

Mechanical Engineering Seminar Series

April 20th, 2026, 2:00PM

Dean's Conference Room, E-203E

Title: From Buildings to Communities: Bridging Physics, Data, and Design through Multiscale Modeling of the Built Environment

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Abstract: Engineering resilient and sustainable communities require predictive understanding of complex interactions among fluid flow, heat transfer, and the built environment across multiple spatial and temporal scales. Many critical transport processes governing urban wind behavior, microclimate dynamics, and environmental exposure occur within the atmospheric roughness sublayer (RSL) of the lower atmospheric boundary layer, where strong coupling among buildings, turbulence, surface morphology, and environmental forcing challenges conventional modeling approaches and is often simplified in current practice. This talk presents a multiscale modeling framework that integrates computational fluid dynamics, wind tunnel experiments, and field observations to characterize environmental transport processes from individual buildings to neighborhood-scale systems. Multi-fidelity surrogate modeling (MFSM) enables scalable and physically interpretable predictions across these interacting scales. The presentation highlights representative engineering problems shaped by the coupled effects of climate and urban morphology, including building performance, urban climate, air pollution dispersion, fire spread, and advanced air mobility. The framework also supports interactive visualization and virtual reality environments that enhance engineering education, training, and data-informed design exploration relevant to smart infrastructure and resilient communities.

Bio: Dr. Navid Goudarzi is an Assistant Professor of Mechanical Engineering at Cleveland State University, where he leads the Multiscale Multiphysics Modeling and Data-Driven Analysis of Thermofluids (M³TFluid) Lab and serves as Co-Director of the Center for Integrated Modeling for Energy, Resiliency, and Sustainability (IERS). His research focuses on multiscale modeling of complex thermofluid systems, integrating computational fluid dynamics, experiments, reduced-order modeling, and data-driven methods to improve predictive understanding of transport phenomena in the built environment. His work emphasizes physics-based and data-informed modeling approaches, with representative applications in sustainable infrastructure, energy systems, urban microclimate, air quality, fire dynamics, and advanced air mobility. His research has been supported by the National Science Foundation (including the NSF CAREER award), Office of Naval Research (ONR), Air Force Research Laboratory (AFRL), National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of Education. Dr. Goudarzi has authored over 100 peer-reviewed publications and has supervised PhD, MS, undergraduate researchers, and postdoctoral scholars working on interdisciplinary problems in computational modeling, machine learning, and environmental systems.