GEOfabrics™

Technical Report

Shear box testing summary: geosynthetic materials intended for use in geomembrane protection applications.

Carried out at: Nottingham Trent University

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Tests carried out on polypropylene and polyethylene geotextiles/geomembrane interfaces with different cover soils.

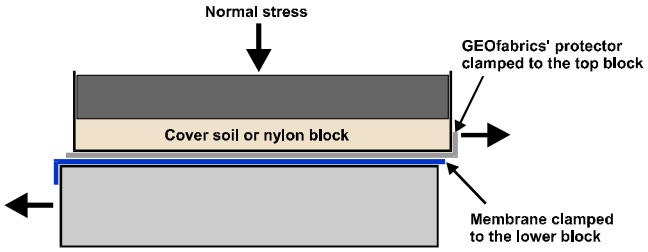
Objectives:

To provide a laboratory-based figure for the angle of friction between needlepunched non-woven, staple fibre geotextiles and various types of geomembrane, and note any characteristics of slippage. This is to help designers to have an initial starting point when designing these interfaces.

Methodology:

Test Parameters:

- 400mm x 300mm shear box
- Normal stresses used 25, 50, 100 and 200kPa
- Constant shearing rate of 3.00 mm/min
- The geomembrane was placed on a wooden or nylon block and clamped to the lower block
- The geotextile was clamped at one end to the top box
- Tests carried out in dry conditions



Materials used:

Typical materials commonly used in UK landfills were selected:

- **HPS7** geotextile protector – **polypropylene (PP)** needlepunched, non-woven staple fibre
- **HPS12** geotextile protector - **polypropylene (PP)** needlepunched, non-woven staple fibre
- **GP141** geotextile protector – **polyethylene (PE)** needlepunched, non-woven staple fibre
- 2mm high density polyethylene (HDPE) double smooth geomembrane
- 2mm high density polyethylene (HDPE) co-extruded double rough geomembrane (Textured CO)
- 2mm high density polyethylene (HDPE) sprayed-on double rough geomembrane (Textured SO)
- Fine to medium gravel

Results:

GEOfabrics' protector	Geomembrane	Cover material	Peak		Large displacement	
			δ	α	δ	α
HPS7	smooth	nylon block	7.2	1.7	5.7	0.6
	textured CO	fine to medium gravel	24.5	5.9	10.7	2.2
	textured CO	nylon block	16.3	6.8	9.7	3.8
	textured SO	fine to medium gravel	25.6	17.5	10.5	5.8
	textured SO	nylon block	-	-	-	-
HPS11	smooth	nylon block	6.8	0.8	5.0	0.0
	textured CO	fine to medium gravel	25.9	3.8	11.5	2.7
	textured CO	nylon block	16.0	3.0	-	-
	textured SO	fine to medium gravel	24.7	15.2	10.0	5.8
	textured SO	nylon block	20.7	3.2	14.4	2.0
GP141	smooth	nylon block	8.7	-0.3	6.2	-0.3
	textured CO	fine to medium gravel	26.3	5.4	14.3	3.8
	textured CO	nylon block	18.0	9.7	11.0	5.7
	textured SO	fine to medium gravel	27.4	13.8	14.2	6.5
	textured SO	nylon block	20.4	5.2	16.4	2.9

Observations:

- Peak loads reached very quickly on smooth membrane within 0.5mm or less
- Roughened HDPE has a *Velcrow* effect - when movement does take place there is a combing effect on the surface of the geotextile

Discussion:

- These tests are on-going and further work is being carried out with different cover soils and in wet conditions. Please contact GEOfabrics Limited for further information.
- The tests are *worst-case* scenarios as the area tested is relatively small and completely flat. On site there will be an undulating or light rippling effect, which will add to the friction angles.
- For initial estimates we suggest a design angle of friction 10^0 maximum for PP needlepunched, non-woven, staple fibre geotextiles against a smooth membrane and 22^0 against a roughened membrane. It is strongly recommended that site specific shear box tests are carried out.
- There does not seem to be any noticeable difference between PE and PP geotextiles.
- As PE geotextiles are considerably more expensive, and there is no obvious chemical resistance advantage (see leachate immersion report), we conclude that PP geotextiles are the preferred option.

Acknowledgements:

It should be noted that this work was carried out by Dr Neil Dixon (Loughborough University Civil Engineering Department) along with Dr Russell Jones of Golder Associates, Nottingham. These gentlemen have co-authored papers giving a comprehensive analysis of the including the additional variables mentioned above. GEO*fabrics* wish to thank Dr Dixon and Dr Jones for their permission to publish these results.