Utilization of Geosynthetics with Used Vehicle Tyres to Cater for Disposal of Drainage

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ABSTRACT: In the free draining sandy conditions of Western Australia the disposal of storm water drainage "run-off" from residential areas is normally catered for by an open retention basin contained within a fenced enclosure. This paper will provide a case history of a project combining 20,000 used vehicle tyres, geotextiles and geogrids to create an underground storage medium.

1 INTRODUCTION

Since their introduction over 30 years ago drainage sumps have evolved into a proven method for the disposal of storm water drainage run off from residential areas. The modern day Local Authorities in Western Australia are generally not in favour of drain sumps as they must be fenced off for safety, and the general eyesore they create, not to mention the area of land they consume. With this in mind Engineers at the City of Belmont decided to create an underground storage medium. This simply involves creating voids in the ground and backfilling with soil.

2 CONCEPT

To cater for storm water drainage run off covering an area of 70,000m², with a run off coefficient of 0.3, Engineers designed a sump with a capacity of 2,800m³.

Conventional drainage media would have resulted in an enormous cost to the project. In order to be cost effective it was decided to adopt the method of utilising used vehicle tyres supplied free of charge by the tyre distributors.

3 GEOTEXTILE CONSIDERATIONS

The first area of investigation started with the examination of the soil characteristics. These showed a soil type of clayey sand having an effective grain size of (D Ten) 0.05, avoids ratio of 0.38 and a permeability rate of 0.26 m/day. The soil classification pointed to the use of a geotextile envelope to:

1. Prevent the migration of fine particles into the main body of the drainage media.
2. Have sufficient robustness to resist tearing from any protrusions from the tyres, eg steel.
3. To act as a separator between the soils and the tyres.

A non-woven needle punched geotextile was selected exhibiting the following characteristics:

Trapezoid tear strength 260/260 newtons.
G rating - >1350 robust
Pore Size - >230 microns
Flow rate - > 454 litres/m²/sec

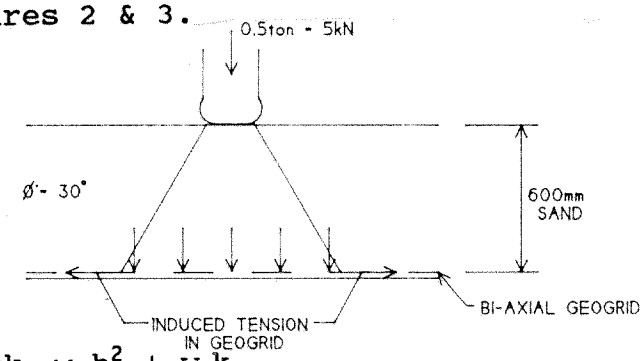
Refer Figure 1.

Fig. 1 Geotextile envelope around tyres

4 GEOGRIDS CONSIDERATION

In order to minimise differential settlements and increase the tensile capacity of the 600mm thick sand layer covering the sump. A biaxial geogrid was chosen to perform this function. When granular material is compacted over the geogrid it partially penetrates and projects through the apertures creating an interlocking action between the stone and the grid. This interlocking action enables the grid to resist horizontal shear from the fill and thereby mobilise the maximum bearing capacity of the formation.

The geogrid has to provide support for vehicles up to a maximum weight of 1 tonne. Refer Figures 2 & 3.



$\sigma h = \frac{1}{2} k_a \gamma h^2 + w_s k_a$

$= \frac{1}{2}\frac{(1-\sin 32)}{(1+\sin 32)} \times 18 \times 0.6^2 + 5 \times \frac{(1-\sin 32)}{(1+\sin 32)}$

$= 1.1 + 1.7$

$= 2.8kN$

Load at 2% strain is 6.0kN, therefore, this satisfies design criteria

Fig. 2 Loading Effect on Geogrid

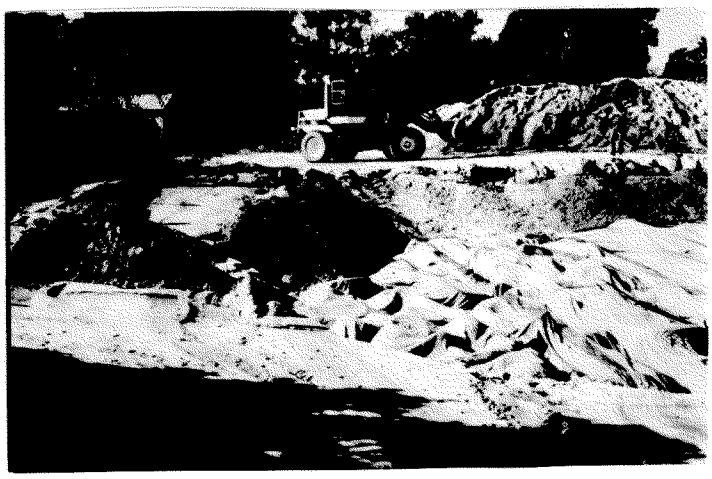


Fig. 3 Geogrid Installation

5 CONCLUSION

The construction of an underground storage medium incorporating used vehicle tyres has created a keen interest amongst Western Australian Engineers by providing an environmentally cost effective solution.

6 REFERENCES

"Tensar Geogrids in Civil Engineering" a guide to the products and their applications., Netlon U.K. 1993

PC Sump user Guide version 1.0., January 1990., Main Roads