V_{S30} Empirical Prediction Relationships Based on a New Soil-Profile Database for the Beijing Plain Area, China

Xie, J., Zimmaro, P., Li, X., Wen, Z., & Song, Y. (2016). VS 30 empirical prediction relationships based on a new soil-profile database for the Beijing plain area, China. *Bulletin of the Seismological Society of America*, *106*(6), 2843-2854

Presenter：Thi-Mai-Linh Nguyen

Advisor：Prof. Jia-Jyun Dong

Date：2022/05/27

Abstract

The site effect is an important issue in strong ground motion studies. Because the site effect is the soft deposits overlaid on hard rock, increasing seismic amplification and damage during a large earthquake. In recent years, the time-averaged shear-wave velocity in the upper 30 meters (V_{S30}) has been used to classify sites to predict seismic shaking and estimate from velocity measurements directly with the depth reaching at least 30 meters. However, in many cases, the time-averaged shear-wave velocity in the upper 30 meters (V_{S30}) can be estimated by extrapolation methods when data to 30m is not available. A soil-profile database for the Beijing plain area (China) using data from research documents and technical reports with 479 soil profiles, 463 of which have depths greater than 30 meters. Using extrapolation methods develop regional relationships for the Beijing plain area with $V_{S(z)}$ (z less than 30 meters) to V_{S30} and compare the performance of available models. The results of the second-order polynomial model (Boore et al., 2011) based on data from Japan provide an overprediction, whereas the linear model (Boore, 2004) calibrated on data from California underestimates V_{S30}.

Bulletin of the Seismological Society of America, Vol. 106, No. 6, pp. 2843–2854, December 2016, doi: 10.1785/0120160053

Ⓔ

V_{S30} Empirical Prediction Relationships Based on a New Soil-Profile Database for the Beijing Plain Area, China

by Junju Xie,* Paolo Zimmaro, Xiaojun Li,* Zengping Wen, and Yisheng Song

Abstract Earthquake ground-motion prediction models usually define site conditions based on the time-averaged shear-wave velocity in the upper 30 m (V_{S30}). Proxy-based estimations of V_{S30} are commonly used, if velocity measurements are not available. We compile a soil-profile database for the Beijing plain area (China), using data from research documents and technical reports. The database contains 479 soil profiles, 463 of which have depths greater than 30 m. We develop regional relationships for the Beijing plain area for extrapolating the time-averaged shear-wave velocity to a given depth less than 30 m to V_{S30}, and then compare the performance of available models. We find that the second-order polynomial model (Boore *et al.*, 2011), based on data from Japan, provides an overprediction, whereas the linear model (Boore, 2004) calibrated on data from California underestimates V_{S30}.

We develop relationships for estimating V_{S30} based on proxies such as ground slope gradients from radar-derived digital elevation models (DEMs) and surface geology at different scales. We find that local V_{S30} data in the Beijing plain are generally lower than existing 30 arcsec gradient-based global models. Regression results show a modest correlation between V_{S30} and topographic ground slope for several DEM resolutions (3, 15, 30, and 60 arcsec). Geology-based proxies are more effective than ground slope for V_{S30} estimation in the analyzed area. We propose a bilinear model based on geologic ages and depositional environments for estimating V_{S30}, which shows a statistically significant trend for application in the Beijing plain area.

Online Material: Figures showing topographic ground slopes and correlations of V_{S30} with topographic slope from digital elevation model (DEM) data and a table summarizing data from the 463 boreholes.