# Usage of Woven Geo-Textiles in the Construction of Subgrade in Flexible Pavements

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#### Abstract

**Objective:** In this research work, emphasis was made on examining the quality of geotextiles in the road construction in flexible pavements and replacement as a binder. **Methods:** This paper examines about the usage of woven geotextiles in flexible pavements. The locally available soil is used for the tests. Different test are performed for soil along with geotextile. In CBR test geotextile is installed at different depths in soil such as 3, 6 & 9 centimeters in the mould. **Findings:** From this study, layer of woven geotextile introduced at the center shows the better performance than those of other layers at different depths. **Application/Improvement:** The use Geotextiles in the flexible pavement can rise the service life of the pavement than the previous pavements. Geotextiles of both natural and synthetic are helpful in improving the geotechnical properties of soil.

Keywords: Subgrade, Woven Geo-Textile

# 1. Introduction

In the past 20 years the geo-textiles<sup>1</sup> growth in the market has risen. In Geo-textiles Geo means Earth and textile means fabric. Polypropylene, polyethylene, polyester are the petroleum products which used in the production of Geo-textiles. Fiberglass is also an alternate source in which geo textile can be made. Depending on the manufacturing they are classified into two types. The flexibility of geotextile is most useful for the filtration purpose and soil, rock and waste material can be reinforced by the geotextiles. These textiles consist of synthetic fibers such as cotton, wool or silk. Flexibility and porous nature can be obtained by the usage of standard weaving machinery. Subsurface drainage and erosion control applications as well as for road stabilization for wet moisture sensitive soils are given by Non-woven geotextiles<sup>2</sup>. Woven geotextile are made from weaving monofilament, multifilament, or silt film yarns. Silt film yarns further subdivided into flat tapes and fibrillated yarns. There are two steps for making woven geotextiles. First manufacturing of filaments or slitting the thin film to create yarns. In second weaving the geotextiles to form yarns as the geo-textile is made from different process the range of properties is very high. Geotextile fabrics come in three basic forms namely woven, needle punched, heat bonded.

There are different types of geo-synthetics namely geo-membranes, geo-nets, geo-composites, geo-mat, geocell, bio-mat and bio-net. Some of the natural forms of geotextiles are jute, flax or coir, coconut matting, cotton, hemp, straw. The different types of composite/synthetic materials of geotextiles are Kevlar, polyester, polypropylene, jute composite.

Geo-textiles are first used in the days of second intermediate period (1802-1550 BC) of Egypt. Even though they were strive for unsteady soils. They finally found that fibers will upgrade the road condition especially for unstable type soils.

Geo-textiles are main largest group of geo-synthetics. The synthetic fibers are main proportions intruded for these textiles. These synthetic fibers are usually built into flexible, permeable fabrics<sup>3</sup>.

The first use of geo-textile used in America in the late 1920's, in the state of south California used a first geo-textile in a road of poor quality soil. After several years also the geo-textile was still useful status. Synthetic fibers are easily accessible to buy in the 1960's, textiles were mostly used in construction of roads.

#### 1.1 Van Santvoort (1994)

When geo-textile is used as a separator there are some requirements to be followed.

#### 1.2 Nishida and Nishigata (1994)

They found the boundary between the separation and reinforcement functions.

#### 1.3 Le (1982)

He describes the various types of geo-textiles used in the construction of different types of roads.

#### 1.4 Tsai et al (1993)

He performed a field test and compared ability of different types and weights of geo-textiles to stabilize the soft subgrade during construction and to investigate their long time performances over the pavement system.

## 2. Material and Methods

#### 2.1 Materials

#### 2.1.1 SOIL

The sample used for this project collected near BH-1 block, LPU, at a depth of 1 metre beneath top surface.

#### 2.1.2 Geo-Textile Properties

The geo-textile is used in this project is geo-textile (woven) bought from 'SRAVYA TEXTILES LIMITED' in Hyderabad, Andhra Pradesh. The different properties of geo-textiles is given in Table 1 (Woven Geotextile Properties).

#### 2.2 Methods

The tests are performed as per the codes of practice. Descriptions of the different types of tests are mentioned.

Table 1.	Woven	geo-textile	pro	perties
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PROPERTY	TEST METHOD	UNIT	300 GSM
Tensile strength	IS 1969	KN/M	60
Trapezoidal strength	ASTM D 4533	Ν	1500
Puncture strength	ASTM D 4833	N	800
Discharge	ASTM D 4491	L/M <sup>2</sup> /S	18
Apparent opening size	ASTM D 4751	MICRONS	250
Roll width		М	4

In experimentation the following tests are conducted:

- Sieve analysis.
- Casagrande's apparatus for Liquid limit.
- Determination of Plastic limit.
- Standard proctor test.
- California Bearing Ratio (CBR).

## 3. Methodology

After taking the soil from the site it should be oven dried and classified according to unified soil classification. After calculating the weight retained in each individual sieve the graph is plotted. The liquid limits are done by the Casagrande's apparatus. After that we are finding the optimum moisture content and maximum dry density by using the standard proctor-test, the reason for not using the modified proctor test is that vibrations are also considered in modified proctor. The vibrations are seen in only airports, so that for normal roads preference is given for standard proctor test<sup>4</sup>. After this test California bearing ratio<sup>5</sup> is calculated and design is done. For the design the load value is calculated by using the traffic data, thickness of each is calculated. The design for the flexible pavement<sup>6</sup> is done according to IRC 37-2001<sup>7</sup>.

## 4. Results and Discussion

Soil selected is a poorly graded soil and the liquid limit of the soil is found. The maximum dry density of the soil is 1.876 g/cm<sup>3</sup> and optimum moisture content is 15%. The maximum dry density<sup>8</sup> of the soil with woven geo-textile

placed under different heights in the mould such as 3, 6 and 9 centimeters is noted<sup>2</sup>. So the maximum dry density and optimum moisture content of soil with woven geo-textile are shown in the graphical representation and tabular forms. (Table 1 Woven Geotextile Properties).

The present site selected is lovely professional university and the average rainfall of this area is 686 mm which is greater than 500 mm as per IRC when rainfall is higher than 500 mm we will consider the soaked CBR values for the design of total thickness of pavement.

At present 70 commercial vehicles are coming daily, this vehicle count is mainly due to the constructions that are going in the university, let us consider 2 years for the modification of the pavements and design life 10 years.

Vehicle damage factor 1.5 and lane distribution factor is 75% of total traffic, growth rate is 7.5%

 $N = \frac{365 * A * D * F\{(1+r)^n - 1\}}{r}$ 

Where  $A = P(1 + r)^x$  Where  $A = P(1 + r)^x$ 

A=  $70(1+.075)^2 = 80.89 \approx 81$  commercial vehicles per day (CPVD)

$$N = \frac{365 * 81 * .75 * 1.5\{(1 + .075)^{15} - 1\}}{0.075}$$
  
= 875853.24 \approx 1msa

## 5. Conclusion

The bearing capacity of the soil increases and the thickness of the pavement decreases and eventually the cost of constructing the project decreases. The CBR value gets varied with the introducing of woven geo-textile at different depths of soil. A geo-textile layer at 6cms introduced in the mould shows better performance than any other layer in different depths. When the geo-textile layer introduced in the 6 cms depth, the CBR value of the sample in soaked condition is 2.72. Future maintenance works can also be reduced by improving the strength of sub grade soil.

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