

# Use of Geosynthetics in Roads to Enhance Resilience and Sustainability



Date: March 13, 2025

**Presenter:** Dr. Jie Han, Ph.D., P.E. (University of Kansas / University of Hawai'i at Mānoa)

**Host:** Dr. Tim Stark (University of Illinois at Urbana-Champaign)

---

## Key Concepts

### 1. Resilience vs. Sustainability

- *Resilience:* Infrastructure's ability to anticipate, adapt, and recover from disruptions (e.g., climate stresses).
- *Sustainability:* Balances environmental, social, and economic factors (e.g., recycled materials, reduced carbon footprint).
- *Synergy:* Geosynthetics enhance both by improving performance and enabling resource efficiency.

### 2. Climate Stresses on Roadways

- Issues: Moisture intrusion, freeze-thaw cycles, extreme temperatures.
  - Consequences: Rutting, cracking, potholes, subgrade weakening (e.g., expansive soils).
  - Case: SpaceX Starbase roads—damage in unreinforced sections; geosynthetic-stabilized areas performed well.
- 

## Geosynthetic Solutions

### 1. Geomembranes for Moisture Control

- Encapsulate expansive subgrades or protect geofoam from petroleum leaks.
- Oklahoma project: 20+ mil geomembrane over clay; eliminated seasonal swelling, reduced maintenance.

- California: Geogrid-reinforced recycled concrete aggregate (RCA) cut deformation by 50% with thinner layers.

## 2. Geogrids for Base Reinforcement

- *Mechanisms*: Lateral restraint of aggregates; load distribution reduces subgrade stress.
- Lab: Geogrids reduced RCA rutting by 30–60%.
- Field (Colombia): Equivalent performance with 6-inch thinner bases.

## 3. Wicking Geotextiles for Drainage

- Removes moisture via capillary action, maintaining subgrade strength.
- Kansas field study: 20–30% lower moisture content after 3 years; vegetation-free zones confirmed drainage effectiveness.

---

## Design and Economic Insights

- Mechanistic-Empirical design: Geosynthetics reduce permanent deformation (not resilient modulus).
- Cost-benefit: UN estimates 3% upfront cost increase yields 10× lifecycle savings.
- Multi-layer geogrids justified for base courses thicker than 14 inches.

## Challenges and Future Work

- Research needed on standardizing geosynthetic contributions in AASHTOWare Pavement ME.
  - Assessing long-term durability under UV and chemical exposure.
  - Emerging: 3D geocells for ultra-thin pavements.
-

## Conclusion

Geosynthetics mitigate climate vulnerabilities while promoting sustainability by:

- Using recycled materials (RCA, RAP).
- Reducing cross-section thickness (lower embodied carbon).
- Extending service life (fewer reconstructions).

**Next Webinar:** *Geosynthetic Caps for Leachate Reduction* (April 8, 2024).

**Materials:** Available at [www.thefgi.org](http://www.thefgi.org)

---

## Appendix

- Figures: Moisture profiles, rutting data, geomembrane installations.
  - References: Han & Yang (2023) *Geotextiles and Geomembranes*, Stark (2021) *Geofoam Guidelines*.
- 

This summary provides a concise academic overview. For detailed data, consult the webinar recording or contact Dr. Jie Han ([jiehan@ku.edu](mailto:jiehan@ku.edu)).

---