



## Thermal Integrity Profiling

Thermal Integrity Profiling (TIP) uses the temperature generated by curing cement along the entire length of a foundation element to evaluate concrete integrity inside and outside the reinforcing cage. TIP can be used to assess the integrity of drilled shafts, augered cast-in-place piles, barrettes, slurry wall panels, and soil nails. Necks, voids or inclusions are generally indicated by cooler than average temperatures, while bulges or increases in cross section correlate with higher than average temperatures. For circular elements, the foundation shape, average effective radius, reinforcing cage alignment, and concrete cover can be evaluated.

### Test Preparation

GRL Engineers reviews the construction drawings to determine the number, length, and potential splice requirements for Thermal Wire® cables. GRL then supplies the Thermal Wire cables for installation in the element prior to concreting or grouting. The cables have digital temperature sensors located every 12 inches over the portion of embedded cable length. At the start of construction, a GRL engineer will work with and train the contractor's designated personnel on proper wire attachment and field documentation procedures. For drilled shafts, slurry wall panels, and barrettes, the Thermal Wire® cables are attached to the reinforcing cage. For smaller diameter augered piles and soil nails, the cables are attached to a reinforcing bar equipped with centralizing spacers. GRL also supplies the necessary number of Thermal Acquisition Ports (TAP-Edge) and a Thermal Integrity Profiler tablet. A TAP-Edge box is attached to the top end of each cable after the concrete or grout is placed. The TAP-Edge collects temperature data at regular time intervals. GRL engineers also utilize a Thermal Aggregator (TAG) unit that collects TIP data from multiple TAP-Edge boxes attached to the same foundation element and sends the data via cellular modem to the Cloud. This technology accelerates the reporting of TIP results since the data is available in near real time by the test engineer. Pertinent construction information such as installation logs, soil borings, and concrete volume records are also required for data analysis.

### Benefits of TIP Testing

- Evaluates concrete quality inside and outside the reinforcing cage
- Accelerates construction schedule as tests are conducted during concrete curing
- Reveals necking or inclusions, bulges, variations in concrete cover, shape of shaft, and cage alignment
- Cloud enabled technology allows for data review in near real time

#### GRL Engineers, Inc.

Corporate Office  
Ohio

#### Office Locations

California	Georgia	Louisiana	Pennsylvania
Colorado	Hawaii	Massachusetts	Texas
Florida	Illinois	North Carolina	Washington



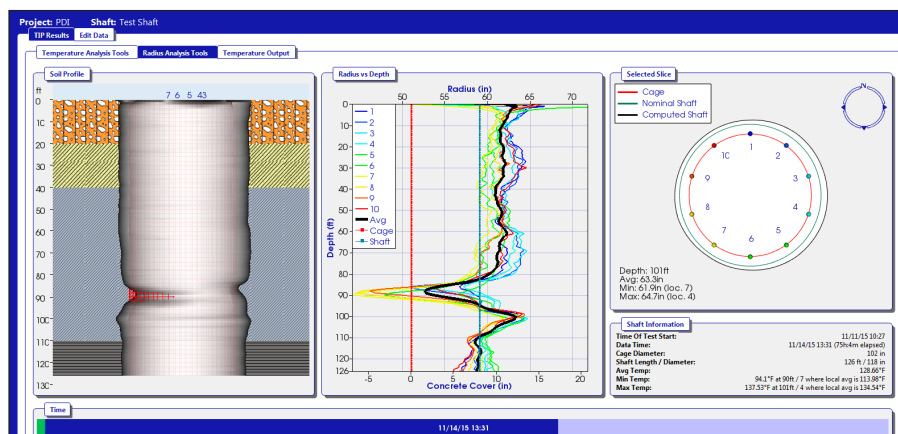
## Data Collection

The critical time for recording TIP data occurs during the curing process, until peak concrete temperature is reached. Approximately 12-24 hours after placement, a GRL engineer or trained personnel on site takes a preliminary reading from one of the TAP-Edge boxes to evaluate if the concrete has reached peak temperature. Once a determination is made that data is suitable for analysis, data is collected from each TAP-Edge box and transferred to the Thermal Integrity Profiler (TIP) main unit. Direct observation of the temperature profiles on the TIP main unit may provide preliminary information regarding the overall shape and integrity of the foundation element. After peak temperature is reached, the TAP-Edge boxes can be transferred to another shaft for data collection. Alternatively, all of the TIP data sent to the Cloud from a TAG unit can be accessed at any time and reviewed. No other integrity test method can be performed as quickly as Thermal Integrity Profiling after the construction of cast-in-place foundations.

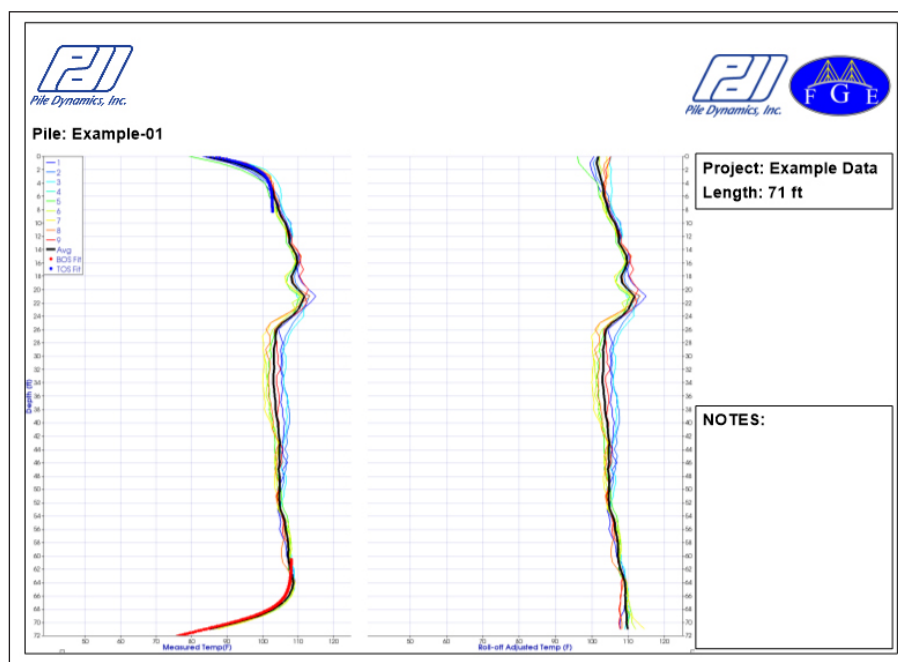
## Data Analysis and Reporting

A GRL engineer loads the TIP data to a computer for analysis using the TIP Reporter software. The TIP data consists of temperature measurements from the moment that the TAP-Edge boxes were connected to the cables until the moment they are disconnected. The engineer views this entire record of the Temperature versus Depth plots for each Thermal Wire cable and selects the most appropriate time for analysis. GRL then prepares a summary report that includes a graphic representation of the general shape of the shaft, noting depths where the effective shaft radius may vary from the design. The report also includes visual indications of cage alignment shifts and identifies areas, if any, where the concrete cover may need to be reviewed by the design engineer.

For additional information on Thermal Integrity Profiling or any other GRL Engineers service please contact [info@GRLengineers.com](mailto:info@GRLengineers.com) or visit us at [www.GRLengineers.com](http://www.GRLengineers.com).



Visual representation of shaft radius with depth and radius scale, temperature vs depth chart, and 3D shaft profile



Temperature output

### ASTM Standard

GRL performs Thermal Integrity Profiling (TIP) in general accordance with ASTM D7949 to assess the quality of drilled shafts, augered cast-in-place piles, barrettes, slurry wall panels, micropiles, soil nails, and jet grouted columns.

