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Effect of Bamboo Mat on Clayey Soil Stabilized with Bamboo Leaf

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Abstract: *The fast pace of industrialization and urbanization increasing the demand for constructing infrastructure. The land shortage is a primary hassle arising now and it is very important to utilize all of the available land at its maximum extent. Therefore, soil stabilization is a crucial technique to enhance the properties of soil to allow it to the construction. Due to the rising value of synthetic fibres and toxicity of petroleum-based products, the natural fibres have had significant function in soil development. Bamboo is a type of plant and natural resource that have high rate of growth and high yield strength. This paper presents the applicability of randomly distributed natural fibres by conducting an extensive series of experimental investigation carried out on cohesive soil with bamboo leaf and bamboo mat. Bamboo leaves were made to a powdered form and mixed with the soil. 6% addition of bamboo leaf powder is found as the optimum value after experimental investigation. Bamboo mat were used as a reinforcement along with this optimum percentage of bamboo leaf treated soil. Settlement analysis were conducted on natural soil sample, soil reinforced with bamboo mat and soil reinforced with bamboo mat along with powdered bamboo leaf. From comparative study, it is concluded that settlement is lower for bamboo mat reinforced soil treated with optimum percentage of bamboo leaf when compared to natural soil sample and soil reinforced only with bamboo mat.*

Keywords: Bamboo leaves, Bamboo mat, Clayey soil, Settlement analysis

I. INTRODUCTION

Due to the fast pace of industrialization and urbanization, the demand for constructing infrastructure is likewise growing day by day. The land shortage is one of the predominant problems that the country is going through. Furthermore; the prevailing soil deposit is susceptible and contaminated.

Consequently, it's far vital to enhance such vulnerable deposits with sustainable alien material that may mimic the improved engineering behaviour of soils. Presently, due to the growing price of artificial fibres and toxicity of Petroleum primarily based products, the natural fibres have had large function in soil improvement. The objective of the research is to determine the strength behaviour of cohesive soil using bamboo leaf and bamboo mat and to provide an economic and engineering usage for bamboo materials.

II. LITERATURE REVIEW

K.S. Akhil et.al (2020) Use of bamboo mat as a potential soil reinforcement material – An experimental study. This paper discusses the consequences of laboratory model assessments on soil strengthened with distinct weaving patterns of bamboo mat. The test results suggest that the inclusion of the bamboo mat improves the bearing capability of soil and the weaving styles have an impact on at the performance of reinforced soil bed.

V.P. Jishnu et.al (2020) Strength behaviour of cohesionless soil reinforced with coconut leaf let as a natural material. This paper presents the applicability of randomly distributed natural fibres by conducting an extensive series of experimental investigation carried out on sandy soil with coconut leaf-let.

Hegde et.al (2019) Use of bamboo in smooth-ground engineering and its performance assessment with geosynthetics. The effects of the laboratory investigation carried out on clay beds reinforced with natural (bamboo) and commercial (geosynthetics) reinforcement materials are stated in this paper

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III. MATERIALS AND METHODOLOGY

A. Materials

Clayey soil sample taken for the study was collected from Chenkal, Trivandrum. Bamboo leaves used were collected from a nearby bamboo tree and leaves were dried and made into a powdered form are used in this study. Bamboo mat were procured from the Kerala State Bamboo Corporation Ltd, Kerala, India

Fig.1 Chenkal clay

Fig.2 Bamboo leaves

Fig.3 Bamboo mat

B. Methodology

Preliminary tests like Atterberg's limits, hydrometer analysis, specific gravity etc. were done on the soil samples. Proctor compaction and Strength determining tests were also done on the natural soil sample. Optimum percentage of bamboo leaf addition were investigated by conducting different tests on soil samples mixed with different percentage of bamboo leaf powder. 6% is found as the optimum percentage of powdered bamboo leaf addition. Settlement analysis were conducted on natural soil sample, soil reinforced with bamboo mat and bamboo mat reinforced soil mixed with bamboo leaf powder. Optimum percentage for bamboo leaf addition is considered as 6% which is obtained from primary investigation

IV. TEST RESULTS AND DISCUSSIONS

A. Study on natural soil sample

TABLE I properties of natural soil sample

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Property	Test result
Water content	31.29 %
Specific gravity, G	2.15
Liquid limit	74 %
Plastic limit	25%
Percentage of clay	63%
Percentage of silt	32 %
Unconfined Compressive strength	60.8 kN/m^2
Maximum dry density	14.12 kN/m^3
Optimum moisture content	26%

B. Study on Bamboo Leaf Treated Soil Sample

1) Atterberg's Limit

TABLE II Atterberg's limits of treated soil sample

% Of additive	Liquid limit (%)	Plastic limit (%)	Plasticity index(%)
0%	72	25	47
1%	68	22	46
2%	66	21	45
3%	62	19	43
4%	59	18	41
6%	60	16	44
8%	61	16	44
10%	60	15	45

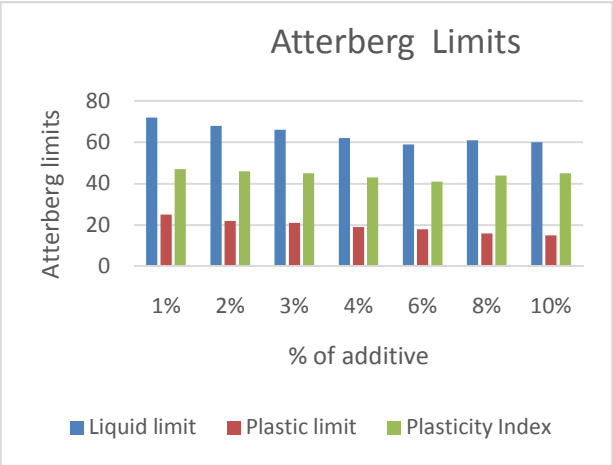

Fig.4 Atterberg's limits analysis

Liquid limit shows a decrease and then shows an increase after 6 % addition of bamboo leaf powder. Plasticity index also decreases primarily up to an optimum value and then increases.

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2) Standard Proctor Compaction Test

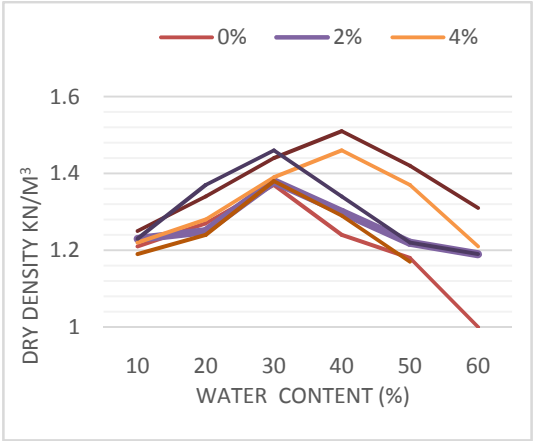

Fig.5 Compaction curves

It was observed that, addition of Bamboo leaf powder decreases the OMC and increases the MDD.
6% addition of bamboo leaf found as the optimum percentage of additive.

3) Unconfined Compressive Strength

Table III Analysis of unconfined compressive strength

% of Additive	UCS
0%	0.64
2%	0.65
4%	0.68
6%	0.74
8%	0.72
10%	0.711

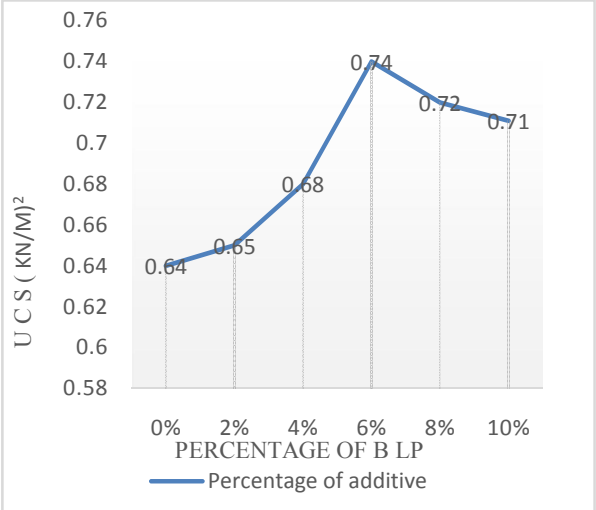

Fig.6 Variation of UCC with different percentage of additives

6 % is found as the optimum value of addition of BLP.
It shows an increasing in the unconfined compressive strength.
After optimum value, UCC shows a decrease.
From the studies 6% is considered as the optimum percentage of additive. Around 15 % improvement is identified by the optimum addition. Further research, which is the settlement analysis of soil with bamboo mat is done based on this optimum percentage of additive.

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C. Settlement Analysis

From the results obtained above, 6 % is considered as the optimum value of addition of bamboo leaf powder in soil sample. Bamboo mat is reinforced across the soil treated with this optimum percentage of bamboo leaf. Settlement analysis were conducted on natural soil sample, soil reinforced with bamboo mat and soil reinforced with bamboo mat along with powdered bamboo leaf.

TABLE IV Comparison of settlement analysis

Load	Settlement		
	Natural soil	Soil with BM	Soil with BM and BLP
0.4	5.28	4.09	3.8
0.6	10.34	6.78	5.72
0.8	15.44	12.56	9.21
1.0	18.2	16.3	11.34
1.2	21.63	18.4	17.1
1.4	24.73	21.6	20.24

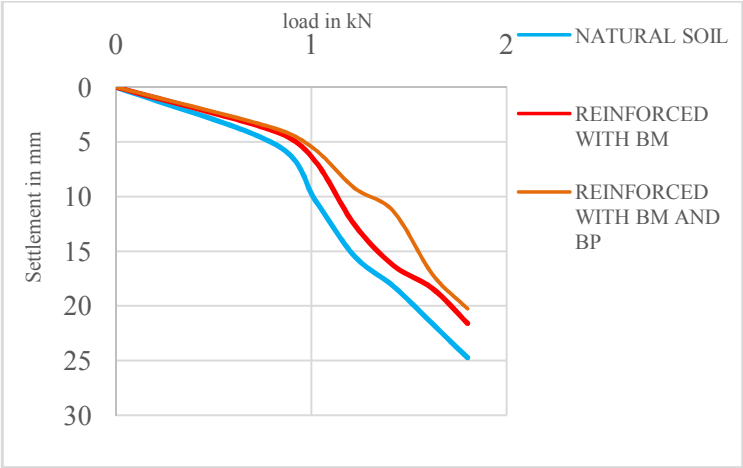

Fig.7 Comparison of settlement analysis

V. CONCLUSION

The results obtained from the experiment revealed that powdered bamboo leaves improve the properties of soil. 6% is considered as the optimum percentage of addition of powdered bamboo leaf and around 15% improvement is identified by the optimum addition of bamboo leaf. From settlement analysis, it is concluded that settlement is lower for bamboo mat reinforced soil which is treated with optimum percentage of bamboo leaf when compared to natural soil sample and soil reinforced only with bamboo mat.

Even though, strength of soil is achieved through this reinforcement, one of the major drawbacks it encounters is bio degradation. In the case of clayey soil, while it takes time to degrade, consolidation of soil occurs simultaneously. Therefore, degradation will not become a major problem up to a certain extent. In the end, this reinforcement technique can be applied in small scale ground improvement applications like slope stability, embankment erosion and in subgrade of pavements.

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