GRL Engineers, Inc.

Tri-State Tollway (I-294) Mile Long NB Bridge

Challenge:

The Mile-Long Bridge has been in use since 1958. It carries up to 150,000 vehicles per day over two major railroads, three waterways, several local roads, and over major distribution centers for UPS and BNSF Railway. The original bridge requires frequent repairs resulting in traffic disruptions as it nears the end of its service life and is being replaced by new NB and SB structures. The Mile-Long NB Bridge Project consist of 27 spans supported by 26 piers. Each pier is generally supported by five drilled shafts with a diameter of 4 to 5 feet. The new foundations for the NB bridge began in the summer of 2019 and continued until summer 2020. Crosshole Sonic Logging (CSL) testing was specified to evaluate drilled shaft integrity. Stalworth Underground, along with GRL Engineers, proposed Thermal Integrity Profiling (TIP) services as an alternative test method. The TIP method was preferred by the contractor based on ease of thermal wire installation and quicker availability of integrity test results.

Method:

GRL provided the TIP wires and data collection equipment as well as on-site training for thermal wire installation. Following concrete placement, the drilled shaft contractor attached the Thermal Acquisition Ports (TAPs) and a Thermal Aggregator (TAG) box to each completed shaft. The TIP data was sent to the Cloud system from each TAG unit for data review and integrity assessment as each shaft cured. With this method, site visits were not required to perform the integrity testing. The thermal data collection was completed after each shaft reached its peak temperature, typically within 48 hours after concrete placement. The data was then analyzed using TIP-Reporter Software provided by Pile Dynamics Inc.

GRL performed TIP analysis and reporting for the approximately 150 shafts that support the NB bridge. For each shaft, the TIP data was preliminarily reviewed to identify any apparent issues shortly after concrete placement, and the thermal data was fully analyzed after each shaft reached peak temperature (approximately 24 to 40 hours after placement). Utilizing TIP, the integrity testing process was completed significantly faster than with CSL testing, which required 5 to 7 days curing time after shaft placement. Additionally, the Thermal Integrity Profiling method did not require testing personnel to visit the site for performing on-site testing, resulting in lower testing costs.

Project Details

Client: F.H. Paschen, S.N. Nielsen & Associates LLC

Drilled Shaft Contractor: Stalworth Underground LLC

Owner: Illinois State Toll Highway Authority

Location: Willow Springs, IL

GRL Office: Illinois

GRL Services

- Thermal Integrity Profiling (TIP) Installation Training
- TIP Data Analysis and Reports

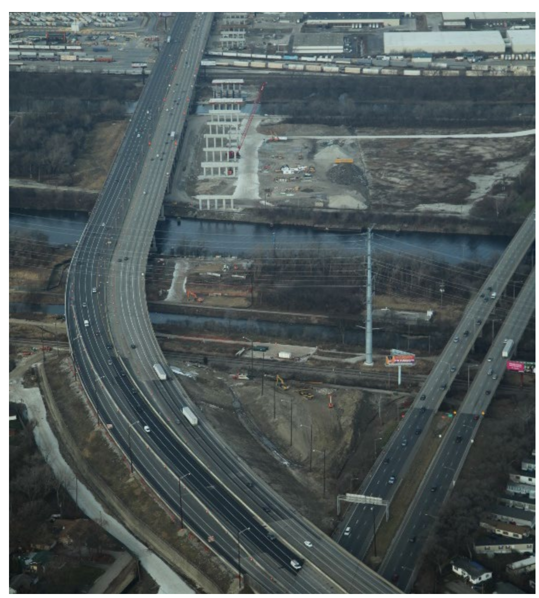

Figure 1: Aerial View of Mile Long Bridge During Construction – Photo Courtesy of Brian Fritz Photography

Results:

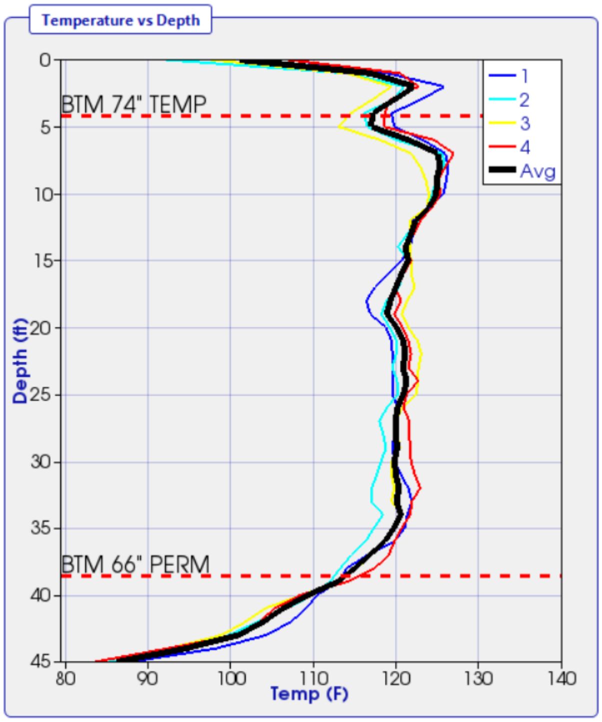

Figure 2: Individual Thermal Wire and Average Temperature vs. Depth graphs for a tested shaft.

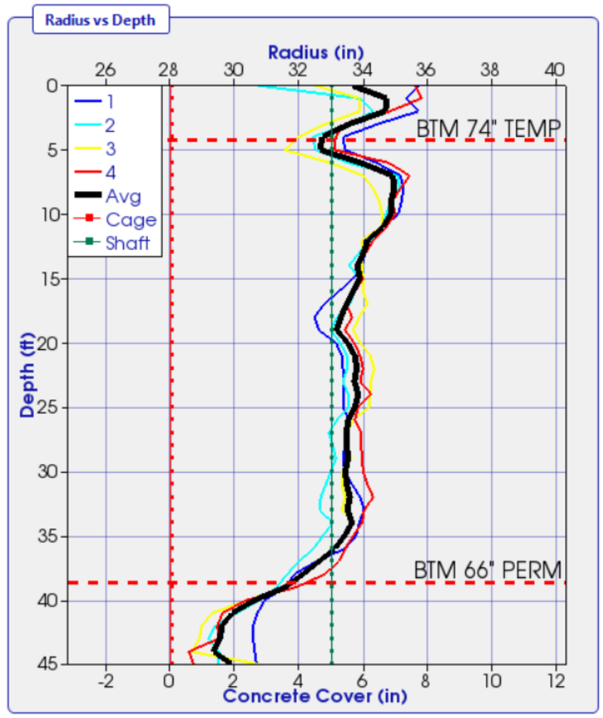

Figure 3: Effective Radius and Concrete Cover vs. Depth graphs for a tested shaft.

Representative TIP results for this project are presented in Figures 2 and 3. The temperature vs depth graphs in Figure 2, presented at peak temperature, indicate a temperature of approximately 120 degrees Fahrenheit over the majority of the shaft length. Rolloffs in the concrete temperature occur near the shaft top due to losses to the air and in the lower portion of the shaft due to a reduced diameter rock socket and the cooler rock temperature at the base of the shaft. Once adjusted for the measured air and known soil/rock temperatures at the shaft top and the bottom, the test results are processed using the placed concrete volume to obtain the effective radius versus depth graph presented in Figure 3. This test data indicates the average radius is oversized in the upper 15 feet and then reduces to the approximate nominal diameter (as expected) to the top of the rock socket near 39 feet. A further reduction in effective shaft radius consistent with the location of the rock socket is evident and the rock socket is the expected diameter.

Both CSL and TIP are effective test methods frequently specified to evaluate shaft integrity. TIP is often attractive based on the ease of TIP wire installation compared to the attachment of steel CSL tubes, as well as the earlier testing and reporting of shaft integrity possible with the TIP method and the Cloud. Please contact our office to discuss the merits of both methods and best application for your project.

To learn more about GRL Engineers, visit www.grlengineers.com or email us at info@grlengineers.com.