

STRENGTH IMPROVEMENT OF BLACK COTTON SOIL WITH LIME, FLYASH AND CEMENT USING GEOGRID

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Abstract : The providing low cost housing is a challenge around the world. The Challenge to solve the house problem are less availability of land and high cost building materials. The bricks has been regarded as long lasting and strong building blocks are made of a mixture of clay, which is subjected to various processes according to the nature of the material, after it is properly prepared the clay is done in moulds to the desired shape, and then air dried and burnt. The main objective of this investigation had been focused on the improvement of the compressive strength of the Black Cotton soil blocks with different constituent of Caustic soda, Fly ash and Cement by reinforcing the Geo-grid. The rectangular (200mm × 100mm × 100mm) blocks are prepared with soil treated with 5%,10% and 15% Caustic soda, Fly ash and Cement with the Geo-grid reinforcement in one and two layers of the blocks, the compressive strength of these bricks is obtained by laboratory compression test apparatus are compared with unreinforced samples.

Index Terms - Black cotton soil, Geogrid, reinforcement.

1.INTRODUCTION

Expansive soils in India are popularly known as Black cotton soils, which are nearly 20% of the land area. These soils exhibit volume change characteristics under moisture variations. Soil stabilization is the procedure of expanding the building properties of the soil and to make it suitable. A Geo-grid is geosynthetic material used to reinforce soils. Geo-grids are commonly used in reinforced retaining structures, sub bases or subsoil's below roads or structures. Compared to soil, Geo-grids are strong in tension. Geonetworks are regularly made of polymers, for example, polyester, polyethylene or polypropylene. They may be woven from yarns, warmth welded from segments of material are delivered by putting a consistent example of openings in sheets of material, then extended into a grid. The development method to prepare relatively rigid polymeric material by tensile drawing that is "cold working," raises the possibility that such materials could be used in the reinforcement like walls. Various researchers who worked on this are, S. Siva Gowri Prasad et al (2014)¹ studied the influence of soil is reinforced with stone columns by using geogrid column in a circular pattern to increase the compaction and settlement properties of the soil along with geogrid used as reinforcement at spacing of D and D/2 throughout the column and investigate the improved properties of soil. Satyanarayana et al., (2016)² studied the study the black cotton soil is mixed with various percentage of lime and fly ash and studied the plasticity strength and compaction properties for different curing periods.

2. OBJECTIVE

The main objective of this research is as follows

1. Determination of index properties of Black Cotton soil.
2. Determination of optimum Caustic soda content using compaction test of Black Cotton soil.
3. Determination of compaction characteristic Compressive Strength of Geo-grid reinforced Black Cotton soil with and without optimum Caustic soda content.
4. Determination of unconfined compressive quality of Geo-lattice strengthened black cotton soil with and without ideal Caustic pop substance.
5. Comparative analysis of results with unreinforced Black Cotton soil.

3. SCOPE OF WORK

The motivation behind this venture was to recognize the execution of Geo-network fortified Black Cotton soil, under different conditions. The exploratory work exhibits the aftereffects of perceptions acquired from the test utilizing Geo-matrix strengthened Black Cotton soil. The strengthened Black Cotton soil is subjected to unconfined pressure quality discovers an enormous potential in the functional utilization in numerous field circumstance. In the present test study arrangement of study were made to focus the unconfined pressure quality conduct of both the strengthened and unreinforced soil with and without Caustic

pop, Fly fiery remains and Cement content under diverse condition. The present examination decides the attainability of utilizing the Geo-framework as fortification. Trials are directed to know the unconfined pressure quality of Black Cotton soil with or without Caustic pop, fly slag and Cement unreinforced and fortified Black Cotton soil with or without Caustic pop, Fly powder and Cement content.

4. MATERIALS

4.1 Black Cotton Soil

In this examination Black Cotton soil was taken from the spot called "Challakere" of Chithradurga dist., Karnataka state, India by an open exhuming from a profundity of 1meter underneath the Surface level. The Black Cotton soil which is taken was subjected to air dry and the essential file properties were tried, whose outcomes are given beneath.

Table 4.1: Properties of Black Cotton soil

A. Index properties of soil

Specific gravity	2.65
Liquid limit(%)	57.8
Plastic limit(%)	39.78
Plasticity index(%)	18.02
Shrinkage index(%)	17.4
Free swell index(%)	80

B. Engineering properties of soil.

Optimum Moisture Content(%)	22
Maximum Dry Density(KN/m ²)	16.2
Unconfined Compressive Strength(qu/KN/m ³)	147

Grain Size Distribution Curve for Black Cotton soil

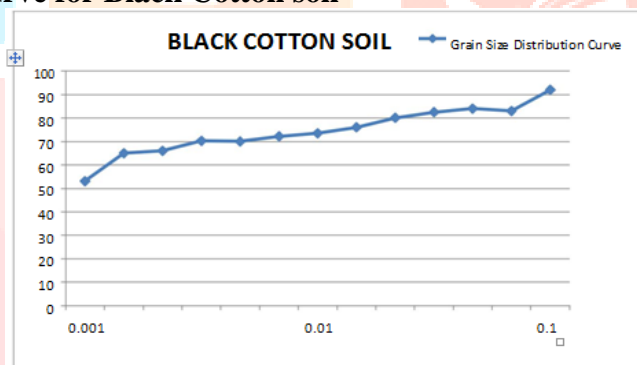


Chart 4.1: Sieve Analysis of black cotton soil

The soil classified based on index properties belong to CH group i.e. inorganic clay with high compressibility.

4.2 Fly Ash

The burning of pounded coal at high temperatures and weight in force stations creates distinctive sorts of slag.

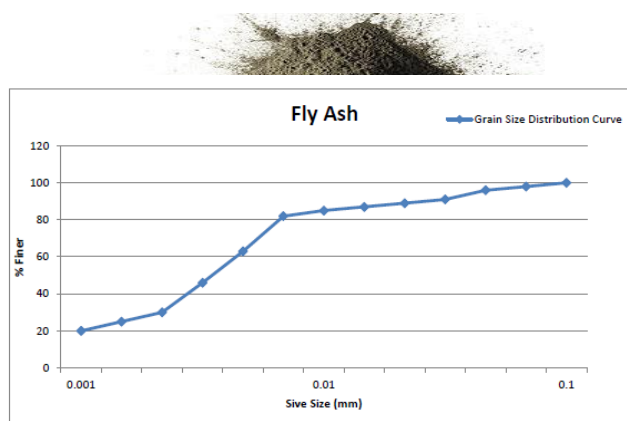


Chart 4.2: Sieve Analysis of fly ash

Table 4.2 : Property of Fly ash as per company details

Constituent of Fly ash	Values(%)
Silica (sio ₂)	57.00
Alumina (Al ₂ O ₃)	29.01
Ferric oxide (Fe ₂ O ₃)	6.34
Calcium oxide(CaO)	6.31
Magnesium oxide (MgO)	0.69

4.3 Caustic soda

Caustic soda is utilized as a stabilizer and is blended impactive rate by weight of soil taken to set up a standard mold of 200mmx100mmx100mm, to lead compaction and un restricted compressive quality test.



Caustic soda used in present study

4.4 Cement

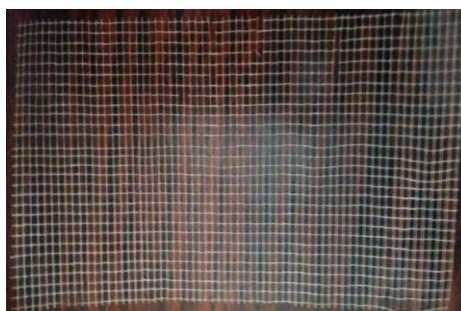
Non-Hydraulic Cement cannot be able to set in wet conditions, it sets as it dries and responds with carbon-dioxide which is present all around. It can be responded by other chemicals in the wake of setting. Hydraulic Cement is made by supplanting some Cement in a blend with enacted aluminum silicates, pozzolans, similar to Fly powder.



Cement used in present study

4.5 Geo-Grid

Geo-grid used in this project is as shown in figure 1 and the physical property of the Geo-grid is given in table 2. The Geo-grid reinforcement of size 2.5x25mm is placed in one and two layers of the rectangular block. Its price ranges between Rs 80/- to Rs 200/-per sq/m.



Geo-grid used in present study

Properties of Geo-grid as per company details

Weight	0.4 51	N/m ²
Mesh size	2 .5*2.5	Mm
Coating content	18	%
Tensile strength	400(M D)	N/5cm

5 Experimental work and methodology

The soil was taken from the challakere village in chitradurga (dist), it was taken 1m below the surface level. The soil was air dried and the lumps in the soil is crushed. Then it is compacted or powdered so that the soil can pass through 425 micron sieve.

1. The soil was taken and the basic tests for the soil are done.
2. OMC and MDD are determined.
3. The mould of 20x10x10cm is taken and it is greased, mould was placed over the smooth flat base plate.
4. The Black Cotton soil was stabilized using the admixture Caustic soda at different percentages of 5,10and 15.
5. The amount of water mixed to the soil has obtained in the OMC of 22% to maintain the MDD of 16.2KN/m³.
6. Bricks were made without geo –grid, with single layer of Geo-grid and with two layers of Geo-grid.
7. The stabilized soil is placed in the mould in layers and each layer is compacted thoroughly.
8. The extra soil is removed with the help of spatula, to get perfect and smooth shape.
9. The casted brick is removed from the mould carefully to maintain the shape.
10. These bricks are kept for air curing for 14, 21 and 28 days.
11. These bricks were taken for the UTM test respectively.
12. The above procedure was repeated using Cement and Fly ash as admixtures



Figure 4.8 Sieving the soil



Figure 4.9 Steel Mold of 20x10x10cm



Figure 4.10 Mixing of Admixture



Figure 4.11 Placing of Geo-grid



Figure 4.11 Safe Removals of Bricks

Figure 4.11 Kept for Air Curing

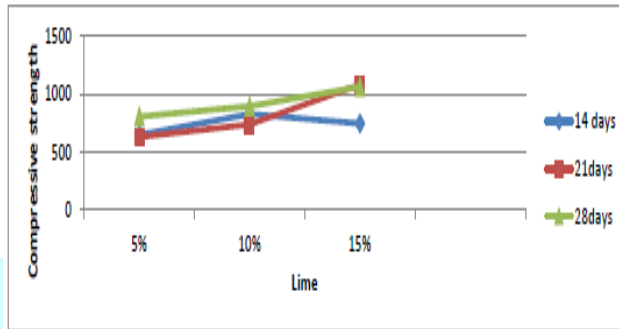
6 RESULTS AND DISCUSSIONS

To evaluate the beneficial effects of providing geogrids and stabilizers in Black cotton soil, We made the different combinations of black cotton soil + varying percent of stabilizers along with encasement of with and without geogrids to find the compressive strength of black cotton soil.

6.1 Black Cotton Soil with Caustic soda

a) With Out Reinforcement

In this the change of compressive strength of Black Cotton soil blocks without Geo-grid reinforcement. The graph is plotted against Compressive strength of Black Cotton soil blocks without Geo-grid reinforcement and % of Caustic soda, Fly ash and Cement for various days of curing period are plotted



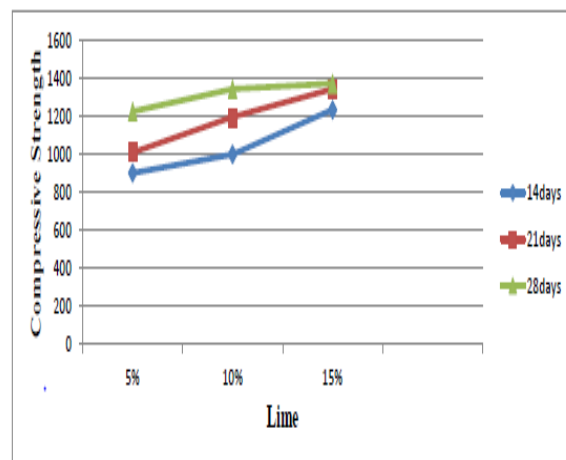
Change of Compressive strength of Black Cotton blocks with Caustic soda and without geo-grid

b) With Geo-grid Reinforcement

In this the change of compressive strength of Black Cotton soil blocks with Geo-grid reinforcement. The graph is plotted against compressive strength of Black Cotton soil blocks with Geo-grid reinforcement and % of Caustic soda, Fly ash and Cement for various days of curing period are plotted.

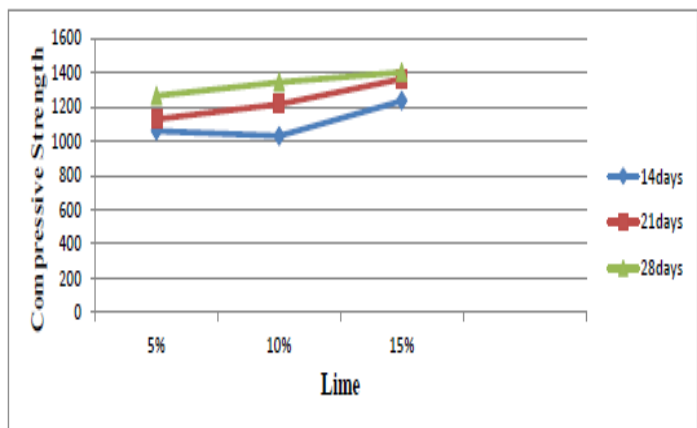
Days of Curing	5% (KN/m ²)	10% (KN/m ²)	15% (KN/m ²)
14	902.12	1000.28	1117.95
21	1010.08	1196.41	1333.70
28	1225.83	1343.51	1372.93

Days of Curing	5% (KN/m ²)	10% (KN/m ²)	15% (KN/m ²)
14	647.24	823.75	745.31
21	627.63	735.92	1078.73
28	804.15	892.41	1059.11



Change of Compressive strength of Black Cotton soil blocks with 1layer Geo-grid reinforcement and Caustic soda

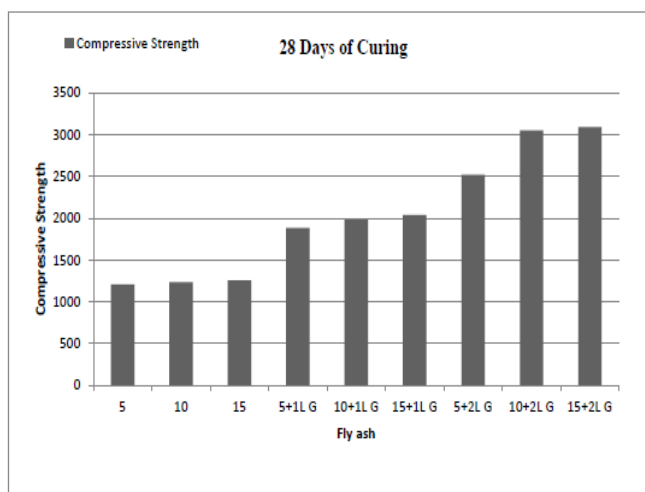
Black Cotton Soil with Caustic soda and 2layer Geo-grid



Days of Curing	5% (KN/m²)	10% (KN/m²)	15% (KN/m²)
14	1059.12	1029.69	1235.63
21	1127.76	1216.02	1363.12
28	1265.05	1343.51	1402.35

Change of Compressive strength of Black Cotton soil blocks with 2layer Geo-grid reinforcement and Caustic soda

Comparison of compressive strength of Black Cotton soil blocks for different percentages of Caustic soda with and without Geo-grid



7. CONCLUSION

Following conclusions were drawn based on the results of the tests conducted on rectangular Black Cotton soil blocks (200×100×100mm), reinforced and unreinforced with Geo-grid.

- 1 With increase in addition of Caustic soda, Fly ash and Cement content the compressive strength of Black Cotton soil blocks increases.
- 2 The soil is classified under CH. Liquid limit and Plastic limit values are 67.06 % and 28.45% respectively it is given that the soil is highly compressible. Thus, from the results obtained, the soil lies below the standard recommended for almost geotechnical work
- 3 Stabilizers and Geo-grid is used as reinforcement for improving the geotechnical characteristic Compressive Strength of Black Cotton soils. Stabilizers significantly improve strength characteristic Compressive Strength of Black Cotton soil
- 4 The effect of stabilizers varies based on the quantity of Stabilizers that are mixed with the Black Cotton soil sample and also with the increase in layers.
- 5 The compressive strength is observed to be more pronounced with the curing of the soil and stabilizers mixed. A curing period of 28 days is observed to yield the maximum compressive strength of Black Cotton soil blocks reinforced with 15% Caustic soda content and 2 layer of Geo-grid.
- 6 The Black Cotton soil stabilized with Fly ash and Cement will give almost same compressive strength.

8. REFERENCES

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