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# Estimation of Site Effect in Zagros on the Basis of Horizontal-to-Vertical Spectral Ratio

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**Abstract**

The consequences of recent earthquakes show the importance of site conditions. This means that, as well as source and path effects, the recorded data on the ground surface may be affected by site conditions. In general, the overall site effect is the site and crustal amplification functions combined with the near-surface attenuation. Site amplification is estimated by the H/V ratio. Diminishing of the amplitude in the high frequency band may be modeled in terms of the Kappa factor. In this study, two datasets are considered for determining the H/V ratio and the Kappa factor. Using the best available information, recording sites are classified into two main geologic categories: rock ($V_{S30}$>500m/s) and soil ($V_{S30}$<500m/s). Correcting the records is done by using the modified wavelet de-noising method. In the frequency domain, this method can attenuate the noise in the whole frequency range of engineering interest while in the time domain it can detect and remove non- stationary noise. Using the modified wavelet de-noising method, it is possible to retrieve a large number of analog acceleration records which was not possible to correct using conventional methods of correction. A linear regression of the $\kappa_{0v}$ estimates compiled in this study indicates that $\kappa_{0v}$ about 0.027, 0.025 for the vertical component, for soil and rock site, respectively. Finally, after determining the Kappa factor and site amplification for the rock and soil sites, total site effect was estimated by multiplying two terms.
**Keywords: Site effect, H/V ratio, Kappa factor, Zagros, wavelet de-noising.**

## 1. INTRODUCTION

The effective earthquake protection requires the codes and standards for seismic design and analysis, which, in turn, are based on study of the regional seismotectonic and strong motion data. The Fourier amplitude spectrum (FAS), among other parameters of earthquake ground motion, is widely used in prediction of strong ground motion and seismic hazard studies. Using a stochastic scheme to simulate ground motion, the FAS allows evaluation of engineering ground motion parameters (peak ground acceleration and response spectra amplitudes). One of the widely used approaches to describe the dependence of FAS on magnitude, distance and local soil condition, is to break the total spectrum of the motion at a site into contributions from earthquake source, path, and site terms. Usually, the source spectral model is defined as a function of magnitude (seismic moment) and stress parameter or maximum slip velocity (source model). A path model is introduced since, due to anelastic attenuation and geometric spreading within the deep crustal structure (approximately dipper than the upper 4 km of the earth's crust), the spectrum decays with distance (path effects). Finally, site amplification factor is introduced as a function of frequency which represents the filtering of waves by the soil sedimentary layers overlying bedrock. The greatest challenge in site response estimation is the removal of the source and path effects.

Building code provisions usually require the explanation of the variety of local soil conditions by a few generalized site classes. A widely used site classification system is based on the properties of the top 30 m of the soil column, ignoring the characteristics of the deeper geology. Four site categories are defined on the basis of average shear wave velocity, that is: I—Rock ($V_{S30} > 700$); II— Hard Alluvium ($500 < V_{s30} < 700$); III—Soft Alluvium ($300 < V_{s30} < 500$) ; IV—Soft soil ($V_{s30} < 300$) [1]. However, for the sake of completeness, it should be noted that there is doubt whether the average velocity of shear waves in the top 30 m of soil, is adequate to soil or rock classification. According to Lee and Trifunac [2], the average velocity of shear waves in the top 30 m of soil should not be the only site parameter used to scale strong-motion amplitudes and soil or rock classification. They recommend use of a parameter that includes a measure of the thickness of the soil layers to considerably greater depths and surficial geology.