Improvement of Strength of Unpaved Road by Using Jute Geotextile

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Abstract

This study illustrates the analysis of improving the strength of unpaved roads by using jute geotextile of different thicknesses. To complete the task, 4 sets of CBR tests had been conducted for the combination of soil only, soil-jute(type-1)-soil, aggregate-soil, aggregate-jute(type-2)-soil. Here jute(type-2) is more thick than jute(type-1). At first, organic soils were collected from Shiromoni and specific gravity, Atterberg limits, optimum moisture content, maximum dry density test of soil had been performed. Moreover, the values of mass per unit area, grab tensile strength, puncture resistance of jute geotextile were measured. From results, an increase in the strength of soil was found due to the use of jute geotextile. While conducting the CBR tests well-graded aggregate had been used as the top layer because a finished road is only as good as the materials that form the riding surface and reduces soil loss from the surface of the road. The CBR value of soil was 8.1% which was increased about 11% due to the use of jute(type-1) at the 4th layer of soil. Again, the CBR value of soil having aggregate on its top surface was 8.6% that was increased to 17% for using jute(type-2) at the interface of soil and aggregate.

Keywords: *Unpaved road; Jute Geotextile; CBR test; Subgrade strength Improvement.*

1. Introduction

Many unpaved roads possess an even, wide, preserved surface with wide shoulders while others have cramped or no shoulders and rutted, loose, or washboard surfaces where vehicles may slide out of control due to a severely raveled surface. Unfortunately, these problems are often the worst where vehicles turn and brake, such as curves and intersections where vehicle control is most critical. In addition, poor quality aggregate can lead to excessive dust, which can obscure a driver's view of the road and oncoming traffic (Wyoming Technology Transfer Center, 2004). A different set of material specifications is needed for unpaved road wearing courses to compensate for this lack of surface containment (David Jones).
The unpaved roads are very much important to deal with the low volume traffic. Large deformations can take place in this type of road due to weak subgrade (Senthill & Rajkumar, 2012). To overcome these deformations, the soil of weak subgrade can be reinforced by using jute geotextile. Jute geotextile (JGT) provides an effective and technically precise alternative to the rearranged granular filters. It restricts the relocation of soil grains and helps in developing natural graded filters by interaction with soil bed. Jute geotextile has been utilized effectively to address a host of geotechnical problems encountered in road construction, river bank erosion, slope erosion, embankment stabilization and soft soil stabilization (Tapobrata Sanyal). Aggregates are allotted over JGT to prevent unswerving exposure to sunlight and water as well

as to disseminate the thrust of wave actions. An unexpected alter from a paved to an unpaved surface creates a risk of skidding and losing control of the vehicle. So, the unpaved roads are reinforced by using jute geotextile.

2. Methodology

Organic soil was used in this regard and soil was collected from Shiromoni, Khulna at a depth of 5 feet from the existing ground. Samples were taken in large polythene bags and transported to the Geotechnical Engineering Laboratory of the department of Civil Engineering, Khulna University of Engineering and Technology, Khulna. The collected soil was dried in the sun for 7 days. Then it was pulverized manually by hammer. Later the soils were screened through the sieve of 4.75 mm aperture before preparing the specimen for testing.

Flow diagram of the whole task is shown below:

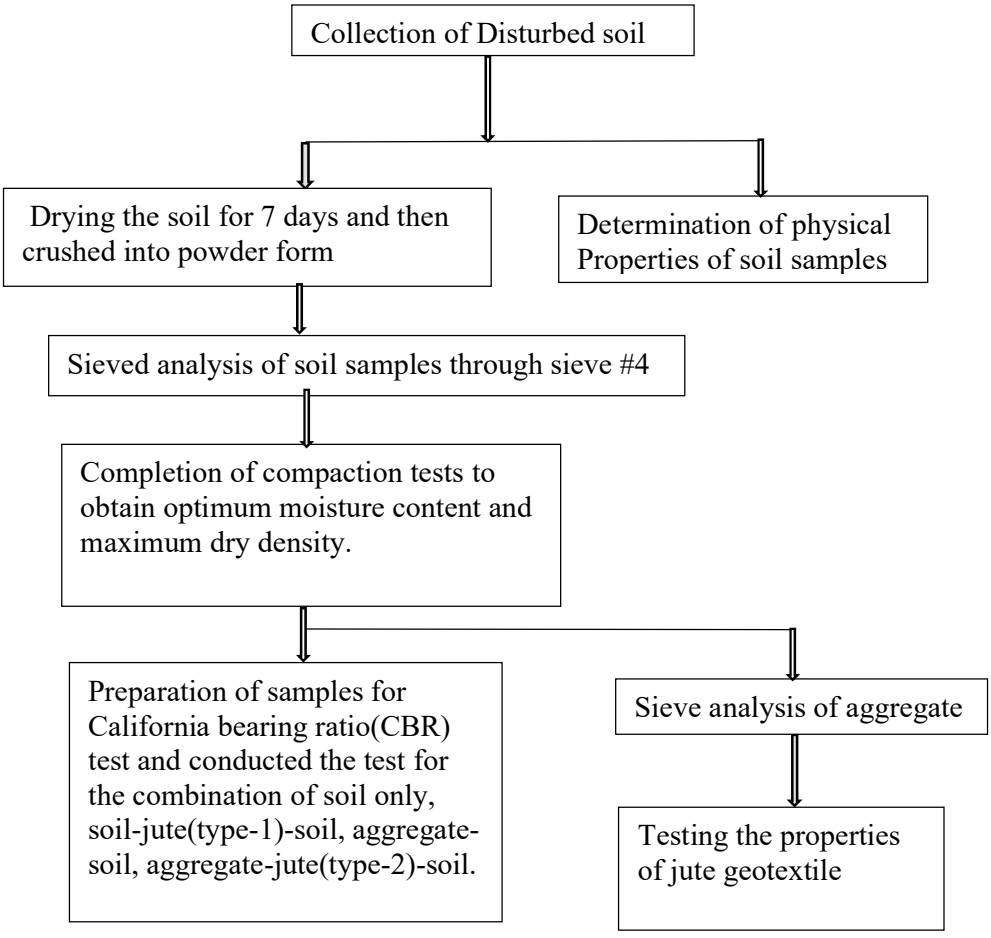

Figure-1. Flow diagram of the task

Sample set up during CBR test:

The figures given below will show the sample setup in the mold during the CBR test.

a) Sample set-up for soil only

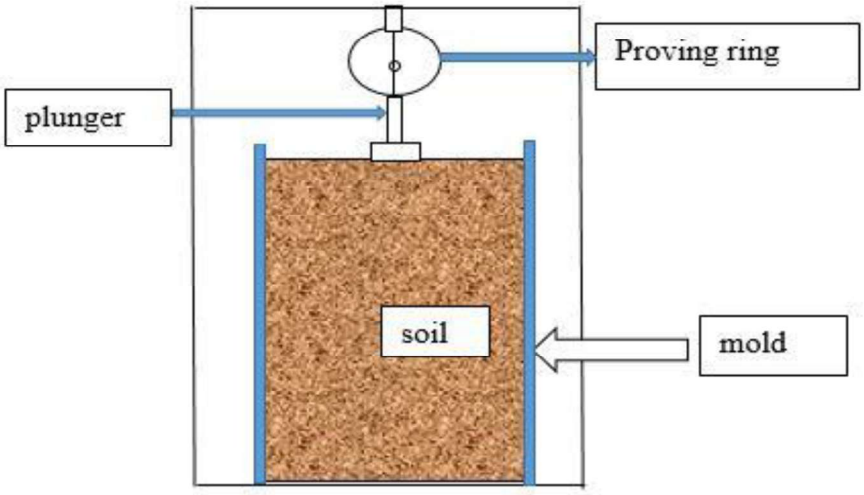

Figure 2. Sample setup for soil

b) Sample set-up for (soil-jute(type-1)-soil)

- During CBR test the jute was placed at 4th layer of each mold at a height of 24 mm from the top of the sample.

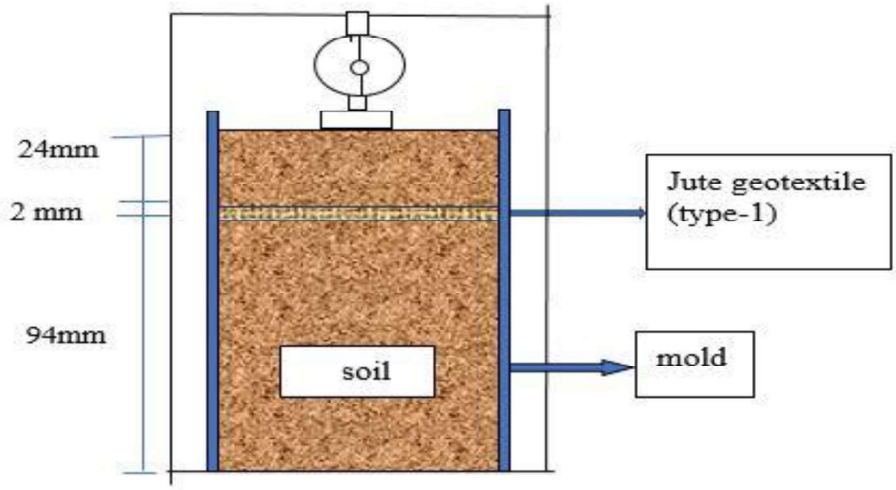

Figure 3. Sample setup for soil-jute(type-1)-soil

c) Sample set up for(aggregate-soil)

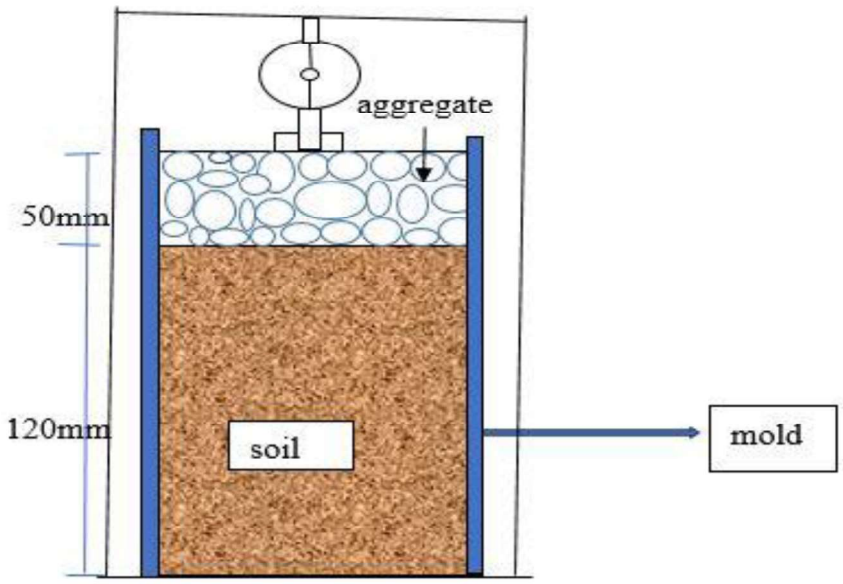

Figure 4. Sample setup for aggregate-soil

d) Sample set up for aggregate-jute(type-2)-soil

- before filling the free space of the mold by aggregate the jute was placed at the top level of soaked sample.

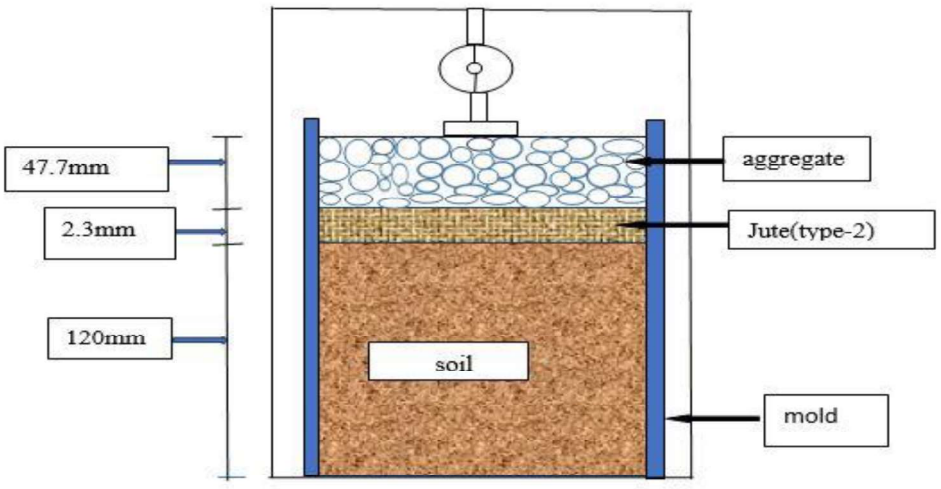

Figure 5. Sample setup for aggregate-jute(type-2)-soil

3. Results

Table 1. Determination of CBR values

Combination	CBR values
Soil	8.1
Soil-jute(type-1)-soil	11
Aggregate-soil	8.6
Aggregate-jute(type-2)-soil	17

From Table 1, the CBR value of soil is obtained from the tests conducted is 8.1% which increases about 11% due to the use of jute(type-1) at the 4th layer of soil. Again, the CBR value of soil having aggregate on its top surface is 8.6% which increases to 17% due to the use of jute(type-2) at the interface of soil and aggregate.

From the results, it can be visualized that, due to the use of jute geotextile the strength of subgrade soil has been improved significantly.
Further, for quantifying the amount of increase in the penetration resistance, the reinforcement ratio is taken into remuneration. The reinforcement ratio (Koerner, 2005) at a particular penetration is,

$$\text{Reinforcement ratio} = \left[\frac{\text{Load with geotextile}}{\text{Load without geotextile}}\right]$$

Based on the reinforcement ratio obtained for both soil-jute(type-1)-soil and aggregate-jute(type-2)-soil, the reinforcement ratio versus penetration curve is plotted-

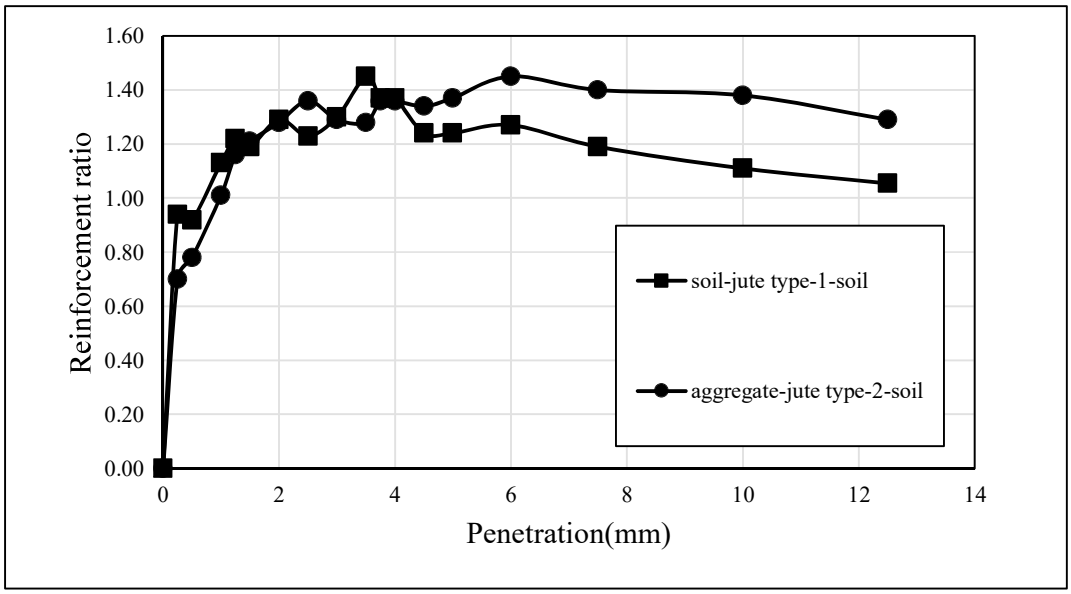

Figure 6. variation of reinforcement ratio with penetration

Figure 6. shows that the reinforcement ratio for jute(type-2) is more jute(type-1), which indicates that the introduction of jute geotextile offers good resistance even to lower penetration. Further, the reinforcement ratio increases with an increase in the thickness of the jute. Hence the use of geotextile is the most advantageous in an unpaved road with soft subgrade at higher penetration.

4. Discussion

It is not well known to many engineers of Bangladesh about high efficiency of jute geotextile in the improvement of subgrade of unpaved road. So, project of unpaved road with jute geotextile is rare in our country. After studies on different uses of jute geotextile, it is found that jute geotextile can be used with different soil improvement purposes. As for example: drainage, separation, erosion control, bearing capacity improvement and many more. The presence of jute layer imposes the development of an alternate failure surface thereby increasing the bearing capacity. Reduction in the transmission of shear stresses to the subgrade and by providing the vertical confinement outside the loaded area helps in improving the bearing capacity.

5. Conclusions

From the above discussions, it is revealed that introduction of jute geotextiles results in a rise in CBR value, indicating improvement of subgrade soil with passage of time. More improvement of subgrade CBR value is likely to occur with passage of time. Hence, JGT is an effective material to strengthen weak subgrade.

References

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