

Improving V_{S30} Mapping in the Taipei Basin: Correlating Soil Parameters with Shear-Wave Velocity and Analysing Extrapolation Methods

Presenter: Stefan Nicholas

Advisor: Prof. Jia-Jyun Dong

Co-Advisor: Prof. Chun-Hsiang Kuo

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Abstract

Taiwan is one of the most seismically active countries in the world, and the Taipei Basin is particularly susceptible to earthquake risks due to its high population density and local geology. The site effect, a crucial factor in assessing seismic intensity and hazards, poses a major challenge in the Taipei Basin. To evaluate the site effect, the average shear-wave velocity of the upper 30 meters (V_{S30}) is commonly used. In this study, we build upon previous research by incorporating a larger and more comprehensive database through extrapolation of shallow borehole data (boreholes less than 30 meters in depth) and improving shear-wave velocity transformation functions. We employed the correlation between shear-wave velocity (V_S), void ratio (e), and effective stress (σ') to establish transformation functions, which were subsequently employed to estimate V_S at more borehole locations. For shallower boreholes, we utilized an extrapolation method, the Conditional Independent Property (CIP), to first estimate the V_S profile to 30 meters and then determine the V_{S30} thereafter. Furthermore, we employed Kriging with varying local means to generate a V_{S30} distribution map across the Taipei Basin. The results indicate that the V_{S30} distribution in the Taipei Basin ranges from approximately 157 m/s to 640 m/s. Additionally, elevated values ranging from 440 m/s to >640 m/s are identified in specific areas along the southern and eastern margins of the Taipei Basin, coinciding with greater concentrations of gravel within the upper 30 meters of the ground and shallower basement rock depths. Compared to previous research, our study demonstrates higher accuracy in estimating V_{S30} values in the Taipei Basin, providing valuable insights for assessing seismic hazard.

Keywords: V_{S30} , Shear-wave velocity, Site effect, Taipei Basin, Kriging with varying local means.