EXPERIMENTAL STUDY ON STRENGTH CHARACTERISTICS OF COCONUT COIR FIBRE REINFORCED SOIL STABILIZE USING MARBLE DUST

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Abstract: In fast growing today's world, development of new construction materials, new technique and industrial waste is being given the top priority. This is important for conservation of scarce resources and for achieving maximum disposal of waste. Use of Coconut Fibre for improving soil property is advantageous because they are cheap, locally available and eco-friendly. In this study, the stabilizing effect of Coconut Fibre on expensive soil properties has been Experimental studied. Keeping this in view an experimental study is conducted on Expensive soil mixed with varying percentage of Coconut fibre. Soil samples for California bearing ratio tests are prepared at its maximum dry density corresponding to its optimum moisture content in the CBR mould without and with Coconut fibre. The percentage of Coconut fibre by dry weight of soil is taken as 0.25%, 0.50%, 0.75% & 1% and corresponding to each Coconut fibre content un-soaked and soaked CBR tests are conducted in the laboratory. Tests result indicates that both un- soaked and soaked CBR value of soil increases with the increase in Coconut fibre content. Soaked CBR value increases from 3.9 % to 8.6 % and un-soaked CBR value increases from 8.1 % to 13.2 % of soil mixed with 1% Coconut fibre. Adding of coconut fibre results in less thickness of pavement due to increase in CBR of mix and reduce the cost of construction and hence economy of the construction of highway will be achieved. This is because of composite effect of Coconut fibre changes the brittle behavior of the soil to ductile behavior.

Keywords— Optimum moisture content, MDD, Soaked CBR & Un-Soaked, Expansive soil, Coconut Fibre

1. Introduction

Expansive soils because more damage to structures, particularly light buildings and pavements, than any other natural hazard, including earthquakes and floods. Engineers are continually faced with maintaining and developing pavement infrastructure with limited financial resources. Traditional pavement design and construction practices require high-quality material for fulfillment of construction standards. In many areas of the world, quality material is unavailable or in short supply. Due to these constraints, engineers are often forced to seek alternative design using substandard materials, commercial construction aids, and innovation design practices. Concrete or asphalt pavement cannot be constructed on weak soil, because in this case the pavement will be easily cracked. As sub grade pavement to the layer beneath, it should have a sufficient load carrying capacity. Coconut Fibre belongs to the group of hard structural fibres. It is an important commercial product obtained from the husk of coconut. The Coconut Fibre is elastic enough to twist without breaking and it holds a curl as though permanently waved. Shorter mattress fibres are separated from the long bristle fibres which are in turn a waste in the Coconut Fibre industry. So this Coconut Fibre waste can be used in stabilization of soil and thus it can be effectively disposed off. The inclusion of fibres had a significant influence on the engineering behaviour of soil-coir mixtures. The addition of randomly distributed Coconut Fibre

Resulted in substantially reducing the consolidation settlement of the clay soil. Length of fibres has an insignificant effect on this soil characteristic, whereas Fibre contents proved more influential and effective. Addition of Fibre resulted in decrease in plasticity and increase in hydraulic conductivity.

MATERIALS

A. Expansive Soil

The materials used in the experiments are soil and Coconut Fibre

The expansive soil used in the experimental work was brought from **MITS College campus, Bhopal, (M.P.), India**. The geo- technical properties of the expansive soil are:

Table-1: Physical characteristics of Expensive soil

Sr. No.	PROPERTIES	Test Values
1.	Specific gravity	2.86
2.	Liquid Limit LL (%)	28
3.	Plastic Limit PL (%)	23
4.	Plasticity Index PL (%)	5

5.	Uniformity coefficient, Cu	5.14
6.	Coefficient of curvature, Cc	0.97
7. I II	Compaction characteristics Optimum Moisture Content (%) Maximum Dry Density (g/cc)	13.65 1.85
8.	California Bearing Ratio CBR (%) Un-soaked CBR Soaked CBR	8.1 3.9

B. Coconut Coir Fibre

Coconut coir Fibre is obtained from the husk of coconut and belongs to the group of hard structural fibres. The fibrous husks are soaked in pits or in nets in a slow moving body of water to swell and soften the fibres. The long bristle fibres are separated from shorter mattress fibres underneath the skin of nut, a process known as wet milling. The coir Fibre is elastic enough to twist without breaking and it holds a curl as though permanently waved. It is an important commercial product used in mattress. Shorter mattress fibres are separated from the long bristle fibres which are in turn a waste in the coir Fibre industry.

The coir is purchased from market. It is the fibrous portion of the coconut extracted mainly from the green nut. Coir extracted consists of rotting the husk in water and removing the organic material binding the fibre. Diameter is 0.5mm. The coir is cut into pieces of 3cm to 5cm, as those percentage remains 0.25, 0.50, 0.75,&1%.

III TESTING PROCEDURE

For studying, the effect of Coconut coir Fibre on expansive soil, the Coconut Fibre was added from 0.25 to 1 % at an increment of 0.25 %.The following tests were conducted on Expansive soil and Coconut r Fibre mixes as per relevant IS code practice.

The experiments conducted are:

Compaction characteristics

Un-Soaked California bearing Ratio (CBR)

Soaked California bearing Ratio (CBR)

IV. TEST RESULTS

The various tests were conducted on Expansive soil mixed with Coconut Fibre in different proportions as per relevant IS Code of practice. The test results obtained from various laboratory investigations are summarized in table 2.

Table 2 – Results of variation of properties

S. No.	Properties	Test Results				
		CM_0	$CM_{0.25}$	$CM_{0.50}$	$CM_{0.75}$	CM_1
1	OMC (%)	13.65	13.45	13.10	12.80	12.60
2	MDD (g/cc)	1.85	1.87	1.885	1.89	1.90
3	Un-Soaked CBR (%)	8.1	9.7	10.8	11.9	13.2
4	Soaked CBR (%)	3.9	5.0	6.2	7.1	8.6

Where: CM_0 = Expansive soil + 0 % Coconut Fibre

$CM_{0.25}$ = Expansive soil + 0.25 % Coconut Fibre $CM_{0.50}$ = Expansive soil + 0.50 % Coconut Fibre $CM_{0.75}$ = Expansive soil + 0.75 % Coconut Fibre CM_1 = Expansive soil + 1 % Coconut Fibre

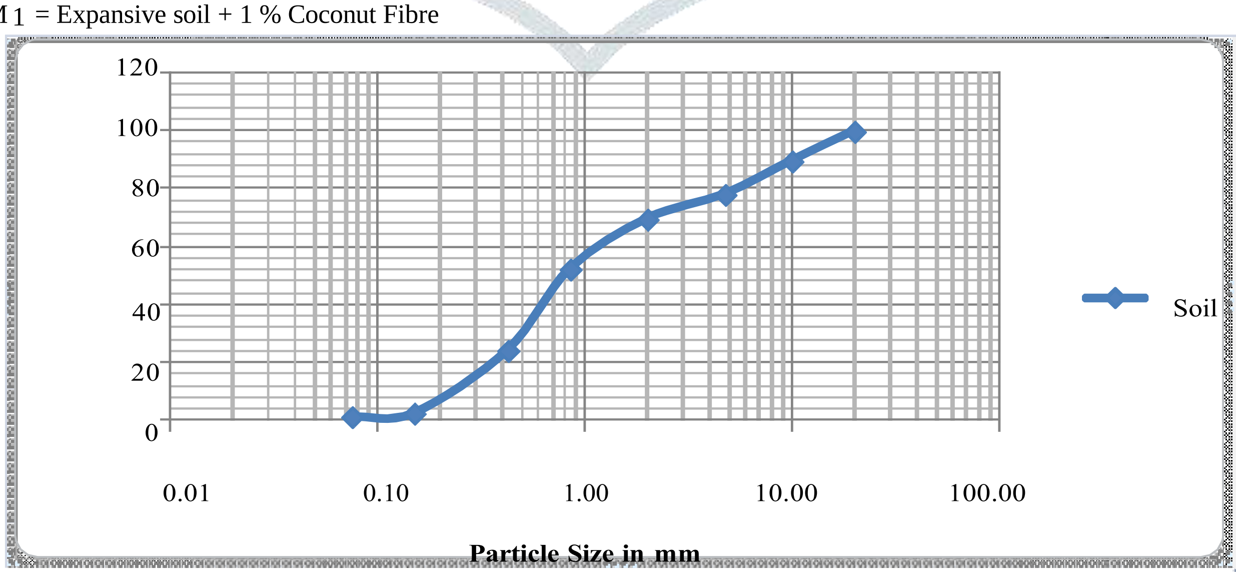

Fig 2 Grain Size Analysis of soil

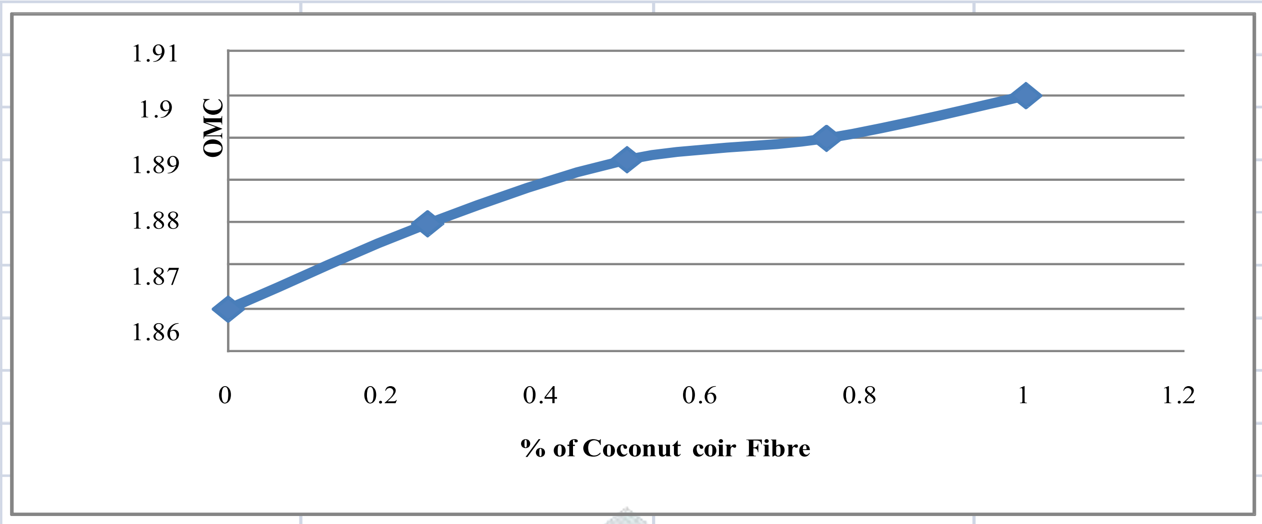

Fig 2 – Maximum dry density (MDD) of Soil with Coconut coir Fibre

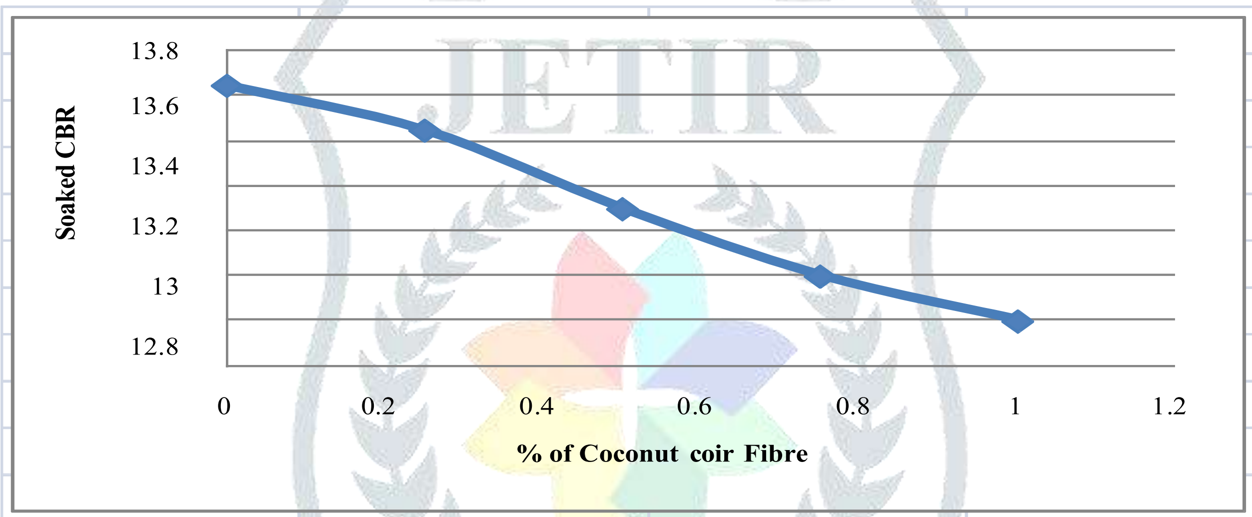

Fig 3 – Optimum moisture content of soil with Coconut Fibre

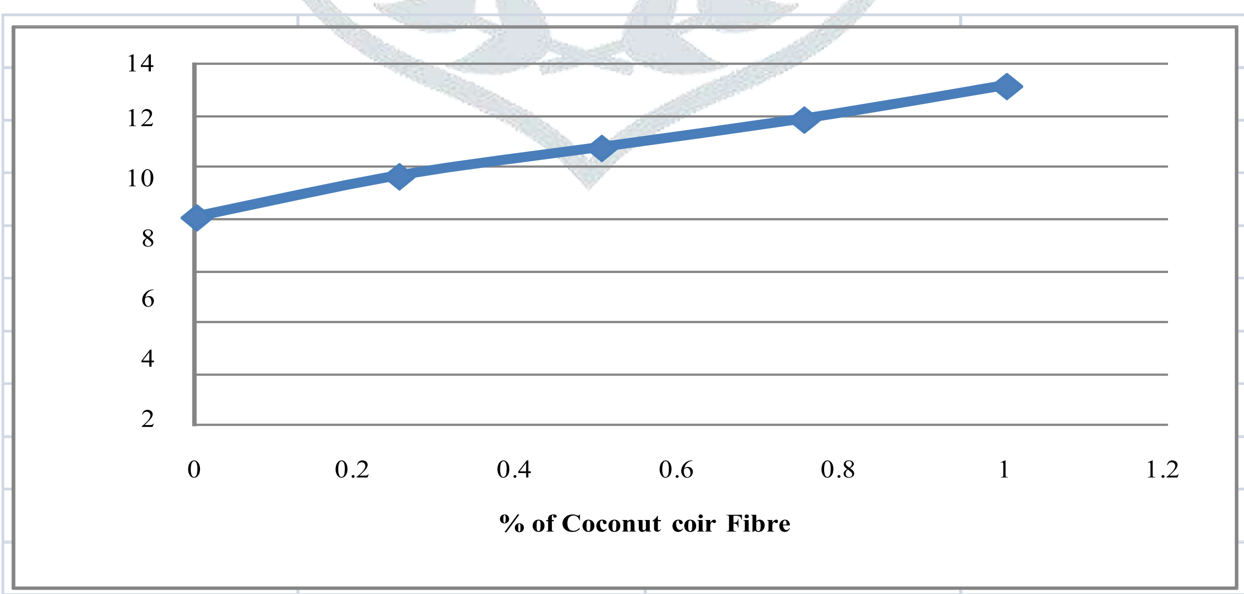

Fig 4 – Un-Soaked California berating ratio of soil with Coconut coir Fibre

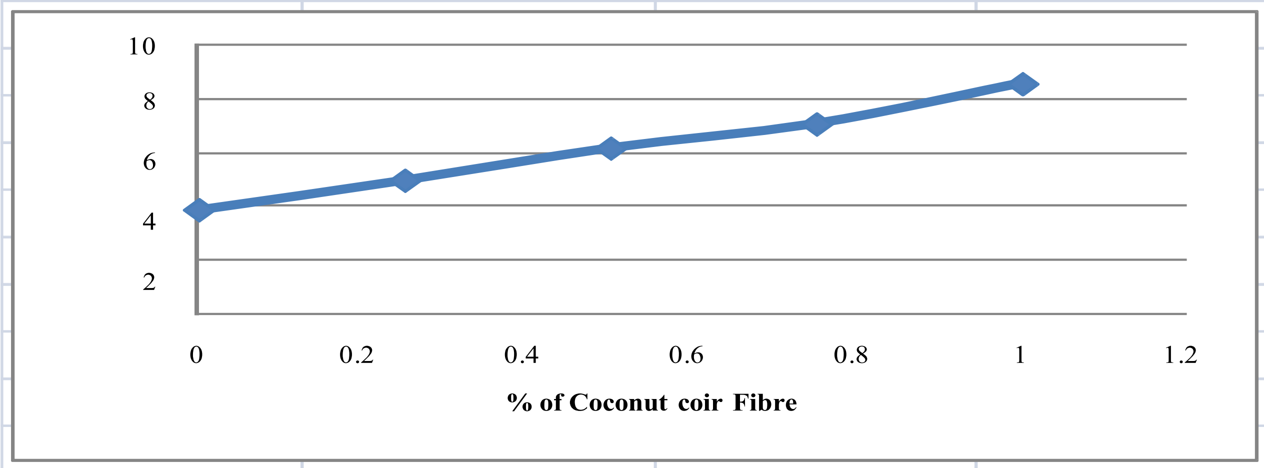

Fig 5 – Soaked California berating ratio of soil with Coconut coir Fibre

RESULTS AND DISCUSSION

Based on the results obtained from various tests conducted on Expensive soil, Coconut Fibre mixes. The variations in various engineering characteristics of the soil are discussed below. The compaction test results showed a decrease in OMC from 13.65% to 12.60 % and increase in MDD values from 1.85 g/cc to 1.90 g/cc with the addition of Coconut Fibre content from 0% to 25%. The variation in OMC and MDD are presented in figure-3 and figure-2 .The soaked CBR test results indicates that the values increase from 3.9 % to 9.6 % as the Coconut Fibre content increase from 0% to 1%. The load penetration curves and the variation of CBR with Coconut Fibre are presented in figure 5.

CONCLUTIONS

Based on above laboratory investigations conducted on Expensive soil-Coconut Fibre mixes the following conclusions can be drawn:
The addition of Coconut Fibre into the Expensive soil has changed the compaction parameters. The OMC of the Expensive soil has decreased and the maximum dry density increased with the addition of Coconut Fibre. The soaked CBR values have also increased significantly with the addition of Coconut Fibre content. The addition of 1% Coconut Fibre into the Expensive soil, increase the CBR values from 3.9 % to 8.6 % From the above laboratory investigation it can be concluded that the industrial waste like Coconut Fibre has a potential to modify the engineering behavior of Expensive soil and to make it suitable in many geotechnical application

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