Application of Probabilistic Methods in Civil Engineering

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Abstract
Performance evaluation of critical infrastructure is needed to provide measures of the asset reliability under operational conditions or extreme hazards, which also facilitates a quantitative decision support system for optimal allocation of natural and economic resources. Probabilistic methods can be used to appropriately quantify large uncertainties in assessing infrastructure’s environmental, social, economic and cost-benefit impacts.

In this presentation, probabilistic methods (such as reliability analysis and life-cycle cost analysis) are used to evaluate long-term structural integrity and serviceability with the consideration of the prevailing uncertainties. Specifically, three applications are presented: (1) A performance-based earthquake engineering framework is utilized to investigate the economic effectiveness of a recently developed self-centering concentrically braced frame (SC-CBF) system. This system is developed to increase drift capacity compared to a conventional lateral-load-resisting system and eliminate the residual drift. Due to the special details required by the SC-CBF system, the construction cost of an SC-CBF is expected to be higher than that of a conventional CBF. (2) The impact of corrosion on bond behavior at a rebar-concrete interface is evaluated in the performance evaluation of aging reinforced concrete structures. Two research objectives are targeted: (a) to better understand the relationship between corrosion deterioration and bond stress-slip through experimental testing and probabilistic modeling; and (b) to study the impact of bond deterioration on structural performance. (3) A risk-based corrosion management framework is developed for different types of structures. This framework requires the incorporation of various sources of uncertainties and quantitative measures related to the deterioration process itself, a reliability assessment of the structure, and life-cycle performances.

Biography
Dr. Qindan Huang is an Associate Professor in the Department of Civil Engineering at The University of Akron, Ohio. She acquired her Ph.D. in Civil Engineering from Texas A&M University, College Station in 2010. Her research work has been supported by federal agencies such as NSF, DOT, and DOD. Several areas of special interest to Dr. Huang are risk analysis, structural reliability, performance assessment of deteriorating structures, and damage detection methods.