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Experimental investigation of clayey sand with plastic gunny bag as reinforcement

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ABSTRACT

The soil which is generally weak and possesses high deformation values in vast areas are covered with soil deposits having low shear strength and high compressibility. Clayey sands (SC) mostly tend to exhibit high liquid limit (LL) and plastic limit (PL). The technique of combining any two materials of different strengths to form a composite single material of greater strength is the frequent procedure followed in civil engineering practice. The soil is quite good in compression and weak in tension can't bear the load alone. When a material of high tensile strength is introduced in the soil as a reinforcing material, the soil turns into a composite material and tends to possess relatively very high strength and attains the ability to carry loads of heavyweights. Reinforced earth is a technique primarily used to increase the ease of construction and cost-effectiveness. Keeping in view the research findings outlined about, in the present experimentation, it was carried out to investigate the efficacy of plastic gunny bags stabilizing the weak soil, thereby, improving the shear strength and bearing capacity of the soil. A systematic methodical process followed involving experimentations in the laboratory under controlled conditions. It was observed that 1cm thickness and 0.03mm thickness of plastic gunny bags with clayey sand effectively improved the shear strength and bearing capacity of the soil.

Keywords—*Clayey sand, Reinforced earth, Plastic gunny bags, Shear strength, Bearing capacity*

1. INTRODUCTION

For any developing countries like India, transportation and communication facilities are necessary. The road construction mainly depends on the vehicular pattern, construction materials subgrade condition.

The internal part of the road pavement structure is subgrade as provides support to the pavement from below. For adequate support, the subgrade should possess stability under any climatic conditions, loading and deformation loading condition. If the subgrade is in poor condition then the formation of fractures, fissures, rutting, pumping, blowing and different types of cracking of pavements occurs.

Plastics are one of the important inventions used in a different aspect of life whether it might be in the scientific field or household packing purpose, used by restaurant and all. It has become a very difficult job to control it, and considered an environmental hazard due to "use and throw" mechanism. The plastic decomposing period is more than 1000 years. To reduce the plastic, it can be used for alternative methods where plastic plays an important role like stabilization of soil. Plastic can be used as reinforcing the material in the construction of subbase of roads, foundations, embankments etc. so that it can increase the strength of the soil.

Soil stabilization is the process to improve the soil material which has all desired engineering properties by different methods. Generally, soils are stabilized to increase their strength and durability and to prevent the erosion and dust formation of soil.

Soil reinforcement is used to improve the stiffness and strength of soil by using geoengineering methods geogrids are the most commonly used soil reinforcement. Geotextiles are also commonly used and popular because they are cost-effective, more profit and high adaptable. Soil reinforcement acts as a tensile element. By providing reinforcement, it increases the bearing capacity of soil and reduces the settlement and also

reduces the liquefaction behaviour of soil. Reinforcement can be placed in different forms like bar or rod, sheet, strip or webbing and anchor.

2. METHODOLOGY

A methodology for the laboratory will be presented along with the properties of materials used during the laboratory experimentation. The Direct shear and C.B.R tests were conducted on both nonreinforced and reinforced soil samples presented. The properties of soil are presented in all the tests carried on the soil as per CED 43: Soil and Foundation Engineering.

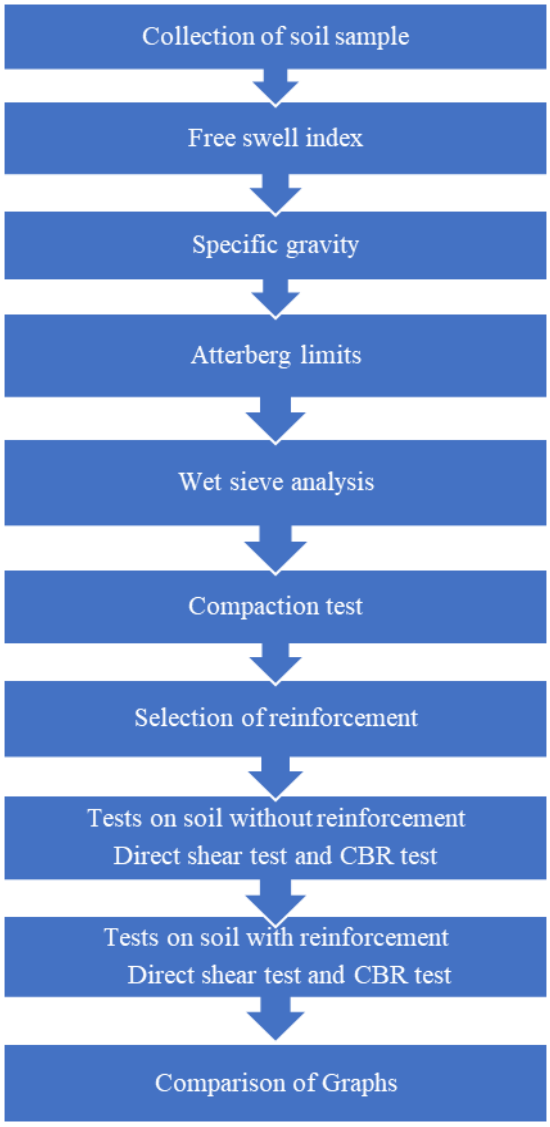

Fig. 1: Methodology

Table 1: Properties of clayey sand

S. no.	Property	Properties
1	Free swell index	0
2	Specific gravity	2.688
3	Atterberg limits Liquid limit (%) Plastic limit (%) Plasticity index (%)	 16 No plasticity (0) 16
4	IS Classification of soil sample	SC
5	Compaction properties Optimum Moisture Content (OMC) (%) Max Dry Density (MDD) (gm/cc)	 10.3 1.658
6	C.B.R (%)	3.88
7	Shear strength (kg/cm^2)	0.365

Reinforcement is provided to increase the strength of the soil. The reinforcement which we used in the laboratory experiments is a plastic gunny bag. The plastic gunny bag is waterproof, highly durable and having good strength characteristics.

Table 2: properties of gunny bags

S. no.	Specifications	Properties
1	Thickness	0.03mm
2	Type	Woven
3	Material	BOPP

Fig. 2: Reinforcement Used in CBR and Direct Shear

For direct shear test 5.5 sq.cm. Area of reinforcement provided with a thickness of 1cm at the centre of the soil.

For the California bearing ratio test is provided with a reinforcement of diameter of 14.8cm in different layers.

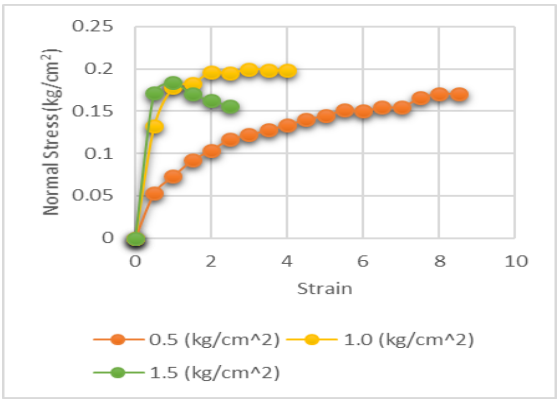

Fig. 3: Direct shear test results for shear strength of the clayey sand non-reinforcement

The figure is drawn between normal stress and strain. The peak values of each loading conditions were drawn in another figure to determine the cohesion, angle of internal friction, and shear strength of the soil.

We found the cohesion value (C) as 0.165, the angle of internal friction (Φ) as 11°19' and the shear strength of the soil as 0.365 kg/cm^2.

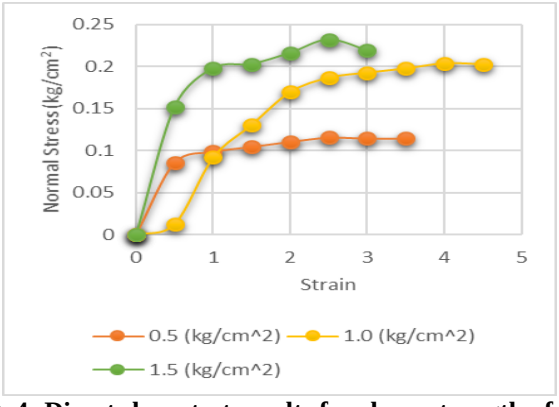

Fig. 4: Direct shear test results for shear strength of the clayey sand with reinforcement

The figure is drawn between normal stress and strain. The peak values of each loading conditions were drawn in another figure to determine the cohesion, angle of internal friction, and shear strength of the soil.

We found the cohesion value (C) as 0.150, the angle of internal friction (Φ) as 27°13', and the shear strength of the soil as 0.664 kg/cm^2.

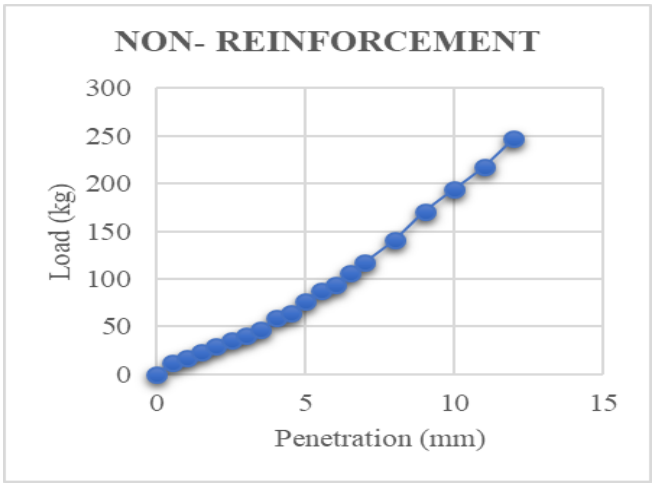

Fig. 5: CBR graph for non-reinforced soil

CBR Value at 5 mm penetration is 3.88%

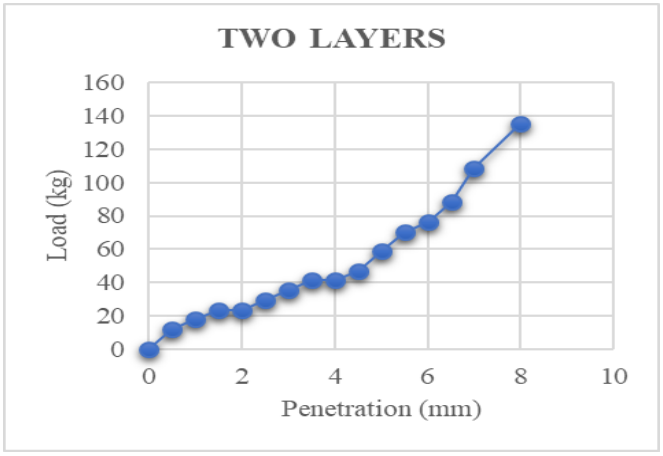

Fig. 6: CBR graph for two layers reinforced soil

CBR Value at 5 mm penetration is 5.35%

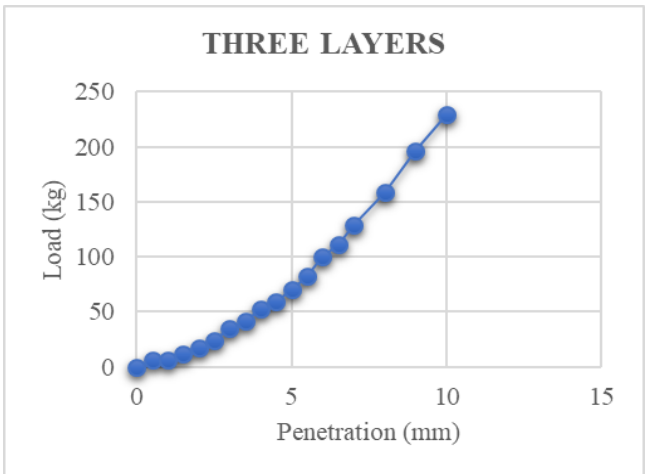

Fig. 7: CBR graph for three-layer reinforced soil

CBR Value at 5 mm penetration is 5.839%

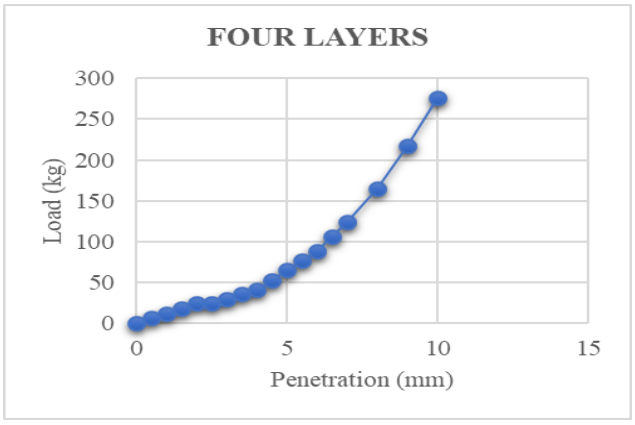

Fig. 8: CBR graph for four layers reinforced soil

CBR Value at 5 mm penetration is 7.3%

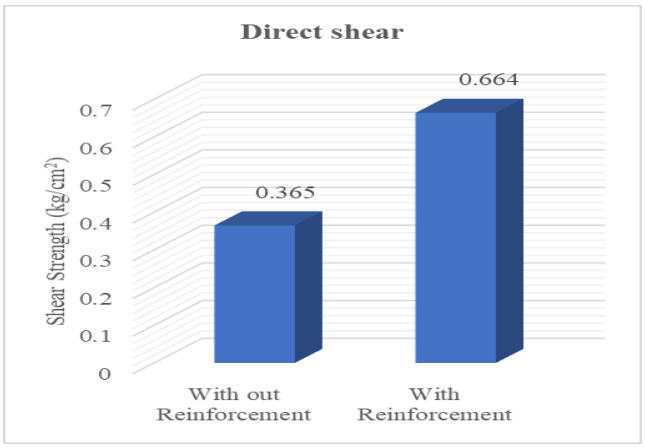

Fig. 9: Comparison graphs for direct shear test

From the laboratory tests, it is observed that for 1cm thickness reinforcement the direct shear value of the soil is increased by 81.9%

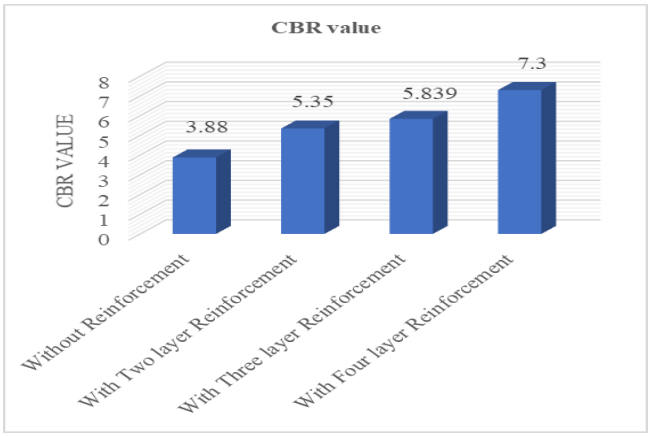

Fig. 10: Comparison graph for CBR test

The CBR value of the non-reinforced, two-layered, three-layered and four-layered reinforced soil is 3.88%, 5.35%, 5.839% and 7.3% respectively.

3. CONCLUSION

- It is observed from the laboratory test results of compaction that the density of clayey sand is 1.658 gm/cc.
- It is observed from the laboratory tests that the direct shear value of the unreinforced soil is 0.365 kg/cm^2 and the soil with reinforcement is 0.664 kg/cm^2.
- From the laboratory tests, it is observed that for 1cm thickness reinforcement the direct shear value of the soil is increased by 81.9%

- The CBR value of the non-reinforced, two-layered, three-layered and four-layered reinforced soil is 3.88%, 5.35%, 5.839% and 7.3% respectively.
- It is observed that the CBR values for two, three, four-layered reinforced soil are increased by 37.88%, 50.5% and 88.1% respectively.

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