CORRELATION OF STRUCTURAL DAMAGE INDEXES WITH STRONG GROUND MOTION PARAMETERS

Reza SHARBATI
Structure and Earthquake Research Center, Amirkabir University of Technology, Tehran ,Iran
R.sharbati@aut.ac.ir

Hamidreza RAMAZI
Structure and Earthquake Research Center, Amirkabir University of Technology, Tehran ,Iran
Ramazi@aut.ac.ir

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ABSTRACT

Comprehensive studies have been carried out to investigate the correlation between structural damage indexes (SDIs) and a number of widely used ground motion intensity (GMI) parameters. To this, Nonlinear time–history analyses of steel and concrete frames are performed under a set of many ground motion records. The frames reflect the features of typical low- to medium-rise structures. The records used in nonlinear time history analyses have intensities to represent a wide range of seismic forces that impose various degrees of elastic as well as inelastic response of the frames. The SDIs were compared with the GMI parameters and correlations between them were investigated through coefficients of correlation and determination.

The results revealed that spectrum intensity parameters, having the strongest correlation, are superior to other parameters such as peak ground velocity, peak ground acceleration, and spectral acceleration. It was concluded that both peak ground acceleration/peak ground velocity (A/V) ratio and effective duration significantly influence the damage potential of ground motions, although they are not represented appropriately by the spectral definitions of earthquake excitations in seismic design codes. The ground motion A/V range had a significant effect not only on peak inelastic response but also on hysteretic energy dissipation and stiffness deterioration of stiffness degrading systems. Also, improved damage spectra were proposed to quantify the damage potential of recorded earthquake ground motion. The improved damage spectra are promising for assessment of the performance-based seismic vulnerability of existing structures.

INTRODUCTION

One of the most important steps in the earthquake-resistant design of buildings is the proper representation of earthquake effects. A common approach in current seismic design practice is to characterize the earthquake effects by simple intensity measure. This measure may not be able to completely consider damage potential of ground motions. Therefore quantification of the potential for damage of earthquake ground motion is one of the fundamental issues in earthquake engineering. A reliable measure of the damage potential of ground shaking has a wide range of applications for analysis and design of new structures as well as for seismic evaluation of existing facilities.

Consequently, reliable and simple intensity measures are required to estimate the damage potential of ground motions. several simple to elaborate intensity measures were proposed, each depending on either ground motion parameters only, namely, peak ground acceleration (PGA), peak ground velocity (PGV), and