Northwest Railroad Bridge Project

Challenge:

GRL Engineers provided testing services for one of the largest freight railroads in North America. The Class 1 railroad company decided to build a second rail bridge over the lake, adjacent to the existing rail bridge to relieve the congested condition. The upgrades would allow the trains to run in both directions simultaneously, thus improving the traffic flow. The geotechnical engineers, McMillen Jacobs Associates designed the pile foundations and provided inspection of pile installations. Ames Construction, Inc., was the contractor and contracted GRL Engineers to provide wave equation analysis and dynamic pile testing on the connector railroad. GRL Engineers performed dynamic testing on 3 indicator piles and 31 production piles. The pile sections selected for this bridge included 36-inch diameter open ended pipe piles and HP 14x89 H-piles. The piles were installed and tested with an APE D 80 single acting diesel hammer. The soil is predominantly soft clay, although it is variable across the site, with interbedded layers of silt, sandy silt, and clay. Previous experience near the site indicated the potential for significant pile capacity increase with time (i.e., soil set-up).

Project Details

Client: Ames Construction, Inc.

Location: Northwest USA

GRL Office: Washington

GRL Services

- GRLWEAP Wave Equation Analyses
- PDA Dynamic Load Testing

Method:

The project specifications required dynamic pile testing be performed on 3 indicator piles during restrike driving at approximately 7, 14, 28, 35, 42, and 49 days after initial driving. The intent was to assess the soil set-up anticipated for the site and to maximize efficiency of restrike testing. Dynamic pile testing was also specified to be performed on 31 production piles at approximately 7, 14, 28, and 35 days after initial driving. In addition to evaluating ultimate capacity during Dynamic Load Testing, the pile stresses and pile integrity were assessed, as well as the hammer efficiency.

Results:

Initially, a restrike was performed 7 days after installation of the first indicator pile, which showed an ultimate capacity of 550 kips with 445 kips in shaft friction. The penetration of the pile was approximately 150 feet below the mudline. Additional restrikes were performed on this pile at the 14, 24, 33, and 46-day marks, with ultimate capacities continuing to increase to 610, 820, 900, and 955 kips, respectively. These results were lower than expected which provided reason to believe the piles needed more time before performing a final restrike. That final restrike was performed 105-days after initial driving and indicated a pile capacity of 970 kips (700 kips in shaft friction and 270 kips end bearing). The results indicated the expected capacity increase trend with time. After waiting 105 days from its initial testing, the indicator pile showed an increase in overall capacity by a factor of 1.76. **Figures 1 and 2** show plots of the data from the 7-day restrike and the 105-day restrike.

Upon completion of testing the designer was able to utilize the results to determine where, increased pile penetrations were necessary. The maximum depth of a 36-inch indicator pile below mudline was 244 feet. This pile also indicated the maximum shaft friction of 855 kips. Most piles tested had a penetration below mudline of less than 200 feet. This project was an unusual use of restrike dynamic testing results to optimize the foundation.

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

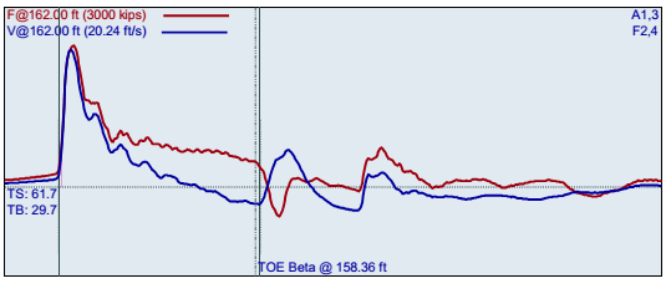

Figure 1. Force and velocity / Wave-up and Wave-down data from 7-day restrike testing

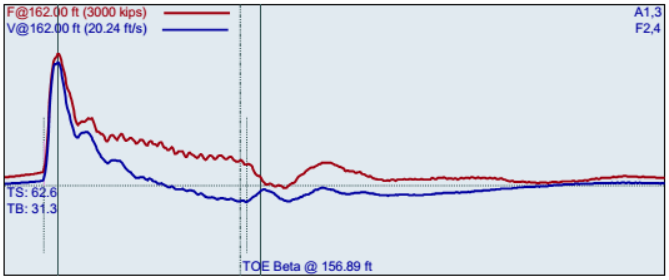

Figure 2. Force and velocity / Wave-up and Wave-down data from 105-day restrike testing