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STUDY ON INTERFACE FRICTION BETWEEN SAND AND GEOTEXTILE

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Abstract:

This project deals with the comparative study of characteristics of sand in natural condition and by reinforcing the sand using Geotextile. The index and engineering properties of sand like Specific gravity, Sieve analysis, Relative density and Direct shear tests were analyzed in the laboratory for sandy soil. To determine the interface friction direct shear test is carried out for sand with and without reinforcement under different loading conditions. The type of Geosynthetic reinforcement used for the study is Geotextile and is placed in the soil at two different positions and the direct shear test is proceeded under various loading conditions. While comparing the results of normal sand with reinforced sand, the reinforced sand shows much higher frictional values which improve the bearing capacity of soil.

Key Words: Sand, Geotextile, Direct Shear Test & Interface Friction

1. Introduction:

Interface friction is generally a force resisting motion between the elements of a solid materials and soil particles undergoing deformation. Interface movement can be due to external forces or deformation. Friction can be increased by providing reinforcement which enriches the tensile bearing capacity of the sample and therefore it reduces the pre failure occurrence. In early days, reinforcement soils are provided using steel etc. But in recent days geo synthetics materials like Geotextile, Geogrid etc are used as alternatives for the older ones. Therefore checking of Interface friction became one of the important factor to be considered during design concepts. Thorough knowledge of the composite members using should be acquired for safe and economical design of the reinforcement structures like retaining wall etc. Geosynthetics is a term of recent origin which essentially includes a family of materials that are used in conjunction with soil to improve the performance of soil in a specific context. The main objective of this paper is to determine the interface characteristics between sand and geo synthetics like Geogrid and Geotextile. In general cohesionless soil is used for better results and performance. The advantages of using granular materials are higher frictional resistance, higher drainage capability and their soil properties stabilize with time and moisture content changes. For these reasons, most of the reinforced soil structures are constructed with sands. The role of reinforcement in affecting the behavior of the reinforced soil is influenced by the grain size, type of material used, deformation. Generally geosynthetics normally includes Geogrids, Geotextiles, Geo-membrane, Geo-nets, Geo-cell, Geo-mat etc. Geotextile is generally made up of polypropylene and it is of two types woven and non-woven types. Due to long performance and durability these materials has become a part of civil engineering practices. Some of the economic benefits of the geosynthetics are reduction in the earthwork quantities, increased construction speed. Based on the related literature surveys, the interface friction can be influenced by the interaction mechanism between sand and the Geosynthetics, physical and mechanical properties of Geosynthetics as well as for sand also. Determination of interface friction for cohesion less soil has some practical applications like steep slopes, embankment etc.

2. Material Used:

Geotextile used is of non-woven type, because non-woven geotextile provides better results and shear resistance than that of the woven type due to its interlocking mechanism. Non-woven Geotextile used in this study are of 3mm thickness.

3. Experimental Program:

In order to determine the frictional characteristics between sand and Geosynthetic surface, direct shear test were conducted to about 110 times. The test for the friction characteristics is carried out normally by using the model apparatus of size 60mm*60mm.Initially before conducting the direct shear test, basic properties of sand were determined using following tests,

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- ✓ Sieve Analysis
- ✓ Specific Gravity
- ✓ Relative Density

Sieve analysis test is conducted on the sand samples and their grades were determined. In sieve analysis the grade separation is based on the values of Cu and Cc from the test result the type of soil is classified as poorly graded soil. Following the sieve analysis, specific gravity and relative density tests were carried out. Specific gravity of the well graded and poorly graded were found to be 2.65 and 2.67 .Based on the relative density test, the density were found to be 50% and 75%. The same relative density is used for filling the direct shear apparatus using sand raining technique. Normal direct shear apparatus is used for determining the shear strength characteristics for unreinforced sand as well as for reinforced sand. In direct shear experiment, tests were conducted for normal sand for both grades under different loading conditions ranging from 1kg to 3kg. The same procedure is repeated for the reinforced sand using Geotextile. For single-layer, the reinforcement is placed at middle of the upper half box and lower half box. For multi-layer, one layer is placed at the middle of the lower shear box and another layer is placed at the middle of the upper shear box. In this test the shear load application, shear displacement in horizontal direction are noted.

4. Experimental Results:

Table 1: Properties of sand used in experiments

Description	Type 1
Effective Size, D_{10} (mm)	0.26
D_{30} (mm)	0.40
D_{60} (mm)	0.73
Coefficient of uniformity Cu	2.8
Coefficient of curvature Cc	0.84
Specific gravity	2.67
Relative density (%)	50
Soil classification	SP

Based on the readings taken from the direct shear test under different conditions the following graphs are drawn,

Comparision of Shear Stress-Horizontal Displacement of Soil:

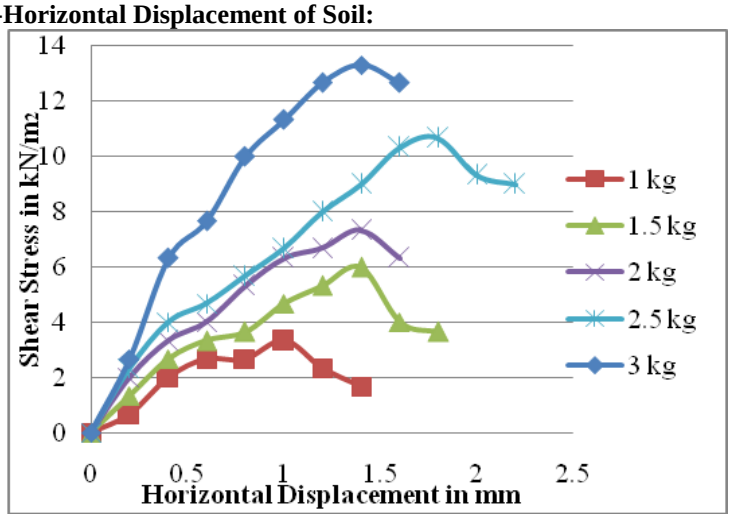

Figure 2: Shear stress-horizontal displacement of poorly graded sand

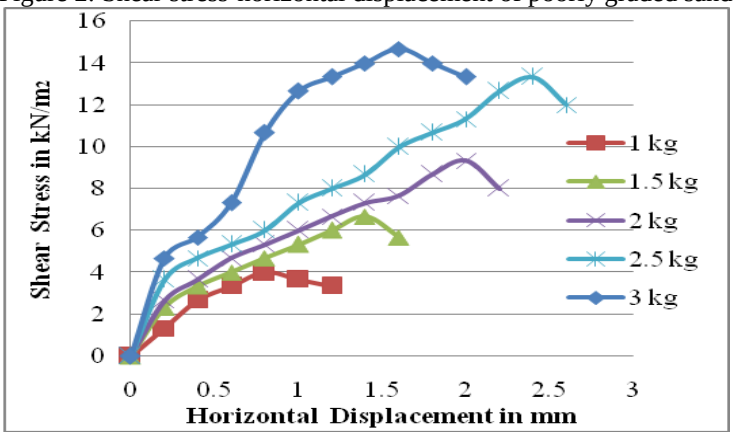

Figure 3: Shear stress-horizontal displacement of poorly graded sand with 1 layer Geotextile

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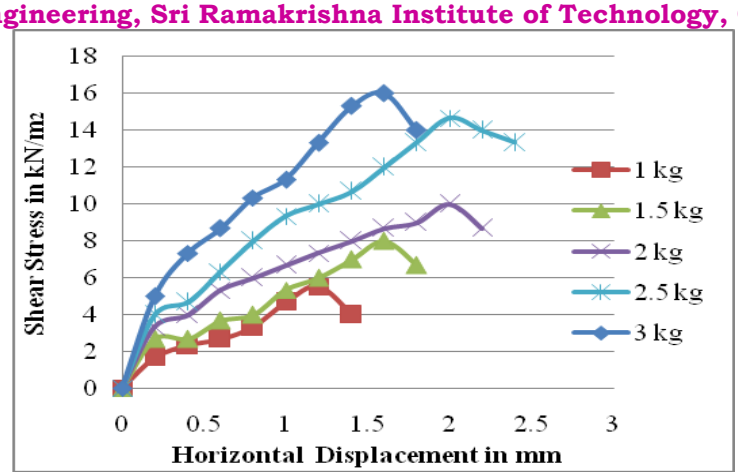

Figure 4: Shear stress-horizontal displacement of poorly graded sand with 2 layer Geotextile

5. Results and Discussion:

From figures 2 to 4 it is observed that for poorly graded soils the peak shear stress value are 13kN/m^2, for soil reinforced with one layer Geotextile the value are 14.8kN/m^2 and for two layers of reinforcement the value increased to 16.5kN/m^2.The peak frictional angles of poorly graded soil were found to be increases from 27° to 36°.

Table 2: Frictional angle for poorly graded sand

Description	Friction angle
SP	27^0
SP with Geotextile in 1 layer	31^0
SP with Geotextile in 2 layer	34^0
SP with Geogrid in 1 layer	32^0
SP with Geogrid in 2 layer	36^0

5. Conclusion:

- ✓ Reinforced sand provides higher shear strength than that of normal sand due to high deformability provided by the reinforcement.
- ✓ Geotextile-sand combination provides more stability than other conditions of reinforcement.(because non –woven Geotextile shows higher horizontal displacement)
- ✓ Gradation of sand also have adverse effect in the frictional characteristics of sand
- ✓ Improvement in the bearing capacity can be achieved by increasing the number of layers of soil reinforcements.

6. References:

1. Awdhesh Kumar Choudhary, A. Murali Krishna March 2014. Influence of Different Types of Soils on Soil-Geosynthetics Interaction Behavior. International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Special Issue 4.
2. S.C. Tuna, S. Altun April 2012 “Mechanical behavior of sand-geotextile interface”. Sharif University of Technology.
3. Arulrajah, M. A. Rahman, J. Piratheepan, M. W. Bo, M.ASCE and M. A. Imteaz 2014. Evaluation of Interface Shear Strength Properties of Geogrid-Reinforced Construction and Demolition Materials Using a Modified Large-Scale Direct Shear Testing Apparatus.