USE OF JUTE GEOTEXTILES IN RURAL ROAD CONSTRUCTION

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Presented by N K Mukherjee
Jute Geotextiles (JGT) is a natural variant of man-made geotextiles loosely called ‘Geosynthetics’.

JGT has been used successfully to address a host of geo-technical problems encountered in road construction, river bank erosion, slope erosion, embankment stabilization & soft soil consolidation.
Studies/research on JGT in research and engineering institutions in India & abroad have confirmed its efficacy.

The paper highlights effectiveness of JGT in rural road construction.
• Functioning of JGT is based on triggering soil-consolidation to an optimum level through processes of separation, filtration & drainage

• It is well established that soil consolidation is a long-drawn process and takes years to maximize (development of effective stress)
Once soil is optimally consolidated, the soil becomes self-reliant and continues to consolidate further with the concurrent functioning of separation/filtration/drainage.

Road sub-grades overlain by JGT is strengthened as a result of such continuing processes of consolidation.
All GTs – man-made or natural-- act as change-agents to the soil by keeping the soil separated from the overlying layers, facilitating release of water across and along the plane of the fabric and controlling migration of soil particles.
• It is for this reason CBR% of JGT-treated sub-grades was found to have increased by even 3-4 times even after a lapse of 6/7 years in some cases.

• It is, however, important that JGT retains its tensile strength and porometry for at least 2 to 3 years for optimizing soil consolidation.

• Eco-friendly additives that can increase its durability to that extent are available.
National Jute Board (NJB) erstwhile JMDC, a national promotional body of jute & jute products under the Ministry of Textiles, GoI, embarked upon a Pilot Project under PMGSY with the support of MoRD/ NRRDA and MoT in December 2006.

CRRI was entrusted by NJB with

- preparation of DPRs
- quality management &
- performance evaluation
Ten roads spread over 5 states were selected for the project.

Ultimately 1 project in WB had to be left out for unworkable site conditions.

Benkelman beam deflection tests were carried out in 5 roads by CRRI.

The road details and the results of BBD are shown in the next two slides.

The roads were constructed by the respective state agencies (State RRDAs & PWD).
## Details of Ten Selected Roads for Pilot Project Using JGT

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>State</th>
<th>Name of the Road</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Odisha</td>
<td>Jadupur to Mahanangal, Kendrapara District</td>
<td>5.50</td>
</tr>
<tr>
<td>2</td>
<td>Odisha</td>
<td>MDR 14 to Chatumari, Jajpur District</td>
<td>4.00</td>
</tr>
<tr>
<td>3</td>
<td>Madhya Pradesh</td>
<td>Berasia to Semrakalan Approach Road, Bhopal District</td>
<td>5.10</td>
</tr>
<tr>
<td>4</td>
<td>Madhya Pradesh</td>
<td>Gehlawan village to PMGSY road, Raisen District</td>
<td>3.14</td>
</tr>
<tr>
<td>5</td>
<td>Chhattisgarh</td>
<td>Kodavabani to Khursi Road, Bilaspur District</td>
<td>4.80</td>
</tr>
<tr>
<td>6</td>
<td>Chhattisgarh</td>
<td>Kherajiti to Ghirghosa road, Kawardha District</td>
<td>5.50</td>
</tr>
<tr>
<td>7</td>
<td>West Bengal</td>
<td>Notuk to Dingal Road, West Midnapore District</td>
<td>4.80</td>
</tr>
<tr>
<td>8</td>
<td>West Bengal</td>
<td>Nandanpur to Marokhana High School Road, Hooghly District</td>
<td>6.20</td>
</tr>
<tr>
<td>9</td>
<td>Assam</td>
<td>Rampur Satra to Dumdumia, Nagaon District</td>
<td>4.20</td>
</tr>
<tr>
<td>10</td>
<td>Assam</td>
<td>UT Road to Jorabari, Darang District</td>
<td>4.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total Length</strong></td>
<td><strong>47.84</strong></td>
</tr>
</tbody>
</table>
# RESULTS OF BENKELMAN BEAM DEFLECTION TEST IN FIVE ROADS

<table>
<thead>
<tr>
<th>ROAD SL NO.</th>
<th>STATE</th>
<th>DISTRICT</th>
<th>RANGE OF DEVIATION OF DEFLECTION IN mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>ASSAM</td>
<td>DARRANG</td>
<td>(+) 0.15 TO (-) 0.09</td>
</tr>
<tr>
<td>9</td>
<td>ASSAM</td>
<td>NAGAON</td>
<td>(-) 0.42 TO (-) 1.86</td>
</tr>
<tr>
<td>2</td>
<td>ODISHA</td>
<td>JAJPUR</td>
<td>(+) 0.13 TO (-) 0.08</td>
</tr>
<tr>
<td>4</td>
<td>M.P.</td>
<td>RAISEN</td>
<td>(-) 0.10 TO (-) 0.91</td>
</tr>
<tr>
<td>6</td>
<td>CHHATTISGARH</td>
<td>KAWARDHA</td>
<td>(+) 0.01 TO (-) 0.46</td>
</tr>
</tbody>
</table>

N.B. (+) SIGN INDICATES REDUCTION IN DEFLECTION WHILE (-) SIGN INDICATES THE OPPOSITE
BBD Studies at 1 site
Exhumed samples of JGT showed reduction of 70% to 90% % of tensile strength after 23 months. Benkelman Beam Deflection tests were taken twice –after 11 & 24 months of their completion. The results indicate satisfactory pavement performance despite reduction of tensile strength of JGT.
The apparent contradiction was corroborated in several laboratory studies notably by Prof R D Ramaswamy of Singapore State University and later by a Jadavpur University Study (by Prof. N. Som and Dr. R. Sahoo) entrusted by NJB.

Loss of strength of JGT is compensated by gain in strength of bearing capacity of soil.
Other Salient Case Studies

1. Re-construction of a damaged road on soft marine soil at Kakinada Port, Andhra Pradesh
   (case study by CRRI) - 1996
   
   **Objective** – Minimising post-construction settlement, lateral dispersion of fill by use of JGT

   - **Soil composition**—Mainly clay up to a depth of 4m
   - **Results**
     - After 7 months the shear strength of the sub-grade ensured the desired Factor of Safety.
     - Water content, void ratio and compression index decreased while dry density and CBR value of the sub-grade increased substantially (nearly 3 times the control value after 7 years!)
     - The road is in excellent shape after more than 10 years after its re-construction.
Kakinada Port, Andhra Pradesh

LAYING OF JGT

FINISHED ROAD
2. **Internal road in Kandla Port, Gujarat** (case study by CRRI) – 1997

- **Objective** - Mitigation of the problem of settlement by separation effect with the use of JGT
- **Results** -
  - Rut depth was minimized and other visual signs of distress were eliminated
  - Settlement of the test section was compared to conventional pavement construction with increment of extraneous load from 0.5 MT/sqm to 2.0 MT/sqm @ 0.5 MT/sqm per month for a period of 3 months. Negligible settlement was observed with no visible signs of distress.
3. Widening and strengthening of Munsirhat to Rajpur Road in West Bengal (case study by Jadavpur University) – Year 2000

- **Objective** - Strengthening of the widened portion of the road with JGT

- **Soil** - Mostly inorganic clay mixed with silt. CBR value of the sub-grade was 3.5% on average. Plasticity Index -20.

- **Results** -

  - CBR value increased to 6.0% from 3.5% No distress was noticed even after 6 years.
Munsirhat to Rajpur Road

WIDENING OF ROAD WITH JGT

FINISHED ROAD
4. Construction of Andulia –Boyratala Road in West Bengal
   (case study by Bengal Engineering & Science University, Sibpur)- 2005
   
   - **Objective**- Strengthening the sub-grade by separation effect with the use of JGT
   
   - **Soil**- Organic silty clay with occasional brown clay mixed with little sand. Soaked CBR value -3.16%
   
   - **Results**-
     
   - Post-work evaluation carried out after 18 months showed that CBR value (unsoaked) rose to 10.47% on average with a high of 14% in one stretch.
Andulia – Boyratala Road in West Bengal

JGT LAID ON SUB-GRADE

FINISHED ROAD
5. Stabilising road embankment in the approach to Hanuman Setu, Delhi (case study by CRRI) - 1997

- **Objective** - Facilitating drainage from the embankment–fill by use of JGT
- **Soil** - Fly ash
- **Results** -
  - Migration of fly ash particles after the rains (100 mm rainfall) could be prevented due to effective drainage by JGT.
6. Joshimath-Mallari road, Uttarakhand (case study by CRRI) - 1996

- **Objective** - Prevention of subsidence and settlement of road by effective side drainage by using JGT-encapsulated road-side drains

- **Soil** - Slide-prone zone, consisting mostly debris

- **Results** -
  - Settlement was found to be in check after a year of construction of jute-encapsulated road-side drains.
Joshimath-Mallari road, Uttarakhand

RUBBLE ENCAPSULATED JUTE DRAIN

CROSS DRAINS
International Project

• An international project on JGT for application in rural roads have been taken up with the financial support of the Common Fund For Commodities (CFC), Amsterdam, a unit of the United Nations, with the in-kind support of the Govts of India & Bangladesh. Field application is in progress.

• Performance will be evaluated by BESU, Sibpur in India and BUET in Dhaka, Bangladesh. (visit web-site at www.jutegeotech.com for details on the project and various technical aspects of JGT).
Indian Roads Congress (IRC) has released a publication on the state-of-the-art report on applications of JGT prepared authored jointly by CRRI & NJB in its last Lucknow Session this year.

BIS standards on rural road and river bank erosions control applications are under print.

IRC has permitted the use of JGT in roads as an innovative engineering material provisionally.
• Facilities for testing JGT are available in reputed Engineering Institutes / IJIRA / IJT at Kolkata

• Jute Mills are fully equipped to supply customized JGT to the end-users
• NJB is ready to render free technical advice on design and installation of JGT
• JGT deserves special encouragement from the decision-makers for its eco-compatibility and competitive price
THANKS