Strengthening of Cohesionless Soils by using Mosquito net and Alert Net as a Geo-Synthetic Material

N. Badrinath, L. Rachana, N. Sandeep Kumar

***ABSTRACT:** The objective of this investigation is to study the properties of cohesionless soils and the ways to stabilize it. Foundations are usually subjected to dynamic loads caused by the earthquakes, bomb blasts and machines etc. The behavior of reinforced foundation bed under the dynamic loads needs to be stabilized. To reduce the slope failure and the soil embankment failure we need to stabilize the soil. There are numerous techniques to stabilize the soils. One of the best methods to stabilize the soil is by using geo-synthetics. Alert net and mosquito net are used in the present study. It is well known that the bearing resistance against aalert net and mosquito net transverse rib is transferred through their junction when these geo-synthetics are placed in cohesion less soils and subjected to the tensile loading. The increased stability is through the frictional interaction between the soil and the reinforcement. Direct shear test is performed by using Alert netandmosquito net by placing in different positions and comparing the shear strength parameters. This paper examines the use of Alert net and mosquito net in cohesion less soils.*

***Index Terms:** Alert net, mosquito net, Direct shear, stabilization, Shear strength , Non cohesive soil.*

I. INTRODUCTION

Now-a-days improvements in the strength parameters of soils play a crucial role in this modern era because the total structure is based on the bearing capacity of the soil. In this project we have concentrated on sandy soils i.e., cohesion less soils generally these are used as the back fill materials etc., because in case of cohesion less soil the strength depends on angle of friction. In this study an attempt has made to investigate the efficiency of geo-synthetics with approximate mix with sand in order to improve the shearing capacity. It has been observed that shearing capacity ofresult was obtained after application of geo-syntheticsGenerally geo-syntheticsare widely using in the Result was obtained after application of geo-synthetics Generally geo-syntheticsare widely using in the constructionpurposes because of their desirable qualities. We choose mosquito net and alert net as geo-synthetic prototype as it was easily available, less in cost when compared to other admixtures and easy to lay on the surface of the sand and other advantage of this mosquito net and alert net is it will be as long mat like material so that we can cover the larger area without any major problems. Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than grave and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e., a soil containing more than 85 percent sand-sized particles by mass. The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO2), usually in the form of quartz. The second most common type of sand is calcium carbonate, for example, aragonite, which has mostly been created, over the past half billion years, by various forms of life, like coral and shellfish. For example, it is the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years like the Caribbean.

II. MATERIALS AND METHODS

A. Materials

The sandy soil samples are collected from the sea area site located near the sea breeze at Chirala to conduct direct shear test to evaluate the interaction parameters of soil with Alert net and mosquitonet as reinforcement material.

Various physical tests like grain size distribution, relative density and specific gravity are conducted on the soil sample. The results of the same are, from the gradation, the effective diameter of particle at 10% finer is 0.22mm, at 30% finer is 0.46mm and at 60% finer it is 0.5mm. The specific gravity of the soil sample is found to be 2.72. Natural water content was found to be 5.71% at time of sampling. The constant permeability head test is done on the soil sample. Table I shows Sieve analysis details and Table II gives properties of sand sample used in the study.

E_{max}= 0.66 and e_{min}= 0.46 .

Table I: Sieve analysis

D60	D30	D10	Cc	Cu
0.5	0.46	0.22	2.116	2.2758

According to IS classification the soil sample is named as poorly graded and represented as SP.

Table II: Properties of sand sample used in study

Type of soil	Poorly graded sand

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Classification of soil	Gravel-0% Sand-99.6% Clay & silt -0.4% Symbol-SP
Natural moisture content	5.71%
Φ value	13.32°
C value	0

Fig. 1 shows the grain size distribution curves of soil.

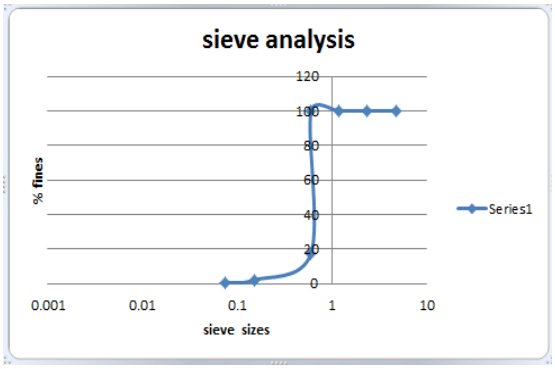

Fig. 1: Grain size distribution curves of soil

B. Mosquito net

The mosquito net is preferred to be used in this work as our testing material because of its easy availability and less in cost when compare with the other geo-synthetics. It is made of polymeric material and possesses good tensile strength properties. Fig. 2 shows the mosquito net.

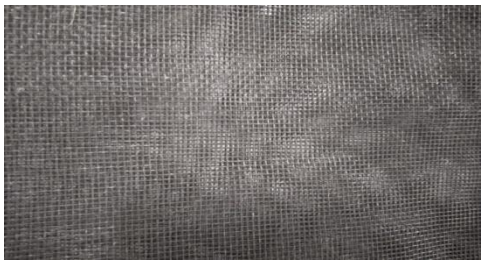

Fig. 2: Mosquito net

C. Alert net

The below Fig. 3 is Alert net, geosynthetic material it is used to reinforce soils and similar materials. These are commonly used to reinforce the retaining walls, as well as the sub-bases or subsoil below the roads or structures. Soils pull apart under the tension. Compared to the soil, Alert net are strong in tension. Fig. 3 shows Alert net.

Fig. 3: Alert net

III. TESTING APPARATUS AND PROCEDURE

A. Direct shear apparatus

This apparatus mainly consist of shear shackle with dimensions of 60mm X 60mm containing lower box as well as upper box. The following modification is done to shackle for analysis of soil and geo-synthetic interaction behaviour. Fig. 4 shows Mosquito net and alert net is placed into soil.

Fig. 4: Mosquito net and Alert net is placed in to soil.

B. Direct shear test procedure

The testing procedure is followed similar to that of the shear test conducted on geotechnical materials except the slight modification is done to apparatus as explained above. The water is added to the soil sample before filling it in the shear shackle up to its optimum level. Then upper box is filled by the soil sample in three layers by apply equal blows for every individual layer with help of small glass tamping rod so that same compaction energy is maintained for every layer and also every trail. The load is applied from the top using loading arm fixed to apparatus vertically to sample which acts as the normal stress. The testing of sample is done three different normal stresses of 0.5, 1.0 and 1.5 kg/cm^2.The vertical load is kept constant during the shearing process. The load applied was measured by the proving ring and horizontal displacement is measured by the dial gauge. The rate of horizontal displacement is applied at 0.5mm/min. At each and every normal stress three trails are done. Totally 18 trails are done which includes 9 trail without using mosquito and 9 trails using mosquito net. The average of three trails at each normal stress is taken as peak shear stress respectively. For all the trails same procedure is followed. For all the trails rate of shearing is 0.5mm/min. Fig. 5 shows direct shear apparatus.

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Fig. 5: Direct shear apparatus

IV. RESULT AND DISCUSSION

To evaluate the shear stress response of the sandy soil under consideration by using mosquito net as reinforcing material, direct shear test is conducted at different normal stresses. The following results, physical and engineering properties, as found for the soil considered are tabulated in Table III and IV.

Table III: Physical properties of soil

Property	Obtained value
Specific gravity	2.72
Relative density (%)	55
Grain size analysis	Classified as SP
Void (natural)	0.598

Table IV: Engineering properties of soil

Property	Obtained value
Permeability	5.1210^{-4}c m/s
Max Shear strength (without using net & grid)	0.355 kg/cm^2
Max shear strength (with using mosquito net)	0.542 kg/cm^2
Max shear strength (with using Alert net)	0.424 kg/cm^2

From the results above, it can be understood that net is applied at both sides of the box. We can notify the change in the shear parameters of the soil. From the of direct shear test the angle of internal friction of soil i.e.., slope of the graph between normal stress and shear stress without using mosquito net obtained as 13.32° in the similar manner the angle of

Fig. 6, 7, 8 shows the Normal stress vs. shear stress graph without using geo-synthetics, Alert net and mosquito net.

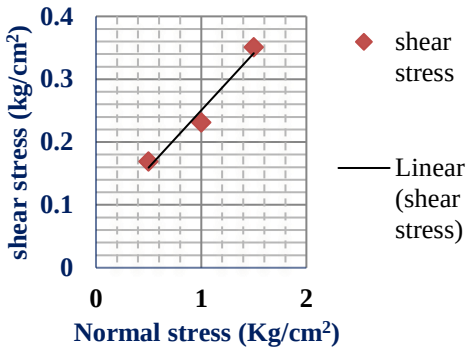

Fig. 6 : Normal stress vs. shear stress graph without using geo-synthetics

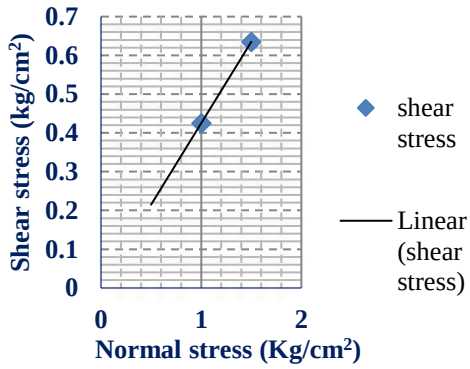

Fig. 7: Normal stress vs. shear stress graph with using Alert net

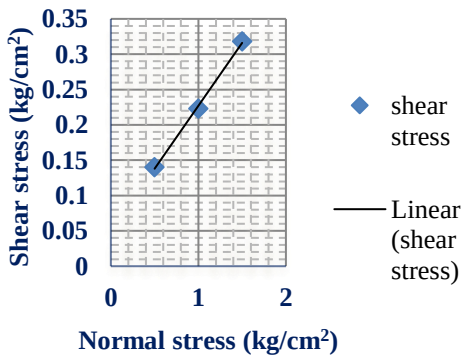

Fig. 8 : Normal stress vs shear stress graph with using mosquito net

Internal friction of soil tested using the mosquito net reinforcing material is obtained as 19.89°, in the similar manner the angle of internal friction of soil tested using the Alert net reinforcing material is obtained as 15.81°and hence the angle of internal friction of the soil is increased by 49.32% and 18.69%. Thus enhanced shear parameters have direct influence on the soil's shear strength to increase

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considerably. These soil reinforcement techniques can be applied for strengthening of the weak soils, in the construction works like embankments and retaining walls in road construction etcetera, where there is no other option available except using weak soils. Soil is constructions activities.

We have calculated shear stress of the soil at0.5 kg/cm2, 1.0 kg/cm2 and 1.5 kg/cm^2, also calculated the shear strength of soil according to Coulomb–Terzaghi equation is:

$$s = c + \sigma.\tan \phi$$

Shear strength of soil before reinforcing:

$$\rightarrow S1 = \sigma.\tan 25.4$$

Fig. 9 shows the variation of shear stress with and without using mosquito net.

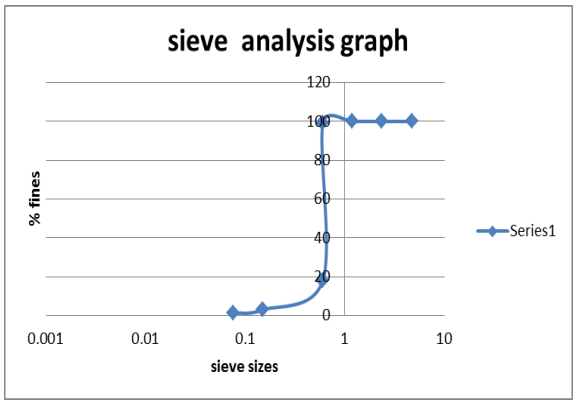

Fig. 9: Variation of shear stress with and without using mosquito net

Shear strength of soil after reinforcing:

$$\rightarrow S2 = \sigma.\tan 31$$

So the increase in the shear strength of the soil is obtained by:

$$\frac{S2 - S1}{S1}$$

$$\frac{\sigma tan19.89 - \sigma tan13.32}{\sigma tan13.32} = 0.528$$

$$\frac{\sigma tan15.81 - \sigma tan13.32}{\sigma tan13.32} = 0.195$$

The increase shear strength of soil by using mosquito net as a layer at 2.5 cm from the top face is 52.8% approximately (Fig. 6), the increase shear strength of soil by using Alert net as a layer is 19.5% approximately (Fig. 6). Hence it is recommended to use this reinforcement technique in various construction activities to enhance to bearing capacity of the soil.

V. CONCLUSION

From the above study of soil geo-synthetic interaction is presented by conducting direct shear test with sandy soil it was clearly observed that a significant change in the sliding friction of the soil sample which directly affects the shear strength of the soil sample. So by applying the mosquito net the sliding friction of the soil is enhanced by49.32%, which will directly influence the shear strength of soil increase by 52.8% , by applying the Alert net the sliding friction of the soil is enhanced by 18.69%, which will directly influence the shear strength of soil increase by 19.5%So the soil can transfer the loads safely and can be prevented from the failure.

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