Stabilization of Black Cotton Soil with Bottom ash and Lime

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***Abstract*—Black cotton soil (BCS) could be stabilized and made a suitable material using bottom ash. The soil treated with optimum bottom ash content of 16% was further stabilized with 2%, 4%, 6%, 8%, and 10% lime. We can see an optimal reduction in liquid limit, plasticity index as well as optimal increase in CBR and specific gravity test.The addition of lime to clay is a widely used means of chemically transforming unstable expansive clay soils into structurally sound foundation materials. Lime in the form of quicklime, CaO, was used for the treatment of the soil-SDA mixture. The lime is a pure amorphous solid with melting point of 2600°C, produced from natural limestone.In our project we are going to add black cotton soil and lime and bottom ash as additive material and stabilize the with increasing plasticity and reducing the saturation of soil.**

Keywords—; Black cotton soil, Bottom ash, Lime

I. INTRODUCTION

Black cotton soil is a medium to high compressible inorganic clay soil. The property of this soil is that it has a high plasticity when they are dry, and they swell when they are saturated as they have high liquid limit. So, it is not advisable to construct any type of building on this soil. This paper presents the study on which the black cotton soil is stabilised using two main components such as Bottom Ash, Lime in the form of quick lime. These components are added to the soil by in different proportions and hence the results are retrieved and use to stabilize the soil for the construction of the building. The main objective of the project is to investigate the effects of bottom ash stabilization on the geotechnical qualities of expansive soils and analyze the findings and give recommendations for best practices. To investigate the impacts of bottom ash on soil permeability reduction. As the nature of black cotton soil is that it shrinks in the summer and swells in the rainy season. The structure of the building will move upward and below because of the soil is more flexible during the wet season, the structure will penetrate deeper into the soil. Using lime and bottom ash, we want to improve the soil's bearing capacity and shear strength. In this paper we are going to see the increase in the plastic limit and decrease in the liquid limit by adding Bottom Ash and Lime in the black cotton soil.

II. MATERIAL USED:

A. Bottom Ash

Bottom as is mostly found in the coal-fired power plant. They are coarse, granular, incombustible by-product of coal combustion that are collected at the bottom. The properties of bottom ash are mentioned in Table.1

Property	Bottom Ash
Specific Gravity	2.4
Dry Unit Weight	1200 kg/m^3
Absorption	1.4 %

Table-1 Properties of bottom ash

B. Lime

Lime in the form of quick lime is a calcium containing inorganic mineral consist of oxides and hydroxides. These are largely used in building materials and other engineering materials.The properties of Hydrated lime are mentioned in Table.2

Parameter	Hydrated lime ($Ca(OH)_2$)
Physical state	White solid
Particulate size	Powder
Bulk density	40kg/m^3
Specific gravity	2.34

Table-2 Properties of Hydrated lime

C. *Specific gravity:*

• Soil specific gravity allows engineers to determine how porous a soil is and how many voids it contains. It also reveals how water-saturated the soil. The result of specific gravity of soil is mentioned in Table-3

D. *Atterberg's test:*

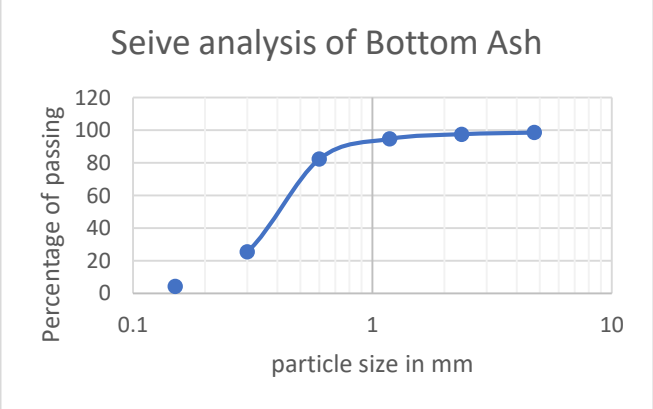
The Liquid Limit and Plastic Limit tests were performed on soil with and without bottom ash. The varying proportions of bottom ash put to the soil were 0%, 5%, 10%, 15%, 20%, and 30%. As per IS:2720 (Part 5) - 1985, this test is used to assess the plastic and liquid limits of soil.The result of plastic limit and liquid limit of soil is mentioned in Table-3

Property	Value
Specific Gravity	2.69 kg/m^3
Absorption	30 %
Liquid Limit	43 %
Plastic Limit	50 %

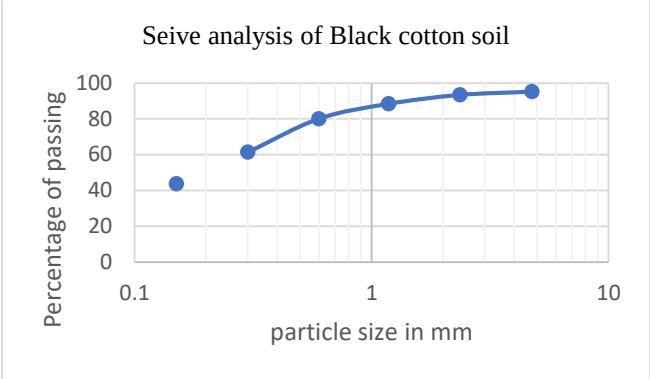
Table-3 Properties of black cotton soil

E. *Fineness test:*

• The fineness of cement is a measure of bottom ash particle size and is denoted as terms of the specific surface area of ash. The Fineness Test of ash is done by sieving ash sample through standard IS sieve. The result of the sieve is mentioned in the graph 1



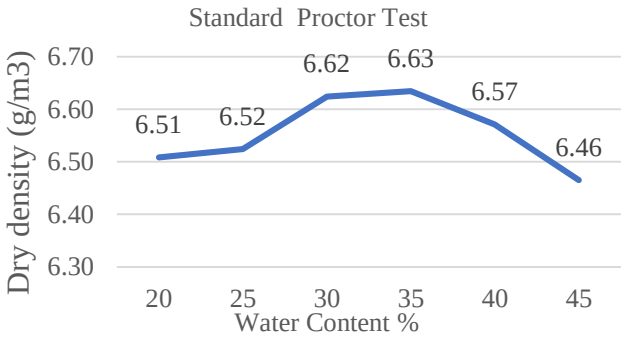
Graph-1Sieve analysis of Bottom Ash



Graph -2 Sieve analysis of Black cotton soil

F. *Standard proctor test:*

• Standard Proctor Test is used to analyzethe soil's compaction characteristics with a variety of moisture content. This test is used to find the bearing capacity of soil which is the maximum amount of load a soil can bear and to reduce the voids in the soil. The graph-2 represents dry density of Black cotton soil

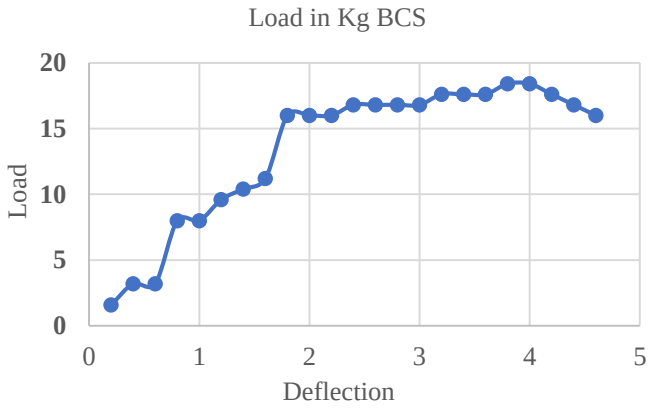


Graph-3Standard Proctor Test

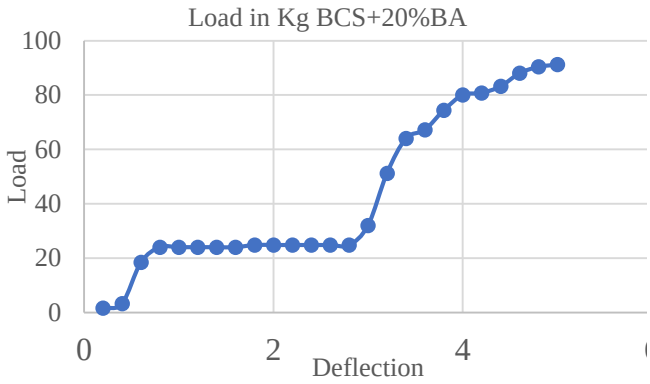
III RESULT AND DISCUSSION

A. *Unconfined compressive test:*

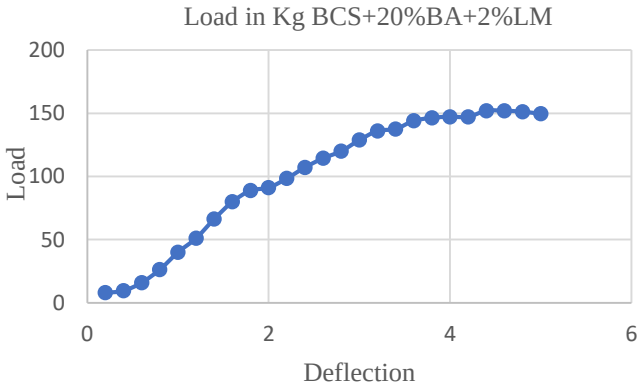
• The unconfined compression test is performed to determine the soil's shear strength. It is the most common, least expensive, and fastest technique of determining shear strength. The strain-controlled application of axial load can be used to evaluate intact, remolded, or reconstituted soil specimens. The unconfined compression test is performed to determine the soil's shear strength. It is the most common, least expensive, and fastest technique of determining shear strength. The strain-controlled application of axial load can be used to evaluate intact, remolded, or reconstituted soil specimens. The graph represents deflection of Black cotton soil.



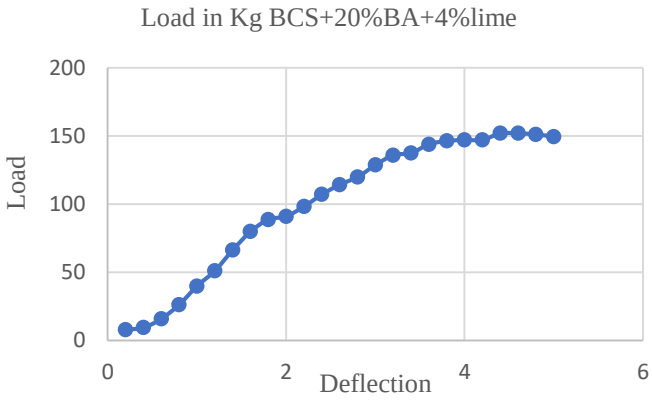
Graph-3Load in Kg BCS



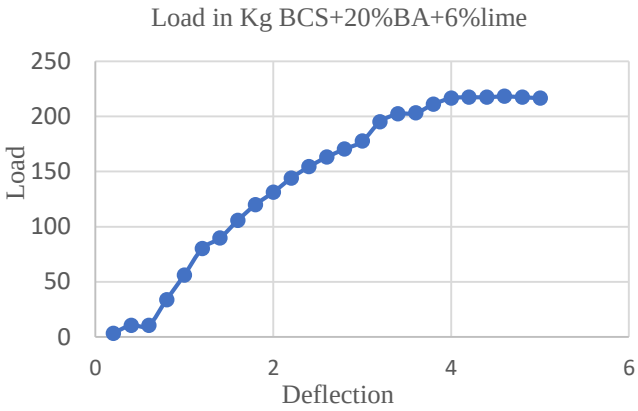
Graph-4Load in Kg BCS+20%BA



Graph-5Load in Kg BCS+20%BA+2%LM



Graph-6Load in Kg BCS+20%BA+4%lime



Graph-7Load in Kg BCS+20%BA +6%lime

IV. CONCLUSION

According to the findings of the aforesaid test, we may achieve unconfined compressive strength test results by adding varied ratios of lime of 2%, 4%, and 6%, and bottom ash at a constant ratio of 20%. It causes the black cotton soil's shear strength to gradually grow. We can add a few more percentages of lime and see if the shear strength increases or decreases.

V. REFERENCE

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