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ABSTRACT

The Central Road Research Institute has been constantly working in the area of geotextiles since early 1980s. A number of laboratory studies on evaluation of geotextiles for their suitability for road application, as well as, actual field trials have been carried out by the Institute. Recently, a project was taken up for the development and promotion of jute based geotextiles for road applications. A number of field trials have been carried out using jute based geotextiles for various applications. The paper presents summary of field experiments carried out to improve the soil behaviour, improvement in the stability of road side slopes and the filteration function in fills behind a retaining wall using jute geotextiles.

KEYWORDS

Geotextiles, Filteration, Drainage function, Ground improvement, Stability of slopes, Consolidation of fill material

INTRODUCTION

Though jute is biodegradable, yet it has capacity to act as effective soil stabiliser in its varied forms as a fabric or netting depending upon its intended use. These fabrics can perform temporary reinforcing function for a limited period of time as desired in some of the applications but permanent filtration and separation functions. Low cost criteria of jute fabrics coupled with sustained geotechnical problems faced by a practicing engineer compels the two factors to understand each other and come closer in the benefit of the society.In such circumstances, there is need to divert away from conventional copy book styles of construction and try something that is more effective. Keeping this in view, a number of field experiments using jute geotextiles were carried out in different parts of India and monitoring of these experiments is in progress. The details of some of these application are given in Table 1. Outcome of these experiments are expected to will provide reasonable solutions to some of the sustained problems in geotechnical engineering.

INSTALLATION OF JUTE GEOTEXTILE AT JOSHIMATH

The stretch of Joshimath-Mallari road has been experiencing subsidences and sinking for last many years. The stretch is located on debris material consisting of micacious sandy silt and has number of seepage points. About 500 sqm of fabric having 750 gsm has been used for drainage application on Joshimath Mallari road during June 1996. Monitoring of field experiments has given encouraging results.

Table 1. Details of Fabric Used

Project site	Purpose	Specification/ Quantity
Hanuman Setu New Delhi	Filter	Non-woven, 750 gsm (500 sqm)
NH-21 HP PWD	Erosion Control	Geogrid, 500 gsm (500 sqm)
Joshimath Mallari road	Drainage	Non-woven, 750gsm (1000 sqm)
Kaliasaur	Erosion control	Geogrid, 500 gsm (1000 sqm)
Kakinada port	Ground improvement	Woven ,750 gsm (3010 sqm)
Kandla port	Ground improvement	Non-woven, 750 gsm (1000 sqm)
Okhla flyover	Landscaping	Non-woven, 750 gsm (500 sqm)

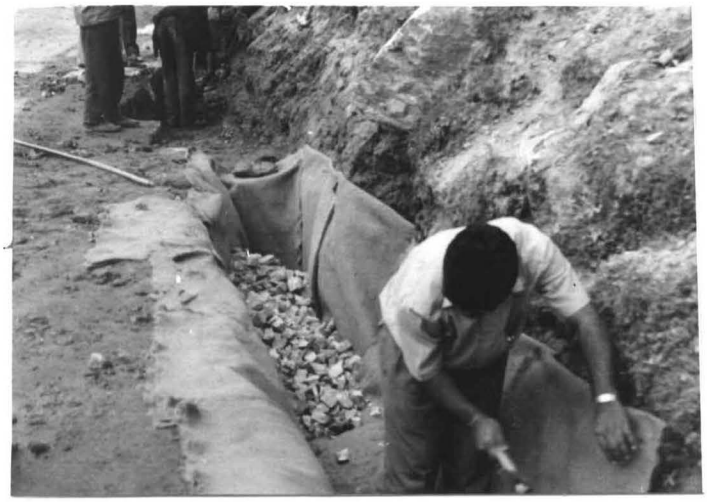

Fig.1. Construction of trench drain in progress

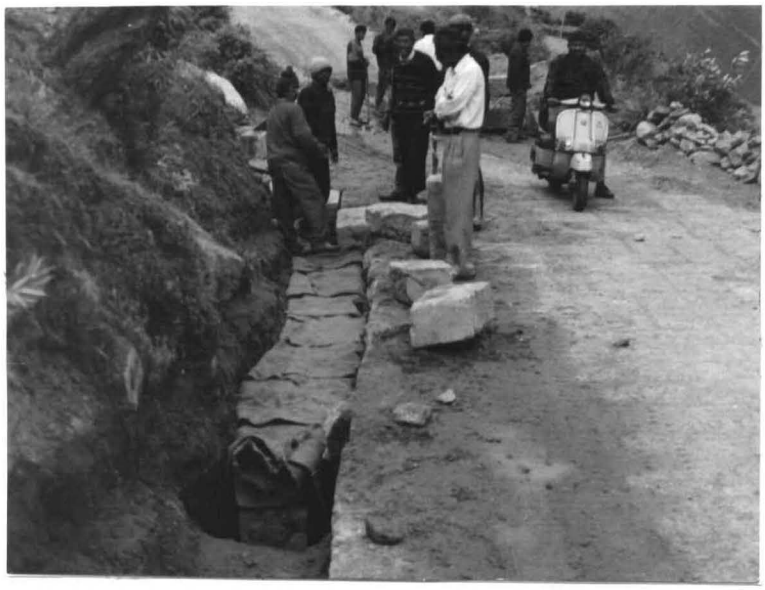

Fig.2. View of completed trench drain

The engineering properties of geotextiles used for drainage applications on Joshimath-Mallari road is given in Table 2. A detailed plan for longitudinal hill side drain and cross-drains was planned and executed. Photo Fig.1 and 2 show the construction of hill side trench drain and completed drain respectively.

STABILISATION OF HILL SLOPE AT KALIASAUR

The landslide at Kaliasaur on Haridwar-Badrinath road has been active since 1920 and since then has repeated itself almost every year. The hill slope consists of a number of scree zones with exposure of quartzites, limestones and slates. The slide is a multi-tier slide having combination of surficial and deepseated movements. About 1000 sqm woven geogrid of 500 gsm has been used for the slope erosion control at Kaliasaur on Hardawar-Badrinath road. The hillslope at Kaliasaur is full of debris material and completely denuded. The slope was protected with jute geogrids to promote vegetation. Table 3 gives the properties of jute geogrid used in the experiment.

Table 2. Properties of geotextile for drainage and filteration

Property	Test Result
Thickness	6.91 mm
Weight	750 gsm
Tensile strength	2.81 kN/m
CBR Push through load	0.50 kN
Failure strain	30%
Index puncture resistance	0.077 kN
Permitivity	3.36×10^{-3}/s
Transmissivity	4.6×10^{-6} m^2/s
Type of fabric	Non-woven
Apparent Opening Size (AOS)	0.05 mm

Table 3. Specifications of geogrids for slope stabilisation

Description	Test Value
Type of fabric	Woven grid
Material	100 % jute
Grid size	2.5cm x 2.5 cm
Mass	500 gsm
Available form	Continuous rolls of 1.2m width

INSTALLATION AT KAKINADA PORT

The subsoil in Kakinada Port area is soft-silty clay and the water table is at 0.5m below the ground level. The problem like subsidence of fill during construction, excessive post construction settlements and lateral spreading of fill, are faced during construction of roads. Among the various options to mitigate these problems, the jute geotextile was experimented with the objectives (a) to improve the stability of embankment against bearing capacity failure (b) to improve the stability against slope failure through foundation (c) to allow better controlled construction and (d) to act as separator between the embankment material and soft subsoil. The fabric at Kakinada Port area was installed during April-May 1996. About 3010 sqm of 750 gsm woven fabric has been used at Kakinada for ground improvement applications in the construction of roads. Further monitoring and also experiments proposed to be carried out at Kakinada Port are in progress. Woven jute geotextiles with properties given in Table 4 has been used as separator between the subgrade and road embankment. The monitoring of these field experiments carried out at Kakinada Port is expected to give comparative results between synthetic and natural fabric.

INSTALLATION AT HANUMAN SETU

During the construction of road over bridge, 'Hanuman Setu' lot of percolation of water was expected in the backfill during construction particularly during the monsoons. After the construction of ROB, the percolation of water was expected to be negligible due to impermeable road pavement material and a camber of 1 in 30 to provide faster runoff. Thus the filter thickness requirement was considered more during construction than after construction. Jute geotextile as filter was considered an effective and economical alternative with reduced thickness of conventional filter (Rao et al 1996). About 1000 sqm of non-woven fabric has been used at Hanuman Setu, New Delhi to work as a filter. The installation work has been completed during August 1996. The details of construction are given in Fig.3. The non-woven jute geotextile with 750 gsm and apparant opening size of 0.05 mm (Table 2) has been used in this application.The fabric has performed well during the construction of flyover which has since been opened for traffic.

Table.4. Properties of geojute used at Kakinada Port

Property	Test value
Thickness	5mm
Weight	750 gsm
Tensile Strength	15 kN/m
Elongation	30%
Puncture Resistance	350 N
Overlap Length	300 mm
Type of Fabric	Non-Woven

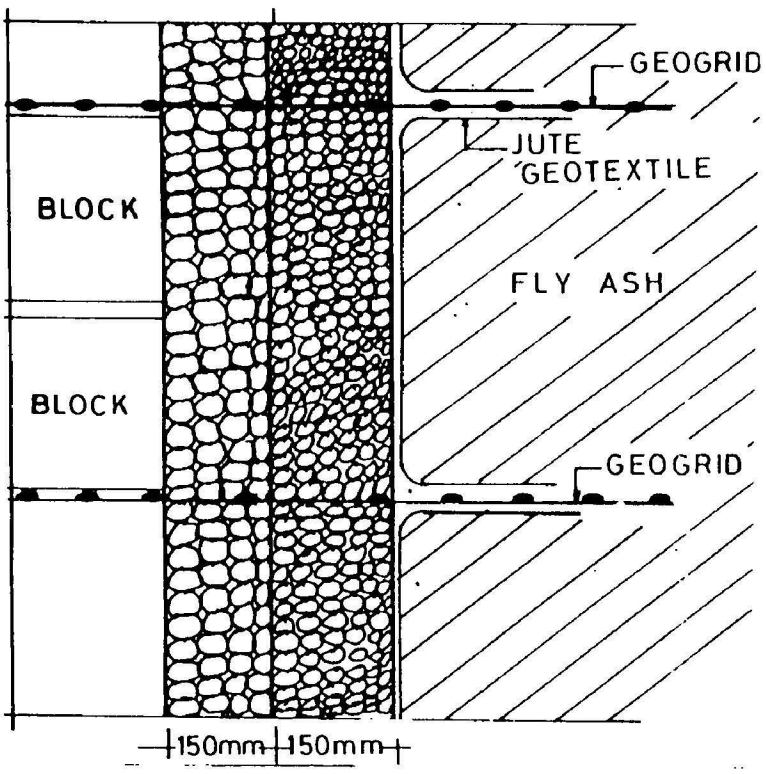

Fig.3. Sketch showing filter media at Hanuman Setu

INSTALLATION AT KANDLA PORT

In Kandla Port area also, authorities are facing the problem of road construction on soft soil. About 1000 sqm of 750 gsm non-woven fabric was supplied to Kandla port to be used as separator for construction of roads in the port area. Fabric was installed in the field during September 1996. The objective of the fabric in this application is to improve the performance of ground to support the construction of roads in the port area. In order to have relative performance, test sections with different specifications have been constructed involving the use of jute based geotextiles as well as synthetic geogrids.

APPLICATIONS AT PORT BLAIR, ANDAMANS

The structures in the coast guard area at Portblair, Andamans have been experiencing deformations due to mass movements in the slopes. The rocks in the area consist of fine grained sandstone and shales. The clayshale though massive, delaminates quickly on saturation with water. The rocks are friable and fissile in nature with foliation planes running parallel to the bedding planes. The soil is moist through out the year. The buildings and roads in the area are located on slopes which are made flat through cut and fill techniques. A lot of reclamation has been carried out in the past. The depth of filling varies from 2-3m. The subsidences in loose pockets were found to be the main cause of deformation in the structures. Among other measures for improvement in slope stability and the behaviour of soil, the application of jute geotextile was suggested to expedite the rate of consolidation and drainage in the soil fill. Fig.4 shows the cross-section of fabric drains recommended for new proposed constructions in the area. The jute geotextile drains can be designed and fabricated using non-woven geotextiles. The filled installation of drains is easy and simple (Rao et al 1996).

APPLICATION AT OKHLA FLYOVER PROJECT

The PWD, Delhi Administration has taken up construction of fountain in area adjoining newly constructed Okhla flyover involving the construction of retaining walls and about 4m fill. Soil and flyash have been used as fill in the area. About 1000 sqm of 750 gsm non-woven jute geotextiles was used as filter behind the retaining walls constructed in the area being developed for fountains. The work on the installation of geotextiles was carried out during February-March 1997. Jute fabric was used as filter medium at the sand-soil or sand-flyash interface, as well as, around the weepholes. Graded stone aggregate of 20mm nominal size has been used as filter media as per the details given in Fig.5. The experiments carried out at Okhla Flyover and Hanuman Setu have proved that for short term applications, jute geotextiles are very effective when used as filters.

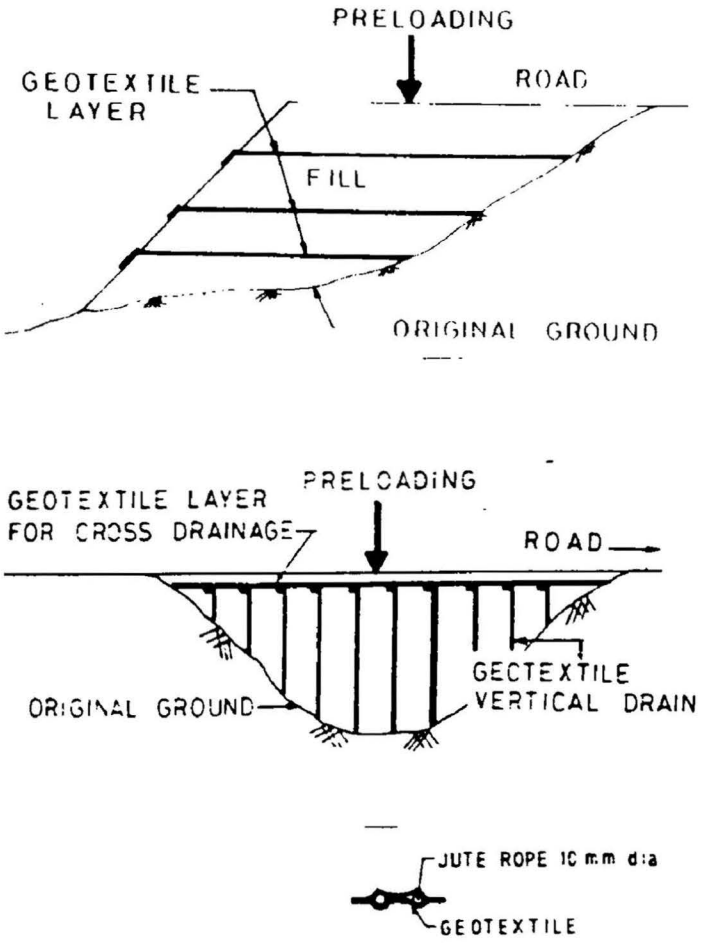

Fig.4. Cross-section showing fabric drains

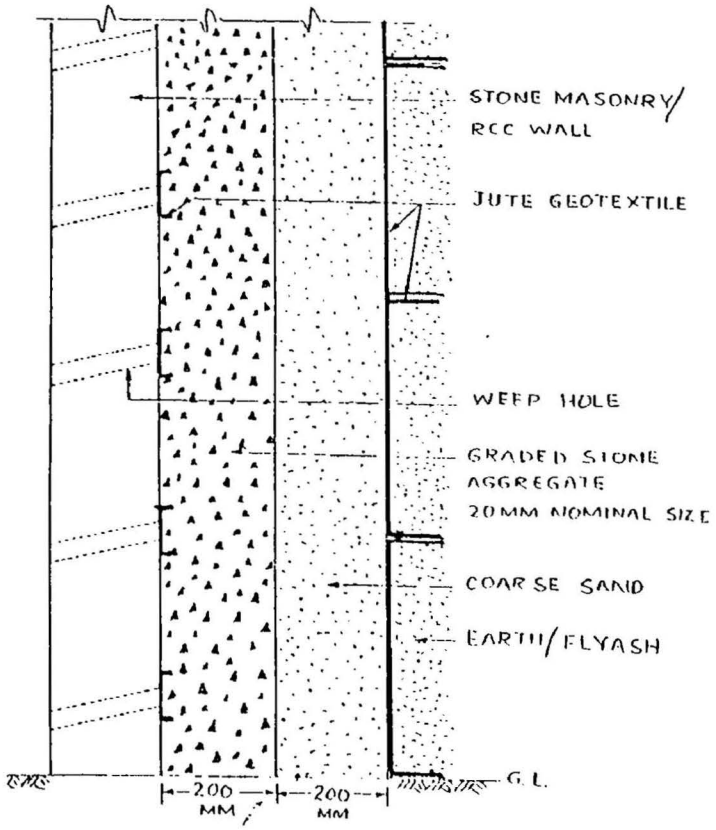

Fig.5. Sketch showing filter media at Okhla Flyover

CONCLUSIONS

The jute based geotextiles can be developed and made suitable for road applications. The fabrics can be very effective and economical, as well as, the installation in the field is easy. The fabrics in their present form are suitable for separation and drainage functions, however, for reinforcement functions, there is need for suitably blending the fabric to increase durability and strength.

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