Empirical Models for Site- and Region-Dependent Ground-Motion Parameters in the Taipei Area: A Unified Approach

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We calculated peak ground accelerations and response spectra for the Taipei area using stochastic simulation technique on the basis of recently obtained empirical models. The source, path and site effects were characterized separately on the basis of the analysis of a large collection of ground-motion recordings obtained since 1991 in the Taiwan area. The simple ω-squared Brune's point-source model combined with regional anelastic attenuation (Q) and duration ($\tau_{0.9}$) models provide a satisfactory estimation of ground-motion parameters for rock sites. Effects of local site response are considered by means of empirical soil/bedrock spectral ratios calculated as ratios between spectra of actual earthquake records and those modeled for hypothetical "hard rock" site. The results of the simulation demonstrate that this combination of source, path and site response models provides an accurate prediction of "site- and region-dependent" ground-motion parameters for the Taipei basin for the broad range of earthquake magnitudes, distances and site conditions. The model, with a set of generic soil profiles, can be considered as an efficient tool for estimating of design input ground motion parameters in the Taipei basin both in deterministic (scenario earthquakes) and probabilistic ("site- and region-dependent" Uniform Hazard response spectra) seismic hazard assessment.

INTRODUCTION

Procedures of seismic hazard assessment are based on ground motion attenuation relationships that can be derived from statistical analyses of recorded ground motions or, in conditions of limited strong-motion records, from the available literature sources. Ideally, these attenuation models should consider regional earthquake source and propagation path effects and local site response peculiarities. The characteristics of site response, in turn, depend on input motion characteristics (amplitude, frequency content, etc.) and, therefore, on the source and propagation path features (e.g., Aki 1988; Aki and Irikura 1991; Bard 1995). Available empirical ground motion models (see Abrahamson and Shedlock 1997, for recent review), even if developed for different tectonic categories of earthquakes, have a large degree of uncertainty. Special studies should be carried out in order to determine whether these global models can be used in any specific case (Somerville 1998).

The needs of realistic representation of source, path and site effects require a model that considers these three factors separately. The approaches to constructing the model include

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