

# Improvement in Subgrade Characteristics of Soil Reinforced with Jute Fiber

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**ABSTRACT:** Use of natural fibers is very effective and advantageous for improving soil properties as they are cheap, locally available, and biodegradable and ecofriendly. The natural fiber reinforcement causes significant improvement in engineering properties of soil. This paper carried out an investigation on CBR value of the soil reinforced with jute fiber. The study is conducted on the soil sample taken from Jammu Srinagar Highway, Pampore. Various tests such as compaction characteristics, index properties and CBR test under soaked and unsoaked are conducted in soil laboratory in order to determine the basic properties of soil sample without reinforcement. After determining the basic properties Jute fiber is used as a reinforcing material for improvement of soil. The length of the jute fiber is kept 30mm, the diameter of jute fiber is kept 1mm and the percentage of Jute fiber by dry weight of soil was taken as .25%, .5%, .75% and 1% and CBR test are conducted on soil under both soaked and unsoaked conditions by varying the percentage of jute fiber. Test results indicate that CBR value of soil increases with increase in the percentage of jute fiber in soil and this increase is maximum at fiber content of 1%.

**KEYWORDS:** Jute Fibre, Soil, Improvement, CBR, reinforcement, Fibre Length

## I. INTRODUCTION

Soil improvement is major concern in the construction activities due to rapid growth of urbanization and industrialization. Soil improvement is that process in which the index properties and other engineering characteristics of soil are improved by using different techniques. In this present study, an attempt is made to stabilize the soil using Jute fiber. From the very inception of the Indian Jute Industry, jute fiber has proved its superiority over other fibers in terms of functionality and reusability due to its considerable tensile strength, low extensibility and good dimensional stability. More recently, jute have been used to enhance tensile and mechanical properties of civil engineering materials themselves, such as road surfaces and sub-surfaces in both construction of new and renovation of old highways. Soil improvement result in increase in the strength of soil, bearing capacity, ductility and inhibits deformations. From that study it has been concluded that addition of fiber to soil is an effective way to enhance the overall engineering performance of soil.

## II. RELATED WORK

Many researchers have worked on the stabilizations of soil using Jute fiber. In(1930) woven jute fabric was used for sub-grade support in construction of highway [1]. Grey et al (1986) studied the comparative behavior of sand with fabric reinforcement and fiber reinforcement [2]. Praveen Aggarwal and Bajinder Sharma(2011), conducted study on the application of Jute fiber in the improvement of subgrade characteristics. In that study it was observed that inclusion of Jute fiber reduces the maximum dry density whereas the OMC increases.[3]. H. P. Singh and M. Bagra(2013), conducted an experimental study on locally available (Doimukh, Itanagar, Arunachal Pradesh, India) soil reinforced with Jute fiber. After the investigation it is concluded that CBR value of soil increases with the inclusion of Jute fiber. [4]. Barnali Ghosh, Dr V Ramesh, Rajarajeswari B Vibhuti,(2014) conducted a study on two different clayey soils (peat and black cotton soil) with and without reinforcement. Jute geotextile (grade-TD-5) was used as a reinforcing material.

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The result show the increment of soil properties like shear strength, dry density, CBR while permeability and settlement decreases on introduction of jute geotextile.[5].HarshitaBairagi ,R,K,Yadav ,R.Jain(2014) conducted a study on the effects of Jute Fibers on the engineering characteristics of Black Cotton Soil and it was concluded that with increase in percentage of jute fiber, CBR value increases [6].Aberdeen.Md. AkhtarHossain, Md. ShakhawatHossain, Md. KamrulHasan(2015) conducted a study on locally available soil reinforced with jute fiber .It was observed that the optimum moisture content and CBR value increases and the maximum dry density decreases with the increase in jute fiber content for each length and diameter of jute fiber. [7]. DharmendraKumar, Sudhir Nigam, AbhinavNangia, and ShailendraTiwari(2015) conducted a study on five soil samples on the improvement in CBR values of soil reinforced with Jute fibers.It was observed that the CBR value of soil increases with the increase in length and diameter of fiber [8].This paper presents the influence of Jute fiber on the CBR value of Pampore, Jammu-Srinagar Highway, India soil. A number of CBR tests were performed both in unsoaked and soaked conditions. Firstly the tests were performed on plain soil, and then jute fiber is added to the soil as a reinforcing material. Then the conclusions were drawn by comparing the CBR values of reinforced and unreinforced soil.

### III. MATERIALS AND METHODOLOGY

**Soil:**This study is conducted on the soil sample collected from Jammu Srinagar highway, Pampore. The various properties of soils such as index properties, compaction properties, shear parameters unconfined compressive strength, and CBR value of soils in both soaked and unsoaked conditions were determined in the laboratory.

**Geotechnical properties of soil collected from Jammu Srinagar Highway, Pampore are enlisted below:**

Table 1: Geotechnical properties of Pampore soil.

Property	Value
Specific Gravity	2.643
Coefficient of uniformity ( $C_u$ )	7.083
Coefficient of curvature ( $C_c$ )	1.33
Liquid Limit	35.8 %
Plastic Limit	25.87%
Optimum Moisture Content	16.5%
Maximum Dry Density (gm/cc)	1.785
CBR value under unsoaked conditions	3.94%
CBR value under soaked conditions	2.40 %

#### Reinforcement Material

The reinforcing material used in this study is Natural Jute Fiber. The Jute fiber used is procured from the local market. These fibers are generally available in the threaded form

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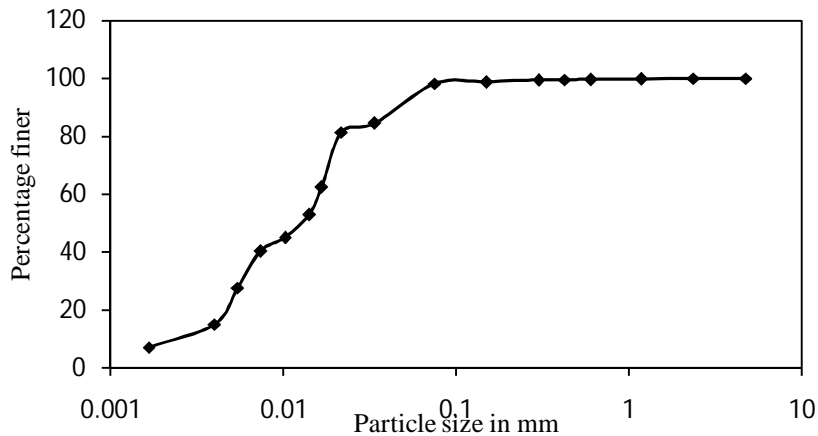


Fig 1: Particle size distribution curve of soil sample from Hydrometer test.

## METHODOLOGY

Soil used in this study is taken from Pampore, Jammu-Srinagar highway. After the process of drying soil in oven, various tests were carried out on soil sample and its basic properties such as specific gravity, liquid limit, plastic limit, maximum dry density, optimum moisture CBR value were determined. Then jute is used as a reinforcing material in the soil. Jute is added to soil in different percentages which vary from .25% to 1%. Again same tests were conducted on soil and the change in the properties of soil on the inclusion of jute fiber is determined. The CBR values of the test samples of unreinforced and reinforced soil were determined corresponding to plunger penetrations of 2.5 mm and 5 mm as per the standard procedure laid down in IS: 2720, Part XVI (1965).

## IV. EXPERIMENTAL RESULTS AND DISCUSSIONS

### Effect of Jute reinforcement on CBR value under unsoaked conditions

A number of CBR test were conducted on the soil sample under unsoaked conditions. The CBR tests were initially conducted on unreinforced soil sample and CBR value in terms of percentage is determined for unreinforced soil sample under unsoaked condition. After determining the CBR value of plain soil the Jute fiber is added to soil as a reinforcing material. The percentages of jute fiber vary from .25% to 1%. After conducting various CBR test on soil in soaked conditions following results are obtained.

Table 2: CBR value of soil reinforced with Jute Fiber under unsoaked conditions.

Length of Jute Fiber (mm)	Fiber Diameter 1mm		
	Percentage of Fiber by Dry weight of soil	CBR Value (%)	% Increase in CBR value
30	0%	3.941%	0%
30	.25%	4.671%	18.52%
30	.50%	5.693%	44.45%
30	.75%	6.569%	66.68%
30	1%	8.029%	103.73%

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From the above table, it can be concluded that with the inclusion of jute fiber in the soil, the CBR value of soil increases. Initially the CBR value of soil sample under unsoaked conditions was 3.941%. With the addition of jute, the CBR value of soil increases up to 8.029%. The maximum increase is experienced at 1% jute. The maximum increase in CBR value was found to be more than 103% over the plain soil under unsoaked conditions at the fiber content of 1% for the fiber having length 30mm and diameter 1mm.

### Effect of Jute reinforcement on CBR value under soaked conditions.

CBR test were conducted on the soil sample under soaked conditions. For soaked test the CBR mould compacted with soil along with surcharge is kept in soaking condition in water tank for the time period of 4 days. After conducting various CBR test on soil in soaked conditions following results are obtained.

Table 3: CBR Value of soil reinforced with Jute Fiber under soaked conditions.

Length of Jute Fiber (mm)	Fiber Diameter 1mm		
	% of Fiber by Dry weight of soil	CBR Value (%)	% Increase in CBR value
30	0%	2.408%	0%
30	.25%	2.992%	24.25%
30	.50%	3.722%	54.56%
30	.75%	4.671%	93.97%
30	1%	5.328%	121.26%

Based on the above table, it may be concluded that with the inclusion of jute fiber in the soil, the CBR value of soil increases. Initially the CBR value of soil sample under soaked conditions was 2.408%. With the addition of jute the CBR value of soil increases up to 5.328%. The maximum increase is experienced at 1% jute. The maximum increase in CBR value was found to be more than 121% over the plain soil under soaked conditions at the fiber content of 1% for the fiber having length 30mm and diameter 1mm.

## V. CONCLUSION

From the above discussions following results are obtained from CBR tests performed on soil samples mixed with different percentages of jute fiber under both soaking and unsoaking conditions. On soil sample, under unsoaked conditions, the CBR value of plain soil sample increases from 3.941% to 8.029% on inclusion of jute. The maximum CBR value is observed as 8.029% at 1% jute fiber an increase of about 103.78%. Under soaking conditions the CBR value increases from 2.408% to 5.328% when the jute is added from .25% to 1%. The maximum CBR value is observed as 5.328% at 1% jute fiber an increase of about 121.26%.

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