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Enrichment of black cotton soil using demolished crushed concrete from Maradu

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ABSTRACT

Some natural resources such as gravel are not renewable, therefore, it is necessary to reduce the use of such resources and replace them with other recycled, economic, and environmentally friendly materials. Recycled crushed concrete aggregates demolished from old buildings and blocks of waste concrete can be used to replace the natural aggregates. The present study focused on using recycled crushed concrete in improving the geotechnical properties of soft soil having undrained shear strength of 4.15 K Pa. The soft soil samples were mixed with 5, 10, and 15% of crushed concrete. The blocks of waste concrete are grinded by mills to get crushed concrete which passing sieve no. 4.75. Such aggregates are lighter than natural aggregates and provide a good deformation modulus when mixed with soil.

Keywords— *Improvement, Crushed Concrete, Soft Soil, Mixing, Geotechnical Properties*

1. INTRODUCTION

Black cotton soil is considered as a problematic soil due to its swelling and shrinking properties when it comes in contact with water. Due to problem of non-availability of suitable soil, so many techniques of stabilization are carried on it. Stabilizing with demolished crushed concrete is one among them. In the present paper, investigations were carried out on the compressive strength of black cotton soil at different demolished crushed concrete dosage. In India almost 20% of land is cover by expansive soil, black cotton soil being one of its type having less engineering properties for the construction. Expansive soils are those soils which swell on absorption of water and shrink on removal of water. The amount of volume changes in expansive soil is related to initial dry density, water content, amount of clay fraction and type of clayey minerals. For highway pavements, building footings, expansive soil may displace by moisture change, hence it is necessary to stabilize the expansive soil for construction. Stabilization is a process to upgrade the engineering properties of soil by addition of suitable` admixtures or stabilizers to serve its purpose as a construction material. Stabilization means to improve the properties of soil so as to obtain the desired effect on soil as to make it fit according to use. In other words, stabilization improves the physiochemical properties of soil; these properties are dependent on the mineral present in the soil. Stabilization of soils done to overcome problems of settlement and shrinkage and stability. Construction waste is becoming a serious environmental problem in many countries in the world. Construction and demolition (C and D) debris frequently makes up 10-30% of the waste receive at many landfill sites around the world. The construction industry has long been regarded as one of the major contributors of negative impact to the environment, due to the high amount of waste generated from construction, demolition, renovation and activities associated with construction. The three buildings -Holy Faith H2O, Jains Coral Cove and Golden Kayaloram -were razed through controlled implosion by South Africa's leading demolition firm Jet Demolition. On January 11 and 12, four luxury waterfront apartments in Kochi's Maradu municipality were reduced to rubble following a 2019 Supreme Court order which found the buildings to be constructed in violation of the Coastal Regulation Zone norms.

2. EFFECT OF CRUSHED CONCRETE AT DIFFERENT DOSAGES ON UNCONFINED COMPRESSIVE STREGTH OF BLACK COTTON SOIL

The Black cotton soil was mixed with various percentage of crushed concrete and their strength properties have been studied. From the test results as shown in table 3, Black cotton soil alone have Unconfined compressive strength of 0.087 kg/cm^2 and shear strength of 0.0435 kg/cm^2. By the addition of crushed concrete, as the curing period increases, the compressive strength also gets increases than black cotton soil

alone. The figure 1 shows the graph of the unconfined compressive strength of BCS.

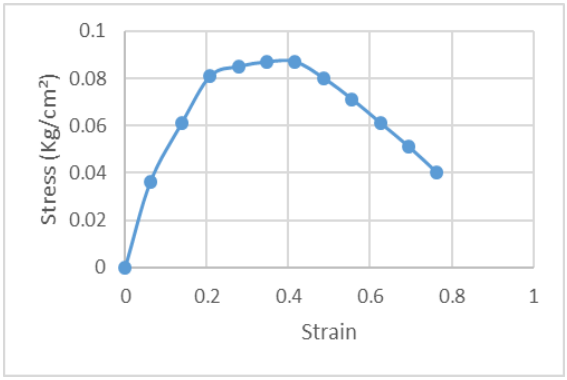

Fig. 1: Unconfined compressive strength of BCS

The below table 1. shows the unconfined compressive strength of black cotton soil treated with various percentage of crushed concrete.

Table 1: Unconfined Compressive Strength of Black Cotton Soil Treated with Various Percentage of crushed concrete

Combination	Unconfined compressive Strength (kg/cm^2)
BCS+ 5% Crushed concrete	0.105
BCS+ 10% Crushed concrete	0.1593
BCS+ 15% Crushed concrete	0.16

The figure 2 shows the graphical representation of Unconfined compressive strength of black cotton soil treated with 5% of crushed concrete, figure 3 represents the graph of Unconfined compressive strength of black cotton soil treated with 10% of crushed concrete and figure 4 shows the graph of Unconfined compressive strength of black cotton soil treated with 15% of crushed concrete.

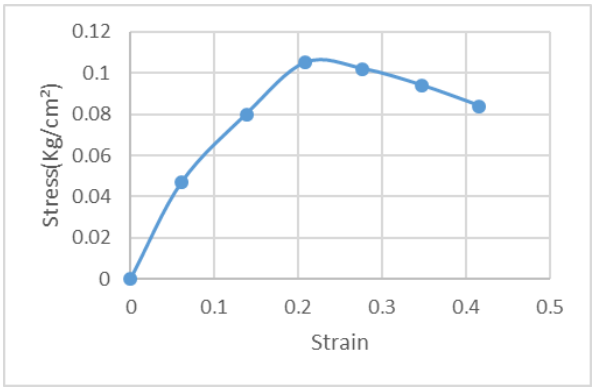

Fig. 2: Unconfined compressive strength of black cotton soil treated with 5% of crushed concrete

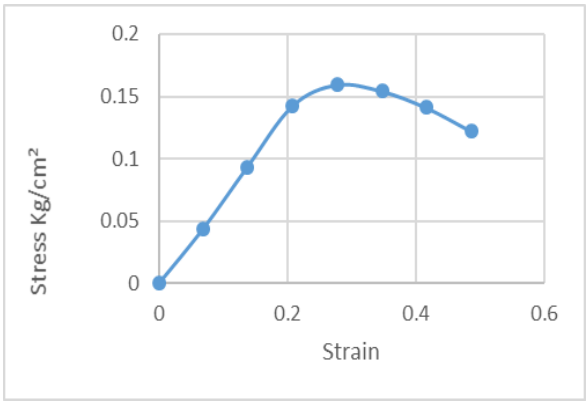

Fig. 3: Unconfined compressive strength of black cotton soil treated with 10% of crushed concrete

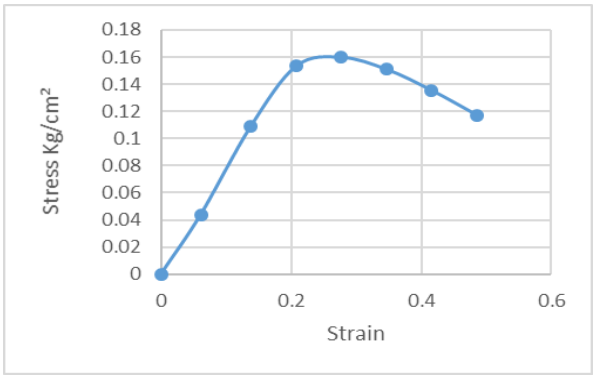

Fig. 4: Unconfined compressive strength of black cotton soil treated with 15% of crushed concrete.

3. EFFECT OF CRUSHED CONCRETE AT DIFFERENT DOSAGES ON UCC

From the below graph (figure 5), it is obtained that the unconfined compressive strength of BCS increases with different crushed concrete dosages. The maximum unconfined compressive strength is obtained at 15% of dosage.

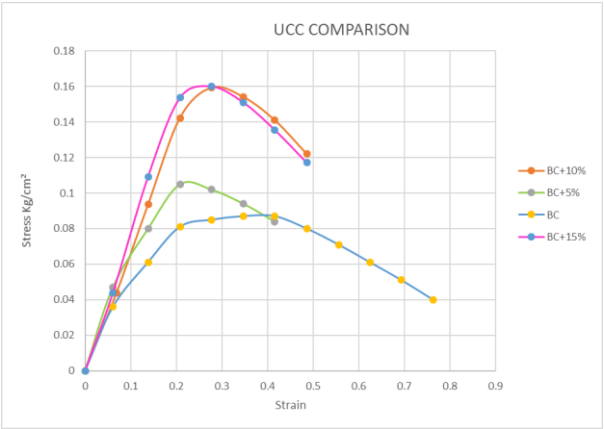

Fig. 5: UCC of BCS at different crushed concrete dosages

4. SHEAR STRENGTH OF BCS AT DIFFERENT COMBINATIONS

From the above graphs it is obtained that the shear strength of Black Cotton Soil is: Shear Strength of Black Cotton Soil alone = 0.0435 kg/cm^2. The table 2. given below shows the S Percentage of Crushed Concrete.

Table 2. Shear Strength of Black Cotton Soil Treated with Various Percentage of Crushed Concrete.

Combinations	Shear Strength (kg/cm^2)
BCS+ 5% Crushed Concrete	0.0525
BCS+ 10% Crushed Concrete	0.07965
BCS+ 15% Crushed Concrete	0.08

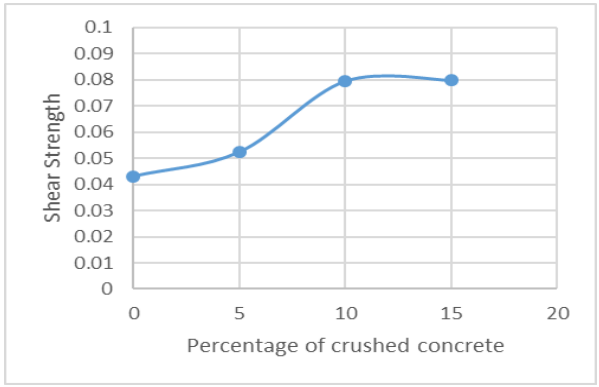

Fig. 6: Variation of shear strength with different dosages of crushed concrete

The above graph (figure 6) shows the variation of shear strength with different dosages of crushed concrete. Since black cotton soil is cohesion less, the shear strength is obtained as half of the unconfined compressive strength of the soil.

5. CONCLUSION

Natural resources are limited and their extraction requires energy consumption and produces environmentally harmful emissions. Thus, recycled materials such as construction and demolished wastes can reduce the cost of energy consumption and emission of gases and can be used in many civil engineering works. One of the constructions and demolished wastes is the concrete blocks. The black cotton soil sample were mixed with 5% to 15% of crushed concrete calculated by weight of soil. Crushed concrete can improve the strength of black cotton soil due to rehydration of the remaining un hydrated cement in the cement motor. The mixing of black cotton soil with crushed concrete increases soil cohesion and also shear strength get increased.

4. REFERENCES

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