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# Effect of layered jute reinforcement on engineering properties of expansive soil

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*ABSTRACT*

Improving soil base is a major challenge in engineering. Buildings built on dark cotton soil are possible damaged due to high swelling and signs of depletion of this soil by varying the water content. The black cotton soil is wide sand that loses its strength in the presence of water. On the other hand, it has a tendency to shrink when lost moisture is present. About 20% of the land area in India is covered with dark cotton soil. Because of its swelling and shrinkage properties, also called broad soils. The current paper is an attempt to study the study of jute fiber (reinforcement) with control layers for its strength characteristics and dry mass with non-reducing strength test. Test results show that the soil when reinforced with 2 layers reached a large dry size and in the 4-layer reinforcement attained maximum unconfined compressive strength.

*Keywords: Jute Geotextile Sheet, Geotextile Reinforcement, Expansive soil, Stabilization, UCS, Strength of soil.*

## 1- *Introduction*

Soil has been used as building materials for roads, irrigation building etc worldwide. Due to weakness in mechanical properties and strength, the soil needs to do developed according to a different requirement of him site on site. Soil stabilization has been achieved since then many centuries ago to develop soil engineering structures. The main method of Stabilization involves mixing the soil with high strength soils or binding materials such as limestone / cement / calcium or solid reinforcement / fiber. The solidification of the soil increases the strength of the soil, it carries energy, ductility and prevents deformation The soil can be strong with the installation of straps / straps of strong steel and comparable low modulus of natural and / or synthetic fibers. During the last few minutes for decades, much work has been done to improve it soil engineering structures and that has already been discovered fiber supplementation is an effective way to improve everything soil engineering performance. Fiber soils emphasized is effective for all types of soils (eg sand, mud and clay). The the idea of compacting soil with natural fibers is ancient. Natural fibers are found locally, they can form compounds with it cement / lime, cheap, perishable and perishable friendly. They are biodegradable and hence do not create disposal problem in environment. Processing of these materials into a usable form is an employment generation activity in rural areas of these countries.

## 2- *Literature Review*

In the 21st century use of jute fiber in society Construction work has taken place rapidly, especially the subgrade of a flexible road. Savastano et al. (2000) used waste jute fibers as reinforcement for cement-based composites in construction work instead of concrete. Dhariwal (2003) carried out performance study on California bearing ratio (CBR) of fly ash reinforced with jute and non-oven fibers. Sanyal (2005) studied soil improvement by using jute fibre and applied Jute Geotextiles in Rural Roads. Chandra et al. (2008), studied CBR and shear values of Jute fibre for preparation of fibre reinforced flexible pavements. Bairagi, (2014) studied the Effect of jute fibers on engineering characteristics of black cotton soil and gave result that CBR and UCS values of soil were increased significantly when mixed with jute fiber from 0% to 5%. Choudhary et al, (2012) studied the improvement in CBR of expansive soil with a single Jute reinforcement layer and gave results that reinforcement in layer controls swelling and enhances CBR value. Singh, (2013) conducted work on strength and stiffness of soil reinforced with jute geotextile sheets and concluded that there is increase in shear strength of soil with inclusion of jute in soil. Pandit et al, (2016) conducted experimental work on Effects of Jute Fiber on Compaction Test and concluded that OMC of soil increases upto 1.25% of jute fibres and then decreases for 1.50%. MDD decreases upto 1.25 % of jute fibre and then increases for 1.50%. Hamid (2017), Subgrade Soil Stabilization Using Jute Fibre as a Reinforcing Material.

## 3- *Materials used*

*Soil*
*Jute fibres*

*Soil*

The soil sample is collected from Ayodhya vihar, near Pushpak vihar, Bhilai (CG). The location of site can be exactly given by its latitude and longitude i.e. $21°22'37.5''N$ and $81°32'13.7''E$ respectively. The various index properties and compaction properties (maximum dry density and optimum moisture content) of soil were determined in the laboratory. Following results were obtained:

Table-1

| Sno. | Property | Notation | Value |
|---|---|---|---|
| 1 | Specific Gravity | G | 2.43 |
| 2 | Soil classification | CH | - |
| 3 | Liquid Limit | LL | 68.34% |
| 4 | Plastic Limit | PL | 30.05% |
| 5 | Plasticity Index | PI | 38.30% |

| | | | |
|---|---|---|---|
| 6 | Differential free Swelling | DFS | 60% |
| 7 | Optimum Moisture Content | OMC | 18.54% |
| 8 | Maximum Dry Density | MDD | 1.59 g/cc |
| 9 | California Bearing Ratio | CBR | 2.67% |
| 10 | % Passing 75 micron sieve | - | 98.54% |
| 11 | Unconfined compressive strength | UCS | 166.6K $N/m^2$ |

**Jute Fibres**

The Jute fiber sheets (woven type) taken from the Jute bag, were procured from the local market. The average thickness of the sheet was 2.0 mm. Figure shows a view photograph of the Jute fiber sheet.

**4-Methodology**

The soil sample is tested for different tests listed below:

- Sieve Analysis
- Pycnometer test for Specific Gravity
- Liquid Limit
- Plastic Limit
- DFS
- Modified Proctor Test
- CBR test
- UCS

The sample was tested as listed above and values obtained are shown in table-1. After the tests on Natural Soil Specimen Unconfined compressive strength test was again again conducted on soil specimen reinforced with 2-Layer and 4-Layer respectively

**Unconfined Compressive Strength Test:**

The Soil Sample was prepared by using UCS sampler having diameter 3.8 cm and length 7.62 cm. Soil was compacted in 5-layers in between layers 3 samples of 2-layer reinforcement and 3-samples of 4-layer reinforcement were prepared and the sample was tested for unconfined compressive strength the average values of stress is obtained and taken as UCS of sample.

## 5-Results and Discussion

The Unconfined compressive strength of soil is improved. The maximum improvement is seen in 4- layers of reinforcement. The results are tabulated below:

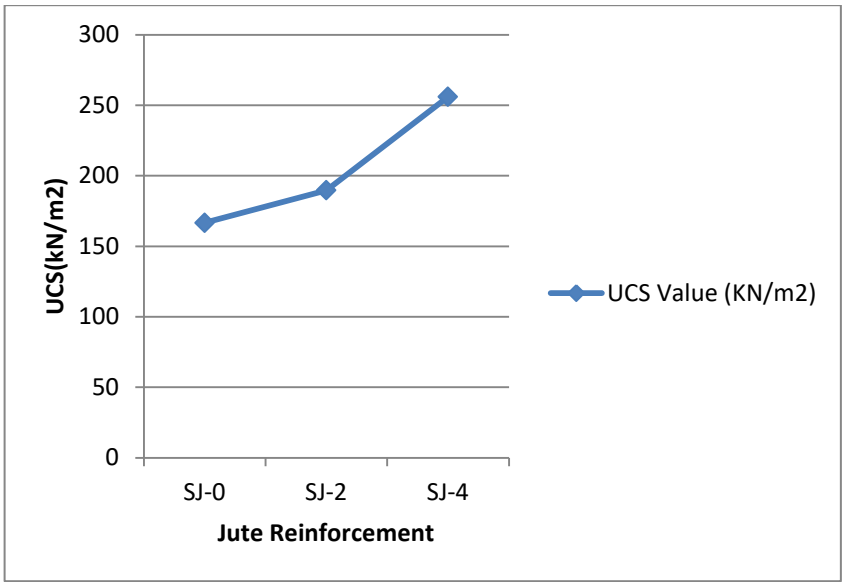
| Reinforcement | Notation | UCS Value ($KN/m^2$) |
|---|---|---|
| Soil with No Reinforcement | SJ-0 | 166.6 |
| Soil with 2-layer Reinforcement | SJ-2 | 189.7 |
| Soil with 4-layer Reinforcement | SJ-4 | 255.9 |

SJ-0 = Soil sample with no reinforcement

SJ-2= Soil sample with 2-layer jute reinforcement

SJ-4= Soil sample with 4-Layer jute reinforcement

The above results indicate that the UCS (Unconfined Compressive Strength) of the soil is maximum in 4-layer sample and there is improvement in UCS of soil after reinforcement of jute layers as the UCS is improved from 166.6 $KN/m^2$ to 255.9 $KN/m^2$..




## 6-Conclusions

The Expansive soil when attempted to stabilize with Jute layer reinforcement the remarkable changes was observed as the UCS was seen to be increased from 166.6 KN/m$^2$ to 189.7 KN/m$^2$ in the 2-layer jute reinforcement and 255.9 KN/m$^2$ in 4-layers of jute reinforcement. Jute was found out to be very effective in improving Unconfined Compressive Strength of the expansive soil.

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