DID YOU **KNOW?**

50 years ago a thesis by Case student Eiber prompted the PDA research.

Pile Dynamics, Inc.

GRL engineers, inc. Dynamic Measurements and Analyses

Can PIT do it all?

By Frank Rausche, PhD, PE

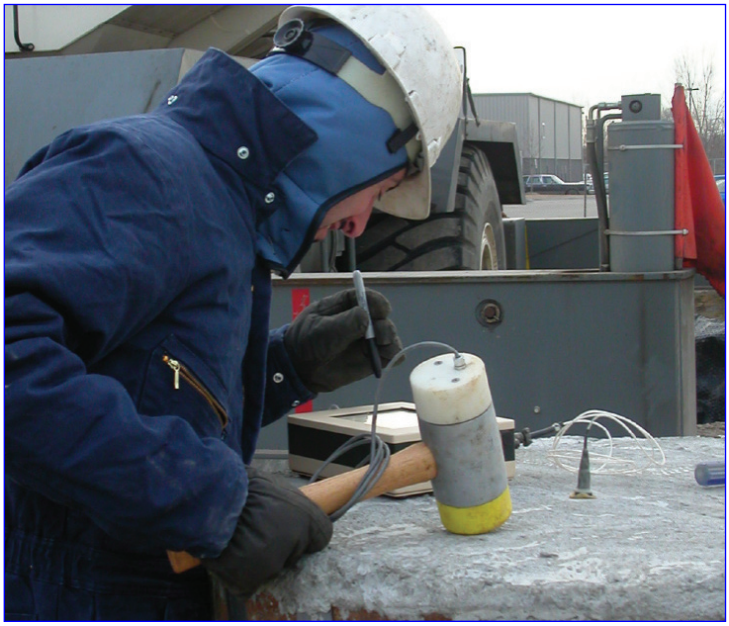
Phone call to GRL: "Can you tell me the length of a pile under a building? We don't know what type of pile; since it was driven in the 1930s, it may be a step tapered pile. No, we cannot access the side of the pile and we don't know exactly where it is located except under a pile cap." GRL's test engineers frequently get such inquiries. The structures in question are buildings, bridges, retaining walls, sheet pile walls etc. We readily admit that it might be easier to fly to the moon than to answer these simple questions. But dynamic testing may be able to help.

The Pile Integrity Tester (PIT), which performs the Low Strain or Pulse Echo Method, has been available since the 1980s to indirectly determine length and search for major defects. This method has a number of advantages over other indirect methods primarily because it can be quickly applied to any drilled shaft, precast concrete or auger cast-in-place pile without much preparation. In many European and Asian countries, construction specifications require a large percentage or all cast-in-situ shafts or piles to be pulse-echo tested. Also, in many countries, if construction problems cast doubts on the quality of a deep foundation, a first response is usually to perform the pulse echo test. And for existing "unknown" deep foundations, PIT is the first non destructive testing (NDT) tool that comes to mind.

It is quite amazing that a light hammer tap generates a stress wave that can travel 50 m or more down the foundation, reflect at its bottom, travel back to the top and there, upon arrival, generate a measurable, quick movement. Actually, the light hammer impact moves the top only a fraction of a millimeter and therefore does not generate much soil resistance. This is one of the reasons why the Low Strain method works. However, the very small motions require a very careful test execution including proper pile top preparation and use of the most sensitive equipment with an extremely high digital resolution. The more demanding the job is, the greater the care required.

GRL Colorado's Project Engineer Anna Klesney, recently successfully determined the length of drilled shafts buried under a cap with a column already in place. The top of the column was accessible for impact and measurement. Senior Engineer Jorge Beim performed the very complex data interpretation with the help of the wave propagation simulation program PIT-S (download it free from www.pile.com).

Absolute depth, relative length (Length/Diameter) and number of major cross sectional or concrete quality variations constrain PIT results, causing some foundation engineers to altogether reject trying this method. Cross Hole Sonic Logging (CSL) and Single Hole Sonic Logging (SHSL) do perform better for long and complex piles, but at a higher cost and requiring access holes inside the foundation. The Parallel Seismic Test (PST) and the Length Inductive Test Equipment (LITE, see page 2) only provide length information and require a borehole in the immediate vicinity of the existing foundation. To assess pile caps or slabs of less than 1 m thickness, an Acoustic Concrete Tester (ACT) may be helpful. Length or thickness limits for these methods are shown in Table 1.



GRL Cleveland office manager C. Michael Morgano applies PIT to a 4ft diameter drilled shaft

Ultimately, we really would like to evaluate not just the foundation length or quality but also its bearing capacity. In that case only a High Strain Test according to ASTM D4945 will help. It requires the impact by a drop weight of about 2% of the ultimate test capacity and is the dynamic testing method that provides the greatest wealth of information. No NDT method yields length results with 100% certainty and 100% precision, and GRL's professionals are open and honest about this. However, very often it is quite surprising how much information can be gathered, particularly if experienced test engineers employ a combination of dynamic testing methods.

NDT Method	Application	Length or Thickness Limit
PIT (Pulse Echo) ASTM D5882	Concrete Piles; Concrete Filled Pipes; Pile Caps; Slabs	0.3m < L< 50+ m and L < 60 D
PIT	Timber Piles	L < 15 m
PIT	H-Steel Piles in soft soils; not for open pipe piles	L < 15 m
ACT ASTM C1383	Concrete Slabs, Pile Caps, tunnel liners, floors	0.1 < t < 1 m
CSL, SHSL ASTM D6760	Concrete shafts or piles with access holes	Unlimited
PST	Concrete, masonry foundations with parallel borehole	L < 15 m
LITE	Steel piles/pipes; steel sheet pile walls with parallel borehole	Unlimited

Table 1- NDT Method Comparison

2008-2009 Calendar of Events Highlights

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

September 12, New Orleans, Louisiana: Design and Installation of Cost Efficient Piles. Sponsored by Pile Driving Contractors Association. **Visit the GRL booth.** www.piledrivers.org

September 25-26, Houston, USA: Basics Design of Piled Foundations. Sponsored by GIC. **Bengt Fellenius will present.** www.gic-edu.com/coursedetail.aspx?id=115. **Also offered on October 2-3 in Vancouver, Canada, October 13-14 in Milwaukee, WI and November 6-7 in New York.**

October 1-4, Piacenza, Italy: GEOFLUID 2008. Sponsored by Piacenza Expo. www.geofluid.it/uk/index.html. **Visit the booth of PDI representative Eurosit.**

October 1-6, Goa, India: 12th Conference of International Association for Computer Methods and Advances in Geomechanics. Sponsored by IACMAG. www.12iacmag.com. **Visit the booths of PDI representatives Earth Products India and AE&C – Advanced Test Systems**

October 15-17, New York, NY: DFI 33rd Annual Conference on Deep Foundations and 11th International Conference on Piling and Deep Foundations. **Visit the PDI booth.** www.deepfoundations08.org

October 20-22, Cleveland, OH: 2008 GRL - Case Dynamic Foundation Testing Seminar and Workshops: General Seminar, PDA and CAPWAP Workshop and GRLWEAP Workshop. Frank Rausche, Garland Likins, CWRU Faculty and guests will present. FQA High-Strain Dynamic Pile Testing Examination offered on October 22. Download brochure at www.pile.com/events/pdievents

October 28, Mannheim, Germany: Low Strain Integrity Testing (Impact Echo) Workshop. Sponsored by GSP. **Dr.-Ing. Oswald Klingmüller will present.** www.gsp-mannheim.de/pdfs/Einladung_Dyn_Okt_08.pdf. In German

October 29, Mannheim, Germany: High Strain Dynamic Foundation Testing. Sponsored by GSP. **Dr.-Ing. Oswald Klingmüller will present.** www.gsp-mannheim.de/pdfs/Einladung_TRAPF_Okt_08.pdf. In German

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

November 6-7, Charlotte, NC: Deep Foundations: Design, Construction and Quality Control. Sponsored by ASCE. **Mohamad Hussein will present.** www.asce.org/conted/seminars. **Also offered March 26-27, 2009 in St. Louis, MO**

March 15-19, 2009, Orlando, USA: 2009 International Foundation Congress and Equipment Exposition. Sponsored by GeoInstitute of ASCE, PDCA, ADSC. **www.IFCEE09.org**

CLARIFICATION

The following is a clarification to our January, 2008 Newsletter. In the article titled "FHWA Releases GEC 8 – Design and Construction of CFA Piles" it should be noted that the FHWA and co-author Silas Nichols (FHWA Senior Bridge Engineer) were not endorsing any specific products. The contributions to the article where PDI products are specifically mentioned were made by co-author George Piscsalko from PDI.

CALL FOR ABSTRACTS ANNOUNCEMENT

The ASCE Geo-Institute is soliciting abstracts for technical papers to be considered for the Geotechnical Special Publication "The Art of Foundation Engineering Practice", honoring Clyde N. Baker, Jr., P.E., S.E. Hon.M.ASCE. Papers covering all aspects of foundation engineering (research, design, construction practices, testing, and performance) will be considered; case histories are particularly welcome. E-mail 300 to 400 word abstracts by November 30, 2008 to ClydeBakerGSP@uncc.edu.

READERS WRITE

William G. Chambers, Project Engineer for the Gateway Piling Alliance in Australia, reports having "used the wireless equipment today at two separate locations. It worked wonderfully. The data was great. (…) Well done PDI. The guys in the field were very impressed with the ease of connection/conductivity with the radio units to the PAX. This makes me look good and I tell them that PDI has the equipment I need for the job".

Filippo Di Fronzo from the Italian company Field has been monitoring piles at Bechtel's Angola LNG project with GRL support for data analysis. He writes: "Trevi appreciates your data processing of the first 11 piles. They appreciate your rapidity, your professionalism and your clearness… Thank you very much!!!!!"

LITE ASSESSES DEPTH OF EXISTING FOUNDATIONS

It is often necessary to determine the length of existing deep foundations when unexpected settlements or scour lead to bearing capacity concerns or when the foundation is to be reused for a new or heavier structure. With original foundation drawings often not available, engineers rely on various methods of length determination. Pile Dynamics, Inc. has recently developed the LITE (Length Inductive Test Equipment), an instrument that determines foundation length by the Inductive Field Method. The LITE should be a welcome addition to the test engineer's tool box, being particularly suitable to find the length of existing steel piles (sheet pile walls, H-piles, pipe piles, cased drilled shafts). For concrete deep foundations other tools like the Parallel Seismic Method and the more frequently used Pulse Echo (low strain or PIT) Method are generally more successful. The LITE has been successfully used by GRL Engineers; for additional information please contact info@pile.com.

Visit us at WWW.PILE.COM

GRL engineers, inc. Dynamic Measurements and Analyses

GRL Engineers, Inc.
Main Office: 4535 Renaissance Parkway
Cleveland, Ohio 44128 USA
E-mail: info@pile.com
Phone: +1-216-831-6131
Fax: +1-216-831-0916

California • Colorado • Florida • Illinois • North Carolina • Ohio • Pennsylvania

Pile Dynamics, Inc.

Pile Dynamics, Inc.
4535 Renaissance Parkway
Cleveland, Ohio 44128 USA
E-mail: info@pile.com
Phone: +1-216-831-6131
Fax: +1-216-831-0916