USE OF GEOCOMPOSITE DRAINAGE SYSTEMS

INTRODUCTION

The performance of pavements, retaining structures, slope stability and many civil structures requires installation of appropriate and effective drainage systems in order to minimise the effects of hydrostatic pressure on the structures. Natural materials such as crushed rock have been used to form such drainage systems.

With the advance development of geo-synthetic material, geocomposite drainage systems consisting solely of geo-synthetic materials have been introduced as an alterative drainage system in road construction.

Where a geocomposite drainage system has been designed to be integrated with a soil reinforcement system to perform multiple functions (e.g. separation, filtration, protection, soil reinforcement, stabilisation, or a combination of these), the drainage requirement of this system must be clearly stated in the design.

This Technical Note provides guidance on the use of geocomposite drainage systems in general road construction application.

THE NEED FOR A DRAINAGE SYSTEM

A drainage system is needed wherever groundwater is expected to have an adverse effect on the behaviour of a structure or the stability of batter slopes (natural or man-made). An increase in pore-water pressure could result in collapse of a structure, pavement distress or landsides.

Typical applications of a drainage system in road constructions are:

- drainage blanket for pavement
- drainage layer behind a retaining structure
- stabilisation of road fill embankment
- cut batter protection work
- sub-surface cut-off drains
- pavement drains.

TYPES OF GEOCOMPOSITE DRAINAGE SYSTEM

A typical geocomposite drainage system consists of a drainage core made of high or low density polyethylene (HDPE or LDPE) with a geotextile laminated to one or two sides and are designed for in-plane flow (i.e. transmissivity) over a large surface area (Figure 1).

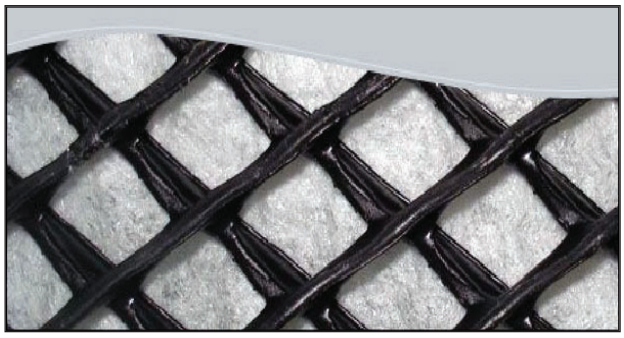

Figure 1. Geocompoisite Drainage layer.

In some cases where drainage lines are required at regular intervals such as a drainage system required behind a retaining structure, the drainage core is fully encapsulated in a layer of non-woven geotextile. Figure 2 below shows a typical geocomposite system designed to provide a localised drainage line.

Figure 2. Geocomposite Drain

Typical applications of a geocomposite drainage system are illustrated in Figures 3 and 4.

Figure 3. Drainage line behind retaining panels

Figure 4. Drainage provision over the entire face of a structure

GEOCOMPOSITE DRAINAGE SYSTEM–DESIGN AND APPLICATION

Design

A geocomposite drainage system should be designed to satisfy the following requirements:

- minimise hydrostatic force on a structure (e.g. retaining structure, pavement, etc)
- adequate strength to sustain the design load on the system (e.g. normal pressure or lateral pressure increase with depth in the case of retaining structures)
- positioned to intercept groundwater (e.g. located in area wherever seepage of groundwater is likely),
- sufficient capacity to dissipate groundwater (e.g. volume of water with respect of time)
- reduction of pore-water pressure in hillside slope, road cutting or road fill embankment can minimise the likelihood of slope instability (i.e. landslide)
- used in conjunction with wick drains to assist dissipation of pore-water resulting in acceleration of consolidation of subsurface material (e.g. reduce long term settlement effects when constructing a high road fill embankment on saturated soft clay, reduce surcharge time)
- the interception of over land / subsurface flows (e.g. cut-off drains)
- provision of suitable drainage outlet for the system (e.g. natural by gravity force or mechanical pumps).

Application

The following issues will need to be considered in the adoption of a geocomposite drainage system in road construction works:

- The material has the required strength to withstand the design load to ensure that the system will maintain its effectiveness during its design life (e.g. increase of earth pressure with depth and traffic loading).
- The relationship between flow rate, hydraulic gradient and the normal pressure to the drainage system would need to be carefully considered so that the effectiveness of the system does not reduce with time (e.g. if used as a pavement drainage blanket or a drainage layer behind a abutment fender wall).
- Long-term flow capacity of a geocomposite is directly related to the compressive creep behaviour of the geo-synthetics which are made of polymeric materials. These materials tend to creep with time. As a result, a reduction of permeability during the design life of the system is a possibility (e.g. typically 100 years for structures).
- The drainage layer is normally very thin, 10 to 50 mm, when compared with conventional permeable filling. Therefore, performance of the system is very sensitive to installation. Appropriate specification should be provided for installation of such drainage system.
- In addition, care should be undertaken to minimise potential damage to the system during construction (e.g. compaction of soil adjacent to the drainage layer and construction traffic).
- Consideration should be given to replace the geocomposite drainage system with a conventional drainage system with permeable filling, if the construction environment is likely to pose an unacceptable risk of damage to the geocomposite materials.

SELECTION CRITERIA FOR A GEOCOMPOSITE DRAINAGE SYSTEM

There is a wide variety of geocomposite drainage systems available from a number of manufacturers. The following criteria need to be considered in the selection of a geocomposite drainage system:

- maximum normal pressure on the geocomposite layer
- transmissivity (i.e. relationship between hydraulic conductivity, flow rate, volume and loads)
- strength of the geocomposite system to span over weak material
- the durability of the material and effectiveness with time (e.g. chemical and biological degradation, creep and elongation when the material is subject to the design loads)
- potential clogging from deposition of fines
- the availability of natural permeable filling material.

All these factors indicate the importance of considering the difference between geocomposite and natural permeable drainage materials in design. It is recommended that a geotechnical/hydro-geological specialist with appropriate experience should be consulted when selecting a geocomposite drainage system as an alternative drainage system.

REQUIREMENT FOR TESTING

Samples of each batch of the geocomposite material supplied to a construction site should be tested in accordance with appropriate Australian Standards (AS3706 series). Test results obtained under the ASTM D6574 may provide an indication of the transmissivity property of a geocomposite system. Strength of drainage cores should be tested under ASTM DG244 and AS2439 for crush strength testing. VicRoads Standard Specification Section 210 Geotextiles in Earthworks also covers the requirements for the supply, handling and placing of geotextiles as a separation layer, or as a separation and filtration layer, in earthworks. In addition, reference to subsurface drainage systems may be obtained from VicRoads Standard Specification Section 702.

REFERENCES

1. *ASTM D6574 for determination of transmissivity*
2. *ASTM 6244 Vertical Compression of Geocomposite panel drains.*
3. *Australian Standards AS 3706 (Series) – Geotextiles – Methods of test*
4. *VicRoads Standard Specifications for Roadworks and Bridgeworks – Standard Section 210 – Geotextiles in Earthworks*
5. *VicRoads Standard Specifications for Roadworks and Bridgeworks – Standard Section 702 – Subsurface Drainage*

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