# GRL Services

*by the Foundation Testing Experts*

# Integrity Assessment of Piles and Shafts

***When it comes to assessing foundation integrity, GRL offers its clients various options, including Crosshole Sonic Logging and Low Strain Dynamic Testing. The expertise of GRL Engineers is key to selecting the right test for each situation:***

## *LOW STRAIN DYNAMIC TESTING (PIT testing)*

GRL tests precast concrete piles, drilled shafts, augered cast-in-place piles, concrete filled pipe piles and timber piles using this method. Length / depth ratios and soil types may limit its applicability. This method is also known as Pulse Echo Testing.

**Results:**
Estimate of location of major cracks, necking, soil inclusions and voids

Estimate of severity of major defects

Approximate foundation shape

**Advantages:**
Evaluation of integrity within the cross section of the pile

Pile preparation often consists only of smoothing top surface

Quick: dozens of piles tested on a single day

Applicable to piles that are part of an existing structure

**Test Procedure:** The GRL engineer attaches an accelerometer to the top of the foundation and impacts the foundation with a small hand held hammer. The impact of the hammer produces a stress wave that travels down the pile - the engineer observes the wave propagation signals on the screen of a Pile Integrity Tester. The pattern of wave propagation and reflection along the pile or shaft is directly affected by discontinuities along the shaft. Back in the office, the engineer post processes the signals with the PIT-W Software to enhance and interpret test results, and issues a test report.


*GRL engineer performing low strain dynamic testing.*

GRL is also prepared to employ more complex variations of the low strain dynamic testing method:

- GRL may place 2 accelerometers on top of the foundation when testing shafts of large diameter.
- GRL engineers may use 2 accelerometers, one placed on top and one on the side of the shaft, or 2 placed on the side, in an attempt to evaluate foundations of unknown depth. Other length evaluation options include the Parallel Seismic and Inductive methods.
- Certain situations require testing with one accelerometer plus an instrumented hand held hammer that measures the force applied to the top of the pile. In this case data is analyzed by the Transient Response Method in the frequency domain, which may help identify potential defects.
- Slabs and other non-slender structures require either PIT test with an instrumented hammer or to perform the test with an Acoustic Concrete Tester.

*GRL performs low strain dynamic testing in general accordance with the latest version of ASTM D5882, Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations.*

GRL engineers, inc.
Dynamic Measurements and Analyses

***Quick response . . . results you can trust***

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## CROSSHOLE SONIC LOGGING (CSL)

GRL performs CSL on drilled shafts that have been pre-prepared for the test. CSL requires that steel or PVC access tubes be installed in the shaft prior to concrete pouring, or that core holes be provided.

**Results:** Evaluation of integrity within the perimeter defined by the tubes

Estimate of location and severity of shaft flaws and defects

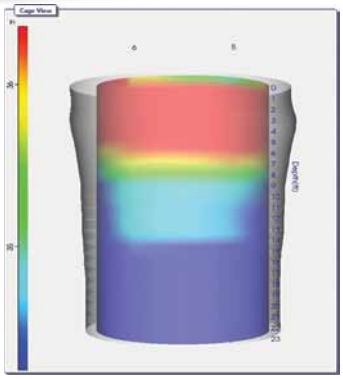
**Advantages:** No depth restrictions

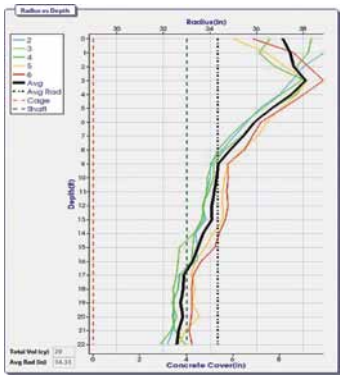
Relatively quick

**Test Procedure:** The GRL engineer lowers a receiver and a transmitter into parallel tubes. The transmitter emits a pulse, and the engineer observes its propagation signals on the screen of a Cross-Hole Analyzer. The time it takes for a pulse to travel from transmitter to the receiver, and the magnitude of the received signal, are directly related to the quality of the concrete within the travel path. GRL scans the entire depth of the foundation – each pair of tubes at a time – in this fashion. Back in the office, GRL enhances and analyzes the data with the CHA-W software, may perform a Tomography analysis, and issues a test report.

*GRL performs CSL in general accordance with the latest version of ASTM D6760 - Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing.*

*GRL engineer performing cross hole sonic logging.*





*Output graphics typically included in a GRL Thermal Profiling report. Left, general shape of the shaft. Right, estimated radius versus depth.*

## THERMAL INTEGRITY PROFILING (TIP)

GRL performs TIP to assess the quality of cast in place concrete foundations. Other potential applications include micropiles, soil nails and jet grouting columns. TIP meaures the temperature generated by curing cement. Necks, voids or inclusions tend to be indicated by cool temperatures, while bulges tend to correlate with relatively warmer ones.

**Results:** Locations of abnormalities
General shape of the shaft
Cage alignment irregularities
Concrete cover

**Advantages:** Assesses the totality of the cross-section
Relatively quick
Data collected soon after casting

**Test Procedure:** If Thermal Wire® cables are installed in the shaft prior to concreting, GRL supplies Thermal Acquisition Ports (TAP) for installation at the top end of each cable. TAPs continuously collect temperature data from the time concrete is poured. After the curing process is past its peak heat generating point, TAPs are disconnected and data transferred to a TIP. A GRL engineer uploads TIP data to a computer for analysis with the TIP Reporter software.

If access tubes are installed in the shaft prior to concrete pouring, the GRL engineer goes to the job site at approximately the time when the curing process is at peak heat generation. The engineer lowers a Thermal Probe into each tube, scanning the entire depth of the foundation to collect temperature data. The temperature versus depth record is evaluated in the field on the screen of a Thermal Integrity Profiler (TIP), and is later uploaded to a computer for analysis with the TIP Reporter software.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