SOFTWARE STUDY AND COMPARISON SITE RESPONSE ANALYSIS RESULTS

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The study of ground response analysis is one of the most significant subjects discussed in the field of earthquake geotechnics. Ground response analysis is used in stability analysis of ground and retaining structures to predict the ground surface motions and determination of design response spectrum in order to determine the dynamic stresses and strains for calculation of forces resulting from earthquakes. With the development and progress in technology, quantitative and qualitative growth is nowadays observed in the field of soil dynamics and its relevant sub-disciplines. For instance, site analysis of a project via existing and available software has led to more accurate estimation of the dynamic behavior of soils at the construction site of projects. Among the highly efficient software in this regard are EERA which stands for Equivalent-Linear Earthquake Site Response Analysis and NERA which is an abbreviation for Non-Linear Earthquake Site Response Analysis. Indeed, EERA and NERA are appropriate software for equivalent linear and non-linear analyses, respectively. An attempt has been made in this study to use the aforementioned software and the reference article to study and compare the derived results such as acceleration, velocity and displacement responses at the ground surface, acceleration response spectrum, peak ground acceleration, shear stress and shear strain against depth.

The site may be considered in one, two and three dimensions in order to analyze the ground response. One dimensional ground response analyses are based on the hypothesis that both the ground surface and interfaces of underlying ground layers are horizontal and indefinite in all lateral directions. Although the two and three dimensional methods are the developed versions of one-dimensional method, the ground response analysis methods are categorized according to the problem on hand. The following section discusses the methods of ground response analysis.

The study of distribution of damages caused by various earthquakes indicates the significance site effects on earthquake characteristics (Idriss and Seed, 1968). Seismologists since 1920 and more recently the earthquakes geotechnical engineers have proposed a variety of techniques for simulation of this amplifying behavior of site soil (Kramer, 1996). Ground response analysis may be used for prediction of ground motions and development of design response spectrum in order to determine the dynamic stresses and strains for assessment of liquefaction hazard and calculation of forces resulting from earthquakes that may lead to instability of ground and retaining structures. Study of past earthquakes usually suggests that ground response in soft deposits is larger than that of the rock outcrops (Idriss and Seed, 1968).

San Fernando Earthquake time history data recorded at Pasadena station was selected as the reference time history the peak acceleration of which is 0.202g at time interval of 0.01s. The second input seismogram pertains to Loma Prieta earthquake recorded at station LGPC 16 with 0.605g peak acceleration and time interval of 0.05s.

A maximum of 25 Hz has been considered for frequencies that may occur due to seismograph errors and used as filter in the program. The results obtained from these adjusted values will be used as the main information in the calculations. The time history plot of the abovementioned earthquakes are presented below.

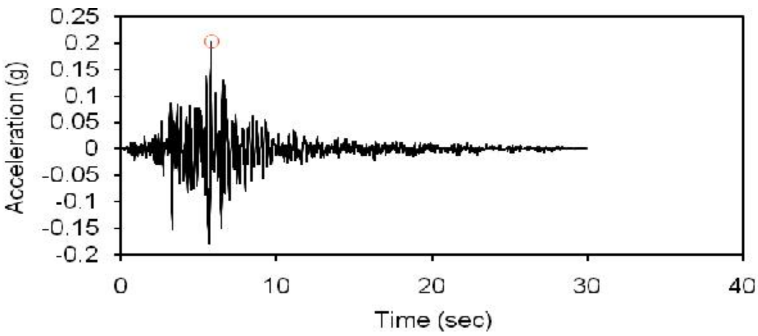

Figure1. Seismogram of San Fernando Earthquake, 1971(Hashash and Phillips, 2009)

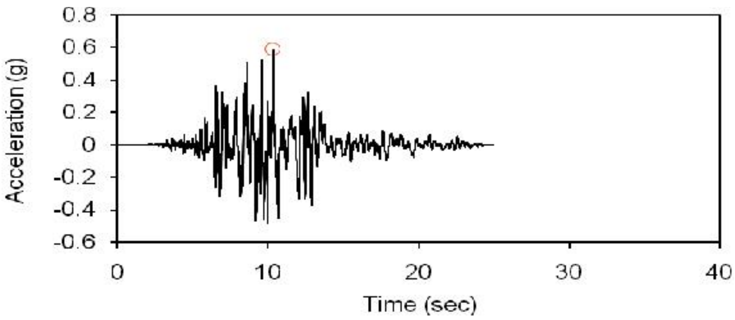

Figure 2. Seismogram of Loma Prieta Earthquake, 1989 (Hashash and Phillips, 2009)

Results of site analysis in this research have been studied according to San Fernando earthquake, 1971(Hashash and Phillips, 2009) as the first seismogram as well as Loma Prieta earthquake, 1989 as the second seismogram the results of which are described as follows:

Maximum shear strain for both seismograms: the output values of strain are very similar to the results obtained in the reference article (Hashash and Phillips, 2009). Shear stress plot is always declining. Values of acceleration, velocity and displacement at the ground surface are greater than those of bedrock. This increase is nearly 10 times in case of velocity and displacement. The dominant frequency at the ground surface derived from the Fourier plot is about 4Hz. Peak acceleration and velocity responses decrease as the critical damping ratio increases, but the maximum displacement sustains less change compared to acceleration. The maximum velocity and displacement response spectra occur when the acceleration is nearly at its minimum. The output acceleration response spectrum of the software is closer to the value in the reference article (Hashash and Phillips, 2009) calculated in the linear mode.

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