

Wednesday, 3/15/2017

1:30–3 p.m.

Site Investigation and Characterization 2

Chairs: David Frost, Georgia Tech; Alejandro Martinez, University of California, Davis

Qualitative Endoscopic Observation of Hydraulic Fractures to Investigate The Effect of Fluid Viscosity

Seong Jun Ha and Tae Sup Yun, Yonsei University; Kwang Yeom Kim, Korea Institute of Construction Technology

The control of induced fracture network generated by hydraulic fracturing treatment plays an important role in predicting the productivity of hydrocarbon resources. In particular, both nature of pressurized injection fluid and in-situ stress condition significantly affect the formation of fracture network. The previous studies have mostly reported qualitative tendency of fracturing mechanism and its manifestation that are partially understood by numerical and experimental results. To better understand the effect of fluid viscosity, a series of experimental tests are systematically performed with cylindrical specimen under axisymmetric condition. The artificially made specimens with cement paste and mortar ensure the homogeneity and isotropy for experimental consistency. Water and oil are served as fracturing fluids at constant pumping rate. The monitoring of stress evolution with increasing pressurization and high-resolution optical endoscopy imaging together allow assessing the morphological characteristics of generated fracture.

Multichannel Analysis of Surface Waves (MASW) Using Both Rayleigh and Love Waves to Characterize Site Conditions

Siavash Mahvelati, Siavash Mahvelati, and Joseph Coe, Temple University

Since its inception in the late 1990's, the Multichannel Analysis of Surface Waves (MASW) method has become increasingly common for geotechnical site characterization purposes. In most applications, MASW estimates the subsurface stiffness based on analyzing the measured dispersion behavior of Rayleigh waves (i.e., MASRW) at a site. The Rayleigh waves are typically generated using vertical impacts on the ground surface, which develop coupled P-SV wave energy. Much research has been devoted to various aspects of MASRW, including optimization of survey parameters and the development of robust inversion algorithms. However, little work has been devoted to better understanding the effects of using horizontally-polarized Love waves in MASW investigations (i.e., MASLW), despite evidence to support advantages in their use at particular sites. For example, much of the basic information regarding optimal field data acquisition (i.e., source effects, near-field limitations, and receiver spacing) is unavailable or not quantified on the basis of experimental studies that compare MASRW and MASLW at the same location. This paper presents results from ongoing research that explores the role of source type, source offset, and receiver spacing on MASLW data in the field. In this particular study, MASW was used with both Rayleigh and Love waves to characterize conditions at the same site location. Multiple source offsets and receiver spacings were used to generate the dispersion curves and collocation of the arrays and sources allowed comparison between the results from Rayleigh waves and Love waves. There was considerable agreement between the resulting shear wave velocity profiles, though there were some subtle differences in interpretation of the dispersion images and in optimal experimental parameters. This paper summarizes conditions at the site and configuration of the experiments, followed by a discussion of data analysis and interpretation.

The Use of Two Dimensional (2D) Multichannel Analysis of Surface Waves (MASW) Testing to Evaluate the Geometry of an Unknown Bridge Foundation

Siavash Mahvelati and Joseph Coe, Temple University

The evaluation of subsurface geometry continues to be a major issue for the thousands of bridges across the country with unknown foundations. These bridges pose a threat to the vitality of the nation's infrastructure, particularly given the difficulties in establishing their vulnerability to scour. In addition, unknown foundations present a major barrier to foundation reuse and rehabilitation. In many cases, geophysical methods can provide a suitable measure of confidence regarding the geometry of these unknown foundations. The Multichannel Analysis of Surface Waves (MASW) technique presents a number of potential advantages to evaluate unknown foundation geometry, including increased signal to noise ratio and ability to resolve stiffness inversions. However, very few studies have examined the use of MASW to specifically evaluate unknown bridge foundations. This gap in the literature may be related to concerns regarding vertical and lateral resolution. For example, vertical resolution decreases as the surface waves sample deeper material and the phase velocities are determined by materials over a greater depth range. Additionally, MASW largely averages out lateral variations in stiffness because a layered earth model is used in the data processing. MASW was utilized in this study to determine the two-dimensional (2D) shear wave velocity (V_s) profile over a bridge foundation. The purpose of this testing was to examine the viability of MASW when evaluating unknown bridge foundations, particularly with regards to vertical and lateral resolution. Generally, the results demonstrated that MASW is capable of providing a conservative estimate of depth. MASW proved more capable in accurately assessing the lateral dimension of an embedded foundation, though the results were a function of the survey parameters used during 2D testing.

Quantifying and Analyzing the Signal to Noise Ratio in Down-hole Seismic Testing

Mark Styler and Ilmar Weemees, ConeTec Investigations; John Rogie CPT Inc.

Seismic traces are obtained during the seismic cone penetration test (SCPTu). These traces are compared to determine the propagation time, which is used to calculate seismic wave velocities. We present a method to quantify the quality of the trace by calculating the signal to noise ratio (SNR). We analyzed a set of 25 SCPTu profiles to investigate how SNR degrades with increased penetration depth. We show that signal-stacking repeated seismic tests can be used to mitigate the loss of signal to noise ratio without a significant penalty to the production rate of the seismic cone penetration test at typical test depths. Our work has implications in the development of best-practice down-hole seismic testing. This may improve the confidence in the reported shear wave velocities and lead to improved shear wave velocity applications.