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## Use Of Jute Geo Textile For Strengthening Of Sub Grade Of Road Work

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### Abstract

Jute Geo - textiles have been successfully used for reinforcement of soil to improve bearing capacity. In this paper the jute Geo - textiles as a tensile materials have been used for reinforcement of different kind of soils. Laboratory California bearing ratio (CBR) tests were performed to investigate the load – penetration behavior of different 3 kinds of soils ( B. C. Soil, Murum & both soil ) with different kind of jute Geo – textiles ( Woven jute Geo – textiles thickly netting & with thinly netting ). Samples of soil tested for CBR without reinforcement & samples are also tested with jute Geo – textiles. Laid at various distance from top (i.e 1/3, 2/3 & half distance) of compacted thickness of soil suitability for improvement of sub –grade in all aspect is calculated. Result shows that soil sample of 50% B. C. soil & 50 % murum with thick jute Geo – textiles laid at 1/3<sup>rd</sup> distance from top are most economical & increases the CBR to considerable extent.

**Keyword:** Jute Geo – Textiles, Soil Murum, Mixed Soil, Reinforced Soils, CBR Tests.

### Introduction

The use of Geo – textile in many engineering applications has become more apparent and has proven to be an effective means of soil improvement. Jute Geo – textiles have also used in many civil – engineering works like air port, road works, flyovers, drainage works etc. The results showed that jute Geo - textiles layer placed between sub base & sub grade can significantly improves the bearing capacity of sub grade soil. 1. S. D. Ramaswamy in his “Jute textile for road” discussed feasibility for application in road construction. 2. P. S. Prasad of central road research in this paper experiments for improvement of CBR & reduction of thickness of sub grades are made. Different kinds of soils have different CBR values. If it is reinforced with jute Geo textile it increases the CBR value. Further investigations are made for economical

improvement of CBR value of sub grade soil. To have comprehensive economically feasible results one should undergo a experiments like

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kind of soil jute type at what distance Geo textiles should be laid gives improved CBR values with economically is tried to find out in this paper. Comparative investigation has stated that mostly black cotton soil prone areas are feasible to use of Geo – textiles. Geo textiles are more efficient as compared to use of conventional technique for BC soil. The book of standards for applications of jute – Geo textiles in strengthens of sub –grade in road works and control of bank erosion & water ways and advised to consider the enhancement of CBR sub – grade by 1.5 the control figure.

### **1.Details of Material used**

- 1 Black cotton soil
- 2 Murum
- 3 Mix soil (50 % B. C. Soil & 50% Murum)
- 4 Woven jute Geo textile (Thick)
- 5 Woven jute Geo textile (Thin).

#### **1.1CBR Test Procedure:**

The soil was placed in three layers at the mould. Each of layers was compacted by 56 blows of a rammer dropped from a distance of 304 mm. In the test thicknesses were 40 mm. A woven jute Geo textile sheet was used at the interface as reinforcement. Then it is soaked for 96 hours and tested in CBR test apparatus & CBR is calculated, CBR expressed in % age.

#### **1.2Performance :**

General: Literature review shows that jute-geotextile have been successfully used for reinforcement soil to improve bearing capacity. As it increases CBR values of soil, it has also used in many civil. Engineering works like air-port, road works, flyovers, drainage works etc. In line of this I decided to further study of jute-geotextile as a reinforce material. I concentrated on properties of soil, properties of jute, which kind of jute will improve CBR values of soil? which kind of jute will improve CBR of what kind of soil? What will be the position of jute-geotextile as a reinforce material in soil go as to increase CBR value of soil all this is studied & experimented. Actual results obtained is tabled here. Graphs are plotted for comparative study. Apart from this also attention is paid to collect indirect benefits from this kind of reinforcement. Once the CBR of sub-grade is increased it will help to design the base course & accordingly

courses. It will directly / indirectly reduce the cost of road works and increase the life of road works. Sound foundation give long life to any structures.

Accordingly attempts are made to findout good combination of jute with soil so as to increase CBR values of soils / Sub-grades, to build a intact road. Less attention are paid to roads in the rural areas, By making such attempts on experimental basis, low maintenance & long live road can be prepared in future. Comparative investigation has stated that mostly black cotton soil prone areas are feasible to use of jute – geotextiles, geotextiles are more efficient as compared to use of conventional technique for B.C. soil.

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1.3 Properties of Material :

**2.Details of Experimental Studies:**

Table: 1

S. n	Material	Wt. Dry in gm	Wt. Normal in gm	% age Of W.C	MDD g/cm <sup>3</sup>	OMC %	Liquid limit	Plastic Index
1	Black cotton soil	920	1000	8.69	1.652	17.13	60.52	20.60
2	Murum	960	1000	4.16	1.924	10.19	NP	NP
3	Mix soil	945	1000	5.82	1.813	14.17		
4	Woven jute Geo textile (Thick)	23	68	33				
5	Woven jute Geo textile (Thin).	20	74	16				

oil samples without Jute reinforcement

Sr. no	Material	CBR (%)
1	Black cotton soil	1.59
2	Murum	16.71
3	Mix soil	4.82

Table:2  
 Soil samples with Jute Sample I

Sr. No	Material	CBR (%) Jute laid at different
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		distance from top		
		1/3 <sup>rd</sup> distance	1/2 distance	2/3 <sup>rd</sup> distance
1	Black cotton soil	4.46	3.18	2.71
2	Murum	25.94	22.44	21.48
3	Mix soil	13.21	11.30	10.34

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Table:3  
 Soil samples with Jute Sample II lead at different layers

Sr. No	Material	CBR (%) Jute laid from top		
		1/3 <sup>rd</sup> distance	1/2 distance	2/3 <sup>rd</sup> distance
1	Black cotton soil	3.98	2.23	1.91
2	Murum	24.66	19.09	17.98
3	Mix soil	12.25	9.07	7.79

Series of CBR tests are carried out to find out best suitable

### 3.Comparative study :

To find out cost effective solution it is necessary to compare the pavement cost of road residing over different subgrades. As we have tested the CBR values of different samples including bc soil, murum and mix soils. How it affects on cost of road, it is interesting to see.

3.1 B.C. soil – sub grade :

(a) CBR value determined in lab – 1.59%

(b) Sub-grade of BC soil when its CBR is 1.59% as per Charts – I No Designed Crust for such kind of CBR value of soil. Though it is decided to build a road over it by conventional method, following are the contents.

(i) Total Crust Thickness required for low traffic intensity is 475mm.

(ii) Murum Sub base - 300 mm

(iii) Aggregate – I - 100 mm

(iv) Aggregate – II - 75 mm

(v) Estimated Cost for 1 Km. of Road for BC soil :

Table:1

Sr. No.	Item	Qty	Rate	Amount
I	Murum Earthwork for road work (As per typical Drawing)	$5.15+3.95/2 \times 0.30 \times 1000 = 1365 \text{ Cum.}$	Rs.350 per cum	4,77,750.00
ii	Prov. & laying Aggregates – I over compacted earth work	$3.95+3.55/2 \times 0.10 \times 1000 = 375 \text{ Cum.}$	Rs. 850 per cum	3,18,750.00
iii	Prov. & laying Aggregates – II over compacted earth work	$3.55+3.35/2 \times 0.075 \times 1000 = 258 \text{ Cum.}$	Rs. 890 per cum	2,29,620.00
<b>Total Cost Rs.</b>				<b>10,28,120.00</b>

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### 3.3 B.C. soil with jute sample laid at 1/3<sup>rd</sup> distance from top of embankment :

i) CBR value determined 4.46%

For A type of traffic loading thickness required is 275 mm as per design chart attached following are base & Sub-base course thickness.

ii) Sub-base course - 100 mm. murum filling

iii) base course - 100 mm. Aggregates 1<sup>st</sup> type.

base course - 75 mm. Aggregates 2<sup>nd</sup> type.

iv) Estimated cost with jute – material for BC soil as jute is laid 1/3<sup>rd</sup> distance from top:

Table:2

Sr. No.	Item	Qty	Rate	Amount
I	Murum earth work (As per typical Drawing)	$4.45+4.05/2 \times 0.10 \times 1000 = 425 \text{ Cum.}$	Rs.350 per cum	1,48,750.00
ii	Providing & laying jute.	$4.00 \times 1000 =$	Rs. 20 per sqm	80,000.00

		4000 Sqm.		
Iii	Providing & laying Aggregates-I embankments over	$4.05+3.65/2$ $\times 0.10 \times 1000 =$ 385 Cum.	Rs. 850 per cum	3,27,250.00
Iv	Providing & laying Aggregates-II	$3.65+3.35/2 \times$ $0.075 \times 1000 =$ 262 Cum.	Rs. 890 per cum	2,33,810.00
<b>Total Rs.</b>				<b>7,89,180.00</b>

As we have seen the approximate cost of road constructions for bc type of sub grade soil samples.

If sub grade is of B.C. soil & jute is introduced it improves CBR value & strengthens the sub grade, simultaneously it saves approximately Rs.2.50 lacs per km.

Similarly if subgrade is of mix soil & jute –geotextile is introduce it improves the CBR value tremendously & strengthens the sub grade, simultaneously it saves approximately Rs.3.00 lacs per km.

In case of murum based sub grades if it is reinforced with jute geotextile cost will increase little bit, but CBR value of sub grade increases 150%. It also strengthens the sub grade of road construction. For heavy traffic it will be beneficial.

The most cost effective solution is B.C. soil with jute material satisfies both economy and strength. Secondly mix soil also has very good results with jute material. This is economical next to B.C. soil.

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#### 4.Result and Discussion

The experimental moisture content & the dry density were the results achieved during determined samples for the CBR were compacted. After, the CBR test, the CBR values were obtained by compacting penetration one of the best combination suggested is mix soil + jute 1 of different soils with different jutes are tested and results are obtained graphical representation of CBR values show the best combination of soil sample & jute sample. Jute samples no 1 & soil sample III i.e. mix soil gives a economical solution to many problems. Where only BC soil is present introducing only jute Geo textile is not a solution in that case mix of murum & jute sample 1, whose opening % age is 58 % is more economical & suitable for strengthening of sub grade. The jute Geo textile laid at 1/3<sup>rd</sup> distance from top gives best results and allowed to reduce the thickness of sub grade.

Similarly murum with jute sample no 1 also gives best results. The site where murum is available, jute 1 placed at 1/3<sup>rd</sup> distance from top increases CBR value of sub grade and altimetry strengthens the sub grade for experiments, a site near Aurangabad is selected, murum samples

are collected CBR for murum is 16.71%. But when same is tested by reinforcing jute sample 1 at 1/3<sup>rd</sup> distance from top increase CBR value upto 25.94 % thus here CBR value increases 2.54 times at old one.

Table:%age increase in CBR values of soil after reinforcement of jute geotextiles

Soil Type	% age increase over original CBR value of soil					
	Jute Sample – I			Jute Sample – I		
	1/3 <sup>rd</sup>	1/2	2/3 <sup>rd</sup>	1/3 <sup>rd</sup>	1/2	2/3 <sup>rd</sup>
i) B.C. soil	280	200	170	270	140	120
ii) Murum	155	134	128	147	114	107
iii) Mix soil	274.7	234	214	260	118	161

The best combination & economically suggested is that if BC soil is available at site whose CBR is tested 1.59% & if is sub grade is made up of mix soil & jute Geo textile - 1 is laid at 1/3<sup>rd</sup> distance from top of sub grade gives CBR 12.25 % which is in result increase CBR up to 7.70 times. This also suggests decreasing the thickness of sub grade.

### 5.Conclusion :

A series of CBR test was under taken to investigate the effect of jute – Geo textiles on various soil samples, the major inclusion from this study are summarized as fallows.

- 1.The inclusion of reinforcing jute – Geo textile materials in soils improves strength ofsubgrade soils. It implies that jute Geo textiles – reinforced soils in unproved roads will perform better than un reinforced ones and increases load carrying capacity of soils.
- 2.The improvement of soil strength of CBR with jute – Geo textile material depends upon type of jute Geo textiles & its placing from top layer. The effect is significant for soils having no more fine percent.
- 3.The introduction of jute – Geo textile reinforcement in soil leads to decrease surface penetration & deformation
- 4.In the uniform deposit of murum type soil, introduction of a single layer of jute – Geo textile reinforcement from top 1/3<sup>rd</sup> distance of sub grade soil, increases significantly CBR values & soil – strength

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### 6.Grahical Comparision:

**Graphical Comparision**

**Jute Laid at 2/3rd Distance**

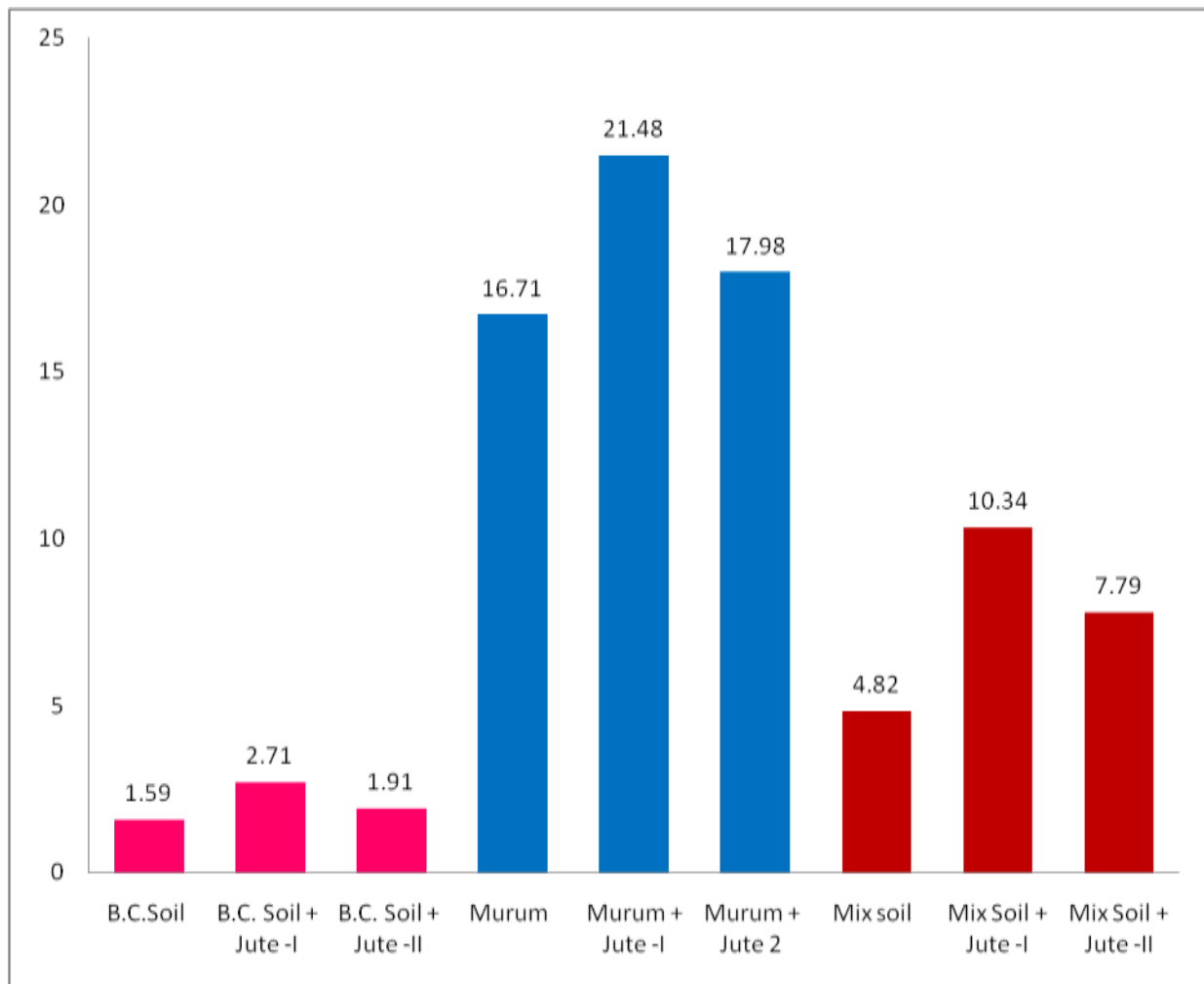


Figure 1. The Trend Of CBR By Use Of Jute

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