Use of geosynthethics for subgrade stabilization

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ABSTRACT: The present case history illustrates the application of Geosynthetics (Woven Polyester geotextile, Nonwoven Geotextile and Biaxial Geogrid) for subgrade stabilization for industrial application. 'Balkrishna Industries Ltd. (BKT)' is one of the major player in 'Off Highway tires' industry, having its one manufacturing unit at Kutch in Gujarat district. The internal roads of around 2.5km network was facing problems of failure due to weak foundation soil, heavy concentrated load and water percolations. Pavement were becoming muddy in the rainy seasons and problem of uplifting of metal along with soil has become common and troublesome. M/s Techfab India had proposed use of Geosynthetics in order to strengthen the pavement against heavy vehicular impacts & also restrict the percolation of water through pavement. M/s TechFab India had engineered and proposed the cross section and construction methodology by removing the road crust and applying biaxial geogrid & woven geotextile. The road were repaired accordingly and have been serving the required function since then.

Keywords: Geosynthetic, Woven geotextile, Biaxial Geogrid, Traffic load, Subgrade stabilization, Pavement

1 INTRODUCTION

The application of geosynthetics for infrastructure projects (highways, roadways) are somewhat different than that of industrial application. The case discussed here is an example of industrial application, where geosynthetics were successfully designed and used for subgrade stabilization. The case study is divided into problem description and solution proposed and executed.

2 PROBLEM DESCRIPTION

The client 'Balkrishna Tyres (BKT) is one of the world's leading manufacturers of "off highway tyres". The company had set up a new plant for the manufacturing of specialty tyres on Bhuj-Bhacahu road, District Kutch in the state name Gujarat in India. The factory premises consisted of a vast network of roads, used to carry heavy machinery on large trailer trucks very often for the manufacturing unit. The pavement was approximately 14.0 m wide for these traffic. The approximate length of this road network was around 2.5 km.

The pavement was constructed by laying a layer of sand over the compacted sub grade; above which rubble soling of 230mm thickness was provided and it was followed with metal cover. The typical details can be refer from Fig.1 below. However, the pavement was not sealed to prevent water ingress by providing any overlay at the top. Only binder was used, at the top for the half width of the road and quarry dust for the remaining half width of the road. During monsoon season, water percolated through the pores of the existing pavement into the sub grade and thereby reducing the bearing capacity of the sub grade. The existing soil having 31 % to 50 % swelling index. Liquid limit & plastic limit were in the range of 31 to 57 & 20 to 28 respectively. Ph value observed was around 8.0. The soil belongs to CH and SC group in

the classification chart. Hence, when the heavy vehicles had passed over the prepared pavement, due to the heavy tyre pressure, the soil immediately below the tyre got deformed. The soil on the surrounding sides of the tyre thereby got uplifted along with the metal laid in the pavement. The condition of the deformed pavement is shown in Fig.2.

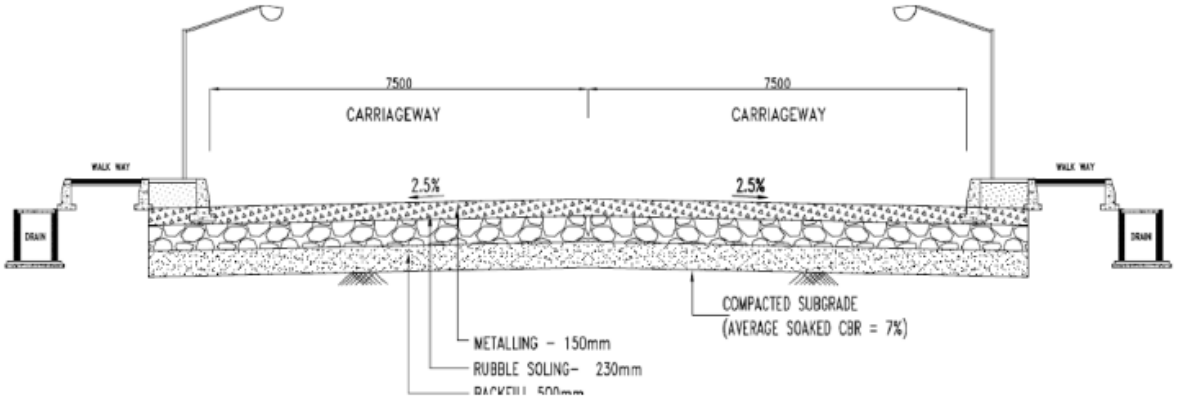

Figure 1. Cross Sectional Details of Existing road.

Figure 2. Photographs illustrating deformed pavement condition at site.

3 SOLUTION PROPOSED

A proposal consisting use of Geosynthetics was engineered and proposed to strengthen the pavement against heavy vehicular impacts & also to restrict the percolation of water through existing pavement. For treatment of such type of pavements, the existing road crust shall be first removed after that the various products as suggested below shall be applied to cater the needs of high stresses developed by heavy vehicles.

- TechGeo PR series Nonwoven Geotextile is strong, flexible and dimensionally stable fabric structure, with optimum pore sizes and high permeability. TechGeo PR Geotextile can be used as a separator, filter & drainage purpose.
- Woven Geotextile TFI 3000 Series having high tensile strengths, low elongation and low creep. It has been used for basal reinforcement and to minimize the differential settlement.
- TechGrid Geogrid TGB Series having with high tenacity, high tensile modulus, low creep and low shrinkage. The PVC coated grids shows a protective cover enhancing the dimensional stability of the geogrid, resistance to installation damage and protection from the environment act as an area stabilization & reinforcement for the granular road base & sub base.

4 APPLICATION ON SITE

M/s TCS has finalized the cross-section, considering the proposal, and based on that high strength woven geotextile has been used. Final cross-section, approved from M/s TCS has attached as Fig.3. Considering site condition and water level, other products (Techgeo PR and TGB) are also used with consultation of Engineer-in-charge. Execution sequences are as follows:

- Preparation of Sub grade with compaction.
- Over the leveled and compacted sub grade, 230mm rubble soling is provided. To avoid the puncture of Geosynthetic material, sand cushion of required thickness is provided, after rubble soling.
- Compacted sand layer is laid over the Woven Geotextile, followed with Water bound macadam and other pavement layers.
- In some locations, where less severe condition is prevailed, with high water level, it has been recommended to use of Nonwoven Geotextile, along with biaxial geogrid, followed with sand layer and other pavement layers, with the consultation of Engineer–in-charge.
- It has been decided, not to lay, any bituminous layer for at least a year to allow settlement.

Fig 4 illustrates the photographs for the execution of pavement with the above mentioned Geosynthetic materials under the guidance of site engineer.

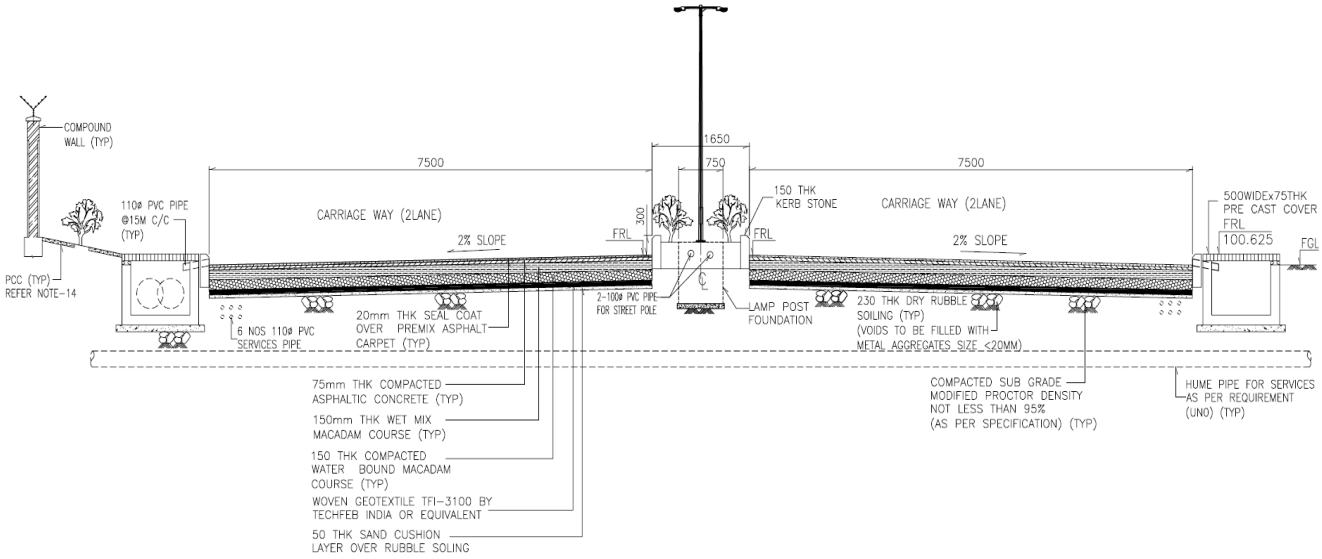

Figure 3. Cross sectional details of pavement with geo synthetics.

Figure 4. Laying of Non-woven geotextile.

Figure 5. Laying of bi-axial geotextile over non-woven geotextile.

Figure 6. Sand layer placement over geo-grids.

Figure 7. Sand layer placement over woven polyester geotextile.

5 ADVANTAGES AND BENEFITS

Nonwoven Geotextile:
- Acts as a 'Filter' by preventing the backfill material from being washed out.
- Acts as a 'Separator' between the two dissimilar materials, restricting them to mix with.

Biaxial Geogrid:
- Better Interlocking and load transfer, due to apertures and high interface frictional resistance between Geogrid and granular fill material.
- Will help to reduce bearing pressure and also minimize the differential settlement.

Woven Geotextile:
- Used as a 'basal reinforcement' and also for subgrade stabilization for soft ground conditions.
- Act as a separator, between two dissimilar materials, as secondary function.

6 CONCLUSIONS

- Geotextile is equally beneficial for industrial applications in comparison to infrastructure projects.
- Conventional pavement of thickness more than 800mm couldn't bear the loading from heavy vehicles particularly due to type of soil in the foundation.
- Engineered solution to provide geosynthetics – combination of geotextiles and geogrids – had been accepted and adopted at site. The use of geosynthetics had worked in a multifold ways like filter, separator and reinforcement.
- The application of geosynthetics for subgrade stabilization has been proven better and successful; technical as well as economical point of view too.