Design Earthquake Based on Deaggregation of Seismic Hazard

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Abstract
The disadvantage of probabilistic seismic hazard analysis is that the concept of a “design earthquake” is lost; i.e. there is no single event that for design or retrofit. The relative contributions of the various sources to the total seismic hazard are determined as a function of their occurrence rates and their ground-motion potential. This study describes a method wherein a design earthquake can be obtained that accurately represents the uniform Fourier hazard spectrum from a PSHA. If different seismic sources dominate the hazard at different frequencies, then contributions to the hazard come from significantly different magnitudes, distances, and ε's. In this case, a single design earthquake is not appropriate and it is necessary to represent design earthquake for short and long periods.
Keywords: Design spectra, Probabilistic, Hazard.

1. INTRODUCTION

Probabilistic seismic-hazard analysis (PSHA) consists of a methodology with which to compute the ground motion that is exceeded with a fixed probability, *P*, during an interval, *t*, through the consideration of the contribution of the seismic sources affecting the investigated site [1]. A principal advantage of the probabilistic method stems from the nature of Cornell’s scheme [1] that systematically combines the contributions to hazard from all the earthquakes generated by the seismic sources of engineering significance to the investigated area. Unfortunately, the integrative process of PSHA also carries some disadvantages. The main disadvantage of PSHA is that the concept of a "design earthquake" is lost; i.e., there is no single event specified by magnitude *M*, distance *R*, and epsilon ε, which is the number of standard deviation from the median intensity measure predicted by an attenuation relation [2,3,4].

A disadvantage of PSHA is that the concept of a “design earthquake” is lost; i.e., there is no single event that for design, analysis, retrofit, or other seismic risk decision a single “design earthquake” is often desired wherein the earthquake threat is characterized by a single magnitude, distance, and perhaps other parameters [2]. This property results directly from the integration of PSHA, and it means that other characteristics of the ground motion must be estimated in an ad hoc fashion if these characteristic are important for analysis or design.

In 1995, McGuire [2] published a disaggregation method that finds an earthquake, the “beta earthquake”, representative of the disaggregated uniform hazard-response spectrum. Bazzurro and Cornell [4] analyzed possible choices for disaggregation computation with particular attention to their relevance and their influence on the computed results. Some researcher proposed an improvement on standard disaggregation by substituting latitude and longitude for distance to clearly identify contributions coming from different sources [4, 5].

In this study, to derive a single or several design earthquake that can replicate the uniform hazard frequency spectrum over all frequency, we use a "composite seismic hazard analysis" that combines the contributions by *M*, *R* and ε, for each frequency, for a hypothetical site.

2. DEAGGREGATION

The probabilistic analysis procedure for the evaluation of the seismic hazard at a site has been long established; it has been widely used and elaborated on by many. The conventional PSHA implies an integration of all the potential magnitudes and source distances to estimate the mean frequencies of earthquake ground motions occurring at the site in any given time period. For the same local soil conditions,