Rapid 3D Prototyping of Geosynthetics

School of Civil and Building Engineering
Loughborough University

Work is being carried out at Loughborough University, UK to develop rapid 3D prototyping techniques for geosynthetics, based on state of the art rapid 3D prototyping processes. The rapid 3D prototyping process allows for designing textured geomembranes for specific projects with improved shear strength at the shearing interface on steep slopes. The project brings together a long history of geosynthetics research at Loughborough and close collaborations with the industry.

Advanced Textured Geomembranes

Using Rapid 3D Prototyping Techniques researchers and designers can propose and manufacture textures specifically to achieve the shear strengths required for stability.

This gives much greater freedom to explore differing geometric layouts before committing to full scale production, reducing time and cost of development.

Rapid 3D Prototyping Techniques

- Additive Manufacturing — Selective Laser Sintering (SLS)
- Subtractive Manufacturing — Laser Thermal Ablation (LTA)

Selective Laser Sintering (SLS)

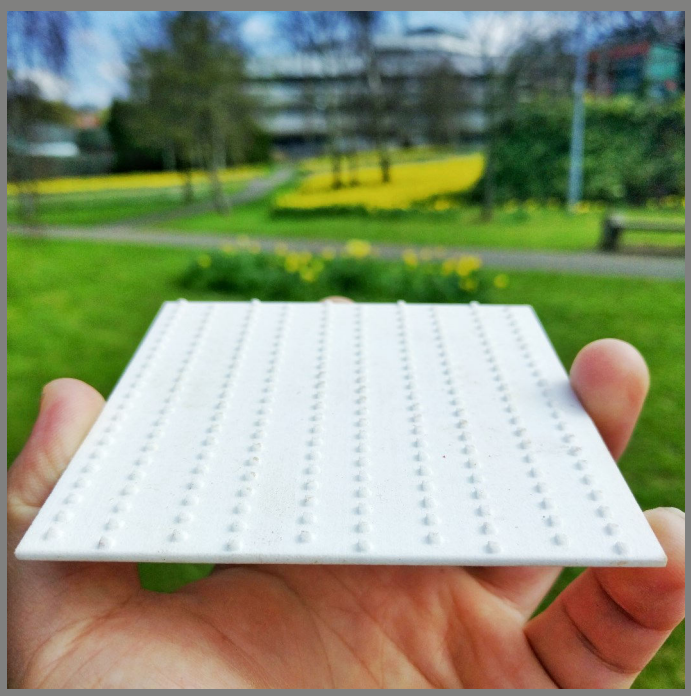
Laser Thermal Ablation (LTA)

The Selective Laser Sintering (SLS) process is a rapid additive manufacturing process in which a rigid structure is formed from micro- and/or nano-particle powders through the sintering effect, allowing construction of 3D polymeric shapes with limitless possibilities.

The research team have utilised both extruded models where plastic is extruded and built up in layers and SLS.

The advantages of using this method are as follows:

- Rapid prototype
- Complex 3D structure capable



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For more information contact Dr Gary Fowmes, Loughborough University, UK
[g.j.fowmes@lboro.ac.uk]

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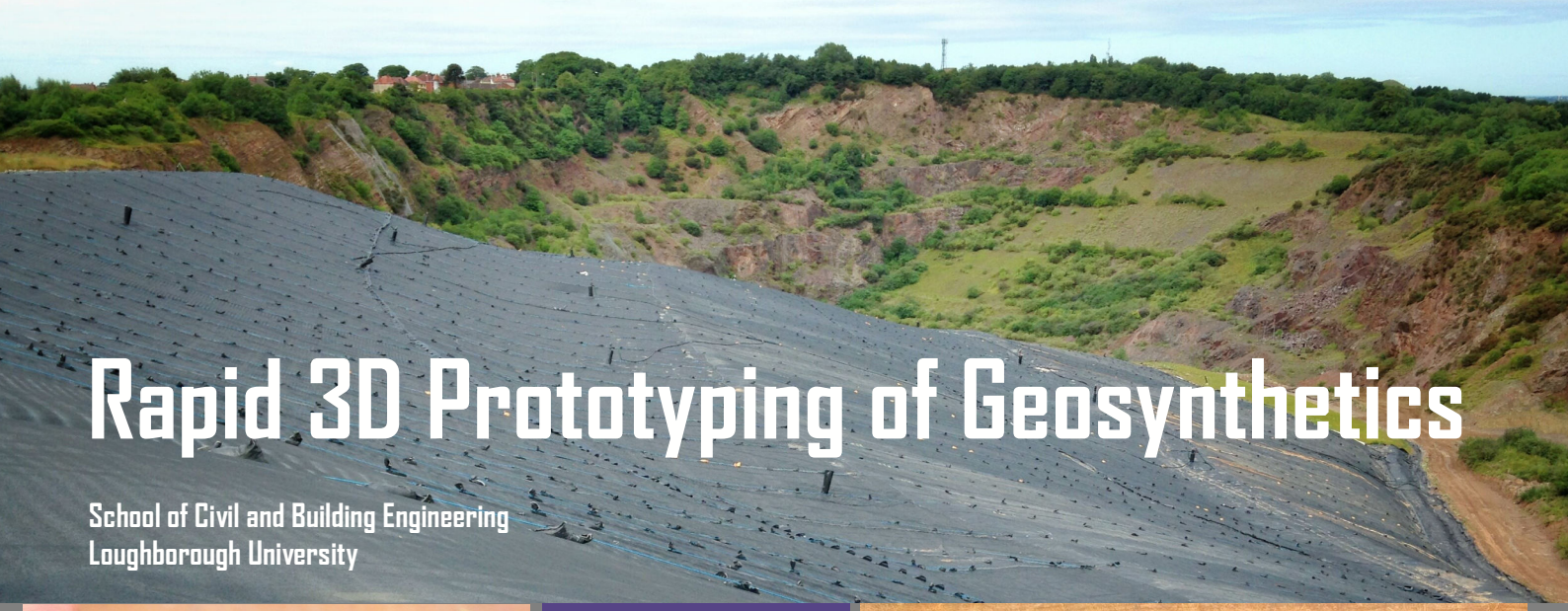

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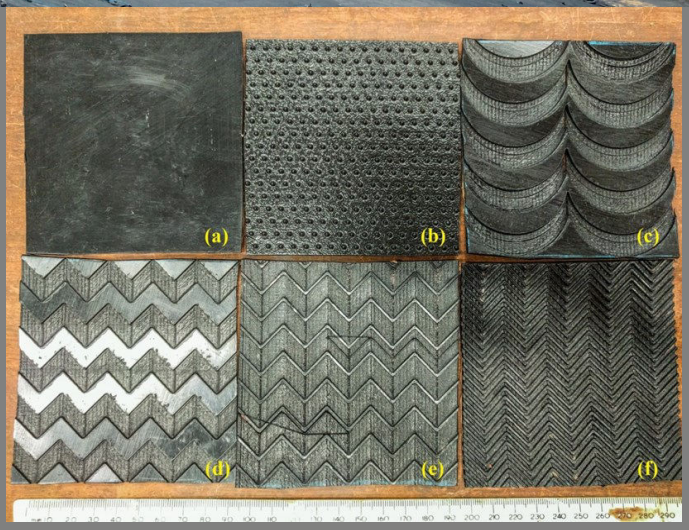
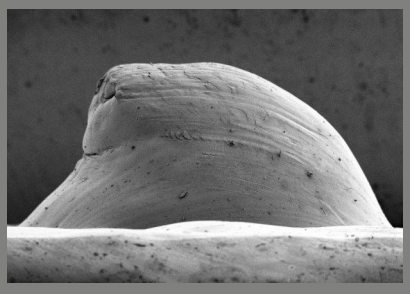
In a Laser Thermal Ablation (LTA) process, unwanted material is eliminated through the photo-thermal ablation effect. The patterns are "carved" into the top of smooth HDPE geomembranes.
This process offers some big advantages such as:

- Rapid process on existing material
- Cheap running cost

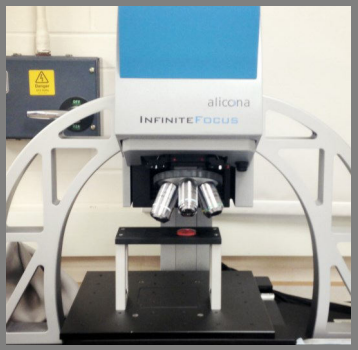


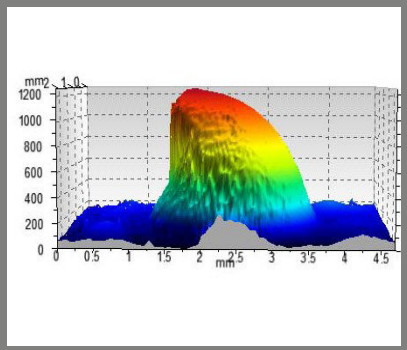
Rapid 3D prototyping samples are measured and analysed using Loughborough's state of the art metrology equipment. This includes sample's spatial analysis of internal structure by a Scanning Electron Microscope (SEM), as well as the sample's morphological study by a laser-based interferometer.



SEM measurement to investigate sample's internal structure

The shearing strength of geomembrane prototypes are tested using state of the art direct shearing apparatus at Loughborough University. The sample is sheared with a 300x400 mm fully automatic large shear box apparatus.





Interferometry analysis to investigate sample's surface morphology

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