



## Civil and Environmental Engineering Department Seminar

### Shallow Geothermal Energy Storage in Unsaturated Soil Layers

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**Abstract.** This presentation will introduce the concept of shallow geothermal energy storage systems that function by injecting waste heat from buildings or collected from renewable sources (e.g., solar thermal panels) into the subsurface soil or rock using geothermal heat exchangers in arrays of boreholes or energy piles, where it is stored until needed later for heating of buildings or other applications. Geothermal energy storage systems are an excellent strategy for providing space-efficient, renewable and low-cost district heating on different scales. Simulations of geothermal energy storage systems will be presented that highlight the main variables affecting their performance, focusing on systems installed in the vadose zone. Unsaturated soils in the vadose zone provide an excellent location for storing thermal energy due to their relatively low thermal conductivity and good specific heat capacity, but the performance of geothermal energy storage systems in the vadose zone requires consideration of coupled heat and water flow analyses and liquid-vapor phase change of pore water. Results from a case study on a solar thermal energy storage system installed in San Diego will also be presented to highlight the practical implementation of these systems.

**Biosketch:** John S. McCartney is a Professor in the Department of Structural Engineering at the University of California San Diego, specializing in Geotechnical and Geoenvironmental Engineering. His research interests include unsaturated soil mechanics, geosynthetics engineering, and energy geotechnics. He has received several research awards, including the R.M. Quigley Award from the CGS in 2020, the Walter L. Huber Research Prize from ASCE in 2016, the Arthur Casagrande Professional Development Award from ASCE in 2013, the J. James R. Croes medal from ASCE in 2012, the DFI Young Professor Award in 2012, the NSF Faculty Early Development (CAREER) Award in 2011, and the IGS Award and Young IGS Award from the International Geosynthetics Society in 2018 and 2008, respectively. He is currently the president of the North American Chapter of the International Geosynthetics Society (IGS-NA). He is an editor of the ASCE Journal of Geotechnical and Geoenvironmental Engineering (JGGE) and Computers and Geotechnics. He received BS and MS degrees in civil engineering from the University of Colorado Boulder in 2003 and a Ph.D. degree in civil engineering from the University of Texas at Austin in 2007.

