

Site response evaluations through vertical arrays in Istanbul

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Vertical (downhole) seismic arrays have become a very suitable approach for the evaluation of dynamic characteristics of ground response throughout the world. The method is generally applied in seismically active regions in order to validate modelling parameters and uncertainties in site response analysis by evaluating site amplification and vertical wave propagation. In recent years, a large number of small scaled earthquakes with various epicenter distance, focal depth and local magnitude $ML < 5.5$ occurred around Marmara Region were recorded by three vertical arrays of accelerometer in Ataköy, Zeytinburnu and Fatih districts of Istanbul and Istanbul Rapid Response Network (IRRN) strong motion stations. In the scope of Istanbul Microzonation Project for the European side, grid based site investigation studies were held for the detection of representative soil profiles and shear wave profiles down to the engineering bedrock. By combining geological and geotechnical laboratory and in situ testing data with measured seismic wave velocity, engineering properties of soil and rock layers were determined for each grid. In this study, 1D and 2D site response analysis were conducted for the locations of Ataköy, Zeytinburnu and Fatih by using representative soil profiles and the strong motion records obtained from each array. Among the strong motion database, epicentral distance of $ML 4.2$ Marmara Sea earthquake (16.11.2015) is estimated approximately 21 km to Ataköy vertical array, defined as the closest earthquake as well, whereas 81 km for $ML 4.7$ Marmara Ereğlisi earthquake (27.11.2013) and 94 km for $ML 4.5$ Marmara Sea earthquake (28.10.2015). The comparison of 1D and 2D site response analysis based on strong motion records from IRRN stations indicate the necessity of the 2D analysis to estimate site response when soil stratification becomes slightly complex. In addition, statistical studies are being conducted based on available relatively large number of records and site parameters to evaluate available empirical relationships proposed in the literature for site amplification.