# A Preliminary Study of Vertical-to-Horizontal Response Spectral Ratios for Taiwan

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For general structure design, considering the horizontal force is enough, or using the simplify method by taking the vertical force as 2/3 of the horizontal force. But recent observation and study indicate that the vertical-to-horizontal response spectral ratio will exceeds the commonly assumed value of 2/3. Moreover, for important structure like dam or nuclear power plant, vertical design spectra are needed in the design process. In probabilistic seismic hazard analysis, in order to construct vertical design spectra that are consistent with the results for the horizontal component, the vertical response spectrum is to scale the horizontal spectrum by vertical-to-horizontal spectral ratios. The need of a model for vertical-to-horizontal response spectral ratio is rising in modern earthquake engineering.

In this study, we develop ground motion prediction equations (GMPEs) for the vertical-to-horizontal spectral ratio using strong ground-motion data from TSMIP in Taiwan. A total of 91 earthquakes with 9676 records are selected and nonlinear mixed-effect model with maximum likelihood method is used. A model for the prediction of vertical-to-horizontal ratio for peak ground acceleration and spectral accelerations from 0.01 to 10.0 s is developed with a functional form consider the V/H ratios as a function of magnitude, distance, and site characteristic by using Vs30.

The preliminary result shows that the vertical-to-horizontal response spectral ratio is strong dependent on natural period, local site conditions (Vs30), and source-to-site distance. The dependent of vertical-to-horizontal response spectral ratio with magnitude is stronger in the short period then in the long period. The highest vertical-to-horizontal response spectral ratio is around the period of 0.06 sec and very with magnitude. At short periods, the vertical-to-horizontal response spectral ratio decreases with increasing Vs30. At long periods, the vertical-to-horizontal response spectral ratio increases with increasing Vs30 and also the distance attenuation is similar between the horizontal and vertical ground motion components as shown by the similar vertical-to-horizontal response spectral ratios.

The result of the vertical-to-horizontal response spectral ratio GMPE is used to compare with other model in Europe and North America.