



GRL NEWSLETTER

No. 20

INFORMATION GATHERED BY THE ENGINEERS OF
GOBLE RAUSCHE LIKINS AND ASSOCIATES, INC.

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CAPWAP® - A REGISTERED TRADEMARK

One bright Cleveland morning in the early 1970's, *Dr. George Goble*, then Professor of Structures at **Case Institute of Technology**, shouted **EUREKA!** What he had found was a name for what we then briefly called our "wave equation program". *Goble* named it the **Case Pile Wave Analysis Program**, in short **CAPWAP**. The program uses a wave equation type analysis and iteratively finds those soil parameters that bring field measurements into agreement with calculated pile top quantities. *Goble Rausche Likins and Associates, Inc.* applied to the US Patent and Trademark Office for registration of the **CAPWAP** label and on June 23, 1992 the Patent and Trademark Office registered **GRL** as Principal Register of **CAPWAP**.

CAPWAP predicts the static pile behavior by determining parameters of a soil model such that dynamic pile top measurements and calculations of force or velocity agree. **CAPWAP**, therefore, performs a "System Identification" analysis or simply a signal matching procedure.

CAPWAP today is very versatile and can not only be used to calculate the static and dynamic soil parameters but also to investigate the pile integrity, check data quality, teach wave transmission in piles, statically analyze piles and last but not least, enjoy watching the program quickly obtain a solution, completely automatically.

CAPWAP 1993 RELEASE

GRL has now released the 1.993-1 version of **CAPWAP**. Many new features and graphics screens were added. Users will particularly benefit from the new manual which includes a variety of solved sample problems, covering a variety of analysis situations and background information on dynamic pile testing. **CAPWAP** users with update support will soon receive their new copy.

GRLWEAP NEWS

More than 500 firms worldwide use **WEAP** or **GRLWEAP**. Our goal is to make the program even easier to use, aid in educational endeavors and improve **WEAP** predictions. For the 1993 update, additional graphic displays and help screens are planned for the input program. Additional hammers will be entered in the data file. The diesel hammer logic (when and how to iterate on stroke or pressure) will be improved and non-uniform ram shapes accepted. Furthermore, responding to a request by Prof. Bengt Fellenius, **GRL** has prepared a University Version. The program itself may be acquired free of charge by educational institutions to assist instruction of this improved technology. The options available in this version are limited but sufficient to demonstrate major capabilities. If you have any suggestions for our next **GRLWEAP** update, please drop us a note.

NEW PILE DESIGN MANUAL

ASCE has published "**Design of Pile Foundations**," an engineering manual prepared by the US Army Corps of Engineers (EM 1110-2-2906). This document summarizes important aspects of design and includes recommendations for wave equation and **PDA** testing.

NEWS FROM PILE DYNAMICS, INC.

PDI currently emphasizes further development of the **Pile Driving Analyzer™ (PDA)**, **Model PAK** and the **P.I.T. Collector** software. For the **PAK**, four channel strain measurements as suggested by Dieter Schau, **DMT**, Germany are now in final development by *Dave Peterman*. This feature is particularly valuable for large diameter piles.

For the **P.I.T. Collector**, **PDI** software engineer *Bob Neifert* (M.S., Akron University) who has joined **PDI** in November, produces enhanced, more powerful, user interactive screens.

PDI has now developed a sturdier and better protected strain transducer. In the inset of the photograph below, a new transducer (to the left of the accelerometer) is attached to a test pile in Dubai (see back page), a drilled shaft of 60 cm diameter, which was dynamically tested to 250 tonnes.



PDA test of Drilled Shaft (Photo courtesy of Dr. M. Mukaddam, I&M, Dubai, UAE)

PCI SUGGESTS WAVE EQUATION, PDA TESTING

In the March/April 1993 issue of the **Prestressed Concrete Institute Journal**, a report is published entitled "**Recommended Practice for Design, Manufacture and Installation of Prestressed Concrete Piling**." The committee, chaired by McLeod C. Nigels, includes in Chapter 5 specific references to wave equation analyses for equipment selection and dynamic testing for both equipment selection and field confirmation of hammer performance, pile stresses, pile integrity and bearing capacity.

CALENDAR OF EVENTS WITH GRL PARTICIPATION 1993-1994

- Jun 1-6, 93 **Third International Conf. on Case Histories in Geotechnical Engineering**, Univ. of Missouri-Rolla, St. Louis, MO, 314-341-4489.
- Jun 14-16 **Ninth International Bridge Conference**, Pittsburgh, Pennsylvania, Engineer's Society of Western Pennsylvania.
- Sep 23-24 **PDA Users Days**, Singapore, ABV Technology Pte Ltd, K.L. Cheong, fax (65) 746-9934.
- Sep 27-29 **PDA Users Days**, China, Earth Products China Limited, Frank Ko, fax (852) 395-5655.
- Oct 18-20 **Deep Foundations Institute 18th Annual Members' Conference**, Pittsburgh, Pennsylvania.
- Oct 24-27 **American Society of Civil Engineers Annual Conference**, Dallas, Texas, 1-800-548-ASCE.
- Nov 4-5 **Seminar on Offshore Applications of Dynamic Pile Testing and Analysis**, New Orleans, LA, Jay Berger, 303-494-0702.
- Nov 12-13 **Seminar on Pile Design with Static and Dynamic Methods**, Orlando, FL, Mohamad Hussein, 407-826-9539 or fax 407-857-6837.
- Jan 5-10, 94 **XIII International Conference on Soil Mechanics and Foundation Engineering**, New Delhi, India.
- February **PDA Users Days**, Orlando, FL, Pile Dynamics, Inc., 216-831-6131 or fax 216-831-0916.

BRAZIL

The Brazilian Association of Technical Norms currently formulates a Standard for High Strain Dynamic Pile Testing which is expected to be published during mid-1993.

Consultant Geomec Engenheiros Consultores S/C Ltda. and piling contractor Estacas Benaton Ltda. both have acquired PDA equipment. Jorge Beim, PDI Engenharia, Rio De Janeiro, provides training and support.

CHILE

José Veiga and colleagues of Geovenor, Santiago received training in PDA and CAPWAP when Michael Morgano (GRL Cleveland) delivered a PDA. The equipment was used to monitor the installation of 1.2 m diameter steel pipe piles in the harbor of San Antonio.

DUBAI

Mohamad Hussein (GRL Orlando) traveled to Dubai, UAE in April to deliver a PDA and CAPWAP to I&M, Dr. Mohamad Mukaddam, Director. I&M has been using P.I.T. for integrity tests since 1991. They prepared a 2.8 ton weight for impact testing (see front) of 60 cm diameter drilled shafts.

WAVE EQUATION SEMINARS

An offshore pile testing seminar and wave equation workshop is scheduled for Nov. 4-5 in New Orleans. The program will deal with offshore conductor and jacket installations. Lecturers include Profs. Roy Olson and George Goble and Jay Berger (303-494-0702).

Profs. Fellenius and Goble and M. Hussein announced a Nov. 12-13 seminar in Orlando. Topics include design and testing of piles and pile groups using static and dynamic methods.

EUROPE

On March 18-19 the Foundation Institute of Prof. Rodatz, Univ. of Braunschweig, Germany, conducted a "Piling Symposium" for 250 attendees. In Mannheim, O. Klingmüller, Director of GSP, on March 23 conducted a workshop on pile testing techniques and wave equation. Dr. Frank Rausche made presentations in both events.

Dr. Stefano Piccoli and colleagues of ISMES, Bergamo, Italy conducted a test series on drilled shafts using their P.I.T. Collector. They combined data interpretation with P.I.T.WAP training when F. Rausche visited them in March.

C. J. Grävare, Pile Dynamics Europe, trained several engineers of Lloyd Acoustics Ltd, Belfast, Northern Ireland for P.I.T. and PDA testing.

CANADA

Bert Miner (GRL Seattle) made PDA measurements on a Becker Hammer Drill (an exploratory test suited to coarse grained soils) at the Keenleyside Dam for the British Columbia Power and Hydro Authority. The PDA provided energy transfer and shaft resistance estimates for Alex Sy of the Univ. of British Columbia in his study of liquefaction potential. GRL had performed similar tests for both Washington D.O.T. and US Geological Survey.

Prof. Bengt Fellenius announced the release of a new "UNI" program. UNISETTLE now joins UNIPILE in the Unisoft series. Fax 613-741-5594 for information.

BOULDER COLORADO SEMINAR NEWS

GRL conducted a seminar and workshop on dynamic testing and wave equation on February 18-19 in Boulder. Evaluation by the attendees gave high marks for presentations.

FAR EAST

Arranged by PDI China representative Earth Products, delegations from Guanzhou (Institute of Archit. Science) and Shanghai (Baogang Metallurgical Const.) visited GRL/PDI Cleveland. At press time, Prof. George Goble travels and lectures in Manchuria and Japan. Mohamad Hussein will be in Singapore presenting a paper at the 11th SE-Asian Geot. Conf., and also travels to Thailand, Brunei and Hong Kong.

PDA Users Days are planned for September in Singapore and China. PDA/P.I.T. Users (and those interested in purchase) should ask contact name in above Calendar for details or invitation.

In April, Pat Hannigan (GRL Chicago) tested piles in Osaka, Japan, demonstrating our technology to engineers of the Konoike Construction Co., Ltd. and Osaka Gas Co. High soil set-up effects were noted. The tests were arranged by PDI rep. Charles Heidengren who has over a decade experience in the Japanese deep foundation industry.

CONGO

Jay Berger (GRL Boulder) and Steve Abe (GRL Cleveland), in cooperation with Sage Engineering Ltd. of Great Britain, performed PDA tests at an offshore installation near Pointe Noire, Congo. The tests also included HPA (ram velocity measurements) on the Menck MRBS 4600 and 5000 hammers.

CARIBBEAN

Early May saw completion of pile driving at the San Jose Lagoon Bridge and the start of an addition to an existing dock in the San Juan Bay, Puerto Rico. Dynamic PDA tests were performed by Mohamad Hussein and Mark Johnson (GRL Orlando). Mark also tested piles for the Savonetta Pier in Trinidad.

GRL

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