters. Also CBR tests were done only on Bottom sample as a representative sample for other two. The CBR tests on the soil sample indicate that CBR value improved on inclusion of jute fibre up to 1% and then gradually decreases up to 2%. Thus there is a significant increase in compaction parameters of soil due to Jute fibre and this will considerably increase the load carrying capacity and reduce the value of immediate settlement of soil significantly.

Keywords- California Bearing Ratio, Dry density, Optimum Moisture Content, Proctor Compaction, Slope stabilisation

I.INTRODUCTION

Man does not have any control on the process of soil formation as such the soil strata at the site has to be accepted as it is, construction has to be adopted to suit the sub soil condition. The existing soil at a given site may not be suitable for supporting the desired facilities such as building, bridge, dams and so on because safe bearing capacity of the soil may not be adequate to support the given load. Quite often, engineers may encounter

situation where the selected site is not found suitable to take the load of the proposed structure. In such cases, various methods of soil stabilisation can be used to improve the ground condition. The main objective of the soil stabilisation is to improve the characteristics of the soil at the site. Soil stabilisation is a rapidly developing field because good site for construction are became limited day to day. The geotechnical engineer has the challenge of construction of foundation at the site which is previously considered unsuitable and unacceptable. Deep foundations are quite expensive and are cost effective only where the structure to be supported is quite heavy and huge. Sometimes, the soil conditions are very poor even at greater depth and are not practical to construct even deep foundation. In such cases various methods of soil improvement (stabilisation) techniques are adopted. The objective is to improve the characteristics at site and make soil capable of carrying load and to increase the shear strength, decrease compressibility of the soil, so that bearing capacity of the soil is increased and the settlement of the structure built on it are reduced [1-9].

II.EXPERIMENTAL PROCEDURE

The soil used in the present investigation was collected from BGSB University campus at Dhanore area of Rajouri, J&K (33º39'N 74º35'E). In the present study, jute thread was collected from the Rajouri main market. The length of the jute fibre used in the study was approximately 20 mm and diameter 4 mm. The soil was blended with different percentage of jute thread. The mix specifications are as under:

SF0 – Soil with 0% jute fibres.

SF0.5 - Soil with 0.5% jute fibres.

SF1 - Soil with 1% jute fibres.

SF1.5 - Soil with 1.5% jute fibres.

SF2 - Soil with 2% jute fibres.

The consistency limits (liquid limit, plastic limit) tests were conducted as per IS: 2720 (Part5) - 1985

Standard Proctor tests and CBR tests were conducted as per IS: 2720 (Part 7) - 1980 and IS: 2720 (Part 16) - 1987 respectively.

III.TABLES AND FIGURES

The test results are summarised in the Table 1, 2 and 3. The comparative results are shown in Figure 1-4.

Table1- Test results of Top soil sample

Test Performed	**SF0**	**SF0.5**	**SF1**	**SF1.5**	**SF2**
Sieve Analysis (Percentage Finer)	12.42				
Liquid Limit (%)	33.8				
Plastic Limit (%)	24.99				
Specific Gravity	2.585				
Soil Characterization	CL				
Optimum moisture content (%)	14.92	13.03	14.44	14.73	13.48
Maximum Dry density (g/cc)	1.834	1.840	1.781	1.77	1.810
Undisturbed Dry density (g/cc)	1.827				

Table 2- Test results of Middle soil sample

Test Performed	**SF0**	**SF0.5**	**SF1**	**SF1.5**	**SF2**
Sieve Analysis (Percentage Finer)	10.90				
Liquid Limit (%)	34.6				
Plastic Limit (%)	25.73				
Specific Gravity	2.63				
Soil Characterization	CL				
Optimum moisture content (%)	12.58	13.63	14.44	14.32	13.77
Maximum Dry density (g/cc)	1.83	1.75	1.69	1.72	1.745
Undisturbed Dry Density (g/cc)	1.711				

Table 3- Test results of Bottom soil sample

Test Performed	**SF0**	**SF0.5**	**SF1**	**SF1.5**	**SF2**
Sieve Analysis (Percentage Finer)	10.90				
Liquid Limit (%)	34.2				
Plastic Limit (%)	24.48				
Specific Gravity	2.59				
Soil Characterization	CL				
Optimum moisture content (%)	12.34	14.45	14.47	14.43	14.10
Maximum Dry density (g/cc)	1.83	1.735	1.685	1.795	1.798
Undisturbed Dry density (g/cc)	1.78				

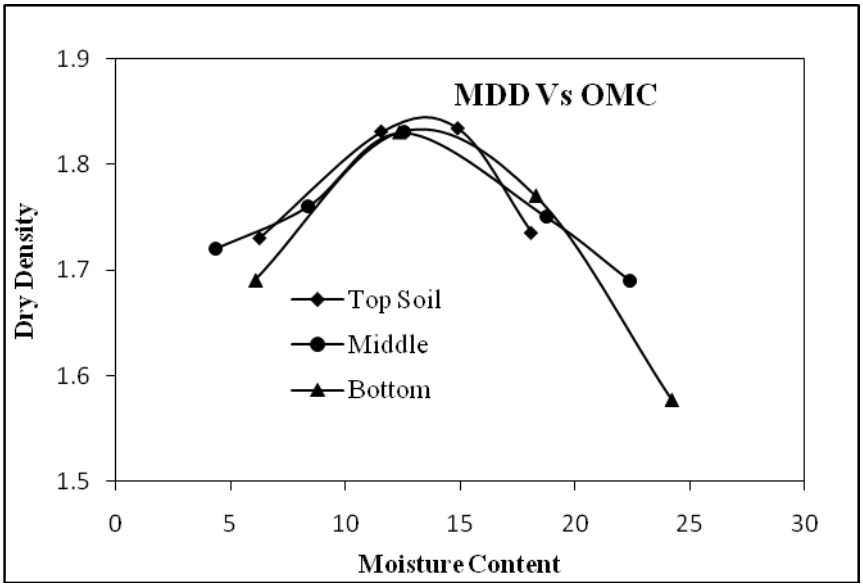

Fig.1 compaction curves for top, middle and bottom samples without jute

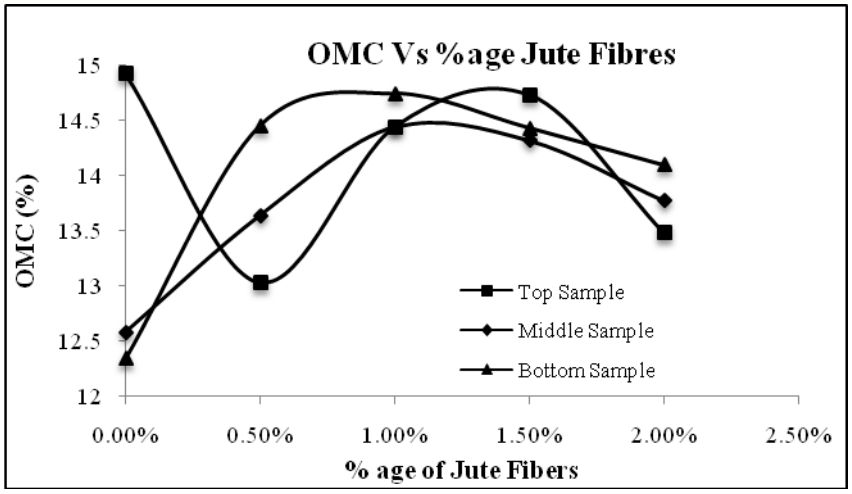

Fig.2 variation of optimum moisture content with percentage of jute fibres

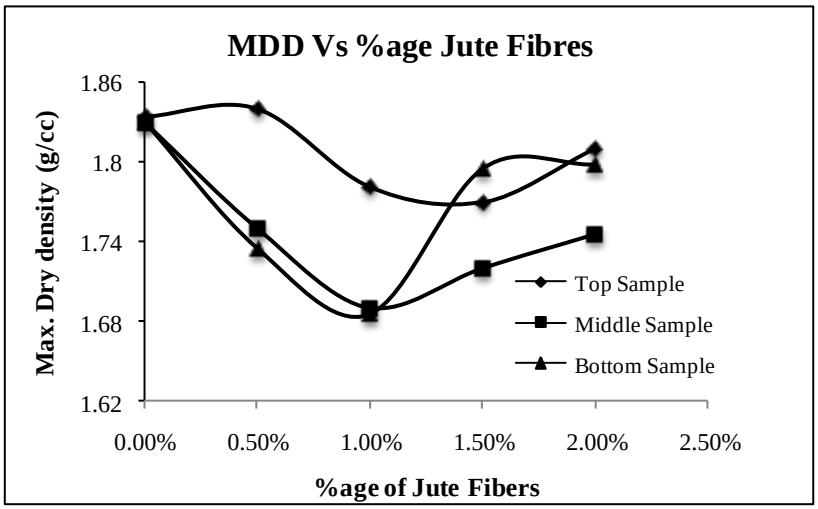

Fig.3 variation of maximum dry density with percentage of jute fibres

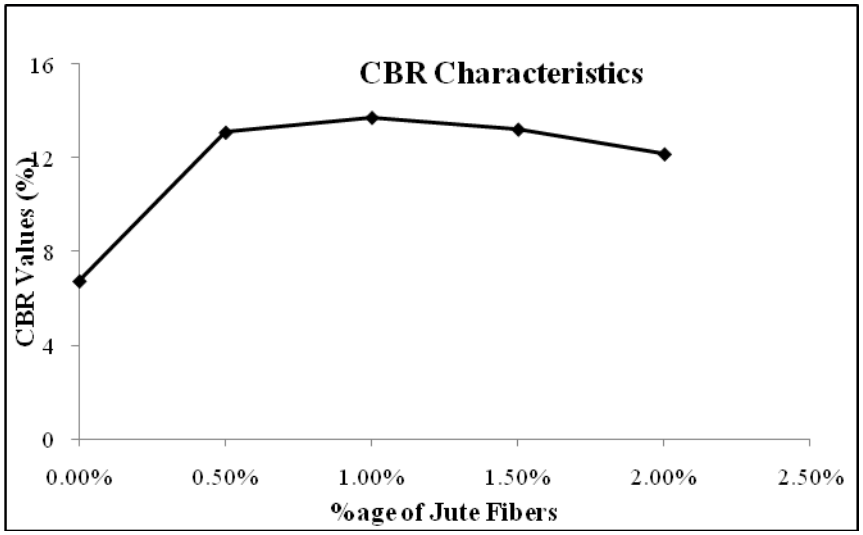

Fig.4 variation of california bearing ratio with percentage of jute fibres

IV.CONCLUSION

From the series of tests conducted on the Soil blended with different percentages of Jute fibres, the following conclusion were drawn

1. The Optimum moisture content values increase from 12.5% to 14.5% and Maximum dry density values decrease from 1.82gm/ml to1.69gm/ml up to 1% Jute fiber inclusion (by dry weight of soil sample).
2. There is a significant increase in California Bearing Ratio. The CBR value increases from 6.75% to 13.71% (up to 1% Jute fiber).
3. From the test results, it can be concluded that the addition of jute fibres to the "CL" soil decrease its Maximum dry density and increase its OMC and CBR value up to a certain percentage

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