

Geomembrane Protection Efficiency



Warren Hornsey Pr. Eng.

TRI Australasia Pty Ltd, Gold Coast, Australia



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- * Strain Measurement Comparison

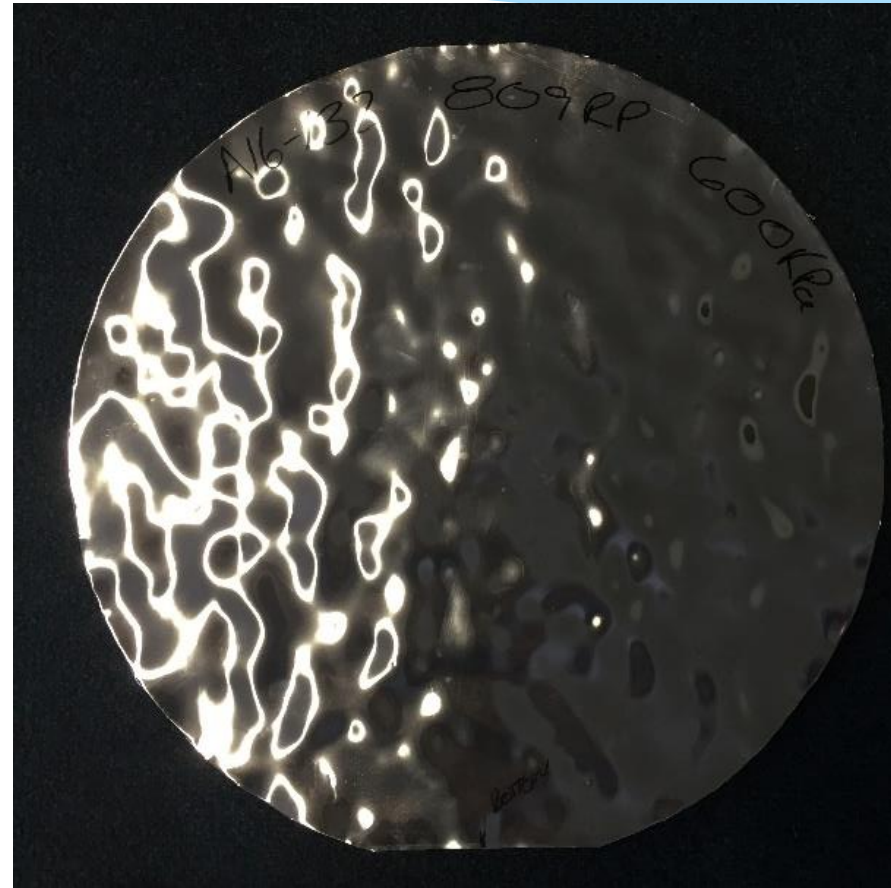
- * Conclusions
 - * What you need to know when specifying

Introduction

- * Protection geotextiles are not new
- * There can be multiple inputs
- * Test methods vary
- * Analysis techniques vary

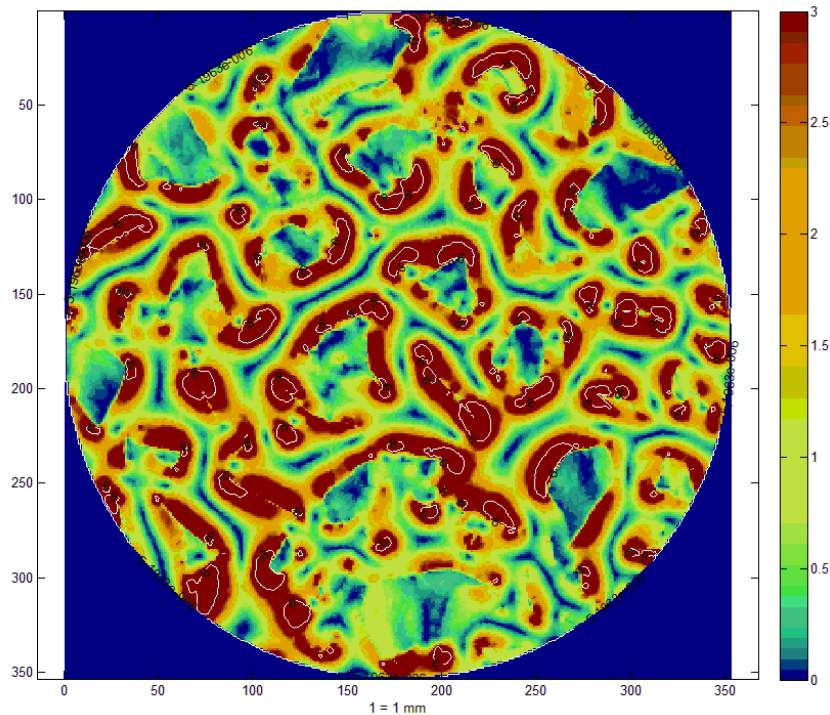
Introduction

- * Geotextiles do reduce strain

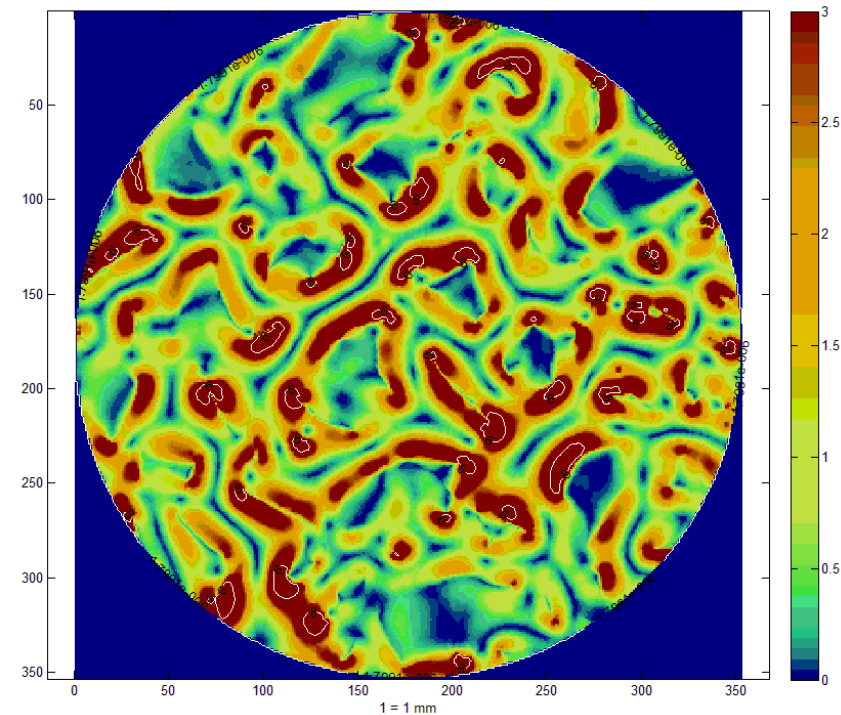


Introduction

- * Graphical Output
- * Strain Distribution

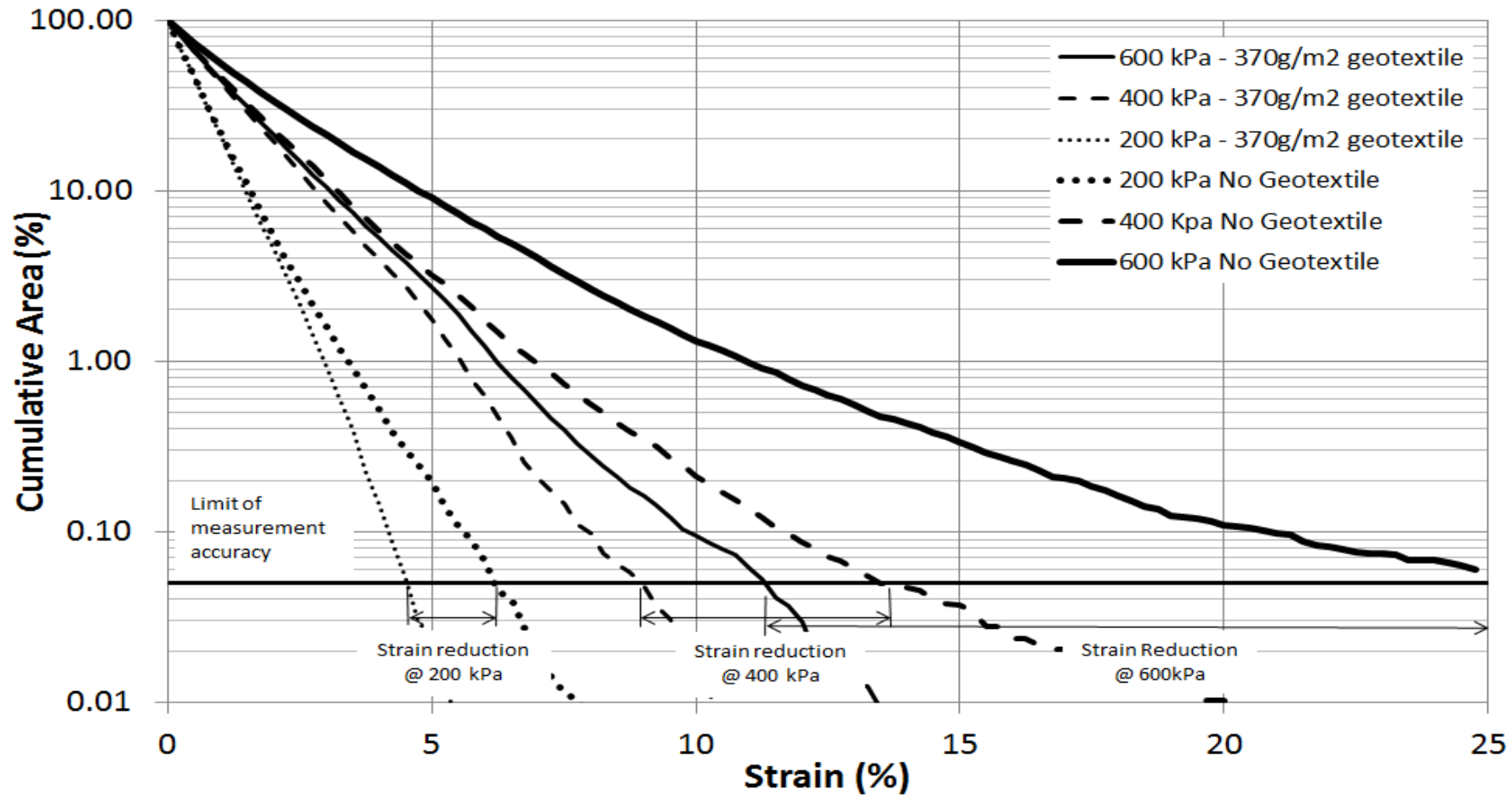


No geotextile protection



370g/m² Geotextile protection

Introduction



Introduction

- * Testing
- * The results depend on a number of variables which are built into the tests
 - Gravel
 - Geotextile
 - Subgrade
 - * Rubber or Clay
 - * GCL (level of hydration)
 - Recording plate
 - * Position
 - * Materials
- * Good science = limited variables

Europe vs. America

THIS IS IMPORTANT

- * European philosophy
 - * Stain limitation
 - * As close to zero as possible
 - * 2000 – 3500g/m² geotextile
- * American philosophy
 - * Puncture limitation
 - * Strain is not an issue
 - * 250 – 400g/m² geotextile

Different Resins used!

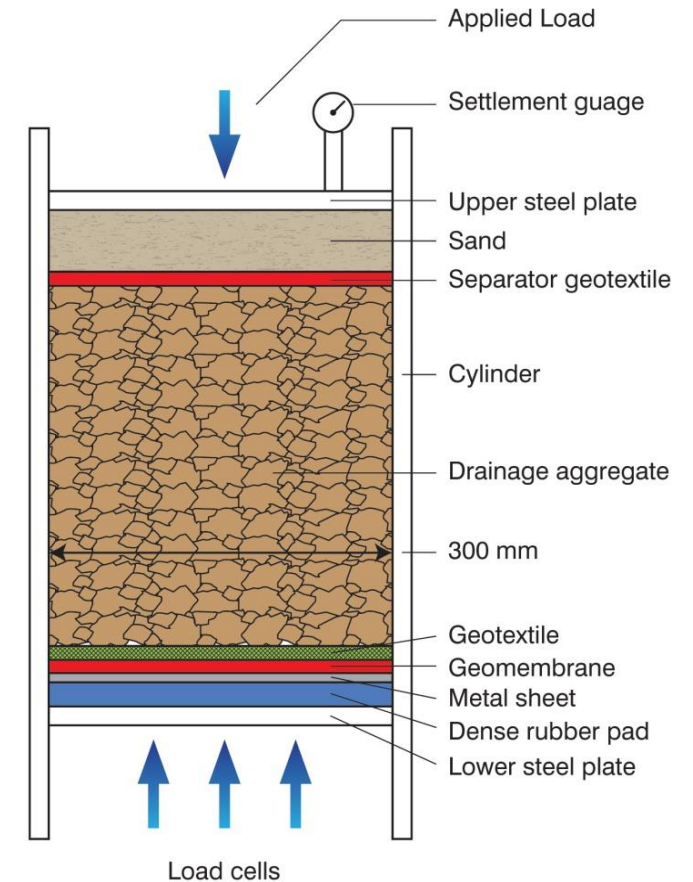


Standard Test Methods

- * EN 13719 (2016): Geotextiles and geotextile related products - Determination of the long-term protection efficiency of geotextiles in contact with geosynthetic barriers.
- * LFE 2 - Cylinder testing geomembranes and their protective materials
- * ASTM D5514-06 (2011): Large scale hydrostatic puncture testing of geosynthetics

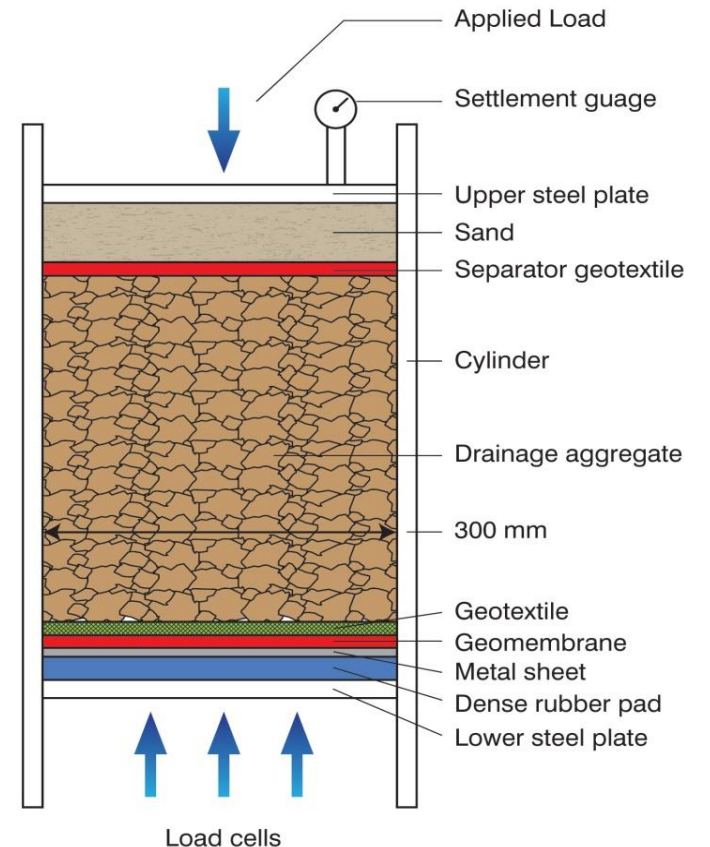
Method Comparison - European

- * EN 13719 (2016)/LFE 2
 - * 300mm dia
 - * Rubber base
 - * 1.3 mm lead recording plate
 - * Readings at 3mm intervals
 - * 5 indentations measured
 - * Worst 3 reported



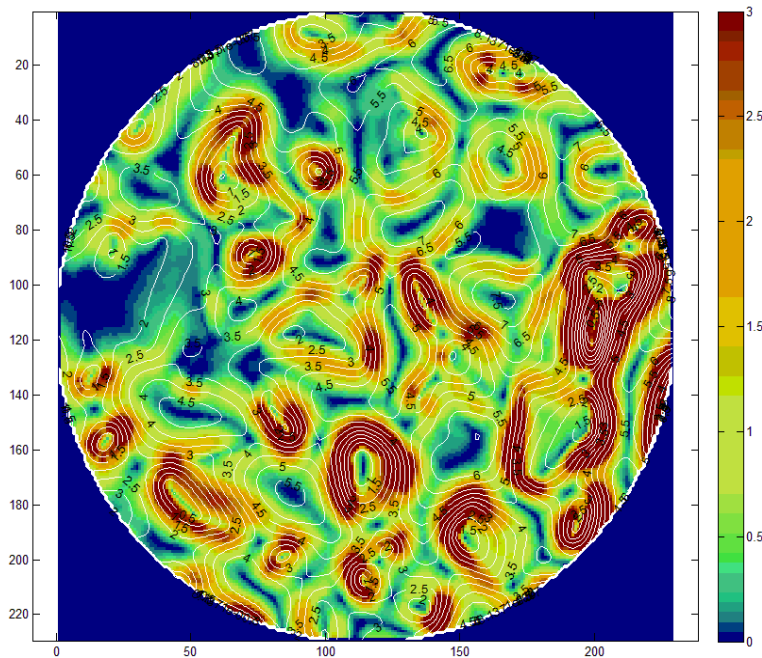
Method Comparison - European

- * EN 13719 (2016)/LFE 2
- * Advantages
 - * Test setup allows the influence of the sub to be assessed.
 - * Loose gravel layer allows deformation of drainage aggregate
- * Limitations
 - * Profile changes with each test.
 - * The rubber subgrade.
 - * limited area.
 - * Manual selection of points analysed.
 - * Limited number of measurement points.

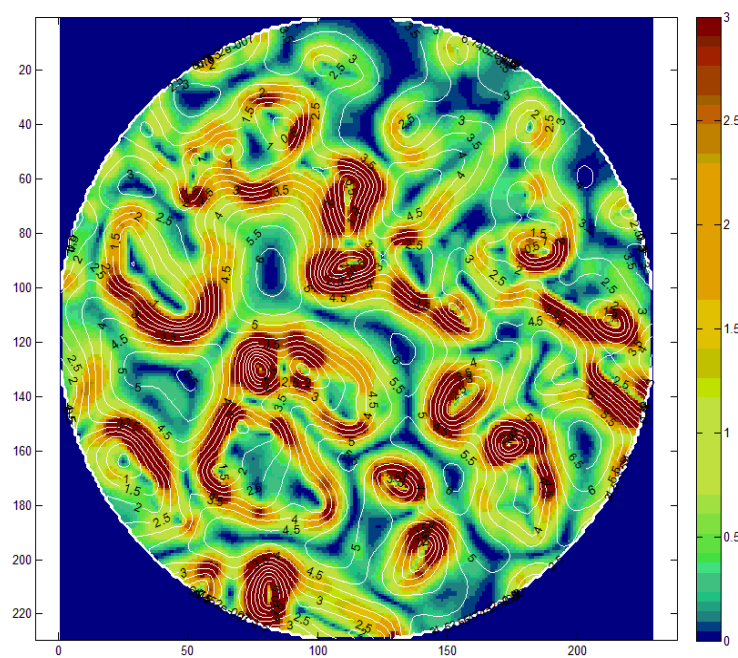


Method Comparison - European

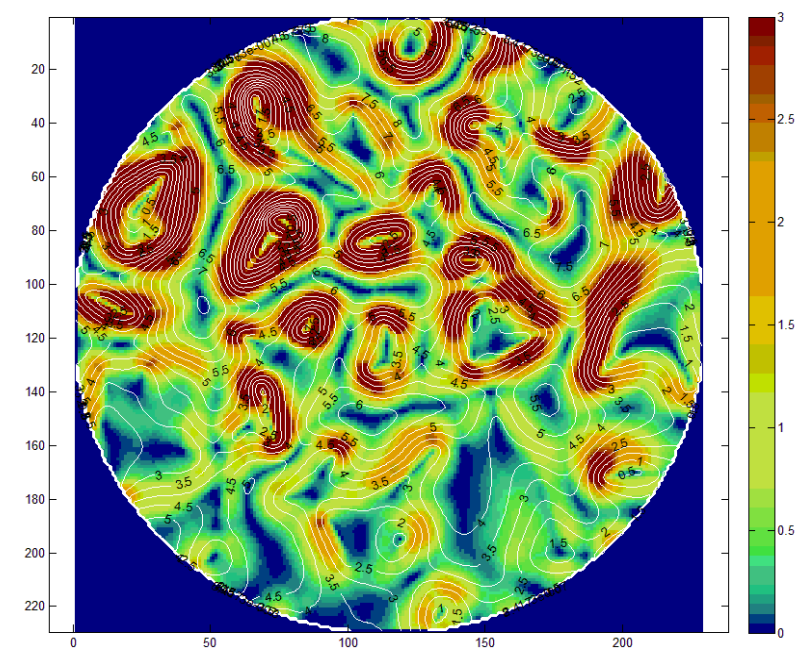
- * Profile changes with every test
- * Are you analysing the geotextile or the change in rock profile



Max Inc. Strain 13.97%



Max Inc. Strain 9.98%



Max Inc. Strain 15.41%

Method Comparison - European

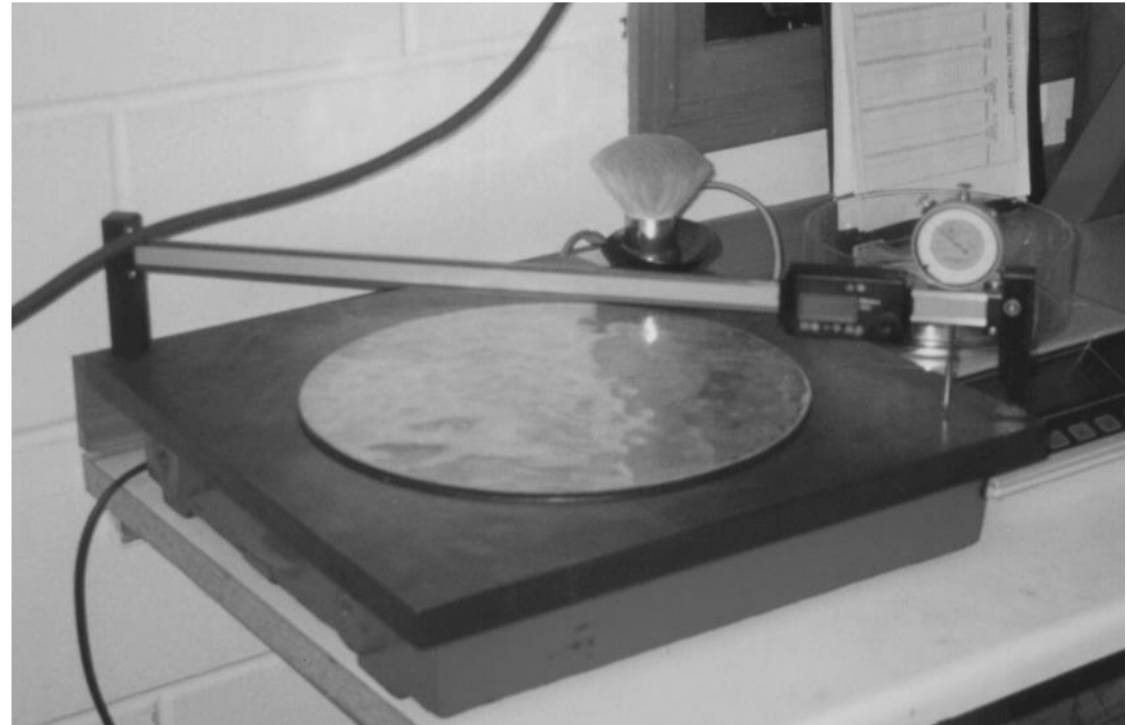
- * Rubber subgrade
 - * 25mm thick
 - * Shore hardness 45 – 55A
- * Does it represent a CCL?



Method Comparison - European

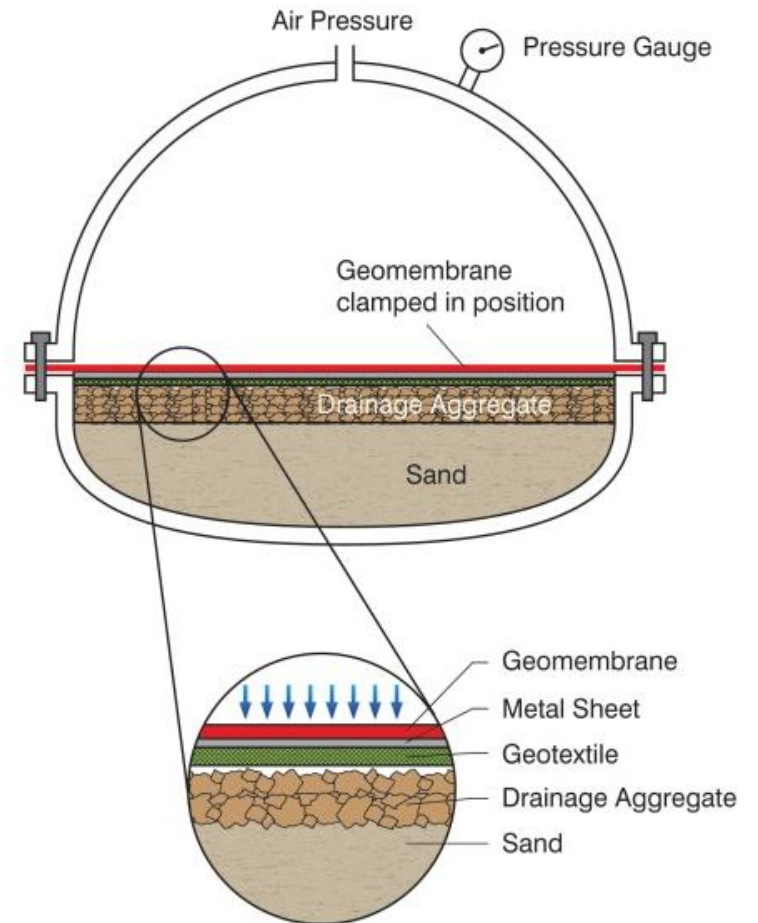
- * Selection of worst deformations is subjective

3.2% strain



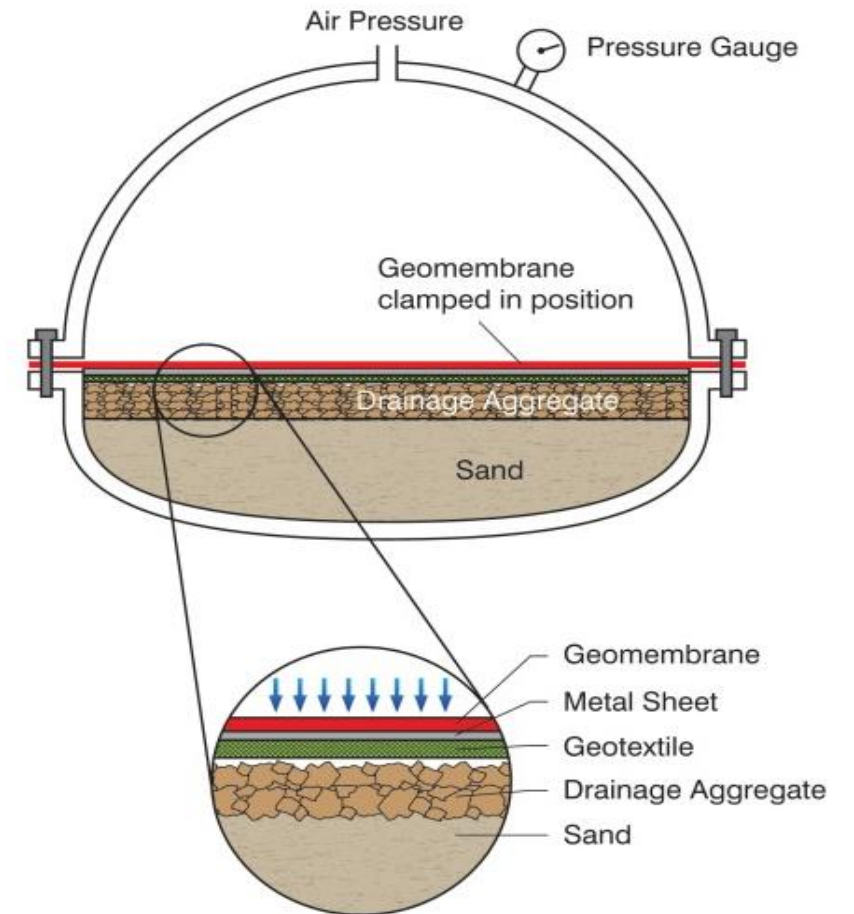
Method Comparison - America

- * ASTM D5514-06 (2011):
 - * 450mm dia.
 - * Inverted profile
 - * 0.5 mm organ pipe recording plate

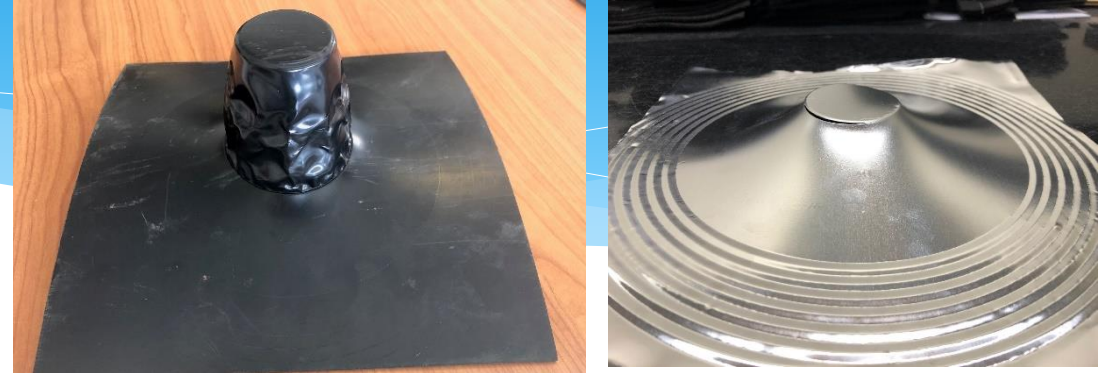


Method Comparison - America

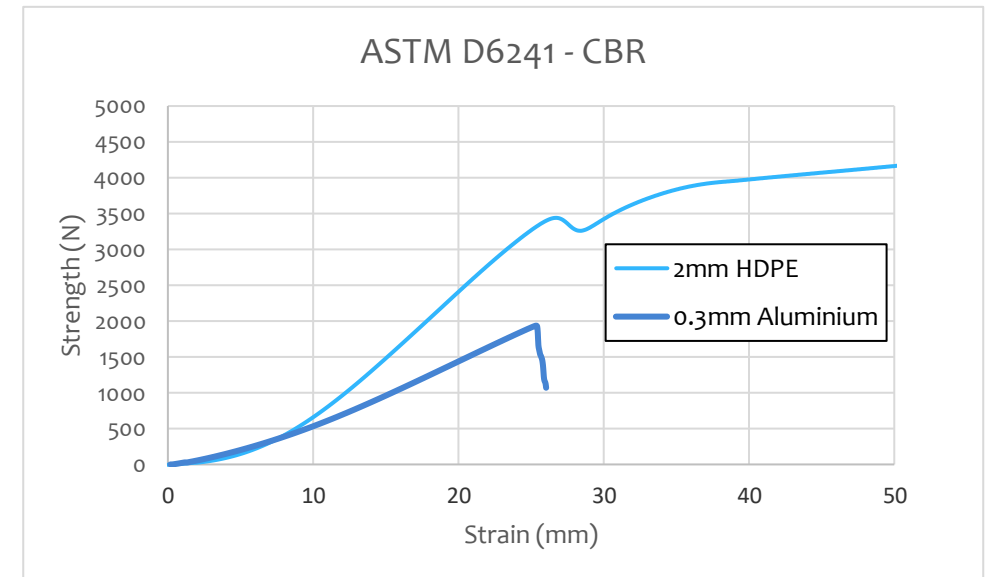
- * ASTM D5514-06 (2011):
- * Advantages
 - * Simple test assembly.
 - * Repeatable testing .
- * Limitations
 - * Placement ≠ site
 - * No influence of subgrade (conservative)
 - * Stain calculation
 - * Method A Influence of consolidation of subgrade
 - * Method B High strains
 - * Method C Low strains



Strain Measurement - Australia

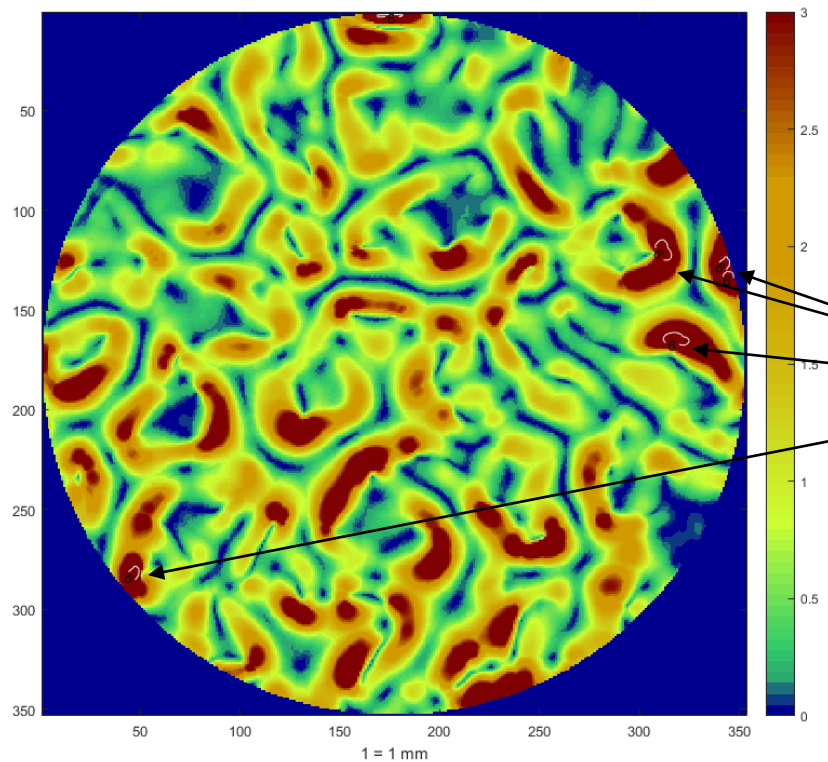


- * 0.3mm aluminium
- * Overlapping passes of the scanning device
- * > 200,000 points measured
- * Accuracy 0.009mm
- * Outer 50 mm removed – edge effects



Strain Interpretation

- * Strain image
 - * Highlights strains across surface

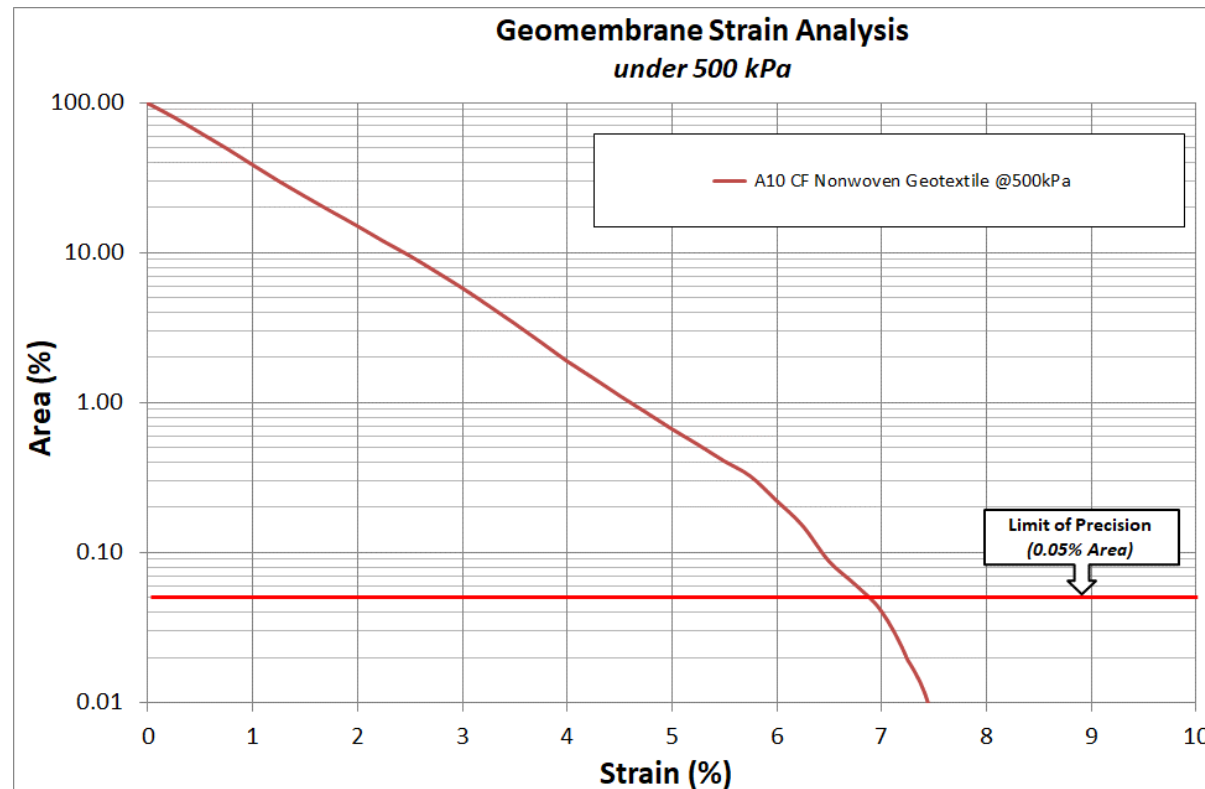


Multiple points where strain exceeds 3%

Multiple points where strain exceeds 6%

Strain Interpretation

- * Strain graph
- * Based on total area



Method Comparison – USA/AUS

Australian Methodology

- * Fixed gravel profile
- * Inverted
- * As built
 - * Subgrade
 - * GCL – Hydrated or not
 - * Compacted clay subgrade
- * Strain Measurement – Laser scanning
 - * *Development of a methodology for the evaluation of geomembrane strain and relative performance of cushion geotextiles.*

Method Comparison – USA/AUS

- * Gravel placement
 - * Gravel tends to fall with flat side down
 - * Standard creates a very aggressive profile
 - * Unrealistic
 - * OK if all you want to measure is puncture



Method Comparison – Australia

Gravel “Pizza”

- * Manufactured to mimic construction
 - * Multiple layers of resin
 - * Gravel
 - * ± 10mm Silicone
 - * Geotextile
- * Remove silicone
- * Grind resin filling voids

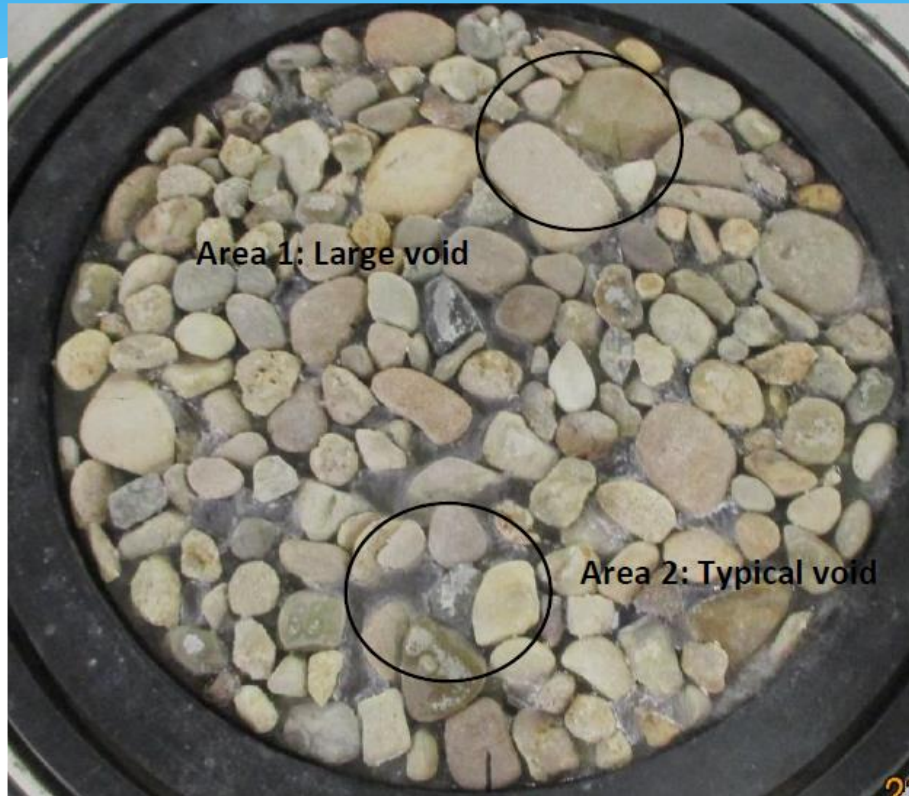
- * Concerns / Limitations
 - * Fixed profile doesn't allow rock to move
 - * Rock can break down with multiple uses



Method Comparison – Australia



Method Comparison – Australia



Method Comparison – Australia

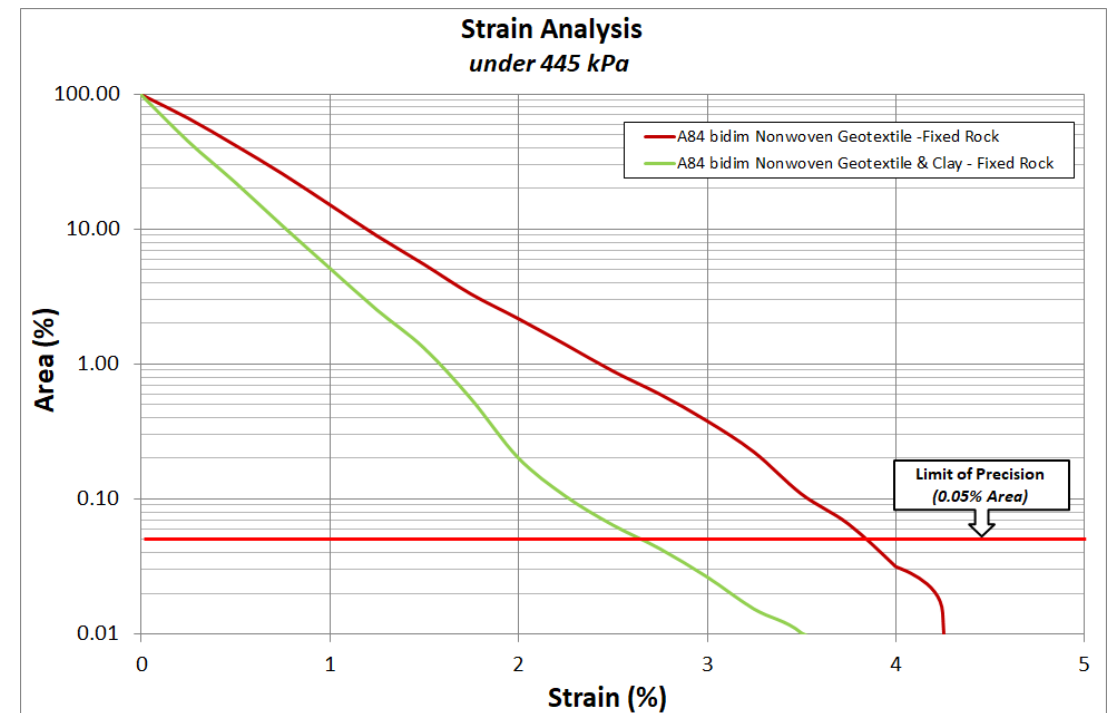
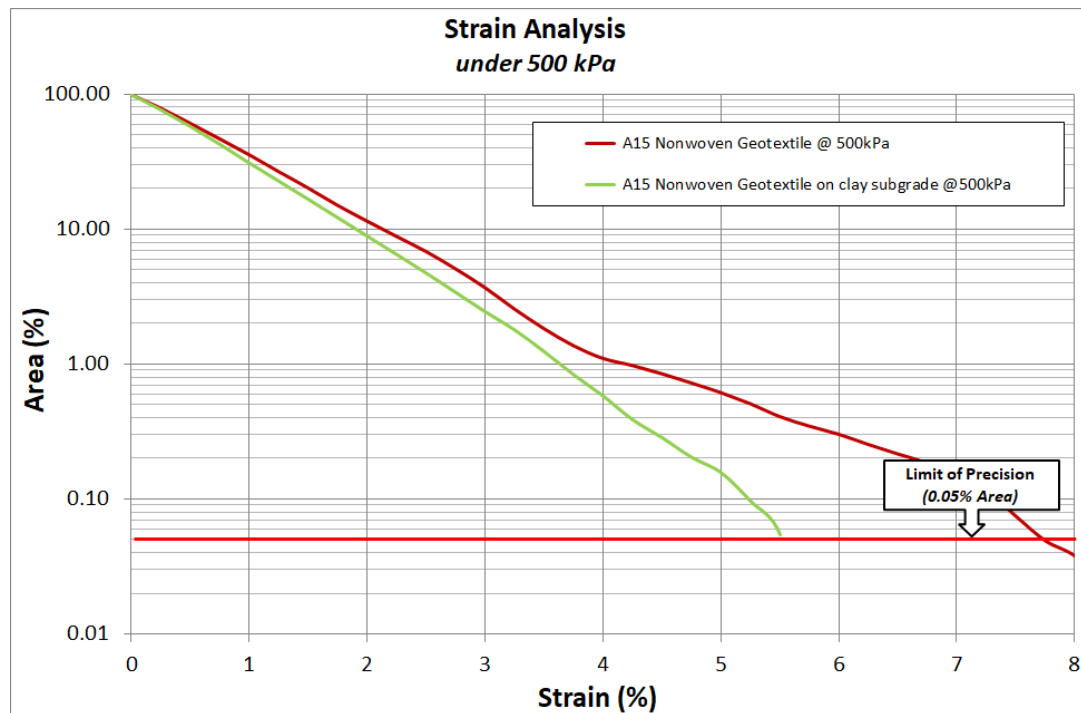
Compacted Clay Liner

- * Condition clay to OMC
 - * MC can have significant impact on compressive strength
- * Compact in 3No. 25mm layers

- * Concerns / Limitations
 - * Apply final load on an unconsolidated clay
 - * No drainage path for clay
 - * Load applied very quickly

Method Comparison – Australia

- * Subgrade has a significant influence
- * Clay characteristics are very important



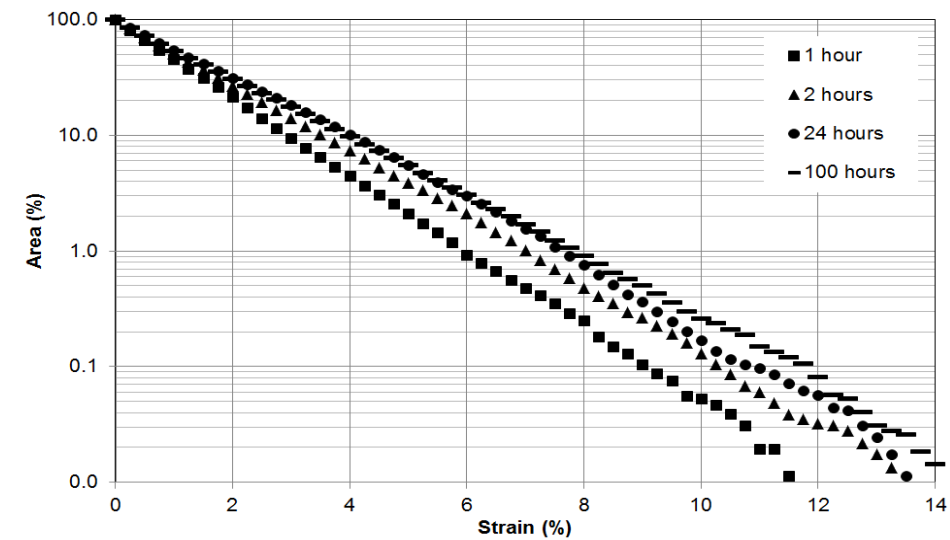
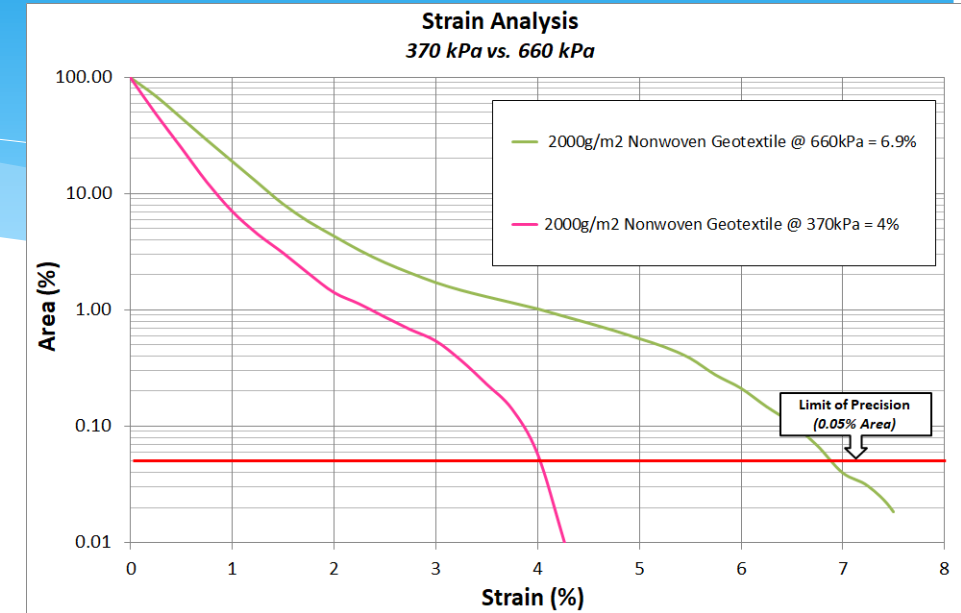
Method Comparison – Australia

- * GCL Subgrade
 - * Hydration has a significant impact
 - * 24 hours under 10kPa (>100% MC is it realistic)
 - * 24 hours under 25kPa (>80% MC)
 - * 50% moisture content = firm subgrade

Test Specification

- * Loads
 - * Use design height
 - * Double load = \pm Double strain
 - * Use accurate waste density
- * Duration
 - * 24 hours is adequate
- * Temperature
 - * Temperature vs. stress relaxation

This is a rapid test it does not allow for consolidation of subgrade during fill placement or stress relaxation due to temperature



Geotextile specification

- * Needle Free!!!
 - * None of what we have talked about matters if the geotextile contains needles
 - * If the supplier cant certify needle free don't use them



Conclusions

- * The method used will influence strain results reported.
- * The Lower the strain the lower the difference
- * HDPE in USA since 1982 (37 years)
 - * Strains approx. 11%
 - * No documented failures due to NCTL
- * NCTL has increased by 2 to 2.5 times
- * There is a limit to how much protection a geotextile can provide.
 - * Sand protection is the next step (> 150mm)



Thank You For Your Attention!

W.P. Hornsey

TRI Australasia Pty Ltd, Gold Coast, Australia