

Keynote Paper

## **Performance-based wind design and nonlinear dynamic analysis approach**

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### **ABSTRACT**

In the design of high-rise buildings, wind load is one of the most critical design considerations for structural engineers. The concept of performance-based design (PBD) is well established for seismic load, while wind design has been mainly based on elastic analysis for both serviceability and strength. For high-rise buildings vulnerable to wind load, inelastic behavior and application of the concept of PBD bear consideration. First, in this keynote presentation, a framework for application of a wind-response modification factor ( $R_w$ ) will be proposed. For seismic design, current practice mainly presumes inelastic nonlinear behavior of the building and that energy is dissipated by plastic deformation. Initial design and proportioning are often performed using elastic analysis and a response modification factor ( $R$ ). Inelastic analysis is optionally performed to check the accuracy of the design. The theoretical background on the application and implementation of  $R_w$  factor will be provided, along with the wind fatigue issues to be considered for the purpose of quantifying the modification factor  $R$  for wind design.

Then, this keynote will explain present design philosophy for wind and seismic loads and inherent connection between the components of performance-based seismic design (PBSD) for development of a framework for performance-based wind design (PBWD) of high-rise buildings. In light of such a connection, the PBWD framework that is based on limits set for serviceability and strength design will also be proposed. Finally, the keynote will discuss nonlinear dynamic analysis approach and time history wind loads for PBWD, which mainly rely on wind tunnel tests but can be generated from power spectral density (PSD) function. Conducting wind tunnel tests at the early phase of structural design may not be practical due to changes in design and cost. Thus, generation of time history wind loads from PSD for inelastic analysis is a key to success of PBWD in the wind engineering community. In this process, vertical distribution and maximum directional load occurrence should be meticulously applied. This talk will briefly introduce the whole process, including case studies.

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