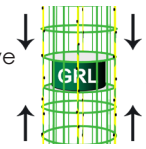
DID YOU KNOW? WHAT'S NEW

Shaft Quantitative Inspection Device **(SQUID)**



Bi-Directional GRL-Cell

Shaft Area Profile Evaluator **(SHAPE)** ***Coming Soon!***

GRL engineers, inc. Pile Dynamics, Inc.

Newsletter No. 84 - May 2017

Static and Dynamic Load Testing of Large Diameter Pipe Piles

By Ben White, P.E.

The design and application of Large Diameter Open End Pipe Piles (LDOEPPs) is of significant interest to designers. Larger foundation elements are commonly chosen to provide solutions to a variety of design challenges including vessel collision, seismic events, liquefaction, or scour. For construction of the SR 36 bridge over the Tuscarawas River in Gnadenhutten, Ohio, 48" diameter, open end, pipe piles with interior constrictor plates were chosen for the foundation type. EPA regulations restricted the amount of concrete that could be placed in the river, and therefore, a traditional cofferdam and pile cap was not an option. A static load test (designed up to 2,200 kips) was also specified to evaluate the API design methods used by the designer.

The Ohio Department of Transportation (ODOT) concurrently had funded a research project on large diameter pipe piles with Case Western Reserve University (CWRU), for which GRL had agreed to provide in-kind support. GRL, CWRU, and ODOT developed an instrumentation plan to satisfy the needs of both projects by collecting measurements during pile driving and during static load testing. The instrumentation program included 16 vibrating wire strain gages, 28 resistive strain gages, and 10 accelerometers at various locations along the pile. With help from the contractor, Complete General Construction Company, GRL and graduate students from CWRU spent 5 days instrumenting the load test pile. The results of the dynamic pile testing during production pile driving will also be included in the research study.

The static load test pile was just 50 feet in total length, but was instrumented at six elevations and included over 2,000 feet of instrumentation wire and 250 feet of steel angle for wire and gage protection. The constrictor plate was located 20 feet above the pile tip and was a reinforced flat steel plate with a 23" opening in the center to allow soft soils to pass and alleviate trapping water during driving. The pile was driven with an APE D100-42 diesel hammer to 40 feet embedment into dense sand and gravel. Dynamic data was collected with three Pile Driving Analyzers® during driving, each collecting up to 14 individual channels of data through wireless connection. At the end of initial driving, data analysis using CAPWAP® software indicated the soil resistance was well below the required ultimate bearing capacity. Restrike testing two weeks later indicated a 40% increase in soil resistance. For comparison, dynamic monitoring was also performed on one reaction pile which did not have an interior constrictor plate. These results indicated that the reaction pile without the constrictor plate had 60% less compression capacity at the end of driving and during restrike than the pile with the constrictor plate. This demonstrated the effectiveness of the interior constrictor plate to increase the soil resistance by forcing a soil plug.

The static load test was performed 16 days after the restrike dynamic test using the ASTM D1143 quick test loading procedure. The pile was loaded to plunging failure, a success for research purposes. However, the initial pile capacity from the load test load cell measurements was well below the required ultimate bearing capacity. Through comparison of the pile forces determined from the strain measurements along the pile length, confirmed by the calibrated hydraulic jack pressure gage readings, it was determined that the load cells were under predicting the actual applied load and that the pile had achieved a capacity in excess of the required ultimate bearing capacity.

LESSON LEARNED: Always have a means of checking which load measurement system is "correct"!

Load transfer data from the static load test instrumentation was compared to the CAPWAP determining the resistance distribution to further refine pile and soil modeling in the CAPWAP program (This has always been a challenge, see PDI/GRL Newsletter No. 79; September 2015). The collected data will be used to further evaluate design methods, develop finite element models of LDOEPP's with constrictor plates moving through soil, and evaluate appropriate modeling of the pile and soil plug in the CAPWAP program. A special thanks to all involved from the Ohio Department of Transportation, Case Western Reserve University, and Complete General Construction Company. Keep an eye out for publications of the findings of this load testing program!

Upcoming Events

For a complete list of 2017 events and contact information, please visit www.pile.com/events

MAY

23-31: Webinar: Advanced Applications of CAPWAP® 2014 Software

JUNE

4-8: The International Bridge Conference (booth #127)
6-14: Webinar: Wave Equation Analysis of Piles using GRLWEAP
14-16: SuperPile '17 (booth # 215 & 216)
28-30: PDCA Annual Conference (booth #207)

AUGUST

1-3: ADSC Summer Meeting
14-15: Seminar & Workshop: PDCA & PDI Deep Foundation Integrity Testing & Wave Equation Analysis; High Strain Dynamic Testing & Proficiency Test Bangkok, Thailand
17-18: Seminar & Workshop: PDCA & PDI Deep Foundation Integrity Testing & Wave Equation Analysis; High Strain Dynamic Testing & Pro iciency Test Sydney, Australia

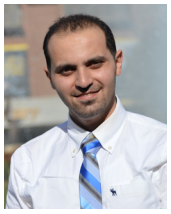
SEPTEMBER

17-20: AREMA Railway Interchange (booth #3888)
19: Webinar: Quality Control of Drilled Shafts
27-28: 19th Annual PDCA DICEP Conference

OCTOBER

11-13: Seminar & Workshop: PDCA & PDI Deep Foundation Integrity Testing & Wave Equation Analysis; High Strain Dynamic Testing & Proficiency Test Cleveland, Ohio

GRL Welcomes Two Engineers



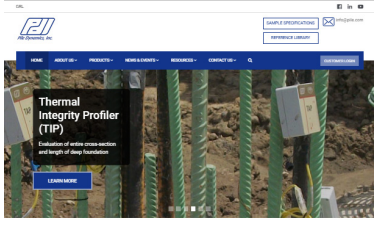
GRL Engineers has expanded its personnel with the addition of Mehdi Alirezaei, PhD. And Joel Webster, E.I. Dr. Mehdi Alirezaei joins the GRL Florida office after recently completing his Ph.D. in Civil Engineering from the University of Central Florida. Mehdi has international experience in project management and planning in oil and energy mega-projects as a structural designer working with a broad range of codes.

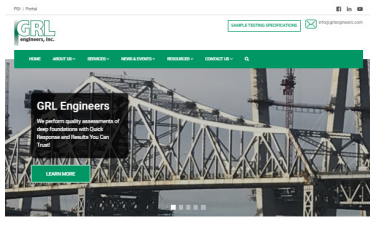
Joel Webster joins GRL North Carolina with two years of site design and structural engineering experience. He graduated from NC State University with his Bachelor of Science degree in Aerospace Engineering.

Welcome Mehdi & Joel!

PDI and GRL Launch Newly Redesigned Websites

This month, both Pile Dynamics and GRL Engineers launched their newly redesigned websites. The objectives of the site development efforts were focused on simplifying navigation and content, while enhancing mobile and tablet viewability. The new designs also allow streamlined menus, responsive layout for all platforms, and direct download of content. We invite you to explore each site at www.pile.com and www.grlengineers.com.





Bi-Directional Load Testing with GRL-Cell

Bi-Directional Load Testing is a high capacity static load test method for drilled shafts, bored piles, barrettes and ACIP/CFA piles. As the GRL-Cell is pressurized, it loads the foundation element in two directions. The portion of the foundation element above the cell location is pushed upward against its shaft resistance, and the portion of the foundation element below the cell location is pushed downward against the toe bearing or "base resistance" and against any shaft resistance below the cell. Shaft and toe movements, as well as embedded strain gage instrumentation, are monitored for each applied load. An equivalent top load movement curve is constructed from the measured shaft resistance load-movement and base resistance load-movement responses. Contact info@grlengineers.com for additional details on our bi-directional services and the GRL-Cell, manufactured and calibrated in Cleveland, OH.

Pile Dynamics, Inc. Celebrates 45 Years in the Deep Foundation Industry

2017 marks the 45-year milestone for Pile Dynamics, Inc. (PDI) as the largest manufacturer of foundation dynamic testing equipment in the world. PDI has experienced steady and continuous growth since the early days when Dr. George Goble, Dr. Frank Rausche and Garland Likins combined their expertise and passion to create a firm dedicated to developing quality assurance instruments for the deep foundation industry. Our original and still flagship product, the Pile Driving Analyzer® (PDA) is the industry's most trusted high strain dynamic load testing and pile driving monitoring system. While the driven pile market has benefitted for decades from PDI products, PDI has developed an impressive array of QA/QC devices for drilled and augured pile foundations. Today, PDI has over 20 products and software applications specifically designed for all types of deep foundations and continues to innovate through the development of quality assurance/quality control testing equipment and technologies. We are expanding our international support with Anna Sellountou, Senior Engineer, now operating in Greece to better support the European community. Anna will continue her involvement in supporting codes and committee assignments internationally as well. With over 60 employees and clients in 100+ countries, PDI continues its commitment to quality, research, innovation and superior customer care.

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