Paper Number: 3897

Estimation of the seismic risk in major cities of Gangwon province, Korea using shear-wave velocities

Ali, A.[1], and Kim, K.Y.[1]

[1]Kangwon National University, Chuncheon, Korea; kykim@kangwon.ac.kr

_____

Chuncheon, Wonju, and Gangneung are three cities where population densities are the largest in Gangwon Province, Korea. To reveal the potential seismic risks in these major cities, active and passive seismic surface waves were recorded at 313 sites using 1-Hz velocity sensors and 4.5-Hz vertical geophones. At 25 sites, passive seismic data were recorded for 300 s at a 250 Hz sample rate using the extended spatial autocorrelation (ESPAC) method utilising four portable seismographs. At other sites active and passive data were recorded using 12 or 24 vertical geophones with receiver intervals of 2 to 5 m. Both active and passive seismic signals were recorded for 2 or 8 s at a 1000 or 500 Hz sample rate.

To determine the dispersion curves of Rayleigh waves at 239 sites, the phase-velocity spectra of both active and passive records were combined to enhance signal-to-noise ratios and improve resolution. At the remaining 74 sites, the dispersion images were obtained from passive data only. Shear-wave velocity (Vs) profiles were derived by inverting the dispersion curves using damped least-squares inversion. The initial Vs models were constrained with 20 layers of 2 m thickness. To generate final models, the initial models were iteratively modified more than 20 times to reduce root-mean-square (RMS) errors to less than 5%.

From the 313 1-D Vs profiles, the average Vs to the uppermost 30 m depth (Vs_{30}) were determined. The estimated average Vs_{30} ($EAVs_{30}$) in Chuncheon is 463±17 m/s; 448±17 m/s, 388±24 m/s, 638±46 m/s, and 287±26 m/s for the agricultural, downtown, forest, and bare ground areas, respectively. In Wonju, the $EAVs_{30}$ is 439±12 m/s; 449±20, 391±16, and 547±24 m/s for the agricultural, downtown, and forest areas, respectively. The $EAVs_{30}$ in Gangneung was estimated to be 374±16 m/s; 303±24, 314±19, and 445±25 m/s for the agricultural, downtown, and forest areas, respectively. Having lower $EAVs_{30}$ than those in Chuncheon and Wonju, the residents of Gangneung are exposed to higher risks of ground shaking.

Where recordings were not performed, Vs_{30} values were computed using the derived relationships based on proxies of elevation and topographic slope. Seismic microzonation maps were prepared according to the site classification of National Earthquake Hazard Reduction Program. The grounds in Chuncheon are categorized into classes B (35%), C (60%), and D (3%), with less proportion of A. In Wonju, the grounds are mainly classified into B (4%) and C (96%), with minor occupation by D (0.4%). In Gangneung, the grounds were characterized into classes B (44%), C (39 %), and D (15%), with small proportion of E (2%) and A (0.1%). In these major cities, the densely populated downtown and agricultural areas categorized into classes D and E are more prone to seismic amplification compared to forest areas.