SECTION 115 GEOSYNTHETICS

2548. **General.** Geosynthetics are becoming more widely used as a construction component with the uses and quality of products between manu facturersvarying greatly. Geosynthetics fall into three main categories:

a. Geomembranes. Geomembranes act as a barrier to liquids and gases.

b. Geotextiles. Geotextiles allow the passage of liquids and gases. Depending on their composition, they contribute varying degrees ofstrength to different civil engineering applications, either directly orindirectly.

c. Geocomposites. Geocomposites consist of two different geotextiles bonded together with or without a combined geomembrane.

2549. Manufacture. Geosynthetics are formed from a variety of synthetic polymer materials, including polyethylene, polyester and polypropylene. These materials are extruded to form threads, tapes and sheets, which are then formed into textiles and grids by weaving, bonding and punching. The materials formed have different properties and uses depending on their method of manufacture, thickness and porosity. With modern manufacturing methods, geosynthetics are durable, have consistence properties and are now widely available.

Figure 25-23: Geocomposites

2550. Characteristics**.** Plastic mesh sheet, when used as a horizontal sheet,has an advantage over solid materials in improving the load bearing capacity of natural soils. Solid materials, such as fibrous felt sheeting, cause problems due to the clogging of the sheet. This results in build-upof pore water in the sheeting. This, in turn, leads to separation of thesheeting from the soil and the development of slip surfaces, which weaken the ground structure. Polythene sheeting also causes water retention with resulting weakness because of the excess of water in the ground above the sheeting. With plastic mesh or net, the water can drain through the mesh and so avoid the clogging and weakening effect. The mesh can be used to reduce the thickness of road construction required and allow traffic to use ground of very low CBR value with a minimum of surface material. Care must be taken to leave sufficient thickness of material for frost protection as many low CBR subgrades are frost susceptible. The mesh helps to produce a high density sheer resistance layer of soil which can distribute vertical loads and restrain soft ground in the lower layers of the subgrade.

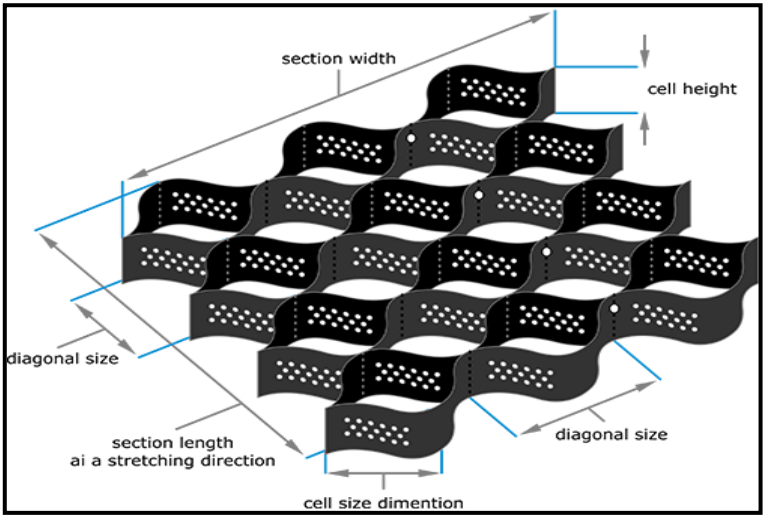

Figure 25-24 : Geo cell

2551. **Types of Geotextile**. Geotextiles are divided into five classes:

a. Woven Fabrics. The material is woven on conventional textile industrylooms and although fairly strong has useful strength in only two directions.

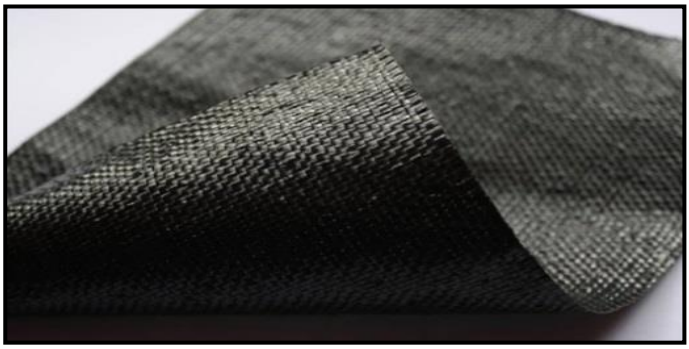

Figure 25-25: Woven Fabric

b. Non-woven Fabrics. Non-woven fabrics can be divided into two further types:

(1) Heat-bonded fabrics which form thin, fairly stiff sheets depending on the number of layers bonded together.

(2) Needle-punched fabrics that form a thick, felt-like material which is more flexible.

Figure 25-26: Non-woven Fabric

c. Geogrids and Geonets. Geogrids are formed by extruding polymer sheetsthat have been punched to leave a principal axis or uniform grid. Geonetsare, in contrast, formed by bonding two layers of evenly spaced fibres toform a weak uniform net.

Figure 25-27: Georigid

d. Impermeable Geomembranes. Membranes are produced by extruding asheet of polymer. The strength and stiffness of waterproofing is dependenton the thickness and type of material used.

e. Geocomposites. Geocomposites are multi-layer composites where nonwoven,woven and membranes are bonded together.

Figure 25-28: Geocomposites

2552. Functions. Geosynthetics provide the engineer with the capability to enhancethe construction by assisting in the following functions:

a. Separation. Woven or non-woven geotextiles are used as a separationlayer to prevent the mixing of the subgrade with the lower

layers of the road construction. Separation is the function of a water-permeable barrier positioned between soils of different grading and structure to prevent the intermixing of solid particles from the adjacent layers while permitting the free flow of fluids across the barrier (*see* Figure 8/16). They do not contribute any significant strength to the construction, but increase the overall life of the pavement.

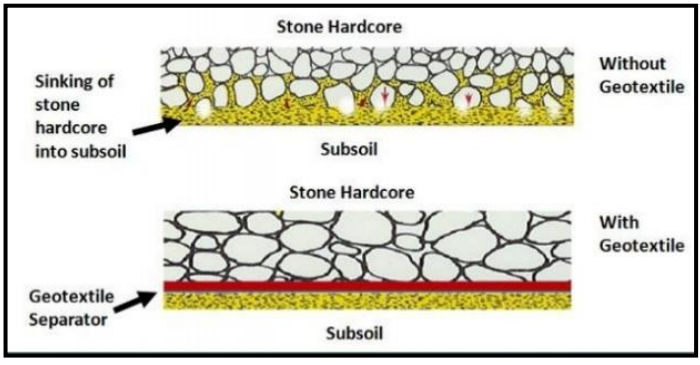

Figure 25-29: Functions of Geosynthetics

b. Filtration. Drainage systems remove excess water from the soil and, forlasting efficiency, it is essential that these systems are protected against the ingress of fines from the soil by the use of filtration. The constant increasingand decreasing of pore water pressure in the subgrade and fill materialscauses a pumping of water between these. This results in the watercarrying fines into graded fills and weakening their mechanical properties. A geotextile layer is used to filter the water, allowing the pore water pressure to dissipate in the subgrade but preventing deterioration of the fill. This extends the life of the pavement.

c. Drainage. Geotextiles are used extensively to improve and enhanceland and highway drainage systems. Combinations of variousgeotextiles can be produced to form complete drainage systems ontheir own. The most common form is the ‘Fin Drain’ which consists of afabric wrapped around a single-sized aggregate (*see* Figure 8/17). Theresulting drain performs more efficiently, with the geofabric causing afilter to be set up in the adjacent soil and enabling the aggregate

toprovide a passage for the water. Horizontal drainage can be producedby sandwiching a layer of sand between two geofabrics. The fabriccontains the sand and prevents contamination, while the sand allowswater to travel horizontally.

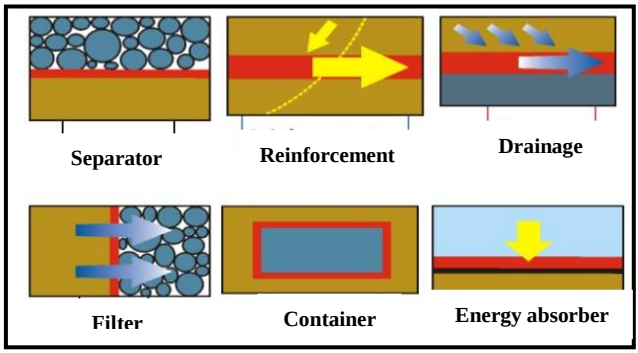

Figure 25-30: Drainage

d. Reinforcement. All geotextiles provide some measure of reinforcement but, where reinforcement is required, a geogrid is used. These can varyin strength from lightweight meshes up to very heavy pierced and stretched grids used for embankments and retaining walls. The grids function by interlocking with the soil and providing very high tensile strength. Added to this is the high shear strength of the grid so that if slippage in the soil starts to occur, the grid is stretched quickly to the point where it resists tensile stress and the slippage is held.

e. Protection. Geotextiles have become increasingly more important inmarine and river works due to their ability to separate soils and their properties of filtration and permeability. The provision of a felt-type geotextile over a waterproof membrane helps to protect the membrane from abrasion and puncture. Where geotextiles are used under an armour of rock, a filter layer of soil is rapidly built up, so protecting the banks from further erosion (*see* Figure 8/18).

f. Sealing. Where a geotextile has been impregnated with a bituminous or similar waterproofing material, the geotextile can be used as a high strength waterproof membrane, resistant to rips, tears and punctures. It is commonly used in asphalt overlay work to enable the waterproof material to bridge small cracks and joints. This can eliminate

‘reflective cracking’ when overlaying concrete roads. A geosynthetic can also be used as a waterproof barrier in pollution control, containment and dam construction.

2553. **Application**. Whilst there are many applications of geotextiles in roadconstruction, the standard use of a geotextile is as a separation ordrainage layer. The procedure is as follows:

a. The ground is cleared of tree stumps and rocks and any large ruts andpotholes are filled. On temporary roads or haul roads, there is norequirement to strip the topsoil: this is only necessary on permanentroad structures.

b. The geotextile is laid along the proposed alignment. This should be foras short a distance as possible to allow for filling over to take place. Ifnecessary, the edges can be held down with a small amount of fill alongthe edges.

c. The first load of sub-base is dumped just before the start of the geotextile and dozed on to the geotextile. This reduces the drop height of the sub-base material and so reduces the possibility of puncture.

d. Subsequent loads are dumped on previously dozed areas and do zed forward, while the geotextile is unrolled in front of the material to give working space. The first layer is compacted and any other layers prepared as in normal road construction.

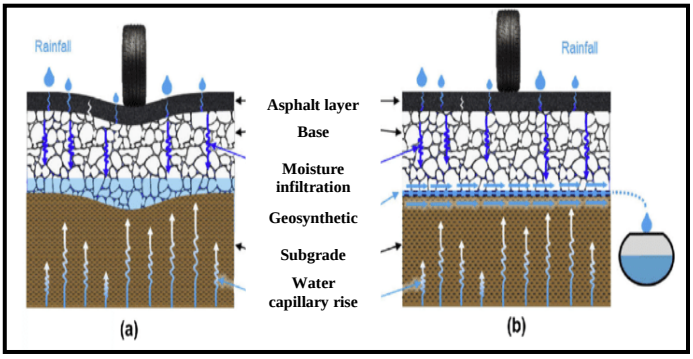

Figure 25-31: Geotextile use in the Separation Function

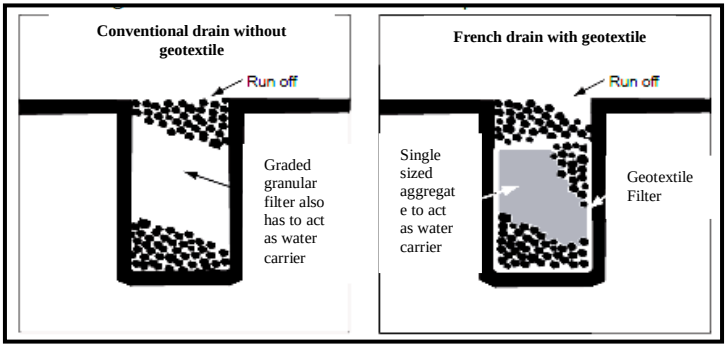

Figure 25-32: Geotextile 'Fin Drain' Construction

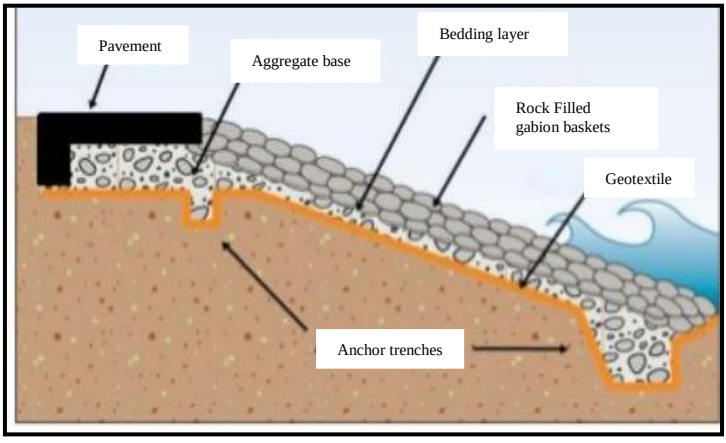

Figure 25-33: Geotextile Protection Against Erosion.

2554. **Overlapping**. The degree of overlap depends on subgrade conditions, but is usually between 0.3 - 1.0 m; the wider overlap being necessary on very soft subgrade. To avoid displacement of the fabric during sub-base placement, the 'continuation' roll should be lapped under the fabric already in position.

2555. **Unbound Haul Roads**. Where frequent use is made of an unbound haul road, the sub-base material can spread sideways with use. To prevent this happening, the geotextile layer and the sub-base material can be placed in excess width and toed-in or pillow-rolled to form an edge support. The pillow-roll takes most construction effort but produces the most satisfactory result. It can also reduce

costs for sub-base material, which may be of considerable importance if long haul distances or a shortage of suitable materials is a problem.

2556. **Guidance.** Circumstances vary and the engineer on site should use his own judgment and, in case of difficulty, refer to the manufacturer's instructions.

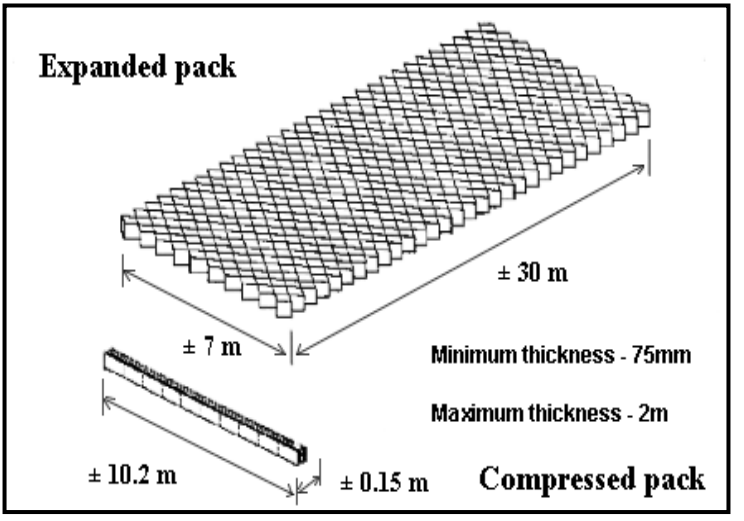

Figure 25-34: Geotextile

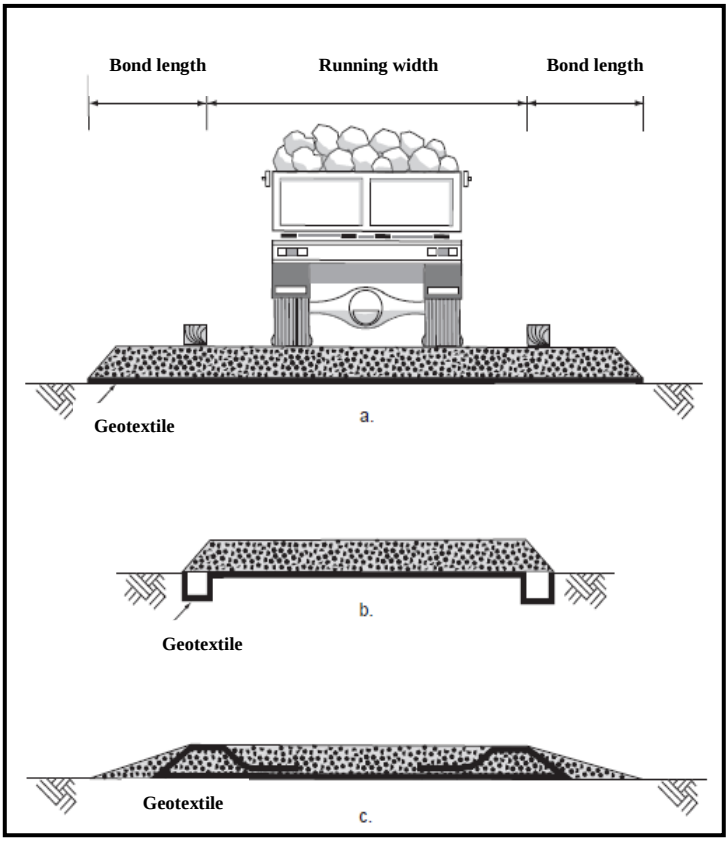

Figure 25-35: Use of geo Textiles in Temporary Road Construction.