



DID YOU KNOW?

OUR NEWSLETTER WILL TURN 18 YEARS OLD, AND WE ARE CELEBRATING WITH AN UPDATED LOOK.



DYNAMIC TESTING OF MICROPILES

Scott Webster (GRL Engineers Inc., Charlotte, NC)
Jesús Gómez (Schnabel Engineering, West Chester, PA)

Micropiles are more and more frequently chosen as a solution for difficult foundation problems. Although they may differ in size, length and construction method, they are generally built by drilling a hole less than 300 mm diameter and then grouting around a center steel reinforcement or pipe. They usually have a high capacity relative to their diameter. This bearing capacity is frequently verified by static load testing of a few initial test piles. The following case shows dynamic testing as an economical and effective alternative to static testing, and a supplemental quality control tool.

On a recent fast track project, geotechnical consultant Schnabel Engineering recommended that a new structure be supported by a micropile foundation. The piles were drilled using a down-hole hammer with a bit diameter of about 200 mm (8 inch). The pile was then constructed with a 180 mm (7 inch) casing above the bond zone and a 3 m (10 ft) socket to bond the pile into a Karst bedrock. Two 57 mm (#18) reinforcing steel bars connected the socket to the upper cased pile section. The contractor installed two initial test piles and then immediately began production piling. Unfortunately, one of the two static test piles failed before the required ultimate pile capacity was reached. A third static test pile was therefore quickly installed, but it also failed prematurely. This caused all other already installed production piles to immediately become suspect. An efficient and rapid method to assess the capacity of these installed production piles was needed.

Based upon the need to evaluate multiple piles and the desire to start and complete the testing quickly, the consultant recommended performing dynamic tests with the Pile Driving Analyzer.

The geotechnical consultant considered both Dynamic and Rapid load testing methods to evaluate the micropile foundations. Based upon the need to evaluate multiple piles and the desire to start and complete the testing quickly, the consultant recommended performing dynamic tests with the Pile Driving Analyzer®. A local pile driving contractor was selected who could quickly mobilize a single acting air hammer with 2.2 Mg (5 kip) ram weight and 0.9 m (3 ft) drop height. The hammer was evaluated by wave equation analysis and, while not perfect, was considered suitable to accomplish the necessary dynamic loading.

The first piles to be dynamically tested by GRL Engineers (see photo) were the ones on which static tests had been performed. This was done to establish a Class A correlation between static and dynamic testing, therefore GRL was not made aware of the load testing history of the piles before submitting the dynamic test results. These results, obtained after



Scott Webster attaching a transducer on a micropile

CAPWAP® analysis of the Pile Driving Analyzer data, are shown in Table 1, and were only slightly higher than static test capacities.

Table 1. Class A Correlation Results

Pile	Static Load Test		CAPWAP	
	(kN)	(kips)	(kN)	(kips)
TP-1	1000	225	1110	250
TP-2	>1330	>300*	2200	495
TP-3	1160	260	1170	263

* TP-2 static load test did not fail

Satisfied with this good correlation, the geotechnical engineer called for dynamic testing of an additional 22 production piles. However, before testing of these piles could be accomplished, the pile driving hammer had to be fitted with a follower that would accommodate the hook bars protruding from the top of the micropiles. Ignoring one statistical outlier defective pile with a 360 kN (81 kips) capacity, the results shown in Table 2 were obtained for the other 21 production piles.

Table 2. Capacity results for 21 production piles

Unit	Min.	Max.	Mean	St. Dev.
kN	880	1420	1240	180
kips	198	320	278	40

Dynamic testing of the 22 production piles was successfully completed within two test days. Results demonstrated which piles had adequate bearing capacity and identified questionable production piles. Dynamic testing also assisted in revising pile installation techniques for the remaining production piles.

Dynamic testing was clearly a valuable tool for very efficient and economical load testing of the micropiles, and was most effective in resolving the foundation problems encountered at the start of this project.

Calendar of Events

February 19-21, 2004, Orlando, FL: PDCA Winter Roundtable. Dr. George Goble and Mr. Mohamad Hussein (GRL Florida) will teach short courses in conjunction with this conference. For information visit <http://www.piledrivers.org>, or email info@piledrivers.org.

February 26, 2004, Halifax, NS, Canada: The Canadian Geotechnical Society, Halifax Chapter, presents a Pile Foundation One-Day Short Course. For information email bgrace@jacqueswhitford.com

March 18-19, 2004, Honolulu, HI: ASCE presents the short course "Deep Foundations: Design, Construction, and Quality Control". For information visit <http://www.asce.org>

March 31 - April 2, 2004, Orlando, FL: Pile Dynamics presents PDA, CAPWAP, GRLWEAP and Integrity Workshops. The Foundation QA exam for certification of PDA testers will be offered in conjunction with this event. Call 216-831-6131 or email info@pile.com

April 13-17, 2004, New York City, New York: The 5th International Conference on Case Histories in Geotechnical Engineering. Presented by the University of Missouri-Rolla Civil Engineering Dept. For information visit <http://web.umar.edu/~eqconf/5thCHConf/> or email Shamsher Prakash at eqconf@umar.edu.

April 22-23, 2004, Miami, FL: "Deep Foundations: Design, Construction, and Quality Control". For information call 800-548-2723, email conted@asce.org or visit <http://www.asce.org>

May 5-6, 2004, Akron, OH: Short course "Construction Monitoring and Acceptance of Deep Foundations," Jerry A. DiMaggio and George G. Goble, instructors. For information call 330-972-7190 or email rliang@uakron.edu

May 7, 2004, Akron, OH: Great Lakes Geotechnical and Geoenvironmental Conference. Organized by the GLGGC Planning Committee, the University of Akron, ASCE Akron/Canton and Cleveland Sections, and ODOT. For information email rliang@uakron.edu

August 8-10, 2004, Petaling Jaya, Malaysia: The Seventh International Conference on The Application of Stresswave Theory to Piles, Stresswave 2004, the Millennium Challenge. For information contact sec@iem.po.my

August 11-13, 2004, Malaysia: Pile Dynamics will hold PDA, CAPWAP, GRLWEAP and Integrity Workshops. The Foundation QA exam for certification of PDA testers will be offered. Details to be announced.

September 16-17, 2004, Los Angeles, CA: PDCA Design & Installation of Cost Efficient Driven Piles Symposium. For information visit <http://www.piledrivers.org>, or email info@piledrivers.org

September 29 - October 1, 2004, Vancouver, BC, Canada: DFI's 29th Annual Conference on Deep Foundations. For information visit www.dfi.org or email staff@dfi.org.



Standard Handbook for Civil Engineers

The newly released "Standard Handbook for Civil Engineers - Fifth Edition" by McGraw-Hill Publishers contains a chapter on Geotechnical Engineering authored by Mohamad Hussein (GRL Florida) and Jerry DiMaggio (Federal Highway Administration - FHWA). The book preface expresses the editor's attempts "to bring together in a single volume the best ideas for current practice in the professional field of civil engineering". The handbook can be ordered via the web site: www.books.mcgraw-hill.com.

SOFTWARE RELEASE

New release of PIT-W Professional software

PIT-W Professional Version software processes data obtained with the Pile Integrity Tester (PIT), and includes tools such as profile analysis (suggests a pile shape) and analysis of records in the frequency domain. The latest release of the PIT-W Professional Version includes two-velocity analysis, surface wave analysis and β analysis. When data is obtained with two accelerometers (requires Pile Integrity Tester model FV) the two-velocity analysis calculates wave speed using two velocity measurements and separates upward from downward traveling velocity waves. Two accelerometers are also used for surface wave analysis, which consists of automatically subtracting the effect of horizontally traveling stress waves from the data, yielding a clearer, easier to interpret record. β analysis quantifies impedance changes.

Research in Self Consolidating Concrete for Drilled Shafts

GRL Engineers has teamed up with Master Builders to investigate various aspects of the applicability of Self Consolidating Concrete (SCC) for drilled shafts. As a first step, an experimental drilled shaft was constructed. The shaft is composed of four layers, each one with different concrete mix designs, including one layer of SCC. Access tubes were installed at the time of construction, permitting the performance of cross hole sonic logging tests. These tests are being periodically performed, and data analyzed with the aid of conventional and tomographic cross hole software. The analysis provides information on the ultrasonic responses on concrete of different nominal strengths and on the evolution of these responses with time for the various layers.

Highway Construction Specifications On Line

The Federal Highway Administration and the American Association of State Highway and Transportation Officials have launched a web site that makes thousands of highway construction specifications available. Visit www.specs.fhwa.dot.gov to search, review, and download current specifications from all 50 States. (We tried searching for specs that mentioned "pile driving analyzer" and found 14 matches!).

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 don't hear from you in more than five 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

♻️ Printed on Recycled Paper

VISIT US ONLINE AT WWW.PILE.COM

GRL Dynamic Measurements and Analyses
engineers, inc.

GRL Engineers, Inc.
Central Office: 4535 Renaissance Parkway
Cleveland, Ohio 441428 USA
E-mail: info@pile.com
Phone: +1-216-831-6131
Fax: +1-216-831-0916

PD
Pile Dynamics, Inc.

Pile Dynamics, Inc.
4535 Renaissance Parkway
Cleveland, Ohio 441428 USA
E-mail: info@pile.com
Phone: +1-216-831-6131
Fax: +1-216-831-0916