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PARAMETRIC STUDY OF SEISMIC SITE RESPONSE UNDER SHEAR WAVE VELOCITY VARIATION OF BEDROCK

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SEISMIC BEDROCK POSITION

In site effects investigations, the only part of subsurface layers are considered cause amplify or reduce the seismic motions. This part of subsurface layers is located on hard layer that earthquake-induce waves are not amplified. This layer called seismic bedrock is defined based on shear wave velocity and may not absolutely geologic bedrock and alluvial layer with high elastic stiffness can be. According to the Uniform Building Code (UBC-1997), the seismic bedrock is defined as an environment that shear wave velocity is about 760 to 1500 m/sec. According to Ishihara and Ansal (1982) the shear wave velocity of the soil layers between 600 to 1000 m/s as seismic bedrock. The second (1999) and third (2005) edition of Iranian seismic code (Standard No. 2800), is introduced an environment with the shear wave velocity greater than 750 m/sec as seismic bedrock. According to the TC4 micro zonation guide, soil layers with shear wave velocities greater than 600 m/sec is considered as seismic bedrock. This code has recommended that shear wave velocity in seismic bedrock is greater than 3000 m/sec for tall building. In this research, profiles with the same average shear wave velocity of the top 30 m soil () value but in different shear wave velocity structures proportional with soil type (II, III, IV) Standard No. 2800 were produced. Profiles depth are extended for five different shear wave velocity (750, 1000, 1500, 2500 and 3000 m/sec) as seismic bedrock using the baseline profiles shown in Figure 1. The profiles in the top of 30 m that have VS30 constant with the profiles below 30 m continued similar to baseline values used from linear equation. The shear wave profiles for each VS30 the profiles all have the same average shear wave velocity Equation 1 as controlled by the baseline velocity profile at 30 m.

$$\bar{v}_s = \frac{\sum d_i}{\sum d_i / v_{si}} \qquad (1)$$

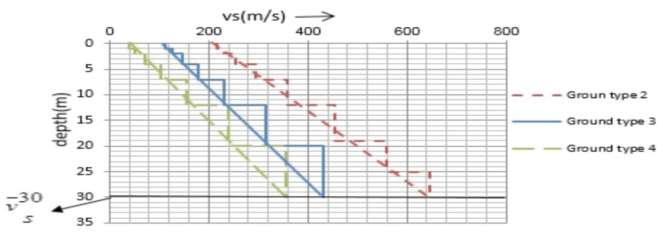


Figure 1. Average shear wave velocity until 30 m (VS30) for soil type of (II, III, IV) Standard No. 2800.

SOIL PROFILE

In this study, five types of sand profile were created artificially according to ISC proportional to variation depth of bedrock. Properties of each layers applied to dynamic analysis included specific gravity of sand $\gamma = 17KN/M^3$ damping (D = 5%), depth of layers till bedrock 1(m) and bedrock specific gravity is considered respectively $\gamma = 23KN/M^3$.

INPUT ACCELERATION SEISMIC MOTION

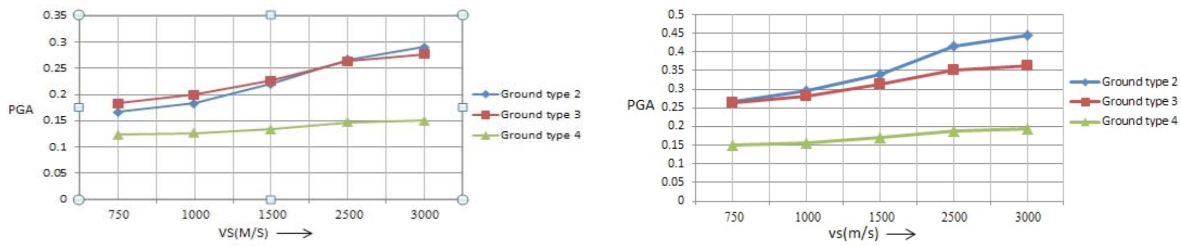
The seismotectonic environments that is selected for strong motion records would be as much as possible alike to those of the study region. As the input motions is applied to the soil profile seismic bed rock motion, all selected acceleration time-histories would be also recorded on rock materials. In this research, 25 near and average-fault and 15 far-fault ground motion records were selected for evaluating the peak ground surface acceleration (PGA) for dynamic analysis. Records that used in this study classified based on soil type I (Vs ≥750) according to the ground categories defined by the Iranian Earthquake Code of practice (Standard No. 2800).

DYNAMIC ANALYSIS

For dynamic analysis, the site can be considered one-dimensional, two-dimensional and three-dimensional. In this research, one-dimensional analysis was performed due to horizontal construction of site and parallel layers of soil. In one-dimensional analysis assumed that soil surface and bedrock continue infinitely in horizontal way. Linear analysis, equivalent linear and nonlinear analysis can be used for one-dimensional analysis. In equivalent linear analysis the nonlinearity of the shear modulus and damping is used for determination of equivalent linear soil properties using an iterative procedure to obtain value for modulus and damping compatible with effective strain in each layer. In this study equivalent linear method and SHAKE 85 software were used for evaluating peak acceleration values at the top of each layer.

AVERAGE PEAK GROUND ACCELERATION

In this study, to estimate the peak ground acceleration, seismic bedrock accelerations are firstly applied to soil profile, then the result was analyzed and the PGA value and average value was obtained (see Figure 2).



(a) (b)

Figure 2. Average of Peak ground surface acceleration for soil type of (II, III, IV) Standard No. 2800: (a) 0.15 g, and (b) 0.25 g.

CONCLUSION

- Considering Figure 2, these result are concluded:
- Peak ground acceleration (PGA) increase with increasing shear wave velocities as a result of increasing the depth of bedrock for 3 types of soil (II, III, IV) according to the Code No. 2800.
- Depth of bedrock influences seismic amplification for different depths at different shear wave velocity for type of soil in Iranian code. It also observed the amplification potential for soil type IV due to nonlinearity behavior caused to decreasing in PGA and accrued de-amplification.
- Peak ground acceleration (PGA) increased by the effect of peak rock acceleration (PRA). The soil type of (III) is upper than soil type of (II) in peak rock acceleration (0.15 g) so that at higher peak rock acceleration (0.25 g), nonlinear behavior of soil in higher can be seen.

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