Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 05, May -2018

FRICTIONAL INTERACTION BETWEEN SOIL AND GEOTEXTILE

[1]Khushbu Shah, [2]Mit Shah, [3]Tirth Shah

[1]*Assistant professor, Civil department, Navrachana University, Vadodara, Gujarat, India.*
[2]*Student, Civil department, Navrachana University, Vadodara, Gujarat, India.*
[3]*Student, Civil department, Navrachana University, Vadodara, Gujarat, India*

Abstract- *The most important aspect of any project is its cost, performance, durability and time. As the methods used conventionally were very uneconomical and time consuming, there is an urgent need for development of new techniques which enhances the geotechnical properties of the soil.*
Geosyntheics have emerged as a material which drastically improves the properties of soil and it is cheaper than any other method. In the present study, the virgin soil was reinforced with woven geotextile and was tested for the shear strength parameters by direct shear test. There was a change in the shear strength parameters of the soil when it was reinforced with geotextile. The geotextile increases the internal frictional angle which in turn increases the shear strength of the soil as per mohr-coloumb's equation.

Keywords: *Geosyntheics; Geotextile; Shear strength; direct shear test; Mohr-Coloumb's Equation*

I. INTRODUCTION

A large part of India is covered with soils having low shear strength. It is very difficult to work with this soil, as do not possess sufficient strength to support the loads imposed upon them either during construction or during the service life of the structure. For better performance of structures built on such soils, the performance characteristics of such soils need to be improved.

The poor engineering performance of such soils has forced Engineers to attempt to improve the engineering properties of poor quality soils. There are various methods that could be used to improve the performance of poor quality soils. These methods range from replacing it with a good quality soil to methods that involve complex chemical process. The choice of a particular method depends mainly on the type of soil to be improved, its characteristics and the type and degree of improvement desired in a particular application.

The process of improving the soil engineering properties using various methods and making it more stable is termed as Soil Stabilization.

Stabilization methods can be divided into various categories, such as mechanical Stabilization, Chemical Stabilization, Geosynthetic Stabilization, Lime Stabilization, etc.

Recently Geosynthetics have emerged as a new method for soil stabilization. The Geosynthetics do not change the index properties of the soil such as Liquid limit, PlasticLimit,etc but they increase the soil engineering properties such as Shear strength, C.B.R, Stability of slopes, etc.

1.1 Geotextile as a stabilizer

Geotextile is a permeable in nature and it can be artificial or nature depending on the fibers used. Artificial fibers include Propylene, PVC and natural fibers include jute, cotton, bamboo, etc. It improves the quality of soil like CBR, durability, etc. Geotextile can be woven or non-woven depending on the method of preparation.

Geotextile act as a resisting layer between the soil layers and it increases the internal friction angle of the soil. There are various methods for preparation of woven Geotextile are kneading, tamping and for non-woven Geotextiles needle punching, etc

1.1.1 Benefits of Geotextile

As the strength and stiffness of the soil is increased by adding Geotextile to soil maintenance cost gets reduced by 30 to 50%. Pavement thickness of the road is reduced by 30 to 50%. Construction time is reduced by 50 %. Geotextile improves load bearing capacity of soil and also increases the shear strength of the soil.

1.1.2 Functions of Geotextile

A) Separation
B) Reinforcement
C) Filtration
D) Drainage

E) Protection

1.1.3 Application of Geotextile

Typical applications of Geotextiles are:

- Retaining walls
- Steep slopes
- Landslide repairs
- Embankments on very soft soils, combined with vertical drains
- Roadway reinforcement
- Reinforcement under tramways or railway ballast, foundation layers.
- Erosion control in sea embankments and waterworks slopes or beds
- Reinforcement or bridging over potential weak zones, voids or cavities Piled embankments with basal reinforcement.

1.1.4 Properties of Geotextile

The Geotextile obtained was made up of polypropylene fibers. It is a woven Geotextile by kneading

Table 1: Properties of Geotextile

Property	Value
Ultimate Tensile Strength(N/mm^2)	62
Puncture strength(N)	760
Apparent Opening Size(µm)	136
Water permability(L/m^2/s)	36
Grab Elongation	22.5%

II. Experimental Study

The materials which were used in the test is clayey Soil(from Anklashwer),sandy soil (from Valsad) and Geotextile. To find out the suitability of Geotextilesoil laboratory test were performed. The Geotextile was obtained from Hari Om Industries.
To study the variation of Season on the shear strength of the soil we have taken different moisture content and the soil is tested on the Direct Shear apparatus.
The soil was crushed prior to tests and the soil was remoulded with required moisture content and density and tested with direct shear test with three normal stress 0.5 Kg/cm^2,2.0 Kg/cm^2 and 3.0 Kg/cm^2 and after that the soil was reinforced with Geotextile and then tested with the same normal stresses.
According to IS 1498 Part 4(1980), Clayey soil was categorized as clay 'CH' type and the sandy soil as 'SP' .Table 3 shows the geotechnical properties of clayey soil and Table 2 shows the geotechnical properties of sandy soil.

III. Results & Discussion

3.1 Geotechnical properties of the Clayey and Sandy Soil

Table 2: Geotechnical properties of sandy soil

Sr No	Property	Value
1	Specific Gravity	2.68
2	Grain size distribution (%)	
	Gravel	0
	Sand	98
	Slit	2
	Clay	0
3	IS Classification	SP
4	70% of RD Density(g/cc)	1.8
5	Direct shear test	
	C(Kg/cm^2)	0
	Ø(°)	28

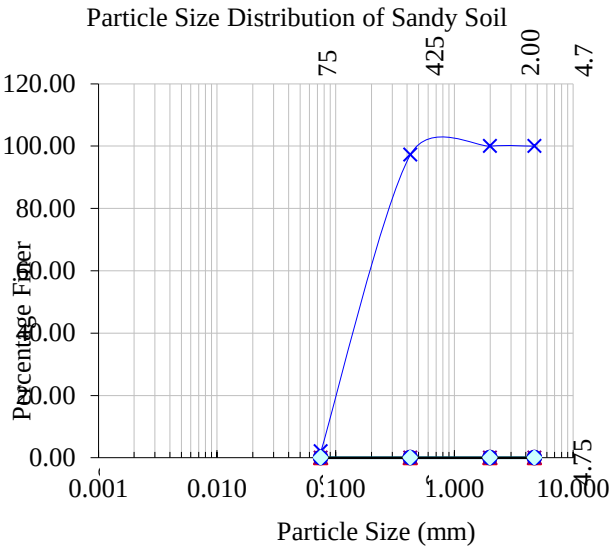

Fig 1: Particle size distribution for sandy soil

Table 4: Size distribution co-efficient

Coefficient	Value
C_u	2.55
C_c	0.76

Therefore the soil is SP according to IS-1498(Part 4)

Table 3: Geotechnical properties of the clayey soil

Sr. No	Property	Value
1	Specific gravity	2.62
2	Grain size distribution (%)	
	Gravel	8
	Sand	37
	Slit	25.5
	Clay	29.5
3	Consistency limits (%)	
	Liquid limit	57
	Plastic limit	24
	Plasticity index	33
	Shrinkage limit	6.57
4	Is classification	CH
5	Swelling index (%)	166.66
	Engineering properties	
6	Standard proctor	
	Max dry density(g/cc)	1.52
	OMC (%)	16.2
7	Direct shear test	
	C(Kg/cm^2)	0.15
	Ø(°)	10

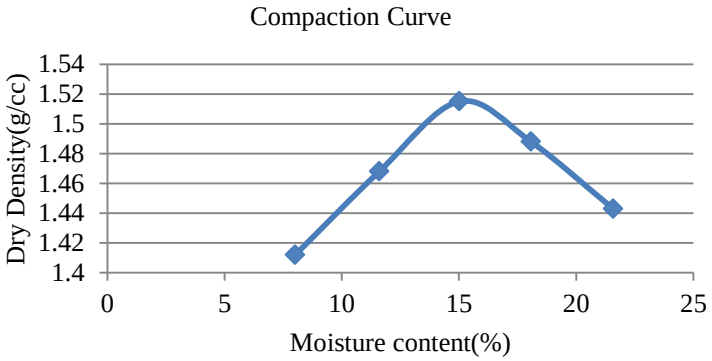

Fig 2: Standard Proctor Test for Clayey soil

The figure above states that the MDD is 1.52 g/cc and OMC is 16.2%.

3.2 Direct Shear Test (IS 2720 Part 13, 1986)

In this test the samples having less than 4.75 mm size is taken and remolded and are sheared at a constant rate of 1.25mm/minute. It can be performed in Unconsolidated-Undrained test, Consolidated-Undrained test and Consolidated-Drained test like other shear strength tests. Normal stresses taken are 0.5, 2&3 Kg/cm^2. Three moisture contents 16.2%, 11.6%, 21.58% were taken for the clayey soil.

3.2.1 Clay-Clay

Table 5: Comparison of shear strength parameters for clayey-clayey layer

Soil	Without reinforcement of Geotextile		With the reinforcement of Geotextile	
	C(Kg/cm^2)	*Ø*(°)	*C*(Kg/cm^2)	*Ø*(°)
Virgin soil(16.2% moisture content)	0.15	10	0.15	13
Virgin soil (11.6% moisture content)	0.125	9	0.125	11
Virgin soil(21.58% moisture content)	0.15	8.5	0.15	10

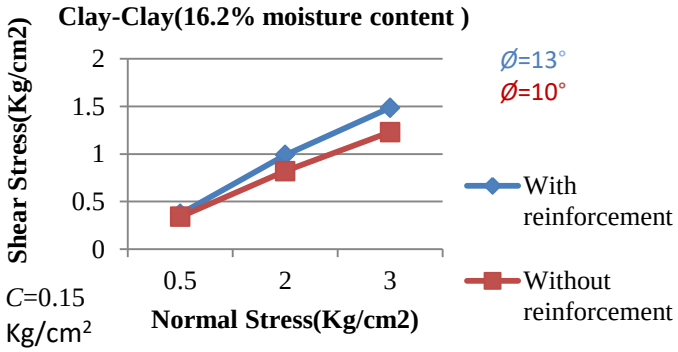

Fig 3: Comparison of the Shear strength parameters of the soil for clay- clay+16.2% moisture content

The above figure states that there is an increase of 3° in the internal frictional angle when the soil is reinforced with geotextile.

4.2 Clay-Sand

Table 6: Comparison of the shear strength parameters for clay-sand layer

Soil	Without reinforcement of Geotextile		With the reinforcement of Geotextile	
	***C*(Kg/cm^2)**	***Ø*(°)**	***C*(Kg/cm^2)**	***Ø*(°)**
Virgin soil+(16.2% moisture content)	0.12	16	0.12	18
Virgin soil+(11.6% moisture content)	0.1	15	0.1	17
Virgin soil+(21.58% moisture content)	0.12	14	0.12	16.5

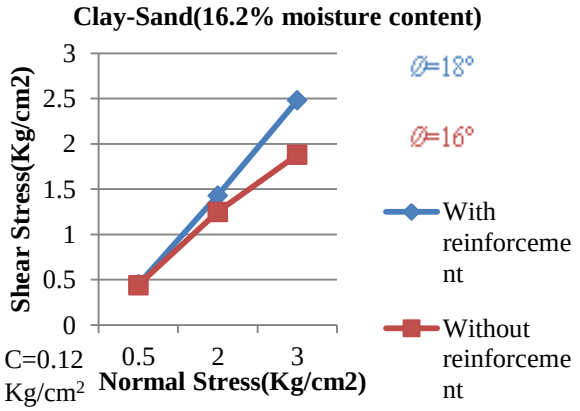

Fig4: Comparison of the shear strength parameters of clay-sand+16.2% moisture content.

The figure states that there is an increase of 2° in the internal friction angle when reinforced with geotextile.

4.3 Sand-Sand

Table 7: Comparison of shear strength parameters for sandy-sandy layer

Soil	Without reinforcement of Geotextile		With the reinforcement of Geotextile	
	***C*(Kg/cm^2)**	***Ø* (°)**	***C*(Kg/cm^2)**	***Ø*(°)**
Virgin Soil	0	28	0	30

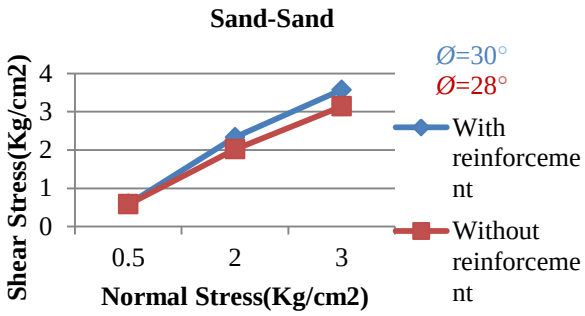

Fig 5: Comparison of the shear strength parameters of sand-sand

The figure states there is an increase of 2° in the internal friction angle when the soil is reinforced with geotextile.

V. Conclusions

- With reinforcement of Geotextile the internal frictional angle increases and as a result the shear strength of the soil increases and the bearing capacity also increases.
- The shear strength of the soil having 11.60% moisture content is higher compared to the one having 21.58% for the same density but they are lower than shear strength at 16.2% moisture content.
- With application of Geotextile the failure time increases.
- There is a slight increase in the cohesion of the soil due to reinforcement of Geotextile.
- There is a decrease in the internal frictional angle when there is increase in the moisture content from the optimum moisture content because the dry density of the soil decreases with the increase in the moisture content.
- There is a decrease in the internal frictional angle when there is decrease in the moisture content from the optimum moisture content because the maximum dry density is not achieved.

VI. Future Scope

- Plate load test can be performed on Various soil samples reinforced with and without Geotextile. So the change in safe bearing capacity can be determined.

References

[1] Choudhary A.K., Krishna A.M.(2014) “Influence of DifferentTypes of Soils on Soil Geosynthetics Interaction Behavior”,IJIRSET.
[2] Coronel J (2006)”FRICTIONAL INTERACTION PROPERTIES BETWEEN GEOMATERIALS AND GEOSYNTHETICS”, Louisiana University.
[3] IS 2720 (Part 3) (1980) “Determination of Specific gravity” Bureau of Indian Standards, ManakBhavan, New Delhi.
[4] IS 2720 (Part 4) (1985) “Grain size analysis” Bureau of Indian Standards, ManakBhavan, New Delhi.
[5] IS 2720 (Part 5) (1985) “Determination of Atterberg limits” Bureau of Indian Standards, ManakBhavan, New Delhi.
[6] IS 2720 (Part 6) (1972) “Determination of shrinkage factors” Bureau of Indian Standards, ManakBhavan, New Delhi.
[7] IS 2720 (Part 7) (1980) “Determination of water content-dry density relation using light compaction” Bureau of Indian Standards, ManakBhavan, New Delhi.
[8] IS 2720 (Part 40) (1977) “Determination of Free swell index of soil” Bureau of Indian Standards, ManakBhavan, New Delhi.
[9] IS 2720 (Part 13) (1987) “Direct Shear Test” Bureau of Indian Standards, ManakBhavan, New Delhi.
[10] IS 2720(Part 14)(1983)”Determination of density index (relative density) of cohesionless soil”, Bureau of Indian Standards, ManakBhavan, New Delhi.

