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EVALUATING CFA/ACIP PILES

Garland Likins, P.E. and George Piscalko, P.E.

Any deep foundation must be structurally sound and have adequate geotechnical capacity. The methods to establish that the foundation will indeed perform satisfactorily, however, vary with their type.

Driven piles are “tested piles” because the blow count (or permanent set per blow) is often correlated with static or dynamic testing, giving an indication of their structural integrity and capacity. Drilled shafts (bored piles) are designed conservatively and can be inspected prior to concrete placing, with integrity confirmed by nondestructive tests. Their capacity can be evaluated by static tests (load applied conventionally at top, or using embedded bi-directional load cells), or by dynamic testing using a large drop weight. Evaluation of Continuous Flight Auger (CFA) or Augered-Cast-In-Place (ACIP) piles is generally more complicated since during installation you cannot directly inspect structural integrity; the inability to inspect the hole prior to grouting causes some engineers to avoid this alternative. Fortunately there are methods available to monitor CFA/ACIP piles during installation and to evaluate them after construction.

Low Strain Integrity Testing (ASTM D5882) has been successfully used for decades to inspect CFA/ACIP piles for structural deficiencies. An accelerometer is attached (typically with wax) to the pile top and an input is generated by a hand-held hammer. The Pile Integrity Tester (PIT) evaluates the resulting signal for early tension reflections which indicate a structural weakness. The method should be used to look for major defects and evaluated with consideration of the soil profile. There are limitations to the tested pile length (although critical major defects occurring near the pile top are still easily found), while evaluation below the first major non-uniformity is generally inconclusive.

For larger diameter CFA/ACIP piles, Crosshole Sonic Logging (CSL; ASTM D6760) may be performed but requires multiple access tubes attached to the reinforcing cage (it is not an option if there is no cage, and for partial length cages it can only inspect the section of pile that has a cage). A transmitter probe in one tube sends a signal to a receiver probe in another tube. The probes are pulled simultaneously from bottom to

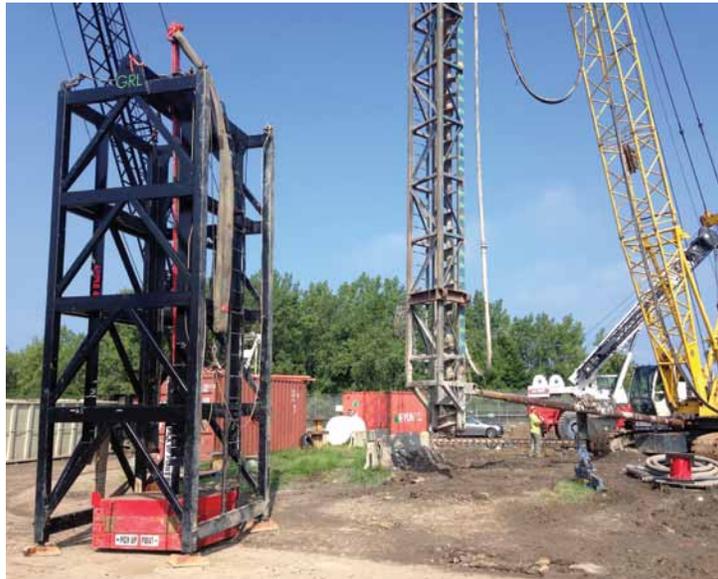
top to evaluate the signal arrival time and strength along the entire pile length; the test is repeated for each pair of tube combinations. Significant arrival time delay or weak signal strength indicate an anomaly or potential problem.

Thermal Integrity Profiling (TIP) is a new option that uses the heat of cement hydration to evaluate pile integrity. A Thermal Wire[®] cable with temperature sensors closely spaced along its length is attached to the center bar (or multiple cables attached to the reinforcing cage). If there is a lack of heat-producing cement at any location (defect) there will be a sharp reduction in temperature at that location. This method has advantages over PIT in that large bulges do not diminish the ability to evaluate the shaft below the bulge and there are no pile length limitations. Further, testing is generally done in the first day after casting rather than after the concrete has cured as PIT and CSL require, speeding construction approvals. If the center bar or reinforcing cage is not full length, TIP can only inspect the section of pile that has a center bar or reinforcing cage.

Evaluating the capacity of CFA/ACIP piles requires large forces. Traditional static load testing is always an option, but requires either a large dead weight (greater than the desired maximum test load) or anchor piles, and either can be relatively costly and time consuming. Alternately, CFA/ACIP piles can be evaluated dynamically using a drop weight of approximately 2% of the desired maximum test load. This much smaller weight requirement, and the speed inherent to dynamic

testing, typically allows a larger number of piles to be tested at a greatly reduced cost. GRL Engineers often tests these piles with one of its APPLE systems (systems weigh from 5 to 80 tons to accommodate a whole range of ultimate capacity requirements). Testing is according to ASTM D4945 and results are evaluated by the signal matching software CAPWAP[®].

By using the PIR to monitor the installation of all CFA/ACIP piles along with one or more options now available to evaluate their integrity and capacity, the designing engineer can confidently specify CFA/ACIP piles.



ACIP piles were selected for the Easterly Waste Water Treatment Plant expansion in Cleveland, Ohio. Installation cranes were fitted with Pile Installation Recorders. Seen on the foreground is the APPLE 4 system utilizing a 12 ton drop weight being used to load test 16 test piles across the site. Pile Integrity Testing is specified for 10% of the piles.

Highlights of the 2014 Calendar of events (Sept.-Dec.)

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

PDI Workshops, Seminars and Proficiency Tests:

September 17-19 in Cleveland, OH: **Seminar on Deep Foundation Testing and Wave Equation Analysis**, followed by **Dynamic Foundation Testing Workshop (PDA) and Proficiency Test**. Info: Jessica Fasanella at Jessica@piledrivers.org.

October 9-10 in Melbourne, Australia: Intensive Workshop for PDA users, and Dynamic Measurement & Analysis Proficiency Test, presented jointly with EMP Piletec Pty Ltd. Info: Richard Yu at richard@empasia.co.

October 13-15 in Jakarta, Indonesia: Seminar on Deep Foundation Testing and Wave Equation Analysis, followed by Dynamic Foundation Testing Workshop (PDA) and Proficiency Test. Presented jointly with Geotech Efathama. Info: Aksan Kawanda at aksan@geotech-indonesia.com.

PDI and GRL Webinars: Learn without leaving your desk:

September 23: Thermal Integrity Profiling of Concrete Foundations with George Piscsalko

September 23 and 24 (3 opportunities): Meet the PDA model 8G with Ryan Allin and Brent Robinson

October 28-November 5 (4 sessions): Wave Equation Analysis of Piles using GRLWEAP with Dr. Frank Rausche

November 11-19 (4 sessions): Advanced Applications of CAPWAP® Software with Brent Robinson

December 2: Pile Driving Hammer Performance Webinar with Dr. Frank Rausche.

December 3: Load Testing & Quality Control of Pile Foundations Webinar with Michael Morgano

Other Learning Opportunities

September 25-26 in Orlando, FL: Mohamad Hussein speaks at the ASCE seminar Deep Foundations: Design, Construction, and Quality Control. Info and register: www.asce.org/Continuing-Education/Seminars/Face-to-Face-Seminars/

October 16, in Cleveland, OH: Pile Dynamics, Inc. and Wagner Komurka Geotechnical Group present a Cost-Effective Driven-Pile Course. Info: registration@pile.com.

November 4 in Mannheim, Germany: PDI representative Dr. Ing. Oswald Klingmuller (GSP) presents a Workshop on Deep Foundation Integrity Testing, followed by a Workshop on High Strain Dynamic Foundation Testing on November 5. Both in German. info@gsp-mannheim.de.

PDI will exhibit the Deep Foundations Institute 2014 Annual Conference, October 21-24 in Atlanta, GA. A good chance to learn about new developments!

News Briefs

The American Society of Civil Engineers, ASCE, announced on July 24 the Thermal Integrity Profiler (TIP) as the 2015 winner of the Charles Pankow Award for Innovation.

The Deep Foundations Institute announced that Prof. Gray Mullins and his research team at the University of South Florida were the recipients of the 2014 Ben C. Gerwick Award for Innovation in the Design and Construction of Marine Foundations. That honor was granted "for practical research on multiple subjects", among them Thermal Integrity Profiling of drilled shafts.

GRL welcomes Diego Campos to its California office and Alex McCaskill to its Illinois office.

PDI welcomes Jim Zammataro to its Sales Team.

Important Announcement From Pile Dynamics

Garland Likins has recently announced that, after 36 years in his capacity of President of Pile Dynamics he would pass the torch to George Piscsalko, effective July 1, 2014. In an email to the PDI community, Garland declared that he will remain as an active principal partner in the company and, therefore, for the foreseeable future, would continue assisting in product development and helping customers with their unusual projects or difficult tasks, something he has always enjoyed doing.

Upon accepting the position, George noted that under Garland's leadership PDI evolved from a company offering just the Pile Driving Analyzer® to a company with 11 products and a host of sophisticated software applications to support them. George echoed the sentiment of the Deep Foundations industry in an open letter of appreciation to Garland: "Self-less dedication to the industry has been a hallmark of your career as you have helped educate the next generation of engineers in seminars, workshops, customer trainings and field testing around the world, from Beijing to Jakarta to Tuktoyaktuk and many points between. As author, co-author or reviewer for countless papers and journal articles, you have helped the industry to move forward with the intellectual rigor necessary for confidence in foundation testing. (...) Finally, but no less importantly, you have provided continual support to our many clients, seemingly answering emails 24 hours per day. Your great integrity, work ethic and dedication to helping our customers has defined what quality service means at PDI."

Pile Driving Analyzer® model 8G

Pile Dynamics is releasing a completely redesigned Pile Driving Analyzer system. The PDA-8G is as sophisticated in its looks as in the software that powers it. Thin, light and ergonomic, it features touchscreen gesture controls like swiping and pinch-to-zoom. All PDA 8Gs have 8 universal channels of data acquisition capable of reading data from Smart Sensors, be it in traditional (cabled) or wireless mode. This allows for extreme testing flexibility. For driven piles, improved data transfer makes it easier to test piles driven by hammers with high blow rates. Of course, SiteLink® capability for remote testing is still an integral part of the system. At the same time, an entirely new version of the CAPWAP® program is being unveiled. While it is optimized for use with the PDA-8G, this highly enhanced version is compatible with data obtained with previous PDA models. Learn more by attending one of these webinars: Tuesday, September 23 at 7 am and 9 pm or Wednesday, September 24 at 1 pm. All times are Eastern Time (New York Time). Email registration@pile.com to attend.



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 • Washington

Pile Dynamics, Inc.

30725 Aurora Road

Cleveland, Ohio 44139 USA

+1-216-831-6131

info@pile.com

www.pile.com/pdi

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