Effect of Shear Strength of BC Soil with Nano Material and Fly Ash

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Abstract- India about 51.8 million hectares of the land area are covered with Expansive soils (black cotton soil). The Black cotton soils are very hard when dry, but lose its strength completely when in wet condition. Expansive soils are a worldwide problem that poses several challenges for Civil Engineers because of its high swelling, shrinkage nature when exposed to moisture content in soil and hence have been found to be most tribalism from engineering consideration.

Black cotton soil is one of the major soil deposits in India so there is need of enhancing its geotechnical properties and make it suitable for the construction purpose. Various methods can be followed to improve the characteristics of Black cotton soil.

In the present work stabilisation method is used to improve the properties of expansive soil and it is treated with fly ash and zeolite in various proportions. The main aim of this work is determination of MDD, OMC, and shear strength of soil for various proportions of admixtures(% of Fly ash from 0% to 20% and % of Zeolite from 0% to 1.0% by weight of soil).

Keywords – Zeolite, fly ash, consistency limit, Shear strength, MDD and OMC

I. INTRODUCTION

Black cotton soil is one of real soil stores of India. They display high rate of inflammation and contraction when presented to changes in humidity content and consequently have been observed to be most troublesome from building consideration. The charge of montmorillonite is more in dark cotton mud which causes breadth and split happens in soil with no notice which is unsafe for development. The black cotton soils are hard in dried up situation and week in soaked situation.

It seems that on ventilation, the black cotton soil creates breaks of changing profundity. Figure 1.1 demonstrates the commonplace breaks in Black cotton soils (BC soils) in a dried state. Because of wetting and drying process, vertical development happens in the dirt mass. Every one of these developments prompt disappointment of asphalt, as settlement, substantial wretchedness, splitting and unevenness..

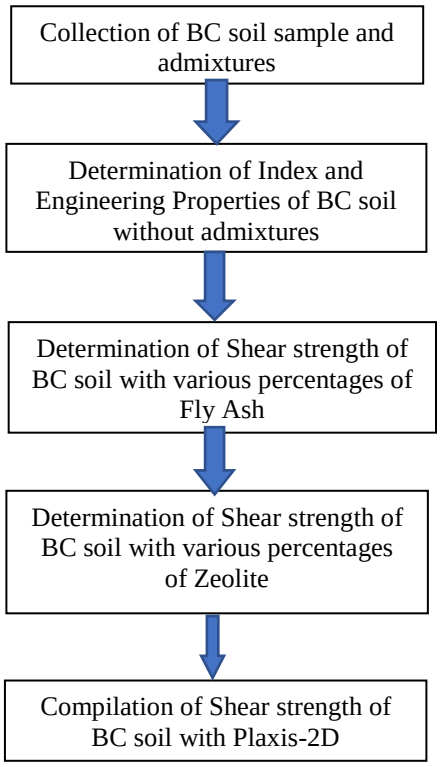
The streets laid on "BC soil premise construct undulation in the road by virtue of loss of nature of the sub level through softening amidst rainstorm. The dull shading in Black cotton soil is an aftereffect of the vicinity of titanium oxide in little fixation". The Expensive soil has a high level of earth, the corporal property of Black cotton soil shift from position to position.

Figure 1.1 Black Cotton Soil in Dry Condition Cracks

II. Materials And Methodology

2.1 Introduction –

A brief description of the experimental procedures adopted in this investigation and the methodology adopted during the course of study are briefly presented.



III. Results and Discussion

3.1 Physical Properties of Black Cotton Soil

SNo	Laboratory Test	Result	Relevant IS codes
1	Water content (w)	8.4%	IS 2720 Part II
2	Specific gravity (G)	2.45	IS 2720 Part IV
3	Liquid Limit (LL)	54.7%	IS 2720 Part V
4	Plastic Limit (PL)	34.41%	IS 2720 Part V
5	Shrinkage Limit (SL)	11.5%	IS 2720 Part V
6	Plasticity Index (PI)	22.43%	IS 2720 Part V
7	% of Gravel	0	IS 2720 Part IV
8	% of Sand	34	IS 2720 Part IV
9	% of Silt	17	IS 2720 Part IV
10	% of Clay	50	IS 2720 Part IV
11	Organic Content	4.75	IS 2720 Part XXII
12	Free Swell Index	49%	IS 2720 Part XI
13	IS classification of soil	CH	IS 2720 Part IV

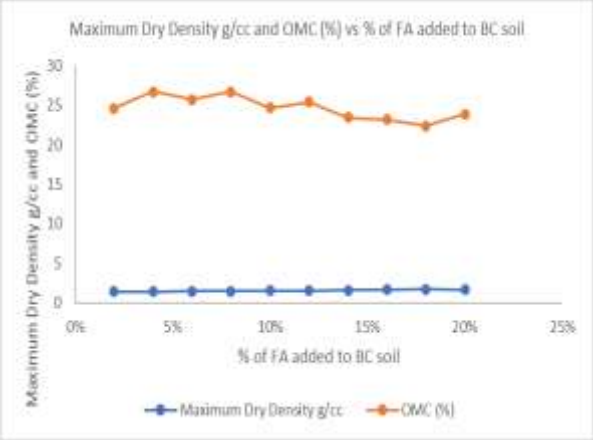
3.2 Geotechnical Properties of Black Cotton Soil

S.No	Laboratory test	Result	Relevant IS codes
1	Optimum moisture content	19.4%	IS -2720 PART 7
2	Maximum dry density	1.32g/cc	IS -2720 PART 7
3	CBR @2.5mm	2.25	IS -2720 PART 16
4	CBR @5mm	2.16	IS -2720 PART 16
5	Unconfined compression strength	5.34 kN/m^2	IS -2720 PART 10

3.3 MDD And OMC Values of BC Soil with different percentage of Fly Ash

S No	% of FA added to BC soil	Maximum Dry Density g/cc	OMC (%)
1	2%	1.428	24.61
2	4%	1.456	26.71
3	6%	1.471	25.7
4	8%	1.511	26.7
5	10%	1.541	24.65
6	12%	1.583	25.43
7	14%	1.621	23.45
8	16%	1.662	23.2
9	**18%**	**1.723**	**22.4**
10	20%	1.664	23.87

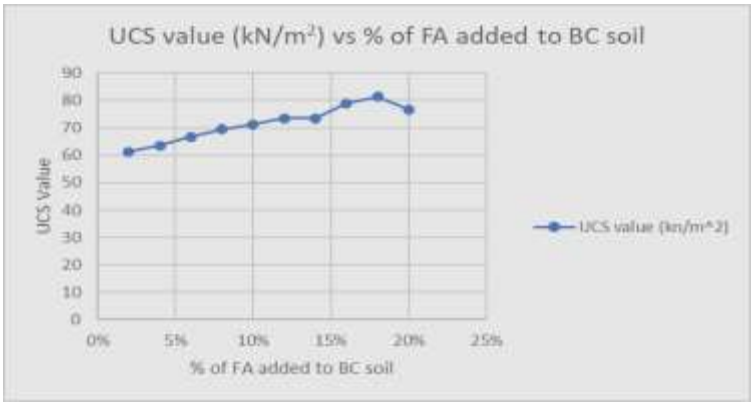
Figure 1.2 % of FA added to BC Soil vs Maximum Dry Density g/cc and OMC (%)



3.4 UCC Values of BC Soil with Different Percentage of Fly Ash

S No	% of FA added to BC soil	UCS value (kN/m^2)	S No	% of FA added to BC soil	UCS value (kN/m^2)
1	2%	61.32	6	12%	73.4
2	4%	63.54	7	14%	73.5
3	6%	66.71	8	16%	78.95
4	8%	69.4	9	18%	**81.34**
5	10%	71.23	10	20%	76.75

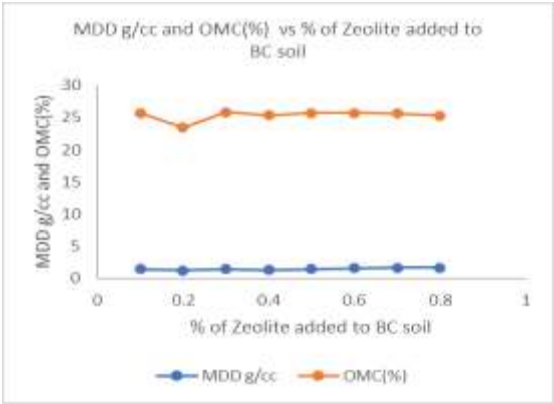
Figure 1.3 UCS (kN/m^2) vs % of FA added to BC soil



3.5 MDD And OMC Values of BC Soil with Different Percentage of Zeolite

S No	% of Zeolite added to BC soil	MDD (g/cc)	OMC (%)	S No	% of Zeolite added to BC soil	MDD (g/cc)	OMC (%)
1	0.1	1.469	25.67	5	0.5	1.45	25.7
2	0.2	1.233	23.41	6	0.6	1.59	25.71
3	0.3	1.44	25.81	7	**0.7**	**1.71**	**25.6**
4	0.4	1.34	25.35	8	0.8	1.676	25.3

Figure 1.4 % of Zeolite added to BC Soil vs Maximum Dry Density g/cc and OMC (%)



3.5 MDD And OMC Values of BC Soil for Different Percentage of Zeolite added

S No	% of Zeolite added to BC soil	UCS kN/m^2	S No	% of Zeolite added to BC soil	UCS kN/m^2
1	0.1	61.9	5	0.5	70.1
2	0.2	62.8	6	0.6	72.34
3	0.3	65.23	7	0.7	**76.38**
4	0.4	68.12	8	0.8	73.12

Figure 1.5 UCS (kN/m^2) vs % of FA added to BC soil

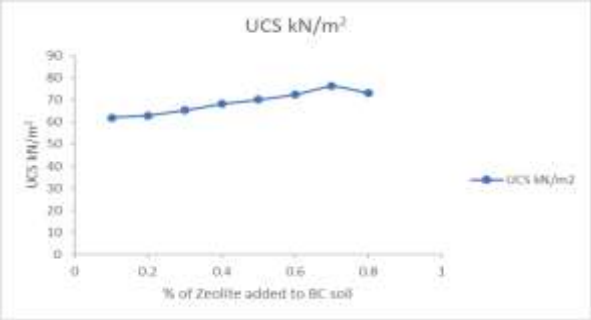
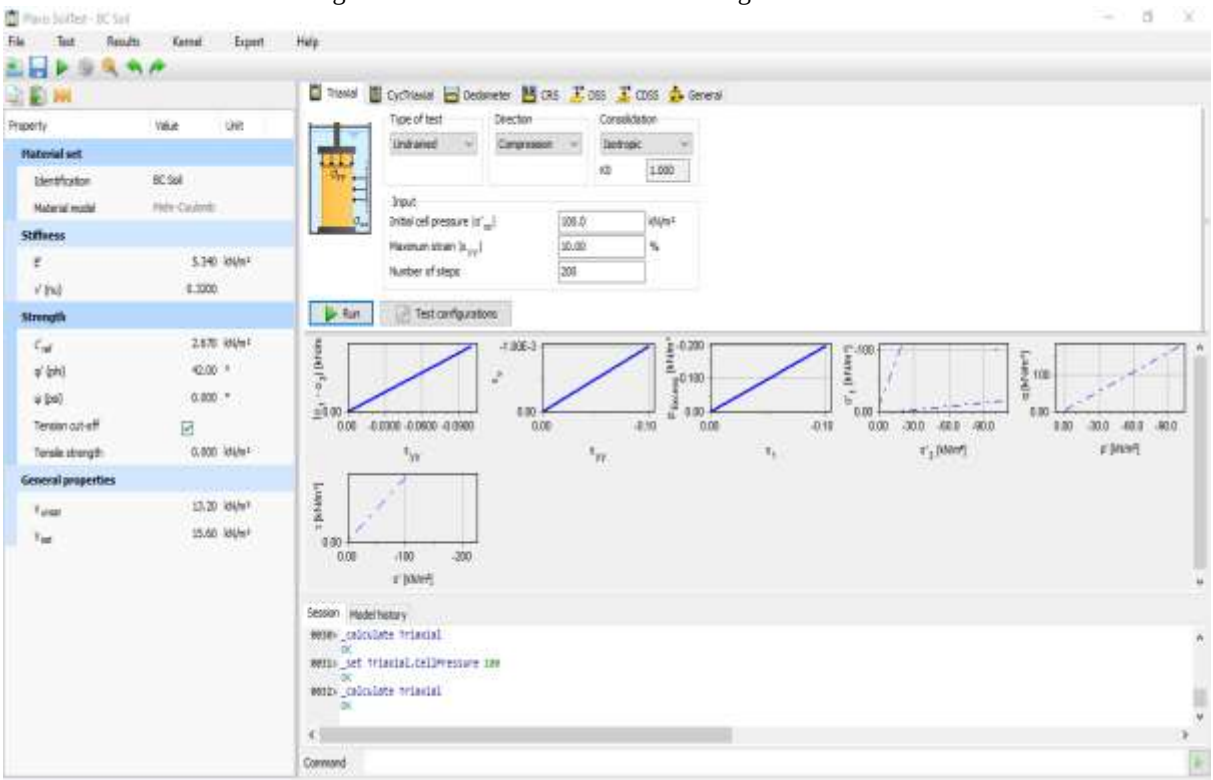
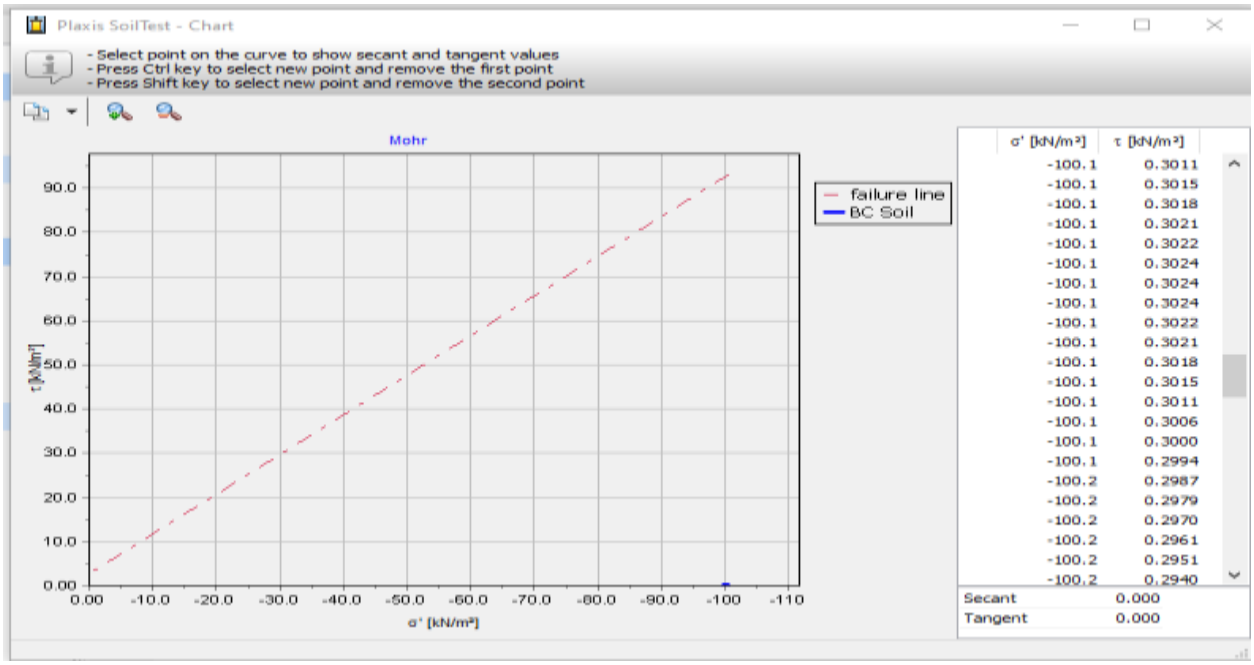


Figure 1.6 Triaxial test on BC Soil through Plaxis-2D



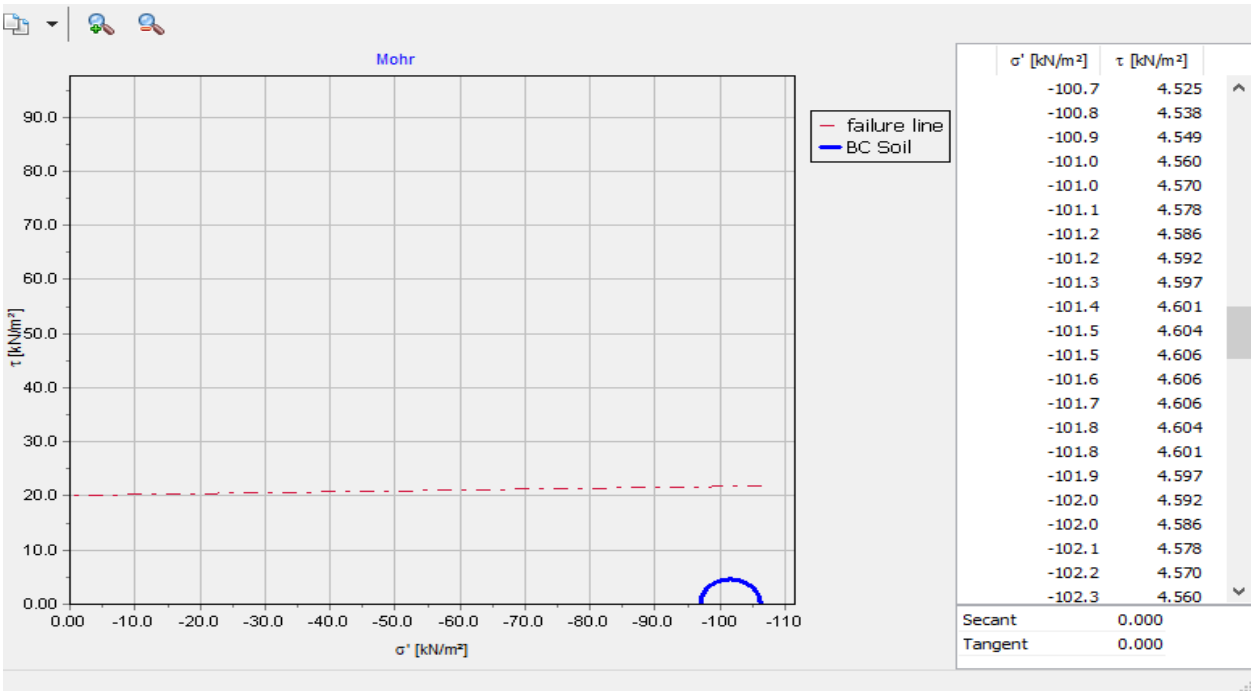
Triaxial test were performed in Plaxis-2D which can gives the normal stress and shear stress amount, the stresses amount noted as 100.1 kN/m^2 and 0.324 kN/m^2.

Figure 1.7 Triaxial test on BC Soil through Plaxis-2D



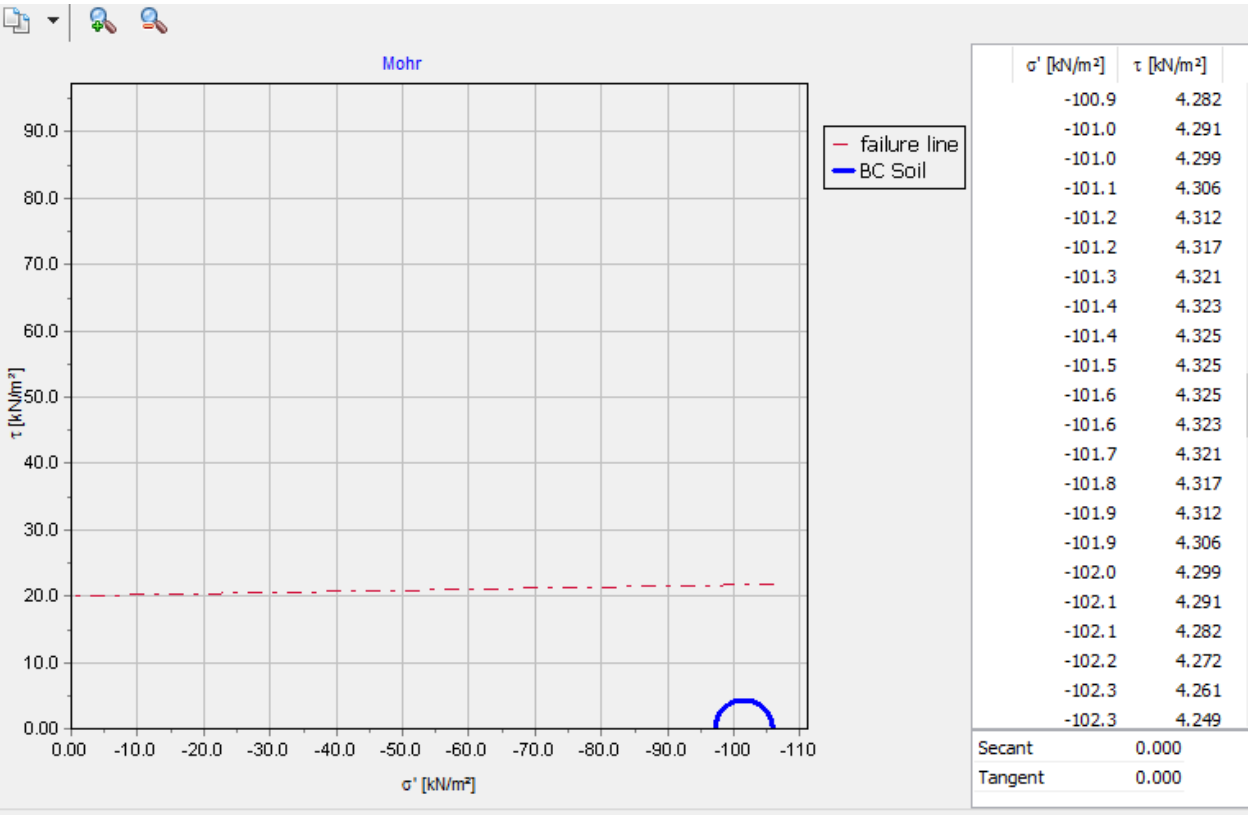
After adding 18% of Fly ash to the soil the triaxial test were performed in Plaxis-2D which gave the normal stress and shear stress amount, the stresses amount noted as 101.8 kN/m^2 and 4.606 kN/m^2.

Figure 1.6 Triaxial test on BC Soil through Plaxis-2D



After adding 18% of Fly ash to the soil the triaxial test were performed in Plaxis-2D which gave the normal stress and shear stress amount, the stresses amount noted as 101.6 kN/m^2 and 4.323 kN/m^2.

Figure 1.6 Triaxial test on BC Soil through Plaxis-2D



IV. CONCLUSIONS

In compaction test at **18%** of Fly ash and at **0.7%** of Zeolite, the maximum dry density of BC soil achieved **1.723 g/cc and 1.69 g/cc** respectively. Before addition of admixture it was **1.48g/cc**. Hence hereby the dry density of soil got increased at **14.1%** and **12.42%** Optimum moisture Content 22.4% and 25.6% respectively. From the unconfined compression test without adding admixtures to the soil the stress value was obtained as **61.68 kN/m^2**. At **18%** of Fly ash and at **0.7%** of Zeolite the compression value got increased by **24.17%** and **19.24%** respectively. Tri-axial test results were obtained from Plaxis-2D, based on this the shear strength of soil improved at optimum percentage of admixtures i.e., 18% of fly ash and 0.7% of Zeolite.

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