

***Performance-based wind engineering:
from non-linear dynamics to computational fluid dynamics***

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Abstract: Due to the generality of the Performance-based design (PBD), there is a strong interest in applying the concepts of PBD to the performance assessment of structures subject to severe windstorms. Despite the abundance of methods for the inelastic response characterization of seismically excited systems, application of these methods to wind engineering is computationally challenging due to the extremely long duration of windstorms (as compared to seismic events). Another key aspect of applying PBD to wind is to recognize how the majority of losses associated with extreme wind events are related to nonstructural damage. This seminar will discuss recent advances in performance-based wind engineering for overcoming these fundamental challenges. In particular, approaches based on the use of dynamic shakedown for describing safety against failure mechanisms such as low-cycle fatigue or incremental plastic collapse will be presented as a comprehensive means to assess the performance of wind excited structural systems experiencing inelasticity during extreme wind events. Simulation-based data-driven frameworks will then be introduced that describe performance in terms of system-level decision variables that are wind centric, such as water ingress due to building envelope damage. Methods for efficiently simulating over all uncertainties affecting the capacity of the building envelope and hazard intensities will be discussed. In particular, the possibility of combining proper orthogonal decomposition informed by wind tunnel data – for describing the stochastic wind pressures – with Eulerian multiphase CFD models – for describing the turbulent-dispersed wind-driven rain – is investigated. Case studies are presented as is the concept of optimizing within the setting outlined above.

Bio: Seymour M.J. Spence is an Assistant Professor in the Department of Civil and Environmental Engineering at the University of Michigan, Ann Arbor. He joined the University of Michigan in September 2014 from the University of Notre Dame where he was a Research Assistant Professor in the NatHaz Modeling Laboratory. Spence's history encompasses experiences in both academia and industry. In particular, during his Ph.D. studies he spent six months as a Visiting Scientist at Cornell University and one year as Guest Researcher at the National Institute of Standards and Technology (NIST) of the United States. In 2009, he worked for the multinational engineering consultancy ARUP Ltd. on a number of high profile projects. He earned his M.S. in Civil Engineering in 2005 from the University of Perugia, Italy, and received a joint Ph.D. from the University of Florence, Italy and the University of Braunschweig, Germany in 2009. Spence has authored over 50 publications in leading journals and conference proceedings over the past five years and has given a number of invited talks at leading institutions around the world. In 2015 he was the recipient of the ASCE's J. James R. Croes Medal and, in 2018, of the National Science Foundation's CAREER Award.

**Monday, October 29th, 4:00-5:00pm
1310 Yeh Student Center**