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Soil Stabilization by using Plastic Waste

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ABSTRACT

Soil stabilization is a process which improves the physical properties of soil, such as increasing shear strength, bearing capacity etc. which can be done by use of controlled compaction or addition of suitable admixtures like cement, lime and waste materials like fly ash, phosphor gypsum etc. This new technique of soil stabilization can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials.

Plastic such as shopping bags is used to as a reinforcement to perform the CBR studies while mixing with soil for improving engineering performance of sub grade soil. Plastic strips obtained from waste plastic were mixed randomly with the soil. A series of California Bearing Ratio (CBR) tests were carried out on randomly reinforced soil by varying percentage of plastic strips with different lengths and proportions. Results of CBR tests demonstrated that inclusion of waste plastic strips in soil with appropriate amounts improved strength and deformation behavior of sub grade soils substantially

Keywords: CBR, Plastic bottle, Plastic bag, Soil Stabilization.

I. INTRODUCTION

Stabilization of soils is an effective method for improving the properties of soil and pavement system performance. The objectives of any stabilization technique used are to increase the strength and stiffness of soil, improve workability and constructability of the soil and reduce the Plasticity Index. For any given soil many stabilization methods, using different stabilizing agents, may be effective to improve the soil properties in-place rather than removing and replacing the material. Availability or financial considerations may also be the determining factor on which a stabilizing agent is selected.

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.

IV. PLASTIC AND ITS POTENTIALITY FOR RECYCLING

Plastic and materials made with plastic have become the integral part of our day to day life in various stages and also in various forms, but then, the disposal and dumping of the used and unwanted plastic has become a major threat for the civilized society, as the production and usage of new plastic and plastic associated materials are not in balance with its recycling recycled plastic products status.

Plastic bottle and plastic bags recycling has not kept pace with the dramatic increase in virgin resin polyethylene Terephthalate (PET) sales and the aspect of reduce / reuse / recycle, has emerged as the one that needs to be given prominence. The general survey shows that 1500 bottles are dumped as garbage every second. PET is reported as one of the most abundant plastics in solid urban waste whose effective reuse/recycling is one of the critical issue which needs immediate attention.

Waste water bottle samples

Waste bag samples

V. OBJECTIVES OF THE PRESENT STUDY

- To determine the properties of red soil procured.
- 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-Plastic strips combination.
- To manage the indecomposable and upgradable plastic waste.
- To alter the soil condition in the site by using low cost plastic waste.

VI. METHODOLOGY

Soil samples 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.

VII. RESULT AND DISCUSSION

Tests results of the soil sample are,

1. FREE SWELL INDEX TEST:

Free swell index ratio of soil is 10.57%

2. LIQUID LIMIT OF SOIL:

Moisture content of soil is 50%

Liquid limit of given soil sample = 53%

3. PLASTIC LIMIT OF SOIL:

Plastic Limit: 16.66%

Plastic Index: 33.34%

4. SPECIFIC GRAVITY OF SOIL

PERTICULARS	**TRAIL 1**	**TRAIL 2**
Empty weight of pycnometer $_{W1}$ gms.	660	660
Weight of bottle+drysoil sample $_{W2}$ gms.	1090	935
Weight of bottle+soil+water $_{W3}$ gms.	1790	1695
Weight of bottle water $_{W4}$ gms.	1545	1545

SPECIFIC GRAVITY OF SOIL $= \frac{(w2-w1)}{(w2-w1)-(w3-w4)}$

Specific Gravity Of Soil = 2.32.

5. CORE CUTTER OF SOIL:

Volume of core cutter (VC) = 1021 cm^3

Mass of core cutter (WC) = 915gms

Mass of core cutter + wet soil (WS) =2780 gms

Mass of wet soil (WS-WC) = (2780-915) = 1865 gms

BULK DENSITY = $\gamma = \frac{M}{V}$

$= \frac{1865}{1021}$

= 1.81 g/cm^3

DRY DENSITY (d) = $\frac{\gamma}{1+w}$

$= \frac{1.81}{1+16.66}$

d = 0.103 gm/cm^3.

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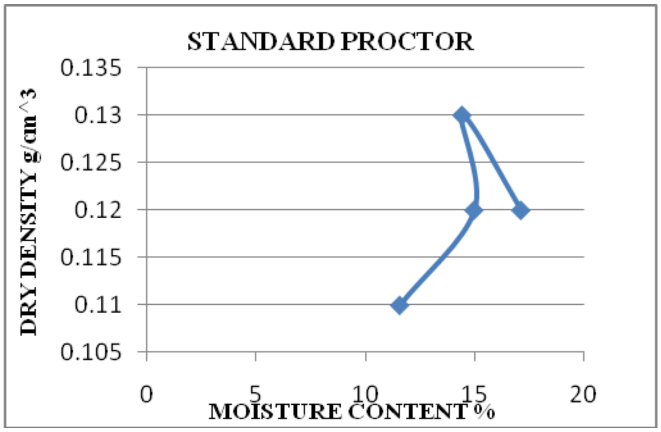
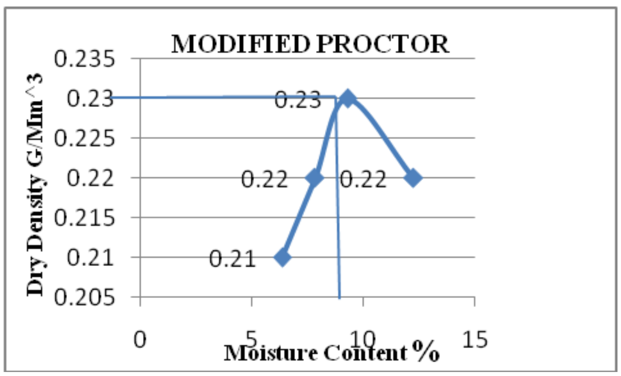
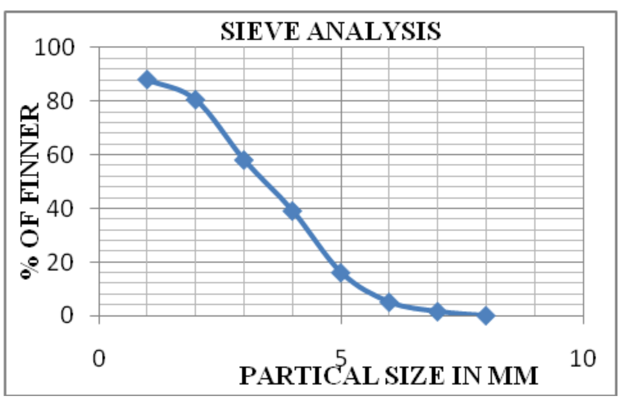
VI. STANDARD PROCTOR OF SOIL



VII. MODIFIED PROCTOR OF THE SOIL



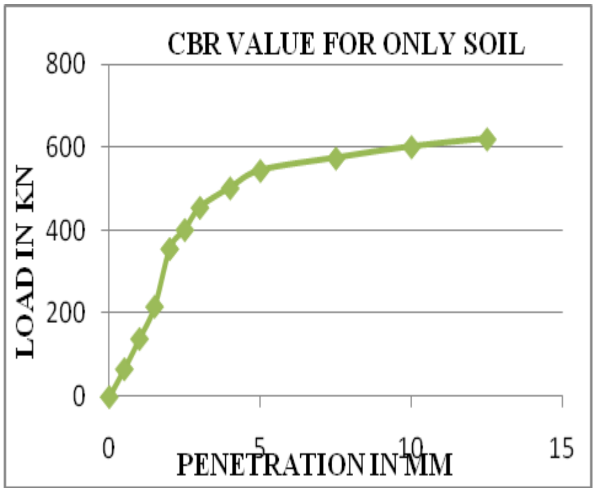
VIII. SIEVE ANALYSIS OF SOIL

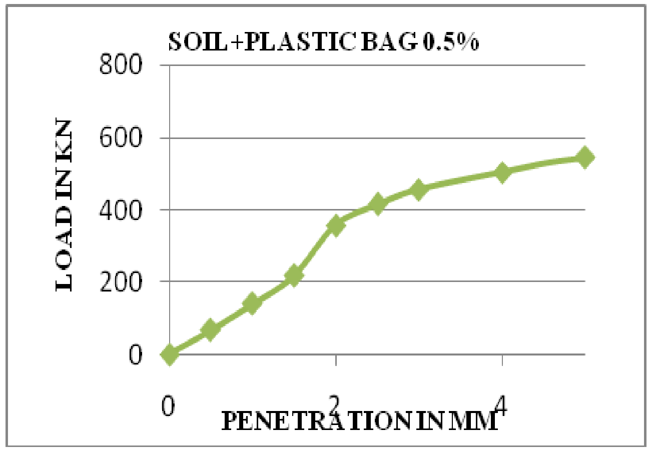


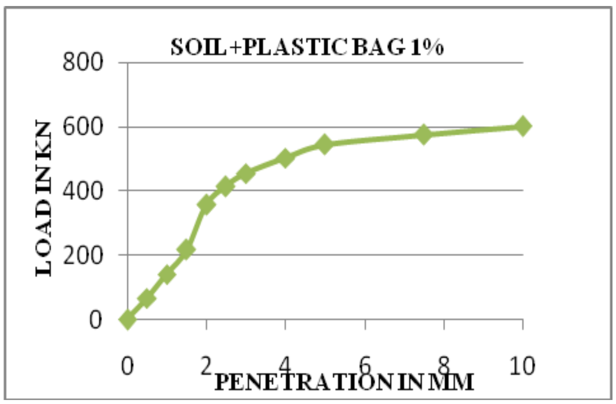
Co-efficient of curvature = 1.15.

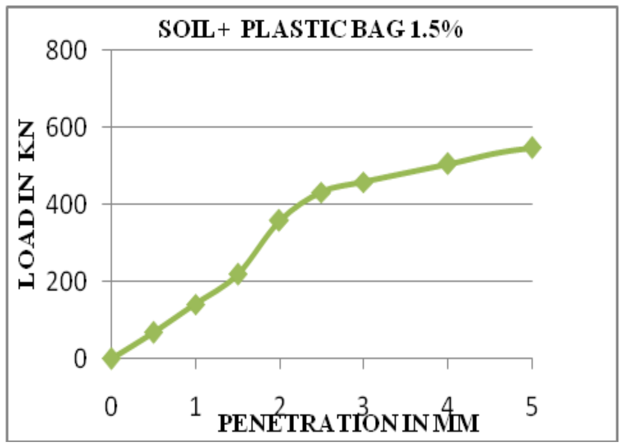
Co-efficient of uniformity = 5.68.

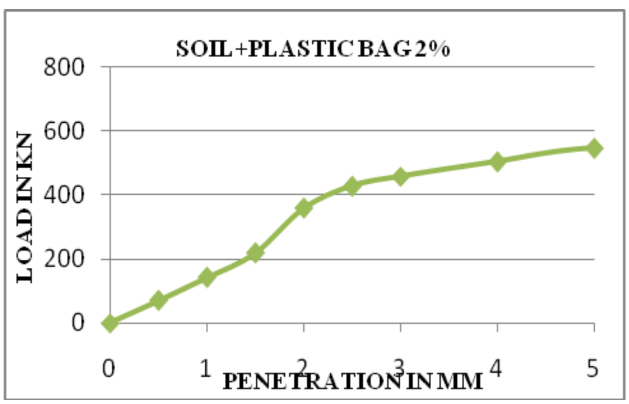
IX. CALIFORNIA BEARING RATIO OF SOIL

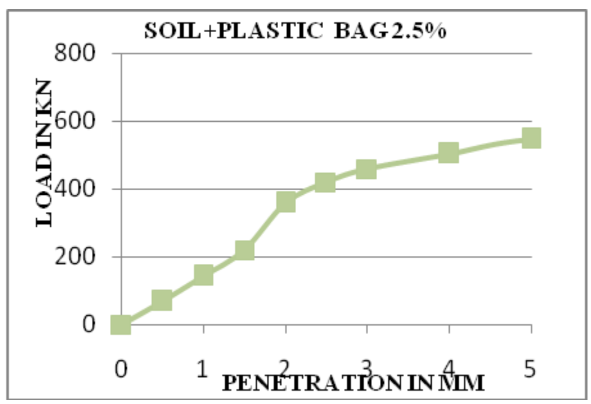












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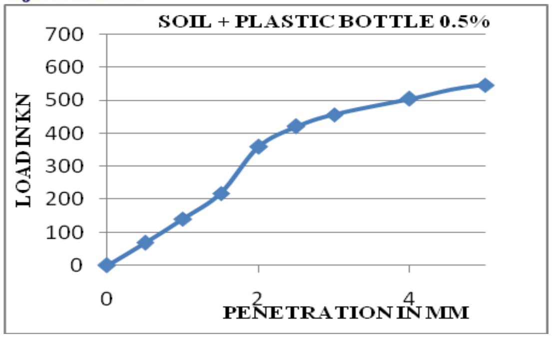

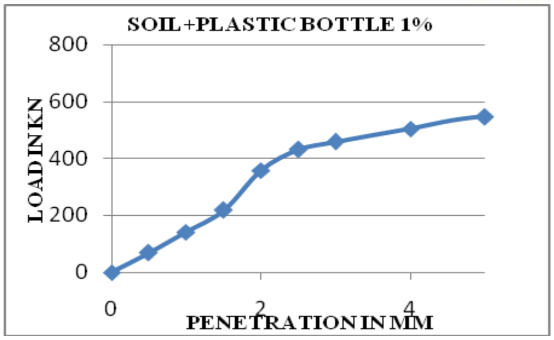

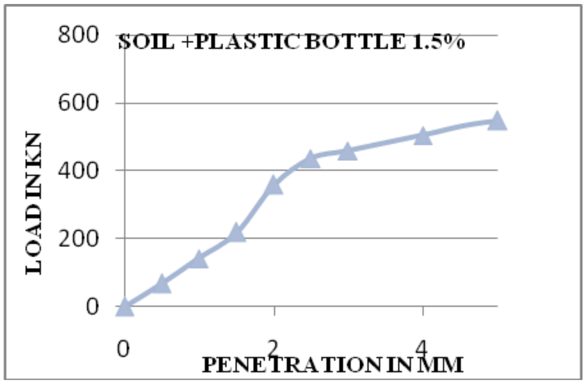

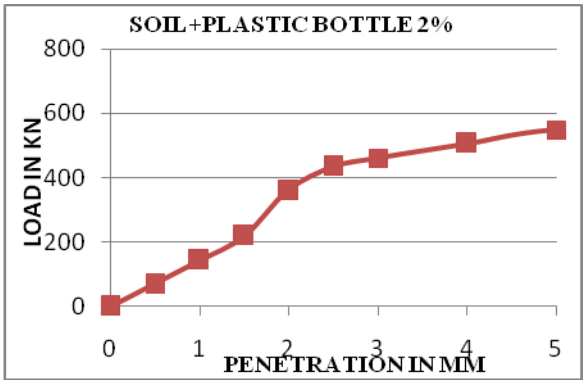

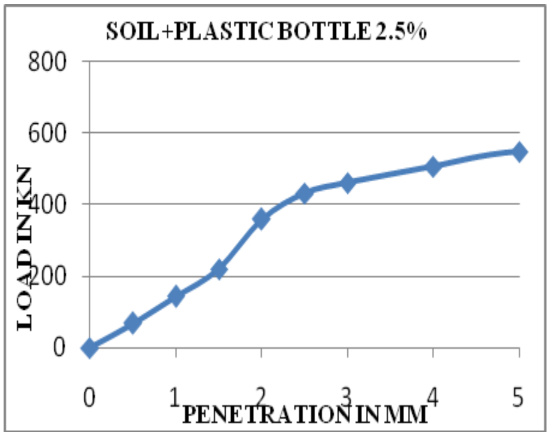

Consolidated CBR values

SOIL + PLASTIC BAG	SOIL + PLASTIC BOTTLE
Only soil =29.34%	Only soil =29.34%
0.5% = 30.50%	0.5% = 30.72%
1% = 30.80%	1% = 31.38%
1.5% = 31.40%	1.5% = 31.89%
2% = 29.56%	**2% = 31.67%**
2.5% = 29.54%	2.5% = 31.45%

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X. CONCLUSION

- From this study, we can conclude that plastic bottle strips can be used to increase the CBR value of a soil considerably. in this study we can see that the maximum CBR value can be achived when 2% amount of plastic bottle strips are added to the soil. but it decreases when further amount of plastic bottle strips is added.so from this study,0.75% is optimum amount of the strips that can added to soil the soil for efficient use.
- We can conclude from the results obtained after performing the test with plastic bag strips that 2% of the total weight of the soil is the optimum proportion of strips cutfrom plastic bags to be added to the soil for reinforcement.but it decreases when furthure amount of plastic bags strips is added.
- We can also state from this study that strips cut out of plastic bottles are a better option than the strips cut out of plastic bags,as the cutting of plastic waste from bags is too laboures and time consuming ,to enhance the CBR value of the soil.

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