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Modifications to Low-Plasticity Clay Reinforcement

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Abstract

In a controlled laboratory environment that was neither drained nor solidified, triaxial tests were performed on clay with a low plasticity. Soil behavior under strength deformation was examined for both geotextile-reinforced and unreinforced soils. Geotextiles, both woven and nonwoven, were used for strengthening reasons. The trial took place at OMC. The shear parameter fluctuation and stress-strain characteristics of geotextile reinforced soil are discovered. We varied the geotextile type, number of layers, confining pressure, and layout to see how the composite material mechanically behaved. Adding geotextiles increases both the peak strength and the axial strain at failure, according to the results.

Keywords: *Maximum Dry Density, Cohesion, Angle of Internal Friction, Deviator Stress*

1. Introduction

There is a plentiful supply of soil in nature. Using various elements to fortify soil has been a tradition that dates back to prehistoric times. Different types of soil, different moisture contents, different densities, etc., have different strength qualities. Soil with low shear strength and high compressibility is prone to large settlements. Consequently, it is very dangerous to build houses or other civil engineering projects on soil that is not strong enough. Many areas of the building industry make use of soil enhancement. Roads, airport runways, construction sites, backfills, embankments, and landfills all make use of soil stabilisation or alteration processes.

2. LITERATURE REVIEW

Soil stabilisation by mechanical means has been practiced by Vidal (1969) [1], who used a variety of inclusions, from rather stiff, high-strength metallic components to low-modulus polymeric materials. When building reinforced earth embankments, Subrahmanyam and SrinivasaRao (1989) [2] investigated the frictional properties of various soils and reinforcing strips. All of the experiments are conducted in a designed a modified direct shear box apparatus to measure the adhesion and angle of friction between various soils and reinforcing strips composed of materials such as stainless steel, galvanised iron, aluminium, bamboo, etc. In their study, Latha and Murthy (2007) [3] examined the impact of reinforcement on the strength enhancement of geosynthetic-reinforced sand using triaxial compression tests. The cellular kind of reinforcement outperformed the other two types in terms of strength improvement. Samples of geotextile-reinforced sand were studied for their stress-strain-volumetric response by Nguyen et al. (2013)]. Various confining pressures and numbers of geotextile reinforcing layers were used to test the sand specimens. The reinforcement's mobilised tensile strain grows in proportion to the confining pressure and the number of reinforcement layers.

3. Objectives

This study focuses on utilization of geotextiles for improvement of soil strength and stress-strain characteristics. The objectives of the work are

- To study the index properties and to classify the unreinforced soil.
- To study the engineering properties of unreinforced soil.
- To study the properties of geotextiles i.e. mass per unit area, thickness,tensile strength.
- To study the strength characteristics of reinforced soil.
- To study the stress-strain characteristics of unreinforced and reinforced soil.
- To study the effect of material, water content, confining pressure andgeotextile arrangement.

4. Results and Discussion

4 Soil samples were subjected to tests to ascertain soil properties, compaction characteristics, geotextile properties, stress-strain curve variation with woven and nonwoven geotextiles positioned at varying heights within the sample, and shear parameter variation with woven and nonwoven geotextiles positioned at varying heights within the sample.

4.1 Soil Properties

The soil is obtained from yendada, Visakhapatnam. The soil properties are shown in Table 1. From the Table 1, the soil has 30% sand sized particles and 58% fines. It has liquid limit of 27% and plastic limit of 18%. The soil is classified as low plasticity clay(**CL**) according to IS 2720.

Table 1. Soil Properties

Gravel (%)	12
Sand (%)	30
Fines (%)	58
Liquid limit (%)	27
Plastic limit (%)	18
Plasticity index (%)	9
Soil classification	CL
Specific gravity	2.67
Optimum moisture content (OMC) (%)	17.8
Maximum Dry Density (MDD) (g/cc)	1.83
Cohesion (C) (kPa)	25
Angle of internal friction (Φ)	22°

4.2 Geotextile Properties

Two types of geotextiles woven and nonwoven were used to reinforce the samples. The geotextiles used for the

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present study are woven geotextile and nonwoven geotextile. The properties of both textiles are given in Table 2 and 3.

Table 2 Woven Geotextile Properties

Nominal Thickness (mm)	0.352
Mass per unit area (g/m^2)	142
Tensile strength(kN/m)	20.4
Elongation (%)	55.5

Table 3 Nonwoven Geotextile Properties

Nominal Thickness (mm)	2.827
Mass per unit area (g/m^2)	334
Tensile strength (kN/m)	27.5
Elongation (%)	126.37

4.3 Placement of Reinforcement

The reinforcements were placed at centre that is one layer reinforcement, two layer reinforcement spaced at H/3 and three layer reinforcement spaced at H/4 Where H is theheight of the sample. Fig 1a shows unreinforced sample. Geotextile is placed at differentheights as shown in Fig.1b,c,d.

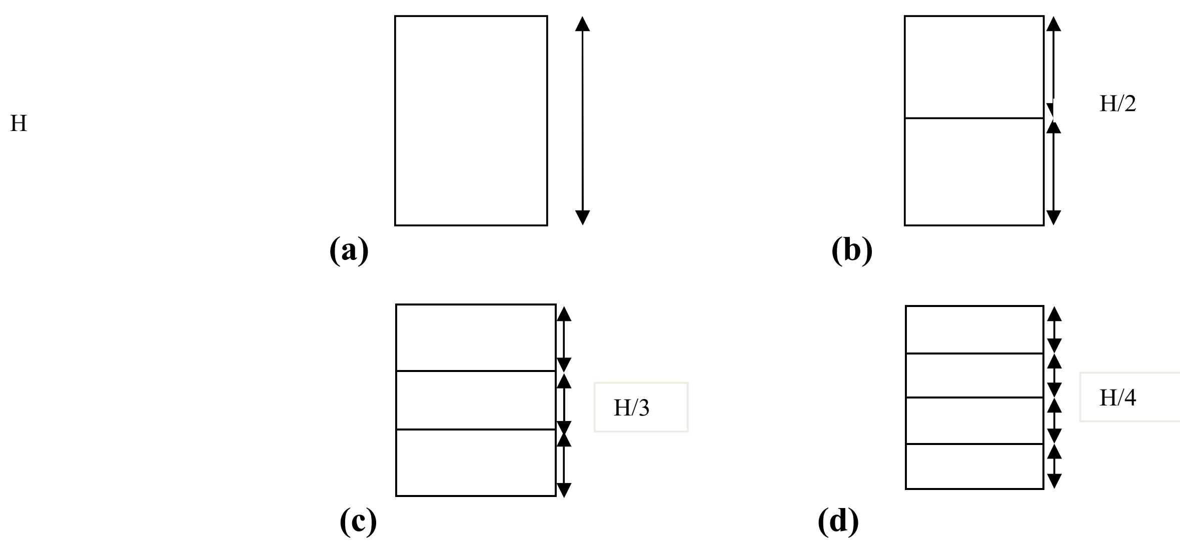

Fig 1 Placement of geotextile in the soil sample

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Soil that was either unreinforced or reinforced with woven or nonwoven geotextiles applied at varying heights underwent triaxial testing. Samples manufactured under both OMC and MDD conditions were tested. For both unreinforced and reinforced soil specimens with woven and nonwoven geotextile, the relation between normal stress, shear stress, and stress-strain was determined at half, one third, and one fourth heights of the specimens at pressures of 50 kPa, 100 kPa, and 200 kPa, respectively.

4.4 Effect on shear parameters

We derived the shear parameters by plotting the Mohr circles. For both woven and nonwoven geotextile reinforced soil, the shear parameters cohesion and angle of internal friction are shown in Table 4. Both woven and nonwoven geotextiles showed an increase in the angle of internal friction as the number of layers rose. Adding more geotextile layers also improved the cohesion values.

Table 4. Shear Parameters for Un-Reinforced and Reinforced Soil

Type of sample	C-value (kPa)	Φ - value
Unreinforced soil	25	22^0
one layer woven geotextile	30	27^0
Two layer woven geotextile	47.5	31^0
Three layer woven geotextile	67.5	34^0
One layer nonwoven geotextile	42.5	37^0
Two layer nonwoven geotextile	77.5	41^0
Three layer nonwoven geotextile	122.5	43^0

Both reinforced and unreinforced soil have stress-strain curves that exhibit a non-linear distribution. See stress-strain curves in Figure 2 and Figure 3 for the unreinforced and two-layer reinforced samples, respectively. Deviator stress is directly proportional to the number of geotextile layers. The peak strength is greatly enhanced by the use of geotextiles. A higher number of geotextile layers results in a more noticeable increase in peak strength.

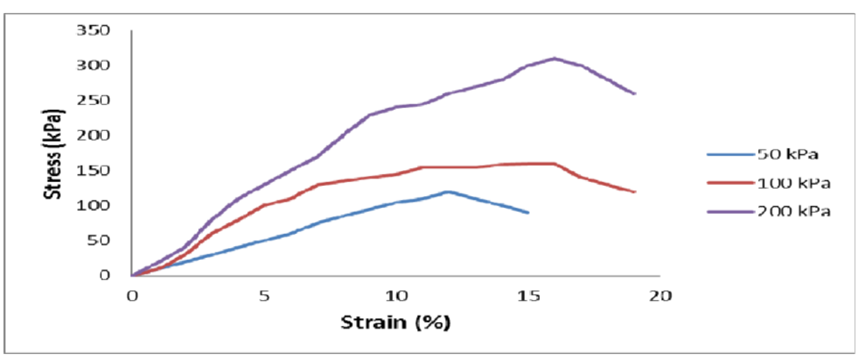

Fig.2 Stress-strain curve for unreinforced soil

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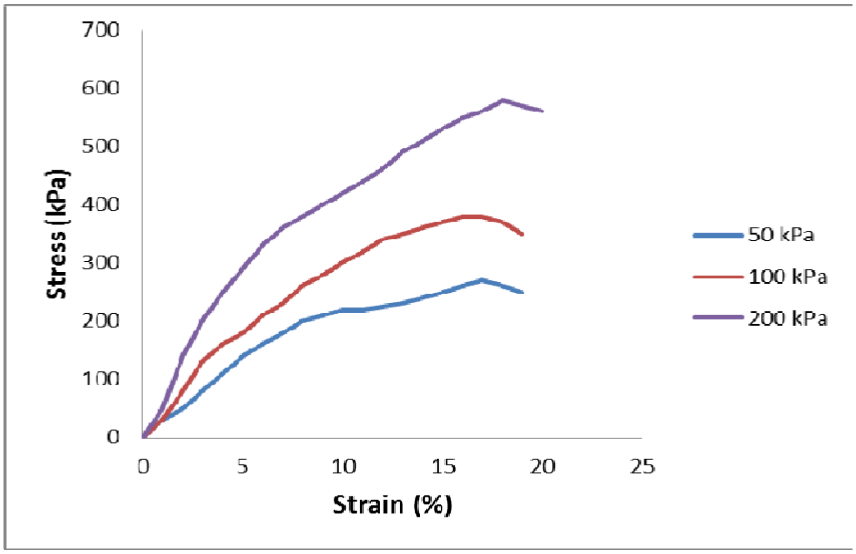

Fig.3 Stress strain curve for two layer woven geotextile

5. Conclusions

1) Geotextile inclusion enhances peak strength, axial strain at failure. The progressis more effective with a higher number of geotextile layers.
2) There is an improvement in cohesion value with increase in the number ofgeotextiles.
3) The angle of internal friction increases with increasing number of geotextiles.
4) The increase in confining pressure increases the peak deviator stress of the soil.
5) Failure of reinforced soil was observed by bulging.
6) The test samples reinforced with nonwoven geotextiles exhibited a significantly higher cohesion than those reinforced with woven geotextiles.
7) Maximum increase in cohesion and friction angle is observed with three layer woven and nonwoven reinforcement.
8) The maximum increase in cohesion is 63% and 80% with three layer woven and nonwoven geotextile. About 55% and 95% increase in friction angle is observed with three layer woven and nonwoven geotextile.

References

Citation: Vidal, H. (1969). "The Principle of Reinforced earth." Highway Research Record, No. 282, pp. 1-16, Washington, DC: Highway Research Board. [2] "A study of frictional behaviour of soil reinforcements" was published in 1989 by Subramanyam G and Srinivasarao T in the Proceedings of the Indian Geotechnical Conference (IGC 89), volume 1, Visakhapatnam, and runs from pages 437 to 438.Referenced in [3] Latha and Murthy's 2007 article "Effects of reinforcement form on the behaviour of geosynthetic reinforced sand" in Geotextile and Geomembranes, volume 25, issue 1, pages 23–32. As stated in a 2013 publication by Nguyen, Yang, Lee, Tsai, and Wu, the work is cited as [4]. "Operational characteristics of nonwoven geotextile-reinforced sand and the distribution of strain during triaxial compression." Global Synthesis, 20(3), 207–225.