DID YOU **KNOW?**

GRL Florida worked on the project with the longest single-piece concrete beams in the USA: US 17-92/SR 436

Pile Dynamics, Inc.

GRL engineers, inc.

NEWSLETTER No. 82 - September 2016

PDI-TOMO Helps GRL Evaluate Shaft

Anna Klesney and Gina Beim

Crosshole Sonic Logging (CSL) evaluates the integrity of the concrete of drilled shafts and other cast-in-place deep foundations. Ultrasonic transmitters and receivers are inserted in water-filled tubes pre-installed in the foundation. A signal generated by the transmitter travels through the concrete and is picked up by the receiver in another tube. An instrument such as PDI's CHAMP-XV collects the data as the probes are raised from bottom to top. The test is repeated for all pairs of tubes; data collected from each pair is called a profile. An important result is the time when the signal first arrives at the receiver, called First Arrival Time (FAT). The speed at which the signal travels in the concrete, which is distance between tubes divided by FAT, gives some indication of concrete quality. The signal strength at the receiver, typically called "Energy", is also helpful in assessing concrete quality; a large reduction in signal strength indicates a potentially serious defect in the shaft.

The interpretation of CSL results benefits from comparisons with nearby similar shafts, knowledge of soil conditions and installation details, engineering judgment, and experience. The standard CHAMP-XV processing software displays FAT and Energy versus foundation depth and the location of potential defects for each profile, but does not provide an estimate of the extent of the defect. Tomography analysis was therefore developed to supplement standard CSL analysis. It combines FAT data from all pairs of tubes, interprets the combined profiles and produces a representation of the shaft, with different colors indicating ranges of measured data. This allows a better visualization and estimate of the scope of potential problems.

Software for tomography analyses of concrete foundations had been available for several years, but the recent release of PDI-TOMO considerably improved their speed, ease, and reliability. GRL offices in Texas and Colorado used PDI-TOMO to enhance the results supplied to their clients in recent projects.

GRL tested all four drilled shafts of a bridge foundation pier in the Southwestern United States. The 152 cm (60 inches) diameter, approximately 6 m (20 ft) long shafts were each installed with four steel access tubes. Subsurface conditions were mostly silty sand and sandy-silty clay over sandstone. CSL was performed within 40 days of concrete placement. Four perimeter profiles and two diagonal ones were collected.

GRL used a project specified drilled shaft defect classification system which took into account percent increases in FAT. Based on that classification, three of the four shafts received an overall satisfactory (G) rating. One of the shafts, however, exhibited increases in FAT between 25 and 90 percent and reductions in signal strength of up to 12.7 dB on all six profiles, near the bottom of the shaft. It therefore received a rating of poor (P/D) (see the GRL/PDI September 2007 newsletter for criteria for evaluating CSL data). One of those profiles is shown in Figure 1. It is representative of the other five.

The fact that problems were present in all six profiles led to the suspicion that poor material was likely present throughout the cross section. GRL followed recommended practice of attempting to quantify the area of poor material, since defects covering the entire horizontal extent may affect the structural integrity of the foundation element and require repair. This evaluation was performed with PDI-TOMO, and confirmed the suspicion of poor material throughout. Figure 2 shows PDI-TOMO results of an effective area of essentially zero below a depth of 5.9 m (19.5 ft). GRL was satisfied with the quality of the test data and with the performance of PDI-TOMO. Coring confirmed the findings of CSL and tomography, resulting in pressure grouting being performed as a corrective action.

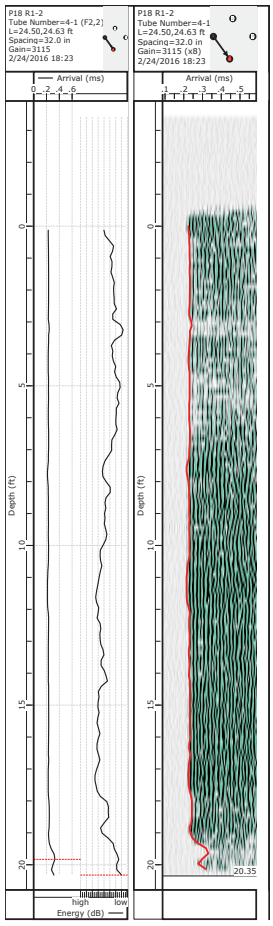

Figure 1

In as much as nobody appreciates receiving a bad diagnosis, engineers recognize that if a problem exists, it should be brought to light as expeditiously as possible, so corrective actions may be taken and the safety of the public protected. Prompt attention to potential problems also likely eliminates expensive remediation costs. Constantly improving technologies and testing practices – such as tomography with PDI-TOMO - help achieve a more complete diagnosis when CSL reveals significant problems.

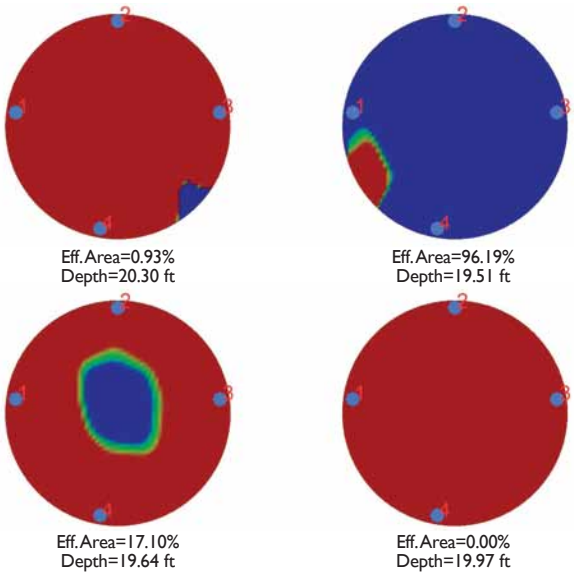

Figure 2

Highlights of the 2016 Calendar of events (Sept-Feb 2017)

More events, info and registration forms at www.pile.com/events

Pile Dynamics Seminars on Deep Foundation Integrity Testing and Wave Equation Analysis, followed by High Strain Dynamic Foundation Testing Workshop and Proficiency Test Workshops - 3 opportunities around the world, all featuring senior PDI engineers as instructors:

September 21-23 in Guilin, China, in cooperation with Earth Products China, with Dr. Liqun Liang

October 5-7 in Cleveland, Ohio, in cooperation with the Pile Driving Contractors Association, with Garland Likins, Brent Robinson and Ryan Allin. Info: Steve@piledrivers.org

November 8-10 in Amsterdam, the Netherlands, in cooperation with GSP, with Dr.-Ing. Oswald Klingmueller, Frank Rausche, Ph.D., P.E., D.GE and Dr. Ing. Matthias Schallert. Info: af@gsp-mannheim.de

PDI and GRL Webinars - Learn without leaving your desk.

All webinars require Internet and phone connection, last approximately 2 hours and start at 9:00 am Eastern Time (New York Time). More details and registration on www.pile.com/events or email registration@pile.com:

October 18-26 – Wave Equation Analysis of Piles using GRLWEAP with Frank Rausche and Ryan Allin

November 8-16 – Advanced Applications of CAPWAP® 2014 Software with Brent Robinson

November 29 – Thermal Integrity Profiling of Concrete Foundations with George Piscsalko

December 6 – Pile Driving Hammer Performance with Frank Rausche

December 7 – Load Testing and Quality Control of Pile Foundations with Ryan Allin

December 13-14 – Integrity Testing of Concrete Foundations by Low Strain Dynamic Testing and Cross Hole Sonic Logging with Ryan Allin

January 17-18, 2017 – Benefits of Sensors at Multiple Depth Locations in Foundation Testing with Brent Robinson and Van Komurka

GRL, PDI and/or PDI representatives will participate in the following events *(a good chance to learn about new developments!)*

September 21-22 in Charleston, SC: Visit the PDI booth at the PDCA 17th Annual DICEP Conference

October 2-5 in Vancouver, Canada: Visit both the GRL booth and the PDI booth at the Canadian Geotechnical Society's Geovancouver 2016

October 12-15 in New York City, NY: Visit PDI at Booth 811 at the Deep Foundations Institute's 41st Annual Conference on Deep Foundations. George Piscsalko will make a presentation on Thursday the 13th.

November 7-10 in Biloxi, MS: Visit PDI at Booth 39 at the 47th Annual Southeastern Transportation Geotechnical Engineering Conference.

GRL Welcomes New Engineers

GRL has welcomed three new engineers to its staff since our last newsletter. Rozbeh B. Moghaddam, Ph.D. P.E. (Central Office), Georges Valcour, E.I. (Florida Office), and Patrick Baccarini (Pennsylvania Office).

Rozbeh has a Doctorate in Geotechnical Engineering from the Texas Tech University, an MBA from the Eastern New Mexico University and a Civil Engineering Degree from Instituto Politecnico Nacional in Mexico City. He has more than one decade of academic and professional experience on deep foundations and underground structures.

Georges has a B.S in Civil Engineering from the Rose-Hulman Institute of Technology, while Patrick has a B.S in Civil Engineering from the Pennsylvania State University. Both are promising young engineers who are quickly developing their deep foundation testing skills.

Rozbeh B. Moghaddam, Ph.D. P.E.

Georges Valcour, E.I.

Patrick Baccarini

ASTM Updates Two Standards

The American Society for Testing and Materials, ASTM, has revised two standards relevant to readers of our newsletter. Both may be obtained from **www.astm.org/Standard/index.html**.

D5882-16 - Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations now encourages considering the soil profile, construction method, site records and results of tests on other foundations at the same site when evaluating data obtained by this method, which is often performed with the Pile Integrity Tester. Depending on the type of deep foundation tested, it also suggests examining data from concrete placement automated monitoring, concrete cylinder or core strength tests, crosshole sonic logging and thermal integrity profiling.

D4633-16 - Standard Test Method for Energy Measurement for Dynamic Penetrometers now calls for the calibration of the accelerometer and of the instrumented subassembly not only "as required in the quality assurance plan (…), recommended by the manufacturer, or every three years, whichever is least", but also if any maintenance, such as a repair, is performed on the instrumented subassembly. Changes were also made on terminology and on the number of significant digits required on energy measurements.

Jim Dessoffy Retires from PDI

Jim Dessoffy is retiring after 36 year as a member of the electrical engineering design staff. If you are a customer of Pile Dynamics, you have most likely used an instrument that Jim helped design! We wish Jim the best in his forthcoming adventures.

www.pile.com: *the portal for deep foundation testing services, instruments and software*

GRL Engineers, Inc.
216-831-6131
info@GRLengineers.com
www.GRLengineers.com
California • Colorado • Florida • Illinois • Louisiana
North Carolina • Ohio • Pennsylvania • Texas • Washington

Pile Dynamics, Inc.
30725 Aurora Road
Cleveland, Ohio 44139 USA
+1-216-831-6131
info@pile.com
www.piledynamics.com

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