Influence of Site Conditions on Near-field Effects in Multi-channel Surface Wave Measurements

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Abstract

Geophysical measurements using surface wave methods (SWM) are in widespread use as a means to non-destructively and non-intrusively characterize geotechnical site conditions for a variety of applications. Surface wave measurements are used to develop shear wave velocity (V_s) profiles which are directly related to the small-strain shear modulus (G) of the soil, an important parameter for dynamic and static geotechnical analysis. One of the potential sources of error in SWM is the underestimation of surface wave velocity due to inaccurate measurements in the near-field, where the receiver array is located too close to the source. These near-field effects have been studied extensively for the two–channel SASW method, but few cases have been studied using multi-channel arrays. A recent criteria developed by Yoon and Rix (2009) for multi-channel measurements suggested that the normalized array center (NAC) distance (i.e. the number of wavelengths between the source and array center) should be 2 or greater. However, this finding conflicts with recent experimental data collected in the Mississippi embayment by Rosenblad and Li (2011), which showed near-field effects occurring at NAC values of about 0.5. The objective of this research is to investigate and explain this contradiction and better understand the factors influencing near-field effects. It is hypothesized that the primary reason for the discrepancy is different conditions of saturation (and hence, Poisson's ratio) in the Yoon and Rix (2009) study and the

Rosenblad and Li (2011) study. Numerical simulations of surface wave propagation were performed for five synthetic V_s profiles under different assumed saturation conditions. It was found that Poisson's ratio did have a significant influence on the required source offset distance to minimize near-field effects. However, the effect was complex and strongly influenced by the V_s profile. For the profiles considered, limiting NAC values ranged from about 2 to as low as 0.3. The lowest values were observed for cases of linearly increasing V_s with depth under saturated conditions. Simulation of surface wave measurements for a site in the Mississippi embayment produced results that were consistent with the experimental observations. The findings from this work have important implications on both the measurement procedures and inversion methods used in multi-channel surface wave methods.