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Methods to Assess the Site Effects Based on in situ Measurements in large urban Areas. Application in Bucharest City, Romania

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In seismic microzonation we want to display the variation in seismic response of the subsurface and subsequently determine where the soil is being amplified to a level that may damage existing buildings. Although is not always adequate, frequently peak ground acceleration (PGA)is used to determine the maximum horizontal forces that can be expected. Considering the earthquake of 27.10.2004 (Mw = 6), the PGA map of the horizontal component EW shows variation in the PGA from 16 to 60 cm/s*s in the Bucharest area of 20 km diameter. Most of this variation is due to the package of the Quaternary sedimentary layers which amplify the original strong motion arrived from the earthquake. The largest amplification of the soil will occur at the lowest natural frequency or its fundamental frequency. In situ measurements of shear wave velocity in the soil and the soil thickness, provide a direct measure of the characteristic site period. But the sedimentary layers will also amplify the original frequency content of the earthquake signal arriving at the bedrock during a moderate or strong earthquake. Thus borehole recordings of acceleration during an earthquake is also an important issue.
Extensively seismic noise measurements is a much accessible method and computed H/V spectral ratio can also provide a good indication on the fundamental frequency of the site.
Within the NATO-funded Science for Peace Project 981882 “Site-effect analyses for the earthquake-endangered metropolis Bucharest, Romania” the drilling and the Vp and Vs (seismic longitudinal and shear-wave velocities) measurements in ten boreholes were done in the years 2006-2007 (Bala et al., 2007). Rock samples were taken from each borehole at different depths for laboratory tests to determine the geotechnical parameters of each sedimentary rock type at the sites. Thus a valuable data base is assembled which contains: Vp and Vs values for each sedimentary layer, density and geologic characteristics of each layer, which are the basic data for equivalent linear modelling of the site; other geotechnical parameters measured in the laboratory on the rock samples will permit the nonlinear modelling of the site.
Average shear wave velocity in the first 30 m depth (VS-30) as defined in EUROCODE 8 is a useful indicator in seismic microzonation, showing zones with low values of average seismic velocities in Bucharest, Romania.
Using the program SHAKE2000 and EERA we compute spectral acceleration functions at specific depths and transfer functions for the 1D models obtained from the in situ measurements. The acceleration response spectra correspond to the wave amplifications due to the package of sedimentary layers from 50 m depth (maximum depth) up to the surface, that are expected for a moderate real earthquake motion incident at the bottom of each 1D model. Because of the lack of outcropping bedrock in the Bucharest area, a seismic signal recorded in a borehole (PRI station, 50 m depth) at a moderate earthquake (Mw= 6), is used as input for the entire study area. 1D models obtained were tested in order to strengthen the importance of various input parameters in the obtained results.