

# The Department of Civil and Environmental Engineering at the University of Houston presents...

## CIVE 6111 Graduate Seminar

### SOIL-STRUCTURE INTERACTION IN ENERGY PILES IN CHALLENGING SOIL DEPOSITS



**John S. McCartney, Professor and Department Chair**  
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California San Diego

**Friday, April 21, 2023**

2:45pm-3:45pm

Classroom Business Building (CBB) - Room 104

Zoom: <https://uh-edu-cougarnet.zoom.us/j/94589160391>

## Abstract

Drilled shaft foundations with embedded geothermal heat exchangers (energy piles) have gained attention by employing the same materials to provide structural support and improve the energy efficiency of building heating and cooling systems. Data from two case histories of instrumented energy piles beneath buildings in Colorado will be presented, focusing on their thermo-mechanical and thermal performance. The results from the case studies indicate that there are no adverse effects of heat exchange on the performance of drilled shaft foundations in heavily overconsolidated soils or rock, confirming that energy piles are a sustainable solution for new building construction. Challenging issues that could not be evaluated in field case studies were investigated in a series of centrifuge model experiments, which were used to calibrate a thermo-mechanical load-transfer analysis that can be used for the thermo-mechanical design of energy piles. These include energy piles in soft clay, where heat transfer leads to soil volume change and an increase in pullout capacity, and energy piles in unsaturated soil layers, where coupled heat transfer and water flow lead to an increase in axial capacity. The presentation will conclude with a summary of future research needs for incorporating geothermal heat exchangers in civil engineering infrastructure.

## Bio

John S. McCartney is a Professor in the Department of Structural Engineering at UCSD, where he also serves as Department Chair. He received BSCE and MSCE degrees from the University of Colorado Boulder and a PhD degree in civil engineering from the University of Texas at Austin. Dr. McCartney's research interests include unsaturated soil mechanics, geosynthetics, and thermally active geotechnical systems like energy piles. He has received several research awards, including the R.M. Quigley award from CGS in 2020, Walter L. Huber Civil Engineering Research Prize in 2016, 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 and Young IGS Award from the International Geosynthetics Society in 2018 and 2008, respectively. He is currently the Past-President of the International Geosynthetics Society-North America Chapter (IGS-NA). He is an Editor of the Journal of Geotechnical and Geoenvironmental Engineering and Computers and Geotechnics and is on the editorial boards of several other journals. Homepage: <http://mccartney.eng.ucsd.edu>