1. Introduction

It is notably accepted among the earthquake engineering that local geology especially sediment thickness has a crucial effect on seismic motion. That’s why, a detailed study of this effect is substantial for geotechnical and geophysical discipline. Boreholes surely provide detailed depth information but they are expensive and slow. The horizontal-to-vertical technique applied to ambient noise recordings (Nakamura, 1989) has been recently used widely. It is confirmed (e.g. Ficht and Jacob, 1993, Bard, 1999) that H/V provides a good estimate of the fundamental frequency of soft soils in the case of a large impedance contrast between sediments and bedrock. Different studies (Selit et al., 99, Paraloo et al., 2002) show that noise measurements can be used to map the thickness of soft sediments.

The aim of this study is to obtain a new relationship between the main resonance frequencies of sedimentary cover in the area and soft sediment thickness. Within this scope it has been used two types of data to determine an empirical relationship between resonant frequencies calculated from tremor measurements, calculated depths and digitised depths from gravity bedrock in the study area.

2. Field Study and Data Processing

43 great tremor measurements were carried out in the Gölcük-Değirmendere Area (Figure 1). We used Güralp CMG 740 velocity based broad-band sensor (flat response between 0.01-50 Hz). All data were acquired with the same sensor. Well-known various data processing techniques is applied in one-station microtremor method. We applied firstly butterworth band pass filter with the order of 2 on the full wave form in the range of 0.1 Hz-20 Hz. We choose 20 second window length with anti-triggering on raw signal to eliminate the unwanted high amplitude in time domain. A smoothing type called Konno-Omachi was applied with constant number 40. Then cosines taper with %10 width was applied to truncate the spectrum. Finally we obtain horizontal and vertical spectrums and on that note the resonant frequencies. In figure 2 some approximate ideal calculated spectrums is shown.

3. Geology and Velocity-Depth Functions

It is observed Paleozoic aged metamorphic, Pliocenic aged Arslanbey formation and quaternary aged alluvial deposit in the study area. The metamorphic are seen in the south and southwest region of the study area. The Pliocene aged units are the product of terrestrial and marine deposits. The alluvial and Pliocene units corresponding to sediment thickness is indeterminate and has different depths in the area (Figure 3). Thus, we aim to determine the sediment thickness.

Site effects may cause the amplification of seismic waves during earthquakes and we calculated resonance frequency and amplification so-called site effect by using single-station Horizontal-to-Vertical spectral ratio method. The site effect term can be clarified as transfer function for a bedrock basement covered by soft sedimentary model. In figure 4 the principle of site-resonance, transfer function (2) and 3 wave-velocity depth relations (2) are given.

4. Determining New Velocity-Depth Function and the Relationship Between fr and h Characterizing the Region

In a study (Ocalay et al. (2011)) was accomplished which brighten the sediment thickness of the region by gravity anomalies. Budny (1984) parameters are specific with the Cologne region (Germany). So the velocity-depth function parameters could not represent the our study area. Because of this it was used a iterative-statistical method to obtain a new Vp and x.

In figure 5, a south to north sectioning is shown. It can be clearly seen escalating sediment thickness.

Here now we investigated the most acceptable x and Vp parameters for the local-specialized to obtain velocity-depth function. Budny (1984), using downhole measurements in the Lower Rhine Embayment, acquired a value for the surface shear-wave velocity of Vso ~162 m/sec and the depth dependence x=0.27. However, Budny’s parameters might not be the most adequate ones for the area under investigation. Therefore, to derive an improved velocity–depth function for the study area, an iterative fitting procedure was fulfilled. h was calculated for every site with acquired gravity depths, varying the velocity Vso and the depth dependence of the velocity x in a wide range of values (for Vso between 80 and 400 m/sec and for x between 0 and 0.99, respectively) in steps of 20 m/sec and 0.05, respectively. This grid search allows us to find the optimal combination of Vso and x that led to minimum misfit between the observed and the computed h. The rms values between the calculated and observed depths and correspondence x and Vso were shown in Table 1.

5. Discussion and Conclusion

Looking for opportunities of different geoscience data to evaluate the study area’s sediment thickness is a distinctive way that had been tried. We investigate and compare the concordance between the parameters which calculated and obtained. We had tried to derive a new relationship. The depths but also are compatible with the geology of the area that the sediments filling the Gölcük basin. It was obtained better velocity-depth function parameters (x and Vp) and more reliable goodness of fit. Besides that it is calculated up to 800 m sediment thickness in the study area (Figure 8). Eventually these thick sediments, under the dynamic loads, enhance the wave amplitude and increases the period of shaking so produces more local site hazard. That’s why it is important to keep away from such areas for the seismic risk assessment and crucial for land-use planning.