Effectiveness of using Geotextiles in Flexible Pavement

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Abstract

Although relatively weak in tension, soil is powerful enough in compression. Tensile elements are inserted into the soil as part of the soil reinforcement method to increase stability and reduce deformation. For use in building, a wide range of reinforcing materials have been created, including metal strips, bar mats, sheets of geotextile, geogrids, etc. Over the past few decades, reinforced soil technologies have been widely employed in the building of (railway formation, highway embankments, earth dams and retaining walls). The primary purpose of the geotextiles, which are used as reinforcement, is to give soil tensile strength at a strain level consistent with the functionality of the soil structure. The fibres and cloth types of textiles, such as woven, knitted, and non-woven, are used as reinforcement.

Keywords: Geotextiles, Soil Improvement, Reinforced Soils, Weak Sub Grade Soil

Introduction

The strength of soil alone is in compression, but it is relatively feeble in tension. Tensile elements are inserted into the soil as part of the soil reinforcement method to increase stability and reduce deformation. The primary function of the geotextiles, which are used as reinforcement, is to give soil tensile strength at strain levels consistent with the functionality of the soil structure. The fibres and cloth types of textiles, such as woven, knitted, and non-woven, are used as reinforcement. Geosynthetics are used as reinforcement in paved roadways, train tracks, earth retaining walls, mining subsidence protection, and embankments of shallow weak soils. This article discusses the various geosynthetics that are primarily used in soil reinforcement to stabilise the soil and reduce problems like erosion etc.

Permeable textiles that are used with dirt or rock as a crucial component of man-made projects are known as geotextiles. A geotextile is any fabric buried in the ground. As a separator, filter, drainage substance, reinforcement, sealing, and security, geotextiles serve these purposes. They are used in open mesh, woven, non-woven, and knitted forms depending on the needed function.

Geotextiles

One of the two biggest groups of geosynthetics is the geotextile type. They have grown significantly over the past 35 years, and it hasn't been anything exceptional. They are fabrics in the traditional sense, but instead of natural fibres like cotton, wool, or silk, they use artificial ones. Therefore, biodegradation and the ensuing short existence are not a burden. These synthetic fibres are matted together in a random non-woven way or turned into adaptable, porous materials using standard weaving equipment. Some are not even made. Although geotextiles have at least a hundred different applications, they always serve at least one of the following four purposes: separation, reinforcement, filtering, and/or drainage.

Geotextiles are classified based on manufacturing process into the following:

- **Woven GT:** A geotextile made by interwoven, sometimes at right angles two or a lot of sets of yarns or other parts employing a typical weaving method with a weaving loom.
- **Non-woven GT:** A geotextile made from directionally or willy-nilly oriented fibers into a loose internet by bonding with partial melting, needle punching or chemical binding agents.
- **Knitted GT:** A geotextile made by inter-looping one or a lot of yarns beside a textile machine rather than a weaving loom.
- **Stitched GT:** A geotextile within which fibers or yarns or each are interlocked by handicraft or stitching.

Figure: Geotextiles

Advantages of Geotextiles

- They are lighter in weight which makes it easier handling and laying on site.
- Transport and labour costs are less in real terms.
- Knitted geotextiles have a high tear strength.

Disadvantages of Geotextiles

- Installation of geotextile is critical and requires experienced contactors.
- These may delay seed germination, due to reduction in soil temperature.
- Geotextiles have maximum flow rate.
- Not suitable for areas that have foot traffic.

Function of Geotextile

Separation

The primary application of geotextile separation work is in the building of roadways. The interception between two adjacent soils is avoided via geotextile. For instance, the drainage and strength properties of geotextile composite materials are preserved when fine subsurface soils are separated from lower coarse particles.

Filtration

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Drainage

The composite drainage geotextiles prevent clogging and extend the life and efficiency of drain pipes. **Applications:** French drains, vertical drains, agricultural pipe drains, blanket drains in roads and sports fields, side drains, and wall drains.

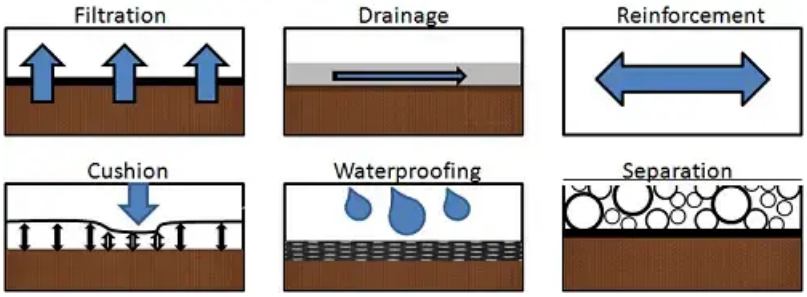
Reinforcement

The addition of geotextiles will boost the soil's tensile strength by an amount comparable to that of metal concrete.

Sealing

A layer of non-woven geotextile is saturated between existing and new asphalt layers.

Figure: Functions of Geotextiles



Applications of Geotextiles

Geotextiles are used in various infrastructural works, which increase the strength of weak nature soils and prevent erosion. As a result, unsuitable places become suitable for building / civil construction.

Some of the notable uses are:

1. Temporary & Permanent Roadways, Parking lots & Construction sites.
2. River, Canals & Coastal works.
3. Filtration& Drainage
4. Separation
5. Agriculture
6. Railway works

7. Reinforcement
8. Protection& erosion control
9. Retaining wall structures
10. Embankments

Literature Review

- Manpreet Kaur, S.K. Agarwal (2020): They presented a research on geogrid-reinforced weak subgrade soil. Geosynthetic reinforcements increases pavement performance, according to their field tests. Numerous uses for geosynthetics include drainage, filtering, strengthening, and separation. This essay aims to examine the findings of numerous investigations into the use of reinforcement in weak subgrade soils.
- Adnan Zafar, Shivam Singh Patel (2020): According to the results of their study, fiber geotextile-enhanced soil performs better than unreinforced soil in terms of load carrying capacity, stress distribution, and degree of deformation. Fiber geotextiles are also deduced to provide efficient subgrade improvement and soil structure protection. They advised to build test tracks using several types of fiber geotextile (unwoven and woven) for varied soil conditions to gauge their performances.
- R. Madeswaran et al. (2019): They presented the interlocking and interaction between the soil sample; and geotextile provides the foundation for soil stabilization using reinforcing fiber geotextile material. It is advised to build test tracks using several types of fiber geotextile (unwoven and woven) for varied soil conditions to gauge their performances.
- Vikash Singh et al. (2019): They found that the roads are being damaged before they can be repaired due to heavy traffic. The black cotton soil has a great capacity for swelling. Undulations are caused by compression and contraction as a result of the heavy rains. Geotextile materials can be used to solve this issue. One of the first textile products in human history is geotextile. In order to prevent undulations and extend the lifespan of the road, geotextile improves the soil layers beneath the highway surface by increasing their carrying capacity. For more than 30 years, geotextile has been employed with great success in the field of transportation engineering. For building roads and other types of infrastructure, geotextiles are superior material.
- A.A. Bhosale et al. (2017): They studied the effect of permeability and CBR tests contrasted before and after geotextile laying. Despite an improvement in CBR, permeability fell on Geotextiles introduction indicates a major improvement in engineering behavior. In order to increase soil qualities, geotextiles work very effectively by making soil more robust and less compressible.

Objectives

- The primary goal of the current work is to investigate the relationship between soil strength and the ideal depth for placing geotextiles after applying geosynthetics. The strength variations in various soils were noted in the current investigation.
- To look into the different engineering qualities of soil.
- To look at the mechanical and physical characteristics of geotextiles.
- To investigate the friction properties of the geotextile-soil interface using a modified direct shear test.
- To conduct California Bearing Ratio (CBR) experiments in the lab and outside on a two-layered soil system both with and without a geotextile layer there.
- Based on the laboratory and field CBR values, determine the thickness of the pavement over the unreinforced and reinforced two-layered soil system.

- To calculate the thickness of the pavement when compared to a reinforced, two-layered soil system.

Effectiveness of using Geotextiles in India

There are some makers of geotextiles that believe that attention may be enhanced within India, which is a very large problem for the expansion of geotextile, since the need and use of geotextiles are getting more prominent. Since 2000, Jeevan Products, a reliable and well-known company, has been producing non-woven geotextiles in India. But the key issue is whether or not the existing particularization will be appropriate for the climate, and the scarcity of supplies for geotextile is considered to be a significant impulsion. Geotextiles are increasingly being used to prevent soil erosion on embankments and hillsides since India experiences significant soil loss each year as a result of its monsoon seasons.

Conclusion

According to the findings of the various research,

1. Geosynthetics is a well-established technology within the range of options for geotechnical engineering projects.
2. Nevertheless, creativity is still important in geotechnical projects that incorporate them.
3. The application of exposed geomembranes as a promising method for resistive covers the application of geotextiles as capillary barrier in unsaturated soil.
4. In general, due to their adaptability, cost effectiveness, ease of installation, and accurate assessment of their mechanical and hydraulic properties, geosynthetics play a significant role in all geotechnical applications. As manufacturers create new and better materials and as engineers and designers create analysis procedures for novel applications, the inventive use of geosynthetics in geotechnical practise is certain to increase.
5. Integral geosynthetic reinforced bridge abutments, which are used to lessen the "bump at the end of the bridge."
6. The use of geogrids in the construction of the tallest geosynthetic-enhanced reinforced soil wall.
7. Using geosynthetic reinforcements to lessen the negative impact that expanding clays have on pavement.

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