



# GRL NEWSLETTER

No. 28

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GOBLE RAUSCHE LIKINS AND ASSOCIATES, INC.

MAY 1996

## THE GRL UPDATED FHWA PILE DESIGN MANUAL by Pat Hannigan

The Federal Highway Administration in 1993 contracted with GRL to update their Manual on **Design and Construction of Driven Pile Foundations** and to teach its contents to transportation engineers across the country. The original Manual had been written by Mr. Suneel Vanikar of FHWA and released for the first time in 1985. The abstract of the Manual is as follows:

*This manual is intended to serve a dual purpose, first as a participant's manual for the FHWA's National Highway Institute courses on driven pile foundations and secondly as FHWA's primary reference of recommended practice for driven pile foundations.*

*The Design and Construction of the Driven Pile Foundations manual is directed to geotechnical, structural, and construction engineers involved in the design and construction of pile supported structures. The manual is intended to serve as a practical reference on driven pile foundations. Volume I of the Manual addresses design aspects including subsurface exploration, laboratory testing, static analyses, as well as specification and foundation report preparation. Volume II covers construction aspects including dynamic formulas, wave equation analyses, dynamic testing, static load testing, Statnamic testing, the Osterberg cell, as well as pile driving equipment, pile accessories, and pile installation inspection. Step by step procedures, workshop problems and solutions are provided to demonstrate use of the manual material.*

The FHWA's Technical Manager was Mr. Jerry DiMaggio. GRL's team that modified major sections of the manual included Mr. Pat Hannigan (GRL Chicago), Dr. George Gable (GRL Boulder) and Messrs. Gabriel Thendean, Garland Likins and Frank Rausche (all GRL Cleveland). GRL's team also included Dr. Joe Caliando (Utah State University), Dr. Michael Holloway (InSituTech), and Mr. Robert Lukas (Ground Engineering Consultants) who reviewed selected chapters of the manual. External review was also provided by a technical working group comprised of 11 FHWA or State geotechnical engineers.

The introduction to the manual explains that document was needed in order to assemble the vast array of available information in a single source and to avoid unnecessary expenditures from overly conservative design methods. The economic impact of using overly conservative methods is significant since Federal and State governments spend nearly one billion US Dollars per year for bridge foundations alone.

In the preparation of the 1300 page manual, great care was taken to give the reader the big picture before starting very detailed descriptions of available methods and design tools. The reader and workshop participant will therefore receive information not only for solving specific design problems but for understanding why certain steps are taken and what alternatives would be available, considering economic aspects.

The first volume presents an overview of subsurface exploration and analysis and then explains the steps necessary before a pile foundation can be justified. The first volume contains static analysis methods for the design of single piles and pile groups under compression, uplift and lateral loading. Special design events discussed in the chapter include downdrag, scour, lateral soil squeeze, and soil and pile heave. Other topics covered include time effects on pile capacity and pile driveability.

The design chapter of Volume I closes with a discussion of how construction issues impact on design such as jetting, predrilling, dewatering, densification, vibrations, etc. The first volume ends with chapters summarizing the pile design process through an example problem, contract documents and specifications, and recommendations for the preparation of a foundation design report. *(Continued on Page 2)*

## NEWS FROM PILE DYNAMICS, INC. (PDI)

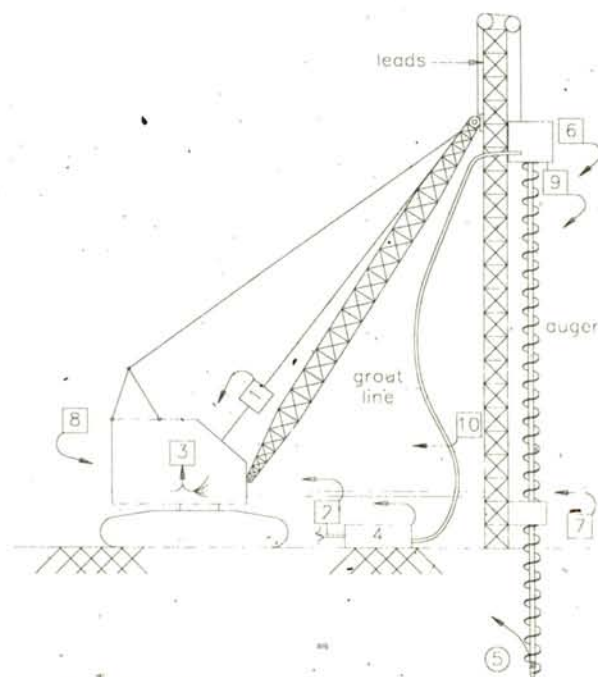
### PILE INSTALLATION RECORDER FOR CFA-AUGER CAST PILES (CFA-PIR)

World-wide the requirement to document the quality of manufactured products has led to the need for automatic recording systems even for pile installations. Construction sites are particularly adverse for complex monitoring systems. Pile Dynamics, Inc. has therefore used its expertise with rugged and complex systems to design and build Pile Installation Recorders (PIR) for both driven and auger cast piles.

Pile Dynamics' CFA-PIR is now available to the industry either on a trial basis to gain experience or for permanent QA use. The system measures important parameters during the installation of Continuous-Flight-Auger (CFA), also called Auger Cast Piles, recording all or a selected number of the following quantities (numbers refer to devices in figure):

- Depth of auger bottom (1 on crane line or 6, 7 radar)
- Grout Volume (4, from pump volume or magnetic flow)
- Grout Pressure in the grout line (2)
- Grout Pressure at the bottom of the auger (5)
- Hydraulic Drive Pressure (8)
- Number of auger rotations (9)
- Auger inclination (10)

*(Continued on Page 2)*



Schematic of PIR-CFA

## MANUAL ... Continued

The second volume focuses on construction monitoring of pile foundations. This volume covers pile equipment and accessories as well as the numerous methods for pile capacity evaluation in the field. An important section of the manual deals with dynamic analysis by the wave equation. Additional discussions of dynamic, slow dynamic and static test methods for field capacity evaluation are also provided.

Two types of workshops are offered through the National Highway Institute (NHI) including a 2 day course on Construction Monitoring or a 4 day course on Design and Construction. To date, instructors have been Messrs. Jerry DiMaggio and Pat Hannigan, and Professors George Goble, Joe Caliendo and Frank Townsend (Univ. of Florida). The Design and Construction course has been presented in Oregon, Florida, Indiana and Minnesota and the Construction Monitoring course has been taught in Massachusetts.

Many GRL-Newsletter readers have asked for a copy of the manual. Unfortunately, GRL cannot provide copies upon request, however, once the final printing has been made (expected in fall of 1996) the National Highway Institute will be in charge of the distribution of the document. A future GRL Newsletter will announce when the manual is available and the name of the government contact. In the meantime, only course participants are entitled to receive a copy. Interested parties should contact their State Department of Transportation's foundation unit or training office for their workshop plans. For course information you may also call Mr. Jerry DiMaggio at 202-366-1569. ■

## PIR CFA ... Continued

The CFA-PIR electronics is contained in a small box (3), easily mountable near the crane operator, or carried in the hands of the foreman and powered by the crane. A touch screen allows for control of data acquisition and user input. Measurements are displayed on the LCD touch screen and stored on a flash card memory which can be removed at the end of the day for PC processing and printing.

This system has been field tested on sites in the USA by Berkel & Company Contractors. It is now being used by Wagstaff Piling in Australia. Engineers or contractors desiring to learn more about this equipment or use it on their sites should contact Pile Dynamics, Inc. (216-831-6131). The equipment allows for custom tailoring of some of its output modes. PDI delivers to site, installs it in the user's equipment and then turns it over to the user's personnel with sufficient operating instructions. ■

### • MORE NEWS FROM PDI

PDI is now shipping the Pile Driving Analyzer® Model PAK with a 5x86 processor at 75 MHz. While the PDA's speed of operation has always been more than adequate, the new processor speeds up CAPWAP or GRLWEAP analyses. Hard disks with capacities in excess of 350 MB are also available.

## GRL

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## 1996 CALENDAR OF EVENTS WITH GRL PARTICIPATION

### USA

July 15-17 Logan, UT, Pile Foundation Short Course, information from Utah Stat Univ., Civil Eng. Dept., Ph: 801-797-2663, Fax: 801-797-0036.

July 31-  
Aug 3 Madison, WI, ASCE Geotechnical Engineering Congress, contact ASCE at 212-705-7496

Sep 10 Orlando, FL, PDA Users Day, for information contact GRL, Ph: 216-831-6131.

Oct 2-4 San Francisco, CA, 21st Annual DFI Members' Conference and Meeting, contact Geordie Compton at 201-567-4232.

### INTERNATIONAL

Sep 11-13 Orlando, FL, Stress-Wave '96, Fifth Int'l Conference on the Application of Stress-Wave Theory to Piles, contact Dr. F. Townsend, Ph: 904-392-0926.

### CAPWAP UPDATE

GRL has shipped the 1996-1 CAPWAP update including a complete Manual. The program now allows for the analysis of up to 10 consecutive blows at one time. With this analysis type, it is hoped changes of capacity due to dynamic effects and partial capacity activation can be investigated and better understood.

### GRLWEAP NEWS

The 1996-1 version of GRLWEAP (including replacement pages for the Manual) is now being shipped to users with support. Main improvements are a graphic input mode for simple input error checking, particularly for driveability analyses. For some help screens, direct data transfer to the input file has been made possible. For many of the printed messages, headers have been entered in a file which is translatable to non-English languages. The Bearing Graph plot for two analyses now includes a parameter listing for both results. An error was detected and corrected in the vibratory hammer data conversion to the SI system.

### USERS DAYS, SEMINARS

As this Newsletter is being printed, PDI's Garland Likins and GRL's Gabriel Thendean are on their way to PDA Users Days in Kuala Lumpur, Malaysia and Nanjing, China. Also, they will hold seminars in Taipei, Taiwan; Seoul, Korea; Jakarta, Indonesia; and Nanning, Tianjing and Shi Jia Zhua, China. Arrangements are being made by PDI rep's. Richard Yu, Soil Dynamics (Malaysia) Sdn. Bhd. and Frank Ko, Earth Products China Ltd.

A PDA Users Day has been slated for **September 10, 1996** (note change in date from our previous GRL Newsletter) in Orlando at the Grosvenor Resort. This meeting of PDA Users will precede the Stress Wave Conference (see box).

### UTAH SEMINAR

Please note the enclosed invitation to the Utah PDA seminar and GRLWEAP workshop.

### The FIFTH INTERNATIONAL CONFERENCE on the APPLICATION of STRESS-WAVE THEORY to PILES

This is the most important Conference for dynamic pile testers and analysts. It will be held in Orlando on September 11 through 13 of this year. We have been informed by Conference Chairman Professor Frank Townsend, University of Florida, and Conference Secretary Mohamad Hussein, GRL Florida, that 86 papers have been accepted for presentation; proceedings are now being prepared for printing. Please consider including your business card in the proceedings; contact Prof. Townsend immediately; Fax 904-392-3394.

**Please Register Soon!**

### REPRESENTATIVE FOR TURKEY

Mr. M. Hamdi Kaya of ERKE Diş Ticaret Ltd. Şti. (0212 231 72 50) contacted PDI and arranged a seminar for some 50 engineers from universities, government agencies, engineering consulting firms and construction companies for March 26. ERKES engineers, Ms. Değer Çaktı and Mr. Mehmet Akçay, helped with preparation and translation of lectures presented by Dr. F. Rausche.

Turkey's economy is growing at an amazing rate and construction needs are therefore at a peak. In fact, Construction International reported that Mensoy, a Turkish contractor, has achieved a world record by installing in one year 800,000 m of piling, mostly of the Vibrex type.

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