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Observations on 1D local seismic response analyses: a case study in the Molise region, Italy

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In this work, a review of the seismic microzonation for the city of Campobasso, conducted after the 2002 Molise earthquake (Italy), is made. Fourteen sites to perform 1D analysis were selected. The stratigraphy and the physical and mechanical properties of the soils were available from both direct tests and literature survey. Down-hole profiles were accessible for the area and additional MASW tests were conducted in 2016.

A seismic hazard analysis was performed by accounting for the characteristics of the active faults located in a range of about 50 km, the disaggregation of PGA with a probability of exceedance of 10% in 50 years and the Gutenberg-Richter recurrence law for a return period of 475 years based on the Parametric Catalogue of Italian Earthquakes. The magnitude and distance ranges that are most probable to contribute to the seismic hazard of the municipality are 5.5-7.5 and 0-50 km, respectively. These ranges were used for the selection of a set of design earthquake motions to be representative of the seismicity of the site, which, consequently, matches the requirements of the Italian code in terms of target spectrum. Eight earthquake motions were selected from the ESM and PEER databases; the target spectrum refers to a Safe Life Limit State (SLV) with return period of 475 years, topographic category T1 and soil type A. The compatibility is verified by fitting the mean spectrum obtained from the accelerograms within a tolerance of 10 % in the lower bound and 30% in the upper bound for a specific range of periods of the design spectrum. The software InSpector was used to check the match.

1D local seismic response analyses were performed in the frequency domain by using the software STRATA.

There was a good agreement between the shear wave velocity profiles obtained from down-hole and MASW tests, except for few cases in which problems during the test execution or high environmental noise could have affected the down-hole results by providing meaningless profiles. Even though the shear wave velocity profiles have a good agreement, the transfer functions computed with both profiles show different resonance frequencies as expected. From the 1D seismic response analyses, the importance of the superficial layers in the amplification of the earthquake motion was highlighted, thus showing a substantial difference in the acceleration profile at the surface and a few meters below the top ground. The spectra at the surface were compared with the relative target spectra for the same site class of the considered soil deposit and the accelerations were found to be higher than those provided by the code spectra for the small

periods range and the design spectra become instead much conservative for periods higher than 0.4 s. The latter two considerations underline the importance of conducting site response analyses in engineering applications to optimize the design seismic forces on the structures.