



Importance of Multiple Geophysical Tests for Effective Subsurface Profiling

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Abstract

The dynamic properties of subsoil such as Shear modulus (G), S-wave velocity (V_s), P-wave velocity (V_p) and Poisson's ratio (ν) help us to understand the response of a site under dynamic and seismic loading. These properties are determined using geophysical and laboratory testing methods. Geophysical methods can be Invasive methods which use a borehole to conduct tests such as Standard Penetration Test (SPT), Crosshole (CH), Downhole (DH), Dilatometer (DT) and Seismic Cone Penetration (SCPT), or Non-invasive methods which consist of surface tests that do not require a borehole, like Multichannel analysis of Surface Waves (MASW), Seismic Refraction, Microtremor HVSr (MHVSR) and Electrical Resistivity Survey (ERT). Often because of the ambiguity associated with the profiles obtained from surface methods, a need to compare them with borehole-based methods arises. In this study MASW, MHVSR, DH and CH tests are performed at the same location in Chennai, Tamil Nadu to estimate V_s profile up to the depth of 40 m. These test results are then correlated with the borelog obtained during SPT. It is observed that V_s profiles obtained from different geophysical tests are not similar and vary in their prediction of soil stiffness and bedrock depth. The V_s profiles obtained from CH, DH and MASW, are similar up to the depth of 18, beyond which the CH and DH results show an increase in V_s . Interestingly, 18 m is the depth where weathered rock occurs in the borelog. However, the MASW V_s profile does not capture the velocity contrast. The MHVSR method shows a fundamental frequency of 3.0 Hz which also agrees with the fundamental frequency obtained from the MASW method. However, MASW is not able to differentiate between soft and hard rock present in this area and underpredicts the bedrock depth. The difference might be because of the more global spread of the MASW test, whereas CH and DH tests are localized around the borehole.

Keywords: Site characterization, MASW, Downhole, Crosshole, HVSr