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FHWA Releases GEC 8 – Design and Construction of CFA Piles

By Silas Nichols (FHWA) and George Piscalko (PDI)

The Federal Highway Administration (FHWA) has recently published Geotechnical Engineering Circular (GEC) #8 – “Design and Construction of Continuous Flight Auger Pile Foundations”. CFA piles have been a popular foundation alternative in the United States private sector and in international private and public sector work for years. Until recently, CFA piles were only approved by State DOTs on a project-specific basis considering technical feasibility, suitable project conditions, project performance requirements, construction quality control and assurance procedures, and cost. GEC 8 documents the current state-of-practice and presents FHWA’s recommended guidance for the design and construction of Continuous Flight Auger (CFA) piles, including Auger Cast-in-Place (ACIP) and Drilled Displacement piles.

GEC 8 addresses several issues on which there had been lack of industry consensus, recommends pile design and construction methodologies, and identifies technology gaps in current practice. In addition, GEC 8 provides a performance-based guideline specification that addresses different equipment and installation techniques which clearly have a significant effect on the performance and acceptance of CFA piles. Several important issues addressed in GEC 8 include:

- minimum requirements on rigs and equipment
- drilling penetration rates and controls related to soil mining, subsidence, damage to nearby structures, etc., including how to monitor and address these items
- rotation of the auger during grouting, and control of the operation during grouting and after grout return is observed
- use of CFA in dense soil and/or weathered rock
- specific requirements when a problem develops during installation
- test pile requirements, including proof load tests and non-destructive integrity testing
- QA/QC requirements to verify that production piles are consistent with test piles.

CFA piles have been infrequently specified in public works transportation projects due to the variable nature and the difficulties in quality control. Simple manual observation and control methods historically used in the USA for quality control of CFA pile installation have been deemed inadequate for transportation projects.

The most reliable means of achieving consistent quality control employs automated monitoring equipment during construction to provide a real time evaluation of each CFA pile installed. GEC 8 recommends the use of automated monitoring equipment as a mandatory contract requirement. As a minimum, the automated monitoring equipment should monitor and record the following:

- auger tip depth measured with a position sensor
- incremental grout or concrete volume measured with an in-line magnetic flow meter
- delivered grout pressure (from an in-line pressure sensor)
- auger rotation from a sensor mounted on the gearbox
- auger withdrawal rate.

Although it is possible to estimate volume by counting pump strokes and using an assumed volume per pump stroke, this volume determination is generally inaccurate due to inconsistencies of the pump and inaccurate “calibrations” of pump stroke volume. The Pile Installation Recorder (PIR-A) from Pile Dynamics, Inc. (see photo below) meets all the above requirements including incremental volume measurements via an in-line magnetic flow meter.

A pre-production testing plan is another GEC 8 recommended contract requirement. This plan includes pre-production static load tests, production static and/or dynamic load tests, and post installation integrity tests in sufficient quantities to demonstrate that the installed piles meet the intended performance requirements. The contractor must then install production piles in the same manner and to the same standards as the test piles to insure production piles will also perform as well as the test pile. An automated monitoring equipment (like the PIR-A) documents that each production pile is installed with the same care and volume as the test pile.



The Cross-Hole Analyzer (CHA) and the Pile Integrity Tester (PIT) manufactured by Pile Dynamics are used to perform integrity tests to verify that CFA piles are structurally acceptable. A dynamic load test system (e.g. APPLE available from GRL Engineers) can quickly perform dynamic load testing on CFA piles. Tests on production piling verify design parameters, reduce uncertainties, and increase reliability.

The GEC 8 design and construction guidance, coupled with performance based specifications, facilitates the implementation of CFA piles on highway projects. The use of automated monitoring equipment during CFA pile installation, along with integrity testing and dynamic load testing after installation, provides sufficient quality control to allow the use of CFA piles on highway projects.

A copy of GEC 8 can be downloaded from www.fhwa.dot.gov/engineering/geotech/pubs/gec8.

2008 Calendar of Events Highlights

For a complete listing visit www.pile.com/events

February 10, Dubai, United Arab Emirates: Foundation QA Seminar: Every Thing You Always Wanted to Know About PDA Testing . . . But Were Too Afraid to Ask. Dr. Julian Seidel will present. www.foundationqa.com

February 11-12, Dubai, United Arab Emirates: Foundation QA PDA testing data evaluation workshop. Dr. Julian Seidel will present. www.foundationqa.com. Followed by FQA High-Strain Dynamic Pile Testing Examination.

February 20-23, Phoenix, Arizona: PDCA 12th Annual International Conference and Exposition. Visit the PDI booth. www.piledrivers.org.

March 9-12, New Orleans, LA: GeoCongress 2008 - The Challenge of Sustainability in the Geoenvironment. Sponsored by Geoinstitute of ASCE. Visit the PDI booth. content.asce.org/conferences/geocongress2008/

March 27-28, New Orleans, LA: Deep Foundations: Design, Construction & Quality Control. Sponsored by ASCE. Mohamad Hussein will present. www.asce.org/conted.

June 8-14, Sequatchie, TN: ADSC's 2008 Civil Engineering Faculty Workshop with Field Day & Technology Exhibits. Visit the PDI exhibit booth. adsc@adsc-iafd.com.

June 17, Istanbul, June 24, Dubai, October, Cleveland, OH (tentative dates): Seminar on Deep Foundation Testing - details to be announced at www.pile.com/events.

September 8-10, Lisbon, Portugal: The 8th International Conference on the Application of Stress Wave Theory to Piles. Sponsored by ISSMGE, the Portuguese Society for Géotechnique, and Instituto Superior Tecnico of the Technical University of Lisbon. Info: www.stresswave2008.org.

September 11-12, Lisbon, Portugal: PDA, CAPWAP and Wave Equation Workshops. Details to be announced. Followed by the FQA High Strain Dynamic Pile Testing Examination.

October 1-6, Goa, India: 12th conference of International Association for Computer Methods and Advances in Geomechanics (IACMAG). Visit the booth of PDI representative Earth Products India. www.I2iacmag.com.

October 15-17, New York, NY: DFI 33rd Annual Conference on Deep Foundations and 11th International Conference on Piling and Deep Foundations. www.dfi.org/update/CFPNY2008FINAL.pdf

November 3-5, São Paulo, Brazil: Seminário de Engenharia de Fundações Especiais e Geotecnia. Sponsored by ABEF. Visit the booth of PDI representative CARMIX do Brasil. www.acquacon.com.br/sefevi.

CALL FOR PAPERS

April 30, 2008 is the deadline for submittal of abstracts for the 2009 International Foundation Congress and Equipment Exposition, sponsored by Geoinstitute of ASCE, PDCA and ADSC. The congress will be held March 15-19, 2009 in Orlando, Florida.

EDUCATIONAL EVENTS: 2007 SUCCESS, 2008 PLANS

An extremely successful seminar was held in Dublin, Ireland last November. A workshop for dynamic testers attracted 35 people, while a general seminar for those interested in an introduction to dynamic foundation testing attracted around 80 participants.

PDI is planning several workshops and seminars in 2008. One special event will be in conjunction with Stresswave 2008 in Lisbon (September). Other events will take place in Turkey and in the United Arab Emirates, in June, and in Cleveland, OH in October. Watch for details on our website, www.pile.com/events.



PDI NEW HIRE

Customers who contact the sales department of PDI may be greeted by Tony Barbieri, whom we recently welcomed to the PDI sales team.

"MEET THE PAX" WEBCASTS

PDI will broadcast hour-long live webcasts with Garland Likins introducing the PDA model PAX. Login instructions will be available at www.pile.com/events.

- Wednesday March 5, 8:00 pm New York Time (1:00 London Time)
- Wednesday March 26, 7:00 am New York Time (11:00 London Time)
- Friday March 28, 3:00 pm New York Time (19:00 London Time)

ASTM NEWS

ASTM has approved updates to D5882 Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations. Changes in relation to the previous standard are minor. Pile Dynamics' Pile Integrity Tester continues to meet or exceed D5882 requirements for the performance of this test.

An update to D6760 Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing was recently approved. Issuance of the updated document is expected in the coming months. The most significant change is the inclusion of Single Hole Testing in the standard. Pile Dynamics' Cross-Hole Analyzer may be used for Single Hole Testing and continues to meet or exceed D6760 requirements for the performance of both single hole and crosshole tests.

PAX GETS KUDOS FROM DOWN UNDER

Bill Chambers, Project Engineer with the Gateway Piling Alliance in Australia wrote: "I just tried out the (PAX in local mode) and am very impressed. I really like the user friendliness of the PAX. Congratulations again, PDI - You Rock!"

Ken Wright, senior engineer with Frankipile Australia also has a PAX and "is very impressed with the new gear."



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