PAVEMENT STABILIZATION OF E10, E14 & N16 ROADS IN AMARAVATI, ANDHRA PRADESH

AMARAVATI, ANDHRA PRADESH, INDIA

TECHFAB INDIA

Pavement Stabilization

Client:	Products used:
AMARAVATI DEVELOPMENT CORPORATION LTD. (ADCL)	TECHGRID PP BIAXIAL 30/30 GEOGRID TECHGEO PN25 NONWOVEN GEOTEXTILE
Main contractor:	**Quantity supplied:**
BSCPL INFRASTRUCTURE LTD.& BIMA DEVELOPERS PVT. LTD.	TECHGRID PP BIAXIAL GEOGRID - 2,50,000 SQM TECHGEO NONWOVEN GEOTEXTILE - 25,000 SQM
Manufacturer & Supplier:	**Year of construction:**
TECHFAB (INDIA) INDUSTRIES LTD.	

Abstract:

This case study discusses the possible causes of flexible pavement failures under soft and expansive clayey soils, recommends Techgrid PP Biaxial Geogrid and Techgeo Non Woven Geotextile for sub grade stabilization instead of conventional stabilization methods. Sub grade stabilization using Geogrid + Geotextile resulted in minimizing the causes of failures in flexible pavement.

Project brief:

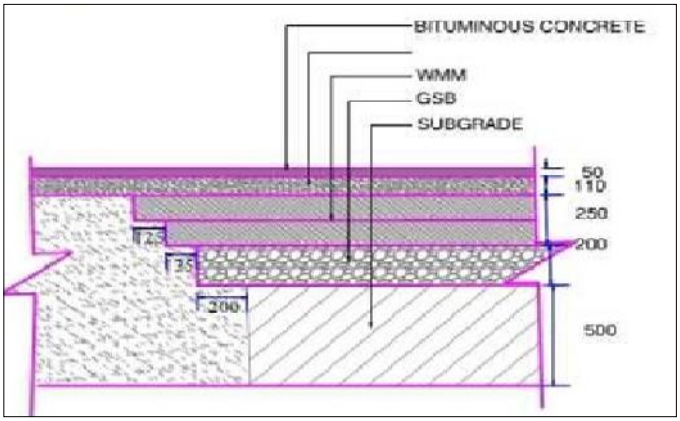
Amaravati, the new capital city for the state of Andhra Pradesh is envisioned to be not only as a government administrative city but also as an economic hub. The vision is to develop Amaravati as the global economic hub and emerge as global destination of people, investments, jobs endowed with world's best infrastructure. The road network of the capital city has been planned to in line to the vision and objectives of the new capital city.

There are major challenges to achieve the objectives as the entire city of Amaravati is to be developed on the agricultural fields which contain black cotton soils having more than 200% swelling index. So, the government is taking all necessary measures to adopt the global technology to strengthen the road network and make the road infrastructure more durable.

Project Challenges:

Soil reports show that the subgrade soil present in the project site is mostly clay with high plasticity having soaked CBR of 2 and swelling index in the range of 200%. These soils are potentially expansive soils, such as, black cotton soils and montmorillonite clays. When these soils subjected to changes in moisture content due to seasonal wetting and drying or due to any other reason undergo volumetric changes leading to pavement distortion, cracking and general unevenness. In semi-arid climatic conditions, pronounced short wet and long dry conditions occur, which aggravate the problem of swelling and shrinkage.

Shrinkage cracks in the existing subgrade soil



Typical conventional pavement section of capital region roads

To construct a flexible pavement over a weak subgrade like this, it requires higher thickness of pavement section to sustain for design traffic.

According IRC 37: 2012, where this type of potentially expansive soils are present, due considerations should be taken at the design stage itself, so that counter measures could be devised and incorporated in the pavement structure.

It was suggested to provide 0.6-1.0 m thick buffer layer consisting non-expansive impermeable soil to prevent ingress of water in the underlying expansive soil layer, counteracts swelling and secondly even if the underlying expansive soil heaves, the movement will be more uniform and consequently more tolerable. But its adequacy was not calculated and confirmed at the design stage. In such conditions, an additional and economical solution was supposed to be adopted which would satisfy the objective of the project needs.

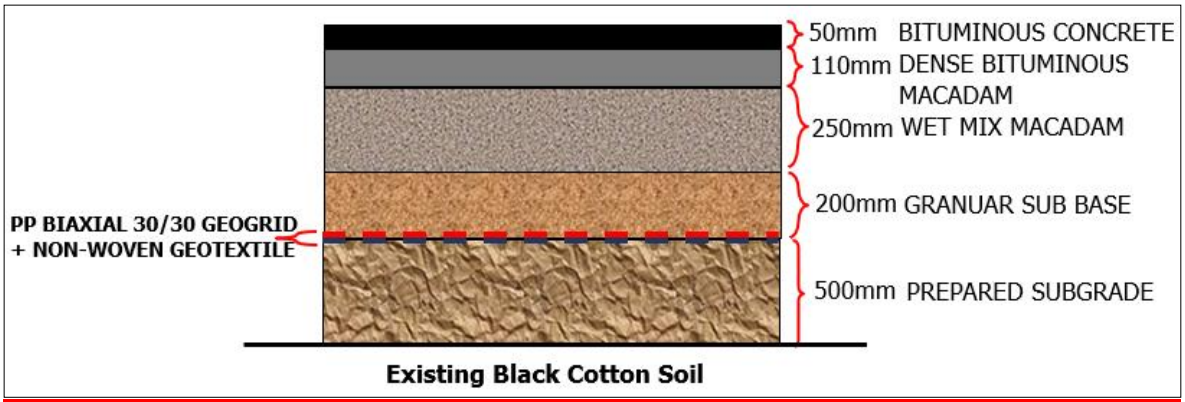
Solution proposed:

After a careful evaluation of the project requirements and site conditions, it was decided to reinforce the pavement section with Techgrid PP biaxial 30/30 Geogrid + Techgeo PN25 Non-Woven Geotextile at the subgrade level.

Following outcomes are desired by introducing Techgrid PP biaxial Geogrid and Techgeo NonWoven Geotextile:

- Techgrid PP Biaxial reinforcement helps in preventing the development of longitudinal cracks, whereas the section with no geogrid develops cracks within a few months of construction due to the subgrade soil properties.
- Researches and Previous case histories have shown that the junction efficiency (i.e. within the bonded portion of the longitudinal and transverse ribs) plays a major role in the performance of the geogrid. In comparison the polyester geogrid failed and the polypropylene grid performed well, as junction efficiency of the PP Biaxial Geogrid is higher than other types of Geogrids.
- PP Biaxial Geogrid has apertures of sufficient size to allow interlocking with surrounding aggregate materials. Biaxial geogrid increases the stiffness of unbound aggregate base layers and confines the aggregate particles under repetitive loading.
- PP Biaxial Extruded geogrid shall reinforce the granular layer and basic mechanism of reinforcing can be identified as (a) lateral restraint (confinement of granular material in grid), (b) improved bearing capacity, and (c) tensioned membrane effect. Biaxial geogrids must be punched and drawn polypropylene material.

Specific to the roads developed in the Amaravati capital region of Andhra Pradesh, the subgrade soil is purely black cotton with high free swell index, wherein the current solution to counter the effect of free swell index proposed is to prepare a subgrade of 0.5m with sand before laying the pavement layers (Base and Sub base).



Typical Section of Reinforced Pavement with PP Biaxial Geogrid and Non Woven Geotextile at the subgrade level

In this scenario addition of PP biaxial geogrid will further improve the elastic modulus of the prepared subgrade by the mechanism of lateral restraint and tension membrane effect. This improvement in elastic modulus will minimize the strains developed due to high expansiveness of existing subgrade.

The soil thrust developed on the prepared subgrade due to high swelling of existing subgrade will be laterally transferred by the geogrid, thus nullifying the effect at the subgrade level itself. With the incorporation of PP biaxial geogrid, the loads from the superstructure are dispersed into the wider area. This reduces the load intensity on the existing subgrade.

Considering the effect of shallow ground water table, a non-woven geotextile layer is provided below the geogrid. The function of Non-Woven geotextile is to act as separation layer between the subgrade layer and the granular base and sub base layers. The separation function refers prevention of intermixing of the two layers of dissimilar materials throughout the design life of the material. Normally, geotextiles provide for separation between layers in pavement. It prevents intrusion/pumping of soil particles into the base/sub-base course. Simultaneously, it performs the function of filtration by dissipating the pore water pressure and allowing the passage of fluids into or across the plane of the geotextiles while preventing the uncontrolled passage of soil particles.

Execution on Site:

Storing and Handling:

- Never drag the Geogrid or Geotextile Rolls, it may lead to damages.
- The recommended method of unloading is, to use the Stout Bar. A Bar can be passed through the roll tube & attached via chain, which in turn can be lifted by Hydra Crane or Forklift. The sequence for the same is shown in figure below.
- The forks of a fork lift should never be used, under any circumstances, to unload rolls, this would incur heavy damage to the roll.
- The Geogrid and Geotextile shall be kept dry and wrapped such that it is protected from any damage during shipping and storage. If stored outdoors, it shall be elevated and protected with a cover.
- The Rolls should also be carefully handled when being deployed from storage to their position just prior to installation.

Handling of Geosynthetic Rolls

Prepared Subgrade before laying structural layers of the pavement

Rolls of Techgrid PP biaxial Geogrid and Techgeo Non-Woven Geotextile ready to be laid

Installation of TechGeo Non-Woven Geotextile:

The following sequence shall be adopted for the laying of Non-Woven Geotextile:

- Clean the ground from debris, tree trunks etc. smooth and level the subgrade to the prescribed elevation as required by the contract.
- Unroll the non-woven geotextile on the subgrade and apply tension by hand to minimize the wrinkles. Geotextile panel overlap requirements, either side by side or end to end with overlapping (150-200mm), shall depend on strength of subgrade.

Installation of Techgrid PP Biaxial Geogrid:

The following sequence shall be adopted for the laying of Techgrid PP Biaxial Geogrid:

- Unroll the geogrid on the subgrade and apply tension by hand to minimize the wrinkles. Geogrid panel overlap requirements, either side by side or end to end with overlapping, shall depend on strength of subgrade.
- The overlapping (150-200mm) shall be made in the direction of GSB spreading to avoid the geogrid uplift. The geogrids may be tensioned and fixed along the outer edges with 12mm “U” bars 3 to 4m intervals with 200 to 300mm U-pin length or as per site requirements.
- Fill grain size distribution shall be carefully selected in order to optimize geogrid performance.
- When applying fill material over relatively competent subgrade (CBR>8), rubber tyre trucks can drive directly over the geogrid with speeds lower than 10 kmph and dump the GSB material. As they go, operators must not apply excessive braking when driving across the geogrid.
- Tracked vehicles should not be driven on the geogrid directly. Minimum of 100 mm fill/GSB should be placed between the geogrid and tracks.
- Base course material should be placed in lift thicknesses and compacted as per the design requirements.
- Any rut developed during spreading and compacting should be fill with GSB material to reach to the design thickness.

Unrolling of Geogrid & Geotextile and Inspection for any wrinkles

Techgrid PP Biaxial Geogrid:

Techgrid PP Biaxial Geogrid are high modulus polypropylene geogrids, produced by an extrusion process characterized by a tensile resistance both in the longitudinal and transverse direction. Techgrid PP Biaxial Geogrid can enhance the performance of paved and unpaved roadways, parking lots, airports, loading docks, and storage areas through stabilization / reinforcement of the base aggregates. Geogrids act as a tensile element at the bottom of a base or within a base course to:

1. Improve the service life, and/or
2. Obtain equivalent performance with a reduced structural section.

PP Biaxial Geogrids are mainly used for “soil stabilization” and also, for soil reinforcement applications.

Geogrid Overlaps of 150mm at the side edges

Techgeo Non-Woven Geotextile:

This type of geotextile is made by needle-punching of synthetic fibres together to create a single sheet. They are not as stiff as their woven counterparts, so whilst the uses are similar, they are generally used when a lesser load capacity is required. The main quality of non-woven geotextile is their excellent filtration capacity, because of this they are most often used in drainage applications. Techgeo non-woven geotextile allows the water to pass through while retaining the soil particles. So, the most common use is wrapping and protection works where water drainage is required and soil particle movements needs to be restricted.

Dumping of GSB material on the geogrid + geotextile layer

Spreading and compaction of GSB material on the geogrid + geotextile layer

Conclusion:

Techfab India has supplied the entire quantity of Techgrid Geogrid within the stipulated time and meeting all the quality requirements. The granular layers of the pavement have been completed by the contractor with full satisfaction of the Amaravati Development Corporation and Project Management Consultants. Bituminous layers are to be laid further.

For further details kindly contact :

TechFab India Industries Ltd.
711/712, Embassy Centre, Nariman Point, Mumbai – 400021
Tel: + 91– 22 - 2287 6224 / 6225 Fax: + 91– 22 - 2287 6218
E: info@techfabindia.com
W: www.techfabindia.com