# Enhancement in Engineering Properties of Soil Reinforced with Jute Fiber

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**Abstract – In this paper we focus on the improvement of engineering properties of soil by using jute fiber treating with the chemical phenol. Jute fiber is treated with the chemical phenol to enhance the engineering properties in case of pavement and earthen slopes. The aim of the present investigation is to determine the jute geo textile as soil reinforcement. The soil mixed with at varying % of processed jute to study the effects of geo textile as an arrests migrating of soil particles and allows water to permeate across it (to check permeability and direct shear tests). In this paper jute is mixed in soil with 0%, 1%, 1.5%, 2.0%, 2.5%, and 3.0% and the jute fiber cuts into different sizes. And the specific gravity of jute is 1.15. Having different diameters, such as: 2mm, 4mm, 6mm and 8mm, length having 0.5 to 2.0mm. Aspect ratio of jute fiber is 16.52. The soil has been taken from the river ganga which is sandy soil and the specific gravity of sandy soil is 2.656. The fineness modulus is 2.865. OMC 10% maximum dry density of soil is 1.704 gram/cc and bulk density is 1.36 gram/cc.**

**The natural fibers reinforcement causes significant improvement in shear strength, tensile strength and other engineering properties of the soil i.e, permeability and direct shear. Over a year many research and development studies has been carried out in national and international projects using jute fibers. The overall objective of this paper is to improve the engineering properties of soil. Jute fibers have been widely used because it is biodegradable and plenty of nature. To increase the durability of the jute fibers it will mixed with phenol or other chemical like acetylene, bitumen e.t.c. Tests results indicate that by the using of jute fiber in soil the permeability is less in every different percentage of jute mixed in soil. And in direct shear the cohesion values should be increasing by different percentage of jute fiber and Φ values should be decreasing accordingly by the treatment of soil with jute fiber.**

**Index Terms – jute fiber, direct shear, permeability, phenol, shear strength, tensile strength, durability, pavement, earthen slopes, biodegradable, acetylene, bitumen.**

## 1. INTRODUCTION

A weak subgrade needs thick pavement which makes it uneconomical. Hence soil stabilization is the very technique to improve subgrade engineering properties. An attempt has been made to improve the sandy (cohesionless and silty sand) to improve its engineering properties by adding jute fibers. The study improves OMC and reduces the maximum dry density. The jute is biodegradable and no environmental hazard. In this paper jute fiber is used with varying amount and their effect was analyzed on shear strength and frictional angle. Jute is used in various works due their cheapness and soft in nature.

## 2. LITERATURE REVIEW

In study of Vinod Sonthwal, Dheeraj Sahni [1] CBR value of soil increases up to 131.81 % with the inclusion of Jute fiber coated with bitumen. Jute fiber reinforcement also increases the optimum moisture content (OMC) and reduces maximum dry density (MDD). Also Md. Akhtar Hossain et al [2] concluded that Jute fiber reinforcement reduces the maximum dry density and increases the optimum moisture content of the subgrade soil for each aspect ratio. H. P. Singh, M. Bagra [3] Based on the present investigation it is concluded that CBR value of soil increases with the inclusion of Jute fiber. When the Jute fiber content is increases, the CBR value of soil is further increases and this increase is substantial at fiber content of 1 %. R.H Jadvani et al[4] found that use of geotextiles are very affective solution in various geotechnical problem like foundation on soft soils, landslide control, pavement subgrade stablisation in road and railway construction, erosion control, etc. Barnali ghos et al [5] concluded that the jute geotextile used in the project has a significant influence on the soil properties while shear strength, dry density and CBR increased, permeability and penetration decreased on introduction of jute geo textiles.

## 3. TESTS AND RESULTS

Firstly, the materials have been collected for the testing. The soil has been collected from the river Gomti, lucknow. The jute fiber is then collected from the market after that the chemical phenol is also arranged from the lab. Then the jute is cutted off in small pieces having different lengths. The sandy soil has also been putted in the hot freezer for 24 hours to retain the moisture content. Jute fiber is chemically treated with the phenol to increase the durability.

The jute fiber has been taken in some quantity to identify the absorption weight. So the jute fiber has been taken 5grams and phenol is taken 2 grams having 200 grams of water is mixed with phenol after that the jute is inserted inside chemical phenol, then after 24 hours of absorption the jute fiber has been weighted once again. The result shown that in 5 grams of jute becomes 5.2 grams which means that the phenol absorption is 0.2 grams.

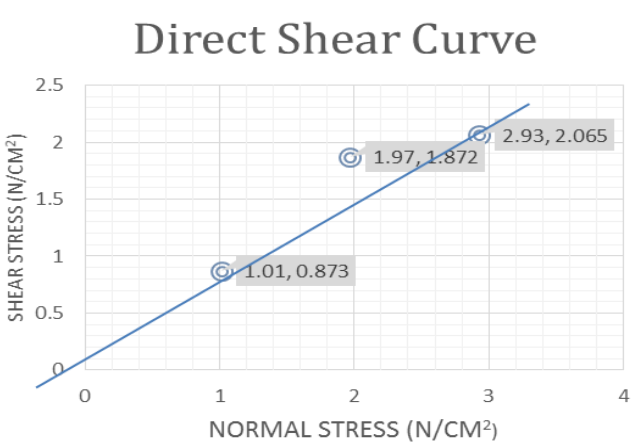
Again the soil samples will be tested accordance with IS 2720( index and other engineering properties) such as permeability, shear strength and direct shear. After that the soil is to be tested with mixing the jute fibers in a ratio of 1%,1.5%,2.0%,2.5%,3.0% and then tested in terms of index and engineering properties. The graphs would also be developed and the values in every stage of percentage of mixing.

Sieve Analysis of Soil Sample-A Sample of 1Kg was taken and Sieve analysis was performed according to IS460-1972 and Fineness Modulus was found to be 2.65. The Specific Gravity of the sample was found out to be 2.656. Standard Proctor Test was performed in which OMC= 10% and Maximum dry density (M.D.D)= 1.704.

TESTS

1.) Permeability tests

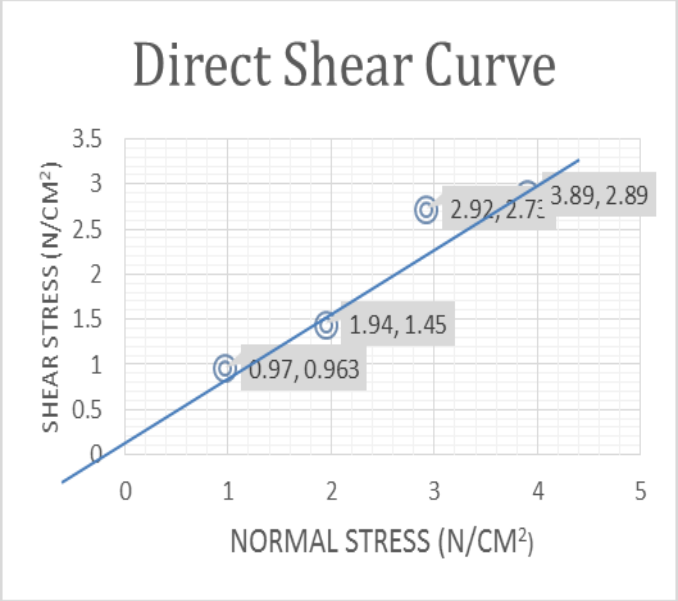
2.) Direct shear tests

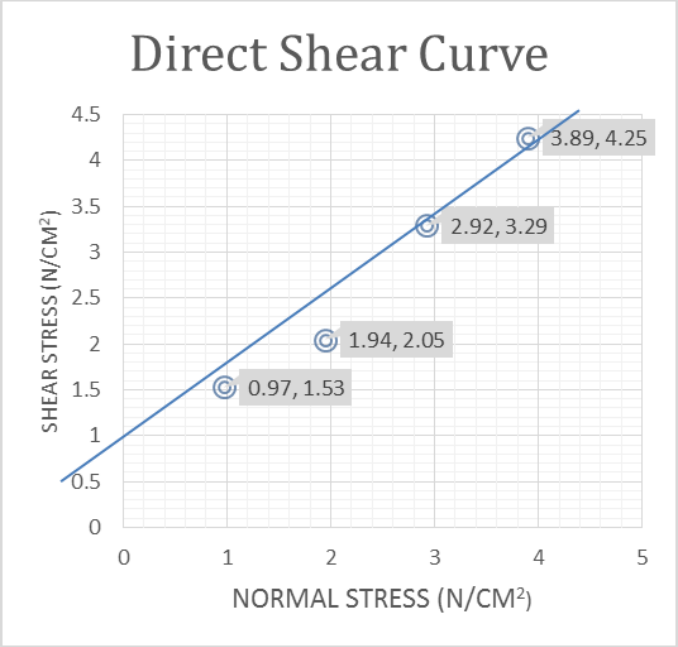



For untreated soil at 0%-Cohesion = 0.2 N/Sq. cm & angle of internal friction = 35.75 degree.

AT 1%

| | | | | |
|---|---|---|---|---|
| Normal | 0.97 | 1.94 | 2.92 | 3.89 |
| shear | 0.963 | 1.45 | 2.73 | 2.89 |



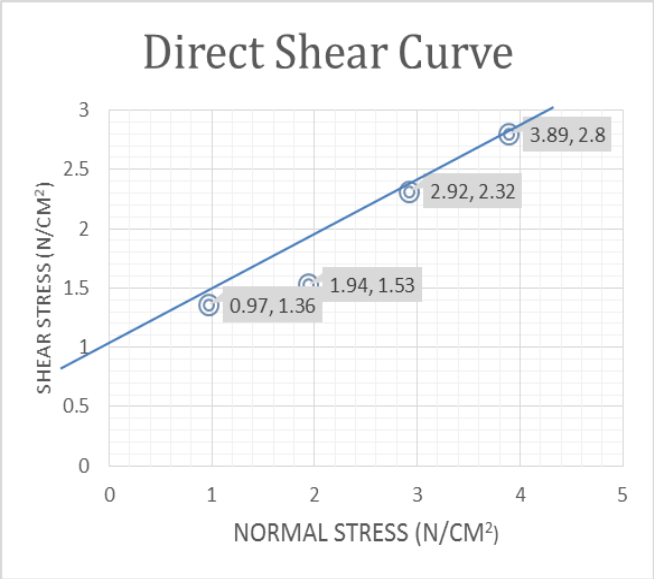




At 1.5%

| | | | | |
|---|---|---|---|---|
| Normal | 0.97 | 1.94 | 2.92 | 3.89 |
| shear | 1.53 | 2.05 | 3.29 | 4.25 |

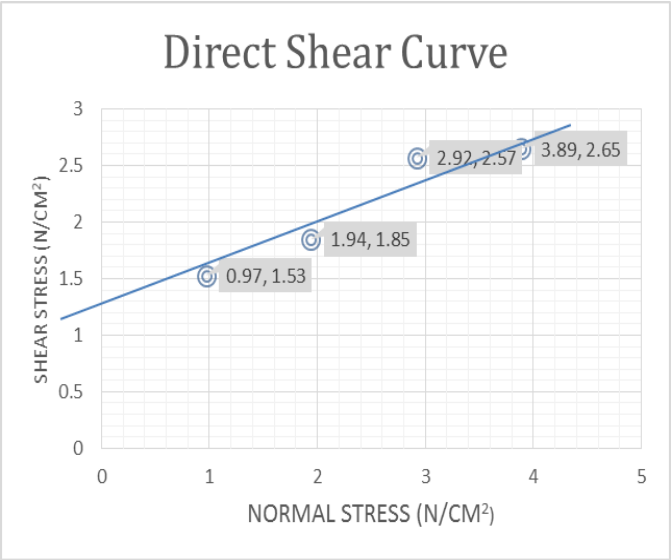
At 2.0%

| | | | | |
|---|---|---|---|---|
| Normal | 0.97 | 1.94 | 2.92 | 3.89 |
| shear | 1.36 | 1.53 | 2.32 | 2.8 |



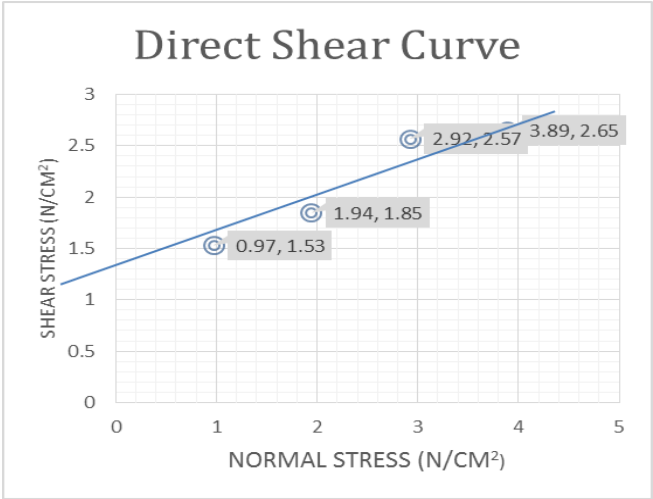

At 2.5%

| | | | | |
|---|---|---|---|---|
| Normal | 0.97 | 1.94 | 2.92 | 3.89 |
| shear | 1.53 | 1.85 | 2.57 | 2.65 |




At 3.0%

| | | | | |
|---|---|---|---|---|
| Normal | 0.97 | 1.94 | 2.92 | 3.89 |
| shear | 1.53 | 1.85 | 2.57 | 2.65 |




PERMEABILITY TESTS:

| $H_1$ | $H_2$ | T (Sec) | Percentage of Jute (%) | Permeability (k), cm/s |
|---|---|---|---|---|
| **90** | 70 | 30 | 1.0 | $0.9873 \times 10^{-3}$ |
| **93** | 76 | 30 | 1.5 | $0.793 \times 10^{-3}$ |
| **90** | 76 | 30 | 2.0 | $0.664 \times 10^{-3}$ |
| **93** | 84 | 30 | 2.5 | $0.3973 \times 10^{-3}$ |
| **90** | 85 | 30 | 3.0 | $0.2245 \times 10^{-3}$ |

## 4. CONCLUSION

For the series of tests conducted on jute fiber and proctor tests is also conducted in present study. From the above discussion it is clearly shown:

1.) The permeability is going to be decrease at every percentage of jute mixed with soil.

2.) The direct shear tests results shown that cohesion values has been increased at every percentage of mixing and angle is going to be decreased.

## REFERENCES

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