



## DID YOU KNOW?

Pile Dynamic Analysis topped Clyde Baker's list of geotechnical breakthroughs of his 50 year career. Read more on page 2.



## Just drop an APPLE

Frank Rausche

Johnny Appleseed would have appreciated GRL's modern days' efforts. Johnny roamed the fertile Ohio Valley in the 1800s and helped build a vibrant fruit industry; but GRL has gone beyond the Ohio borders with its APPLES (Advanced Pile Proof Loader/Evaluator) which are drop weights weighing between 5 and 40 tons, having adjustable drop heights of up to 2.5 m (8 ft).

Since 1974, GRL has dynamically tested drilled shafts or augered piles and several correlation tests were reported<sup>1</sup> (reference papers in [www.pile.com](http://www.pile.com)). The need for a well controlled, high energy impact device to dynamically load test a variety of high capacity piling, prompted GRL to build its first 7 ton APPLE in 2001. GRL later added another four APPLES. Prior to that time, GRL utilized and still uses its 3-ton "Green Monster" (actually a modest device by today's standards) or a client provided drop weight, to dynamically load test deep foundations.

In December 2005, we reported (view GRL/PDI Newsletter No. 51 on [www.pile.com](http://www.pile.com)) on a particularly challenging test over water using a 20 ton APPLE. In the meantime, several tests have been conducted with a 40 ton APPLE activating more than 4000 tons when testing drilled shafts founded in hard rock<sup>2</sup>.

The test piles may be augered-cast-in-place piles, micropiles, drilled shafts (up to 7 ft diameter shafts have been tested) or driven piles. Driven piles are sometimes "APPLE'd" when the pile driving hammer is either not available or has insufficient energy to activate the required capacity.

A complete test system consists of the APPLE loading device, a Pile Driving Analyzer® (PDA) and GRL's test team. The APPLE frame supports the drop weight and the frame guides the falling ram after a hydraulic clamp releases it. The traditional PDA instrumentation of 4 each strain and acceleration sensors, attached to the pile top, measure impact force and pile motion which the PDA transforms to bearing capacity, stress and energy values. Modified systems determine the pile top force directly



Figure 1: Load cell and cushion system on shaft top



Figure 2: GRL's self-elevating 16-ton device

either with the  $F=ma$  approach or using a load cell. The former measures the ram deceleration, which when multiplied with the ram mass provides the impact force according to Newton's Second Law. The load cell force measurement is useful for drilled shafts where a high quality concrete extension cannot be cast onto the pile top or is not needed to protect the pile top reinforcement. Figure 1 shows the bottom of a 20 ton APPLE positioned on a load cell which, in turn, rests on a cushion inside a helmet-type container. The cushion properties can be modified to adjust the load duration to a particular pile and soil type combination. In all cases, it is helpful and in most cases required that the PDA has a total of 8 measurement channels available.

The most recent addition to GRL's APPLE basket is a system with an 8 or 16 ton modular ram, a hydraulic self lifting system, and a relatively short frame (5 m - 16 ft high) (Figure 2) which is particularly helpful in restricted headroom situations (in buildings, under bridges, etc.). Thus, a crane is only needed for initial assembly, while the testing itself can be accomplished by this APPLE model's electric hydraulic pump. On sites with good access, 2 to 10 piles or shafts can normally be tested in one day depending on the extent and topography of the site.

For a successful dynamic load test, the ram weight should be at least 2% of the required test load. The latest APPLE can, therefore, mobilize test capacities of up to 800 tons. For rock socketed shafts, only 1% impact weight is typically needed allowing the 16-ton ram to test for as much as a 1600-ton capacity. Testing is usually done with a few impacts of increasing drop heights until either the required capacity or the shaft's structural strength is reached (see Ref. 2).

Like Johnny spread apple seeds around the country, GRL has spread its APPLES in a few locations to reduce transportation cost. Though it would certainly make it easier if they were growing on trees, APPLE dissemination is unstoppable.

[1] Likins, G., and Rausche, F., 2004. Correlation of CAPWAP with static tests. Proc. of the 7th Int. Conf. on the Appl. of Stress Wave Theory to Piles. Malaysia, 153-165.

[2] Rausche, F., Morgano, C.M., Hannigan, P., Bixler, M., and Beim, J., 2006. Experiences with heavy drop hammer testing of rock-socketed shafts. DFI 31st Annual Conf., Washington, DC, 133-144.

**What's happening in 2009 -  
more info at [www.pile.com/events](http://www.pile.com/events)**

**Foundation Testing Workshops and Seminars:**

September 24-26, Philadelphia, PA, by PDCA and FQA: PDA and CAPWAP Workshop and Foundation QA HSDPT Exam. Instructors: Garland Likins and Jorge Beim

November 5-7, Rome, Italy, by PDI and Eurosit: Dynamic Foundation Testing Seminar; High Strain Dynamic Foundation Testing Workshop, GRLWEAP Workshop, Integrity Workshop and Foundation QA HSDPT Exam. Instructors: Frank Rausche and Garland Likins

November 9-11, Dubai, UAE, by PDI and Al Bayan Technical: Dynamic Foundation Testing Seminar, Integrity Workshop, High Strain Dynamic Foundation Testing Workshop and Foundation QA HSDPT Exam. Instructors: Frank Rausche and Garland Likins

October 20-21, Mannheim, Germany: Low Strain Integrity Testing (Impact Echo) and Dynamic Load Testing Workshops (in German). Instructor: Oswald Klingmüller/GSP

November 16, Santiago, Chile, by PDI: Seminar on Foundation Testing and Analysis. Instructor: Jorge Beim

**Presentations by GRL / PDI engineers**

October 8-9, Charleston, SC: ASCE Short Course Deep Foundations: Design, Construction and Quality Control. (Mohamad Hussein)

October 20, Kansas City, MO: DFI pre conference short course: ACIP/Drilled Displacement Pile Course. (George Piscalko)

November 13, São Carlos, SP, Brazil: Symposium in Honor of Prof. Nelson Aoki. (Jorge Beim)

**PDI and/or GRL exhibiting at:**

DFI 34th Annual Conference on Deep Foundations, Kansas City, MO, October 21-23

Ohio Transportation Engineering Conference, Columbus, OH, October 27-28

24th Central Pennsylvania Geotechnical Conference, Hershey, PA, November 2-4

SE Transportation Geotechnical Engineering Conference, Wilmington, NC, November 2-5

PDCA Design and Installation of Cost Effective Piles, San Francisco, CA, November 19

**more info at [www.pile.com/events](http://www.pile.com/events)**

**GRL WELCOMES NEW ENGINEERS**

Three new engineers have joined the ranks of GRL Engineers. Brandon Phetteplace, who spent last year as a co-op with GRL, is joining the Ohio office. Al Ziai is joining the Main office. Ryan Gissal is joining the Florida office.

**FREQUENTLY ASKED QUESTIONS**

If you own or operate PDI equipment, you now have access to a valuable repository of technical information designed just for you. To gain access to the new Frequently Asked Questions Area, please visit [www.pile.com/pdi/users](http://www.pile.com/pdi/users) and follow the instructions to obtain a password. You will need the serial number of your instrument.

**TEA TIME IN THE TROPICS – THANKS TO PDA WITH WIRELESS TRANSMITTERS**

Jon Cannon, of Independent Geoscience Pty Ltd in Australia, wrote to us from Lae, Papua New Guinea, where he is using a Pile Driving Analyzer® model PAX with smart (wireless) sensors on the job site pictured: "I have just finished testing on the first pile. I am sitting in the air-conditioned site office



Lae, Papua New Guinea

(...) The pile is about 250m away\*. No problem! Radio worked well. Data of very good quality. I am impressed. I liked sitting in the air-conditioned office with the PDA on the desk. Very civilised. Having a cup of tea, while the others are outside sweating in the tropical heat. Way to go!"

\*note from Pile Dynamics: Although 250m transmission ranges have been reported, PDI wireless transmitters specifications rate its range as up to 100m.



Clyde Baker, Jr. - 2009 Industry Hero of IFCEE09 and Mohamad Hussein (GRL-FL) - IFCEE09 Chairman

**CLYDE N BAKER JR. HONORED AT IFCEE, MENTIONS PDA AND CAPWAP ON PILEBUCK INTERVIEW**

Clyde N. Baker, Jr., PE, SE, internationally renowned foundations engineer and Senior Principal Engineer of AECOM, Inc. was honored as Industry Hero at the International Foundation Congress and Equipment Expo '09 in Orlando earlier this year. Sarah Milstead from Pile Buck International, Inc. marked the occasion with an interview, during

which she asked Mr. Baker to name "the five technological breakthroughs that have most impacted the world of the geotechnical engineer" over his career of almost half a century. Sarah reports "topping the 'Baker List' are the computer and Pile Dynamic Analysis and the CAPWAP computer program". Pile Buck has graciously allowed PDI and GRL to reprint the interview. Read it at [www.pile.com/inthenews](http://www.pile.com/inthenews).

**GRL ON THREE SEAS**

It has been a demanding ten months for GRL's engineering staff with frequent pile monitoring assignments in the Persian Gulf, Gulf of Mexico and lately the Caspian Sea. Offshore and North Carolina manager Scott Webster took the lion's share of this work, but every one of GRL's engineers with sufficient experience took on at least one assignment. GRL's Business Manager, Adrian Rausche, also arranged with Bill Chambers, Director of Ngamo Dynamics, Inc, Brisbane, QLD, Australia and Antonio Mendez, Manager of PDPSA, Mexico City, Mexico to PDA monitor and CAPWAP analyze the large diameter leg piles of the 28 installations. GRL would like to thank Bill and Antonio for their excellent and experienced assistance.



Pile being lifted - offshore oil platform in the Persian Gulf

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