ENGINEERING ASSESSMENT METHODOLOGY

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PEER's efforts, so far, have been focused on a rigorous performance assessment methodology, with an emphasis on the probabilistic evaluation of decision variables associated with discrete limit states (e.g., collapse) or with losses and downtime. This rigorous approach may be too complex for most of the performance assessment tasks accounted in engineering practice. The objective of this research is to develop quantitative information and simplified procedures that permit approximate performance assessment by means of commonly employed engineering analysis methods and with a focus on the most relevant engineering demand parameters (EDPs) and damage measures (DMs). Performance will be expressed in terms of confidence levels and mean annual frequencies of exceedance of selected performance parameters (collapse, story drifts, inelastic deformations, and selected damage measures). The research will consist of extensive simulations, synthesis of simulation results, assessment of uncertainties, derivation of bias factors and dispersions for standard engineering analysis methods, development of EDP and DM hazard curves, and development of simplified procedures for performance assessment that are based on standard engineering analysis methods but account for important sources of uncertainty. The expected outcomes of the research are information and procedures that will assist the engineering profession in carrying out performance assessment with currently available tools and with tools that are under development by the research community.

In order to accomplish the project goals, series of simplified two-dimensional single-bay frame structures and single-wall structures with various heights and structural properties are modeled and subjected to a suite of 40 ground motions at different IM levels using Drain2dx (Powell 1993) for a nonlinear time-history analysis. It is assumed that by considering certain simplifications and a large variation of structural properties, these simplified models can represent most of real existing structures. The results of these analyses are expressed in term of EDP given IM and collapse capacities central values and dispersions due to two different sources of variability that are; ground motion variability (aliatory), and structural properties variability (epistemic) using the First Order Second Moment, FOSM, approximation. Then, a simple mathematical framework that permits assessment of bias factors and dispersion in EDPs' given IM and collapse capacities central values evaluation using simplified engineering procedures is introduced. By using simplified engineering procedures to evaluated EDPs given IM and collapse capacities of those structures mentioned previously and feeding the results into this mathematical model, bias factors and dispersions in EDP given IM and collapse capacities central values due to use of simple engineering analysis methods will be derived. The combination of these two consecutive processes will provide bias factors and total dispersion due to different sources of uncertainty for any simplified engineering procedure used to evaluate EDPs given IM and collapse capacities. Finally, in order to test the observations and results obtained from using simple structures as the base of this study, a two dimensional model of a real structure, the Van Nuys Holiday Inn, is modled in Drain2dx and EDPs at different hazard levels and collapse capacities are evaluated through a nonlinear time history analysis and different simplified engineering procedures. The sensitivity of EDPs at different hazard levels and collapse capqacities to different sources of uncertainty is investigated. The effectivness of simplified engineering procedures in conjunction with the bias factors obtained from the previous study in estimating EDP central values and collapse capacity is investigated.