



TEXAS TECH UNIVERSITY

Multidisciplinary Research in Transportation

Non-destructive Testing of Installed Soil Nails Using Sonic Echo Test Method

Hardware Specifications

Research Project Number: 0-4484
Research Product Number: 0-4484-P2

Yajai Tinkey and Priyantha Jayawickrama

Performed in Cooperation with the Texas Department of Transportation
and the Federal Highway Administration

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SOIL NAIL TESTING SYSTEM

Hardware Specification

The Soil Nail Testing System shall consist of the components listed below. Each component shall have the minimum capabilities as detailed to meet the requirements of this specification.

1.0 Data Collection Computer

- a. The Data Collection Computer shall consist of a ruggedized unit which is weather-tight (can be operated in dusty or rainy conditions without extra precautions) and integrates into a single package the signal conditioning (see b. below), the signal digitization (see c. below), data processing (see d. below), color display, and data storage. The unit shall have an integrated storage case which is water-tight and impact resistant when closed for storage or transport. The Data Collection Computer shall be battery-powered via internal batteries, and have a minimum run time of 6 hours between charging.
- b. The Signal Conditioning component of the Data Collection Computer shall supply the required constant current (or ICP) power to run accelerometers and modal hammers through coaxial cables connected to each input. A minimum of 2 input channels is required. The Signal Conditioning shall also have filtering to allow a minimum band-pass of 0.5 to 50,000 Hz. The Signal Conditioning component shall have a variable gain which is user controlled and covers the range from 1 to 1000 in 3 steps/decade or more.
- c. The Signal Digitization component of the Data Collection Computer shall consist of an analog to digital converter system with a minimum bit resolution of 16 bits, and an input range of at least +/- 10V. The sampling rate shall be a minimum of 4 microseconds/point on each of 2-4 channels. The Signal Digitization component shall be capable of triggering off of the level of the input signal (on a hammer impact) and shall allow for a user-settable amount of pre-triggering to allow for full signal capture. This component shall be capable of acquiring waveforms from each channel which have a minimum of 512 samples per channel. The analog pass-band for this component shall be a minimum of 0.1 to 100,000 Hz.
- d. The Data Processing component of the Data Collection Computer shall consist of an integrated software package which can control the Signal Conditioning and Signal Digitization components as needed, as well as allowing data processing, storage, and display. The data processing portion shall allow the full display of raw and processed waveforms to the user, and shall provide tools to assist the user in the determination of the length of the soil nails. Examples of these tools include variable filters and windows, as well as full cursors with depth marking capability. The software shall also allow for storage and printout (via external printer or other means) of processed data

2.0 Accelerometer

- a. The system shall include an accelerometer capable of being mounted via magnetic base and a glue-on washer to the end of the soil nail. The accelerometer shall have a maximum diameter of 0.5 inches, and have a removable magnetic base. The frequency response of the accelerometer shall be at least 1.0 to 10,000 Hz, with a minimum sensitivity of nominally 100 mV/g. The accelerometer shall have a screw-on connector or equivalent to allow replacement of cables in the field, and shall be of the “ICP” type, meaning it is powered by a constant-current source through the signal cable, and has a low-impedance output which is not susceptible to environmental noise or noise from cable impact.

3.0 Modal Hammer

- a. The system shall include a modal hammer which integrates a force sensor into the head to allow measurement of the impact time and waveform. The modal hammer shall be a 0.2 pound type, equipped with replaceable steel or hard plastic tips. The hammer shall be equipped with a screw-on connector or equivalent to allow field replacement of the connection cables, and shall be of the “ICP” type, meaning it is powered by a constant-current source through the signal cable, and has a low-impedance output which is not susceptible to environmental noise or noise from cable impact.

4.0 Miscellaneous Components

- a. Coaxial cables for the Modal Hammer and Accelerometer, including spares.
- b. Steel flat fender washers or disks, 0.5 inch OD, with a maximum opening diameter of 0.2 inches.
- c. 5 minute epoxy or similar, to allow mounting of washers to the soil nail ends
- d. Portable grinder or equivalent to allow surface preparation of the soil nail ends prior to testing.
- e. Charger/power supply for the Data Collection Computer.