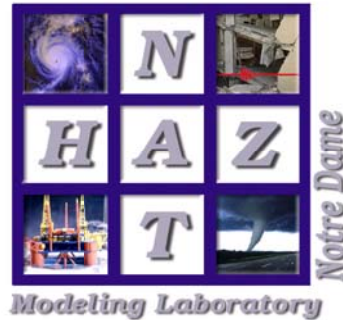


Engineering for Extremes: A Nexus of Modeling, Simulation, Virtualization and Living Laboratories

Professor Ahsan Kareem

NatHaz Modeling Laboratory, University of Notre Dame, USA



Abstract

Current worldwide urbanization requires taller buildings, long-span bridges for connecting communities and drilling platforms that extend to depths in thousands of meters of water. As a result, a new generation of tall buildings, long-span bridges, and deepwater drilling platforms is evolving. These superstructures are very flexible and remarkably sensitive to the dynamic action of extreme wind events like bora, hurricanes, winter storms, thunderstorms and other similar events. Designing these structures in increasingly complex wind environments is challenging to ensure their functionality and safety.

The lecture will provide an interesting guided tour of the evolution of these engineering structures and their sensitivity to extreme wind events. To meet the challenges of designing and building these structures there is a growing need for a new design methodology that implements the advantages of a nexus of new modeling procedures, physical and computational simulations, virtualization and machine learning. This approach also benefits from the real-time structural analysis through a network of instrumented structures that serve as living laboratories.

The lecture presents such a platform to better address the fundamental issues related to the analysis, modeling, and simulation of wind load effects on these structures and their performance at full-scale. The role of visualization in physical and computational simulations and the unprecedented ability of machine learning algorithms to classify and predict complex environments will be presented with examples related to the modeling of the extreme environment.