TRACKBED STABILIZATION USING TECHGRID BIAXIAL GEOGRID AND NONWOVEN GEOTEXTILE

Client : M/s Northeast Frontier Railway

Site address : Km 323/0 to 323/2, Between Jamguri & Oating stations, Golaghat District, Assam.

Completion Date : August 2006

Products Used : Techgrid TGB-40 Knitted & PVC coated polyester Geogrid and Nonwoven Geotextile

BACKGROUND

Ballast sinking is a commonly occurring problem in railway track structures founded on wet fine-grained soils like clays and silts, especially where an adequate and functioning blanket layer is absent. This necessitates frequent and costly maintenance resulting in sub-optimal utilization of track capacity. Large stretches of the tracks of Northeast Frontier Railways are prone to this problem. When Techfab India Industries Ltd put forward a proposal for trackbed stabilization using gesynthetics as a lasting solution to this problem, NF Railways agreed to go for a trial installation on an experimental basis to evaluate the efficacy of this technology. Techfab India Industries Ltd. was assigned the task of assessing the site conditions, designing an appropriate solution, and executing the work

THE SITE

A 100 m long stretch between km 323/0 to 323/2 between Jamguri and Oating stations, in Golaghat District of Assam, experiencing a severe and recurring ballast sinking problem was selected for the trial. Here the track alignment crosses paddy fields and the track structure is founded on embankment of approximately 3 m height constructed largely of silty clays (Photo 1). Because of very high ballast sinking rate, tamping and packing operations had to be undertaken very frequently.

THE PROBLEM

A combination of reasons could have contributed to the severe and recurring ballast sinking problem at this location – subgrade comprising fine-grained plastic soils (photo 2); excessive moisture content of the subgrade due to heavy rainfall in the area, ponding of water on the formation because of lack of proper grading and cross-fall of formation and capillary rise due to standing water in the paddy fields; and absence of a properly functioning blanket course. Because of the above three factors ballast sinking could have taken place both through lateral displacements due to the poor restraint offered by the soft and saturated subgrade and penetration of the ballast particles into the subgrade (photo 3). Packing of additional ballast provides relief only for a short time since none of the above factors are addressed and hence sinking would continue with time.

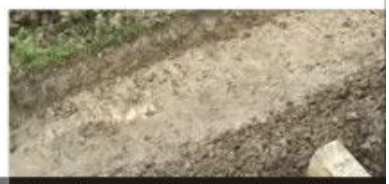
THE SOLUTION

The solution proposed comprised the following measures:

1. Building up / dressing the embankment to the correct level at the required locations and dressing the formation with a cross-fall of 1 in 30 to facilitate drainage.
2. Providing a nonwoven geotextile as a separator and filter between the subgrade and the ballast:

   The geotextile acts as a separator preventing the penetration of the ballast particles into the fine-grained subgrade. The geotextile also acts as a filter which prevents the pumping of subgrade fines into the ballast. A needle-punched nonwoven geotextile with a mass per unit area of 250 g/m2 was used for this purpose. To protect the geotextile from puncture and abrasion by the ballast particles it was decided to sandwich the geotextile between two layers of sand, each 50 mm thick.

1 Site before rehabilitation



2 Subgrade comprising fine grained soil.

3 Ballast penetration into the subgrade

4 Removal of existing ballast from the trackbed

5 A thin layer compacted sand on the subgrade.

6 Laying of non-woven geotextile.

3. Providing a biaxial geogrid reinforcement (5 m width) below the ballast:

   Techgrid TGB-40, a knitted and PVC coated biaxial geogrid with a tensile strength of 40 kN/m in both machine and cross-machine directions, aperture dimensions of 25 x 25 mm and roll width of 5 m, manufactured by Techfab India at its state-of-the-art plant in Silvassa, Union Territory of Dadra & Nagar Haveli was proposed for this purpose. The geogrid is manufactured from superior grades of high tenacity, high molecular weight and low carboxyl end group polyester yarns which are formed into a grid structure using a highly sophisticated warp-knitting process and is then precision coated with a specially formulated PVC plastisol to produce a strong, flexible, tough, dimensionally stable and durable geogrid.

   A layer of Techgrid biaxial geogrids installed below the ballast constraints and confines the ballast particles reducing the lateral and vertical movement of ballast and enhances the strength and stiffness of the ballast. Reinforcement of the ballast results in a marked improvement of the track performance through several mechanisms:

   - Substantial reduction in the lateral spreading of ballast and penetration of the ballast into the subgrade and associated track settlements.
   - Reduction in subgrade attrition and wear and tear of ballast
   - Reduction in vertical stresses on the subgrade because of better load distribution by the reinforced ballast with enhanced strength and stiffness.
   - Lower shear stresses on the subgrade with consequent increase in bearing capacity.

4. Placing cleaned ballast over the geogrid and restore the track to the desired geometry.

7 Spreading sand above geotextile.

8 Laying TechGrid TGB-40 Knitted Polyester Biaxial Geogrid

9 Placing ballast over the geogrid.

10 Train running over the rehabilitated track

11 Condition of the track two years after rehabilitation (as on June 2008)

EXECUTION

The work was executed by Techfab India under the overall supervision of the Permanent Way Inspector. Because of the remoteness of the location and the small quantum of work, the work was carried out manually. The blocks allocated allowed completion of about 10 to 12 m of track each day. The rehabilitation work involved the following steps:

- Removal of the ballast and preparation of the exposed subgrade by dressing to ensure a cross-fall of 1 in 30 and ramming with wooden tampers (photo 4).
- Spreading of a thin layer of sand (about 50 mm thick) on the prepared subgrade to cover any ballast particle projecting from the subgrade (photo 5).
- Laying of the geotextile over the sand layer without any folds or wrinkles (photo 6).
- Spreading of a thin layer of sand (approximately 50 mm thick) over the geotextile (photo 7).
- Installing the geogrid over the second layer of sand (photo 8).
- Placing and compacting cleaned ballast over the geogrid (photo 9).

PERFORMANCE

Approximately two years has passed since the completion of the rehabilitation. As per the feed back from NF Railways, any significant ballast sinking problem has not been observed in the location treated with geogrids and geotextiles and there is an appreciable improvement in the track performance. Taking note of the success of this trail, NF Railways rehabilitated another stretch using the same materials and technique with satisfactory results. An inspection of the site in the first week of June 2008 showed that the condition of the treated portion of the track is quite satisfactory.

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