Topic 4: Hydro-Mechanical Coupling: Does Geogrid Orientation Alter Soil Water Retention?

Preliminary research question: How does geogrid orientation alter the soil water retention curve and suction dynamics in unsaturated earthworks?

Background & Motivation

Geogrids are standard components in reinforced earth walls, bridge abutments, and embankments. While their tensile reinforcement is well-understood, their influence on fluid flow and soil suction in the unsaturated zone remains largely unmapped. Depending on rib orientation, geogrids may act as moisture conduits, capillary barriers, or preferential flow paths, directly shifting the Soil Water Retention Curve (SWRC) and effective stress states.

Research Objectives & Methodology

1. **Experimental Setup:** Set up pressure plates, axis-translation apparatus, or sensors to measure SWRC for soil specimens.
2. **Anisotropy Testing:** Test specimens with embedded geogrids placed at different angles/orientations (horizontal, inclined, transverse relative to hydraulic gradient).
3. **Hydro-Mechanical Modeling:** Compare the experimentally obtained SWRC curves to predict unsaturated shear strength changes under varying weather/infiltration patterns.

What You Will Deliver

- A series of Soil Water Retention Curves demonstrating the exact hydraulic boundary effects introduced by geogrid geometry and orientation.
- A clear conceptual model showing whether geogrids induce preferential flow paths or moisture barriers in unsaturated earthworks.
- Practical guidance on geosynthetic placement in moisture-sensitive unsaturated structures.

Key Skills You Will Gain

- Unsaturated soil mechanics and suction measurement techniques.
- Testing hydraulic boundary layer interactions and retention properties.
- Hydro-mechanical coupling analysis.

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