STABILIZATION OF BLACK COTTON SOIL FOR FLEXIBLE PAVEMENTS BY USING BI-AXIAL GEO-GRIDS

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Abstract:- Soil Stabilization is mainly done to improve the strength of soil and bearing capacity of sub grade soil. Geo grid is most used stabilizer in stabilization of soil in flexible pavements. The main aim of this research was to check the effect of geo-grid reinforcement on CBR (California bearing ratio) value and the effect of geo-grid reinforced sub-grade on the design thickness of low volume paved roads. The different tests were conducted in order to determine the different characteristic and different test were performed i.e., sieve analysis, liquid limit, plastic limit, standard proctor test to find its maximum content and specific gravity, un soaked CBR and soaked CBR test to find it resistance to penetration, by placing a layer of a Bi-axial geo-grid at different heights. The CBR values were used to determine the pavement thickness.

Keywords:- Black cotton soil, Geo-grid, Sub-grade, soaked and un-soaked condition, CBR values.

I. INTRODUCTION

India is country with huge population which requires a large amount of constructions. Soil stabilization is much important process in construction. Soil stabilization is process of improving soil performance by increasing its tensile strength, bearing capacity and also increases the strength of pavement. Black cotton soil will have India is country with huge population which requires a large amount of constructions. High swelling and shrinkage and they exhibit high moisture content. Bearing capacity decreases in black cotton soil because of nature of black cotton soil. Flexible pavement consists of 4 layers which are sub grade, sub base, base and surface course. Expansive soils that increases in volume or expand as they wet and shrink as they dry out.

Design of flexible pavements pays particular attention to two critical locations within the pavement structure the use of aggregates with excessive fines and inadequate inspection may lead to rapid pavement deterioration. Finally pavement distress is also a function of maintenance or, more correctly, lack of maintenance. Geo-synthetics used for separation minimize intrusion of sub grade soil into the aggregate base or sub-base. The potential for mixing of soil layers occurs when base course is compacted overt the sub base during construction and also during operation of traffic. Additionally a geo-synthetic can perform a filtration function by restricting the movement of soil particles while allowing water to move from the sub grade soil to the coarser adjacent base.

Generally, the beneficial influence of geo-grids reinforcement on the bearing capacity, settlement and sub grade modulus has been recognized for quite some time. A full scale field test on geo-synthetic reinforcement unpaved road was carried out including compaction and trafficking to investigate the bearing capacity and its performance on soft sub grade. They implied the reduction of the thickness of the fill layer for specified compaction values and bearing capacities and the reduction in the rut formation as a function of the trafficking , increasing the serviceable life of the track as the benefits of laying a geo synthetic as reinforcing layer between the fill and the sub soil.

II EXPERIMENTAL INVESTIGATION

In this project, the soil is collected from St. Martins engineering college surroundings. The soil used is black cotton soil. Different tests done are liquid limit, plastic limit, compaction test and specific gravity. Compaction test is main test as it determines the optimum moisture content of soil which soil which is used in CBR test. We can see test result from table 1.

Properties of black cotton soil	values
Liquid limit	25%
Plastic limit	9.72%
Optimum moisture content (%)	16.8%
MDD	1.678
Specific gravity	2.31

Table 1. Experimental test results

Objectives:-

1. To improve bearing capacity of black cotton soil.
2. To increase the strength of pavement by using geo grids.
3. To reduce the cost of the project and also reduce thickness of pavement.
4. To increase the structural integrity of black cotton soil used in construction of pavement.

III METHODOLOGY

Collection of Soil Sample

Two samples of soils had been collected in the location of Bowrampet.

Materials Required

1. Black cotton soil
2. Bi-axial geo-grids

Scope of Work

The experimental work consists of the following step:

1) Determination of soil index properties (Atterberg limits)
   a) Liquid limit by casagrande's apparatus
   b) Plastic limit
2) gravity of soil
3) California Particle size distribution by sieve analysis
4) Proctor compaction test
5) Specific bearing ratio test (CBR)

IV RESULTS AND DISCUSSION

LOIQUID LIMIT

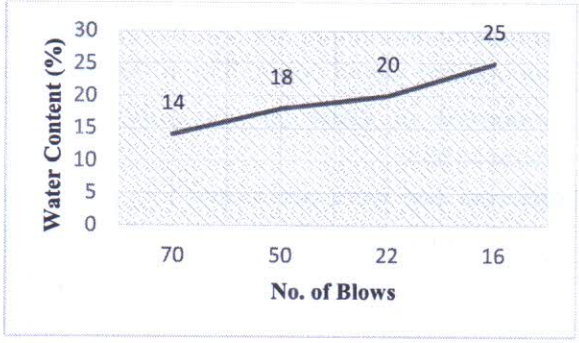

Fig 1. Liquid limit graph

SIEVE ANALYSIS

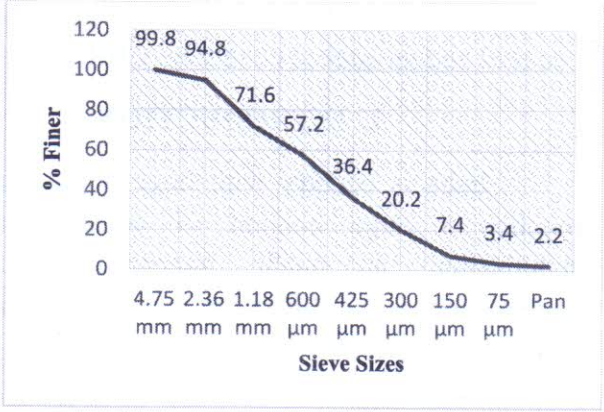

Fig 2. Sieve analysis graph

PROCTOR COMPACTION

SL N0.	Penetration in mm (C_1)	Proving Ring Readings (C_2) KN	Proving Ring Readings in Division ($C_3=C_2*5$)	Load in Kg $C_4=C_4*0.91$
1	0.0	0.0	0.0	0.0
2	0.5	3.0	15.0	13.7
3	1.0	3.8	19.0	17.4
4	1.5	4.2	21.0	19.2
5	2.0	4.8	24.0	22.0
6	**2.5**	**5.0**	**25.0**	**22.9**
7	4.0	5.5	27.5	25.2
8	**5.0**	**5.8**	**29.0**	**26.5**
9	7.5	6.5	32.5	29.7
10	10.0	6.7	33.5	30.7
11	12.5	7.1	35.5	32.5

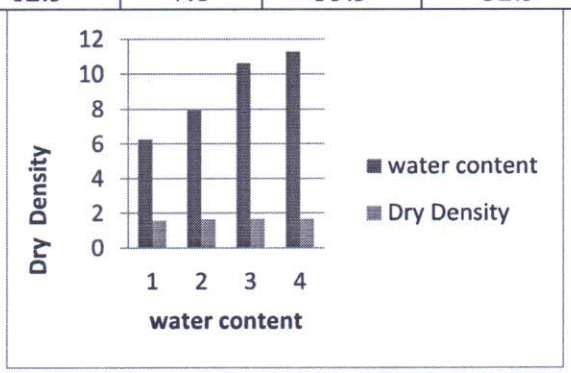

Fig 3. Compaction graph

CBR TEST ANALYSIS

SL N0.	Penetration in mm (C_1)	Proving Ring Readings (C_2) KN	Proving Ring Readings in Division ($C_3=C_2*5$)	Load in Kg $C_4=C_4*0.91$
1	0.0	0.0	0.0	0.0
2	0.5	2.5	12.5	11.4
3	1.0	3.2	16.0	14.6
4	1.5	3.7	18.5	16.9
.5	2.0	4.7	23.5	21.5
6	2.5	5.4	27.0	24.7
7	4.0	5.7	28.5	26.1
8	5.0	6.1	30.5	27.9
9	7.5	6.3	31.5	28.8
10	10.0	6.8	34.0	31.1
11	12.5	7.0	35.0	32.0

Table 2. CBR test data without geo grid

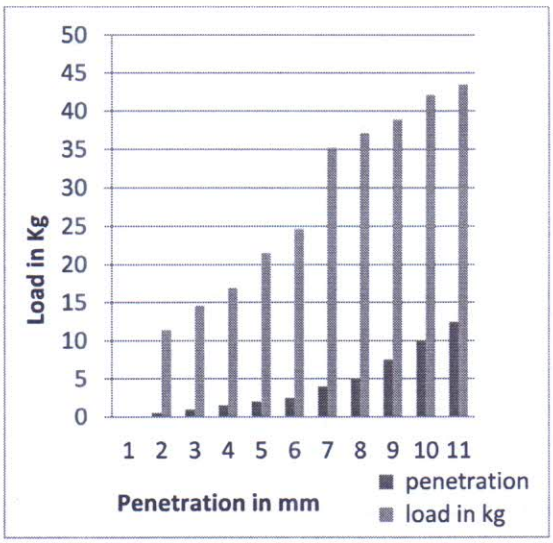

Fig 4. CBR graph without geo grid

Table 3. CBR test data with geogrid at H/4 distance

Table 4. CBR test data with geogrid at 3H/2 distance

SL N0.	Penetration in mm (C_1)	Proving Ring Readings (C_2) KN	Proving Ring Readings in Division ($C_3=C_2*5$)	Load in Kg $C_4=C_4*0.91$
1	0.0	0.0	0.0	0.0
2	0.5	3.7	18.5	16.9
3	1.0	4.9	24.5	22.4
4	1.5	5.6	28.0	25.6
5	2.0	6.7	33.5	30.7
6	2.5	7.5	37.5	33.3
7	4.0	7.7	38.5	35.2
8	5.0	8.1	40.5	37.1
9	7.5	8.5	42.5	38.9
10	10.0	9.2	46.0	42.1
11	12.5	9.5	47.5	43.5

SL N0.	Penetration in mm (C_1)	Proving Ring Readings (C_2) KN	Proving Ring Readings in Division ($C_3=C_2*5$)	Load in Kg $C_4=C_4*0.91$
1	0.0	0.0	0.0	0.0
2	0.5	7.9	39.5	36.1
3	1.0	9.1	45.5	41.6
4	1.5	9.8	49.0	44.8
5	2.0	10.9	54.5	49.9
6	2.5	11.7	58.5	53.5
7	4.0	11.9	59.5	54.4
8	5.0	12.3	61.5	56.3
9	7.5	12.7	63.5	58.1
10	10.0	13.4	67.0	61.3
11	12.5	13.7	68.5	62.7

Table 5. CBR test data with geogrid at 3H/4 distance

Description	CBR Value
Without geo-grid	1.67
With geo-grid @ H/4 from the bottom	1.80
With geo-grid @H/2 from the bottom	2.50
With geo-grid @ 3H/4 from the bottom	3.91

Table 6. CBR value variation with geo grid application

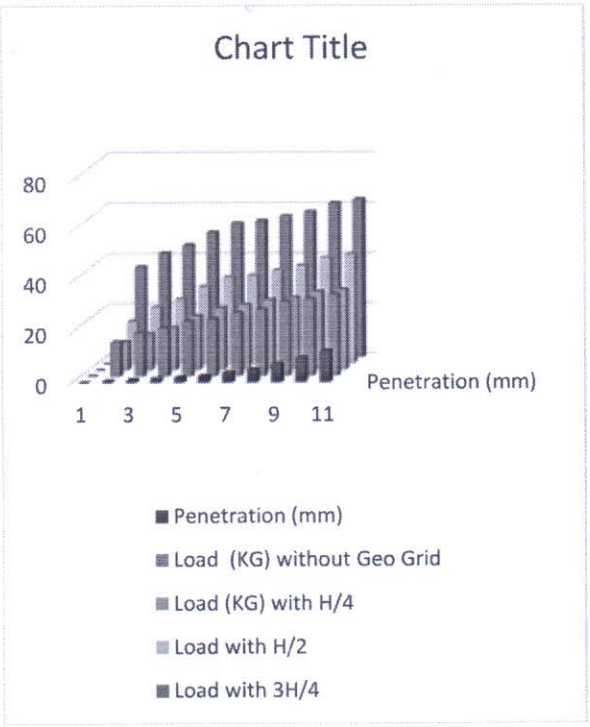

Fig 4. CBR contrast with geo grid application

V CONCLUSION

The positive effects of geo-grid reinforced sub grade courses can economically and ecologically be utilized to reduce layers thickness. And it can also increase the life of the pavement and can also decrease the overall cost of the pavement construction with an increased time.

1. The study investigated the application of geo-grids to sub grade material as a form of reinforcement to road construction.
2. The inclusion of the geo-grid considerably increases the strength of poor soils, which is reflected in the higher CBR values. The study shows that the strength of the sub grade is significantly altered positively by the positioning of the geo-grid at varying depth.
3. It was observed that the highest sub grade strength is achieved when it is placed at 3H/4 (i.e., 3.91) for a single layer although has a satisfactory result at H/2 (i.e., 2.50) and H/4 (i.e., 1.80) respectively.
4. On reinforcing the soil, there is a considerable increase in performance of the sub-grade in the un-soaked condition. The use of geo-grids as reinforcement to poor soils improves its strength.
5. It is non-bio degradable and therefore durable is also increases the ultimate service life of the pavement.
6. The use of Geo-grids should, therefore, be encouraged as an effective and modern form of improving road construction on poor sub-grade materials.
7. Further research should be analyzed in ascertaining the effect of geo-grids on sub-grade soils under the un soaked condition.

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