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Static versus dynamic methods of analysis for estimating seismic performance

Michalis Fragiadakis[1,2], Dimitrios Vamvatsikos[1] and Mark Aschheim[3]

[1]*Department of Civil and Environmental Engineering, University of Cyprus, Cyprus*
[2]*Institute of Structural Analysis and Seismic Research, School of Civil Engineering, National Technical University of Athens, Greece*
[3]*Department of Civil Engineering, Santa Clara University, USA*

ABSTRACT

Nonlinear static and dynamic methods of analysis are evaluated and compared for estimating the seismic performance of structures. Emphasis is given on three tasks: (i) assess the applicability of nonlinear static methods for low-rise RC buildings, (ii) compare the building's capacity obtained using nonlinear static analysis and Incremental Dynamic Analysis (IDA), and (iii) discuss the use of nonlinear static methods for performance-based earthquake engineering considering uncertainties. The first task refers to the ability of alternative static-pushover-based methods to estimate the global and local response of RC buildings. Modal pushover methods such as the Modal Pushover Analysis method (with elastic higher modes) and the Consecutive Modal Pushover method are also evaluated. The second task refers to the qualitative comparison between the static pushover and IDA analysis when alternative intensity measures (IM) are adopted. It is shown that nonlinear static methods compare well with the IDA capacity curve for IM's that are based on the base shear, and that the dispersion of the IDA method can be reduced considerably compared with that obtained with the common format of IDA. Finally, it shown that nonlinear static methods may be a powerful performance-estimation tool when uncertainties are present. With the aid of R-C_1-T relationships (simplified or more advanced e.g. SPO2IDA), sufficient approximations of the dispersion can be obtained, while the mean capacity can be always calculated as a first-order approximation. It is demonstrated that close estimates of the demand and capacity can be easily obtained with reduced computational effort.