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Soil Stabilization Using Rice Husk Ash and Coir Fibre

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ABSTRACT- Soil stabilization is major problem for construction and experimental purposes. Now a days used practical work greatly explains the suitable characters of the locally available Rice Husk Ash (RHA) to be used in the local construction industry in a way to minimize the amount of waste Released in environment causing issues to nature to the environment causing environmental pollution. The soil stabilization methods used in present are very costly because of costly available stabilizing materials like, cement, lime, etc. The cost of stabilization may be minimized by replacing a good proportion of stabilizing agent using RHA. It will minimize the environmental hazards also. Soil sample taken for the study is clay with high plasticity (CH) that requires stabilization. The soil is stabilized using additives rice husk ash and a small amount of coir fibre. Various results are made that shows changes in Maximum dry density (MDD), Optimum moisture content (OMC). California bearing ratio (CBR) and Unconfined compressive stress (UCS). The results obtained in the present study show that the increase in RHA content increases the OMC but decreases the MDD. Also, the CBR value and UCS of soil are considerably improved with the RHA content. From the observation of maximum improvement in strength, 10% RHA content with 6% coir fibre is recommended as optimum amount for practical purposes.

KEYWORDS- Soil stabilization, Rice Husk Ash, fibre of coir, Index properties, Optimum Moisture Content, Unconfined Compressive Strength, Bearing capacity.

I. INTRODUCTION

A. General

Soil is a core component of various building and construction purposes. The Life of a structure is dependent on the soil upon which it rests, therefore, it is important to ensure that the soil over which any structure is constructed, is suitable for construction . for that soil needs to be stabilized .That is why That is why soil stabilization is used.

B. Soil Stabilization

Soil stabilization refers to any physical, mechanical, biological, or combined methodof changing the properties a natural soil to meet an engineering purpose. .Some of the renewable technologies are: enzymes, surfactants, biopolymers, synthetic polymers, co-polymer based products, cross-linking styrene acrylic polymers, tree resins, ionic stabilizers, fiber reinforcement, calcium chloride, calcite, sodium chloride, magnesium chloride and more. Soil stabilization uses hydrophobic phenomena for strengthing the soil. Other stabilization techniques include using on-site materials including soils mixtures, sandy soil, mining products and processed construction waste to provide stable, dust free local roads forcomplete dust control and soil stabilization.

C. Soil

Soil is a complex mixture of minerals, organic matter, various gases, different liquids, and various organisms that together support life on Earth. It serves as soffit over which each structure is constructed. Like holding the roots of vegetation firmly, the soil is required to hold the foundation purely , such that the building will rest without any type of failure for a long period of time. Soil having clayey and cohesive properties prove to be stable and can withstand heavy structures. However, soil with less chemical and physical properties cannot hold structures and may leadto disruption of the structure at a later stage. Variety of Stabilization processes are used to better the mechanical and chemical nature of that particular soil.

D. Rice Husk Ash

The properties of soil can be significantly modified by the incorporation of fillers . Rice husk fillers are derived from rice husks which are usually regarded as agricultural waste and nature pollutant .rice husk when burnt in air outside the rice mill gives two types of ash that can serve as fillers and stabilizing agent in soil the upper layer of rice husk mound is subjected to open burning in air and yield black carbonized ash and the inner layer of the mound being subjected to a higher temperature profile results in oxidation of the carbonized ash to yield white ash that consist silica which is great agent to improve soil behaviour.

E. Coir Fibre

Coir fibre is a material that is obtained from the outer shell of the coconut fruit it is used in a various ways all around being commonly usd for making for rope and matting and there are a number of sources for coir fibre. Both organic and conventionally product versions are available and some firms specialize in coir which has been harvested suistainably by farmers .Coir fibre has properties which are used for astabilization of soil . it improves the soil strength significantly with various propertions.

II. LITERATURE REVIEW

Abarajithan. G et al.[1] studied that eco-friendly and Economic materials like Rice Husk Ash and Coir Fibre, made a various impact on the stability and strength behaviuor of soil, when mixed to the soil sample in required quantities. From the results, it is seen that Coir Fibre and Rice Husk Ash, in suitable quantity have improved the value of the bearing capacity,liquid limit,plastic limit,specific gravity and unconfined compressive strength of the soil.

Sheeba B S et al.[2] found that MDD of soil decreases from 15.205 kN/m3 to 11.180 kN/m3 when 20% of RHA was used. The OMC increases irrespective of percentage addition of RHA. The OMC increases to a value of 43 % from 32% when 20% RHA was added to the soil.The UCS of soil increases from 50.606 kN/m² to 71.78 kN/m², when 15percentage of RHA was added, this is because of the inner friction angle increases and resistance from RHA provides surplus to the cohesion from expansive soil. For best stabilization effective optimum percentage of rice husk ash on soil is obtained as 10% by weight of dry soil. RHA can be used as a soil stabilizer.

Jai Prakash et al.[3] resulted that the addition of RICE HUSK ASH alone to soil being tested resulted in decrease in the value of liquid limit.The addition of RICE HUSK ASH alone to the soil being tested resulted in decrease in the value of MDD.The addition of RICE HUSK ASH alone to the test soil resulted in OMC increase. Silica present in RHA is capable to replace the exchangeable ion present in clay mineral thus can reduce shrinkage and swelling property of clay minerals.

III. EXPERIMENTAL INVESTIGATION

A. Specific Gravity

The specific gravity of soil refers to the mass solids in the soil compared to the mass of water at same volumes .in general its value is 2.65 but by adding rice husk and coir fibre its values gets increased to 2.75 that is further used in every test we performed for soil stabilization process.

Summary of index properties of soil given in table 1 and Variation of CBR values on various loads are showing in figure 1.

Table 1: Summary of Index properties of Soil Sample

S. No	Description	Values
1.	Specific Gravity (G)	2.350
2.	Liquid Limit, W_L (%)	27.9
3.	Plasticity Index, I_P	10.2
4.	Plastic Limit, W_P (%)	22.8
5.	Uniformity coefficient (C_u)	2.7
6.	Coefficient of curvature (C_c)	1.08
7.	Particle size distribution: Gravel content (%) Sand content (%)	 6 94

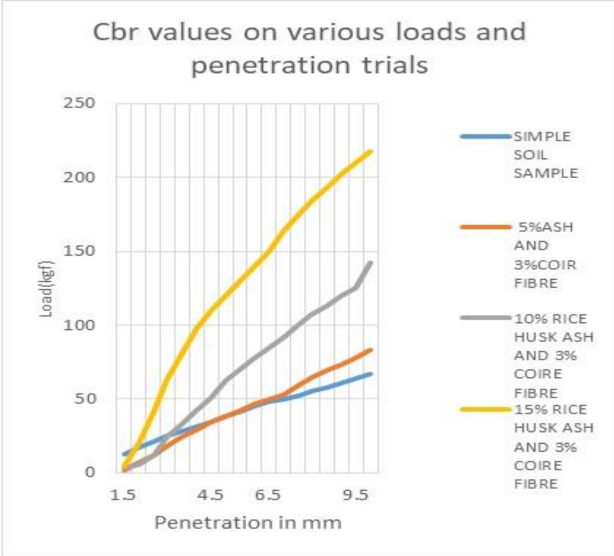

Figure 1: Variation of CBR values on various loads

B. Grain Size Distribution

Particle size distribution also known as gradation refers to dry mass proportions of a soil spreaded over whole particle size ranges. We performed test and calculated as result.

RESULT:C_u = 2.7 < 6 and C_c = 1.08 < 3, the soil sample is classified under the group symbol SW (Well graded sand) with 4% fine as per IS: 1498 – 1970 [1].

C. Liquid Limit

Liquid limit is important parameter used in construction purposes and generally calculated in lab at 25 blows values. From the results obtained in tests for liquid limit, the value of compression index may be estimated. The compression index value will help us in settlement analysis.

The Liquid Limit of the test soil sample was found to be W_L= 27.9% [2]

D. Plastic Limit

The moisture content at which soil behaves as plastic and beyond which it behaves as semisolid.

The Plastic Limit of the test soil sample was found to be W_P= 22.48% and Plasticity Index, I_P= 10.2 [2]

E. Standard Proctor Test

Determination of the relationship between the results gets from the test will be useful in improving the bearing capacity of foundations, Decreasing the undesirable settlement of structures, Control undesirable volume changes, Reduction in hydraulic conductivity, Improving the stability and suitability of slope sand so on.

As per IS:2720(Part 7)-1980{3}

Values of optimum moisture content and corresponding maximum dry density of soil are given in table 2 and CBR variation for unsoaked soil sample is showing in figure 2.

Table 2: Optimum Moisture Content and corresponding Maximum Dry Density of soil

Soil Sample	OMC (%)	MDD (gm/cc)
Unreinforced Soil Sample	12.1	1.78
5% Rice Husk Ash and 3% Coir Fibre	15.6	1.8
10% Rice Husk Ash and 3% Coir Fibre	16.9	1.81
15% Rice Husk Ash and 3% Coir Fibre	15.1	1.82

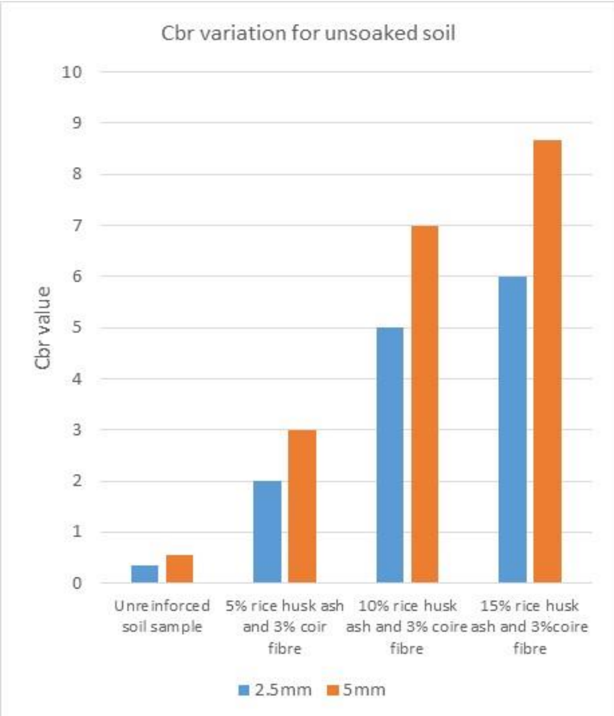

Figure 2: CBR variation for Unsoaked Soil Sample

F. California bearing test

The California bearing ratio test is penetration test meant for the calculation of subgrade subsoils strength and stability of roads and pavements. The results obtained from tests are used to determine the soil characters and its composition variant. This is the most widely used method for the stability of soil . CBR to that required for the corresponding penetration of a standard material. C.B.R. = Test load/Standard load at 2.5 mm penetration. Standard Load = 1370 kg at 5.0 mm penetration. Standard Load = 2055 kg[4].

CBR values of soil sample for standard penetration are given in table 3 and CBR variation for soaked soil sample is showing in figure 3.

Table 3: CBR values of Soil Sample for standard penetration

Soil Sample	Unsoaked		Soaked	
	2.5 mm	5 mm	2.5 mm	5 mm
Unreinforced soil	0.34	0.56	0.43	0.62
5% Rice Husk Ashand 3% Coir Fibre	2	3	2.44	3.81
10% Rice Husk Ash and 3% Coir Fibre	5	7	5.82	7.83
15% Rice Husk Ash and 3% Coir Fibre	6	8.66	6.98	6.55

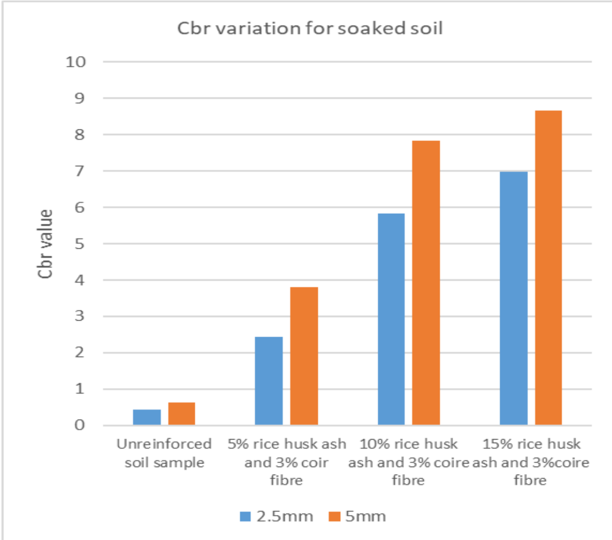

Figure 3: CBR variation for Soaked Soil Sample

ariation of unconfined compressive strength given in figure 4.

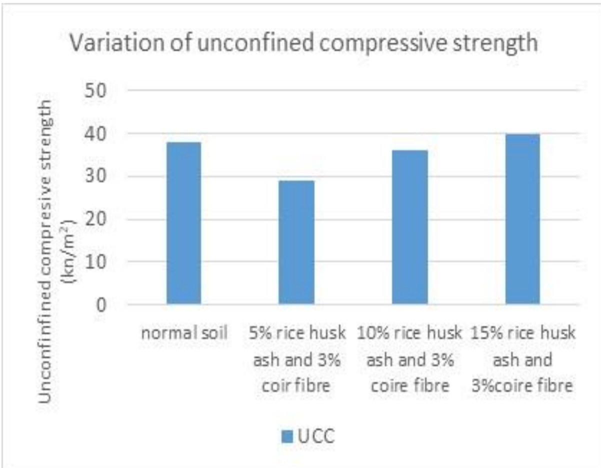

Figure 4: Variation of Unconfined Compressive Strength

IV. CONCLUSION

Based on the results obtained from the CBR and Unconfined Compression test, the CBR value, liquid limit and plastic limit and strength of the soil increases with increasing the proportions of Rice Husk Ash and decrease in Coir Fibre as reinforcements.

From the above graph it is evident that the CBR value and compressive strength of the soil is higher with **15%** Rice Husk Ash and **3%** Coir Fibre than the other reinforcement ratios. Thus, based on the results, the CBR value , liquid limit, plastic limit and strength of soil will certainly increase when a higher percentage of Rice Husk Ash and a lower percentage of Coir Fibre are added to the soil.

At last it is concluded that the stability and strength of the soil is increased variantly with high value of Rice Husk Ash and low value of Coir Fibre.

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