GRL engineers, inc.

Pile Dynamics, Inc.

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INSTALLATION INSPECTIONS: WHY, WHAT, WHEN?

By Frank Rausche Ph.D.

The load test passed with flying colors; all that is left to do now is to install the production piles. Why inspect the installation any further? Additional inspections will only make construction slower and more expensive and possibly cause claims. On the other hand, how can we assure that every production pile will have the same quality as the load test pile? More importantly, how can we assure that production piles will not prematurely corrode, lose strength, or have less capacity because of variable soil conditions or variable installation procedures? Whether it is a driven pile, a drilled shaft, or an augered-cast-in-place (ACIP) pile, the installation of each pile has to be done in a manner that maximizes the probability of a flawless product.

For driven piles, the simplest and most useful inspection method of production piles is counting blows. But how good is a blow count if one cannot trust the performance of the hammer in freezing or hot temperatures, or after many hours, days, weeks or even months of hard work? Since blow count also depends on hammer performance, good recordkeeping requires that the inspector also document stroke or bounce chamber pressure, fuel setting, air pressure or other hammer related parameters. The inspector may not be aware of changes in hammer performance or even operation rate (blows per minute) changes because two different observations simply cannot be counted simultaneously. A seasoned inspector may attempt the simultaneous observation, but may require more blows than necessary — "just to be sure" — thereby possibly causing unnoticed damage. Often errors arise when the inspector is trying to observe these rapidly changing events and is concurrently faced with the typical job-site distractions like someone asking an unrelated question. Lastly, counting is by any measure a boring and mistake-prone task, particularly during long periods of hard pile driving.

The driven pile is not alone in inspection problems. During ACIP pile installation the knowledgeable inspector records grout volume by "feeling" pump strokes while observing auger position and time. Although DFI's new manual for ACIP piles[1] recommends measuring "volume for incremental depth", very few inspectors actually record this information due to the difficulty of the task. Furthermore, the accuracy of visual or "felt" information is questionable. For example, depth determination is distorted by parallax or may change too rapidly, and pumps may have "false strokes" that deliver no grout volume. To complete the inspection, concrete samples must be taken, flow rates determined and other observations such as placement of rebars must be made. Obviously, it is difficult for an inspector to judge if the construction process of each ACIP production pile is similar to that of the test pile.

Tools are now available that can provide more accurate and objective observation and provide the owner or engineer with an unbiased electronic record of the installation history.

[1] Deep Foundations Institute, 2003. Augered Cast-in-Place Pile Model Specification, Englewood Cliffs, NJ.

For driven piles, the Saximeter records blow count and either open end diesel stroke or hammer energy. Hammer energy may be based on stroke or on a measurement of impact velocity. Additionally, spot checking by periodically monitoring the installation of production piles using a Pile Driving Analyzer® is the most thorough way to assess hammer performance, pile stresses, damage potential, and, most importantly, soil response variability.

E-Saximeter in use

For ACIP piles, the Pile Installation Recorder (PIR-A) accurately measures grout volume with a magnetic flow meter independently from counting pump strokes. PIR-A output clearly shows whether or not the incremental and total volume installation criteria have been met.

As drilled shafts have many different installation methods, no one instrument fits all needs. Thus, integrity testing after installation is the current assurance of a proper shaft installation. Cross hole sonic logging is now the industry standard method of checking for defects. Low strain integrity testing with a Pile Integrity Tester using pulse echo methods can also be used economically as a means to reduce the likelihood of major defects in drilled shafts or ACIP piles.

Since any foundation failure can lead to serious consequences, and the cost of inspection is far less than the cost of repairs, claims, or the foundation itself, a little common sense suggests verifying the proper installation of production piles by testing them. Documenting the installation process as production proceeds reduces disputes and claims. It provides the contractor with immediate feedback on the construction method, the engineer with sufficient and reliable information to assess the acceptability of the foundation design, and the owner with the peace of mind that the foundation is solid.

CALENDAR OF EVENTS

2003

Nov. 6-8, Cleveland, OH: Pile Dynamics presents **PDA, CAPWAP, GRLWEAP and Integrity Workshops. Call 216-831-6131 or email info@pile.com.**

Nov. 13-14, Houston, TX: ASCE presents the short course "Deep Foundations: Design, Construction, and Quality Control". For information visit http://www.asce.org.

Nov. 17, Worldwide: Foundation Courses, Inc. presents a 2 hour TeleWeb on Design of Deep Foundations Emphasizing LRFD Methods by Dr. George Goble. Participation requires Internet connection and phone. More information and registration at www.krm.com/regonline/fcsvcregs.nsf/fcs8057-0.

Nov. 17, Paris, France: Pile Dynamics presents **a Seminar on Deep Foundations Testing.** Call 216-831-6131 or email info@g-octopus.com.

Nov. 18-21, Paris, France: Pile Dynamics presents **PDA, CAPWAP, GRLWEAP and Integrity Workshops.** Call 216-831-6131 or email **info@g-octopus.com.**

2004

Feb. 4-7, Orlando, FL: Geo Support 2004 - ADSC/ASCE-G.I. Joint International Specialty Conference and Equipment Exhibition. Visit http://geo-support2004.com.

Feb. 16-17, Orlando, FL: PDCA Winter Roundtable. For information email info@piledrivers.org or visit http://www.piledrivers.org. ASCE presents the short course "Deep Foundations: Design, Construction, and Quality Control". Visit http://www.asce.org.

March 18-19, Honolulu, HI: ASCE presents the short course "Deep Foundations: Design, Construction, and Quality Control". Visit http://www.asce.org.

March 24-26, Orlando FL: Pile Dynamics presents **PDA, CAPWAP, GRLWEAP and Integrity Workshops. Call 216-831-6131 or email info@pile.com.**

April 13-17, New York NY: The 5th International Conference on Case Histories in Geotechnical Engineering, University of Missouri-Rolla; eqconf@umr.edu or visit http://web.umr.edu/~eqconf/5thCHConf/.

Aug. 8-10, Petaling Jaya, Malaysia: The Seventh International Conference on The Application of Stresswave Theory to Piles, Stresswave 2004. Contact sec@iem.po.my.

Frank Rausche Receives Prestigious Award

Dr. Frank Rausche (President of GRL Engineers, Inc.) has been awarded the 2003 Distinguished Service Award from the Deep Foundations Institute, in recognition of his work in the foundation industry over the years. The award presentation took place on October 23rd at the annual DFI meeting. Well deserved!

GRL Expands Staff

Ken Boie, M.S. and *Changsoo Hwang*, Ph.D. have joined GRL Engineers. Ken will be based in Philadelphia and Changsoo will work out of Orlando.

GRL Engineers Opens California Office

Camilo Alvarez, formerly from GRL Florida, is now office manager and lead engineer of GRL's new office in Los Angeles County. For testing and analysis questions or services, please contact Camilo at:

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GRLWEAP News

The 2003 version of GRLWEAP has now been widely distributed. Feedback has been very positive and supports the conclusions that:

1. Driveability analyses are preferred to bearing graphs.
2. Vibratory hammer analyses are now more common.
3. New or modified hammers require continuous file updating. To help you when you need hammer data entered into the file, we suggest you send us all available hammer information to speed up this process.

Notable Paper

"Proven Success for Driven Pile Foundations", by Kenneth Bell, John Davie, Jose Clemente and *Garland Likins*, was among the Bechtel Outstanding Technical papers for 2002. It appears in Proceedings of the International Deep Foundations Congress 2002, O'Neill, M. and Townsend, F., editors. ASCE, NY.

Saving 7 Miles of Piles

Megan Lee (mlee@amengtest.com) of American Engineering Testing in St Paul, MN presented "Design of High Capacity Piles Including Setup and Soil Tightening" at the Pile Driving Contractors Association (www.piledrivers.org) conference in Chicago (Sept. 2003) on Design & Installation of Cost Efficient Driven Piles. The paper focuses on closed end pipe piles for the Metropolitan Wastewater Treatment Plant in St Paul. With value engineering suggested by piling contractor L..H. Bolduc of Anoka, MN, 6 initial piles were tested with the Pile Driving Analyzer® and evaluated by CAPWAP® during driving and restrike. Based on favorable results, an additional 33 piles were subsequently tested during production pile driving with restrikes of 4 to 14 days to confirm the design, eliminating planned static tests and reducing pile lengths by about 7 miles (11 km). This overall 20% length savings of the 1,955 piles required less driving time and eliminated 85% of the splices, saving months of construction time and allowing the project to be completed on time despite a late start. **Total project savings were over $1 million.** (Editor's note: We have observed many similar creative uses and large project cost savings through dynamic pile testing programs).

HELP US KEEP YOU IN THE LOOP.
Please inform us if:
Your company has changed name, address, phone, fax, email
You receive multiple copies of our newsletter.
You want to change the contact person's name.

If we haven't heard from you in more than 5 years, we may remove your name from our mail list. Please drop us a note! Or sign up under "Newsletter" on our website (www.pile.com).

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