Near Surface Characterization of Geological Units using Hybrid Approach

Sarosh H Lodi
NED University, Karachi

Abstract

From the perspective of the seismic induced forces, the characterization of shallow subsurface geological units using shear wave velocity profiles is essential for proper application of the ground motion prediction models, seismic hazard assessment, and ultimately the seismic risk assessment. However, in developing or underdeveloped countries the relevant information is scarcely available due to limited availability of the seismic data. To address the issue, a hybrid approach is proposed herein for estimation of shear wave velocity profile of shallow subsurface geological units utilizing the data from Standard Penetration Test (SPT) and One-dimensional Multi-channel Analysis of Surface Waves (MASW) surveys. To this end, SPT borelog data for 276 wells and MASW data for 25 testing locations present in Gulshan-e-Iqbal Town and peripheral areas are employed to propose the prediction models. In the due course, the features of soil and rock formations present in the study area are investigated and documented for use in various applications. The analysis reveals predominant presence of sandstone in the study area along with other varieties of sedimentary rocks. Furthermore, maximum shear wave velocity of the rock formations within the30 m depth is documented to be 1798 m/sec and average of the maximum velocity for each profile obtained from the seismic surveys is noted to be 952 m/sec, which suggests presence of the soft rocks in the study area. Detailed statistical analysis of the variability of the characteristics of the subsurface materials, measured in terms of the penetration resistance (N) and shear wave velocity (Vs) values using SPT and MASW data shows that the variability of both parameters decreases with an increase in the depth. Finally, the hybrid method is implemented using the available SPT data to calculate average shear wave velocity for 30 m depth, Vs30, and propose Vs30 map for the study area for pre- and post-disaster mitigation procedures.