



DID YOU **KNOW?**

Inventor Charles Brush built the first automatic electricity generating windmill 150 years ago in Cleveland, Ohio.



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DYNAMIC MONITORING OF PILES USING REMOTE TESTING CAPABILITIES

Travis Coleman, P.E. GRL Engineers, Inc., with Gina Beim, P.E.

On a recent interview on National Public Radio, Dr. Cynthia Breazeal, founder and director of the Personal Robots Group at MIT's Media Lab, imagined a time when her mom "could go to her computer, open up a browser, jack in to a little robot and play with her grandson (living in another city), in the real world, with his real toys." GRL Engineers are not doing quite that when they test piles remotely – but close.

Dynamic foundation testing systems with remote capabilities have been around for more than a decade. Systems such as the Pile Driving Analyzer® (PDA) model PAL-R were ahead of their time, really. They relied on cellphone technology that was a bit clunky and quite spotty, especially in remote areas. Sure, some pioneers embraced it right away, but the majority of the geotechnical community sat on their hands, waiting for the so-called "Moore's law"¹ to bring remote data transmission technology to the point where dynamic foundation testing needed it to be. The technology is certainly there now, and GRL is taking full advantage of it, as the case study described here clearly shows.

Jensen Construction Company is currently erecting the U.S. 34 over the Missouri River Bridge in Plattsmouth, Nebraska. The pile foundations for Piers 5 and 6 are located in the river and were driven inside cofferdams. Each pier consisted of thirty - 48 inch (1220 mm) diameter by 1 inch (25.4 mm) thick open-end pipe piles approximately 170 feet (52 m) long. The piles were driven in granular soils to bedrock with a Pileco D160-32 hammer, reaching 105 to 110 (32 to 33.5 m) feet below the bottom of the cofferdam. The piles had a nominal resistance (ultimate capacity) of approximately 4,000 kips (18,000 kN) plus the soil resistance in the scour zone. Jensen Construction retained GRL Engineers to perform the dynamic testing, which was required for each pile to evaluate the nominal resistance and scour zone friction.



Each pier consisted of 30 open end pipe piles.



Aerial view of US 34 Bridge over the Missouri River.

GRL used a PDA model PAX with SiteLink® for the test. After an initial on site visit during installation of a test pile, the GRL engineer did not leave their office again during the production phase of the project – everything was done via the Internet and only the PDA system travelled to the job site. The test pile was installed at a non-production location along the river bank in order to check the suitability of the hammer-pile-nominal soil resistance combination as calculated with the pre-construction GRLWEAP wave equation analysis. GRL performed on-site pile driving monitoring during initial installation and on a series of restrikes. GRL provided Jensen personnel with onsite training on the remote system at that time.

Production piles at each pier were installed over approximately three weeks. The sensors required for dynamic testing were mounted by Jensen, and the test was performed remotely, transmitting the measured force and velocity data to GRL in real time. Jensen consistently provided personnel for handling and operating the testing equipment onsite, and GRL and Jensen were in constant contact for coordination. The SiteLink approach was instrumental in meeting the strict deadlines that the job entailed. Landon Streit, Project Engineer with Jensen, recalled how "no pile driving was allowed between February 1st and June 30th due to restrictions involving the pallid sturgeon", an endangered fish with a unique dinosaur-like appearance. Jensen drove piles seven days a week as long as there was daylight, in order to complete all driving before the end of January, and the dynamic testing did not slow them down as much as it would have, had it been done without SiteLink.

Some cellular transmission hiccups were initially encountered, but an upgrade in cellular equipment resolved them. Even today, some mobile phones can't keep up with GRL's technology needs! The upgrade was a small price to pay when compared to the approximately US \$20,000 that the contractor saved by having the piles tested remotely, instead of onsite. In the end, GRL Engineers and Jensen Construction collaborated to successfully install sixty large diameter relatively long piles to a high nominal resistance under challenging construction conditions. A robot couldn't have done it!

¹ A 1965 quote by Intel founder Gordon Moore is often interpreted as stating that the capabilities of electronic devices doubles approximately every two years.

Highlights of the 2013/14 Calendar of Events (Sept – Feb)

More events and information at www.pile.com/events

PDI Workshops, Seminars and Proficiency Tests:

October 9-11, Cleveland, OH: **Seminar on Deep Foundation Testing and Wave Equation Analysis**. Followed by **Dynamic Foundation Testing Workshop and PDCA/PDI Proficiency Test**. Info: www.piledrivers.org or Jessica@piledrivers.org

October 17, Hamburg, Germany: **Frank Rausche and Oswald Klingmuller (GSP)** will present a **GRLWEAP Wave Equation Analysis Workshop (in English)**. Info: www.pile.com/events/pdievents/ or registration@pile.com

PDI and GRL Webinars: Learn without leaving your desk:

Sessions last 1.5 - 2 hours and start at 9:00 am EST. Contact registration@pile.com

September 17-18: **Introduction to High Strain Dynamic Foundation Testing** with **Brent Robinson**

September 24-October 2: **Advanced applications of CAPWAP® software** with **Brent Robinson**

October 16: **Thermal Integrity Profiling of Concrete Foundations** with **Garland Likins**

December 3: **Pile Driving Hammer Performance Webinar** with **Frank Rausche**

December 4: **Load Testing & Quality of Pile Foundations** with **Michael Morgano (a GRL webinar)**

January 21-29: **Wave Equation Analysis of Piles using GRLWEAP** with **Frank Rausche**

GRL or PDI will exhibit at the following events (a good chance to learn about new developments!)

September 12, Dallas, TX: Visit GRL at the Geo-Texas 2013 seminar "Raising the Bar in our Geotechnical Profession" <http://Texas-Centennial.com>

September 25-26, New Orleans, LA: Visit GRL at the Louisiana Civil Engineering Conference & Show. www.louisianacivilengineeringconference.org

September 25-28, Phoenix, AZ: Visit PDI at the 38th Annual Conference on Deep Foundations. www.dfi.org

September 29-October 3, Montreal, Canada: Visit PDI at GeoMontreal 2013. www.geomontreal2013.ca

September 30-October 2, Williamsburg, VA: Visit PDI at the 2013 GeoVirginia Conference. www.virginiageoinstitute.org

Other Learning Opportunities

September 24-26, Madison, WI: **Travis Coleman** will present at the WDOT/FHWA Midwest Geotechnical Conference. <http://dotmgc.engr.wisc.edu/>

October 23, Houston, TX: **Mohamad Hussein** will present at PDCA's 14th Annual Design and Installation of Cost-Efficient Piles. www.piledrivers.org

October 24-25, San Diego, CA: Deep Foundation Design, Construction and Quality Control. **This ASCE course will be repeated on February 6-8, 2014 in New Orleans, LA.** Info: seminars@asce.org

Thermal Integrity Profiler wins 2013 C. William Birmingham Award for Innovation

The Deep Foundations Institute (DFI) has announced the Thermal Integrity Profiler (TIP) as the winner of the 2013 C. William Birmingham Award for Innovation. Dr. Gray Mullins, from the University of South Florida (USF) and Foundation & Geotechnical Engineering, LLC (FGE) will give a presentation and accept the award, during DFI's Annual Conference in Phoenix, AZ. The thermal integrity profiling technology was developed initially at USF. A joint effort undertaken by FGE and PDI resulted in the TIP, which uses temperatures measured during cement curing to evaluate the shape and quality of cast-in-place concrete foundations. More info: www.pile.com/tip

GRL Welcomes New Thermal Integrity Profiling Project Manager

As GRL Engineers grows its Thermal Integrity Profiling capabilities, it welcomed Danny Belardo to its Central Office. Danny will leverage his construction management expertise to provide client support for GRL's TIP projects around the country.



APPLE testing on large H piles, Innerbelt Bridge Project, Cleveland, OH

Watch a video about the Cleveland Innerbelt Bridge Project

The Cleveland Innerbelt Bridge project includes both drilled shafts and H piles reaching up to 160 ft deep in spots. The project made the cover of Q2 2012 issue of Piledriver Magazine and of Roads and Bridges Magazine November 2012 issue, which listed it among the top 10 bridges of 2012. Roads and Bridges has now produced a video <http://bcove.me/whr5efhc> about the project. GRL, who is proud to have monitored the installation of the record size piles of this project, and tested the integrity of its shafts by multiple methods, is mentioned in the movie. The bridge will open to traffic later this year.



PDI and GRL Headquarters, August 6, 2013. Photo by Paul Brinkerhoff.

www.pile.com: the portal for deep foundation testing services, instruments and software

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