

## **Application of Geotextiles in Pavement Drainage Systems**

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### **Abstract**

Geo-textiles are the permeable fabrics which, when used in association with soil have the ability to separate, filter, reinforce, protect, or drain. Typically made from polypropylene or polyester, geo-textile fabrics come in three basic forms: woven, needle punched, or heat bonded. The original and still sometimes used term for geo-textiles is filter fabrics . Geo-textiles have many applications and currently support many civil engineering applications including roads, airfields, embankments, retaining structures, reservoirs and construction site. Geo-textiles have a major role in construction of paved roads over areas having high ground water table. There are several key applications, construction of pavements, in asphalt concrete overlays and for drainage systems, which helps in enhancing the performance and extending the service life of roads. Drainage of water from pavements has always been an important consideration in road design. When functioning as a drain, geo-textiles acts as a conduit for the movement of liquid or gases in the plane of geo-textile. Some of the geo-textiles used for drainage are wick drains and blanket drains. In this paper, various options available to the civil engineers in the use of geo-textile in the pavement drainage systems have been highlighted.

**Keywords:** Geo-textiles, pavement, drainage.

### **1. Introduction**

Geo-textiles were one of the first textile products in human history. Excavations of ancient Egyptian sites show the use of mats made of grass and linen. Geo-textiles have

been used very successfully in road construction for over 30 years. Water has lots of adverse effects on pavement performance. In fact, moisture damage in asphalt pavements is global concern. In situation when rainwater is not properly drained off the pavement surface, it will penetrate into the pavement thereby deteriorating the pavement layers. Geo-textiles when used for drainage purpose, it act as a permeable separator that allows water to pass into the drainage system, while preventing pavement layers. Key characteristics of drainage geo-textile are the AOS (Apparent Opening Size), which indicates the size of openings in the material, and flow rate, which indicates how much water, can pass through the geotextile.

## **2. Important Characteristics of Geotextiles**

The characteristics of geo-textiles are broadly classified as:

### **2.1. Physical properties**

Specific gravity, weight, thickness, stiffness, density

### **2.2 Mechanical properties**

Tenacity, tensile strength, bursting strength, drapability, compatibility, flexibility, tearing strength, frictional resistance.

### **2.3 Hydraulic properties**

Porosity, permeability, permittivity, transitivity, turbidity /soil retention, filtration length etc

### **2.4 Endurance properties**

Elongation, abrasion resistance, clogging length and flow etc



**Figure 1:** Geo-textile used for drainage.

## **3. Types of Geotextiles**

Geo-textiles are a permeable synthetic material made of textile materials. The geo-textiles are further prepared in three different categories – woven fabrics, non-woven fabrics and knitted fabrics

### **3.1 Woven fabrics**

Large numbers of geo-synthetics are of woven type, which can be sub-divided into several categories based upon their method of manufacture. As their name implies, they are manufactured by adopting techniques which are similar to weaving usual clothing textiles. This type has the characteristic appearance of two sets of parallel threads or yarns-the yarn running along the length is called warp and the one perpendicular is called weft.

The majority of low to medium strength woven geo synthetics are manufactured from polypropylene which can be in the form of extruded tape, silt film, monofilament or multifilament. Often a combination of yarn types is used in the warp and weft directions to optimize the performance/cost. Higher permeability is obtained with monofilament and multifilament than with flat construction only.

### **3.2 Non-woven**

Non woven geo-synthetics can be manufactured from either short staple fibre or continuous filament yarn. The fibers can be bonded together by adopting thermal, chemical or mechanical techniques or a combination of techniques. The type of fibre (staple or continuous) used has very little effect on the properties of the non – woven geo synthetics. Non-woven geo-textiles are manufactured through a process of mechanical interlocking or chemical or thermal bonding of fibres/filaments. Thermally bonded non-wovens contain wide range of opening sizes and a typical thickness of about 0.5-1 mm while chemically bonded non-wovens are comparatively thick usually in the order of 3 mm. On the other hand mechanically bonded non-wovens have a typical thickness in the range of 2-5 mm and also tend to be comparatively heavy because a large quantity of polymer filament is required to provide sufficient number of entangled filament cross wires for adequate bonding.

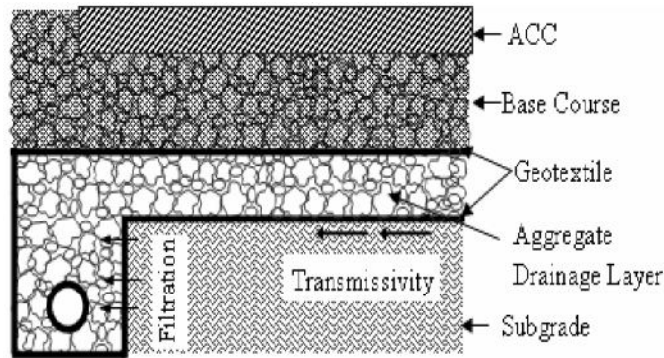
### **3.3 Knitted fabrics**

Knitted geo-synthetics are manufactured using another process which is adopted from the clothing textiles industry, namely that of knitting. In this process interlocking a series of loops of yarn together is made. An example of a knitted fabric is illustrated in figure. Only a very few knitted types are produced. All of the knitted geo-synthetics are formed by using the knitting technique in conjunction with some other method of geo-synthetics manufacture, such as weaving. Apart from these three main types of geo-textiles, other geo-synthetics used are geo-nets, geo-grids, geo-cells, geo-membranes, geo composites, etc. each having its own distinct features and used for special applications.

## **4. Function of Geotextile in Drainage**

In civil engineering, the need for drainage has long been recognized and has created the need for filters to prevent in-situ soil from being washed into the drainage system. Such wash in soil causes clogging of the drains and potential surface instability of land adjacent to the drains. This refers to the ability of thick nonwoven geo-textile whose

three-dimensional structure provides an avenue for flow of water through the plane of the geo-textile. Figure 6 also illustrates the transmissivity function of geo-textile. Here the geo-textile promotes a lateral flow thereby dissipating the kinetic energy of the capillary rise of ground water.



**Figure 2:** Geo-textile layer in sub-grade.

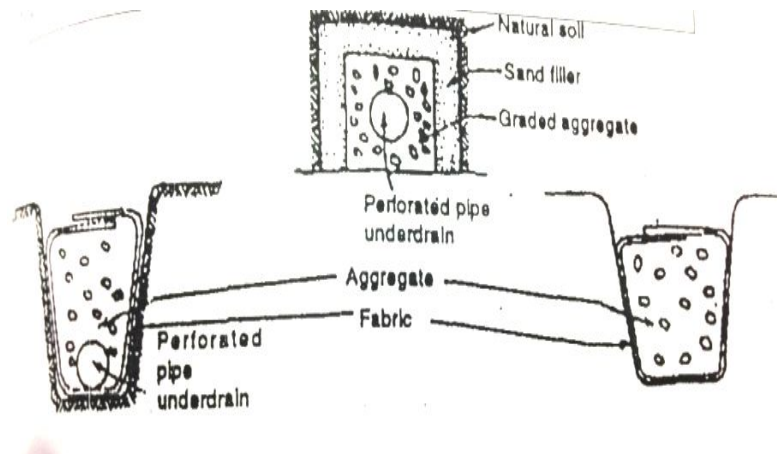
The use of geo-textiles to filter the soil and a more or less single size granular material to transport water is increasingly seen as a technically and commercially viable alternative to the conventional systems. Geo-textiles perform the filter mechanism for drainages in earth dams, in roads and highways, in reservoirs, behind retaining walls, deep drainage trenches and agriculture. When functioning as a drain, a geo-textile acts as a conduit for the movement of liquids or gases in the plane of the geo-textile. Examples are geo-textiles used as wick drains and blanket drains. The relatively thick nonwoven geo-textiles are the products most commonly used. Selection should be based on transmissivity, which is the capacity for in-plane flow. Questions exist as to long term clogging potential of geo-textile drains. They are known to be effective in short duration applications. Function of providing Geo-textile with reference to drainage is to prevent soil particles to migrate and allowing passage of water.

Geo-textile when used as drains, the water flows within the plane of Geo-textile i.e. has high lateral permeability. Geo-textile should also have dimensional stability to retain its thickness under pressure. An ideal Geo-textile should play the role by removing free water from beneath the surface. It is observed that life of pavement section is greatly influenced till the water remains under the structural section and removal of water which depends on its drainage system. The use of Geo-textile has resulted into changing the conventional procedure of using graded filters.

## 5. Advantages of using Geo-textile in Drainage

1. Eliminates the filter sand with dual media backfill.
2. Replaces well-graded lab analysis sand and gravel with less expansive non-graded mix.

3. Eliminates the need for perforated pipe in some cases.
4. Cases where only sand backfill is available, Geo-textile can be used to wrap the drainage pipe to act as a screening agent. Geo-textile results in preventing sand entering the perforation in the pipe.
5. Trench excavation depth can be reduced using Geo-textile.



**Figure 3:** Use of fabrics in drainage.

## 6. Application of Geo-textile in Drainage

- Filter around trench drain and edge drain to prevent soil from migrating into aggregates.
- Filters beneath pavement permeable bases, blanket drain and base courses.
- Drains for structure such as retaining wall and bridge abutment.
- Geo-textile wraps for slotted or joined drain and well pipes.
- Chimney and toe drains for earth dams and levees to provide seepage control.

## 7. Conclusion

Geo-textiles are widely used for drainage in earth and construction works. The drainage function is defined as “The collecting and transporting of precipitation, ground water and/or other fluids in the plane of the geo-textile”. In other words, it is the ability of the geo-textile to drain fluids on its own, meaning that it is not part of a drainage system, but is the drainage system itself. The drainage function is often confused with the filtration function. When a geo-textile forms part of a drainage system, where the geo-textile is used to separate a soil and a coarse-grained drainage layer, the function is filtration.

Excess water is drained off the construction - not by passing through the Fibertex Geo-textile as when used for filtration - but by flowing in the plane of the geo-textile leading it away from the construction.

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