THE EFFECT OF SOIL PROPERTIES UNCERTAINTY ON THE GROUND MOTIONS INTENSITY

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ABSTRACT

Soil properties and soil depth to bedrock are parameters that can alter the ground motions' characteristics as they travel from depth to surface. The goal of this paper is to characterize the uncertainty of the soil properties and to propagate the effect of these uncertainties to the variability of ground motions intensity. It also investigates the effect of soil depth randomness on the ground motions intensity. A sensitivity analysis with the aid of Tornado diagram is performed in order to identify the most important soil parameter that affects the ground motions. Furthermore, two probabilistic analysis approaches, including Monte Carlo simulation technique (MC) and First Order Second Moment method (FOSM) are used for probabilistic analysis. Because of the time and cost consuming feature of full probabilistic analysis methods, such as MC, this study compares two methods to evaluate the accuracy of FOSM approximate method in the seismic response study of soil domain.

Performing nonlinear time history analysis for soil domain samples subjected to real earthquake records, the results of studies show that the soil depth can severely affect the ground motions intensity on the soil surface. The value of PGA of ground motions decreases as the soil depth increases. Soil shear modulus at small strains is recognized as the most effective parameter of soil that controls its dynamic behavior. It is also observed that stiffer soil experiences larger values of PGA. Finally, it's concluded that FOSM approximate method could be reasonably and effectively used instead of the MC simulation technique for evaluating the seismic response of soil domain regarding the uncertainty of soil properties.

INTRODUCTION

Consideration of uncertainties in the earthquake engineering problems is increasingly developing. Including the modeling parameters variability in the evaluation process of the engineering structures is very important since the performance of a structure at the time of earthquake is associated with the structure's characteristic parameters. Characteristically identifying the soil site on which the structure is established helps to precise evaluation and design of the structure because of the proved role of the soil-structure interaction in the structural behavior. However, the characteristic parameters of the soil site, which control its dynamic behavior when subjected to earthquake waves, are not carefully defined in most cases.

The uncertainty of a geotechnical problem can include soil properties uncertainty and soil depth to bedrock randomness. The inherent variability of soil because of being a natural material as well as soil identification sampling and testing methods can cause the uncertainty of its properties. Researchers have investigated the effects of these uncertainties on both the response of structures (Tang and Zhang, 2011; Rachowdhury, 2009; Na et al., 2009; Ray Chaudhury and Gupta, 2002) and the earthquake induced