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STUDYING THE EFFECT OF UNCERTAINTY OF SHEAR WAVE VELOCITY AND STANDARD PENETRATION TEST ON UNIFORM HAZARD SPECTRUM

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The overall assessment of the damage to structures during an earthquake indicates that the site conditions have a significant impact on the distribution of damage. Special probabilistic seismic hazard analysis is conducted in all-important construction projects with specific geotechnical conditions and the site response analysis plays an important role in this regard (Benjamin and Cornell, 1970). In the classic method to seismic hazard analysis, only the integration of uncertainties related to magnitude and distance are addressed and introducing uncertainties related to the effects of the site is actually impossible (Baker, 2013). The purpose of this paper is to study the effects of geotechnical parameter uncertainties on the results of uniform hazard spectrum. One of the most basic parameters is shear wave velocity at a depth of 30 m from the surface (Vs_{30}). Therefore, this parameter has been included with a statistical distribution in order to get a realistic situation through Monte Carlo simulation (Musson, 2000; Weatherill and Burton, 2010).

Sometimes the situation is so that it will be impossible to measure the shear wave velocity in the site. In this case, the relationships and alternatives can be used to estimate this parameter. The relationship between shear wave velocity and standard penetration test has been studied to consider the uncertainties of soil parameters and it is introduced through Monte Carlo simulation (Table 1).

Table 1. Correlation equations Vs based on N-value (Bernard et al., 2012).

	Study	Vs Based on N-Value (m/s)	Standard Deviation
1	Ohba & Turiuma (1970)	$85.3 \times N^{0.31}$	0.41
2	Ohsaki & Iwasaki (1973)	$81.4 \times N^{0.39}$	0.66
3	Ohta & Goto (1978)	$85.3 \times N^{0.35}$	0.5
4	Ohta & Goto (1978)	$92.2 \times N^{0.27}$	0.33
5	Ohta & Goto (1978)	$134.2 \times N^{0.27}$	0.5
6	Imai & Tonouchi (1982)	$97 \times N^{0.31}$	0.45
7	Imai & Tonouchi (1982)	$109 \times N^{0.32}$	0.55
8	Lin et al. (1984)	$65.6 \times N^{0.5}$	1.02
9	Sisman (1995)	$32.8 \times N^{0.51}$	0.52
10	Iyisan (1996)	$51.5 \times N^{0.51}$	0.87
11	Jafari et al. (1997)	$22 \times N^{0.85}$	1.89
12	Kiku et al. (2001)	$68.3 \times N^{0.29}$	0.28
13	Hasncebi & Ulusay (2007)	$90 \times N^{0.31}$	0.42

Therefore, the purpose of this paper is to investigate the effect of uncertainties on geotechnical parameters of shear wave velocity at a depth of 30 m from the surface (Vs_{30}) and standard penetration test on the results of uniform hazard spectrum. Also, these parameters are considered as random variables with a log-normal distribution. Thus, by modeling several sites under an earthquake scenario using the software Strata (Kottke and Rathje, 2008) and consider the uncertainties of soil parameters, the role of these parameters on the spectral acceleration was investigated. The results show that the uncertainties of soil parameters can change the final results of the hazard spectrum in order to ensure or otherwise (Figure 1).

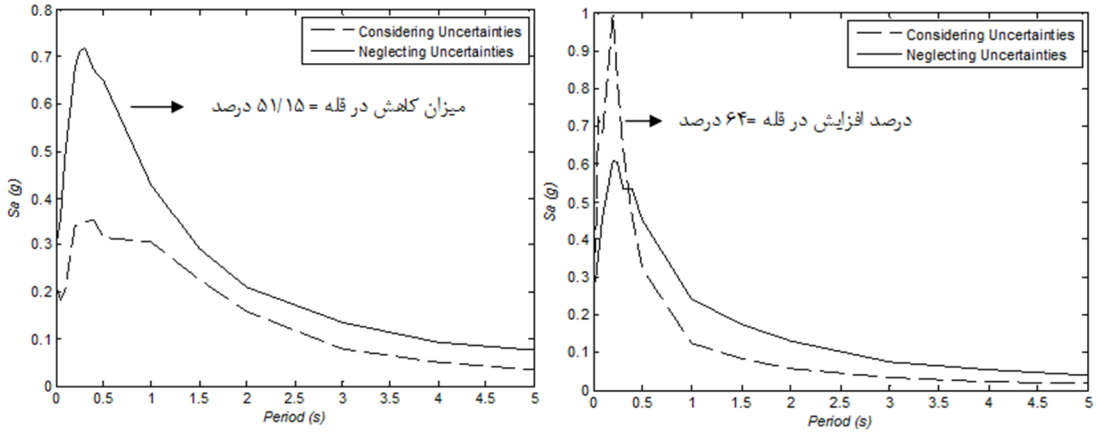

Figure 1. Changes of hazard Spectrum with considering uncertainties and neglecting uncertainties in the form of a sample.

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