STRUCTURE SPECIFIC GROUND MOTION SELECTION: PROS, CONS AND FUTURE DIRECTIONS

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ABSTRACT

Following recent development in the probabilistic approaches for seismic design and evaluation of structures in earthquake engineering; use of Nonlinear Time-History Analysis (NLTHA) is common and is increasing. One important step in NLTHA is to select and prepare a set of Strong Ground Motions (SGMs) as the input of analysis such that they represent a predefined level of seismic intensity. This paper reviews the most common ground motion selection and modification methods in the literature, highlights the pros of targeted selection of SGMs and discusses potential problems with the quantification of selection criteria. After a glimpse on the unresolved problems and controversies related to the structure-specific SGM selection, future research directions are proposed.

Increase in the reliability of the estimated responses in term of statistical dispersion, reduction in the computational cost without losing the accuracy and the prevention of bias in the results are on the "pro" side of the ledger, while the "con" side includes the challenges on involving new selection criteria and intensity measures in the traditional code-based design process, difficulties in the alleviation of uncertainties from ground motion such as near-fault characteristics, frequency content and vertical component of motion and obstacles for the introduction of an integrated selection scheme due to the large variation in the structural systems and details.

After a comprehensive qualitative comparison among the features of most common approaches which have been proposed in recent years; some methods are applied to predict the dynamic response of a 2-D steel frame which represents a typical case of vertically irregular system. Results confirm the superiority of structure-specific selection against the blind selection from preliminary refined SGMs based on seismological requirements.

INTRODUCTION

An important step for the Nonlinear Time History Analysis (NLTHA) of structures is to select a reliable set of ground motions (Ghafory-Ashtiany et al., 2012). In probabilistic seismic demand analysis of structures based on the Pacific Earthquake Engineering Research (PEER) centre framework, described in FEMA-350 (2000), one of the key points to ensure the reliability of results is to reduce the dispersion in calculated Engineering Demand Parameters (EDPs). The Mean Annual Frequency (MAF) of exceedance of a