Selection and Modification of Ground Motions for Nonlinear Dynamic Analysis of Structures

Mehdi Talebi Velni, Farhad Behnamfar, Mohammad Ali Rahgozar, February 2014

One of the most appropriate methods to estimate the seismic behavior of structures is the nonlinear dynamic time history analysis. In such a method, the momentary responses of a structure are calculated under an accelerogram of an earthquake. A prime factor affecting the accuracy of such calculations is an appropriate selection of the ground motion suit so that inconsistency of records can result in an unrealistic comprehension of the seismic behavior of the studied building. In this study, first a three-step screening process is presented for selection of consistent earthquake records in which number of suitable earthquakes is quickly screened and reduced from a few thousands to a handful number for practical use in the time history analysis. Records that remain at the end of this screening process are the most appropriate for the studied structures meaning that they considerably reduce the dispersion of structural responses. Then, an effective method is presented for spectral matching and modification of the selected records. A number of commonly available methods for scaling of records are examined comparatively. Dispersion of structural responses is explored using different statistical measures for each scaling procedure. It is shown that the Uniform Design Method, presented in this study for scaling of earthquake records, results in most cases in the least dispersion measure. It is perceived that the selection and modification procedure presented, leads to less scatter hence more reliability of the nonlinear dynamic response values for structural design purposes.