DID YOU KNOW? *Newsletter No. 101 - April 2022*

GRL Engineers performed testing on the Seattle Center Climate Pledge Arena, which is the first zero-net-carbon arena built in the world.

GRL Engineers, Inc.

Pile Dynamics, Inc. CELEBRATING 50 YEARS! 1972 - 2022

New Technologies Open New Possibilities

By Scott Webster, P.E.

In the past 10 years, Pile Dynamics, Inc. (PDI) has developed several new products while further refining and expanding use of its legacy products, i.e. Pile Driving Analyzer® (PDA) based dynamic pile testing systems. Some of the new developments include Thermal Integrity Profiler (TIP™), Shaft Area Profile Evaluator (SHAPE®), Shaft Quantitative Inspection Device (SQUID™), and the Static Load Tester (SLT). All have been utilized by GRL Engineers on numerous projects. In addition, GRL now offers Bi-Directional Static Load Testing (BDSLT) services which dovetails nicely with all PDI's new product developments. Specifically, GRL has provided TIP, SHAPE and SQUID testing for nearly all their BDSLT tests performed during the past few years. The additional testing (SHAPE, SQUID and TIP) provides specifics of the shaft construction which are used in the assessment of the BDSLT results. In addition, PDI's SLT system has been developed to reduce installation time and complexity of deep foundation loading tests with numerous load, strain and displacement sensors.

SHAPE Testing – Shaft Verticality

SHAPE provided testing of approximately 400 drilled shafts at a new interchange project in Houston, TX. The shafts ranged in diameter from 36 to 96 in (1 to 2.4 m) with lengths up to 105 ft (32 m). Project specifications required that the verticality of the drilled shafts be verified, and that the shafts be installed to a tolerance of 1 in (25 mm) of centroid deviation for every 10 ft (3.5 m) of drilled shaft length, or 0.83%. This requirement is more demanding than normally specified and required coordination between the drilled shaft contractor and onsite GRL personnel who performed the SHAPE tests and assessed the compliance of the shaft verticality with project specifications. Approximately 10% of the shafts required re-drilling to bring the shafts into compliance. Typically, the time required for SHAPE testing and result presentation was less than 20 minutes.

Image 1. Shaft Area Profile Evaluator (SHAPE) descending into drilled shaft

SQUID – Cleanliness and Competency

SQUID testing is most commonly performed to assess the cleanliness of the drilled shaft bottom or toe area. This system uses three penetrometers and three displacement plates to quantitatively measure the amount of soft soil or debris at that bottom of a drilled shaft. Using both force and displacement, the thickness of unsuitable material is determined. While assessment of base cleanliness is the primary function of the SQUID system, the suitability of the end bearing layer may also be assessed from the penetrometer readings as they are pushed into the underlying soil much like a CPT. As noted above, GRL has provided SQUID testing for their BDSLT tests when possible.

The end bearing resistance of the BDSLT and SQUID penetrometer resistances have been compared to establish a correlation between static load test results and the predicted end bearing of the SQUID. Early indications are that a relationship can be developed based upon these results making SQUID results suitable for either assessing or confirming the desired end bearing.

Image 2. Shaft Quantitative Inspection Device (SQUID) descending from drilled shaft

TIP for Mass Concrete

The American Concrete Institute (ACI) identifies mass concrete as concrete volumes large enough to be subject to temperature gradient induced cracking. As such, many designers consider drilled shafts with diameters greater than 4.5 to 6 ft (1.4 to 1.8 m) falling in the mass concrete category. In these conditions, the primary concern is the temperature differential between the center of the drilled shaft and the outer edges, as well as the maximum concrete temperature achieved during curing.

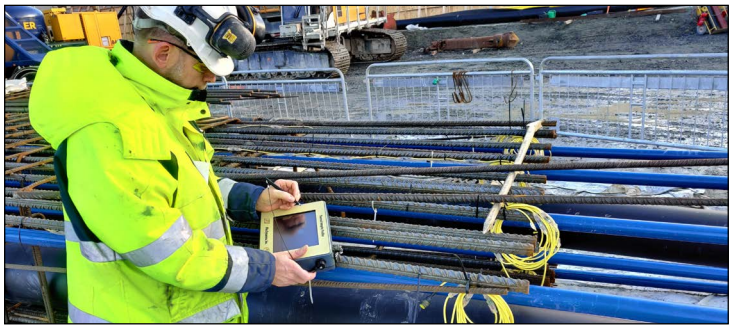

Image 3. Thermal Integrity Profiling for Mass Concrete

Thermal Integrity Profiling or TIP is ideally suited to monitor mass concrete. If integrity testing by TIP is already planned, then simply adding one additional thermal wire attached to a rebar located near the shaft center at the desired depths will be sufficient to measure the temperature gradient. For economy, this additional center TIP wire may be equipped with only a few temperature sensors in the most critical areas. All TIP cables are connected to a standard TAP-Edge box which records and transmits the measured temperatures every 15 minutes. The center sensors will capture both gradient and maximum concrete temperature at the measurement locations. The former is obtained by comparing the center temperature with nearby TIP measurements at the reinforcement cage.

PDA with SiteLink® Uses and Expansion

As stated in the introduction, PDI continues to improve their legacy products. One area which recently had increased usage is SiteLink,

a remote technology using the Pile Driving Analyzer (PDA). SiteLink has been utilized for many years; however, additional demand was generated by the COVID-19 pandemic where travel was curtailed, or engineers were not permitted onsite. In many cases SiteLink technology not only resulted in improved service at a reduced cost but made pile testing possible.

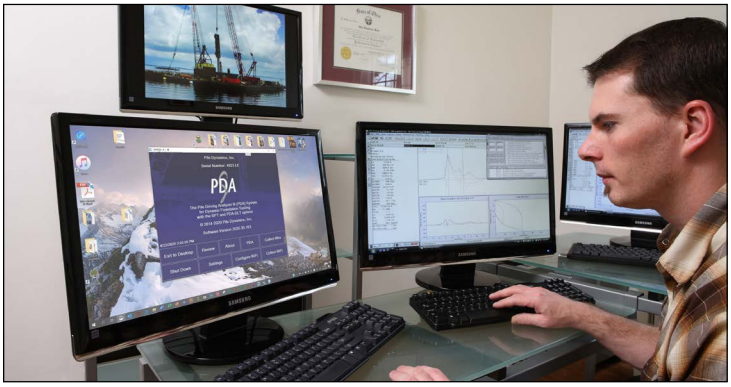

Image 4. SiteLink Remote Testing

Recently, GRL completed SiteLink offshore pile monitoring in the Gulf of Mexico. At the time, COVID restrictions prevented such travel to the site. Remote testing was therefore proposed and accepted. Equipment was shipped to the installation barge, and directions were provided for instrumentation of PDA sensors and connection of the PDA main unit via Internet to an offsite engineer in the USA. Over 11 days, 6 main piles were dynamically monitored. Each main pile consisted of 3 sections, for a total of 18 monitored pile sections. Because offshore operations run 24 hours per day, GRL dedicated 2 engineers (12 hours each per day) to be on call at their home during the pile driving operations to monitor data in real time and immediately begin the analysis work. The data collection was successfully completed for all pile sections with the same data quality that would have been achieved with GRL personnel onsite. More recently, a project in Northern Africa was proposed to use SiteLink technology due to local restrictions. Again, the equipment was shipped to the project site and instructions for sensor attachment and PDA connectivity provided. Similar positive results were achieved for this project even with the 6-hour time difference.

Static Load Testing (SLT)

For many years PDI has offered a SLT measurement system which automatically recorded measurements from dial gages, jack pressure sensors, load cells and shaft internal strain gauges. PDI's recently expanded SLT main unit is now attached to data acquisition boxes that transmit data automatically at selected time intervals. Each data acquisition box can support up to 16 channels of data and multiple boxes can be daisy chained to expand the number of channels. The sensors are quickly and easily connected to the acquisition box(es) via smart universal inputs which automatically read the sensor calibrations. This system keeps the test engineer in a safe place away from the dangerous pile loading area. In addition, the data can now be read remotely in real time by office personnel if desired. GRL Engineers have provided the SLT system for conventional and Bi-Directional Load Testing on numerous test sites.

Image 5. Static load testing performed in Texas

The examples mentioned clearly demonstrate PDI's ongoing commitment to developing innovative, quality assurance testing systems. GRL assists in this process by providing real world feedback making the products effective and user friendly. As PDI celebrates its 50th year anniversary, its dedication to progress and commitment to the deep foundation industry is unwavering.

Van Komurka, P.E., D.GE., Receives the Martin S. Kapp Foundation Engineering Award

At Geo-Congress 2022, in Charlotte, NC, Van Kormuka was awarded the 2022 Martin S. Kapp Foundation Engineering Award for contributions advancing the science and practice of deep foundation and geotechnical engineering. This award was presented by ASCE's Geo-Institute. Van has written numerous publications and has contributed research on various load testing studies.

Upcoming Events

Apr 26-28	**Conference: IPF Wind** *Conference Website*
Apr 27-28	**Seminar: DFI - Dynamic Testing Results on Helical Piles with Ben White** *Register Today*
Apr 29	**Webinar: TIP Discussion Hours with Ryan Allin, P.E.** *Register Today*
May 17	**Seminar: State of Practice - QC of Deep Foundations, Houston, TX** *Register Today - PDA Proficiency Test option available*
May 17, 18, 24 & 25	**Webinar: GRLWEAP14** *Register Today*
May 19, 20 & 21	**Seminar: QC/QA of Deep Foundation Testing, Bangalore Institute of Technology, PDA Assessment Quiz** *Register Today*
Jun 15-17	**Conference: DFI SuperPile 22, St. Louis, MO** *Conference Website*
Jul 15	**Webinar: PDA Discussion Hours with Ryan Allin, P.E.** *Register Today*
Jul 22	**Webinar: TIP Discussion Hours with Ryan Allin, P.E.** *Register Today*

A complete list of PDI/GRL events can be found on pile.com or grlengineers.com

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