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COMPARATIVE STUDY OF COIR FIBER TO REINFORCE SOIL.

Arati B. Gaikwad[1], V.J. Sharma[2]
[1]*PG Student, Department of Civil Engineering, MCERC, Nashik, Maharashtra, India*
[2]*Assistant Professor, Department of Civil Engineering, MCERC, Nashik, Maharashtra, India*

Abstract: Lot of natural fiber available to reinforce problematic soil is advantageous because they are cheap, locally available and ecofriendly. There are two types of coconut coir fiber i.e. White and brown which are used in this study. Because of high lignin content coir fiber are strong than other natural fiber and abundantly available in some parts of south and coastal regions of India. Most of these studies were conducted on soil samples in triaxial, unconfined compression and direct shear tests. Present work focuses on experimental study conducted on locally available soil i.e. clayey soil mixed with varying percentage of coir fiber. Soil samples for California bearing ratio (CBR) tests are prepared at its maximum dry density corresponding to its optimum moisture content in the CBR mould without and with coir fiber. The percentage of white and brown coir by dry weight of soil is taken as 0.25%,0.50%,0.75% and 1% for unsoaked CBR test are conducted in the laboratory. Test result indicates that, for brown coir maximum CBR values of soil –coir achieved with addition of 1% of coir and for white coir maximum CBR value can be achieved with 0.75% of coir. It was also found in this study the brown coir isstronger compared to white coir.

Key words:*white coir fiber, brown coir fiber, soil, MDD, CBR.*

I.INTRODUCTION

Stability of any structure depends on the properties soil. If using land having soft soil it may leads to various problems like settlement. Such soil can be improved by stabilization, reinforcement. Vibratory techniques to stabilize weak soils found acceptance worldwide as technically sound and cost effective ground improvement method (Rainer et.al. 2003).Ground vibration by surface compaction results increase in bearing capacity, reduction in total and differential settlement, decrease in liquefaction potential, and increase in relative density, and reduction compressibility and void ratio by densification (Rajeev Kumar et.al.2003). The stone column can be used in soft kaolinitic clay to reduce settlement and they act as vertical drains and accelerate consolidation (A.V. Shroff 2003).There are many waste materials like coal ash, stone quarry, recycled aggregate, geosynthetic materials, polyethylene can be used to save natural resources. For sustainable development some natural fiber like coir, palm, flax, cane, bamboo, jute, sisal,bhabar,hemp,munja are proved as good reinforcing material. Polyester, polyethylene,glass, nylon, polyvinyl alcohol are some fiber can be use effectively to reinforce soil (sayyed et.al. 2011). Soft clay marine deposits pose major problems to the geotechnical engineers of poor shear strength and high compressibility. With inclusion of coir fiber shear strength increase considerably by the inclusion of the coir fibers by about four times(BinduSebstian et.al. 2011).Coir fiber has higher resistance than polypropylene fiber if comparison is made (BijaynandaMohanty er.al. 2011).All coir fiber falls in to two different categories viz. white coir and brown coir the differences between two categories are due to the conditions of husk used, the method of extraction, the physical properties(Belas Ahmed Khan 2007).If the Randomly distributed coir fiber is used as reinforcing material in black cotton soil engineering properties of soil can be improved (Shivakumarbabu et.al. 2008). Coir content high

percentage of lignin, coir degradation takes place much more slowly than other natural fiber (Sayyed Mahdi et.al. 2012).Coir can be coated with bitumen, phenol, kerosene etc. to increase its life. Coating of coir fiber reduces the water absorption capacity and kerosene is considered to be the best.(H.N. Ramesh et.al. 2011).

Model footing test carried out on clayey soil with and without inclusion of coir fiber results significant increase in bearing capacity of soil with inclusion of coir fiber (Parag Chaple et.al. 2013)

In present study coconut fiber are used to reinforce soil. Coir fiber belongs to the group of hard structural fiber.

II. MATERIALS USED

2.1 Characteristics of the Experimental Soil

Locally available soil was used for the experimental investigation. Soil sample was collected from the local area at a depth of 1.0m to 1.5m.Different experiments were conducted to characterize the soil. Table 1 shows the properties of experimental soil.

Table-1: Properties of Experimental Soil

Sr. No.	Parameter	Values
1.	Specific gravity(Gs)	2.3
2.	Liquid limit(LL)	64%
3.	Plastic limit(PL)	22.71%
4.	Shrinkage limit(Ws)	13.8%
5.	Plasticity index(Ip)	37.83%
6.	MDD(Modified)	1.86g/cc
7.	OMC	18.27%
8.	Swelling Index	22.715%
9.	C.B.R (unsoaked)	9.50%
10.	color	Brown

2.2 Coir fiber

Obtained from Dwarkesh agro and Food Company, Gujarat state from junagadh. Rate per kg of brown coir are 22.22Rs. Andwhite is 25.22Rs. But for this experimental work the company provides fiber free of cost. The specifications (table no. 2) and photograph of the coir fibers used in this study are given in below.

Table-2: Physical and engineering properties of coir

Sr. No.	Properties	White coir fiber	Brown coir fiber
1	Specific gravity	1.1	0.67
2	Cut length	20-30mm	20-30mm
3	Diameter	0.1-0.2mm	0.2-0.25mm
4	Color	Light brown	Brown

Fig-1: Brown coir fiber

III.EXPERIMENTAL PROCEDURE

The soil passing through 4.75 mm was mixed in dry state with different percentage of white and brown coir fiber on weight basis. The required amount of water was added to the soil–coir mix to carryout modified proctor compaction test. Immediately after addition of water, the compaction was carried out to get compaction characteristics of the soil-coir mix for the given percentages. After getting the compaction curve, maximum dry density and corresponding optimum moisture content was obtained for the given soil-coir mix both i.e. for white and brown coir. By using OMC obtained by modified Procter test CBR test carried out.

The following test is conducted for soil and coir. Determination of Modified Procter test,CBR test.

Mix Proportion Used: Soil with 0.25%, 0.50%, 0.75%, 1.0% coir by weight (i.e. both white and brown.)

IV. RESULTS AND DISCUSSIONS

In these results soil is added with different ratios of coconut coir. The main parameters that are studied include, Modified Procter test that has been carried out to calculate MDD and OMC of soil sample. Second parameter i.e. C.B.R. tests are performed on the soil and soil mix with different percentage of coir fiber. Coir increases the C.B.R. value in this investigation. The experimental results are carried out in the following laboratory works.

Table:3 Modified Procter test for Different Coir Mixes

Sr. no.	Sample soil: coir	Brown coir		White coir	
		MDD (g/cc)	OMC (%)	MDD (g/cc)	OMC (%)
1	100.00	1.86	18.27	1.86	18.27
2	99.75:0.25	1.84	18.55	1.90	18.30
3	99.50:0.50	1.82	21.519	1.73	19.7
4	99.25:0.75	1.69	22.3	1.64	20.23
5	99.00:1.00	1.56	24.02	1.56	24.04

There is considerable improvement in the optimum moisture content and decreases the Maximum dry density. From Table 3 the range of OMC for Brown coir varies between 18.27% to 24.02% and for White coir it varies between 18.27% to 24.04%.The considerable decrease in

the MDD value which varies between 1.86g/cc to 1.56g/cc for brown coir and 1.86g/cc to 1.56 g/cc. The variation of OMC and OMC are shown in fig below.

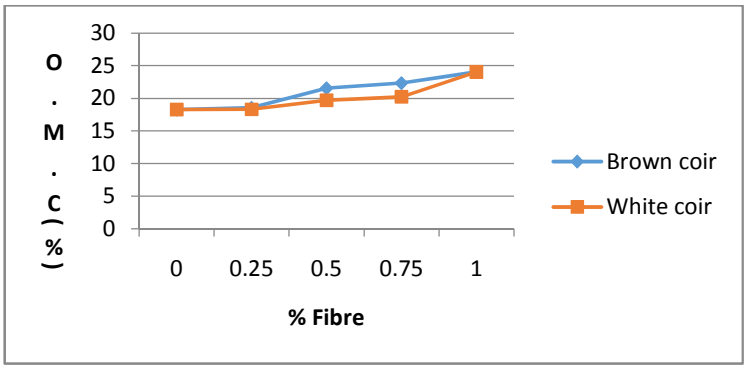

Fig-2: Variation of OMC of soil reinforced with different % oCoir fiber (i.e. White and brown)

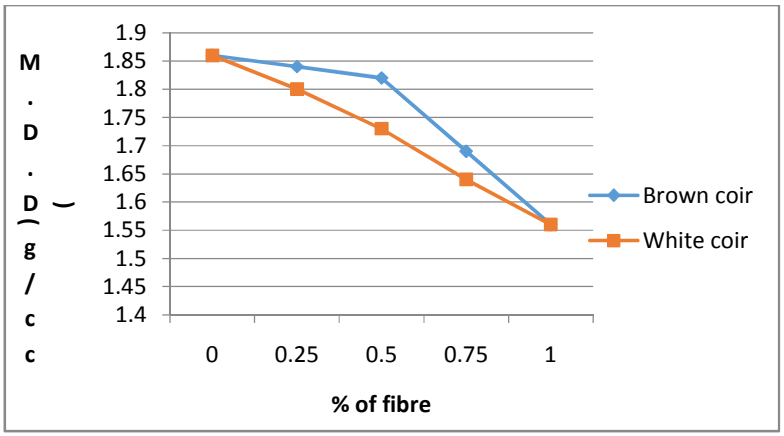

Fig-3: Variation of MDD of soil reinforced with different % of Coir fiber (i.e. White and brown)

California Bearing Ratio Test

The unsoaked CBR values are determined in the laboratory for soil mixed with varying percentage of coir fiber content shown in table 3 respectively. It is clear from the tests results of table 3 that unsoaked CBR value for brown coir are increases significantly and maximum CBR value obtained with addition of 1% fiber. And for white coir fiber the maximum the CBR increases from 0 to 0.75% and after that decreases. The variation of CBR for both fibers is shown in graph.

Table-4:Unsoaked C.B.R. value of soil coir mix

Sample Soil: coir	C.B.R (unsoaked) Brown coir	C.B.R (unsoaked) White coir
100	9.50	9.50
99.75:0.25	13.23	11.55
99.50:0.50	14.38	13.43

99.25:0.75	15.6	14.60
99.00:1.00	16.12	12.71

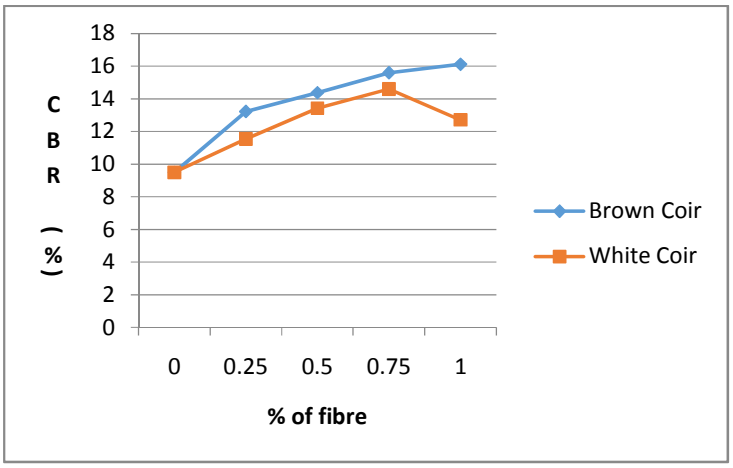

Fig-4: Graph of unsoaked C.B.R for Different Coir Mixes

V.CONCLUSION

The following conclusions were drawn after this work has been carried out:

1. The maximum dry density decreases with increase in fiber content (i.e.both for brown and white coir)

2. Optimum moisture content increases with increase in fiber content (i.e. both for brown and white coir)

3. CBR value of soil coir fiber mix for brown coir increases with increasing percentage of fiber. Maximum improvement in C.B.R. values are observed when 1% brown coir is mixed with the soil.

4. For white coir maximum improvement in CBR are obtained with addition of 0.75% of fiber.

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