

Stabilization of Black Cotton Soil Using Crushed Glass

¹Nilesh S. Pawar, ²Tejas N. Rasal, ³Sourabh B. Shinde, ⁴Supriya S. Gavade, ⁵Mrunali M. Kagwade, ⁶Neha A. Wadkar

^{1,2,3,4,5,6} Department of Civil Engineering
^{1,2,3,4,5,6} Nanasheeb Mahadik College of Engineering, Peth, Sangli, Maharashtra, India.

Submitted: 25-05-2021

Revised: 01-06-2021

Accepted: 05-06-2021

ABSTRACT : Soil stabilization is the process which enhances the properties of soil by mixing different admixtures in various proportion stabilization increases load carrying capacity of the soil. BSC covers 20% of total area of India. Due to its high swelling and shrinkage characteristics, BSC has been challenging for construction works. Thus to overcome the problems caused by BSC, it needs to be stabilized. This project aims at determining the change in properties of soil after adding some admixtures. Before mixing admixtures some basic tests such as a specific gravity, moisture content, atterbergs limits grading of soil etc were to be performed. After this, main tests of the project namely proctor compaction test and CBR test were performed with different proportion of crushed glass. This study process improvement of clay soil using crushed glass. Glass is a one which belong to non biodegradable group. The waste produced from glass can be used in the stabilization of BSC. In this paper, experimental study has been carried out to access the stabilizing effect of crushed glass on clay soil.

Keywords – Black Cotton Soil, Crushed Glass, CBR test, Unconfined Compressive test.

I] INTRODUCTION

Before construction work, we need to keep in mind the major aspect such as a properties of soils. Properties like bearing capacity, moisture content, nature and type of soil determines stability of upcoming project. The BSC generally have weak engineering properties so their properties may need to improve by stabilization. Soil stabilization is the process by which we can improve soil characteristics and economy of construction. The material used in this project for the stabilization of black cotton soil is crushed glass. The main reason for selecting glass is that this materials are becoming much difficult for their recycling and disposal, a problem to the world also these material are easily available and cheaper than

any other materials. Thus with the availability of better research, it is emerging as a popular and cost effective method for soil improvement. This paper represents effect of crushed glass on engineering properties or black cotton soil.

II] LITERATURE REVIEW

J. Olufowobi et.al.[2014]¹: This paper assesses the stabilizing effect of waste glass on black cotton soil. Broken waste glass was collected and crushed in suitable form for addition to black cotton soil in varying proportion of namely 5%, 10%, 15%, 20% cement (base) by weight of the soil sample throughout consequently, the moisture content, specific gravity, particle size distribution, atterberg limits test were carried out to classify the soil using the ASSHTO classification system. There after compaction, California bearing ratio were carried out on the soil with and without the addition of crushed glass. The result showed improvement in the maximum dry density value on addition of the crushed glass and with corresponding gradual increase up to 5% glass crushed content after which it started to decrease and 15% crushed glass content.

Deeraj A.D et.al.[2016]²: The main goal of this stabilization work is to quantify the benefits achieved with the stabilization of black cotton soil, with respect to its engineering properties. Good results were able to bring an to the properties of the soil by stabilization and cost of construction was reduced up to 50% considerably. Marginal and weak soils, including soft clay, black cotton soil, organic deposits and loose soil are often unsuitable for construction due to their poor engineering properties. Expansive soil experience volume change due to alternation in moisture content. The name of “Black Cotton” has an agricultural origin. Most of these soil are black in color and good for growing cotton. In monsoon season soils absorb water swell become soft and capacity to bear water is reduced in drier seasons, these soil

shrink or reduce in volume due to evaporation of water and they become harder. Due to its peculiar characteristic of high plasticity excessive swelling,

shrinkage and low strength when wet the soil is regarded unsuitable for construction.

Properties of glass

1	Compression resistance	800-1000Mpa
2	Density	2500kg/m ³
3	Modulus of Elasticity	70000Mpa
4	Hardness	5.3Mohs Hardness
5	Bending strength	45 Mpa

Ashutosh Bhadoriya et.al.[2018]³: In this paper, effect of crush of glass in varying proportion on mass dry density (MDD), optimum moisture content (OMC), specific gravity and CBR on black cotton soil has been discussed. The percentage of crushed glass by dry weight of soil was taken as 5%, 10%, & 20% by using the above tests on the black cotton soil the compressive strength and its property is increased by using crushed glass as an admixture.

Babatunde O.A et.al. [2019]⁴: Here, waste produced from glass can be used in stabilization of black cotton soil. In this paper an experimental study has been carried out to assess the effect of crushed glass mixed in black cotton soil with respect to its engineering properties. Crushed glass was used as a partial replacement of black cotton soil by weight. Different percentage by weight of 0%, 5%, 10% were used as partial replacement of black cotton soil by crushed glass.

Nooraieen Hashmie et.al.[2020]⁵: Black cotton soil forms a major soil group in India. It covers 20% of the total area of India. Due to its high swelling and shrinkage characteristics. Black cotton soil has been challenging for construction activities to overcome the problems caused by black cotton soil, the soil needs to be stabilized. Stabilization increases the strength of soil and controls the swell and shrinks potential of soil thus improving the load bearing capacity of soil. Recycled crushed glass is rich in silica and alumina.

Ajeet Rathee et.al.[2018]³: The project aims at determining the noticeable change in the behavior of soil after blending in with some

admixture. For this purpose broken glass was taken as admixture in different balance up to 20% the total weight by mass before mixing the soil with this admixture some basic properties of soil like grade of soil, moisture content, specific gravity and Atterberg's limit were to be determined. After determining the basic properties two main tests of this project namely proctor compaction test and California bearing ratio test were performed on soil with adding crushed glass and without adding crushed glass.

III] METHODOLOGY

A soil sample was collected from near by collage area. Which is known to have a clayey subgrade. The waste glass was collected from near by waste disposal area prepared. The crushing is done in laboratory. The glass was crushed in manner that a mixture of fine to gravel size particles were visibly seen. The prepared crushed glass was mixed with natural soil starting with 5% by weight of soil with increment of 5% crushed glass. At each percentage of glass content Atterberg limits, compaction, characteristics, and CBR were determined. The various tests conducted to obtain Engineering Geotechnical properties of black cotton soil.

- i) Specific Gravity
- ii) Liquid Limit
- iii) Plastic Limit
- iv) Standard proctor test
- v) Unconfined compression test.
- vi) California Bearing Ratio test.

Following are the results obtained from the various tests conducted on the black cotton soil:-

Sr. No.	Experiment Name	Result
1	Water Content [oven dry method]	13.54%
2	Specific Gravity	2.17.
3	Grading of soil.	uniformly graded.
4	Plastic Limit	26.40%
5	Liquid Limit	43.95 %

Table 1: Engineering Properties of Black Cotton Soil

IV] TEST PROCEDURE

❖ Unconfined compression test

The black cotton soil was collected and preliminary test were conducted on it to obtain the gradation and index properties of the soil. Tests

such as a liquid limit, Plastic limit, unconfined compressive test, CBR test were all carried. This test were donr on BCS with 5% and 10% crushed glass replacement by weight.

Two different sample are tested

1] Without crushed glass:

Strain	D	H	Change in length	in	Load	Actual area $A_c = A_0 / (1 - \text{Strain})$	Compressive strength(q_u)
0.747	4cm	12cm	8.9cm		139N	49.64cm ²	2.79N/cm ²

Table No.1

2]With crushed glass (5%):

Strain	D	H	Change in length	Load	Actual area $A_c = A_0 / (1 - \text{Strain})$	Compressive strength(q_u)
0.792	4cm	10cm	7.2cm	103N	60.38cm ²	1.70N/cm ²

Table No.2

3]With crushed glass (10%):

Strain	D	H	Change in length	Load	Actual area $A_c = A_0 / (1 - \text{Strain})$	Compressive strength(q_u)
0.811	4cm	10cm	7.7cm	107N	66.45cm ²	1.61N/cm ²

Table No.3

❖ CBR TEST:

The CBR test were performed on black cotton soil as per IS code 2720 part 16 (1987). The result are presented in form of load intensity-Penetration curve for black cotton soil

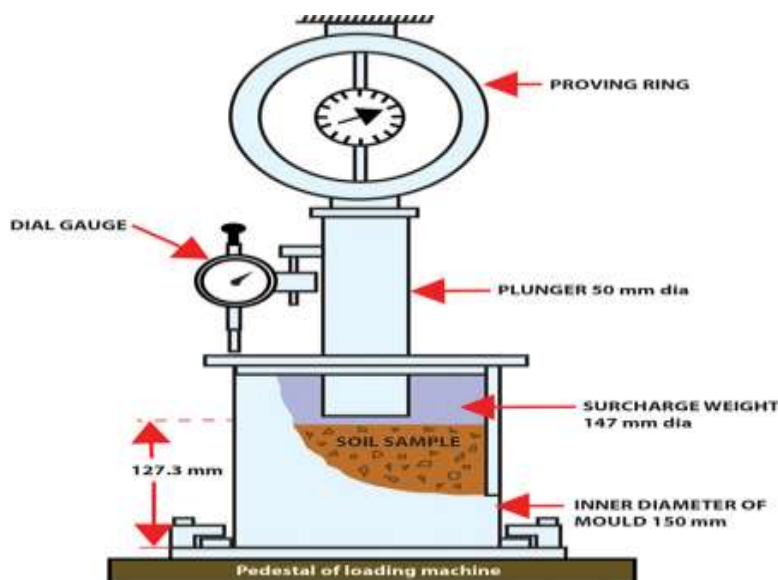
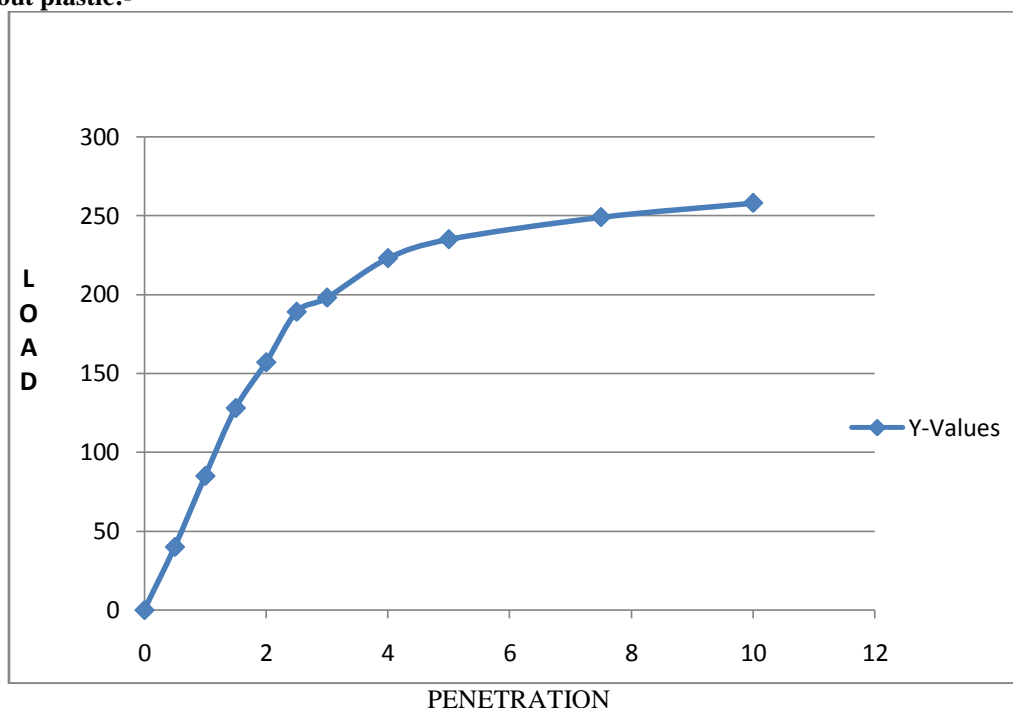


Fig. No.1

Observation Table :-

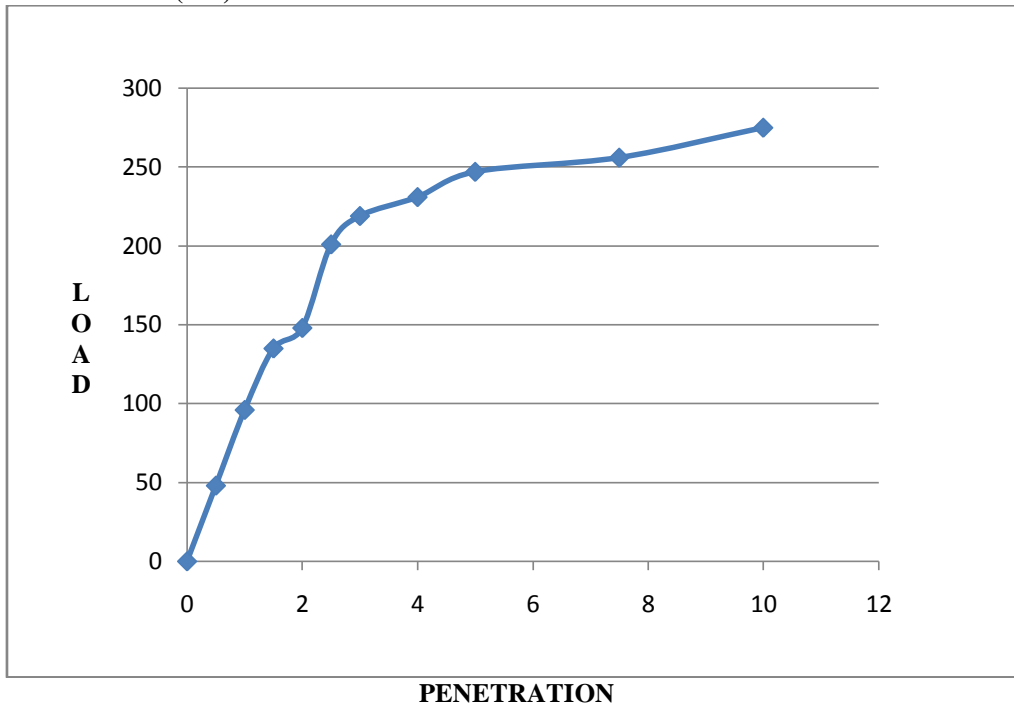
Sr. No.	Penetration	Normal (Without glass)	crushed	5% Crushed glass	10% Crushed glass
1	0	0		0	0
2	0.5	40		48	51
3	1	85		96	101
4	1.5	128		135	140
5	2	157		148	157
6	2.5	189		201	210
7	3	198		219	225
8	4	223		231	246
9	5	235		247	256
10	7.5	249		256	266
11	10	258		275	289

1) Without plastic:-



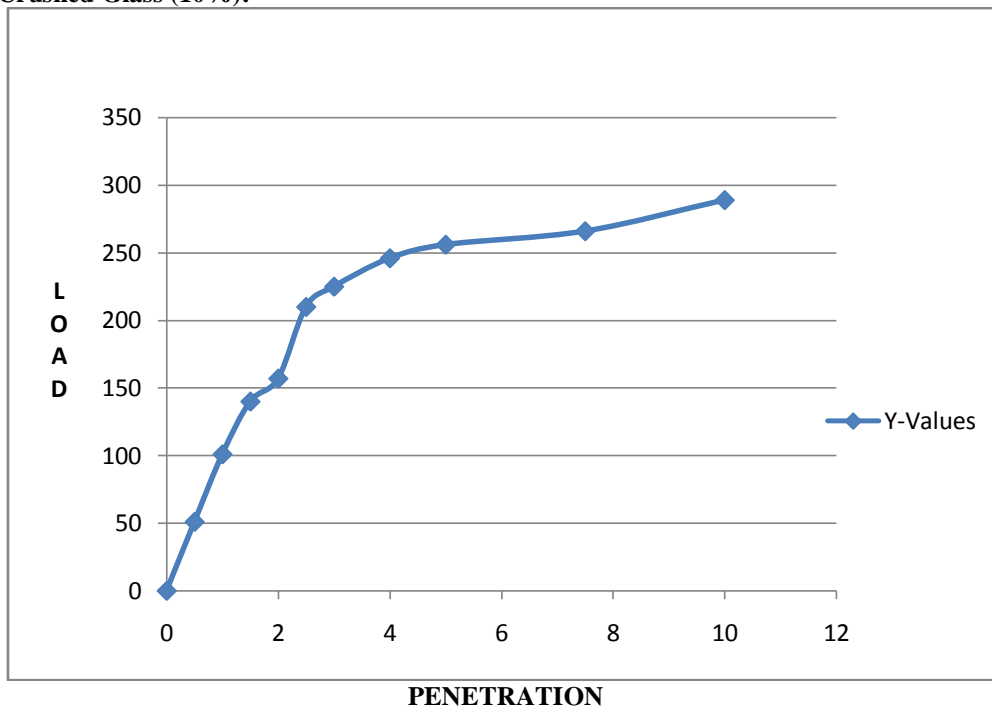
Graph 1: Comparison curves of Load intensity Vs penetration with percentage of without crushed glass

2) With Crushed Glass (5%):-



Graph 2: Comparison curves of Load intensity Vs penetration with percentage of 5% crushed glass

3) With Crushed Glass (10%):-



Graph 2: Comparison curves of Load intensity Vs penetration with percentage of 10% crushed glass

V] RESULTS AND DISCUSSION:

The results obtained from the experimental study of stabilization of black cotton soil by using plastic strips. From the results it is observed that due to increase in plastic percentage in black cotton soil there is significant change in CBR value as compared to untreated black cotton soil.

$$\text{C.B.R.} = \text{Test load/Standard load} * 100$$

Without Crushed Glass:

C.B.R. of specimen at 2.5 mm penetration:
 $189/1000*100=18.9\%$

C.B.R. of specimen at 5.0 mm penetration:
 $235/1000*100=23.5\%$

With Crushed glass (5%):

C.B.R. of specimen at 2.5 mm penetration:
 $201/1000*100=20.1\%$

C.B.R. of specimen at 5.0 mm penetration:
 $247/1000*100=24.7\%$

With Crushed glass (10%):

C.B.R. of specimen at 2.5 mm penetration:
 $210/1000*100=21.0\%$

C.B.R. of specimen at 5.0 mm penetration:
 $256/1000*100=25.6\%$

VI] CONCLUSION:

1. From this study, we can conclude that crushed glass and wastage can be used to increase the CBR value of a soil considerably. in this study we can see that the maximum CBR value can be achieved when 5% and 10% amount of crushed glass are added to the soil.
2. Load carrying capacity with crushed glass soil sample is more than without crushed glass.
3. Compressive strength increased using crushed

glass in soil sample.

REFERENCES:

- [1]. J. Olufowobi, A. Ogundaju, B. Michael, O. Aderinlewo [2014]: Clay Soil Stabilization Using Powdered Glass, Journal of Engineering Science and Technology Vol. 9, No. 5 (2014) 541 – 558
- [2]. Subash K, Sukesh S, Sreerag R, Dilna Sathian V, Deeraj A.D, Dr. Jino John [2016]: Stabilization of Black Cotton Soil using Glass and Plastic Granules, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 5 Issue 04.
- [3]. Ashutosh Bhadoriya, Dr. R. Kansal [2018] : Black Cotton Soil Stabilization using Plastic and Glass Fibres, International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 11.
- [4]. Mwajuma Ibrahim Lingwanda [2018]: Use Of Waste Glass In Improving Subgrade Soil Properties, Ijret International Journal of Research in Engineering and Technology Volume: 07 Issue: 04.
- [5]. Babatunde O.A, Sani J.E, Sambo A.H [2019] : Black Cotton Soil Stabilization using Glass Powder, International Journal of Innovative Research in Science, Engineering and Technology Vol. 8, Issue 5.
- [6]. Nooraien Hashmie¹, Priya Gunagi, Prajwal Belagal¹ and Shimna Manoharan [2020] : Utilisation of Recycled Glass Powder for the Stabilization of Black Cotton soil by Alkali Activation, IOP Conference Series: Materials Science and Engineering 955 (2020) 012063