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An Investigation of Local Site Effects Using Linear and Nonlinear Analysis and Comparison between Them

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Abstract

Recent code provisions for building and other structures (1994 and 1997 NEHRP provisions, 1997 UBC) have adopted new site classification. The new site classification system is based on average shear wave velocity to a depth of 30 m. when the shear wave velocity is not available; other soil properties such as undrained shear strength can be used. The study of propagation damages in various earthquakes illustrates the importance of the site effect on the ground seismic characteristics. From the point of the earthquake engineering view, the most important characteristics of the strong ground motion are amplitude, frequency content and duration. All of these properties have a significant effect on earthquake damage. The behavior of soils under cyclic loading is basically nonlinear and hysteretic. Ground response analysis is used to predict the movements of the ground and develop a design response spectrum in order to determine the dynamic stresses and strains and earthquake forces. The profile was studied by using various methods of soil response analysis and finally, the results were examined. In this paper, soil responses were examined by NERA, EERA software and the results compared with each other. Eventually, we concluded that the values obtained from the EERA are more than the value obtained from the NEERA software.

Keywords: EERA; NERA; Site Effect; Ground Response.

1. Introduction

These Earthquakes are caused by sudden slips on geological faults. Seismic waves are then generated and propagate through the lithosphere up to the earth surface. The induced seismic movement depends on the earthquake magnitude (the energy produced by the source), but also on the path followed within the lithosphere (regional hazard) and on local conditions (local hazard). The modification of the seismic movement due to local topographical and geotechnical conditions is called site effect. This amplification or attenuation is obtained by comparing the response of a site with the one of a reference site, i.e. a site located on flat rock. These site effects are mainly observed at the top of hills or in alluvial valleys, where buildings suffer greater damage than might have been expected from their distance to the epicentre. The most famous example of this phenomenon is the 1985 Michoacan earthquake, during which the city of Mexico, located 400 km from the epicentre, was greatly damaged. The maximum acceleration recorded in the valley had been five times higher than at a nearby site located on rock [1, 2].

Methods of analysis of the response of soil deposits during earthquakes are presented. These methods include linear elastic analysis, a nonlinear analysis and an equivalent linear analysis. All these methods require that: (1) the surface of the layer, the interface between any two sublayers and the base of the layer is essentially horizontal, (2) the material properties of the layer are constant along any horizontal plane and (3) the applied seismic excitation is also horizontal [3, 4].

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