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Comparison of Equivalent Linear and Nonlinear Soft Soil Site Response Analysis Due to Near and Far Field Excitation

Mohammad DAVOODI [١], Seyed Saeed ZOLFAGHARI [٢]

١- Assistant Professor, International Institute of Earthquake Engineering and Seismology, Tehran, Iran, M-davood@iiees.ac.ir

٢- Research Associate in Department of Geotechnical Earthquake Engineering,IIEES,Tehran,Iran

SaeedZolfaghari١٣٥٩@gmail.com

Abstract

The widely investigation about local site effects on strong ground motion characteristics indicate that the peak ground acceleration can be strongly affected by the linear or nonlinear behavior of soil deposit. Moreover, accelerometers recorded near active faults have some important characteristics that make them different from those recorded in far-fault regions. High-frequency components in acceleration records and long-period velocity pulses are among notable specifications of such ground motions. In this paper, the one-dimensional equivalent linear method in frequency domain and nonlinear method in time domain based on total stress modeling for both approach have been performed for soft clayey profile. In order to evaluate the real behavior of the site response due to incident waves, six normalized near field and far field acceleration time histories are selected for input excitation. The analysis results denoted that mean acceleration response spectra for nonlinear method is less than the corresponding values in equivalent linear method.

Keywords: Equivalent linear method, Nonlinear analysis, site effect , acceleration response spectra.

١.INTRODUCTION

The considering about geotechnical earthquake engineering have shown that the role of site effects in the distribution and magnitude of the damages associated with a seismic event is paramount. In ١٩٨٥, the ٨,١ magnitude earthquake caused significant casualties and extensive damages in Mexico City. The occurrence of damage in a city located ٣٥٠ km far from the earthquake epicenter was attributed to the amplification of seismic waves throughout the city's unconsolidated lacustrine deposit. Seismic events such as the Loma Prieta (١٩٨٩), Northridge (١٩٩٤) Kobe (١٩٩٥),and Chi-Chi earthquakes (١٩٩٩) have corroborated the significance of local geologic and geomorphologic conditions on the seismic ground response. The change in the intensity and
the frequency content of the motion due to the propagation of seismic waves in soil deposits and the existence of topographic features, commonly referred to as site effects, have a direct impact on the response of structures during each of these earthquake events(Hashash et al. ٢٠١٠) [١].
Mir Mohammad Hosseini and Asadollahi Pajouh (٢٠١٢)[٢]. analyzed the site responses of four different types of one-layered soil deposit, based on various shear wave velocities assuming linear and rigid base bedrock. They used the equivalent linear and fully nonlinear approaches and said that more practical and appropriate numerical techniques for ground response analysis should be surveyed. Abbaszadeh Shahri et al. (٢٠١١)[٣] studied the effect of nonlinearity on site response analysis and evaluated ground surface response, taking into account the local soil and subsurface soil properties for the proposed bridge over the river at Sirdjan Boulevard road subjected to earthquake vibration with the assumption of rigid viscoelasticity. They showed that based on one-dimensional site response analysis, the effect of nonlinear soil behavior is one of the key factors for response spectra.
Davoodi and Zolfaghari (٢٠١٥)[٤] considered the behavior variation of local site effect in near field and far field ground motion excitation with equivalent linear method. They performed the one-dimensional ground response analysis under near and far fault earthquakes carried out for soft clayey profile with equivalent linear method in frequency domain based on total stress modeling. The analysis results demonstrated that the