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Influence of Lime, Rice Husk Ash and Coconut Fibre on Strength Properties of Subgrade

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Abstract: ***Soil stability is a significant criterion in the field of development, for soil which needs adequate steadiness, different adjustment strategies can be embraced. The entrenched methods of soil adjustment regularly utilize such establishing operators like cement. Substitution of solidifying substance with commercial or agriculture outcome is profoundly attractive. Rice husk ash is an extremely prospective agriculture dissipates as pozzolanic materials that bring about a prevalent property after joined with lime. Also, coconut fibre is well known for its durability and high resistance and gives well establishing results when combined with lime and rice husk ash. This study worked on the experimental investigation of clayey soil with admixtures like lime, rice husk ash and coconut fibre. This study included the calculation of properties of the soil as consistency limits and strength characteristics. Clay type of soil is used in this study. In view of compaction, expansion of lime, RHA and coconut fibre diminishes the dry density and expands the moisture content. From the perspective of strength characteristics and economical terms, expansion of 6% lime, 8 % RHA and 1 % coconut fibre are prescribed as ideal value for subgrade soil adjustment.***

Key words: soil stabilisation, lime, RHA, coconut fibre, clay.

I. INTRODUCTION

Stabilized soils are composite materials that result from mix and upgrade of the properties of individual materials. The entrenched strategies of soil adjustment are regularly used to acquire improved geotechnical materials through either the extension to soil of setting operators, for instance, Portland concrete, lime, black-tops, etc. Due to the extension in the measure of strong waste wherever all through the world, specialists & analysts complete numerous examinations to discover the utilizations for these wastes. Ecological and budgetary problems in numerous nations motivated interest in the advancement of elective substances which can satisfy structural layout. The transit development and ecological ventures have the best potential for re-use since they utilize huge amounts of earthen materials every year. Substitution of virgin soils, aggregates, and concrete with strong modern side-effect is exceptionally alluring. Shrivastava et al. (2014) worked on clay soil stabilization. It was discovered that liquid limit diminished when 5% lime was included yet got expanded when 5 - 20% RHA was included. Plastic limit got expanded, additionally shrinkage limit got expanded yet pliancy file got diminished. Expansion of RHA to lime settled soil diminished the expanding behaviour of soil to an enormous degree. Devdatt et al. (2015) observed that expansion of coconut coir fibre into extensive soil has changed the compaction parameters. The OMC of soil got diminished and MDD got expanded with expansion of coconut coir fibre. Soaked CBR value got expanded fundamentally with expansion of coconut coir content. Expansion of 1% of coconut coir fibre into soil, expanded CBR value from 3.9 to 8.6.

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II. MATERIALS AND METHODS

The materials used in this research are clay soil, lime, and rice husk ash and coconut fiber.

A. Soil:

Clay is the littlest particles among the other two sorts of soil. The particles in this soil firmly stuffed together with one another with no airspace. These soils pass through 4.75 mm sieve. Clay soil is taken from region of Himachal Pradesh. To check the properties of soil, standard proctor test and consistency limit is conducted.

Properties of clay soil

constituent	value
Liquid limit	46%
Plastic limit	26.90%
Plasticity index	19.06%
Optimum moisture content	16%
Maximum dry density	9.2 KN/m^3
CBR	7.60%
Shear strength	15Kg/cm^2

B. Lime

"Lime" means to items got from warming limestone. It begins with its most punctual use as building mortar and has the feeling of "sticking or adhering". The stones and minerals from which these materials are determined, ordinarily limestone or chalk, are made basically out of calcium carbonate (CaCO3).

C. Rice husk ash

Rice husk are the strong-defensive covers of granules of rice. Rice cover is isolated from the rice grain by a procedure of winnowing.

It is utilized as powers in ovens and heaters in specific ventures, for example, rice factories, pastry kitchens, and so forth and because of proper burning, RHA can be drawn.
RHA is synthetically steady and its substantial properties are like that of common sand. The high precision and rubbing edge of RHA add to staggering steadfastness and weight bearing point of confinement. This ash is a potential wellspring of high receptive silica. Silica is the fundamental part of sand, which is utilized with concrete for putting and cementing. The vast majority of the debris is utilized in the creation of Portland concrete.

D. Coconut fiber

Coconut fibre is the stringy substance occurred between the hard, inner and the external layer of a coconut. The high fibre content of coconut helps in enhancing the formational respectability of soil after blended in prescribed extents. In any case, the detriment of using coconut fibre for soil adjustment is that it breaks down after a specific time and isn't useful for a life span. Be that as it may, the lifetime of Coconut Fibre can be drawn out somewhat by synthetic treatment. At the point when utilized in lesser quantity, the impact of disintegration of coconut fibre will be less pronounced. Also, this fibre likewise benefits in encouraging enhanced vegetation by holding dampness & by giving adequate air circulation to the plants.

E. Experimental programme/ methodology

A series of laboratory tests were being conducted on virgin soil to find out consistency limits, optimum moisture content, maximum dry density, and compressive strength and shear strength. These tests include standard proctor test, CBR test and direct shear test.

In next phase, the soil was mixed with different admixtures with different proportions (lime, rice husk ash and coconut fibre). Firstly, lime with varying percentage of 2%, 4%, 6% and 8% were added to the soil to find out the optimum value for which above mentioned tests were conducted. After obtaining optimum value of lime, RHA with a varying percentage of 4%, 8% and 12% were added to soil blended with lime. Similarly, after obtaining optimum value of lime and RHA, coconut fibre was added to soil blended with lime and RHA with same tests. Coir Fibre with fixed aspect ratio is utilized in this study, as reinforcement, with a length of 2cm and a diameter of 0.012mm.

F. Test Results Analysis And Discussion

Figure 1& 2 shows deviation of OMC and MDD along percentage of lime. The decrement in MDD is presumably due to the quick responses among lime and soil, which is spoken to by flocculation and agglomeration. Also, the higher pH condition in the treated soil changed the surface charge conveyance in the mud soil particles, bringing about an expansion in repulsion between molecule layers. This, alongside changes in the molecule size circulation, caused a lessening in maximum dry unit weight. The increments in OMC with expanding lime substance might be because of increment of fine portion and the hydration of lime.

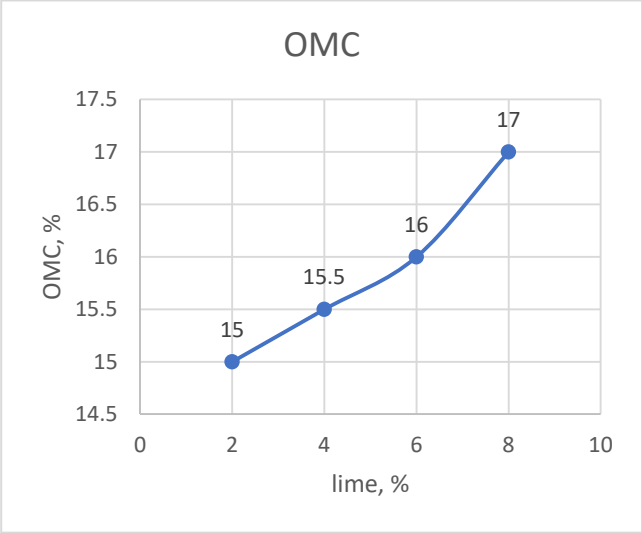

Fig. 1: variation of OMC with lime

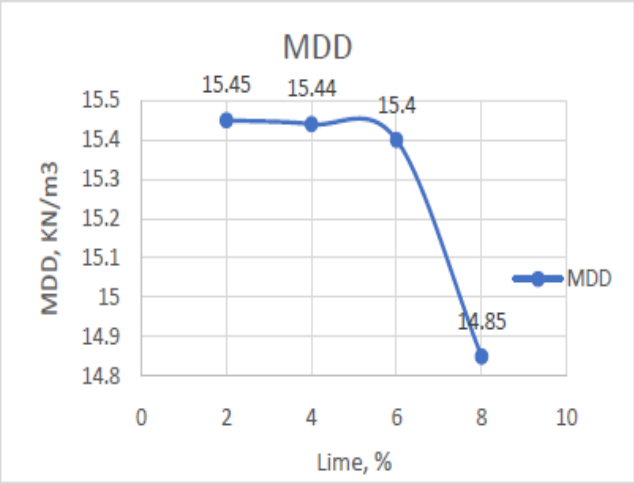

Fig. 2: variation of MDD with lime

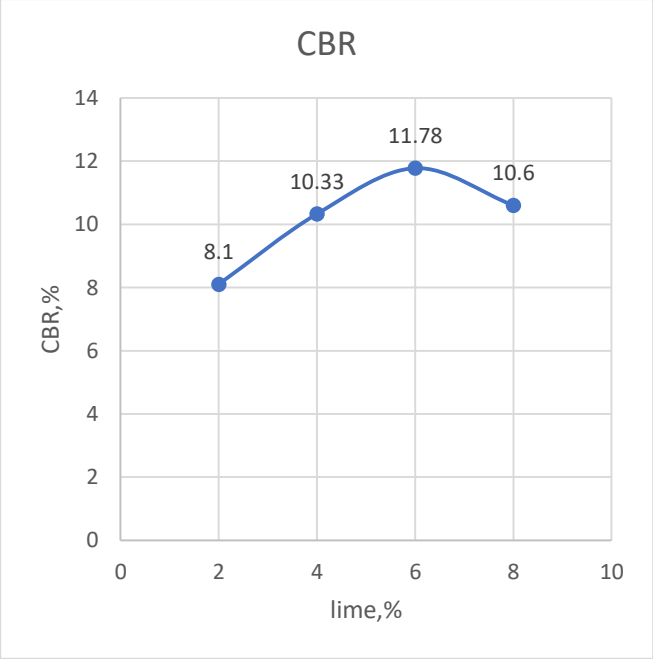

Fig. 3: variation of CBR with percentage of lime

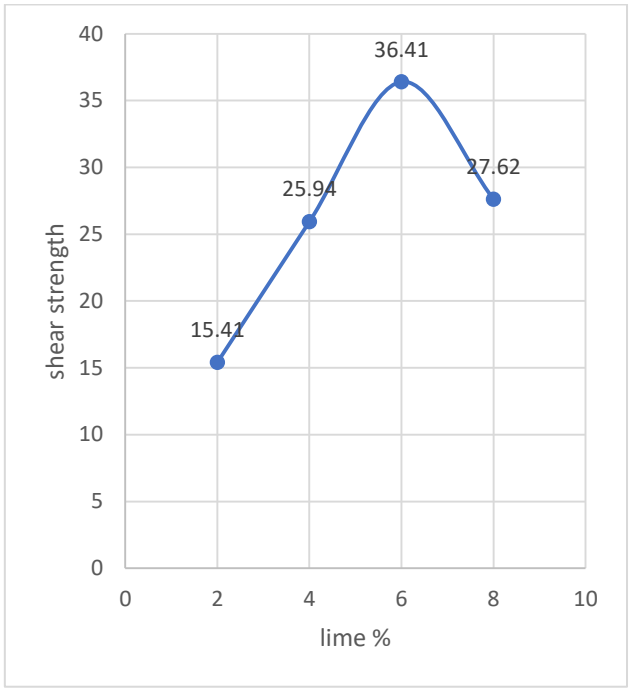

Fig. 4: variation of shear strength with percentage of lime

Figure 3 shows that with addition of lime up to 6% CBR value increases from 8.1% to 11.78%. And with further increment of lime CBR value decreases from 11.78% to 10.6%.Direct shear test was conducted on soil mixed with different admixtures with different percentages. Figure 4 shows variation of shear strength along with different percentages of lime. With the addition of lime up to 6% shear strength increases from 15.41 kg/cm^2 to 36.41 kg/cm^2.This increase is because of the holding of particles into bigger collectives such that the soil carried on as a reinforced & granular substance. Then, with further addition of lime shear strength decreases. This decrease is due to abatement in the pH value of the pore liquid, and a direct relationship is developed. This relationship clarified the way that the balance of lime settled soils brought about a decline in shear strength.

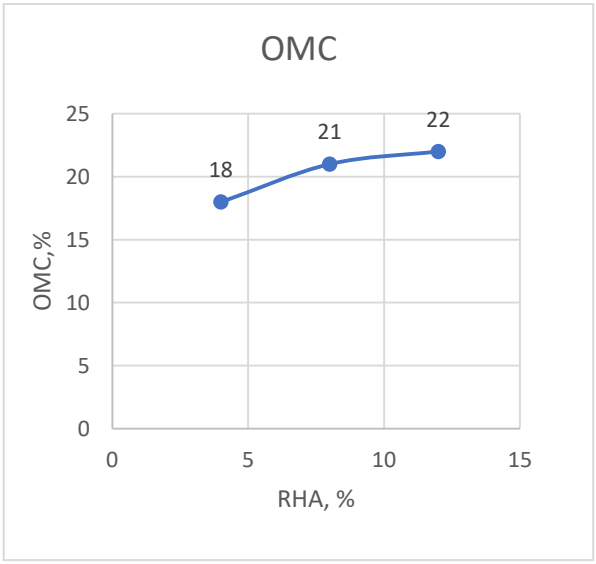

Fig. 5: variation of OMC with the addition of rice husk ash to the soil stabilized with lime.

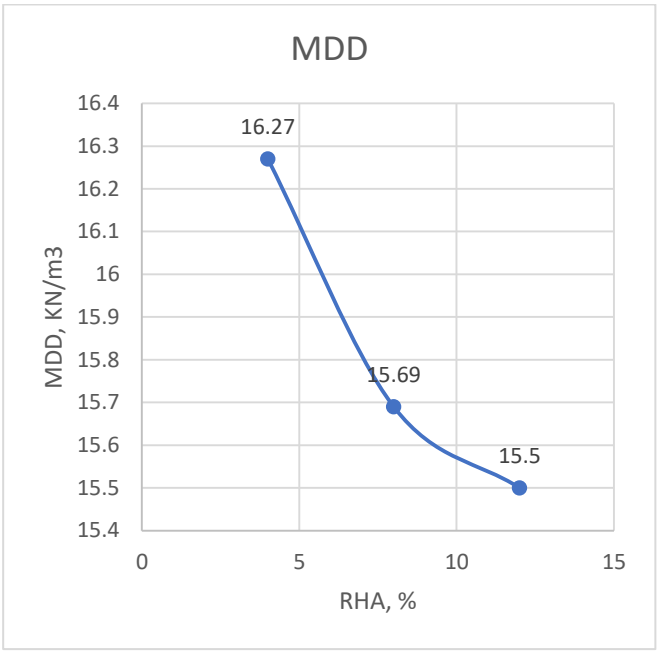

Fig. 6: variation of MDD with the addition of rice husk ash to the soil stabilized with lime.

Figure 5&6 shows variation of OMC and MDD with percentages of rice husk ash and 6% lime. The MDD is diminished while the OMC is expanded with increment in RHA content. The diminishing of MDD can be attributed to the substitution of soil & by the RHA in the blend. The decrease in the MDD may likewise be clarified by thinking about the RHA as filler (with lower specific gravity) in the dirt voids. There is increment in OMC with increment of RHA substance.

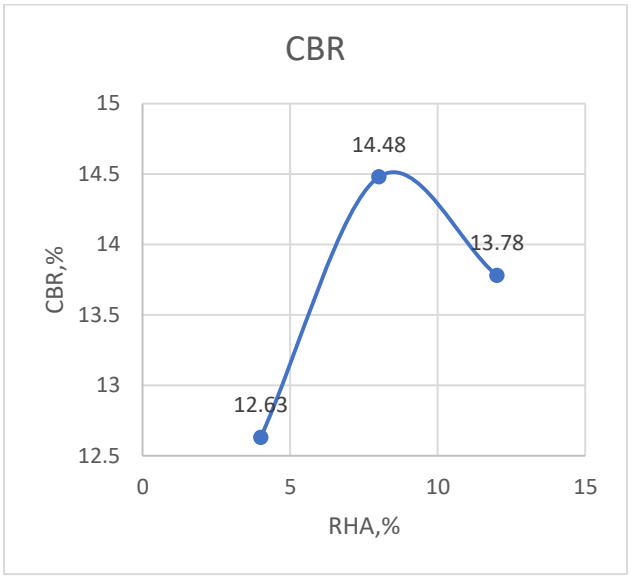

Fig. 7: variation of CBR with the addition of to the soil stabilized with lime.

Figure 7 shows that with addition of lime CBR value increases and this value further increase with addition of RHA. The purpose behind increment in CBR might be a result of the steady development of cementitious mixes in the soil by the response between the RHA,

lime and a few measures of COAH present in the soil. The reduction in CBR at RHA substance of 12% might be because of extra RHA that couldn't be activated for the response which thus consumes spaces inside the sample. This decreased the bond in the soil, lime and RHA blend.

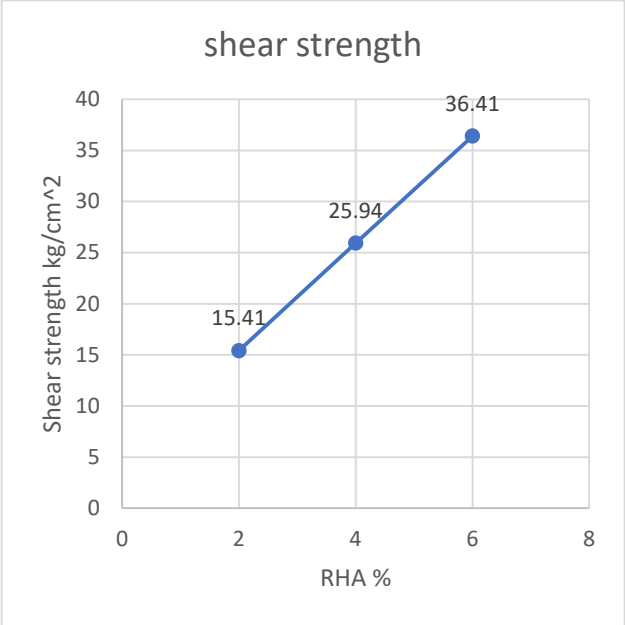

Fig. 8: variation of shear strength with the addition of rice husk ash to the soil stabilized with lime.

The soil blended with lime (6%) is then mixed along various proportions of RHA in order to find out shear strength of mixture. Figure 8 shows variation of shear strength along various percentages of RHA with 6% lime content. With increment of RHA up to 8% shear strength increases from 17.73 kg/cm^2 to 44.49 kg/cm^2. Enumerating lime and RHA to the soil causes an abatement in misshape of soil & provides increasingly weak materials. Likewise, this activity creates an increment in shear quality. But with further addition of rice husk ash shear strength decreases.

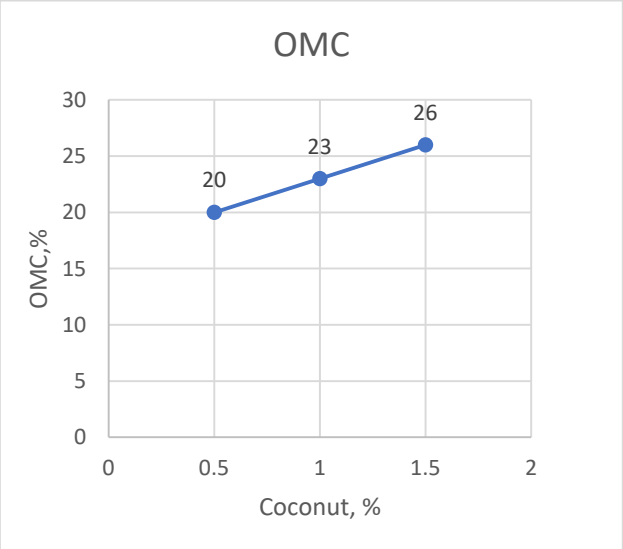

Fig. 9: variation of OMC with the reinforcement of fiber to the soil stabilized with fly ash and lime sludge.

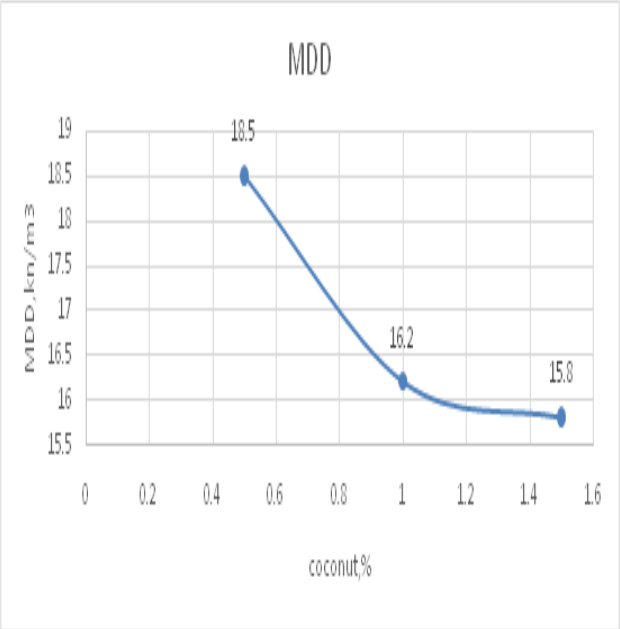

Fig. 10: variation of MDD with the reinforcement of fiber to the soil stabilized with lime and rice husk ash.

Fig. 9 & 10 shows variation of OMC and MDD with percentages of coir along with 6% lime and 8% rice husk ash. Coir fibre causes an expansion in OMC and diminishing in MDD. Fibres tend to absorb moisture and this can be credited to the expansion in OMC. Fibres have less unit weight. Replacing fibre in the clay soil because of lessening in weight involved in the standard volume, causing a reduction in the maximum dry density.

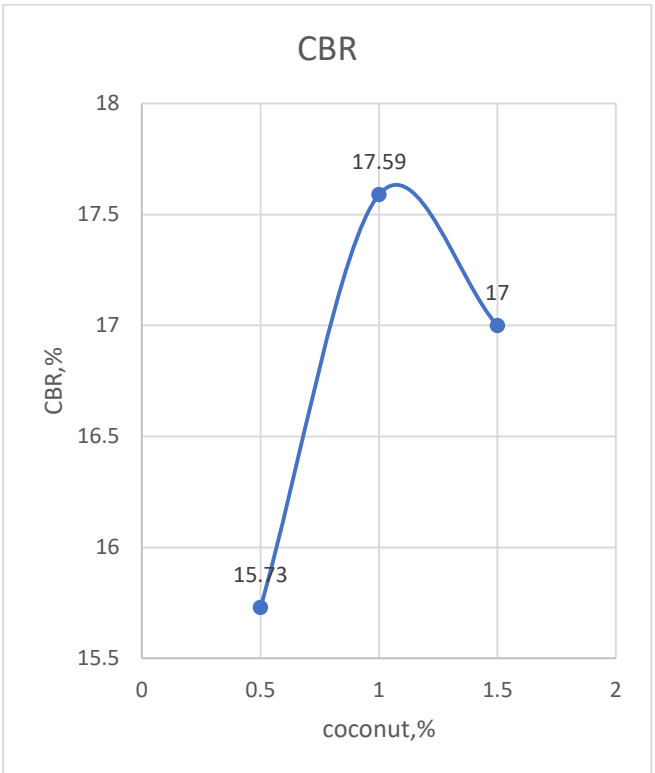

Fig. 11: variation of CBR with the reinforcement of fiber to the soil stabilized with lime and rice husk ash.

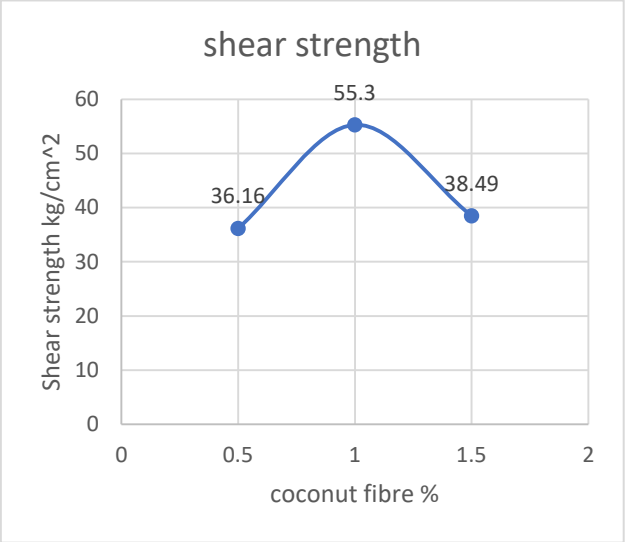

Fig. 12: variation of shear strength with the reinforcement of fiber to the soil stabilized with lime and rice husk ash.

Fig. 11 shows CBR value increases from 15.73% to 17.59% with addition of coconut fibre up to 1% along with 6% lime and 8% RHA. Increment in CBR with expansion of fibres is because expansion of fibre grants shear protection from the soil subsequently it improves protection from infiltration under the stacking. And with further addition of coconut fibre the CBR value is decreased due to further expansion of fibre brings about diminished strength because of over organic matter content. Then soil blended with 6% lime and 8% rice husk ash is mixed with different percentages of coconut fibre. Figure 12 shows variation of shear strength with different proportions of coconut fibre with 6% lime and 8% rice husk ash content. It was noticed that with addition of coconut fibre up to 1% shear strength increases from36.16 kg/cm^2 to 55.33 kg/cm^2.This increase in shear strength is due to reduction of cracks by addition of coconut fibre. But further addition of coconut fibre causes decrease in shear strength. Fibres are the non- cohesive materials may reduce the oil effect; therefore, increase in addition of fibres decreases the shear strength of soil after the optimum limit. Also, due to non-uniform mixing of fibre leads to decrease in shear strength.

III. CONCLUSION

1. Based on experimental investigations, it can be concluded that lime, eco-friendly material like RHA and coconut fibre has a great effect on strengt properties of clayey soil.
2. It is noticed that addition of lime up to 6%, rice hus ash up to 8% and coconut fibre up to 1% increase both compressive as well as shear strength of soil.
3. Lime provides the proper bonding between soil and other admixtures. Rice husk ash is used as a pozzolanic material as its cost is low and it is decomposed easily.
4. Coconut fibre is used as a reinforcing material in soil as it has high tearing strength.
5. Hence, it can be wrapped up that use of lime, rice husk ash and coconut fibre can be beneficial in many ways for stabilizing clayey soil.

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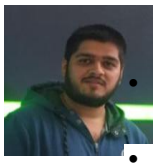

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