The 2018 Structures Congress (Structures18)
Songdo Convensia, Incheon, Korea, August 27 - 31, 2018

Predicting propagation and amplifications of earthquake ground motions

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ABSTRACT

Earthquakes generate strong ground motions that have the potential to cripple existing infrastructure, interrupt businesses, and lead to loss of life. Therefore, it is vital to predict intensity of ground motions which is controlled by various factors such as: earthquake magnitude; source-to-site distance; faulting mechanism; and site condition. It is also well known that the ground motions can be altered due to existence of deep soil deposits. One-dimensional site response analysis can reliably predict ground motions on the ground surface.

1. INTRODUCTION

Earthquakes generate strong ground motions that have the potential to cripple existing infrastructure, interrupt businesses, and lead to loss of life. These impacts can threaten the sustainability of the built environment and result in long-term costs associated with societal recovery. Although there are no reliable means to predict the exact timing of earthquakes, loss of life and damage associated with strong ground motions and their secondary effects can be mitigated through proper evaluation of seismic hazards and associated risks.

2. GROUND MOTION PREDICTION MODELS

Ground motion propagation is significantly influenced by fault mechanism, magnitude of earthquake, source-to-site distance, soil and rock conditions, etc. There is an increasing number of recording stations. Based on the recorded data, various ground motion prediction equations (GMPEs, also known as attenuation relationships) have been developed for various regions. These GMPEs are key components of seismic hazard analyses. The Pacific Earthquake Engineering Research Center (PEER) initiated a research program to develop GMPEs for active tectonic regions such as California, Japan, and Italy (NGA-W2 project). This study introduces recently proposed GMPEs.

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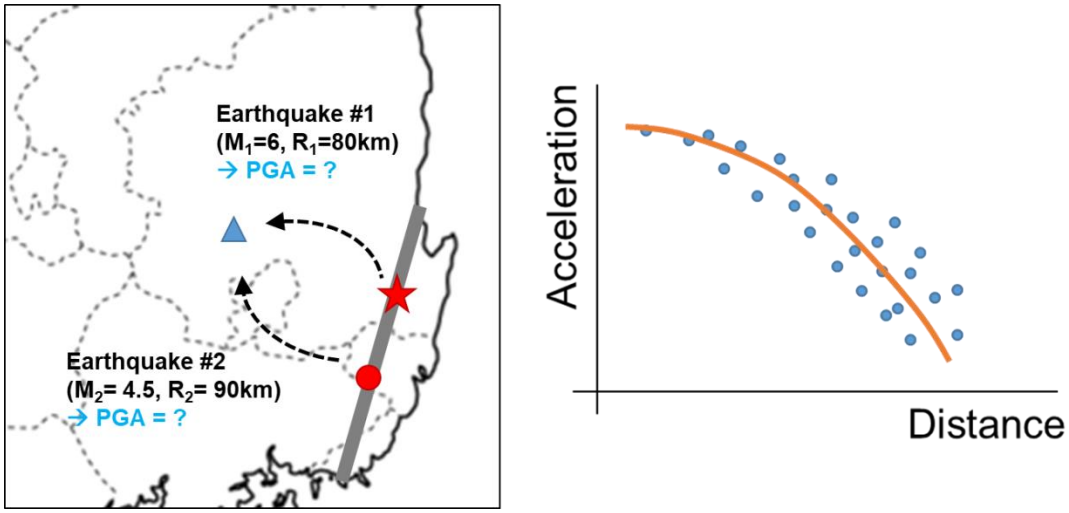

Fig. 1 Prediction of ground motions with respect to earthquake magnitude and epicentral distance

3. GROUND MOTION AMPLIFICATIONS

Deep soft soil deposits can change the intensity and frequency content of earthquake ground motions, which is commonly referred to as site effects. It is widely recognized that peak ground accelerations (PGA) and average shear-wave velocities of top 30-m soil deposits (V_{S30}) affect site effects. There are efforts to develop predictive equations using recorded data to predict site effects. However, often times it is difficult to obtain ground motions measured within rock because most of recording stations measure ground motions on the surface (except for Japan). In addition, ground motion recordings with large intensities are not abundant. Therefore, site effects are commonly evaluated using site response analyses. This study introduces equivalent and nonlinear one-dimensional (1-D) site response analysis methods.

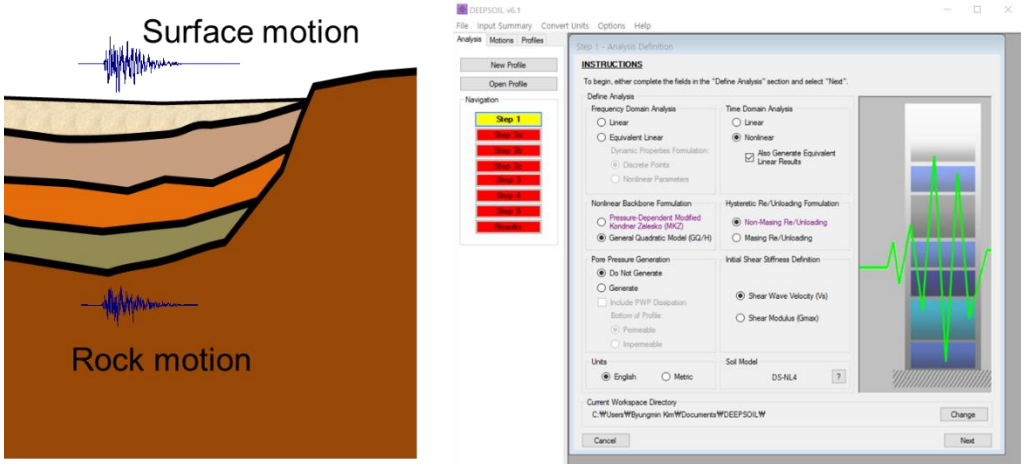

Fig. 2 Prediction of ground motion amplifications using DEEPSOIL

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