STABILIZATION OF SOIL BY USING THE CEMENT : A REVIEW

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Abstract: **Soil Stabilization** is the alteration of soils to enhance their physical properties. Stabilization can increase the shear strength of a soil **,** and control the shrink-swell properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavements and foundations. Soil stabilization can be utilized on roadways , parking areas , site development projects , airports and many other situations where sub-soils are not suitable for construction.

Among the several modes of transportation, the roads have been the most ancient and widely used medium. Since the ancient time for transportation of goods or travelling purpose, we used roads. Heavy loaded trucks running on the roads need special care and attention during construction phase so that they can bear the maximum load. Some of the soil having sufficient load bearing capacity but some of having poor. This research work mainly focuses on soil stabilization using cement to improve geotechnical properties such as plasticity, compaction, and Unconfined Compressive Strength of the studied soil. These properties were determined before as well as after the stabilization of soil. In this work it was found that higher the quantity of cement added to the soil, dry density of soil decreased and optimum moisture content increased. With the addition of cement to the soil, unconfined compressive strength increased, and it was also found higher at higher curing period. A series of California Bearing Ratio (CBR) tests were carried out on randomly reinforced soil by varying percentage of polythene strips with different lengths and proportions. Results of CBR tests demonstrated that inclusion of cement in soil with appropriate amounts improved strength and deformation behavior of sub grade soils substantially. The tests such as liquid limit, plastic limit, standard proctor compaction test, **California bearing ratio (CBR)** test and **unconfined compressive strength (UCS**) have been conducted to check the improvement in the properties of soils having low bearing capacity such as black cotton soil.

Keywords: Soil Stabilization, CBR, Unconfined compressive strength, cement.

INTRODUCTION-

Road stabilization is the method of providing strength to the natural soil against the heavy load of modern day traffic and to reduce the damage of roads in a different climate. The methods employed include the use of admixtures, compaction and densification of soil. Admixture can be chemical binders, industrial wastes, cement, and fly ash. Soil Stabilization is a technique used to change different soil properties and to enhance its performance for engineering purpose .Selection of stabilizer for a certain field depends mainly on the type of soil, type of construction to develop, and availability of materials to be used in construction .Cement base pavement has an advantage of great strength and durability.

Also, it is widely available hence becomes the best material for stabilization of soil. The hydrated product of cement binds with soil to form the cement-stabilized base or cement- treated aggregate base. The strength of stabilized soil will mainly depend on the quantity of cement used in the soil. The proportion of cement required in soil decides based on the type of soil. Portland cement widely used as a soil stabilizers, because of its easy handling and quality control properties .With the increase in cement quantity in the strength of the cement stabilized soil increases .Several researchers have found that stabilization using cement is more suitable for granular soil and clay soil having low PI .Based on UCS value, quality of soil used in subgrade classified as soft, medium, stiff, very stiff and

hard .UCS value of stabilized soils on curing time increases with the higher quantity of cement added to the soil .The curing period effect the UCS test result of cement stabilized soil, and higher strength obtains for the soil sample cured for 14 days compared to 7 days curing .

For different types of soil, a guideline for stabilization has issued specifying the Plasticity Index (PI) of sandy soil to be less than 30. For fine grain soil PI should not be more than 20 and to ensure proper mixing liquid limit (LL) should not be more than 40. For soil having a higher amount of clay two stage stabilization may be adopted i.e. the clay is treated with lime in stage I to reduce the value of plasticity and hence to provide a facility for pulverization, whereas in stage II, the resulting soil stabilizes with cement. Physical properties of soil like particle size distribution, clay content, liquid limit and plasticity index play a major deciding factor in any project. Also, the chemical nature of soil has a great impact on deciding the durability of roads. Hence to achieve a solid and stable foundation we need stabilization technique. Factors affecting soil cement stabilization are soil, cement, pulverization and mixing, compaction and curing. Material requirements for stabilization are the well-graded soil of LL less than 45%, PI less than 20% and cement quantity based on UCS value.

II. TYPES OF STABILIZATION TECHNIQUES

a. Mechanical stabilization: Where the stability of the soil is increased by blending the available soil with imported soil or aggregate, so as to obtain a desired particle-size distribution, and by Compacting the mixture to a desired density. Compacting a soil at appropriate moisture content itself is a form of mechanical stabilization.
b. Chemical stabilization: Mixing or injecting additives such as lime, cement, sodium silicate, calcium chloride, bituminous materials and resinous materials with or in the soil can increase stability of the soil. Chemical stabilization is the general term implying the use of chemicals for bringing about stabilization.

III. APPLICATIONS OF SOIL STABILIZATION –

The process of soil stabilization is useful in the following applications:

- Reducing the permeability of soils
- Increasing the bearing capacity of foundation soils.
- Increasing the shear strength of soils
- Improving the durability under adverse moisture and stress conditions
- Improving the natural soils for the construction of highways and airfields
- Controlling the grading of soils and aggregates in the construction of bases and sub bases of the highway and airfields.

In addition , there are several environmental advantages. When unimproved roadways are stabilized and treated with the right additives , run off of storm water will not cause erosion , which in turn sends silts to river and bays . Thus our soil stabilization methods help to preserve soils , water ways , unimproved roadways and much more.

IV. OBJECTIVES OF THE PRESENT STUDY -

- To determine Specific gravity, Grain size analysis and determine its index properties of soil.
- To mix plastic strips with Red soil in various percentages and determine its CBR value.
- To arrive the optimum mix from Red Soil- cement combination.

- To alter the soil condition in the site by using cement.

V. METHODOLOGY- Soil samples are collected from our college campus are tested for their geotechnical properties and strength characteristics. The various tests conducted to obtain geotechnical parameters are:

a. Free swelling index

b. Liquid Limit

c. Plastic Limit

d. Core cutter method

e. Standard proctor test

f. Modified proctor test

g. Sieve analysis of soil

h. California Bearing Ratio test.

i. Plate load test .

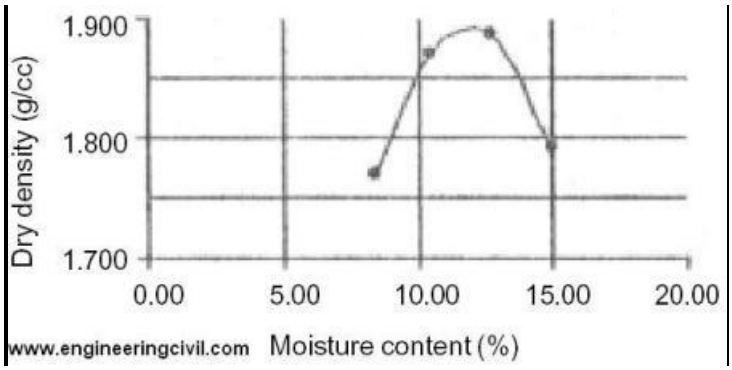
VI. RESULT AND DISCUSSION

Tests results of the soil sample are

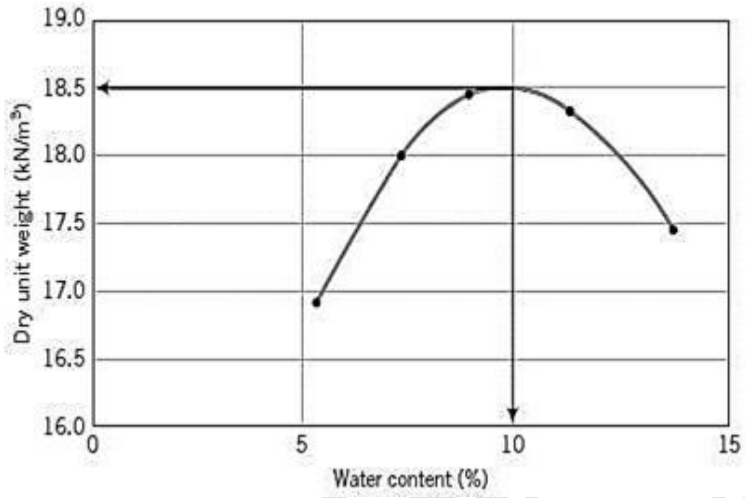
1. California Bearing Ratio

   For untreated soil sample Maximum value of CBR for sub grade = 5.07 %
   For 2% cement added to soil sample Maximum value of CBR for sub grade = 6.62 %
   For 4% cement added to soil sample Maximum value of CBR for sub grade = 8.23 %
   For 6% cement added to soil sample Maximum value of CBR for sub grade = 10.15 %
2. FREE SWELL INDEX TEST: free swell index ratio of soil is 12%
3. LIQUID LIMIT OF SOIL: Moisture content of soil is 45%
4. PLASTC LIMIT OF SOIL:
   Plastic Limit: 18.8%
   Plastic Index: 32.45%

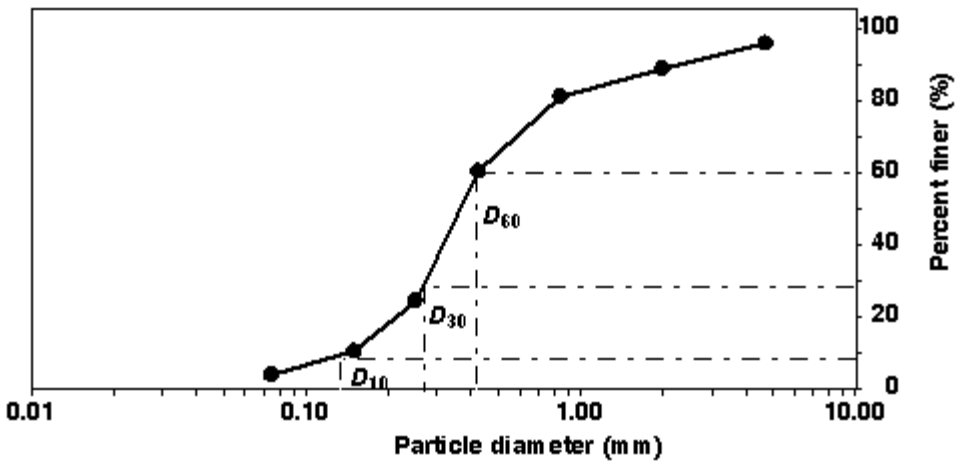
VII. STANDARD PROCTOR OF SOIl-



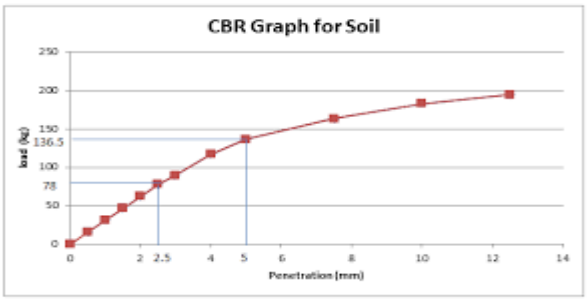
VIII. MODIFIED PROCTOR OF THE SOIL



IX. SIEVE ANALYSIS OF SOIL



XI. CALIFORNIA BEARING RATIO OF SOIL



CONCLUSION : This study made a comprehensive examination of the effectiveness of cement treatment on geotechnical properties of soils.

1. Test result indicate that with the increase in cement content liquid limit, plastic limit and plasticity index decreases as compared to untreated sample.

2. Maximum dry density increases while optimum moisture content reduced with increasing 2%, 4%, and 6% cement with respect to untreated soil sample.

3. Test result of direct shear test indicates with increase in cement content the value of cohesion „c" decreases and the value of angle of internal friction „Φ" increases with every interval of increment of cement.

4. California bearing ratio (CBR) of stabilized samples increases sharply with increases cement content. CBR of sample stabilized with 6% cement and compacted of 5 layers with heavy energy of 55 blown in each layers fulfil the criteria proposed by AASHTO soil classification.

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