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Experimental Study of Application of Natural Geotextiles for Strength upgrade of Soil for Flexible Pavement

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Abstract: ***Subgrade is the compacted supporting soil on which number of building structure lies. So geotextiles are using as a successful application in soil stabilization for improving the subgrade soil properties. The application of geotextiles in structural facilities is mainly concentrated on the raising the strength of structure and also does not address the issue of sustainability of raw materials used. Natural geotextiles are economic, biodegradable and ecofriendly. In India, for evaluating the stability of the soil subgrade CBR test is recommended as per IRC 37-2001 design code in designing the flexible pavements. Use of coir and bamboo is generally preferred to improve strength of soft soil subgrade for flexible pavements. Non-woven coir and bamboo sticks were interfaced with soil individually. CBR for soil alone is less as compared to those with soil and geotextiles together.***
Keywords: Natural Geotextile, Subgrade, Coir, Bamboo, Flexible Pavements

I. INTRODUCTION

The existing soil at a construction site is not always suitable for bearing structures so soil stabilization in road construction is thus a common practice in their construction. A flexible pavement structure consists of series of layers of materials. The subgrade layer is responsible for distributing the load from top layers to the bottom hence the stability of pavement is greatly influenced by the subgrade strength.

"Subgrade" is made up of in-situ material and usually in the forms of foundation of pavement on which the pavement structure is supported. Thickness and performance of the pavement widely depends on the subgrade soil strength. As a highway material the desirable properties of subgrade are Stability, incompressibility, good drainage, ease of compaction, minimum volume changes under adverse conditions (i.e., climate and ground water).

Recently various researches have been made for soil reinforcement/ stabilization by using natural geotextiles because of more susceptibility in both technical and economical aspects than the geosynthetics. There are various applications of geotextiles other than the soil stabilization such as erosion control, separation, filtration, drainage etc. Coir, jute, flax, bamboo, sisal, palm leaves are important natural fibres used as geotextiles.

II. LITERATURE REVIEW

Geotextiles are increasingly used to improve the stability of soft soils and thus help to reduce the cost of constructing earthwork on such soils. Many studies indicate that the CBR value improves with the use of coir and bamboo as reinforcement in road construction.

K. Rajagopal and S. Ramakrishna (2009) studied that the physical and hydraulic properties of coir fibre geotextiles are quite comparable to those of non-woven geotextiles. The large thickness of coir geotextiles helps in good transmissivity properties. Hence, the use of coir fibres can be considered in unpaved roads where the traffic intensity is low, eg: in rural roads. The accelerated degradation tests on coir fibres show that the coir can have a life span of about four years.

Tara Sen and H. N. Jagannatha Reddy (2011) studied that among the various natural fibres such as, sisal, bamboo, coir and jute fibres are such composites which are having high impact strength besides having moderate tensile and flexural properties compared to other lignocellulosic fibres. The application of composites in structural facilities mostly concentrated on increasing the strength of the structure with the help of artificial fibres and doesnot address the issue of sustainability of these raw materials used for strengthening purposes as they solve the problems of waste disposal upto a limited extent.

Sharma and Ravindranathan (2012) explained the field experiments on weak subgrades with and without coir geotextile. Coir netting is spread directly over the roughly levelled poor sub-grade soil (agrarian soil). In the case of clayey subgrades it is recommended to spreading the fabric after placing a layer of sand of 10mm to 20mm thickness. The fabric is then surcharged with granular material preferably sand of 30mm to 50mm thickness to act as a lower sub base. The fabric over the sub- grade may be

spiked, if necessary, by use of J shaped wooden spikes driven at random as necessary to keep the netting in place during construction and rolling.

K. S. Beena (2013) reviewed about coir geotextiles, its potentialities, advantages, application area. It is observed that after 5 years of seasonal changes and traffic usage, the road remains pucca without any damage.

Md Asaduzzaman and Md Iftiarul Islam (2014) concluded that improvement in load bearing bearing capacity is observed considerable in reinforced soil over the unreinforced soil. For single layer reinforced soil, load bearing capacity is maximum and settlement is minimum when the reinforcement layer placed at 0.3 times of width of footing. For multilayered system, Bearing Capacity Ratio increases with increasing number of reinforcing layer.

Aisha Haladu Bornoma, Muhamed Faruq, Moveh Samuel (2016) investigated about the properties and classification of bamboo for construction of building. From one perspective bamboo is more pervious to water harm than the normal hardwood. Extreme dampness of bamboo will make it twist or will enable shape to develop. Because of its remarkable physical qualities, Guadua bamboo is appropriate for a wide range of structures and developments.

K S Beena (2016) examines the improvement in the performance of unpaved roads constructed on silty soils using coir geotextile reinforcement through a number of model tests by performing CBR and Plate Load test. The result of study indicates that the CBR value of the soil reinforced with coir has improved placed at mid depth and also non woven coir shows better result than the woven coir.

So after reviewing different papers we can conclude that coir and bamboo can be used in different forms to improve strength of subgrade soil for flexible pavements. As we are using coir geotextile for strength improvement, bamboo can also be used with it simultaneously to achieve good stability of subgrade soil.

III. METHODOLOGY

A. *Materials Used*

1) Soil sample taken from Junwani Road, Bhilai whose CBR is very low i.e., soft black cotton soil.
2) Non-woven coir sheet of thickness half inch whose properties are mentioned in result.
3) Bamboos sticks having 0.5inch diameter and length- 14.5cm & 10cm were taken.

B. *Materials Testing*

1) For soil various properties are determined by using some specified tests by IS 2720 i.e., Specific gravity, Atterberg's Limit, relation between Optimum Moisture Content (OMC) and Maximum Dry Density (MDD).
2) For coir density and water absorption determination were done.
3) CBR Test- CBR test was done for soil sample alone by heavy compaction method. After that soil was interfaced with coir approximately at 75% height from base. Afterwards bamboos are used in two way- first was in parallel arrangement and another was in square form.

IV. RESULT

Some results are mentioned below:

1) Properties of soil

TABLE I
PROPERTIES OF SOIL

Properties	Soil
OMC (%)	19.5
MDD (g/cc)	1.68
Liquid Limit (%)	54.75
Plastic Limit (%)	40.76
Colour	Black
Specific Gravity	2.4
Shrinkage Limit (%)	16.9

2) Non-woven coir having density 804g/m^2 and water absorption as 93.11%.

3) CBR results:-

TABLE III
CBR VALUE FOR DIFFERENT SOIL CONDITION

Soil condition	Soil	Soil + Coir	Soil + Bamboo (P)	Soil + Bamboo (S)
UNSOAKED	1.03%	2.87%	3.61%	4.07%
SOAKED	0.60%	1.72%	2.06%	3.17%

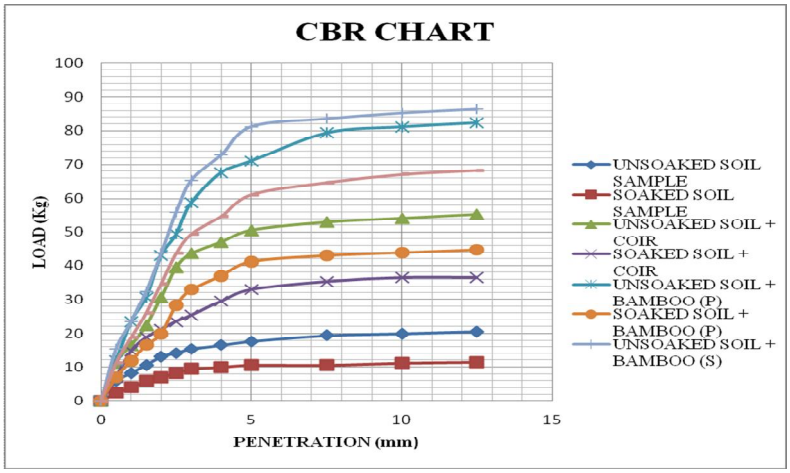

Fig. 1 CBR Chart of Soil Sample for Different Conditions

V. CONCLUSION OF LITERATURE REVIEW

The use of natural geotextile is beneficial to be considered in unpaved roads where the traffic intensity is low. Various applications of coir and jute geotextiles in construction of roads on black cotton soil.in various establishments for instance, a separator in a streets where the geotextile will be subjected to extreme burdens, toughness is of concern. It implicates that the soil with square pattern of bamboo gives more stability as compared to other arrangements. Finally conclusion makes that coir and bamboo can be used for upgradation of subgradesoil strength in roads by evaluating the CBR strength of soil.

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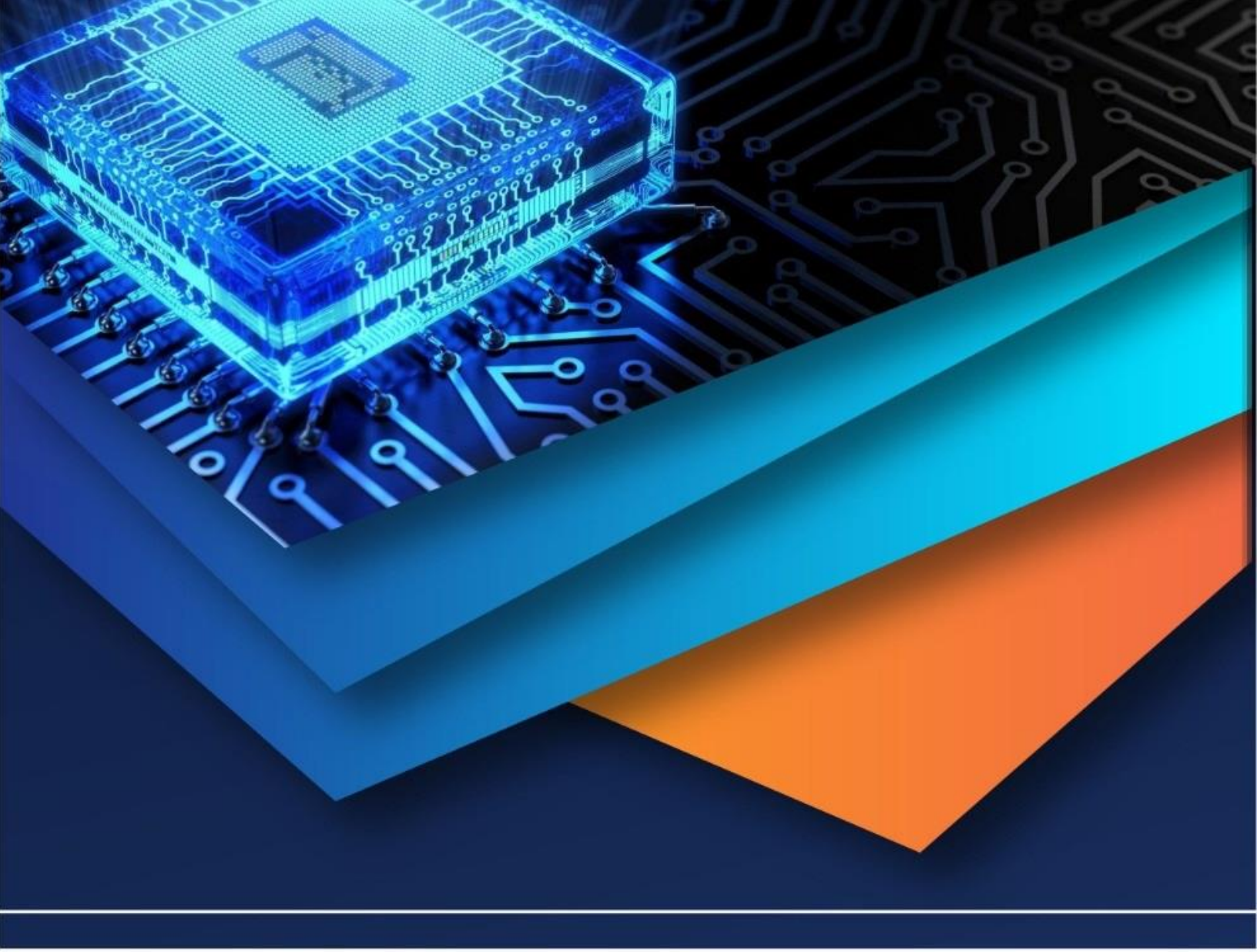

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