

# Role of Geotextile in Highway Stabilization

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**Abstract.** Geotextiles, an efficient engineering technology nowadays, has acquired wide spreads applications in the construction of pavement. The most common use of geotextiles is beneath paved and unpaved roadways, and this is referred to as the separation/stabilization application. Geotextiles used in paved and unpaved roadways actually provide several benefits: Separation, Stabilization, Reinforcement, and Filtration. In many cases, geotextiles replace or reduce the need to use natural aggregate construction materials providing both economic and environmental benefits. In present study overviewed typical distress problems occurs in highway construction due to various factors.

**Keywords:** Geotextile, distress of pavement, filtration, separations and reinforcement.

## 1 Introduction

India has one of the most extensive highway systems in the world most of the roads built in the country pre independence era were constructed using John Macadam more than 100 years old principle in which dry pavement structure would be provided on the sub grade having on slope centre of the section. Still, some of the last decades have seen tremendous increase in the volume at the same time there has been increase in the weight of the vehicles and number of axle loads which accelerated the deterioration of the pavements. To overcome this problem the contact surface is change by asphalt and concrete. There is overwhelming evidence that a larger percentage of the distressed roads sections are poorly drainage which clearly speaks of need providing effective water drainage which is often neglected.

### 1.1 Various modes water penetrates into pavement

1. Subsurface water from sides of the pavements
2. Subsoil water from underside in capillary action.
3. Intercepted water due to over flooding of drainage.
4. Ground water from interrupted aquifers and localized springs.
5. Percolation through cracks and poor pavement surface.
6. Sub-soil water from side of the pavement.

### 1.2 Effect of water pavement (Distress)

1. Continuous contract, causes stripping of asphalt mixture and affects durability and D cracking of concrete.
2. If reduces the strength of granular materials and sub grade soils.
3. It causes pumping of concrete pavement with subsequent faulting and degradation of pavement.
4. Climatic changes severally damage the surface. In cold countries where freezing action and surface continuously supply of ground pavement damages.

Conventional methods of pavement drainage:

- Sub soil drainage.
- Prevention of roof water infiltration.

## 2 GEOTEXTILE MATERIALS

Most of the geotextiles presently in use are manufactures from petroleum derivatives such as polymer, polyethylene and polypropylenes. They are also resistances to wear and tears and to adverse the environmental conditions. Fabrics manufactured from wood plum (rayon and acetate) and silica (glass fibre) have also found in limits use in the civil egg. The term geotextiles is being increasingly used to include such materials as coir and jute netting, which find primary. Application in erosion geogrids, such as tensor and hantoh are also considered the larger members of geotextiles family [7].

### 2.1 Engineering Characteristics and functions

Important engineering properties of geotextiles are tensile strength, burst and puncture strength modulus of elasticity, permeability. Pore size distribution, abrasion resistance ultraviolet, stability against hostile environment.

The main functions of geotextiles are reinforcement, filtration, drainage, control separation. Highways on soft or problematic soils, rails roads, reinforced earth embankment and walls, dams drainage control stabilization of soil and rock slopes, erosion control.

### 2.2 Role of Geotextiles in Highway Stabilization

Weather a drainage system is part of the original road design or remedial measures it must be hydraulically efficient and shouldnt be subject to clogging. It requires course element permit water flow and filter element for restraining soil from piping conventionally, a combination of these requirements are met by the use of well graded aggregates.

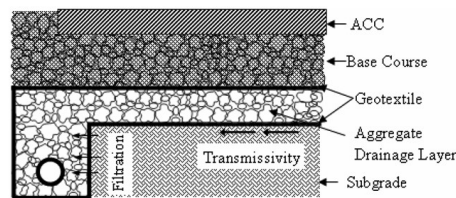
Geotextiles changes this approach. In drainage application geotextiles act as filter elements which prevent drain system from getting clogged. Expensive well graded aggregate can be replaced with open graded gravel. Moreover because of the high filtration efficiency smaller volumes of aggregates are required and construction task is very simple.

### 3 MECHANISM OF GEOTEXTILES

#### 3.1 Filtration mechanism of geotextiles

The effective geotextiles doesn't actually filter the water. It acts as a catalyst for formation of a stable soil filter cake. In the early life of drain, a certain amount of soil fines would pass through the geotextile fabric. Larger soil particles are retained on it a bridge network. Behind this, a layer of finer particles collect from adjacent undisturbed soil. Once the filter cake has been established no soil will pass through the system. While the cake now does the filtering job, the geotextiles holds it in place preventing it from collapsing in to the draining aggregate [4].

Any types of geotextiles will not perform a satisfactory filtration job. An effective fabric should have large number of openings of a fixed size is in woven fabric. Most of the non-woven fabrics meet this criterion. The filter fabric shouldn't trap particles within its pore openings and it shouldn't change porosity being compressed under loads.

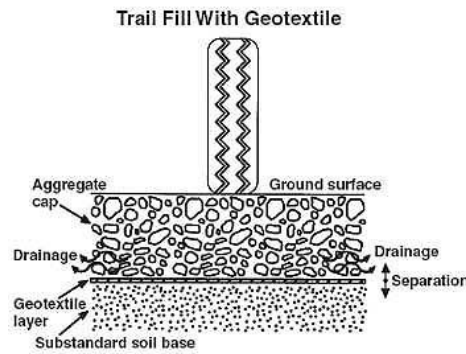


**Fig. 1.** Filtration Mechanism

As far as any construction project local conditions must be evaluated in order to properly design the drainage system such as soil characteristics, external loads imposed on the system (static or dynamic) and prevailing hydraulic condition.

#### 3.2 Separation mechanism of geotextiles

There are several drainage related functions in the construction maintenance and repairs of roads beds. The primary geotextiles functions in roads way application is separations [4]. It consists of placing the geotextiles fabrics as a separation barrier between the sub grade and sub base layer.

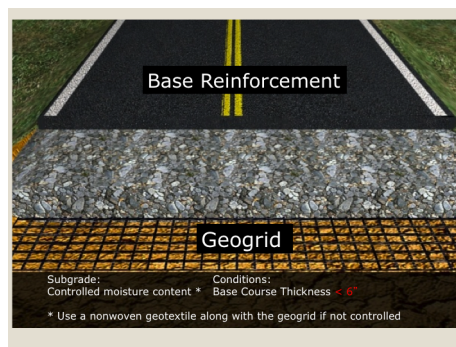


**Fig. 2.** Separation by Geotextile (courtesy: [www.fhwa.dot.gov](http://www.fhwa.dot.gov))

### 3.3 Reinforcing effect of geotextile

Since geotextiles have appreciable tensile strength, the use of geotextiles layers can also be expected to have reinforcing effect. Depending upon the type of sub grade, type of geotextile layer and anticipated wheel loads, a reduction in the thickness of 10 to 25% is possible.

Flexible overlays over distressed rigid or pavements are known to suffer from reflection cracking, leading to increase in the life of the overlay, which is normally a high cost asphaltic concrete surface. The use of existing pavements has been found to sustainability reduce the reflection cracking whenever a deteriorated pavements is to strengthened by providing an overlay with geotextiles cracks if any are to be filled with asphalt and asphalt sealant is supplied on the existing deteriorated pavement. The fabric is then placed on the sealed by hand or mechanical device.



**Fig. 3.** Reinforcement by geotextile (courtesy: [www.geoengineeringpdh.com](http://www.geoengineeringpdh.com))

### 3.4 Some case studies

i. Widening and strengthening of Munsirhat to Rajpur Road in West Bengal - 2000 [2]

1. Objective of work - Strengthening of the widened portion of the road with JGT. The soil is mostly inorganic clay mixed with silt.

2. CBR value of the sub-grade before application of JGT is 3.5% on average and Plasticity Index is 20.

3. CBR value increased to 6.0% from 3.5% after using JGT. No distress was noticed even after 6 years.

ii. Construction of Andulia Boyratala Road in West Bengal - 2005 [2]



**Fig. 4.** JGT laid on subgrade

1. Objective work - strengthening the sub-grade by separation effect with the use of JGT.

2. The soil is Organic silty clay with occasional brown clay mixed with little sand. CBR value of the subgrade before application of JGT is 3.16% and after using JGT that CBR value rose to 10.47% on average.



**Fig. 5.** Finished road

iii. Construction of MDR 82 in Pune, Maharashtra.- 2004 [2]

1. Objective of work Sub grade separation and reinforcement by using Polypropylene.

2. The soil is black cotton on 2km MDR 82. By using Polypropylene geotextile granular base thickness is reduced by 30%. In geotextile reinforced section of the after Black top; there is no visible sign of distress even after 7 years.

iv. Construction of Calicut Bye pass phase III, NH 17, Kerala. -2003 [7]

1. Objective of work- Strengthening of road and reducing excessive settlement because of soft soil erosion.

2. Pre-fabricated Vertical Drains were installed to accelerate the consolidation of the soft clays. Techfab TPP 250 Woven Geotextiles installed at the surface of the sub-grade functioned as a separator between the very soft clay and the better quality fill material.

v. Rehabilitation of 11.5m wide carriageway on Ahmadabad Vadodara. [8]

1. Objective of work Rehabilate 11.5m wide carriage way because of surface deterioration.

2. A non-Woven Geo Paving Fabric is used as moisture absorbing interlayer membrane for 11.5m wide carriageway. The material used is acts as a stress absorbing membrane interface.



**Fig. 6.** Installation of paving fabric (courtesy: TechFab India Industries Ltd.)



**Fig. 7.** Finished road (courtesy: TechFab India Industries Ltd.)

vi. Construction of internal haul roads at Gadimoga, Kakinada, Aandhra Pradesh. Onshore terminal for field development was constructed for Reliance Industries Ltd., at Gadimoga, Kakinada, Aandhra Pradesh.

1. Objective of work improving low CBR value of site.
2. Polypropylene non-woven silt film geotextile was used as reinforcement and separator between granular sub-base and sub-grade.

## 4 CONCLUSION

The geotextiles play a vital role in highway construction. They are effectively used in nearly all facts of new construction. It greatly extends the service life of pavement and effectively brings down the maintenance cost. It significantly separate sub base from sub soil and provide structural strength by virtue of its high resistance to the deformation. It also reduces the thickness of sub base granular course. It would be beneficial if geotextiles were used in highway construction as its application will reduce initial construction costs and bring down frequent repair and maintenance work of road.

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