Geosynthetics for sustainable cities: 3D models and mechanical damage

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Why Geosynthetics?

Figure – Geogrid for pavement reinforcement

Geotechnical Structures

Infrastructure demand is a major global challenge. Geotechnical Engineering is relevant not only for foundations of buildings, but also roads, bridges and even mining, coastal and offshore applications.

Geosynthetics

Geosynthetics are often the most efficient, cost-effective and environmentally-friendly solution to a variety of earthworks, contributing to SDG goals 9 & 11.

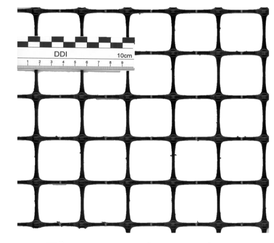

Figure – Geogrid

Geogrids

Used in reinforcement and stability. The apertures promote the interlocking of granular particles and significantly improve soil stability. Used in roads, railways, embankments, dams and more.

Figure – Geotextile

Geotextiles

Major applications are separation, reinforcement and filtration. Improving the performance of soft soils and/or acting as basal reinforcement. Used in landfills, railways, piles, mine integrity and more.

Experimental & Numerical Program

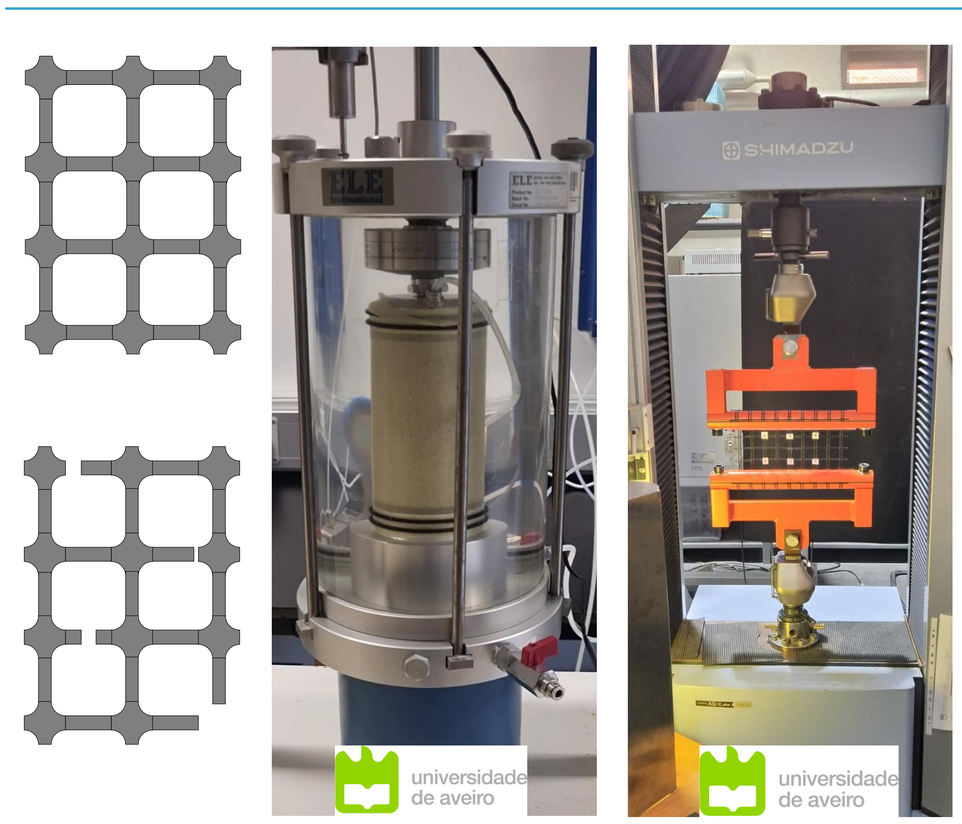

Figure – Mechanical damage (left), triaxial test (middle), tensile test (right)

In-isolation Tensile Tests

To understand the mechanical properties:

- Short-term
- Long-term

Soil-Geosynthetic composite response

To characterize the interaction:

- Perform triaxial tests
- Analyze pullout tests results

Mechanical damage

Parametric analysis on how the damage affects the performance of reinforcement

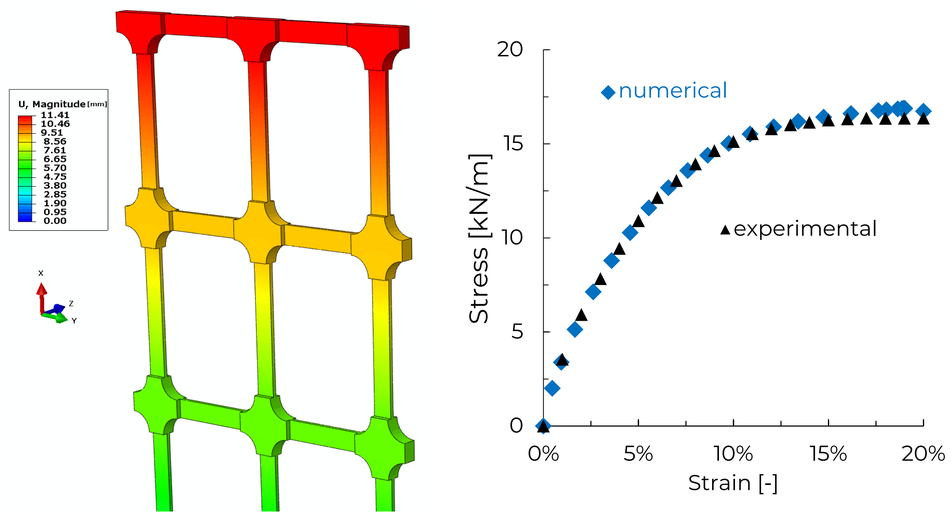

Figure – FEM tensile test first results

3D Models

Simplifications in geometric & mechanical properties often compromises the model. Improve analysis by employing 3D nonlinear models capable of capturing the exact geometry and response over space and time.

Next Steps

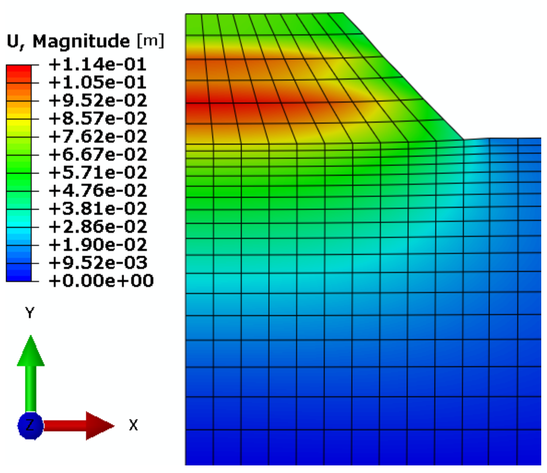

Figure – Settlement in reinforced embankment

Real Structures

Verify if calibrated models replicate the response of real structures. Promote the numerical analysis with nonlinear & time-dependent constitutive models.

Mechanical damage

Expand the current understanding of the synergetic effects of mechanical damage associated with installation and creep.

Highlights

- 3D numerical modelling with exact geometry.
- Advanced constitutive models considering nonlinear stiffness, strain softening, creep and direction dependency.
- Backed by experimental results.
- Assess ultimate and serviceability response of undamaged and damaged reinforced structures.
- Contribute to a better use of both geosynthetics and soil resources.

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