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ΣΧΟΛΗ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ
ΕΡΓΑΣΤΗΡΙΟ ΜΕΤΑΛΛΙΚΩΝ ΚΑΤΑΣΚΕΥΩΝ

ΔΙΑΛΕΞΗ

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ΑΜΦΙΘΕΑΤΡΟ ΕΡΓΑΣΤΗΡΙΟΥ ΜΕΤΑΛΛΙΚΩΝ ΚΑΤΑΣΚΕΥΩΝ, Ε.Μ.Π.

Performance-Based Seismic Design in real life: The good, the bad and the ugly

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Abstract

Designing a structure to deliver the desired performance under the uncertainties of hazard, materials and questionable models, is largely the Holy Grail of structural engineering. This is the premise of performance-based seismic design whereby prescribed levels of structural response, loss or casualties are allowed to be exceeded at a maximum rate less than a given mean annual frequency. Even at its simplest structural response basis, the inverse probabilistic nature of the requirements has not yet allowed a satisfying solution. Resolving a problem of design, where the functional relationship between the design variables and the performance objectives is not invertible, essentially requires iteration. Each iteration for a nonlinear structure means a cycle of design and analysis, where the latter is a comprehensive performance-based assessment involving nonlinear static or dynamic runs. Despite the apparent usefulness of such approaches, their implementation is not trivial. Moreover, the link between a performance objective and the resulting design becomes fundamentally obscured within the outcome of a series of numerical analyses. A number of simpler methods have appeared in the literature claiming to offer this coveted prize. To promote adoption they often display some degree of compatibility with the current seismic codes and yet they may require heavy computations or strict assumptions, sometimes offering a useful but partial solution, perhaps delivering something other than what the user expected, or even failing to deliver altogether. This does not necessarily detract from the usefulness of each method, but it does certainly mean that some differentiation among approaches should be maintained, despite all of them being bundled underneath the moniker of “performance-based”. During the presentation we shall attempt to shed some light on the viability of different approaches and help interested users decide on what may best suit their needs.

Brief CV

Dr. Vamvatsikos studied civil engineering at the National Technical University of Athens (Diploma, 1997) and at Stanford University (MSc 1998, PhD 2002). Since 2011 he has joined the Institute of Steel Structures at NTUA, where he holds the position of Assistant Professor specializing in the static and dynamic analysis of steel structures. His research interests are focused on integrating structural modeling, computational techniques, probabilistic concepts and experimental results into a coherent framework for the performance evaluation of structures and infrastructure under man-made and natural hazards. His seminal work in risk assessment via Incremental Dynamic Analysis has received wide attention leading to more than 2000 citations. He has co-operated with leading structural engineering firms (ARUP, Halcrow/CH2M), the oil&gas industry (Shell, ExxonMobil), catastrophe risk modelers (AIR Worldwide, RED Srl), and insurance/reinsurance companies (AXA Insurance), while his research has been funded by the Applied Technology Council, the Federal Emergency Management Agency, the US National Institute of Standards and Technology and the European Commission. He is a long-time collaborator of the Global Earthquake Model (GEM) Foundation and has contributed to the GEM vulnerability assessment guidelines and the Risk Modeler’s Toolkit for OpenQuake.