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EFFECT OF BOTTOM ASH AND RECRON FIBERS ON STRENGTH CHARACTERSTICS OF BLACK COTTON SOIL

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Abstract— Soil adjustment is the way toward enhancing the building properties of expansive soil like BC Soil and influencing it to stable soil. It should be possible by the utilization of controlled compaction, proportioning and addition of various sorts of admixtures, stabilizers. There are different framework extends in highways, railroads, water stores so forth which requires earth material in huge amount. Thus adjustment of problematic soils by utilizing locally accessible materials like fly ash, lime, sand, bottom ash and so on and fibers like jute, coir, recron, polypropylene, are done. This theory speaks to an investigation of bottom ash, bond and recron fibers as admixtures in enhancing some geotechnical properties of Black Cotton soil.

This investigation is done with a goal to assess the impacts of bottom ash and recron fibers on the geotechnical properties of the locally accessible broad soil from Davanagere. Tests which are to be completed on the sample of soil managed with Atterberg limits, compaction attributes, California bearing ratio, unconfined compressive strength. These tests are led for both non- stabilized and stabilized by including 4%, 8% and 12% Bottom ash with 0,2%,0,4%.0.6%,0.8% and 1% recron filaments.

Keywords— Stabilization, Bottom Ash, Recron Fibers, CBR,Compaction.

I. INTRODUCTION

Stabilization is the way toward joining diverse strategies utilized for changing the properties of a dirt to enhance its building execution. Adjustment is conceivably utilized for a mix of building works, the widest range were adjustment is utilized for the change of street and runway dark best, where the basically most essential is to enhance the quality or execution of soil and diminishing the advancement cost by making the best use of huge accessible assets. Schedules for stabilization might be gathered under two mail sorts: (a) modification and change of soil property of the present soil with no admixture, and (b) alteration of the properties with the help of admixtures. Compaction and waste are the outlines of the primary sort, which upgrades characteristic shear strength of soil. Delineations of the second sort: mechanical alteration, adjustments with bond, lime, bitumen and chemicals.

1.1 STANDARDS OF SOIL STABILIZATION

- Assessing the dirt properties of the zone beneath pondering.
- Determining the benefits of soil which should be changed to get the outline esteem and pick the unequivocal and financially savvy strategy for adjustment.
- Scheming the Reduced soil blend model and troubles in the lab for proposed security and toughness values

1.2 BOTTOM ASH

The standout amongst the most utilized sort of coal consuming heater in the power creation industry is the dry, base pummeled coal evaporator. Exactly when pummeled coal is taken in dry, base heater, around 80 % of un-covered fiery debris is appropriated in tube gas, picked and rediscovered as fly cinder. The left out 20 % of fiery debris is dry base cinder, dim, smashed, permeable, generally of sand assess less 12.7mm (½ in) material that is assembled in a water-filled compartment at the base of the radiator. Right when a sufficient measure of bottom ash drops into the holder, it is cleared by usage of high-weight water flies and is passed on by sluiceways either to an exchange lake or for other re-use purposes.

1.3 RECRON FIBERS

Recron Fiber is a customized polyester. It is usually used as reinforcing material in concrete also in soil to increase their strength. The fibre used for the experiment is having different sizes 6mm and 12mm. Recron fiber is a synthetic material fiber and is utilized because of its ease and hydrophobic so it doesn't permit the retention or response with soil dampness or leachate.

II LITERATURE REVIEW

A.T.Manikandan et al., 2017[1]: Inspected the impact of bottom ash and coconut shell powder on the characteristics of clay soil, furthermore his investigations incorporates the soil properties like OMC, Dry density, and Shear parameters. Distinctive amounts of coconut shell powder and bottom ash (rate by weight) were added to the expansive soil and the investigations were directed on the dirt blends. The outcome demonstrates that the utilization of coconut shell powder and bottom ash builds the quality of soil to a more noteworthy degree.

P. Rajendra Kumar et al., 2017[2]: considered impact of CBR of BC Soil Reinforced with Recron Fiber. He assessed the quality of unsaturated soil by compaction characteristics and CBR on soil test. The filaments were cut long of 6mm and 12 mm, blended haphazardly in fluctuating rates by dry weight of soil, Compacted to most extreme dry thickness at OMC. The test outcomes demonstrated a lessening MDD and OMC of soil because of the increased Recron fiber. It additionally showed a increase in the CBR.

Siyyagalla Subbarayudu et al., 2017 [3]: Had examined the Soil Stabilization by Using Recron -3s, Fly ash & Lime. In this study to stabilize the soil by using Recron-3S, Fly ash, Lime, the recron-3S is used as (1%, 2%,) lime as (2%, 3%, 4%) and fly ash at (10%, 12%, 15%, 20%).With different proportion of soil with various materials California bearing ratio value has increased up to some extent. and from that thickness of pavement can be reduced to the certain extent.

P.Sowmya Ratna et al., 2016 [4]: Had stabilized the expansive soil by using recron-3s fiber and lime for the expansive soil. The general testing method was led by blending dark cotton soil with various level of lime substance, i.e. 2%, 4% and 6% by weight was utilized for arrangement of tests which was in powdered shape. The compaction study was succeeded by CBR tests. In second phase Compaction and CBR tests were carried out by mixing 0.5%, 1%, 1.5% and 2% of Recron-3s Fibres with black cotton soil and optimum percentage of lime (4%) materials for finding optimum percentage of Recron -3s fibers.

III METERIALS AND METHODOLOOGY

3.1.1 Black Cotton Soil

Black cotton soil is additionally called black cotton soil or swelling soil. This dirt is found in broad districts of the Deccan. The name 'Dark cotton' has a horticultural source. The dirt used as a part of this work is taken from Harihara in Davanagere region. The Black cotton soil utilized as a part of this work is excavated from 1m over the ground level.

Fig. 1: Black Cotton Soil

3.1.2 Bottom Ash

The bottom ash utilized as part of this work is procured from the "coal-let go electric force station" situated in Raichur, Karnataka. It is worked by the Karnataka power corporation limited (KPCL). Additionally, was primary warm power plant to be started in state.

Fig 2. Bottom Ash

3.1.3 Recron Fibers

The main role of reinforcing a dirt mass is to enhance its solidness by expanding its bearing limit, the fibers utilized as a part of this work is acquired from the" Aahana fiber industry" Bangalore, Karnataka. The properties of Recron fibers are given below.

Fig. 3 Recron Fibers

3.2 METHODOLOGY

Firstly laboratory tests was performed to record index properties of Natural BC soil. Parameters considered in present experimental work are percentage of bottom ash and length and percentage of Recron fiber.

3.2.1 Index Properties

Following laboratory tests were carried out as per IS: 2720.

1. Specific gravity - IS 2720 Part-3, 1980

2. Grain size analysis – IS 2720 Part 4, 1985

3. Atterberg limits - IS 2720 Part-5, 1985

4. Differential Free Swell index – IS 2720 Part-XI, 1972.

5. Moisture content

3.2.2 Engineering Properties

1. Proctor Compaction – IS 2720 Part-8, 1983

2. Unconfined compression – IS 2720 Part-10, 1991

3. CBR test – IS 2720 Part-16, 1987

3.3 EXPERIMENTAL PROGRAM

- The chose Black cotton soil was treated with different rates of base slag as (4%, 8%, and 12%). The ideal level of base fiery remains was resolved in light of compaction characteristics.
- The ideal level of bottom ash was then treated with recron fiber to discover OMC and MDD at various rates of fiber (0.2%, 0.4%, 0.6% and 0.8%).
- UCS specimens were also prepared for 4%, 8% and 12% of bottom ash and kept for curing at 3,7,14 days and strength were checked.
- Now UCS specimens were made for soil+12% bottom ash + (0.2%, 0.4%, 0.6% and 0.8%) , of recron fibers were randomly mixed and cured for 3, 7 14 days in desiccators and strength were checked.

IV RESULTS AND DISCUSSIONS

The Black Cotton Soil was admixed with bottom ash and Recron fibers. Starting from 4%, 8% and 12% of bottom ash. Different percentages of fibers also admixed with BC soil of 6mm length. And different properties of mixed soils in terms of index properties and compaction were determined.

- The Unconfined compressive strength of BC Soil was found out with various curing periods i.e., 3, 7 and 14 days respectively.
- Index properties of dark cotton soil were also determined. Sieve analysis of black cotton soil was also conducted according to IS classification.
- Grain size distribution curve was drawn from the values obtained from laboratory test.
- Based on the laboratory results the IS classification of Black cotton soil is CH.
- Silt and clay content is calculated in percentage. (92.22).

Properties	Obtained value
Grain Size Analysis Fine Sand % Silt % Clay %	 7.78 33.37 58.85
Liquid limit (%)	58.01%
Plastic limit (%)	39.75%
Plasticity index (%)	18.26%
Specific gravity	2.65
Free swell index	80
MDD (g/cc)	16.38
OMC (%)	21.85
Unconfined compressive strength (KN/m^2)	144.15
CBR (%)	3.22
MDD (g/cc)	16.38

Table. 2 Engineering Properties of soil

4.2 Compaction Characteristics of BC soil blended with bottom ash

% Bottom Ash	OMC (%)	MDD (KN/m^3)
BC Soil +0%	21.85%	16.38
BC Soil +4%	21.45%	16.87
BC Soil +8%	21.00%	17.46
BC Soil +12%	20.50%	18.05

Table.3 Compaction characteristics of BC soil admixed with bottom ash

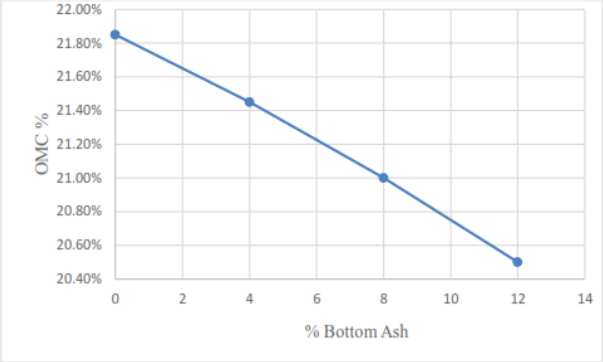

Fig. 4 variation of OMC for bottom ash admixed BC soil soil

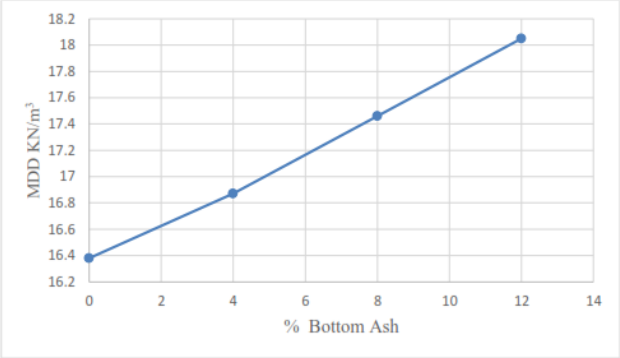

Fig. 5 Variation of MDD for bottom ash admixed BC

Diminishment in OMC is a because of the bottom ash possessing void in the middle of the dirt conditions and contrast on OMC and MDD are because of the outcome in flocculation and agglomeration of fine particles because of trade of particles.Lessening in OMC with increase of bottom ash is found in which all water was utilized by base slag in less level hydration. The water was spent because of hydration response.

4.3 Effect of Bottom Ash on Strength of BC Soil

The Unconfined compressive strength test were done on BC soil passing 4.75 mm IS sieve by blending the dirt with 4%, 8% and 12% bottom ash individually. The dirt sample is blended with base fiery remains at 4% 8% and 12% and were dealt with for a curing time of 3, 7 and 14 days.

% Bottom Ash	3 Days (kN/m^2)	7 Days (kN/m^2)	14 Days (kN/m^2)
BC Soil +4%	150.95	158.19	169.42
BC Soil +8%	348.39	380.40	393.93
BC Soil +12%	329.38	354.17	428.95

Table. 4 Unconfined Compressive Strength Values of Bottom ash mixed with BC Soil

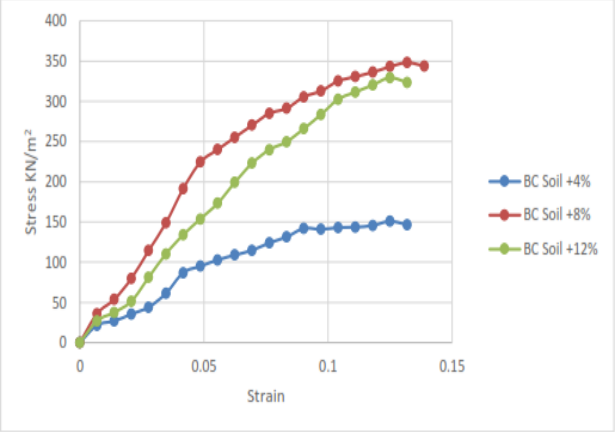

Fig. 6 stress v/s strain of BC soil admixed with bottom ash for 3 days curing.

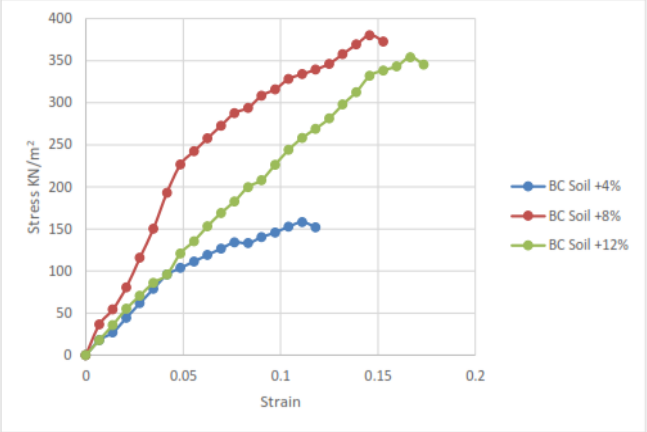

Fig. 7 stress v/s strain of BC soil admixed with bottom ash for 7 days curing.

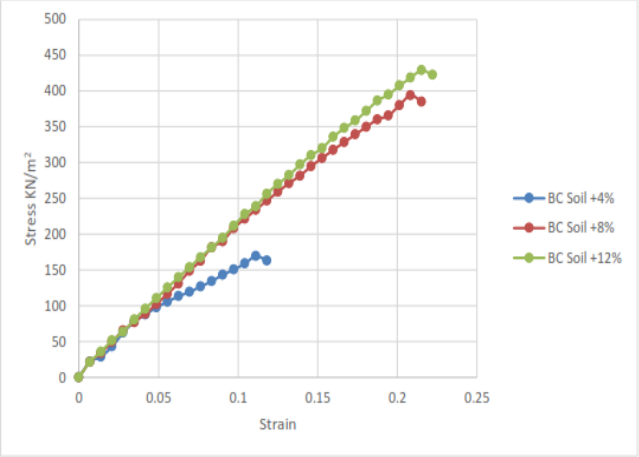

Fig. 8 stress v/s strain of BC soil admixed with bottom ash for 14 days curing

Maximum strength got for all curing days i.e., 3, 7 and 14 days is 428.95 kN/m^2 Contrasted with curing time of 3 and 7 days, the curing time frame for 14 days the strength is increased. As the curing time frame builds the strength in soil likewise increments. As the level of bottom ash rises the strength in soil will likewise ascends because of cementitious mixes in base fiery debris and furthermore certain measure of lime content.

4.4 Effect of Percentage Bottom Ash on CBR

The CBR test were done for BC soil passing 4.75 mm IS sieve by mixing the soil with 4%, 8% and 12% bottom ash respectively. The test results were obtained and CBR of the soil mixed with bottom ash were calculated.

% Bottom Ash Added	Values (%)
Soil + 4% Bottom Ash	7.28%
Soil + 8% Bottom Ash	8.08%
Soil + 12% Bottom Ash	8.49%

Table. 5 CBR Values of Bottom ash mixed with BC Soil

4.5 Impact of Bottom Ash with Fibers on Compaction Characteristics of Black Cotton Soil

% fiber added	OMC (%)	MDD (KN/m^3)
BC Soil +12% BA +0.2% fiber	21.80	16.03
BC Soil +12% BA +0.4% fiber	21.25	16.45
BC Soil +12% BA +0.6% fiber	20.75	17.02
BC Soil +12% BA +0.8% fiber	20.15	17.40
BC Soil +12% BA +1% fiber	19.80	18.01

Table.6 MDD and OMC values of BC soil admixed with bottom ash and Recron fibers.

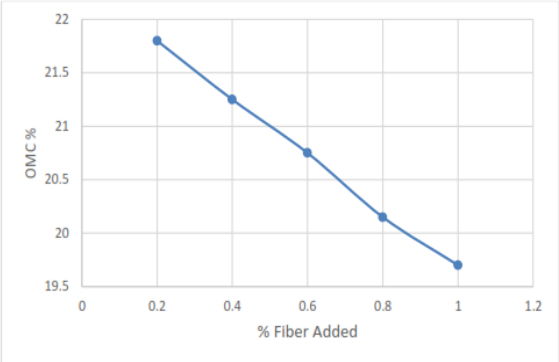

Fig. 9 variation of OMC for fibers admixed BC soil, fibers and Bottom ash

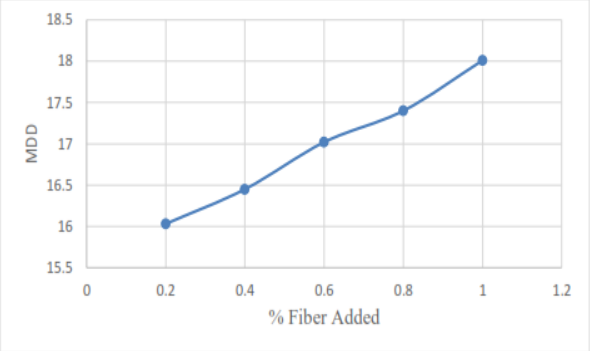

Fig. 10 variation of MDD for fibers admixed BC soil, fibers and Bottom ash

Figure 9 and Figure 10 shows the OMC and MDD of BC soil mixed with and bottom ash and randomly distributed fibers of 6mm length. Graph shows that, as percentage of fiber increases dry density of soil will also gradually increases. Percentage of fibers added is 0.2%, 0.4%, 0.6%, 0.8% and 1%. Up to some instance dry density of soil increases after that its starts decreases. Similarly as the percentage of fiber increases the OMC will gradually decreases. The Maximum dry density found was 18.01 KN/m^3 for a OMC of 19.80 %.

4.6 Effect of % Bottom Ash upon Unconfined Compressive Strength Values of BC Soil with Fibers

Recron fibers were used in this experiment to increase the strength of BC soil. Randomly distributed recron fibers with the diameter of 6mm was used with 12% Bottom ash. The percentage of fibers admixed with BC soil is 0.2%, 0.4%, 0.6, 0.8% and 1%.

BCS + Admixture	3 Days	7 Days	14 Days
BC Soil +12%+0.2%	165.15	170.45	450.3
BC Soil +12%+0.4%	192.23	200.16	497.72
BC Soil +12%+0.6%	259.86	269.74	528.91
BC Soil +12%+0.8%	309.06	320.02	537.15
BC Soil +12%+1%	356.86	369.03	543.11

Table. 7 Unconfined compressive strength values of BC soil admixed with bottom ash and Recron fibers.

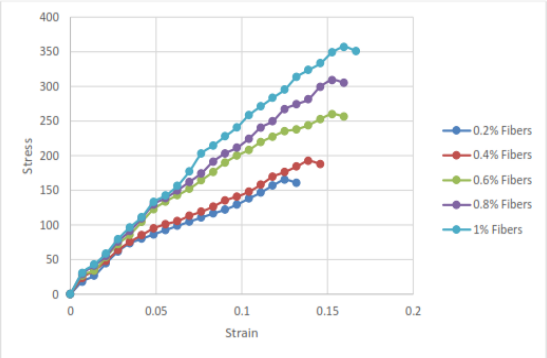

Fig. 11 Stress v/s strain of Black cotton soil admixed with bottom ash and fibers for 3 days curing

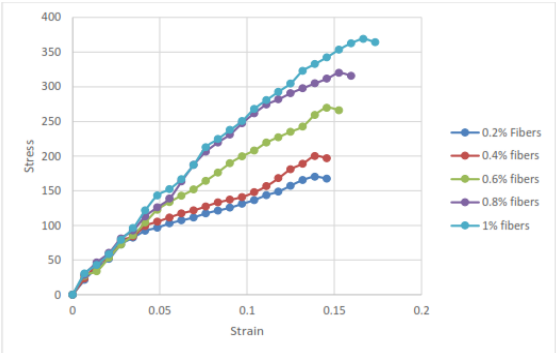

Fig. 12 Stress v/s strain of Black cotton soil admixed with bottom ash and fibers for 14 days curing

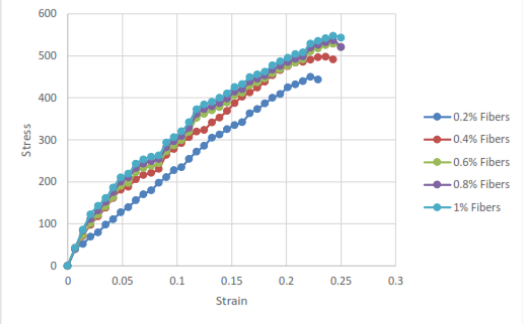

Fig. 13 Stress v/s strain of Black cotton soil admixed with bottom ash and fibers for 14 days curing

The figures shows the variation of stress and strain curve for bottom ash mixed with BC soil, for various curing days of 3, 7 and 14 days respectively. The maximum unconfined compressive strength obtained when fiber reinforced with bottom ash mixed BC soil is 543.11 kN/m^2. The strength of blended BC soil is increased at 12% of bottom ash.

4.7 Effect of % of Fibers on CBR of BC Soil

The CBR test were done for BC soil passing 4.75 mm IS sieve by blending dirt with 12% bottom ash and 02%,0.4%,0.6%,0.8% and 1% of fibers respectively.

Soil + Bottom Ash + Recron Fibers	CBR Values (%)
Soil +12% Bottom Ash + 0.2 % fibers	9.3%
Soil +12% Bottom Ash + 0.4 % fibers	11.31%
Soil +12% Bottom Ash + 0.6 % fibers	12.94%
Soil +12% Bottom Ash + 0.8 % fibers	14.15%
Soil +12% Bottom Ash + 1 % fibers	14.56%

Table. 8 CBR values of BC soil admixed with bottom ash and fibers

V CONCLUSIONS

Based on current investigations the accompanying conclusion have been made.

- The MDD of Black cotton soil increases with increase of bottom ash with parallel decreases in OMC. The adhesion between the soil particles and water increases with the increase in bottom ash up to 12%.
- The addition of randomly distributed Recron fiber of 6mm length for Black cotton soil with various percentages will also increases MDD and decreases OMC for some extent.
- The Black cotton soil when blended with 12 % of bottom ash and 1% of fiber of 6mm length gives greatest estimation of MDD i.e. 18.01 KN/m^3
- The addition of different percentage of fibers (6 mm length fibers) with bottom ash content to Black cotton soil showed that the 1% fibers added gave higher unconfined compressive strength.
- Compared to 3 days, the strength of BC soil increased for 7 days curing and strength is highest for curing period of 14 days ie, 543.11 KN/m^2.
- Percent of bottom ash used in this project is 4%, 8% and 12%. For the percent of 12% the strength achieved was high. Curing period about 12% of bottom ash is considered as high.
- The CBR value increased to 14.56% for 12% bottom ash and 1% fibers.

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