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Pile Dynamics, Inc.

GRL engineers, inc. Dynamic Measurements and Analyses

Remote Dynamic Foundation Testing

Edited by Gina Beim from contributions from Casey Jones (FTC) and from GRL Engineers.

Remote PDA Testing – more formally known as Remote Dynamic Foundation Testing – is popular around the world. In Sweden and Australia, most foundation tests are now performed without an on-site engineer, eliminating testing delays and scheduling the testing at the convenience of the contractor. Australian testers have reported Remote PDA Testing costs four times lower than those of tests with an engineer on site, a result attributed to better time management of the test engineer and avoidance of unproductive time spent on travel and on-site construction delays. In the United Kingdom, Remote PDA Testing has enabled one consultant to test up to 10 piles per hour. This testing method may also avoid the need for a test engineer to undergo safety or hazardous materials training.[1]

Remote PDA Testing consists of equipping job sites with a Pile Driving Analyzer® (PDA) model PAX. Job site personnel attach the necessary sensors to the foundation to be tested. The PDA model PAX then transmits the dynamic test data over the Internet during the test, in real time, to a PDA engineer stationed anywhere in the world.

In the USA, where Departments of Transportation struggle to reconcile reduced budgets with increased testing requirements resulting from FHWA Load Resistance Factor Design (LRFD), Remote PDA Testing is emerging as the solution of choice. Its inherent lower costs allow for an increased number of foundation load tests, yielding in turn a less costly foundation design under LRFD.

For some time GRL Engineers has encouraged its clients to adopt this approach. The Cleveland office of GRL has recently cooperated with PDA owners in Michigan to provide remote testing services for the Hammond-Keystone Connector in Traverse City, MI and for the Hawkins Rd over I-94 project in Jackson County, MI, both MDOT projects. The GRL Chicago office has completed seven bridge projects using remote PDA testing. On these projects, Wisconsin DOT personnel attached their remote PDA system on HP 12x53 H-piles with ultimate pile capacities of up to 215 tons, and the dynamic test data was transmitted in real time to GRL. Fifty-nine piles were tested during initial driving and thirty-seven during restrike. The North Carolina office of GRL performed remote testing on 14 inch square concrete piles supporting the Isle of Wight Water Tank for ECS Mid-Atlantic. The piles, driven by Northstar Contractor, were designed for a load of 70 tons, with an ultimate capacity of 140 tons. GRL will perform a restrike on the test pile to confirm soil setup conditions.

GRL has been conducting Remote PDA Tests for Chris-Hill Construction Company of Memphis, TN routinely for several years. Craig Christenbury and Jon Hill, the owners of the company, have made it clear that "we will not fly in an engineer for testing". A recent project required that 350 mm (14 inch) concrete piles, driven with a D19-42 diesel hammer, be monitored for tension stresses during driving. Long term bearing capacity also had to be assessed, since it was suspected that soil setup would have a significant effect. A PDA Model PAX was shipped to Chris-Hill a few days before the test. Jon Hill operated this equipment while his crew attached the sensors to the pile. When refusal occurred at a shallower than expected penetration, the ultimate capacity was only 75% of the required value. Six days later, however, a restrike test confirmed that sufficient soil setup had generated an ultimate capacity of slightly more than the required 200 tons. Without any time delay, these capacity values were calculated by CAPWAP® analysis and a preliminary report was issued less than two hours after the actual test. Compared to traditional testing, a saving of almost 50% was realized due to reduced engineering time and travel costs.

Concrete Cylinder Piles form the New Orleans IHNC Floodwall; Work Trestle in foreground. Photo courtesy of Foundation Testing and Consulting.

Remote PDA testing was also used on the largest design-build project in the history of the U.S. Army Corps of Engineers, the Inner Harbor Navigation Canal Surge Barrier (IHNC), This floodwall extending from the Gulf Intracoastal Waterway to the Mississippi River Gulf Outlet is being constructed in New Orleans, LA by the joint venture team of Traylor-Massman-Weeks since April, 2009. A part of post-Hurricane Katrina improvements, the 2.3 km (1.4 mile) long wall consists of 43 m (140 ft) long concrete cylinder piles with a diameter of 1,680 mm (66 inch) and smaller concrete piles driven in gaps between the cylinder piles. Lateral support on the protected side of the barrier wall is provided by 910 mm (36 inch) diameter steel pipe batter piles. A temporary work trestle permits pile installation. Genesis Structures of Kansas City, Missouri designed the trestle and retained Foundation Testing and Consulting (FTC) of Overland Park, Kansas, to provide the geotechnical foundation design for this work trestle. The trestle bridge foundation design required pile capacity to be achieved within 7 days of pile installation to support the aggressive schedule of the project, while the soils typically require setup time periods of up to 6 weeks to develop full capacity. FTC's Casey Jones, P.E. used his PDA model PAX to perform extensive Remote Dynamic Testing and confirm installation requirements for the 36-inch diameter steel pipe trestle piles. The PDA was on site for the complete project duration. The project Quality Control staff, from Volkert and Associates, was trained to properly attach the required sensors to the pile and make the Internet connection of the PAX to the FTC Kansas office. Later, the Remote PDA Testing scope expanded to the concrete cylinder piles on an on-call basis during both day and night-time shifts. FTC stated that "...the remote PDA system was a huge success by extending our service capabilities and providing great value to the project. We are looking forward to using the remote system on our next large project."

[1] Likins, Hermansson, Kightley, Cannon, and Klingberg, March, 2009. Advances in Dynamic Foundation Testing Technology. Contemporary Topics in Deep Foundations; 2009 International Foundation Congress and Equipment Exposition, GSP No. 185. ASCE. This paper can be retrieved from PDI's web site: www.pile.com.