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STUDY ON BEHAVIOUR OF A SANDY SOIL BY USING CUTBACK BITUMEN

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ABSTRACT: The key point of a stable and well constructed structure is the stability and strength of its foundation. Weather it is a building or a road pavement both require a good substructure. Fine grained soils are susceptible to expansion, contraction and high compressibility and course grained soils may have a high permeability and are also susceptible to erosion. Sand as a sub-grade soil may have low shearing strength and high permeability. The improvement of sub-grade soil will increase its durability and the performance of road structure as a whole. In the present study, bituminous cutback has been used as a stabilizer to improve the properties of a locally available cohessionless soil.The percentage of bituminous cutback added to the sandy soil has been varied from 4% to 18%. A uniform compaction was provided to all the samples prepared. Unconfined Compressive Strength, CBR value and permeability of the soil samples were studied. From the UCS test, it is observed that maximum unconfined compressive strength is obtained at 12% cutback content further increase of cutback in the soil leads to decrease in UCS value due to excessive fluidity causing decrease in density. A sharp increase in CBR value of sand was observed with a small increment in cutback bitumen content (about 8 %). Further increase in cutback content (8% to 10%) increased the C.B.R value moderately to reach a peak and then still further increase in cutback content (i.e more than 10%) reversed the trend. Permeability test shows a decrease in coefficient of permeability upto 12% of cutback bitumen and then show increase in coefficient of permeability with an increase in cutback bitumen.

Keywords: CBR, Unconfined compressive strength, permeability, bituminous cutback.

I. INTRODUCTION

Modification or improvement in the engineering properties of soils is required, wherever the soils encountered for various engineering projects are unsuitable. Many engineering projects such as improvement of sub-grades under highways and airport runways, stabilization of slopes in cuts and embankments, increasing soil bearing capacity under foundations etc. require some or other form of soil stabilization.There are many methods of soil stabilization applicable to different types of soils, for stabilizing weak sandy deposits - compaction, cement stabilization, lime stabilization has become very popular.In this study, bituminous cutback has been used as a stabilizer to improve the properties of locally available cohesion-less soil. Bituminous stabilization is preferred over other type of stabilizers because bituminous stabilization helps to increase the shear strength and also decreases the permeability of sandy soil.

II. LITERATURE REVIEW

AZM S.AL-HomoudD, Taisir, KhedaywiI, Abdallah M. AL-AjlouniIet al(2008) investigated the effectiveness of "bitumen" as a soil stabilizing agent. For this purpose, four different soils from Northern Jordan, which exhibit certain engineering problems, such as swelling and collapsibility, were selected. Two of these soils were swelling soils (Irbid and Ramtha), while the other two are collapsible (JUST and Mafraq). To conduct this work, soil-bitumen mixtures were prepared at 3%, 5%, 7% and 10% bitumen by dry weight of soil. Both natural and bitumen treated soils were subjected to similar laboratory tests to observe the influence bitumen on swelling and collapse potential. The test results showed that bitumen is effective in stabilizing the tested soils. Upon mixing with soils, bituminous materials act as a binding agent between soil particles. Additionally, test results showed that cutback bitumen percentages in excess of 7% do not show a substantial reduction in swelling and collapsibility potentials.

Parithosha Perika Prof G.Venkataratnam et al (2015) discussed about the application of ambient temperature asphalt emulsion stabilization technology and discussed to the environmental fixation of soils contaminated by organic contaminants. From this study it is clear that there is a considerable improvement in California Bearing Ratio (CBR) of sub-grade due to use of MS bitumen emulsion if proper mixing is done. Observing its economic cost and quality of stabilization improvement, it is clear that this type of stabilization may be applicable in gravel soil road or in shoulder portion of highways.

Simarpreet Singh Batra , Jashandeep Singh Arora et al(2016) carried out experiments on the soil sample to study the effect of Bitumen Emulsion on Shear Strength parameters using Direct Shear Test, the points are observed: At 6% Bitumen Emulsion, the cohesion between soil particles was reduced to 0.1638 N/mm 2 but at the same time angle of Internal Friction „υ‟ was drastically increased to 67.304o resulting in appx. 65% increase in Shear Strength of soil due to sticking property of Bitumen particles that binds the soil particles resulting in increased friction among soil particles. The Optimum Mix containing 9% Water and 6% Bitumen Emulsion gives the maximum Shear Strength of soil equal to 0.38 N/mm2 .

III. MATERIALS

1 SOIL

Nearly 50 Kg of locally available sand was collected from Kurukshetra and thoroughly hand sorted to eliminate the

vegetative matter and pebbles. Then, the soil was sieved through 4.75mm sieve to remove the gravel fraction. Soil was oven dried for 24 hours before execution of geotechnical tests.

Table 1 Physical Properties of Soil

S. No	Parameters	Result
1	Proctor Test results (Light Compaction) MDD (g/cm^3) OMC(%)	1.62 12.24
2	Specific Gravity	2.67
3	Fineness Modulus	2.37
4	Coefficient of curvature	4.27
5	Coefficient of uniformity	0.651
6	Soil Group	SP-SM

2 BITUMEN

Bitumen is an oil based substance. it is a semi-solid hydrocarbon product produce by removing the lighter fraction (such as liquid petroleum gas, petrol and diesel) from heavy crude oil during the refining process. As such. it is correctly known as refined bitumen. At ambient temperature bitumen is a stable, semi-solid substance.

FIGURE 1

Table 2 Properties of Bitumen

Property	Range/Value
Penetration(mm)	31
Softning point (°C)	88
Fire point (°C)	234
Flesh point (°C)	220
Ductility (cm)	27

3 SOLVENT

Bitumen is dissolved in solvent for the formation of cutback. In this dissertation, diesel is used as a solvent. Some solvents which are commonly used are:Kerosene oil, Diesel, Gasoline and Neptha

Diesel was procured from a Hindustan Petroleum dealer, The details of Specification are as per IS 73:2006

Table 3 Properties Of Diesel (Solvent)

1	Density	0.84-0.86
2	Flesh point	68-94
3	Viscosity @40c	2.04-3.23
4	Sulphur ppm	1-10
5	Stability	Good
6	Oxygen content %	0
7	Lubricity	Good
8	Distillation	307-352

4 CUTBACK

Cutback bitumen is simply a combination of bitumen and petroleum solvent. Like emulsions, cutbacks are used because they reduce bitumen viscosity for lower temperature uses (tack coats, fog seals, slurry seals, stabilization material). Similar to emulsified bitumen, after cutback is applied, the petroleum solvent evaporates leaving behind asphalt cement residue on the surface to which it was applied. Cutback is said to "cure" as the petroleum solvent evaporates away. Cutback bitumen is used when there is limited access to heating equipment and bitumen may be cooled throughout working.

IV. EXPERIMENTAL PROCEDURE

The objective of this study is to examine the behavior of sandy soil by stabilizing with bitumen. Nine specimens were prepared to investigate the properties of soil. These specimens were prepared by adding 2%, 4%, 6%, 8%, 10%, 12%, 14%, 16%, 18% of cutback bitumen stabilizer. Standard Proctor Test, Unconfined Compressive Strength Test, California Bearing Ratio Test and Permeability Test were conducted to determine the optimum moisture content (OMC), Maximum dry density (MDD), compressive strength and permeability of the stabilized soil.

1 COMPACTION TEST

This Phase of Study involved a detailed investigation of the compaction characteristics of the parent soil and soil-cutback sample containing different proportion of Cutback contents, in order to obtain the optimum moisture contents and maximum dry densities. The optimum moisture contents thus obtained were used in preparing samples for Unconfined Compressive Strength Test.

i) Sample Preparation

For parent soil, 3kg of oven dried soil sample is taken on tray and mixed thoroughly with water in varying percentage range starting from 2% by weight of soil up to 18% for the determination of optimum moisture contain(OMC) and Maximum Dry Density(MDD). Same test is conducted for bituminous cutback instead of water with same percentage range.

ii) Procedure

The mixed sample is placed in previously weighted (mig) mould of capacity 1000 cc. in three layers. Each layer is

given 25 blows with a 2.6 kg rammer with free fall height of 310 mm. After three successive layers collar is removed and excess soil is trimmed off. The weight of mould with soil is taken (m2g). This process is repeated for other water content also until there is a decrease in m2 value. For each trial a portion of soil is taken for moisture content determination.

iii) Calculation

Bulk density of soil, $\gamma = (m_2 - m_1)/1000$

Dry density of soil, $\gamma_a = \gamma/(1 + w)$

Where, w = moisture content present in soil.

V. CONCLUSION

In this thesis, strength characteristics and permeability of local Sandy soil with about 10% silt content with Cutback stabilizer have been studied. The study lead to the following conclusions :-

- In proctor test (low compactive effort), Maximum dry density of 1.61 g/cm^3 was achieved at a moisture content of 12.24%. Further increase in moisture content tends to decrease dry density of the specimen.
- For soil-cutback specimens, maximum dry density of 1.72gm/cc is achieved at a cutback content of 12%.
- The unconfined compressive strength of sandy soil was practically zero when no stabilizer was added in the soil. The unconfined compressive strength increased upto 0.68 kg/cm² when 12% stabilizer was mixed, with futher increase in cutback bitumen content the unconfined compressive strength decreased.
- The maximum CBR value of soil-stabilizer mix was observed at 10% stabilizer and came out to be 21.85%. Further increase in cutback content decreased the CBR value .
- Permeability of parent soil decreased with the addition of stabilizer content upto12% and with further addition of stabilizer the coefficient of permeability increased at a very slow rate.

VI. FUTURE SCOPE

Improving properties of various soils is paramount importance today. In this study an effort has been made to improve a local sandy soil with cutback bitumen as a stabilizer. Here are some other suggestions made for further research:

- Similar study can be made with different types of cutbacks or bitumen emulsions.
- Studies can be made on various other types of soils.

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