Seismic Refraction/Seismic Reflection »   ASTM D5777-00 /ASTM D7128-05

Seismic Refraction investigations are commonly used to determine bedrock depth & rippability. Seismic Reflection surveys are used to map, detect, & delineate geologic conditions including the bedrock surface, voids, water table and layer geometry (folds).

The Seismic Refraction & Reflection (SRR) system is designed to allow for either seismic refraction or seismic reflection data acquisition. The SRR system, which is designed for shallow surveys, can also be used for detecting voids in large civil structures such as dams (seismic reflection).

Seismic Refraction surveys are used for excavation purposes to map the bedrock depth and evaluate rock rippability. Seismic refraction measurements are applicable in mapping subsurface conditions for various uses including geologic, geotechnical, hydrologic, environmental, mineral exploration, petroleum exploration, and archaeological investigations. Seismic Refraction investigations are commonly used to determine layer thickness and/or the subsurface compressional wave velocity of the overburden and underlying bedrock or to water table, stratigraphy, lithology, structure, and fractures. This inherently shallow technique requires that compressional seismic wave velocities increase with depth so wave refraction occurs.

Seismic Reflection surveys are used to map, detect, and delineate geologic conditions including the bedrock surface, confining layers (aquitards), faults, lithologic stratigraphy, voids, water table, fracture systems, and layer geometry (folds). This methodology requires that the target be sufficiently deep, so that the incoming reflected wave arrives after the surface wave generated from the impact. Near-surface seismic-reflection data are generally high-resolution (dominant frequency above 80 Hz) and image depths from around 20 ft (6 m) to as much as several hundred feet (100+ meters).

Features:

- System design allows for fast and accurate field measurements
- System is compact, durable, and easily transported allowing for multiple tests per day
- System includes a 12-channel geophone (4.5 Hz) string with ~ 10 ft (~ 3 m) spacings and a 100 ft (~ 30 m) extension cable for flexible testing setups
- The National Instruments 16 bit A/D data acquisition card with a maximum sampling rate of 64,000 samples/second for 13 channels allows for user programmable gain from x1 to x10,000 on the channels which makes the sensitivity equivalent to a 24 bit seismic system
- Data is acquired by triggering off of a single 4.5 Hz trigger geophone spiked in the ground by the impact point to record the source impact (sledgehammer, shotgun or other impact source not included)
- Real-time waveform display while testing
- Data is exported in SEG2 format which allows for analysis with both IXRefrax® and Reflexw® optional software packages, as well 3rd party seismic data analysis programs

» Applicable On:
Mass Concrete
Mass Cyclopean Masonry
Rock
Soil
» Test For:
Layer Thickness
Bedrock Topography
Water Table Depth/Mapping
Compressional Wave Velocity Profiles
Rippability/Excavatability
Fractures, etc.

Model	Advantages
SRR-1 Model	Complete system for acquiring both seismic reflection and refraction data
Options	**Advantages**
IXRefrax® Refraction Software	Allows the user to account for topography, perform necessary inversions, and create 2-D forward models for refraction surveys in a quick and easy fashion with state-of-the-art analysis
Reflexw® Reflection/ Refraction Software	Allows the user to create module type processing for 2-D data analysis and 3-D interpretation. More complex and comprehensive processing software.

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Method

In typical Seismic Refraction and Reflection tests, the geophone string is secured to the ground surface along a survey line using the spikes attached to each individual geophone and the roaming geophone is placed near the impact point(s). The testing proceeds by generating hammer impacts at various locations along and near the geophone string. All recorded signals are then compiled and analyzed. The acquisition procedures and processing techniques are dependent on the type of survey being conducted and the target of the investigation. Seismic refraction requires that the seismic velocity increase with increasing depth (otherwise SASW should be used). This allows for analysis of the wave refracted along the boundary of the overburden and underlying bedrock. Seismic reflection surveys require that the target is sufficiently deep so that the surface wave from the impact does not interfere with the reflected wave.

Data Collection

The user-friendly SHM acquisition software is written and tested at Olson Instruments' corporate office in Colorado. The two available processing packages, IXRefrax® and Reflexw®, were created by ©Interpex and ©Sandmeier Scientific Software respectively. We do not outsource any tech support questions and, should you require software support, we welcome your questions and comments.

Available Models

The Seismic Refraction/Reflection system is available in a single model, which can be run from the Freedom Data PC:

1. Seismic Refraction/Reflection – 1 (SRR-1)

The **SRR-1 Model** is the base model for acquiring both seismic reflection and refraction data with a 12 channel geophone string (4.5 Hz geophones spaced at 10 ft or 3m with 100 ft or 30 m extension cable) plus an impact trigger geophone. Export raw data to SEG-2 files for analysis with 3rd party seismic refraction and/or reflection geophysical software.

If the user wishes to utilize either of the compatible processing software packages mentioned on the previous page in the bottom right table, they can be incorporated into the SRR-1 model above.

Freedom Data PC Required, Sold Separately

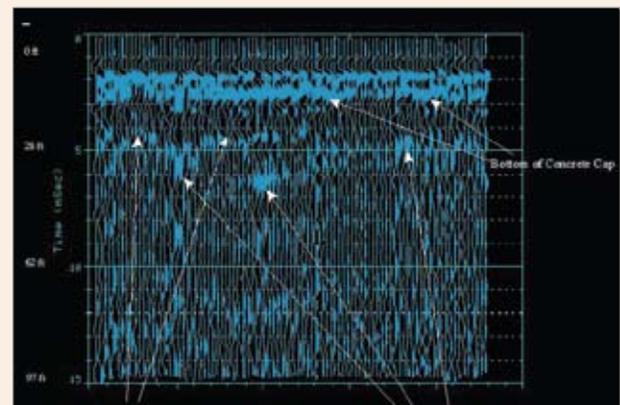### Seismic Refraction/Reflection Method
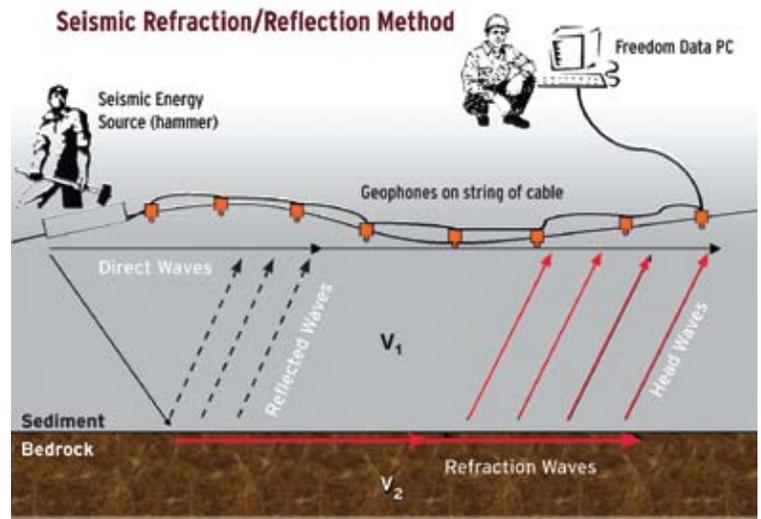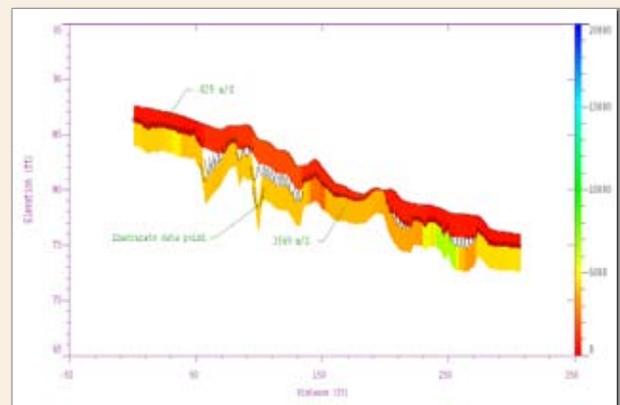
Data Example » 1

Seismic Refraction bedrock profile on highway hillside. Elevation and topography features are accounted for in the bedrock profile display

Data Example » 2

Seismic Reflection survey results from top of concrete dam spillway over cyclopean masonry/rubble fill. Note the depth to the bottom of the top slab and reflections from apparent deeper voids