Stony Brook University

Department of Civil Engineering
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Doctoral Defence Announcement

Multiscale Assessment of the Thermo-hydro-mechanical Behavior of Saturated Earth Materials

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1207 Computer Science

Defense Committee
Dr. Sherif Abdelaziz, Advisor
Dr. Dilip Gersappe, Materials Science
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Abstract.
Earth materials are experiencing severe temperature variations triggered by natural and human-made factors including the intensifying climate changes, nuclear waste disposals, and other energy geo-structures. Accounting for temperature impacts on soils during the rehabilitation and design of the national infrastructure is vital to ensure high climate resiliency of these critical structures. Due to the lack of rigorous explanations for the temperature-dependency of soils' strength and deformation, current designs rely on large safety margins. Therefore, I focused my Ph.D. research on assessing and explaining the temperature impacts on saturated cohesive soils using a multiscale modeling and experimental approach. To achieve this goal, I designed a laboratory testing apparatus capable of assessing temperature effects on saturated soils. Results from laboratory testing suggest a different soil performance, in terms of strength and deformation, at different temperatures. To explain such temperature-dependency of soil behavior, I assessed the temperature impact on virtual soil samples, utilizing computer simulations that model the interactions between individual soil particles. By analyzing the forces and deformations of soil grains at different temperatures, I concluded that the soil behavior observed in laboratory testing arises from changes in the soil microstructure (e.g., orientation of the grains, and interparticle forces) induced by temperature changes. The outcomes of this research will allow the development of more robust thermo-mechanical constitutive models for cost-effective designs of the national infrastructure.