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# Frequency-dependent Site Effects in Central Taiwan

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The site effects are important not only on mitigation of hazard, but also for estimation of source parameters. Boore and Joyner (1997) proposed a method, called the quarter-wavelength approximation, to construct a frequency-dependent function of site amplifications. In their method, the incident-plane waves without attenuation are taken into account. In a depth range from the surface to the depth z, they define $S_n(z)$to be the average S-wave travel time, $\beta(z)$ the average velocity [$=z/S_n(z)$], and $\rho(z)$ the average density. The frequency $f$, associated with a layer of thickness of z is $1/[4S_n(z)]$. They proposed the amplification $A(f)$ to be $A(f)= \sqrt{\rho_s\beta_s/\rho(z)\beta(z)}$ where the subscript "s" represents the source area.
In Taiwan, a project to explore the geological and velocity structures beneath strong-motion stations has been launched by the Central Weather Bureau (CWB) and the National Center for Research on Earthquake Engineering (NCREE) since 2000. The borehole logging is made for measuring the specific gravity, the P-wave velocity ($V_p$), and the S-wave velocity ($V_s$) at different depths. In central Taiwan, we select 35 boreholes with depths in the range of 14–147 m. Chen et al. (2001) infer the 3D tomography for $V_p$ and $V_s$ at central Taiwan down to 35 km by using P- and S-wave travel times. In addition, from the observed microtemors in and around the Taichung basin, Satoh et al. (2001) inferred the S-wave velocity model down to 1450 m based on the Rayleigh-wave inversion technique.
In this study, according to the assumption of the vertical-incident-plane waves without attenuation, we estimate the frequent-dependent site effects for the 35 sites from a model consisting of mentioned shallow and deep S-wave velocity structure. Results show that the average amplifications at all sites increase with frequency, and low $V_s$ and low $\rho$ in the shallow layer are the major factors in affecting the amplifications for $f > 1$ Hz. In the frequency range 1–200 Hz, there are two values of site amplifications: one is greater than 3, and the other smaller than 3. Larger site amplification is in the Holocene alluvium plain, and smaller one in the western foothill with Pleistocene and Miocene formations. When deeper velocity structures are taken into account, the amplifications at low frequencies can be obtained and the values are about 1.