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AN EXPERIMENTAL STUDY ON STABILIZATION OF BLACK COTTON SOIL USING FLY ASH

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ABSTRACT
Black cotton soils are extensively distributed worldwide and covered about 20% of the land area, the foundation designing is a difficult task because they are source of great damage to infrastructure and buildings. In monsoon they swell and in summer they shrink on evaporation of water from there. Because of these fluctuations in moisture content there will be changes in volume, and due to this the civil engineering structures like buildings, pavements, canal linings etc. are severely damaged. It is, therefore, necessary to mitigate the problems posed by black cotton soils and prevent cracking of structures. Stabilization is the process of improving the properties of soils, stabilization methods are of mechanical and chemical. Chemical method is obtained by using stabilizers such as cement, sand, silt, lime, fly ash etc. As fly ash is freely available, for projects in the vicinity of the Thermal Power Plants, it can be used for stabilization of black cotton soils for various uses. The project describes a study carried out to check the improvements in the properties of black cotton soil with fly ash in varying percentages (10%, 20% and 30%).

Keywords: Black cotton soil, Moisture content, Stabilisation, Chemical method, Fly ash, Thermal Power Plants.

INTRODUCTION
Soil stabilisation is the process of improving the engineering properties of soil and thus making it more stable. It is required when soil available for construction is not suitable for the intended purpose in its broadest senses; stabilisation includes compaction, preconsolidation, drainage and many other such processes. However, the term stabilisation is generally restricted to the processes which alter the soil for material itself for improvement of its properties. A cementing material or a chemical material is added to a natural soil for the purpose of stabilisation.
Soil stabilization used to reduce the permeability and compressibility of soil mass in earth structure and to increase its shear strength. Soil stabilization is required to increase the bearing capacity of foundation of soils.

OBJECTIVES OF SOIL STABILIZATION
1. To study the effect of fly ash on properties of soil
2. To study the optimum moisture content by adding fly ash
3. To increase the bearing strength of soil.

FLY ASH
Fly ash is a by-product from burning pulverized coal in electric power generating plants. During combustion, mineral impurities in the coal fuse in suspension and float out of the combustion chamber with the exhaust gases. Two types fly ash are commonly used in concrete.
- Class c
- Class F

Class c are often high-calcium fly ashes with carbon content less than 2 %; whereas class F are generally low calcium fly ashes with carbon content less than 5% but some times as high as 10%. In general, class c fly

ashes produced from burning sub-bituminous are anthracite coals. Performance properties between class c and class f ashes are varying depending on chemical and physical properties of the ash. Many class c ashes when exposed to water will react and become hard just like cement but not class f ashes. Most, if not all, class f ashes will only react with the by-products when cement reacts with water. Class c and class f fly ashes were used in this research project.

LITERATURE REVIEW

1) Zala Yashwantsinh et.al, (2013): The authors had worked on Stabilization of black cotton soil using fly ash in various proportions (5%,10%,15%). These were the observations and conclusions made from the study. Liquid limit was decreasing with increase in percentage of fly ash and Plastic limit was decreasing with increase in percentage of fly ash.

2) Saxena Anil Kumar (2013)- Effect of fly ash and lime on engineering properties of BC soil. A liquid limit & Plastic limit was increases with increases in percentage of fly ash & lime. Compaction characters of soil increase with increasing % of fly ash & lime. CBR value of BC soil increases with increase in % of fly ash & lime.

3) Phanikumar and Sharma (2004**):** A similar study was carried out by Phanikumar and Sharmaand the effect of fly ash on engineering properties of expansive soil through an experimental programme. The effect on parameters like free swell index (FSI), swell potential, swelling pressure, plasticity, compaction, strength and hydraulic conductivity of expansive soil was studied. The ash blended expansive soil with fly ash contents of 0, 5, 10, 15 and 20% on a dry weight basis and they inferred that increase in fly ash content reduces plasticity characteristics and the FSI was reduced by about 50% by the addition of 20% fly ash. The hydraulic conductivity of expansive soils mixed with fly ash decreases with an increase in fly ash content, due to the increase in maximum dry unit weight with an increase in fly ash content.

MATERIAL AND METHODOLOGY

Materials: Black cotton soil and Fly ash

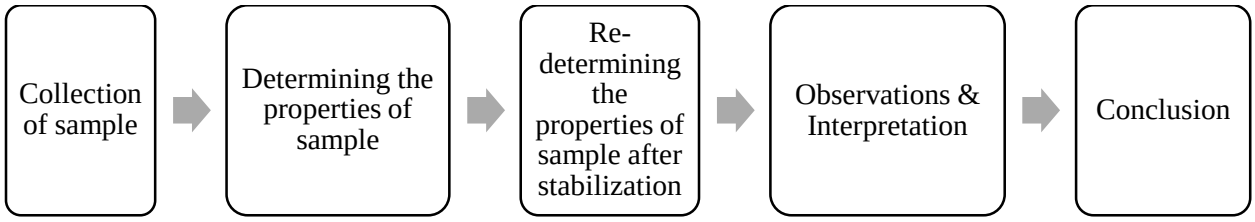
Experimental programme:

1. Grain size Distribution
2. Specific Gravity
3. Liquid limit test
4. Plastic limit test
5. Standard proctor test

a. Maximum dry density
b. Optimum moisture content

6. California bearing ratio test

METHODOLOGY



RESULTS AND DISCUSSION

Table:01. Properties of black cotton soil

S.no	Experiments	Results
1	Specific gravity	2.47
2	Liquid limit (%)	49.2
3	Plastic limit (%)	32.08
4	Plasticity index (%)	17.12
5	Compaction (OMC)%	13.57
6	Dry density (g/cc)	1.382
7	CBR	5.2

Table:02. Sieve Analysis

S.no	Sieve no	Mass of soil retained	Cumulative mass of soil retained(gm)	Cumulative % of soil retained(gm)	% Of finer passing
1	4.75mm	52	52	3.4667	96.533
2	2.36mm	48	100	6.6667	93.333
3	1.18mm	442	542	36.133	63.867
4	600mic	324	866	57.733	42.267
5	425mic	42	908	60.533	39.467
6	150mic	398	1306	87.066	12.934
7	75mic	94	1400	93.333	6.67
8	Pan	100	1500	100	0

Table:03. Specific gravity values

S.no	Content	Specific gravity value
1	Natural soil	2.47
2	Natural soil with 10% fly ash	2.67

Table:04. Results of liquid and plastic limit

S.no	Replacement with Fly ash (%)	Liquid limit	Plastic limit
1	0% Replacement (Natural soil)	49.2	32.08
2	10% Replacement	47.67	30.37
3	20% Replacement	45.68	28.33
4	30% Replacement	44.31	22.53

Table:05. Standard proctor test and CBR Value (unsoaked)

	Natural soil	Replacement with Fly ash (%)		
		10%	20%	30%
Dry density (g/cc)	1.382	1.476	1.556	1.6
Optimum moisture content (%)	13.57	13.2	10.71	9.53
CBR Value	5.2	8.5	10.68	5.95

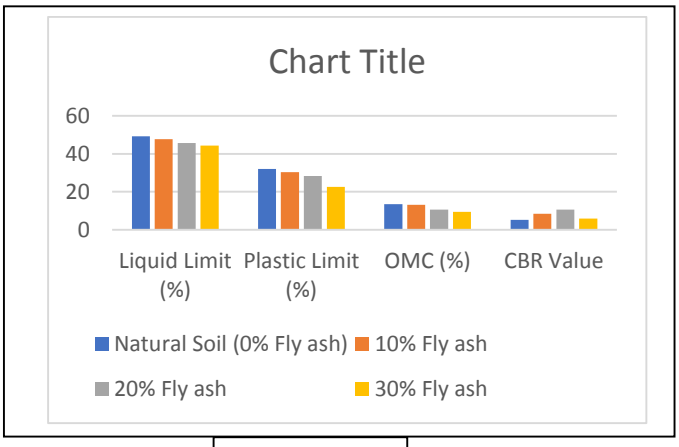


Fig:01.

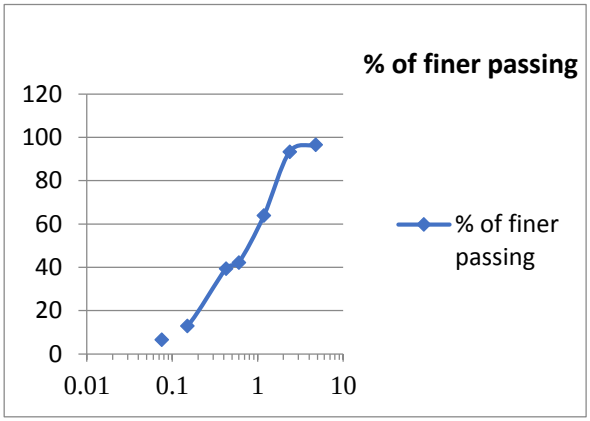


Fig:02.

Graph between sieve size and %of finer passing

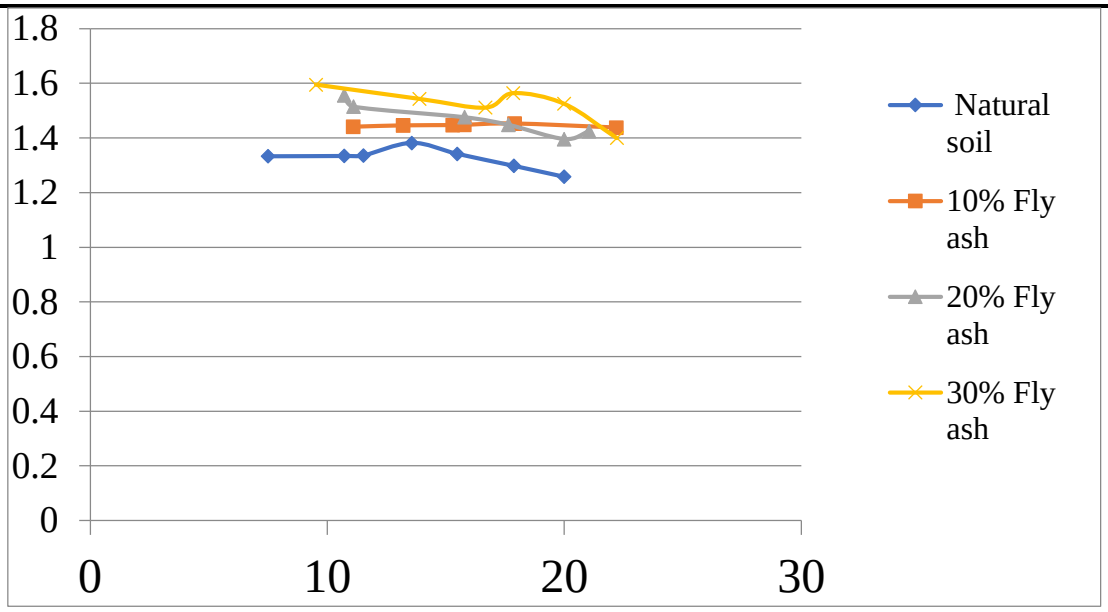


Fig:03.	Standard proctor test

MAIN CONCLUSION

Based on the results obtained and comparisons made in the present study, the following conclusions can be drawn

1. Liquid limit and plastic limit of BC soil decrease with increasing percentage of fly ash.
2. Addition of fly ash with soil increases Dry density value substantially
3. The CBR increased gradually with the increase in fly ash content & its valuation was 20% by weight of the total mixture; it decreased thereafter.
4. The addition of 30% fly ash to the black cotton soil reduces the CBR value by 55% approximately
5. Specific gravity of the soil is increased by adding fly ash to the soil
6. Thus, fly ash as an additive increases the strength of the black cotton soil.

SCOPE FOR FUTURE STUDY

Fly ash along with another additive like lime, Murom, cement, and other such materials can be used together, and may be varied in quantity to obtain the best possible stabilizing mixture.

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