GRL Engineers, Inc.

NICTD South Shore Line Extension

Project Details

Client: Stalworth Underground

GRL Office: Illinois

GRL Services

- High Strain Dynamic Testing
- CAPWAP® Analyses
- GRLWEAP Analyses
- Thermal Integrity Profiling (TIP)
- Mass Concrete Monitoring with TIP

Challenge:

The West Lake Corridor Project was introduced to expand the Northern Indiana Commuter Transportation District's (NICTD) commuter rail service with an approximately eight-mile-long extension of the South Shore Line (SSL). The project included construction of bridges, elevated structures, retaining walls, a pedestrian bridge, pedestrian tunnels, and train stations with buildings and platforms. GRL Engineers provided Dynamic Load Testing Services, Wave Equation and CAPWAP analyses for driven pile foundations. In addition, Thermal Integrity Profiling and Mass Concrete Monitoring Services were provided for the drilled foundations throughout the project.

Method and Results:

The project consisted of a total of 71 abutments which were supported on either driven piles or drilled shafts. Prior to testing, GRL utilized GRLWEAP analyses for different pile sizes and hammers to determine the suitability of hammers in achieving varying pile load requirements. GRL performed dynamic pile load tests at 51 locations with varying compression and tension loads. A Pile Driving Analyzer® (PDA) was used to monitor pile installation and CAPWAP® analyses were performed to assess the pile capacity during the initial drive and restrike. Restrike testing indicated pile setup, which was considered while generating the driving criteria. After evaluation of the PDA and CAPWAP results from the initial drive and restrikes, GRL performed refined WEAP analyses to generate pile driving criteria for production piles.

Thermal integrity Profiling (TIP™) was used in assessing the integrity of drilled shafts. Thermal Wire® cables were installed along the length of the reinforcement cage and thermal data was collected from temperature nodes located at one foot intervals along each wire length. After concrete placement, the cables were connected to data collectors (TAG and TAP Edge) which collect temperature data during concrete curing and automatically transmit data to a remote secure cloud database. The thermal data collected was analyzed at approximately peak temperature and assessed for anomalous temperature readings along the shaft length. This method was implemented to determine the integrity over the entire cross-section of the shaft. The test results are presented as graphs of measured temperature vs depth (Figure 1), estimated effective radius vs depth (Figure 2) and a 3D representation of the tested shaft (Figure 3). The anomalous zones are indicated by a sharp reduction in temperature and a corresponding decrease in effective radius. The tested shafts did not exhibit an anomaly and integrity of the shafts appeared as expected for the conditions encountered during the installation.

Mass concrete monitoring also performed utilizing Thermal Wire cables along the length of the reinforcement cage. Additionally, a wire with a single temperature sensor was placed near the shaft center. The sensor measured the temperature of the curing concrete at the specified depth at the shaft center. The maximum temperatures near the shaft center and the maximum differential temperature were measured. Mass concrete monitoring results can be viewed in Figure 4.
To learn more about GRL Engineers, visit www.grlengineers.com or email us at info@grlengineers.com.

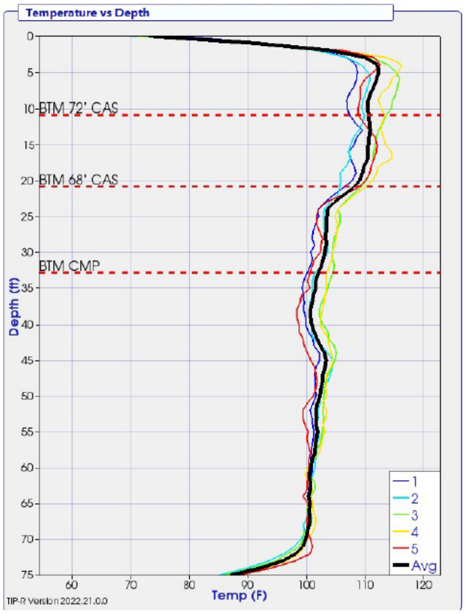

Figure 1. Sample Shaft – Temperature vs Depth

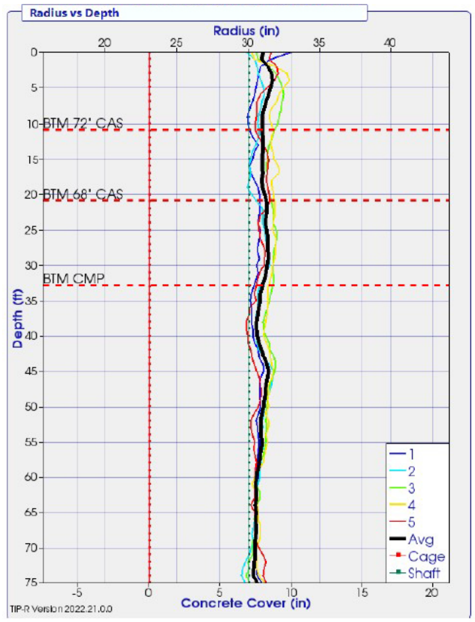

Figure 2. Sample Shaft – Estimated Radius vs Depth

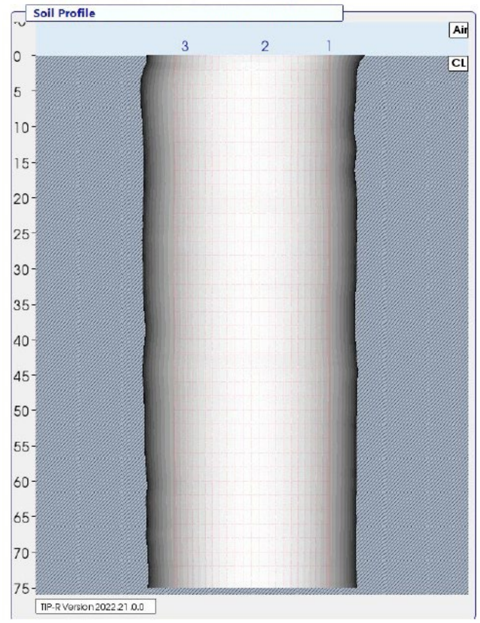

Figure 3. Sample Shaft – 3-D Interpretation with Reinforcing Cage Displayed

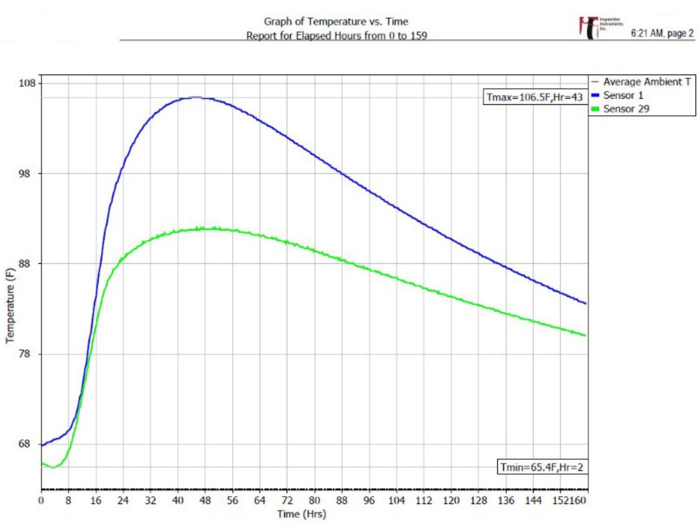

Figure 4. Mass Concrete - Temperature vs Time