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Stabilization of Black Cotton Soil by using Quarry Dust and Lime

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ABSTRACT: ***The Population Is Increasing Day By Day So That No-Of Construction Activities Are Increasing Daily Which Turning The World Into A Concrete Jungle. The Need For Land Is Increasing For Construction Purpose. Black Cotton Soil Is Belonging To One Of The Major Soil Deposits In India. The Nature Of The Black Soil Is Highly Expansive. Its Nature Varies According To Moisture Present In The Soil. It Will Expand In The Presence Of Water And It Will Contract In The Absence Of Water. Due To This Nature, It Becomes A Very Danger To Construct A Structure In This Type Of Soils. It May Leave Severe Damage To The Foundation And Superstructure. Many Stabilization Methods Are Improved To Overcome This Problem. This Experimental Study Was Done One Black Cotton Soil To Improve Its Characteristics By Adding Admixtures Like Quarry Dust And Lime. Various Properties Like Liquid Limit, Plastic Limit, Maximum Dry Density, Optimum Moisture Content And California Bearing Ratio Were Studied By Adding Admixtures To The Black Cotton Soil. Experimental Study Shows An Effective Increase In Properties Of Black Cotton Soil. With The Help Of Studying Different Literature Papers, It Was Found That Black Cotton Soil Which Is Replaced With Quarry Dust Above 10% Shows Some Increase In Properties. Whereas For Lime It Is In Between 2% To 6%.***

Keywords : Black Cotton Soil, Quarry Dust, Lime, California Bearing Resistance.

I. INTRODUCTION

As the year's passing population is increasing rapidly. Natural resources are being exhausted. Usage of Land for various structures is increasing. This phenomenon leading us to use weak or poor soil for construction activities. We can't blindly construct buildings on weak soil. Before Construction some ground improvements techniques must be followed to increase soil Property. Black cotton soil belongs to one of the major soil deposits in India. Black cotton soil is considered as weak soil due to its swelling and shrinkage nature. Construction of Structures in this type of soil may lead to affect the strength of the structure and resulting in a shorter life. To avoid this effect different researches have been conducted and different techniques have been introduced to improve soil properties.

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In that one of the techniques is soil replacement. In this method, all the soft or weak soil will be replaced by another soil which has good engineering properties. But it will increase the cost of construction. It is preferable for small structures. After conducting different researches, they found another way to improve soil properties, that technique is known as soil stabilization technique.
Soil stabilization is very useful for the construction of big structures or any highway works. This technique helps us to improve or increase the engineering properties of any soft or clay soil.

A. Soil

Soil is one of the natural resources which our mother earth gifted us. In General, the term ' Soil' is derived from a Latin word which is known as solium. We can define soil as Soil is a solid material on earth surface which is formed due to weathering of rocks. Soil can be formed under various ecosystems with the help of different natural factors like Rain, Erosion, different Climatic conditions, the topography of the Earth and parent material type. On the earth crust soil is the topmost layer. In olden days classification of soil is done based on, whether it is fertile or not. But in present modern days soil is classified on different basis like texture, Shape, Color etc. Under the Control of Indian Council of Agriculture of the research department, an institute named The Nation Bureau of Soil Survey and the Land Use Planning had done a lot of researches and studied properties of Indian Soil. For current study we collected soil sample from undavalli which is in APCRDA region

B. Quarry dust

Quarry dust is the dust produced during blasting or crushing stones in a quarry. Generally, Quarry dust is waste produced when stones are crushed. From various studies and researches which conducted on quarry dust, it is found that quarry dust is one of the cheapest or cost-effective ground improvement technique for the stabilization of weak or clayey soils. Quarry dust has rough and sharp particles which make good interlocking between soil particles so that soil can gain more strength due to better interlocking

II. METHODOLOGY

Laboratory tests have been conducted to natural soil to determine following properties
1.Specific gravity
2.Atterberg Limits (Liquid limit, Plastic limit)
3.Plasticity Index
4.Maximum dry density
5.Optimum moisture content
6.California Bearing Resistance

For natural soil with admixtures following properties are determined
1.Maximum dry density
2.Optimum Moisture content
3.California Bearing Resistance

III. OBJECTIVES

1.To determine the properties of Black cotton soil without admixtures
2.To determine the OMC, MDD, CBR of soil which is added with 10%, 20%, 30% Quarry dust
3.To determine the OMC, MDD, CBR of soil which is added with 5% lime
4.Determine the OMC, MDD, CBR of soil which is added with both quarry dust and lime
5. Comparison of results and conclusion

IV. RESULTS AND ANALYSIS

Natural soil

A. Specific gravity

Ratio of unit weight of solids in a soil to the unit weight of water present in that soil. In general, specific gravity of soils lies between 2.6 to 2.9. This is standard estimation values, if we calculate manually, we may get other than mentioned above.

Specific gravity test for soil sample was conducted with the help of density bottle. Specific gravity of testing soil is

G= 2.77

B. Atterberg limits

Table-1 Atterberg limits for natural soil

Liquid limit	49.13%
Plastic limit	21.56%
Plasticity index	27.57%

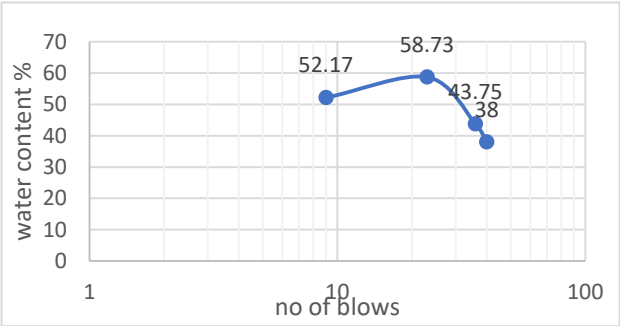

Fig 1. Liquid limit graph

C. Standard Procter test

Table-2 OMC and MDD values of Natural soil

Type of soil	OMC(%)	MDD (g/cc)
Natural soil	19.23	1.66

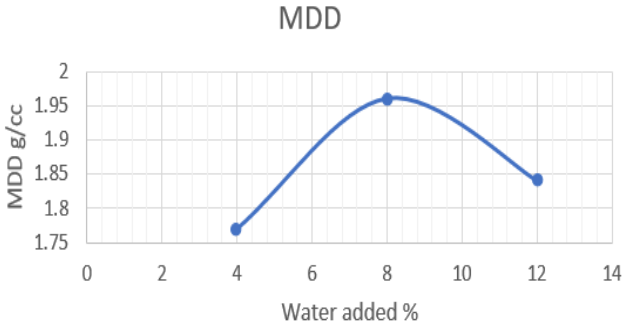

Fig 2. MDD graph of natural soil.

D. California Bearing Resistance (CBR)

Table- 3 CBR value for Natural soil

Type of Soil	CBR (%)
Natural soil	1.63

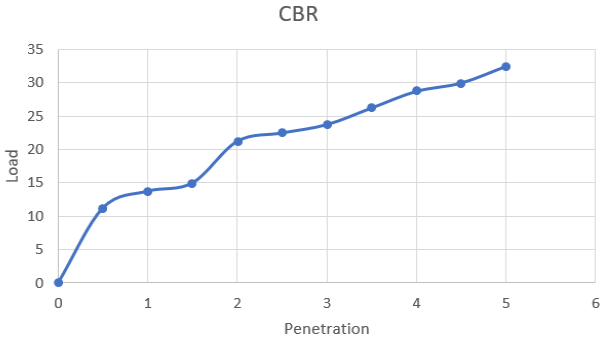

Fig 3. Load Vs Penetration graph for CBR

Natural soil with Lime replacement

Table-4 Results with 5% Lime replacement

Soil Type	Optimum moisture content (%)	Maximum Dry Density (g/cc)	CBR, %
Natural soil	19.23	1.66	1.63
Soil + 5% lime	15	1.8	6.9

Natural soil with Quarry dust replacement

Table- 5 Soil with Quarry dust replacement

Soil type	Optimum moisture conent, %	Maximum Dry density, g/cc	CBR, %
Natural soil	19.23	1.66	1.63
Soil+10% Quarry dust	17.02	1.72	2.18
Soil+20% Quarry dust	15.38	1.8	3.09
Soil+ 30% Quarry dust	13.09	1.9	4.09

Soil with Both Quarry dust and lime replacement

Table- 6 Detailing of samples

Soil Sample	Percentage of Quarry dust and lime
Natural soil	0%
Soil sample 1	Soil+ 10% Quarry dust+ 5% Lime
Soil sample 2	Soil + 20% Quarry dust + 5% Lime
Soil sample 3	Soil + 30% Quarry dust + 5% Lime

Table- 7 Results for Soil samples

Soil type	OMC, %	MDD, g/cc	CBR, %
Natural soil	19.23	1.66	1.63
Soil sample 1	14.58	1.80	7.83
Soil sample 2	12.35	1.82	8.38
Soil sample 3	11.96	1.96	10.84

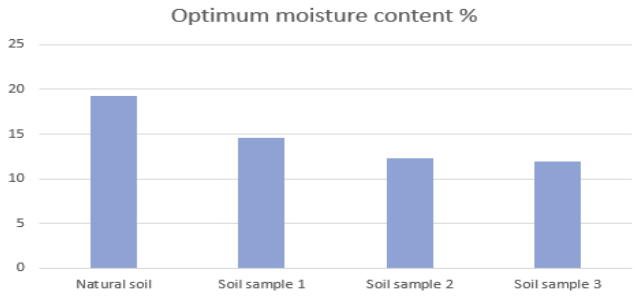

Fig 4. Variation in optimum moisture content, %

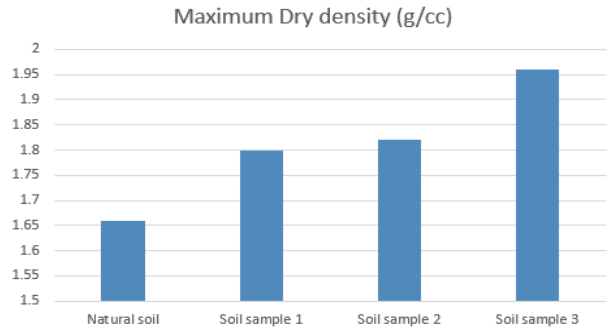

Fig 5. Variation in Maximum Dry density, g/cc

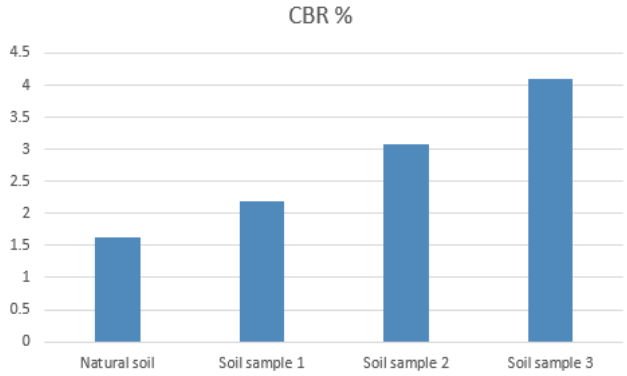

Fig 6. Variation in CBR percentages for soil samples

V. CONCLUSION

The soil is been tested to find out different properties with and without admixtures and results have been analyzed. Finally, we can conclude that

1. It is found that MDD, OMC and CBR values are increased, when soil is added with admixtures
2. It was found that adding quarry dust and lime combinedly to the soil gives more appropriate results when compared to soil that added with admixtures separately
3. Adding Admixtures increase the bearing capacity of Black cotton soil

Adding of admixtures (Quarry dust and lime) to Black cotton soil has shown significant results which is very useful to rectify the problems with expansive soil for construction purpose. So, Quarry dust and lime are also preferable admixtures for stabilization of expansive soils

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