September 26, 2025

More Than Just Sand and Clay: A Deep Dive into Soil Cohesion and Friction

ABSTRACT: Cohesion and friction are the primary parameters used to characterize soil strength in the fields of soil mechanics and geotechnical engineering. However, their physical origins are oversimplified and understudied. In practice, these parameters are typically derived by empirically fitting laboratory data to the Mohr-Coulomb failure criterion, without a clear understanding of the underlying micromechanical processes they may represent. This seminar examines the fundamentals of shear strength at the grain scale, offering a deeper investigation into the mechanisms that bind soil particles together and govern their stability and resistance to shear-induced failure. Drawing on recent experimental research, including microfluidic observations of fluid-driven aggregate formation and stability, atomic force microscopy (AFM) measurement of aggregate strength, and characterization of interfacial forces of colloidal and granular systems, I will demonstrate how capillary forces, submicron and nanoscale particle bridging, and surface morphology influence both cohesive and tribological behavior in natural geomaterials. I will argue that cohesion and friction are not intrinsic material constants, but rather emergent properties governed by particle size, morphology, and interfacial mechanics. By examining these mechanisms through the lens of colloidal and granular physics and interface behavior, this talk aims to bridge the gap between simplified constitutive models and the complex micromechanical reality of soil strength, with implications for erosion, sediment and contaminant transport, liquefaction, slope stability, and offshore geotechnics.

Ali Seiphoori

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Seminar Details

Friday, Sept 26, 2025
2:30pm – 4:00pm

UH Campus
Classroom & Business Building
Room CBB 104

Online via Teams https://www.cive.uh.edu/research/beyer-distinguished-lecture

BIOGRAPHY: Ali Seiphoori is a Senior Geotechnical Engineer specializing in advanced geotechnical laboratory testing. He earned his PhD in Civil Engineering from the Swiss Federal Institute of Technology (EPFL) and has served as research associate at MIT and the University of Pennsylvania before moving into industry. His areas of research expertise include soil and shale multiphysical behavior, soil dynamics, mine waste tailings stability, and marine sediments properties. Ali is Vice Chair of ASTM D18.09 (Cyclic and Dynamic Properties of Soils) and incoming Chair of ASTM D18.12 (Rock Mechanics), contributing to international standards development. He is currently based in Houston, where he leads advanced geotechnical testing programs supporting offshore energy, infrastructure, and mining projects.