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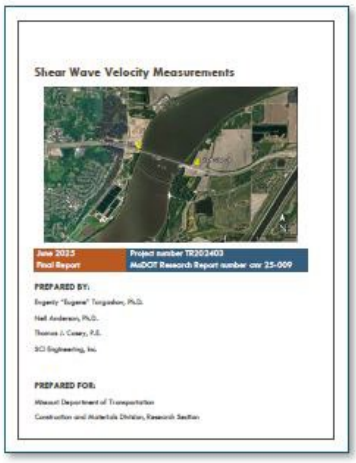
Research Summary

Shear Wave Velocity Measurements



The goal of this research was to identify non-intrusive testing methods capable of determining time-averaged shear wave velocity (Vs) profiles to a depth of 100 feet, by updating and refining MoDOT's seismic site investigation and analysis procedures. The research was performed to support anticipated updates to the AASHTO seismic site classification specifications.

SCI Engineering, Inc. (SCI) conducted the literature search and assessed eight (8) potential applicable methods for determining the shear wave velocity of the subsurface to a depth of 100 feet, which included: Active multichannel analysis of surface waves (MASW), Passive MASW, Active refraction microtremor (ReMi), Passive ReMi, Conventional shear wave seismic refraction, Seismic shear wave refraction tomography, Horizontal to vertical spectral ratio (HVSR), and Seismic shear wave reflection.

Four (4) of the eight (8) methods evaluated during the literature review were identified to be most appropriate and were field tested: Active MASW, Passive (MASW), Active Refraction Microtremor (ReMi), and Passive (ReMi).

For comparative assessment purposes, field testing, using various seismic array configurations, was conducted at three sites: the SCI Office in O'Fallon, Illinois; the I-270 Chain of Rocks Bridge in Missouri and Illinois; and the MLK Connector in Illinois.

The method evaluation focused on the following key points: limited equipment, limited source and personnel requirements for deployment, and straightforward data analysis and interpretation of the results. Based on the literature search, field test results, solicited input from users of the four (4) methods, and discussions with vendors, a combination of Active and Passive MASW methods was identified as the preferred seismic methods for determining time-averaged shear wave velocity (Vs) profiles to a depth of 100 feet. Although these methods employ different sources, they utilize the same field equipment, recording instrumentation, and processing software, and provide both complementary and supplemental outputs.

> *"A combination of Active and Passive MASW methods was identified as the preferred seismic methods for determining time-averaged shear wave velocity (Vs) profiles to a depth of 100 feet."*

SCI then recommended the preferred equipment, hardware, and software to MoDOT for performing the shear wave velocity measurements in-house.

SCI developed a manual for determining time-averaged shear wave velocity (Vs) profiles, comprised of two (2) sections. The first section, General Recommendations for MASW Field

Surveying, includes the general recommendations for MASW field surveying and conceptual survey design parameters for six (6) MoDOT example bridge sites. The second section, Multichannel Analysis of Surface Waves (MASW) Manual, is a step-by-step guide for field equipment setup using the Geometrics Geode seismic system, as well as data processing in the KGS SurfSeis software package, and finally interpretation.

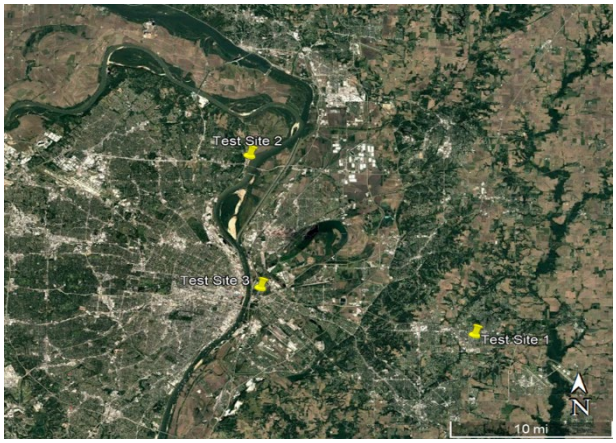


Figure 1: Locations of SCI test sites 1 (SCI office in O'Fallon, Illinois), 2 (I-270 COR bridge over Mississippi River), and 3 (MLK connector, IDOT site) shown as pinpoints on an aerial image.

Project Information

PROJECT NAME: TR202403—Shear Wave Velocity and Seismic Analysis Procedures

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PROJECT COST: $200,000

LEAD CONTRACTOR: SCI Engineering, Inc.

PRINCIPAL INVESTIGATORS: Evgeniy "Eugene" Torgashov, PhD

REPORT NAME: Shear Wave Velocity Measurements

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