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Use of Locally available material for Stabilizing Expansive Soil

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Abstract – *Expansive soil is a highly clayey soil it has very low bearing capacity and high swelling-shrinkage characteristics. Due to very low CBR value of black cotton soil, it forms a very poor foundation material. In most of places of India there is wide spread of black cotton soil which causes problems to the construction activities, especially sub-grade problem. Design of various layers of pavement is dependent upon the strength of sub-grade soil over which layers of pavement are going to be laid. Strength of sub-grade is mainly expressed in CBR. Soil stabilization is an effective method for improvement of soil properties and pavement system. Black cotton soil is mainly stabilized using fly-ash, lime and cement. Some agricultural wastes are also used, but they can't be used as a single stabilizing. This project is an attempt to improve the CBR value and properties of soil using locally available materials in order to effectively lying of road pavement and increase strength of the road pavement economically.*

Key Words: **Expansive Soil, CBR value, Stabilization, Sub-grade strength**

1. INTRODUCTION

In India an expansive soil covers about $0.8*10^6 km^2$ area, approximately 20% of surface area. A large area of south Gujarat is covered by the black cotton soil. In a common practice, expansive soils can't be used as road service layers, foundation layers and as a construction material. The black cotton soil consists of minerals like montmorillonote, keolinite and ilite, which is having properties like high swelling and shrinkage. Due to this the excessive volume changes are occurred in the black cotton soil which reduces the bearing capacity of soil. Therefore the properties of the black cotton soil need to be improved.

The stabilization of soil is proved as the best alternative for the improvement of the black cotton soil properties. By using the lime, cement, fly ash, Geo-textile materials, rice husk, ground nut shell, crushed seashell etc are used. But for the economical point of view locally available materials can be used as like sand, grit, stone dust etc. These materials as stabilizer also improve the properties of soil effectively. The mixture of this materials is increases the CBR value (soaked) of soil by 3-5%. It proves economical than the other

Stabilization materials and also gives the satisfactory results. The reduced cost of stabilization also reduces the overall cost of the construction of road pavement which is best alternative for the construction of village road pavement in economical point of view.

1.1 Objective

- To improve the characteristics of black cotton soil
- To improve CBR value of the black cotton soil.
- To find strength parameter to optimum mix.
- To reduce cost of stabilization using locally available material.
- To reduce cost of construction of village road pavement.

2. Expansive soil and local available material analysis

The sample of expansive soil use for the experiment work was collected from the Olpad village in Surat. The tests are Carried out for analyze the properties of expansive soil. The locally available materials used for the stabilization of expansive soil are 25% yellow soil, 15% stone dust, 10% grit. The properties of the materials are as given in below table.

Table: 1 Geotechnical properties of the expansive soil

S.No	PROPERTY	VALUE
1	Liquid Limit (%)	39.67
2	Plastic Limit (%)	18.65
3	Plasticity Index (%)	21.02
4	IS Classification	CI
5	Optimum Moisture Content (OMC)%	12
6	Maximum Dry Density	19.41
7	Unconfined Compressive Strength(UCS) KN/m2	133
8	Soaked CBR (%)	1.2
9	Free Swell Index (%)	323

Table: 2 Properties of Quarry dust

S.No	PROPERTY	VALUE
1	Consistency	
1.1	Liquid Limit (%)	NP
1.2	Plasticity Index (%)	NP

1.3	Specific gravity	2.71
2	Compaction Characteristics	
2.1	Maximum Dry Density	19.1
2.3	Optimum moisture content (OMC %)	12.6

Table: 3 Properties of the Grit are presented

S.No	PROPERTY	VALUE
1	Specific Gravity	2.69
2	Bulk Density(gm./cc)	1.71
3	Water Absorption	1.67
4	Flakiness Index (%)	9.41
5	Elongation (%)	12.80

3. Test Conducted

The test was conducted on the different proportions of yellow soil, Quarry dust, Grit. In the proportion, the content of expansive soil and yellow soil was taken constant as 50% and 25% respectively. The content of Quarry dust and Grit was varied as needed.

The test was carried out with proportion 10% Quarry dust, 15% Grit and 15% Quarry dust, 10% Grit. The later one gives batter result in compare to another proportion. The test conducted was,

- **Consistency Test**
- **Stander Proctor Test**
- **CBR (California Bearing Ratio) Test**
- **Unconfined Compression Test**

For propose of the construction of road pavement on expansive soil is mainly affected by the properties are CBR Value, OMC, MDD. For this property tests are given below:

- Stander Proctor Test
- CBR (California Bearing Ratio) Test

4. Results

For proportion with 25% Quarry dust, 10% Grit
Stander Proctor Test:

The degree of compaction of a soil is measured in terms of its dry density. The degree of compaction mainly depends upon its moisture content, compaction energy and type of soil. For a given compaction energy every soil attains the maximum dry density at a particular water content which is known as optimum moisture content.

Table: 4 Readings of Stander Proctor Test:

Determination Number	1	2	3
Wt. of mould + Compacted Soil (g)	7681.5	7897	7729
Wt. of mould (g)	2868	2868	2868
Wt. of compacted Soil (g)	4813.5	5029	4861
Water Added(%)	10%	13%	16%
Wet Density (W_d)	2.14	2.24	2.16
Crucible Dish No.	36	18	44
Wt. of Empty Crucible W1(g)	21.47	26.9	22.2
Wt. of crucible + Wt. of soil W2 (g)	73.03	80.06	66.45
Wt. of crucible + Wt. of Dry Soil W3(g)	66.74	73.11	59.51
Moisture Content (W%)	13.89	15.04	18.60
Dry Density (g/cc)	1.88	1.94	1.82

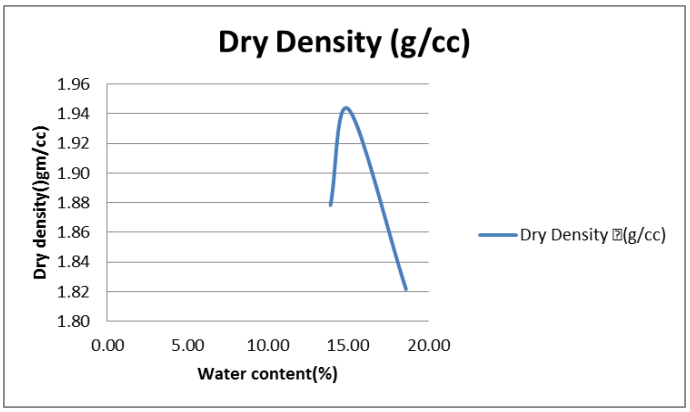

Chart -1: Graph represented MDD and OMC

CBR Test:

California Bearing Ratio is the ratio of force per unit area required to penetration to a soil mass with a circular plunger of 50mm diameter at the rate of 1.25 mm/min to that required for corresponding penetration in stander load. Ratio usually determined for penetration 2.5mm and 5mm.

Table: 5 Readings of CBR Test:

S. No	Penetration Dial Gauge	Load (from top)	Load (from bottom)	Average load	Standard load	CBR (%)
1	0	0	0	0		
2	0.5	18	13.1	15.55		
3	1	36.4	25.9	31.15		
4	1.5	56	40.5	48.25		
5	2	72.2	52.7	62.45	1370	5.32
6	2.5	84.8	61	72.9		
7	3	93.4	71.3	82.35		
8	3.5	101.3	77.9	89.6		
9	4	108.4	83.7	96.05		
10	4.5	114.8	88.7	101.75	2055	5.23
11	5	121.5	93.6	107.55		
12	5.5	126.2	96.8	111.5		
13	6	129.8	100.8	115.3		
14	6.5	135.4	103.7	119.55		
15	7	139.5	106.9	123.2	2630	4.82
16	7.5	142.9	110.5	126.7		
17	8	146.3	114.3	130.3		
18	8.5	150.7	119.5	135.1		
19	9	155.3	124.7	140		
20	9.5	158.9	128.3	143.6	3180	4.65
21	10	162.9	133	147.95		
22	10.5	166.9	136.8	151.85		
23	11	170.6	140	155.3		
24	11.5	176	144.2	160.1		
25	12.5	184	151.9	168.1	3600	4.67

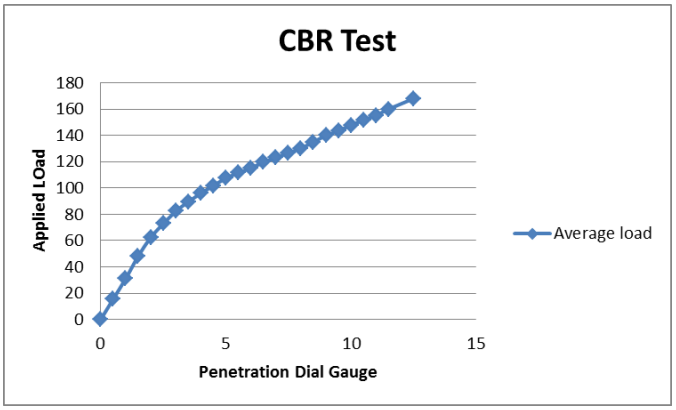

Chart -1: Graph represented CBR Value

4. CONCLUSIONS

The test were conducted to study of effects of stone dust , yellow spoil and grit of different proportion on the MDD, OMC, CBR ,UCS of an expansive soil, collected from the olpad village. On the basis of observation and discussion, following conclusions drawn from the study.

- The MDD is on increasing and OMC is increasing with increase in percentage of stone dust.
- The CBR is improved by 3 to 4 % by increase proportion of stone dust and grit.
- The cost of the construction is reduced due to use of locally available material.

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