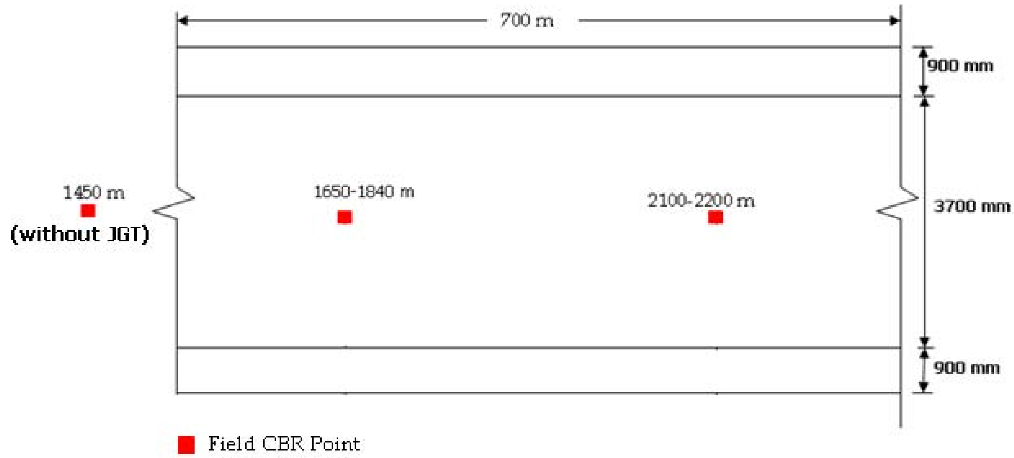
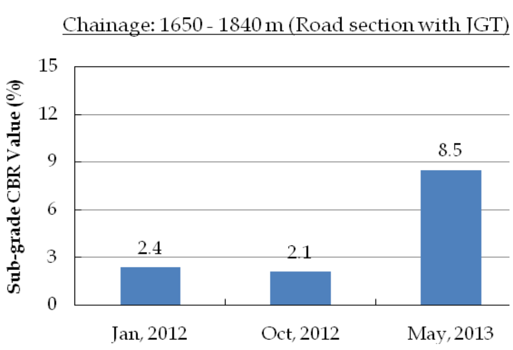


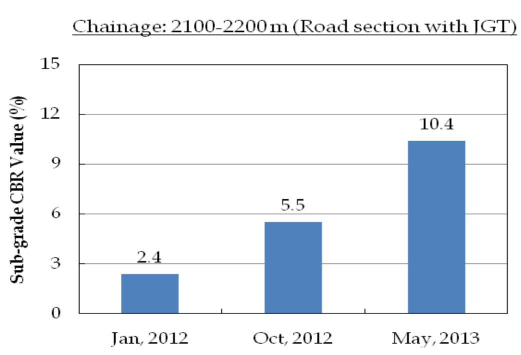
FIG. 3. Monitoring plan of Southpara-Kandapara Rural Road, Bancharampur, B.Baria

FIG. 4. Photos of The Construction Site After Applying JGT

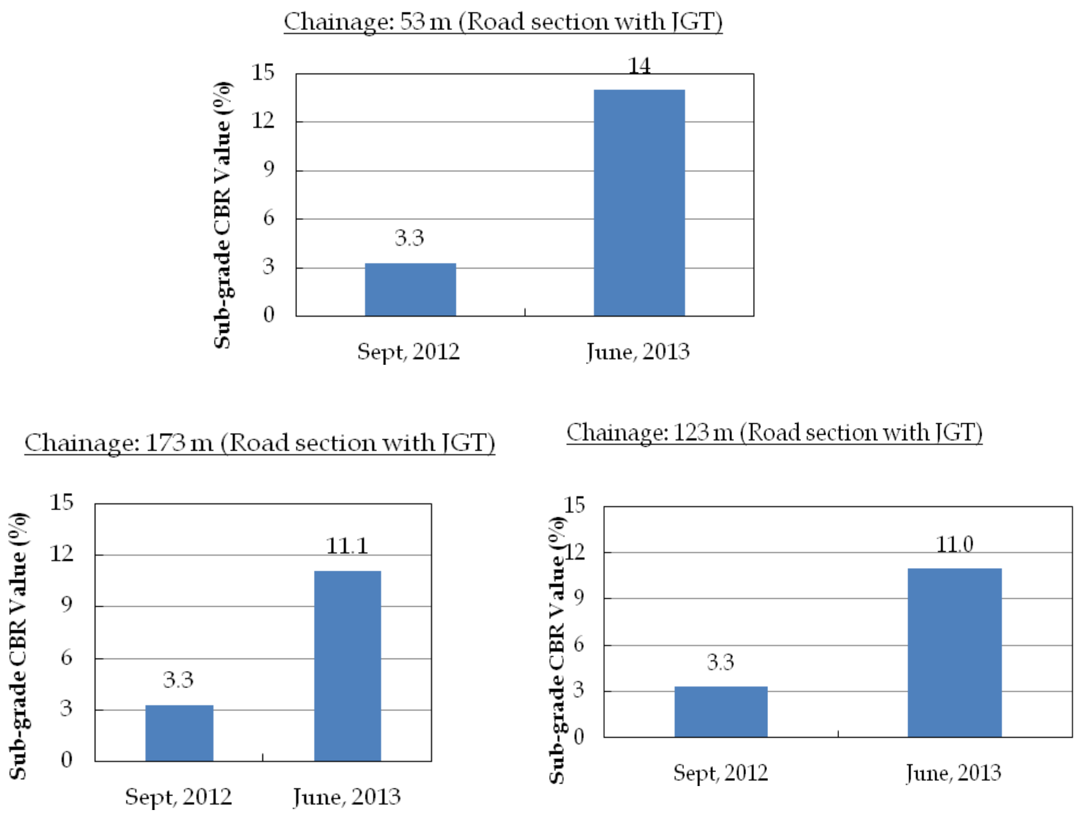
Table 2. Monitoring Data of Roads in Different Geophysical Locations

Road	Chainage	Monitoring Data	
		Date	SG CBR Value
Southpara-Kandapara Rural Road, Bancharampur, B. Baria	1650-1840 m	Jan, 2012	2.4
		Oct, 2012	2.1
		May, 2013	8.5
	2100-2200 m	Jan, 2012	2.4
		Oct, 2012	5.5
		May, 2013	10.4
Tazkhali-Titas river-Chandu Mia Road, Bisnurampur, B. Baria	53 m	Sept, 2012	3.3
		June, 2013	14
	123 m	Sept, 2012	3.3
		June, 2013	11
	173 m	Sept, 2012	3.3
		June, 2013	11.1
Circular Road Savar	600 m	Jan, 2013	3.6
		June, 2013	7
Keraniganj	250-280 m	May, 2011	3
		March, 2012	12.6
		Sept, 2012	18
	310-340 m	May, 2011	3
		March, 2012	7
		Sept, 2012	19.3
	410-420 m	May, 2011	3
		March, 2012	21.3
Noabenki-Garazehat-Harinagarhat Road, Shyamnagar, Satkhira	6700 m	Dec, 2012	2.6
		June, 2013	3.6
	7100 m	Dec, 2012	2.6
		June, 2013	3.9
	7500 m	Dec, 2012	2.6
		June, 2013	3.4

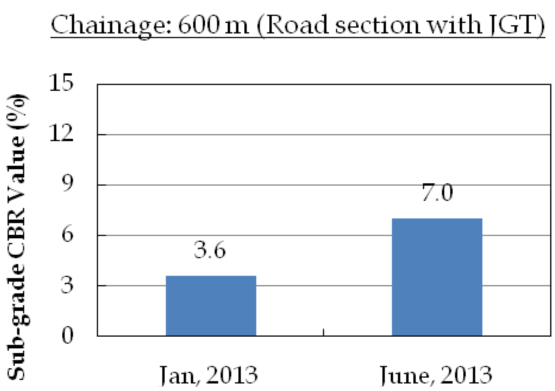




Location: Southpara-Kandapara Rural Road, Bancharampur, B. Baria

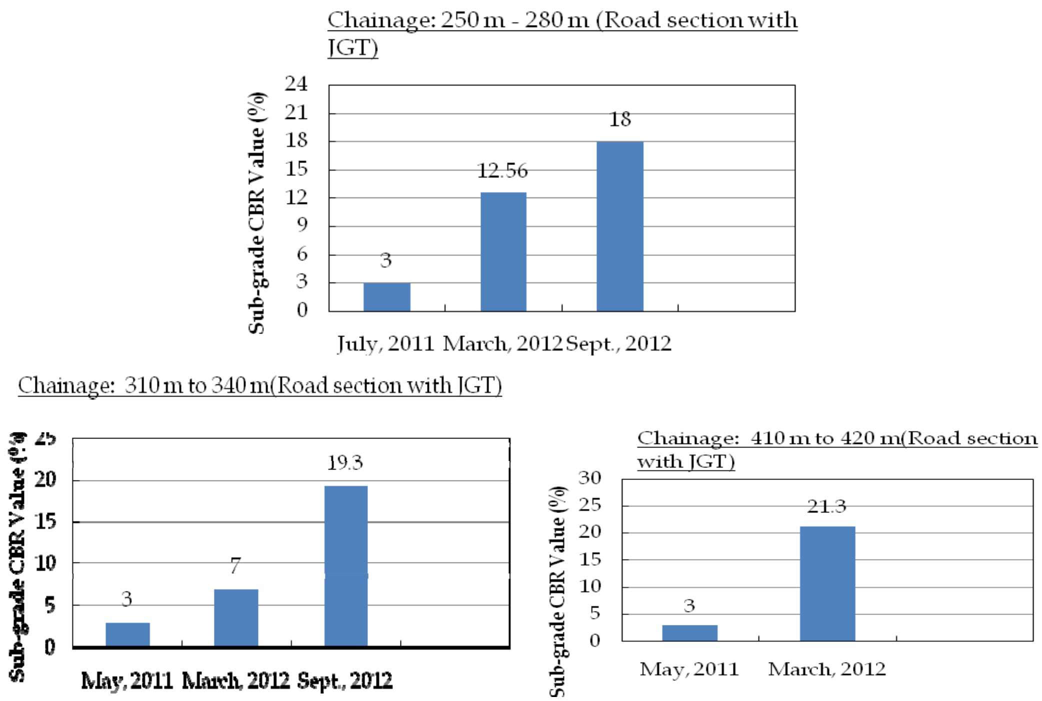


Location: Tazkhali-Titas river-Chandu Mia Road, Bisnurampur, B.Baria

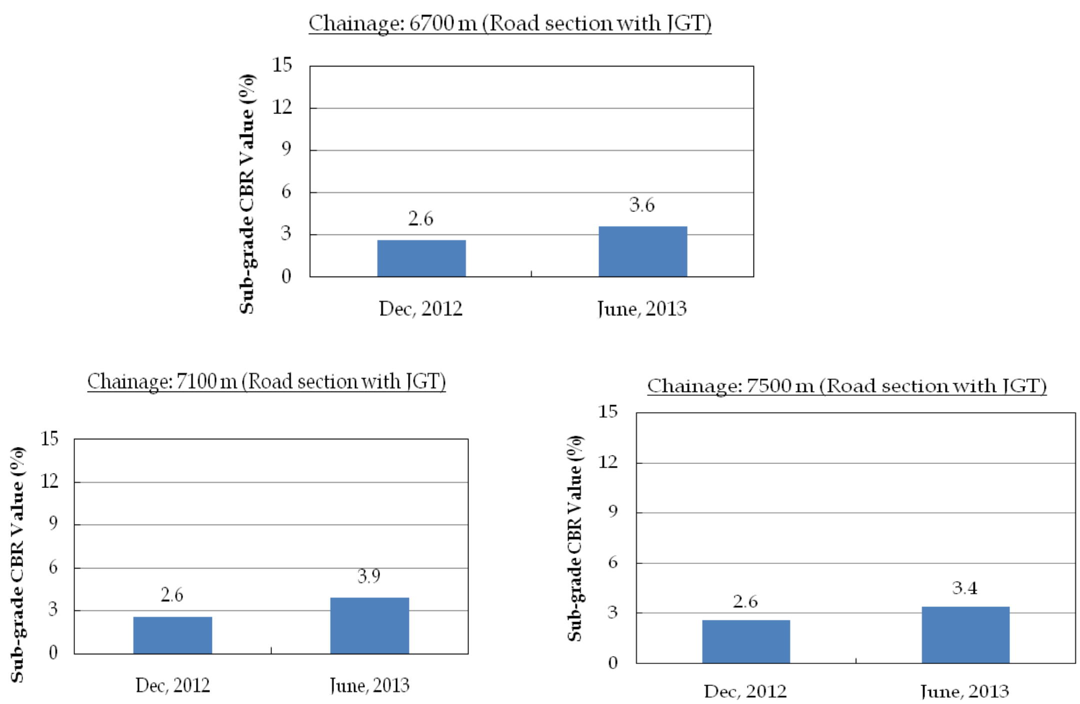


Location: Circular Road of Savar Cantonment

FIG. 5. Graphical representation of field monitoring data from different locations of Bangladesh



Location: Keraniganj



Location: Noabenki- Garazhat-Harihajanhat Road, Shymnagar, Satkkhira

FIG. 5. Graphical representation of field monitoring data from different locations of Bangladesh (continued)

HYPOTHESIS OF THE MECHANISMS

It is hypothesized that three mechanisms are involved with increase of load carrying capacity of weak subgrades due to use of JGT following the process described herein. First, the JGT layer as long as it does not decompose acts as an initial reinforcement through membrane action. JGT takes some extra load via its in-plane tensile resistance. Second, the first layer of ISG, made of sand, absorbs a lot of moisture from the subgrade. This absorbed moisture in the ISG layer is, in turn, absorbed by the JGT layer. It may be noted that JGTs have moisture absorption capacity of 3-4 times their dry weight, i.e. one square meter of 627 gsm JGT is capable of absorbing about 2.0 litre of water. However, this absorption of moisture from subgrade increases the dry density and hence the shear strength of the subgrade material increases. This phenomenon occurs as long as the JGT is not fully decomposed. By the time JGT is decomposed, subgrade soil becomes more competent through the consolidation process due to the surcharge load of sub-base and base layer and also partly due to the traffic movement on the black top. The third mechanism, would have occurred anyway even without JGT application. But the process is enhanced due to the absorption characteristics of JGT. More comprehensive research is being undertaken in order to clearly identify the contribution of each of these mechanisms.

CONCLUSION AND RECOMMENDATION

Performance evaluation data of several case studies encompassing a total 5.0 km rural road sections reinforced with jute geotextile has been presented. 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. Where the CBR value increased as high as seven times or more than that of the non-JGT subgrade soil, the pavement thickness may be effectively reduced. It may be noted that the short effective life of JGT over geosynthetics is not a set-back in a sense that it does its job before decomposing. Considering the versatility, availability and eco friendliness, JGT may be considered as a candidate material for road construction.

ACKNOWLEDGEMENTS

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Effect of Reinforcement Form on the Pullout Resistance of Reinforced Sand

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ABSTRACT: The interaction between soil and geosynthetics is a significant factor for analysis and design of reinforced earth structures which is simplified as pullout resistance. This paper presents the results of pullout tests aimed at studying the interaction of reinforced sand. The relative performance of different forms of geosynthetic reinforcement (i.e. planar reinforcement and three-dimensional grid-rib reinforcements) is compared. Samples of sand reinforced with geosynthetics in four different forms are tested in pullout test and results are analyzed to evaluation the soil-grid interaction improvement in sand due to reinforcement in different forms. Based on experimental results, a strength model of the soil reinforced with grid-rib elements was developed. The comparison between theoretical and experimental results was favorable, thus confirming the suitability of the proposed approach.

INTRODUCTION

Reinforced soil retaining walls with planar reinforcement like textiles and grids have been used commonly for many applications like flyover abutments, retaining soil and industrial materials, roads and for hilly areas due to its cost economy, time saving and ease of construction and these have been the subject of recent research (Won and Kim, 2007; Chen et al., 2007; Chen and Chiu, 2008; Shekarian et al., 2008; Lin et al., 2013). However, scarcity of space and high height requirements in urban areas made researchers consistently to introduce new kinds of reinforcing materials with different shapes and sizes along with better external and internal design strategies for reinforced soil structures. A different type of reinforcement geometry for reinforced soil wall is proposed by Zhang et al. (2008) and Khedkar et al. (2009).

Pullout test behavior has been studied by several researchers to understand various factors affecting the pullout response of reinforcement, i.e., box size, sample size, sleeve length, front as well as side wall conditions, test speed, etc. Many researchers made clear that geometry of the reinforcement is one of the important factors in pullout study (Palmeira and Milligan, 1989; Nernheim, 2005). The work reported in this paper consists of results from laboratory pullout tests. The primary objective of this study is to compare the relative performance of different forms of reinforcement in improving the pullout resistance.

MATERIALS AND EXPERIMENTAL PROGRAM

Sand

Clean, oven-dried, uniform sand from Fujian Province in China was used in the pullout tests. The particle size distribution curve for the soil is presented in Fig. 1. The sand has a relatively uniform grain size distribution with coefficients of uniformity (C_u) and curvature (C_c) of 2.75 and 1.45, respectively. All the specimens of sand were prepared at a unit weight of 17.5 kN/m^3, and a specific gravity of 2.64.

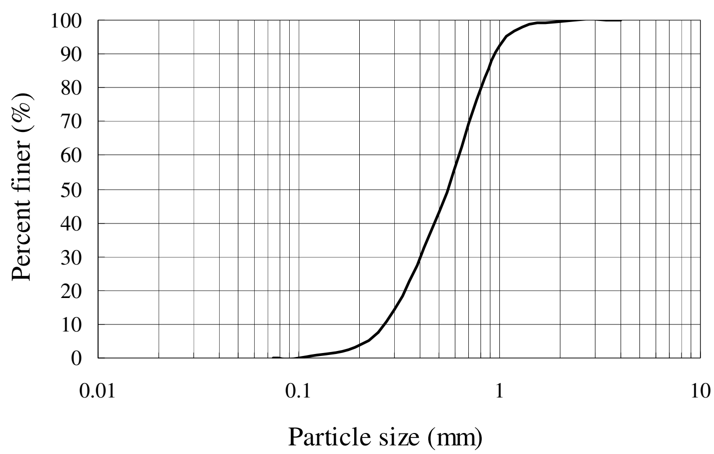

Fig.1 Grain size distribution curve

Reinforcement

The three-dimensional grid-rib reinforcement was adapted in this study. Fig.2 demonstrates the typical grid-rib reinforcement. The heights, *h*, of the different vertical inclusions were 0, 5, 7.5, 10mm (Fig. 2). The vertical reinforcements were carefully glued on the horizontal ones with $CHCl_3$ to ensure firm bonding. Perspex sheet is purposely used for the grid-rib reinforcement to exclude the grid deformation influence on pullout performance of grid-rib reinforcement. Here, the scope of paper is restricted to study the effect of geometrical properties of reinforcement (i.e., planar two-dimensional reinforcement versus three-dimensional grid-rib reinforcements) on their pullout performance. Both the grid spacing between longitudinal members and transverse members of grid-rib reinforcement was 60 mm.

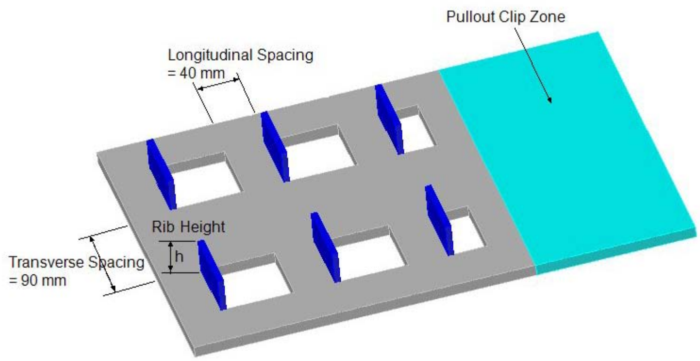

Fig.2 Typical grid-rib reinforcement

Sample preparation and test procedure

The pullout test device consisted of a box of 300mm length, 300mm width and 300mm depth, a vertical load application system, a horizontal force actuator device, a clamp and other required instrumentation. Fig.3 shows the arrangement for pullout test. All the samples were prepared considering the reproducibility of sample. Extreme care was taken to minimize the interference of tank wall in the pullout test results. Non-adhesive grease was applied directly on inner face of perspex wall to reduce the friction between the wall and the sand sample. Rest two walls of the tank were pasted with thin polyethylene transparency sheet and sufficient amount of grease was used over it to reduce the friction. Oven dry sand was used for sample preparation. Each 50 mm thick layer of sand was placed by sand pluvial deposition technique. A height of 150 mm approximately, from the centre of layer was adopted for this purpose. After placing sand to the level of underside of reinforcement, the selected reinforcement was placed and gripped with the lubricated grips. Sand was placed again in layers up to the top sample height was reached. After positioning of the loading plate and setting up the appropriate gauges, desired normal pressure was imposed and testing commenced with no time allowed for the clay to consolidate during the application of the normal and the shear forces. A constant horizontal displacement rate of 1 mm/min is applied to the displacement of 120 mm.

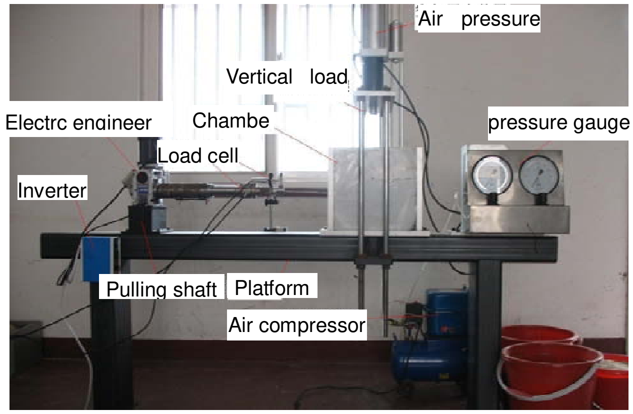

Fig.3 Pullout test apparatus

EXPERIMENTAL RESULTS AND DISCUSSIONS

Pullout load displacement curve

Pullout test results were analyzed in terms of load displacement curves for all the four reinforcements under both the values of normal pressures. In order to take into account the pullout resistance, the results of pullout tests conducted on similar samples under the same conditions have been presented together for easier comparison. Fig.4 shows variations of pullout resistance versus horizontal and pullout displacements for the planar reinforcement (h=0) and grid-fib reinforcement (h=5mm) samples, at applied normal pressures of 25, 50 and 75kPa. It is clearly seen that the pullout resistance significantly increases with the increase in normal pressures. The rate of increase in pullout resistance is very substantial at the early stages of pullout (i.e. <2 mm pullout displacement) which indicates fast resistance mobilization. For samples subjected to 25kPa, initially the pullout resistance increases with increase in pullout displacement to a particular displacement of about 1mm, and further increase in displacement shows a decrement in pullout resistance. The maximum load taken by the reinforcement is said to be the ultimate pullout resistance. The ultimate pullout resistance is seen increased for 5 mm high grid-rib reinforcement as compared to planar reinforcement for the similar normal pressure. In case of other tests carried out at 50kPa normal pressure, the ultimate pullout resistance for planar reinforcement is observed as 7.4 kN/m and for 5 mm high grid-rib reinforcement it is observed as 10.4 kN/m. Therefore, it can be said that pullout performance of grid-rib reinforcement is much better than planar reinforcement.