

# **Black Cotton Soil Stabilization Using Lime for Subgrade Construction**

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**ABSTRACT:** The plan of stabilization on black cotton soil (expansive soil) has dependably been a troublesome assignment for the engineers as the structure laying on black cotton soil splits all of a sudden with no notice. Black cotton soil is found in Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, in India. Soil proportion changes depending upon their constituents, i.e. water content, density, bulk density, angle of friction, shear strength etc. The properties of black cotton soil can be changed by settling the soil with the utilization of admixtures or by mechanical methods. In this undertaking stabilization of the soil has been finished utilizing lime. Experimental work has been finished by including 3 % and 5 % of lime content operating at a black cotton soil and different soil parameters checked. The experimental work is based on different percentages of lime content in soil on tests for soil Liquid limit, Plastic limit, Shrinkage limit, compaction test, O.M.C., M.D.D, Bulk density and Dry density and C.B.R. test, Grain size analysis and Swelling pressure. The point is to improve the designing properties of the soil to such an extent that the structure laying on this soil can be capably withstanding applied load. It was discovered that when the lime is added to the soil for soil stabilization, the engineering properties of black cotton soil significantly upgraded by option of lime.

**KEYWORDS:** Black Cotton Soil, Lime, Stabilization, Engineering properties, etc.

## **I. INTRODUCTION**

Transport in the Republic of India is an imperative piece of the country's economy. Roads are the imperative helps of the economy making conceivable exchange and business. They are the most favoured methods of transportation and considered as one of the practical modes. It is wanted to advance productive and very much established system of roads for satisfies the need of transportation framework for financial improvement.

To withstand distinctive types of load, the roads must be planned and built with most extreme care. The execution of the road relies upon the prevalence of materials for road development.

Subgrade is the layer whereupon the road layer is laid upon. The subgrade soils can be a vital factor in execution of a road. On the off chance that the soil accessible in neighbourhoods not fit for supporting the heaps, suitable strategies used to stabilize the soil and upgrade the properties of soil. Soil stabilization is one of the techniques. Stabilization of the soil subgrade and base with an appropriate substance stabilizer rises subgrade solidness, and lessens extension propensities, it executes as an establishment (ready to help and convey stacks under soaked conditions).

## **II. MATERIALS**

### **Black Cotton Soil:**

Black cotton soil or expansive soils are the soil which extend because of expanded dampness content. Extensive quality of the soil is because of earth mineral montmorillonite. At as far as possible, the volume change is of the request of 200 % to 300% because of which swelling weight as high as 8 kg/cm<sup>2</sup>/to 10 kg/cm<sup>2</sup>. Because of its irregular qualities, it shapes an awful establishment material for soil subgrade.

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**Lime:**

Lime is an inorganic mineral containing calcium in which rich amount of oxides and hydroxides present. This is derived from lime stone. Different types of lime are used in building construction like quick lime, slaked lime, fate lime and hydrated lime.

### III. EXPERIMENTAL WORK

The various tests conducted on the sample are the following:

1. Compaction test
2. CBR Test
3. Atterberg's Limit

Table 1 Compaction Test Comparison

S. No.	Determination No.	B.C. Soil + 0% Lime	B.C. Soil + 3% Lime	B.C. Soil + 5% Lime
1.	Mass of mould + compacted soil "W"(gms)	6993	7263	7202
2.	Mass of compacted soil W3 = W2-W1 (gms)	1807	1743	1682
3.	Wet density $\gamma_t = W_t/v$	1.81	1.74	1.68
4.	Moisture content (%)	14	14	12
5.	Dry density $P_d = \rho/1+W$ (gm/cm3)	1.58	1.53	1.50

Table 2 Standard loads for CBR tests

Penetration depth (mm)	Standard load (kg)	Unit load (kg/cm2)
2.5	1370	70
5.0	2055	105
7.5	2630	134
10	3180	162
12.5	3600	183

**CBR value= (Test load/Standard load) X100**

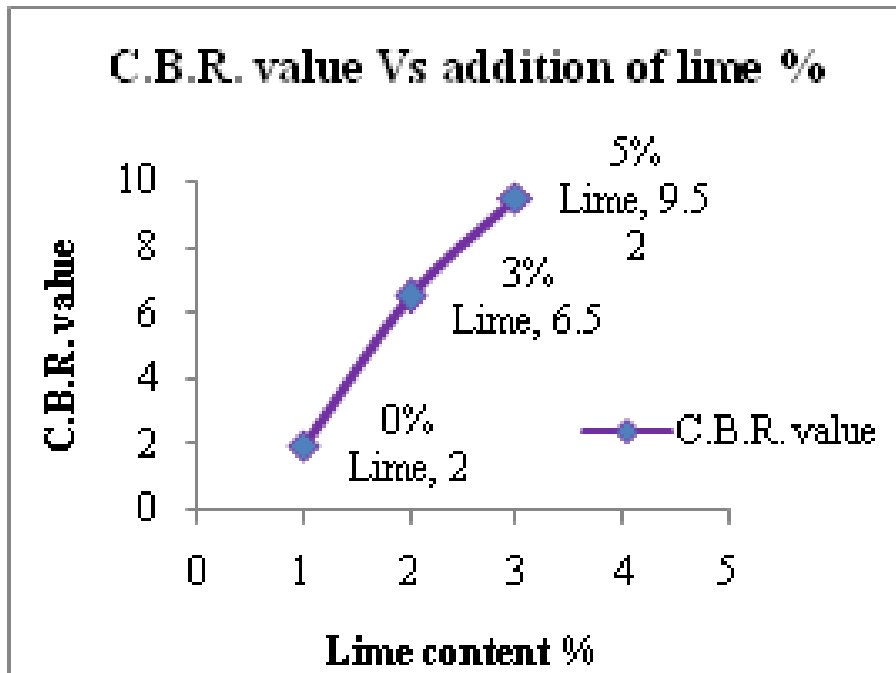
S. No.	Composition of soil	C.B.R. value
1	Black Cotton soil+0% Lime	2.0
2	Black Cotton soil+3% Lime	6.50
3	Black Cotton soil+5% Lime	9.52

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Graph 1 CBR value Vs Addition of lime

Table 3 Comparison of Liquid Limit

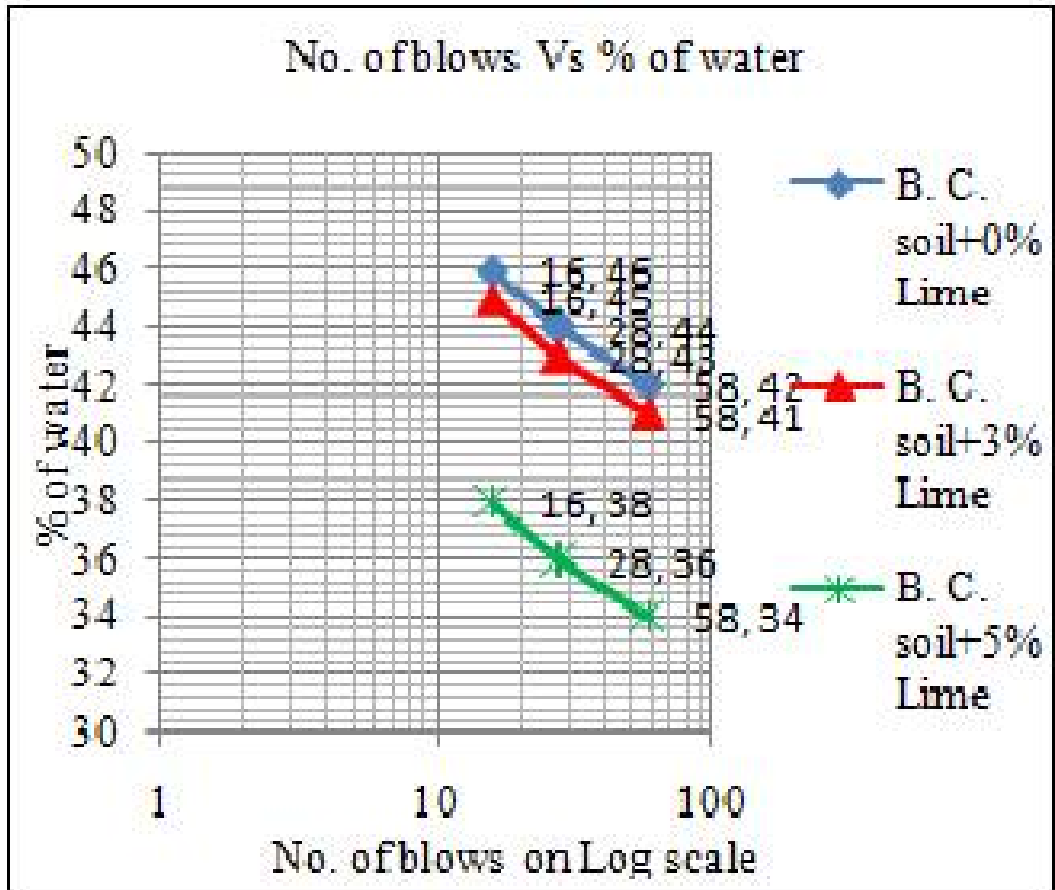
S.No.	Black Cotton soil+0% Lime		Black Cotton soil+3% Lime		Black Cotton soil+5% Lime	
	% of water	No. of blows	% of water	No. of blows	% of water	No. of blows
1	42	58	41	28	34	38
2	44	28	43	17	36	32
3	46	16	45	11	38	16
	Liquid Limit (L.L.) =44.40		Liquid Limit (L.L.) = 43.20		Liquid Limit (L.L.) = 36.40	

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Graph 2 Comparison of Liquid Limit

Table 4 Comparison of Plastic Limit

S. No.	Composition of soil	Plastic Limit
1	Black Cotton soil+0% Lime	30%
2	Black Cotton soil+3% Lime	Non- Plastic
3	Black Cotton soil+5% Lime	Non- Plastic

**Plasticity Index:**

Table 5 Plasticity Index

S. No.	Composition of soil	Plasticity Index (P.I.) P.I. = L.L.- P.L.
1	Black Cotton soil+0% Lime	14.40%
2	Black Cotton soil+3% Lime	-
3	Black Cotton soil+5% Lime	-

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## IV. RESULTS AND DISCUSSION

In this project work we study briefly about the properties of the BC soil and lime and perform various tests to find out whether lime is used for stabilization of BC soil or not and for that we conducted following tests by using different proportions of lime and soil. Here are the tests which are performed in this study:-

1. Compaction test
  2. Atterberg test
  3. CBR test
- the basis of study and experimental work by conducting different tests we found values which are given below

Table 6 Observations of experimental work

S. No.	Composition of soil	Liquid Limit	Plastic limit	CBR Value
1	Black Cotton soil+0% Lime	44.40	30.20	2.0
2	Black Cotton soil+3% Lime	43.20	–	6.50
3	Black Cotton soil+5% Lime	36.40	–	9.52

Table 7 Observation table for standard proctor test

S. No.	Determination No.	B.C. Soil + 0% Lime	B.C. Soil + 3% Lime	B.C. Soil + 5% Lime
1.	Mass of mould + compacted soil "W"(gms)	6993	7263	7202
2.	Mass of compacted soil W3 = W2-W1 (gms)	1807	1743	1682
3.	Wet density $\gamma_t = W_t/v$	1.81	1.74	1.68
4.	Moisture content (%)	14	14	12
5.	Dry density $P_d = \rho/1+W$ (gm/cm <sup>3</sup> )	1.58	1.53	1.50

So by the observations of CBR test standard proctor test and Atterberg test we found that 5% lime proportion is best for stabilization of black cotton soil.

## V. CONCLUSION

Points which were drawn from this study are listed below-

- It is found that when 3% of lime is added, the liquid limit decreases by 2.70% while when 5% added it reflects a decrease of 15.27%.
- M.D.D. increases slightly by 6.29% at 3% and 5.59% at 5% lime content.
- It is also found that there is a decrease in O.M.C. of 3.4% at 3% and 10.7% at 5% lime content.
- This is also observed that C.B.R. value improves considerably to 3.25 times with 3% and 4.76 times with 5% lime.

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