

Experimental Study on Improving the CBR value of Expansive Soil in Vemulawada using Geo synthetics

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Abstract: Expansive soils are those which swells in contact with moisture and shrinks on drying which leads to failure of structures. In India, almost 20 per cent of the soils are expansive in nature spreading mainly in central and Deccan plateau including some parts of Telangana state. So, Soil sample from Chandragiri village near Vemulawada in Rajannasircilla district of Telangana state is collected and laboratory tests are performed. Thus it is found that soil present here is very stiff hard clay of very high degree of expansiveness and inorganic clay with 42 per cent of clay and 58 per cent of silt. Various previous studies have proved that CBR value of Expansive soils can be improved by Reinforcing with Geo-synthetics. In present study soil sample is reinforced with Geo synthetic materials such as Geo-textile and Geo-grids for both soaked and unsoaked conditions and performed CBR test. By which it is proved that by Reinforcing with Geotextile the CBR raised slightly and with Geo-grid its CBR value increased almost twice. So it can be concluded from this study that the CBR value of high degree expansive soils in Vemulawada can be improved by reinforcing with Geosynthetic materials like Geogrid to minimise the settlements and failures in civil engineering structures such as roads and buildings

Keywords: CBR, Expansive soils, Geo synthetics, Geo grid, reinforcement.

I. INTRODUCTION

Expansive soils are those which swells in contact with moisture and shrinks on drying which leads to failure of structures. In India, almost 20 per cent of the soils are expansive in nature spreading mainly in central and Deccan plateau including some parts of Telangana state. Various studies carried by (Nizam et al.2014) explained that the geo-textile as the tremendous invention of geo technical Engineering. Geo textiles are generally used with foundation soil,(Naeini and Moayed2009) indicated that using a geogrid at top of the third layer in a soil sample with different plasticity index causes a considerable increase in the CBR value compared with unreinforced soil in both soaked and unsoaked conditions. In present study, soil sample is reinforced with Geo synthetic materials such as Geo-textile and Geo-grids for both soaked and unsoaked conditions and performed CBR test.

OBJECTIVE

1. To know the various engineering properties of the soil located in vemulawada
2. To classify the soil as per IS by conducting experiments like particle size distribution, here Hydrometer analysis and find percentage of silt and clay present in it.
3. To know the degree of expansiveness of the soil and to know how the soil behaves with increase in moisture content
4. To determine the CBR value of actual soil present in the locality and to have a comparative study on reinforcing with geo textile and geo grid and suggesting the best of them for improving the bearing ratio in future projects.

MATERIALS USED

SOIL

For the present study, the Soil sample is collected from Chandragiri village near Vemulawada in Rajannasircilla district which is located at, a latitudinal extend of 14.8641° N and longitudinal extent of 78.8671° E. The soil is collected from a depth of 1.5m and brought to the laboratory for carrying out various tests and determine index properties, classify soil, know its expansive properties and carry out CBR test to know which Geosynthetics material will increase the CBR value considerably so that it can be suggested to practice in the construction of road and building foundations in the locality to minimize settlement and shrinking of under lying strata of the soil

TABLE 1 PROPERTIES OF SOIL

property	soil
Specific gravity	2.72
Liquid limit(%)	69.2
Plastic limit(%)	38.49
Shrinkage limit(%)	29.82
Plasticity Index(%)	30.71
Liquidity Index(%)	77.01
Maximum dry density	1.265
Optimum moisture content(%)	13.4
Differential Free swell Index(%)	55.03
Unconfined compressive strength(kg/cm ²)	0.215
Shear strength(kg/cm ²)	0.107

GEO-TEXTILE

Geotextile have been very successfully used in roads construction for over 30 years. Their primary function is to separate the sub-base from the sub-grade resulting in stronger road construction. The geotextile performs this function by providing a dense mass of fibers at the interface of the two layers. Geotextile have proven to be among the most versatile and cost-effective ground modification materials. For the present study, the Geotextile is collected from TencateGeosynthetic manufacturers limited having thickness of 1mm, tensile strength of 4 kN/m and is shown in Fig. 1



Fig.1 Geo- Textile

GEO-GRID

A Geogrid is a polymeric (i.e., geo-synthetic) material consisting of connected parallel sets of tensile ribs with apertures to bind any construction materials like stone, gravel and soil. Their primary functions are reinforcement and separation. Reinforcement refers to the mechanism by which the engineering properties of the composite soil or aggregate improves. For present study, the geo grids used are uniaxial geogrid and its properties are shown in Table 2 and it is shown in Fig.2



Fig.2 Geogrid

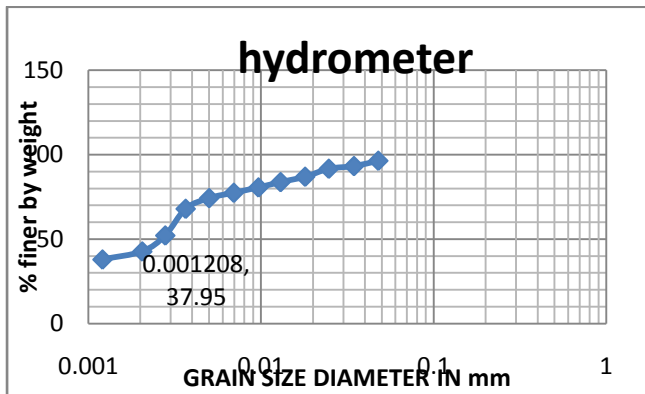
TABLE 2 PROPERTIES OF GEOGRID

property	Geo grid
Mesh aperture size(nominal) mm	40 x 20
Tensile strength in Longitudinal direction(KN/m)	5.6
Stiffness in Longitudinal direction(KN/m)	280
Elongation in machine direction (%)	17
Tensile strength in Transverse direction(KN/m)	3.2
Stiffness in Transverse direction(KN/m)	180
Elongation in Transverse direction(%)	10

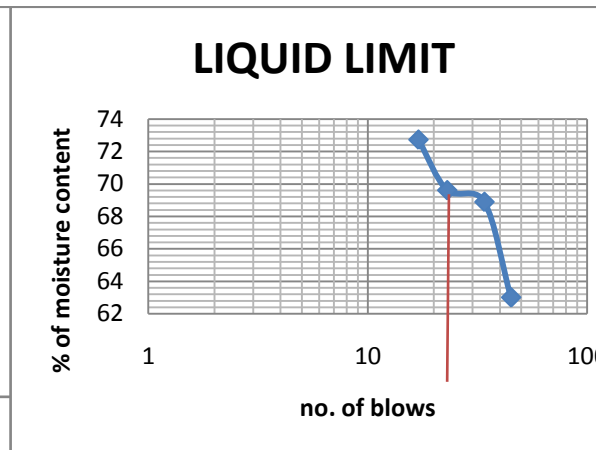


Fig.3 FIGURE SHOWING PROCEDURE WHILE CONDUCTING EXPERIMENTS

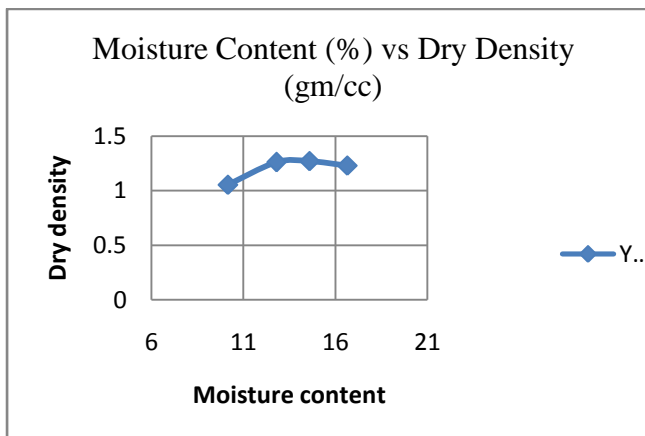
To find the above given soil properties the tests like Differential free swell test, hydrometer analysis, liquid limit, plastic limit, shrinkage limit, specific gravity, standard proctor test, unconfined compressive strength, and CBR test are conducted and corresponding results are plotted in graphs given below



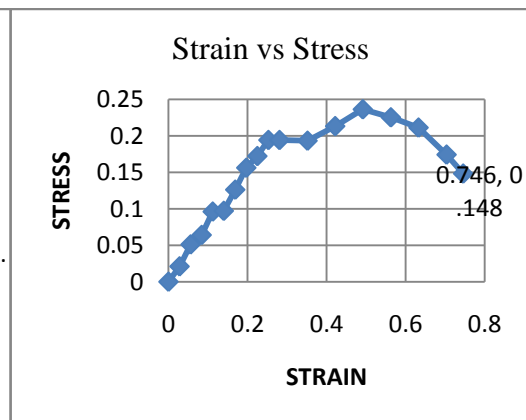
GRAPH 1 SHOWING HYDROMETER ANALYSIS RESULT



GRAPH 2 SHOWING LIQUID LIMIT RESULT

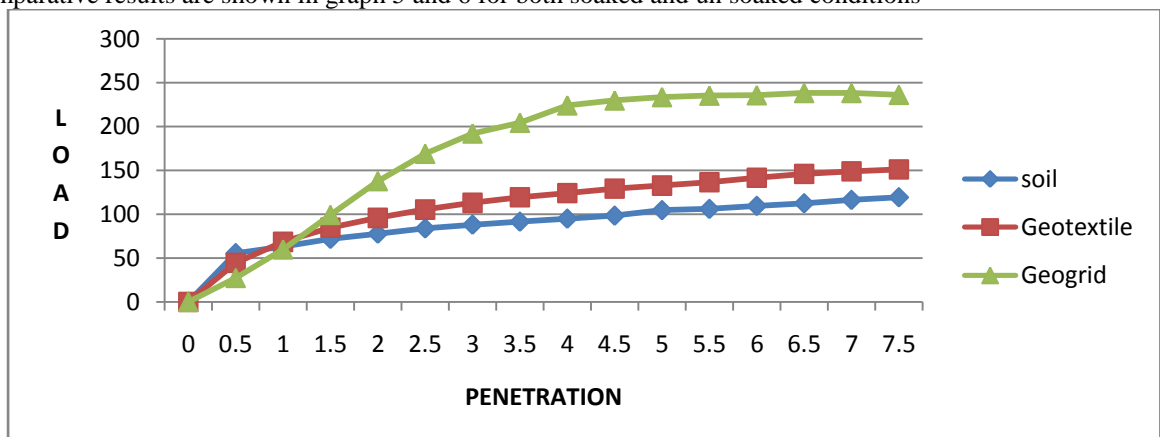


GRAPH 1 SHOWING STANDARD PROCTOR TEST RESULT

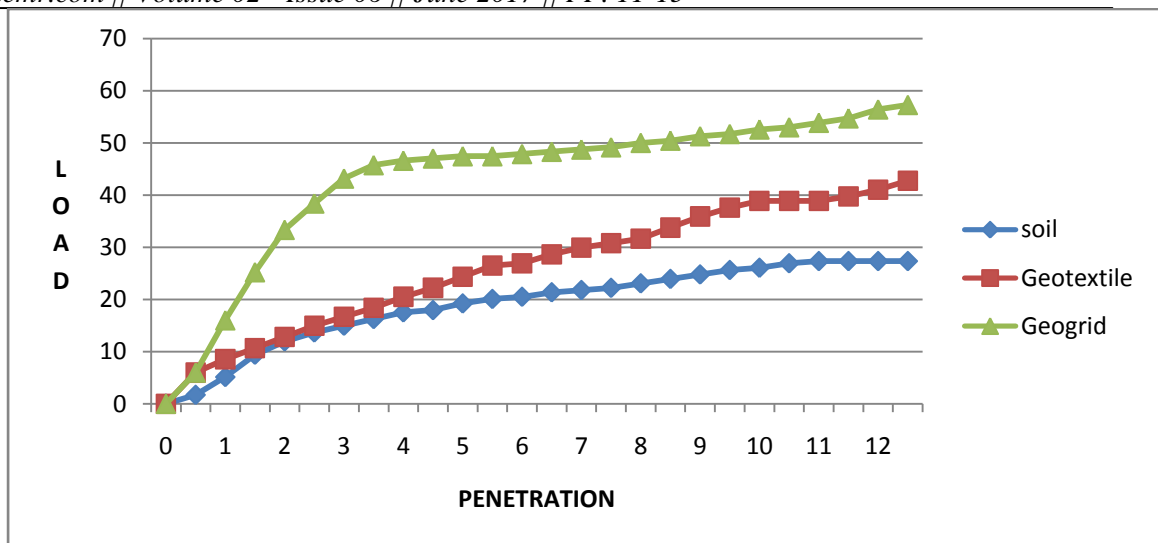


GRAPH 4 SHOWING UCS RESULT

The CBR test is conducted on soil by placing the Geogrid and Geotextile at a depth of 20 mm from the top of CBR mould in each case and the graphs are plotted with penetration on X-axis and Load on Y-axis and their comparative results are shown in graph 5 and 6 for both soaked and un soaked conditions



GRAPH 5 SHOWING VARIATION IN CBR VALUES FOR UNSOAKED CONDITION



GRAPH 6 SHOWING VARIATION IN CBR VALUES FOR SOAKED CONDITION

CONCLUSION

1. The soil sample has a specific gravity of 2.72. Therefore it is an inorganic clay.
2. The soil sample is very highly expansive in nature with differential free swell of 55.03%.
3. From the determination of various index properties like liquid limit, plastic limit, shrinkage limit, plasticity index, toughness index, consistency index, flow index other soil is classified based on consistency as hard soil.
4. From unconfined compression test, Soil sample has unconfined compressive strength as 0.215 kg/cm² and shear strength is 0.107 kg/cm².
5. This soil sample has an optimum moisture content (OMC) as 13.4% and maximum dry density (MDD) as 1.265 g/cc and has CBR of 6.11 for unsoaked condition and 0.99 for the soaked Condition.
6. By reinforcing with geosynthetics, by geotextiles, the CBR value increased to 7.67 in un soaked condition and 1.18 in soaked condition.
7. By reinforcing with geo-grids, the CBR value increases to 12.2 in unsoaked condition and 2.8 in the soaked condition which accounts nearly 200 percent increase in bearing ratio.

Hence, from this results, it can be concluded that the CBR value of problematic expansive soils in Vemulawada can be improved reasonably by reinforcing with geosynthetics especially with geogrids.

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