University at Buffalo
Department of Civil, Structural and Environmental Engineering
School of Engineering and Applied Sciences

ENGINEERING SEMINAR

Advanced Wind Engineering: Changing Climate, Aerodynamics and Dynamics

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Mitigation of losses due to wind hazards has become an increasingly urgent and challenging problem in light of our changing climate. The assurance of structural safety and reliability under extreme winds requires accurate modeling of wind-induced effects. It heavily relies on our understanding of the nature of tropical cyclone and non-synoptic winds (characteristics of wind inputs), the bluff-body aerodynamics (from wind inputs to load outputs) and the characterization and quantification of structural vibrations under winds and their mitigation (from wind load inputs to structural response outputs), which are current research focuses of the WindHub at UB.

Abstract

The simulation of wind-structure interaction generally has implicit assumptions of stationarity and linear features despite observations in storms and the attendant aerodynamic effects and structure behaviors clearly depart from these assumptions. This presentation will introduce some efforts made by the WindHub members on the consideration of the nonstationary winds, nonlinear aerodynamics and nonlinear structural dynamics in the simulation of wind-induced effects on civil infrastructures. Three topics will be covered:

(1) Rapid estimate of tropical cyclone (hurricane) wind and rain fields under changing climate
Hurricanes associated weather extremes (e.g., strong winds and heavy rainfall) are extensively studied in the context of multi-hazard risk analysis. Accordingly, physically-based models are developed and used in conjunction with improved probabilistic risk framework under observed and projected climate conditions.

(2) Analysis and synthesis of nonstationary winds under non-synoptic events (downbursts and tornadoes)
The instantaneous characteristics (amplitudes, phases, and frequencies) of nonstationary winds are extracted from measurements based on Hilbert transform. The wind synthesis is then accomplished by artificially generating the observed instantaneous information. The effects of unconventional vertical profile and evolutionary correlation on structural responses are addressed.

(3) Simulation of transient wind effects on structural aerodynamics
CFD-based simulation of a typical non-synoptic wind event is carried out. Then, the downburst and tornado-induced effects on the bridge responses are investigated based on a modified aerodynamic model that could account for the transient wind effects on changing aerodynamics.

In addition, several collaboration projects related to the nonstationary and nonlinear considerations in wind engineering field will be presented.

Date: Friday, November 10th, 2017 Time: 11.00 am
Location: 140 Ketter Hall, North Campus, University at Buffalo