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

ENGINEERING SEMINAR

Multi-hazard design and cost-benefit analysis of buildings with special moment resisting steel frames

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Abstract

Risk assessment of structures subjected to natural hazards is one of the primary objectives of the performance based engineering. Nevertheless, current practices evaluate the risk imposed by each hazard independently. This presentation will deal with the simultaneous risk imposed on civil infrastructure by seismic and wind hazards and will quantify it in terms of probabilities of damage and potential economic losses through a multi-hazard probabilistic framework.

Earthquake and wind are two common natural hazards that most structures are routinely subjected to during their lifetime. In the United States, the load combinations specified in the ASCE Standard 7 account for earthquake and wind hazards. However, components of the structures are typically designed to withstand the worst case load combination. This means that the design of a structure is dictated by either wind or earthquake load, but rarely both. A worst case load combination design approach can lead to uneconomical and sometimes, unconservative results. In other words, it can compromise not only the safety but also can affect the cost of construction and insurance of the structure. An optimum design should, ideally, be derived through a life-cycle cost analysis that relates the performance of any structure during its lifetime with probable losses due to various loading conditions.

Specifically, this presentation will discuss the economic viability of allowing for controlled inelastic deformation of special moment resisting buildings under wind excitations in seismically active regions. This will be achieved through a set of case studies involving steel buildings of varying heights made of special moment resisting frames located in three different cities in the United States of America, with different intensity levels of wind and seismic hazards. The potential total economic losses to the buildings and the deaggregation of losses due to damages to drift and acceleration sensitive non-structural components and due to structural repair, demolition and structural collapse will be presented in terms of expected annual life-cycle losses and the present value of the life-cycle losses. It will be shown that allowing for controlled inelastic deformation of a building under wind excitation in a seismically active region may be an economically viable strategy, depending upon the characteristics of the building and severity of the hazards.

Date: Friday, October 5, 2018   Time: 11:00 AM
Location: 140 Ketter Hall, North Campus, University at Buffalo