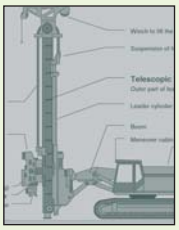

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PILEDRIVER

THE OFFICIAL PUBLICATION OF THE PILE DRIVING CONTRACTORS ASSOCIATION | Q3 2005 VOL. 2, NO. 4

PROJECT SPOTLIGHT:

New Cruise Pier 3, San Juan, Puerto Rico

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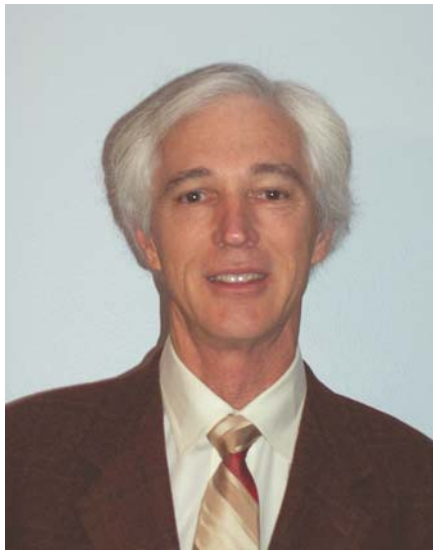
Cruise Pier 3 was commissioned by Royal Caribbean Cruise Lines and the Puerto Rico Ports Authority. The project involved the construction of a pile-supported pier in the bay at Old San Juan, Puerto Rico.



Thank You, PDCA!

By Randy Dietel, PDCA President

As PDCA gets ready to celebrate its 10th Anniversary on Dec. 20, 2005, I have enjoyed the privilege of serving as its president. This is my last opportunity to share with you the many on-going projects which your board of directors, executive director, and members have been doing for the good of all of us connected with the driven pile industry. But first I have some important news to share with you.

Tanya Goble, who has been our executive director for almost three years, will be leaving us at the end of the year. She has done an outstanding job in bringing us out of a financial crisis to a very solvent organization, and did it without sacrificing programs or quality. She should revel in the outstanding 3rd Professors Institute which was held at Utah State University this past summer. It was the best yet. We wish her well and know that she will be successful.

However, we are very blessed to have acquired the qualified talent of Stevan Hall, who you can read about in another section of this publication. His past experience in running the Associated General Contractors of Greater Florida should provide this organization with a new dimension. Please read his Executive Director's Message on the following page.

Four standing committees within PDCA are due some special recognition: the Environmental Committee, the Technical Committee, the Education Committee, and the Communication Committee.

The Environmental Committee, a new committee this year under the able leadership of John Linscott, has six areas of focus. I am particularly proud of two projects. The first is a vibrations and noise case history database which is being developed by Ed Hajduk, PE at WPC and The Citadel in Charleston, SC. This project is nearing completion, thanks to senior undergraduate students in The Citadel Civil & Environmental Engineering program. If you have data which you have not yet supplied, please contact our office or see our Web site.

Their second project was the printing of a short, concise pamphlet, written in laymen's terms, explaining the noise and vibrations from pile driving. These pamphlets are for our PDCA members and can be handed out to both explain and defuse the many misconceptions and myths about noise and vibrations.

The Technical Committee, Dale Biggers, chairman, is finalizing its "Recommended Installation Specifications for Driven Bearing Piles." This document is geared for private sector work, as opposed to governmental jobs. It should be very helpful to engineers and companies looking for a quality set of installation specifications. A special thanks goes to Dr. George Goble, who has done the lion's share of the development of this document. Garland Likins has stepped up to the plate and is helping put the finishing touches on it. The committee met bi-monthly for almost a year, using a Web-telex conferencing system that allowed for quite a bit of participation.

Our Educational Committee, chaired again by Mark Weisz, provided great programs for our Winter Roundtable Conference in Charleston, SC. The Design and Installation of Cost-Efficient Driven Piles (DICEP) conference in Boston this past September had a good turnout. What I believe made this program so special was the excellent dialogue between presenters and attendees. This was the best I have experienced.

We hope you have noticed the continued improvement of Piledriver magazine. We owe a big "thank you" to our Communications Committee, and primarily to Van Hogan, who has chaired this committee for several years. The committee has also improved our Web site, which continues to grow in available information services for all of us.

In closing, I want to say thanks again for allowing me to serve as your President. It has indeed been a privilege and an honor to be involved with this very dynamic organization. Its future looks bright, so stay involved! ▼

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Here's to Another Great 10 Years!

By Stevan Hall, PDCA Executive Director

This is an exciting time in the history of the Pile Driving Contractors Association and an exciting time to be a part of this great organization. In 2006, the PDCA will celebrate it 10th anniversary as an association that is effectively representing the pile driving contractor and your industry.

Over the past 10 years the mission of the PDCA has been to promote the increased use of driven pile for deep foundations and earth retention systems and in all cases where driven pile solutions are effective; to reach out across the nation and internationally to support and provide educational programs for engineers, educators, and contractors on design, methodology, installation, and code; to be involved in research and grant activities designed to advance driven pile trends and technologies; and to promoted the driven pile through a variety of publications produced by the PDCA committees.

Successes in all of these areas during PDCA's first 10 years representing the driven pile industry has been attainable as a direct result of the persistence, hard work, enthusiasm, dedication, conviction, and leadership of members and staff that have dedicated themselves to this organization.

In October 2005, the PDCA Board of Directors selected me as the association's new Executive Director. I am grateful for this opportunity and believe my previous 15 years of experience in association management will be an asset to the continued success of the PDCA.

I am excited about the PDCA's next 10 years and see tremendous potential to advance our association because I see the tremendous potential within our members. I am confident that together, we can make great strides in promoting our industry, members, and mission if we are all willing to seriously embrace our individual and collective responsibilities and commit as stakeholders to the success of the association. All PDCA members need to embrace the idea that PDCA, like all associations, is only as strong as its members and the support they are willing to provide. The membership in successful organizations refuse to accept the statistics that 10 percent do 80 percent of the work, and nothing could be closer to the truth than the saying, "The whole is greater than the sum of its parts." Collectively, we are as strong as the driven pile—independently we will fail to make a significant difference.

So what is in store for PDCA members over the next 10 years? How can you make a difference and help support your association? The first thing you need to do is mark your calendar and set time aside to join your fellow PDCA members at the Winter Roundtable Annual Conference, scheduled for March 2-4, 2006, in San Antonio, Texas. The conference will be held at the Hilton Palacio Del Rio on the Riverwalk. The conference will include a series of excellent topics, informative speakers, as well as some new events designed to entertain the whole family. Registration information will be distributed in the near future, but block out the dates on you calendar today.

PDCA also needs your participation on several fronts, such as participation on one or more of our committees, which include Communications, Education, Environmental, Market

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Development, Technical, and Membership Development. All of these committees have 8-10 dedicated members to accomplish their mission, but they could use your help. Meetings are usually on a quarterly basis and are via conference call so there is no travel involved. The PDCA membership nominates and elects its Board of Directors each year. Each year leaders of the Board rotate off, leaving vacancies for others to fill. Leadership of the PDCA through its Board needs to remain strong, which requires industry leaders to step up and serve their association. Consider it, and contact a Board member to express your interest.

Now let's talk about MEMBERSHIP! Membership is the life-blood of any association. It takes dollars to run an effective association and it take even more dollars to do a great job running an effective association. Membership is everyone's responsibility. When was the last time you asked a "competitor," a vendor, a supplier, or an engineer to join the PDCA. You work with all of them, you have a business relationship with all of them, so why not ask them to support the PDCA through their membership? When they do, we all benefit. Call five companies today that you feel will benefit from membership in the PDCA. If you need membership applications or information, let us know—you will have it tomorrow. If you are reading this message and are not a PDCA member, consider joining. *Piledriver* magazine is just one of the many benefits of membership. You can go to our Web site www.piledrivers.org and click on the "Join PDCA" tab on the left column for more information.

Finally, I want to thank my predecessor, Tanya Goble. While I have not had the pleasure to work with Tanya for any length of time, it is apparent that she has served the PDCA with a true sense of dedication and commitment. I know she has the gratitude of the Board of Directors and members and on behalf of the PDCA, we wish Tanya great success in all her future endeavors. ▼

Boston Conference in September

We held our 6th Design of Cost-Efficient Driven Piles Conference in Boston on September 15 & 16. This was our first conference in the Northeast and attendance was excellent, with participation from more than 85 engineers, contractors, and suppliers. Also a first: the program was qualified by New York State to award Professional Development Hours required for a professional engineer license in that state. The conference program was very well received—there are a few copies of the conference proceedings left and PDCA members can request their copy by calling Headquarters at (888) 311-7322. We want to thank and recognize our speakers for the many high quality presentations that were delivered. ▼

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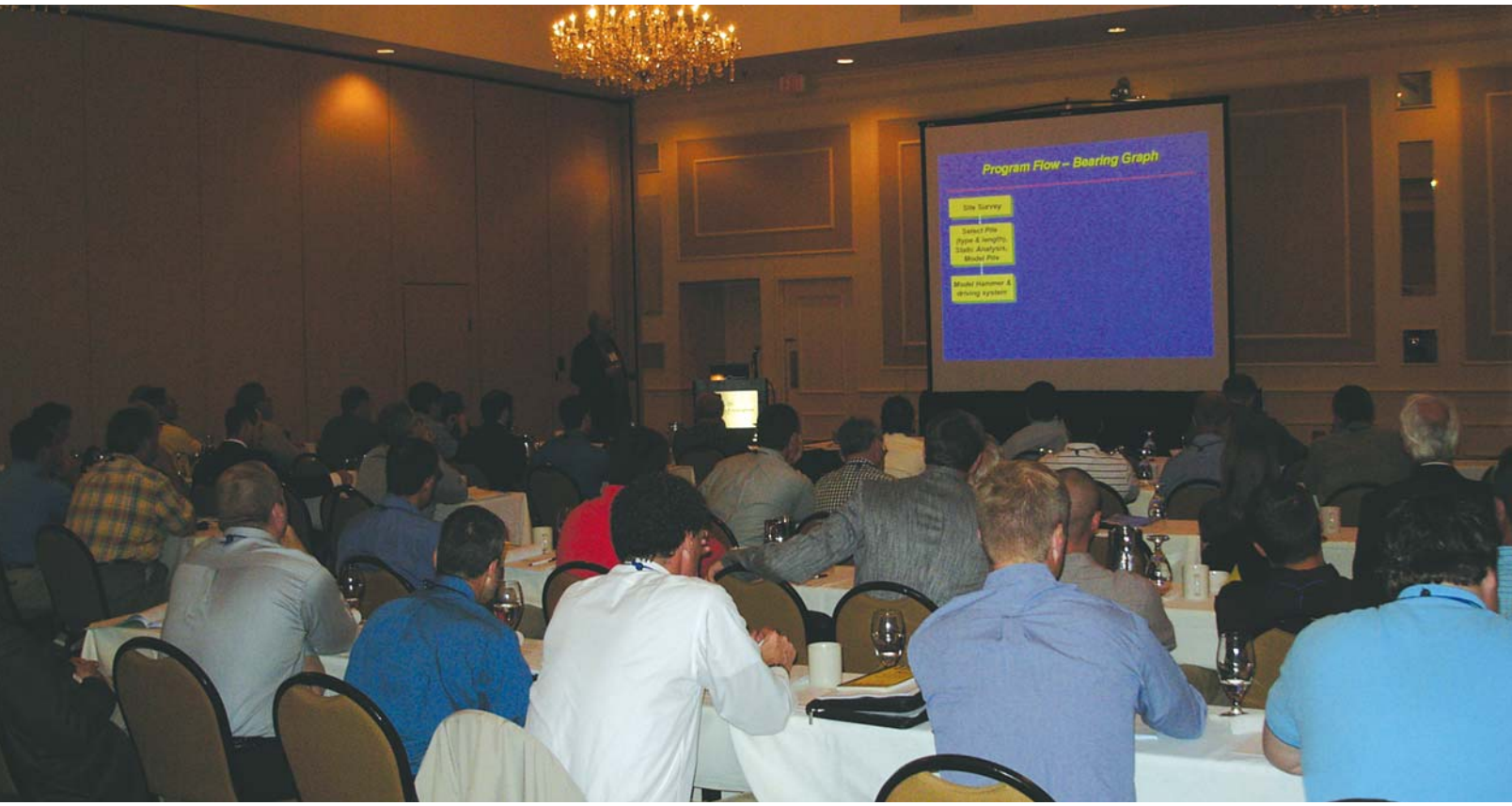
Design of Cost-Efficient Driven Piles Conference Highlights

- George Goble of Goble Consulting presented "Driven Pile Design Process."
- Steve Dapp of Dan Brown and Associates presented "Comparing Static Axial Capacity between Drilled and Driven Piles."
- Garland Likins of Pile Dynamics presented "Wave Equations and Dynamic Pile Testing."
- Stephen Borg of the New York DOT discussed "Wantagh Parkway Bascule Bridge to Jones Beach, Long Island."
- Van Komurka of Wagner Komurka Geotechnical gave two presentations on "Incorporating Setup into the Design & Installation of Driven Piles" and "Support Cost Components of Pile Foundations."
- Billy Camp of S&ME discussed "How Driven Piles saved $7M: A Case History of a Power Plant."
- The PDCA Technical Committee gave a preview of the new PDCA Pile Installation Code for private sector work.
- Peter Osborn of the Federal Highway Administration spoke on "High Capacity Piles."
- Ed Hajduk of Wright Padgett Christopher presented "Pile Driving Vibrations."
- Dick Hartman of Hartman Engineering discussed "A lesson learned from Two Bulkhead Failures."
- J. Brian Anderson of the University of North Carolina presented "The Use of FB-Pier for the Analysis of Pile Groups." ▼



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- Timber Piling Council

The Pile Driving Contractors Association

Presents

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March 2 – 4, 2006, Hilton Palacio Del Rio, San Antonio, Texas

Who Should Attend?
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For Your Spouse or Guest
Plan on bringing your spouse or guest to enjoy beautiful San Antonio. This year's spouses program includes:

- Thursday Welcome Reception
- Shopping tour of Fredericksburg, TX.
- Friday Reception and Dinner
- Morning Tea with a Special Guest

Hotel Information
Hilton Palacio del Rio, San Antonio

All conference programs and exhibits are located in the Hilton Palacio del Rio. This luxury AAA Four Diamond facility is ideally located along the famous River Walk. You'll be surrounded by San Antonio culture and attractions.

Pre-Conference Short Courses

Wave Equations - Basic Pile Design and Installation* - Inspectors Short Course*

This Year's PDCA Conference Features Distinct Tracks for Contractors and Engineers
With Joint Tracks for both and a Roundtable Discussion

Contractor Tracks
Assessing and Mitigating the Effects of Pile Driving Noise on Fish
Horizontal Pile Driving and Cofferdams
Case Study –Value Engineering Driven Piles in Texas
Case Study – Bulkhead Failures
Geothermal Aspects of the Driven Pile

Engineer Tracks
Pile Set up on a Steel Project
Pile Driving Vibrations
High Strength Concrete Piles
Pile Capacity of Driven Piles v. Drilled Shaft
Pile Supported Embankments
and more

Exhibitors

Exhibit opportunities are available. Exhibit Hall opened from Thursday, March 2 through the end of the conference on March 4. The Welcome Reception will be held in the exhibit hall giving exhibitors an additional 1½ hours to display their products and services. Contact PDCA for more information and to reserve your table top or booth.

Contact the PDCA for more information or go to our Web site at www.piledrivers.org
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* Program Speakers not confirmed

Members of the South Carolina Chapter of the PDCA participated last June in a golf outing for the Lou Holtz Foundation. Participating, from left to right, were Harry Robbins (Palmetto Pile Driving), John King (Pile Drivers, Inc.), Lou Holtz, Richard Gilbert (Skyline Steel) and Don Surrency (Koppers).

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New Cruise Pier 3, San Juan, Puerto Rico

By Jennifer Raymond

Tourism revenue is very important to the Puerto Rican economy. A big part of that revenue is derived from the cruise ship industry. Competition between the various cruise lines is growing very intense as they continue to put more and larger ships into their fleets. These upgrades to the fleets often require upgrades to port facilities.

To meet the growing need, Cruise Pier 3 was commissioned by Royal Caribbean Cruise Lines and the Puerto Rico Ports Authority. The project involved the construction of a pile-supported pier in the bay at Old San Juan, Puerto Rico. The design for the new pier utilized a curved deck to neatly accommodate two cruise ships simultaneously and a fabric canopy over 100' high that resembled the sails of a vintage sailing ship. The new structure would also allow Royal Caribbean to accommodate the largest ships they currently have under design and the Puerto Rico Ports Authority the opportunity to attract additional cruise ship traffic to San Juan. The new facility would also provide increased revenue for Royal Caribbean, the Ports Authority and the people of Puerto Rico.

The project owners contracted with QB Construction, S.E. of San Juan to construct the new pier. PDCA member Continental Construction Company, Inc of Memphis, Tennessee was awarded a subcontract to furnish and install the driven piles and construct the concrete deck.

The project started in March 2004 with the mobilization of test piles from the U.S. mainland for the on-site Test Pile Installation / Testing Program.

By the end of the following month the test pile installations, PDA analyses, static compression, and tension tests were completed and production piles were ordered. The actual first load of production piles arrived and installation began the first of June 2004.

Over the next five months, the production piles were driven with one rig while a second barge-mounted crane constructed the concrete pier. Approximately 470, 18"x18" prestressed concrete piles, 105' in length, were driven with a hydraulic impact hammer.

Obstacles had to be overcome early in the project. There was no supplier on the island capable of providing the project with the required prestressed concrete piles. The piles, weighing approximately 8,300 tons, had to be cast on the US mainland and shipped by barge to San Juan.

Rodney Waits, Vice President of Continental Construction stated, "The logistics of this operation were made even more difficult by the fact that almost all of the piles, which were cast in Tampa, FL and barged to San

Juan, were produced and transported during the height of 2004's very active hurricane season." He also noted that in the end it was "good fortune" that allowed the project to stay on track and completed without any serious damage from the storms.

Almost all of the driven piles were installed on a batter to accommodate the lateral loads imposed by ships, wind and earthquakes. Water depths at the site ranged from 15' to 40' and mud depths ranged from 5' to 30'. Continental Construction constructed a two-tier template to position the piles and accommodate the various, required installation angles.

The new pier was constructed near the site of a previous pier. Based on their review of the geotechnical report, Continental Construction expected some interference problems. However, it turned out that the sea floor was littered with debris both at and below the mudline. Continental Construction worked closely with the construction manager, QB Construction SE and structural engineer, Ray Engineers PSC, to work through the conflicts by relocating piles, adding piles or redesigning portions of the pier

The task of driving long, slender piles on a batter through underwater debris proved very challenging. Piles could be easily cracked or broken during driving so great care was exercised throughout the duration of the project. Due to the fact that the piles were manufactured far from the work site meant that there would be tremendous cost and schedule impact if the number of piles that were damaged or lost exceeded the number of "extra" piles that were added to the production pile order. Great attention to every detail was required to avoid damage. Waits said to keep everyone safe and make sure no damage occurred during pile installation, the production and quality control by the pile supplier, soil probing, template structure, hammer criteria and cushioning as well as employee supervision and training were all tailored to the specific conditions of the site.

The result of Continental Construction's perseverance and attention to detail was a striking new pier that will serve the cruise ship industry and benefit the people of Puerto Rico for many years to come.

PROJECT SPECIFICS

Project Name: New Cruise Pier 3, San Juan, Puerto Rico

Project Description: Precast pile supported dock that extends into the bay in Old San Juan to berth Royal Caribbean cruise ships.

Piledriving Contractor: Continental Construction Company Inc., Memphis, TN.

Owner: Royal Caribbean Limited and Puerto Rico Port Authority, Miami, FL.

Architect and Engineer: Ray Engineers PSC, San Juan, Puerto Rico

Geotechnical Engineer: GeoCim, Guaynabo, Puerto Rico

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Part IV

Vibratory-Pile Monitoring

If correct instrumentation is applied to the vibratory driver/extractor, driven pile, and even soil; it's then possible to monitor: i.) the performance of the vibro-equipment, ii.) developed forces and stresses within the pile, iii.) the dynamic soil response, developed pore pressure and eventually induced settlements, together with iv.) magnitude of generated ground vibrations. Furthermore, if contemplating such tasks, several factors need to be considered (different in comparison to monitoring of impact driven piles) and therefore mentioned in the following paragraphs.

Fundamentals

The reader should bear in mind that the key factors related to the use of vibratory drivers/extractors are fundamentally different than conventional impact hammers. Not only does the pile penetrate the soil in a different way (sinusoidal downward directed motion due to the sine force), it also disturbs the soil surrounding the pile in a different way. Since stress waves don't exist within the pile, it is necessary to have sensors both at pile head and toe in order to assess the developed magnitude of dynamic soil response and the driving force delivered to pile head.

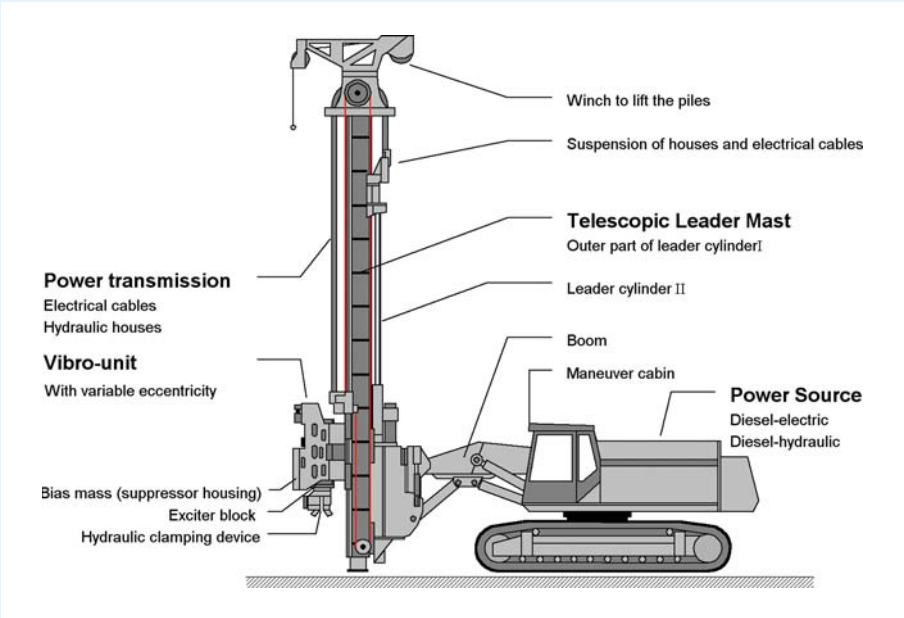

Fig. 1. A modern leader mounted vibratory driving equipment, and its main parts, [16].

Vibro-Instrumentation

Factors of interest and corresponding sensors necessary for monitoring of vibratory driver-related parameters consist of the following.

Magnitude of static surcharge force, F_o, can be monitored by using either a load cell in the case of a free-hanging vibrator, or by an oil pressure transducer in the case of an leader-mounted vibrator. The pressure transducer monitors applied hydraulic pressure in the hydraulic cylinder of the leader mast (see Fig. 1).

Magnitude of eccentric moment, M_e, in the case of using a vibro-unit with the possibility to vary M_e on the fly. This is accomplished by mounting a sensor within the vibro-unit to register the relative position of the adjustable eccentric masses.

Penetration depth, z, to monitor the vertical position of the driven pile when it's driven into the ground, makes it possible to correlate other parameters with penetration depth, i.e., stratigraphy. This is normally accomplished by using a thin steel wire connected to a depth-measuring drum.

With the above-mentioned sensors, it's possible to monitor the performance of the vibro-equipment, i.e., compare theoretically generated driving force with that's actually generated/produced.

It can also be justified, but more from a research point of view, to mount accelerometers on both the vibrating and non-vibrating parts of the vibro-unit, to monitor actually generated acceleration and/or verify that the bias-mass doesn't vibrate.

Pile Instrumentation

The pile-related instrumentation needed to monitor encountered SRVD consists of the following.

Near pile head: at least one axially directed accelerometer and preferably two strain gauges. Accelerometer is for monitoring the magnitude of developed inertia force, and strain gauges are for monitoring the magnitude of delivered driving force F_d (like the PDA analyzer™).

Near pile toe; an equal set of transducers as at pile head. Strain gauges to monitor developed dynamic soil resistance at pile toe R_t, and an accelerometer to monitor magnitude of developed inertia force and to verify assumption of axial pile rigidity. Double integration of acceleration signals provides information of the penetrative motion of the profile as well as magnitude of displacement amplitude.

It can also be justified, but more from a research point of view, to mount accelerometers laterally/transversally, (especially on slender piles), for the purpose of studying the magnitude of lateral motion.

With results obtained from the abovementioned sensors, it's possible to calculate: i.) the dynamic soil resistance along the shaft R_s, ii.) the penetration speed v_p, iii.) displacement amplitude S_p, iv.) penetrative motion u(t), v.) system efficiency ξ, and vi.) verifying that the pile can be treated like a rigid body. Sources on how to accomplish this in great detail can be found in [14], [15] and [16].

Soil Instrumentation

Soil-related factors needed to monitor primary soil mechanisms behind the shear strength reduction of SRVD, should consist of the following parts.

Magnitude of induced ground vibrations can be assessed by using either geo-phones or accelerometers (preferably tri-axial geophones and/or accelerometers) positioned at different radial distances (and depths) from the driven pile.

Magnitude of induced pore pressure at different depths and radial distances in relation to intended position of pile to be driven. This can be accomplished by installing pore pressure sensors prior to pile installation.

Other Instrumentation

The relative ease (read v_p) of vibratory driving, which is the result of the dynamic equilibrium of the vibrator/pile/soil system, can easily be assessed by using a digital camcorder that registers the time differences of depth marks (painted on the side of the pile) as it enters the soil.

Fig. 9a schematically illustrates a simple but useful paper sticker for monitoring the actual peak-to-peak displacement amplitude S_p of the pile as it slides into the ground. The stickers are glued onto the pile at 5 ft intervals and ocular readings of S_p are taken as they slide by the observer. Results of S_p can then be plotted versus penetration depth.

Furthermore, even though dynamic

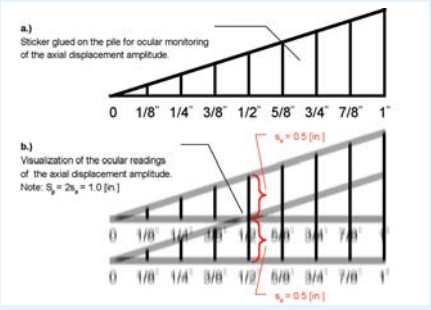

Fig. 9. Paper sticker for monitoring of the peak-to-peak displacement amplitude.

vibratory pile monitoring is not included in the PDA features of today, the authors [7] are of the opinion that it's possible to use a PDA analyzer™ (with some caution and modifications). Obtained results can provide the engineer with a wealth of beneficial information on which to base his/her design recommendations.

Summary

It's well known that impact hammers usually is the conventional method to use in order to install bearing piles. However, sometimes the vibratory technique should be considered as a suitable alternative when favorable soil conditions are present. It is also well known that piles driven into granular soils can be installed more efficiently by the use of a vibratory driver compared with impact hammers. However, the use of the vibratory technique is seldom regarded as the first choice, since the technique is historically constrained by uncertainties regarding the ultimate pile capacity. However, when opportunities arise, e.g., having suitable subsurface conditions and a fair amount of piles to be installed, it's anticipated that the use of this method can result in a tremendous reduction in installation costs.

Basically, the main ingredients for future tentative attempts of using the technique exist. New vibro equipment/machines with new features are constantly developed. These attempts should, however, include the following: the properly equipped vibratory system, a skilled geotechnical engineer with a bit of 'vibratory know how' and previous experience with this technique. An extensive pile trial program should be undertaken prior to installing production piles, with the purpose of eradicating all uncertainties including: i.) restriking, ii.) static load tests, iii.) documentation procedure for the production piles, together with iv.) well-defined instructions of how to end the vibro-installation phase. Although the knowledge of these mentioned ingredients is scarce, together with the fact that there are not many well-documented cases available, it's still anticipated that the technique has significant potential if used under the right circumstances. ▼

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[7] Viking, K., Dietel, R., Roberts, T., (2004), "A case study of vibratory pile installation monitoring of a precast prestressed concrete pile", Proceedings, DFI 29th Annual Conference on Deep Foundations, Vancouver, BC, Canada. 2004, pp. 273-281.

[14] Rao, P.M., (1993), "Effect of pile geometry and soil saturation in the behaviour of non displacement piles installed by vibration", MSc Thesis, Dept. of Civil and Environmental Engineering, Univ. of Houston, TX.

[15] Bonita, J.A., (2000), "The effects of vibration on the penetration resistance and pore water pressure in sands", PhD Thesis, Dept. of Civil and Environmental Engineering, Virginia Polytechnic Inst. and State University.

[16] Viking, K., (2002), "Vibro-driveability –a field study of vibratory driven sheet piles in non-cohesive soils", PhD Thesis, Div. of Soil and Rock Mechanics, Royal Inst. of Technology, Stockholm, Sweden. http://media.lib.kth.se/dissengrefhit.asp?dissnr=3358

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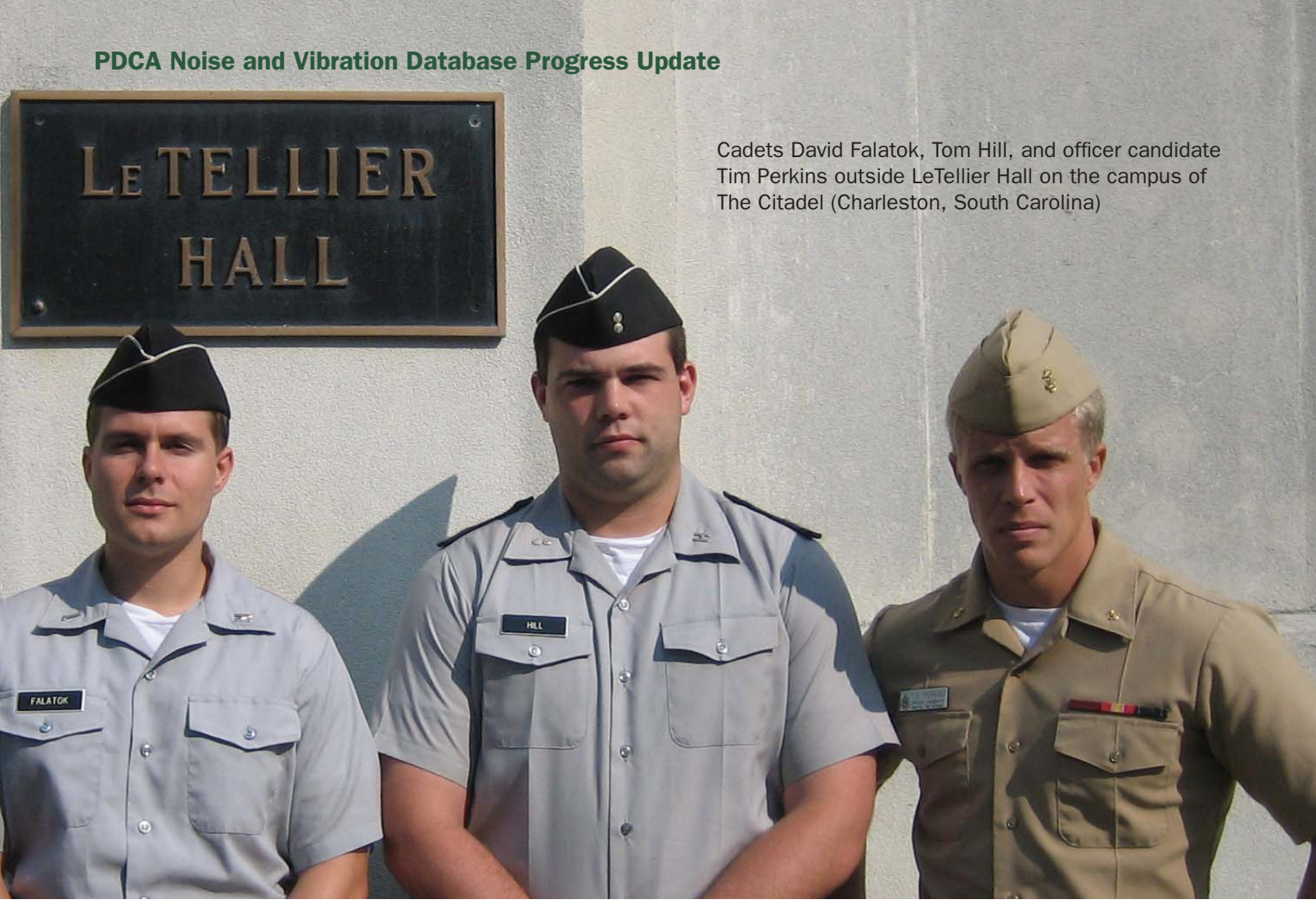

Cadets David Falatok, Tom Hill, and officer candidate Tim Perkins outside LeTellier Hall on the campus of The Citadel (Charleston, South Carolina)

PDCA Noise and Vibration **Database Progress Update**

By: Edward L. Hajduk, Kevin C. Bower, Timothy W. Mays

The ongoing joint research effort between Pile Driving Contractors Association (PDCA), The Citadel, and WPC Inc. to develop a pile driving noise and vibration case history database is approximately 75 percent complete. Deemed a critical first step in future research regarding noise and vibrations due to pile driving, the research effort is proceeding along its planned timeframe.

Three senior undergraduate students in the Civil & Environmental Engineering program at The Citadel are working on the project. Cadet David Falatok is from Spartanburg, South Carolina and he has plans to attend a graduate school in the fall of 2006. Cadet Tom Hill is from Greenville, South Carolina and he intends to pursue graduate studies in structural engineering in the fall of 2006. Officer Candidate Tim Perkins is from South Portland, Maine and he will either attend graduate school or reenter the US Naval Nuclear Power School with hopes of attending graduate school for nuclear/structural engineering. The students are participating on the project through The Citadel's Undergraduate Research and Design Initiative co-founded by Assistant Professors Timothy W. Mays and Kevin C. Bower in the Department of Civil & Environmental Engineering. The program is supported by industry and research grants which allow students to prepare for life after graduation. The focus of the initiative is fostering student development and generating realistic expectations for graduate school and/or the consulting world.

The industry response has been surprising. Mr. Edward Hajduk, PE of WPC and the PDCA Project Coordinator, has given several presentations about the development of the database across the country. "The industry is very receptive to the request for data and the development of the database. Other industry organizations such as the Deep Foundations Institute (DFI) and the American Society of Civil Engineers (ASCE) have been very gracious in helping us

Table 1. Case History Contributors.		
Company	**Contact**	**No. of Case Histories**
Gannett Fleming	Mr. Syed A. Ashraf, PE	1
Geosciences Testing and Research, Inc	Mr. Les Chernauskas, PE	29
GZA	Mr. Michael Derry, PE	4
Foundation Pile	Mr. Russ Taylor	6
H.P. Fleming	Mr. John Linscott	1
WPC Inc.	Mr. William B. Wright	40

spread the word. When Dr. Michael H. Wysockey, chair of the DFI Driven Pile Committee, found out about our efforts, I couldn't send him information about how to help fast enough."

To date, the following tasks have been accomplished:

- A literature survey regarding pile driving noise and vibrations has been completed. A bibliography of the relevant technical literature has also been completed.
- A questionnaire has been developed and sent to PDCA members. This questionnaire, modeled after a pile driving vibration study done by Dr. Woods at the University of Michigan in 1997, asked member firms and individuals about their experience with vibrations and noise issues related to pile driving. Attached to the questionnaire was a request for providing data to the database along with contact information regarding its development. So far the questionnaires have had an 18 percent response rate from the PDCA members list and a 48 percent response rate from the various state Department of Transportations (DOT's). Final results from the questionnaire will be provided to the PDCA when the database is submitted.
- Case history data from industry and technical literature sources has been collected. To date, 81 pile driving vibration and/or noise case histories have been received by the research team. A summary

David Falatok, Tom Hill, and officer candidate Tim Perkins sort through some of the 450 questionnaires sent out as part of the project.

of the various contributors is provided in Table 1. Of these 81 case histories, 25 have been reviewed and prepared for entry into the final Microsoft Access database.

The final phase of the project, which is the development of a Microsoft Access Database for all the case history data, is currently underway. The research team expects to present this database to the PDCA in early 2006. Prior to case history entry into the database, the team has reviewed the provided data to verify that it contains valid, relevant information relating to pile driving vibrations and noise. Where possible, the research team has attempted to contact the providing agency/firm/individual to provide clarification of data and/or additional information. While the team does not anticipate that every desired data field will be available within the collected data, it should be noted that all relevant data will help in the understanding and study of pile driving vibrations and generated noise.

According to Professor Mays, "Mr. Hajduk and WPC have provided an invaluable experience for our students. It is evident in their return to campus this Fall, that Mr. Hajduk has had an outstanding personal impact on their lives and their appreciation for the work that consulting engineers do." According to Mr. Hajduk, "the work ethic and leadership of the Citadel Cadets exceeded my highest expectations. It was a privilege to serve as their research adviser." ▼

The conclusions drawn from the future study of the Noise and Vibration Database depend upon the amount and quality of data collected. Every bit of data adds to the value of the database. While the research team is pleased with the amount of data collected to date, more is needed. Please contact the PDCA if you have noise and/or vibration data that you can contribute to this project. Help us to make this database a truly useful tool in the future use of the driven pile.

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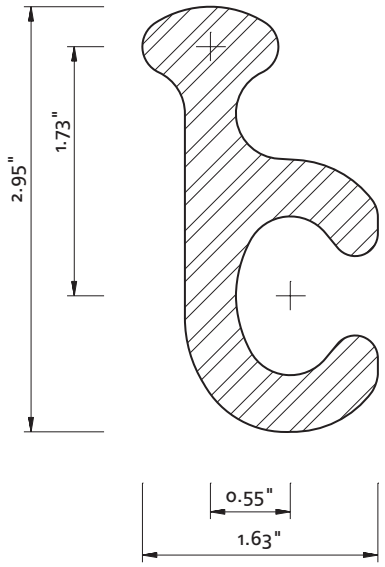
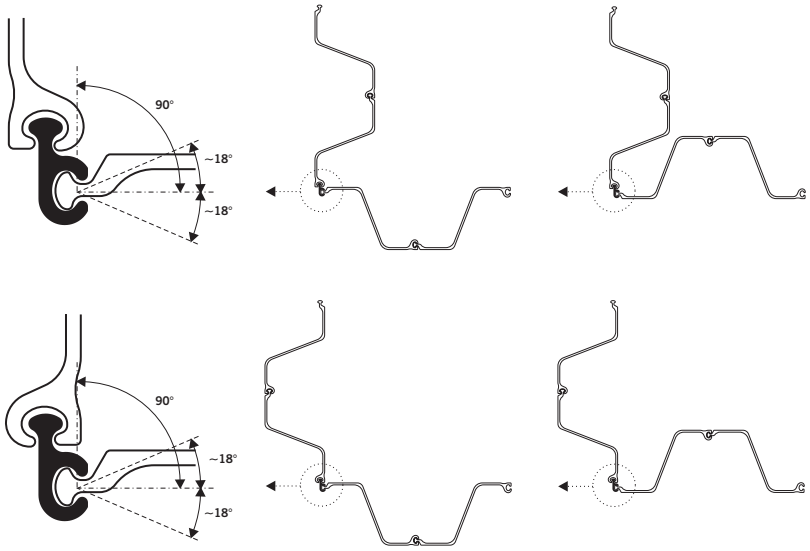


Weight: 7.3 lbs/ft (10.9 kg/m)

Steel grade: Astm A572 Grade 50 (S 355 GP)

Proper Interlocking Examples

Each interlock has a typical degree swing of 20° (+/- 5°) so that the probable swivel range is 40° (+/- 10°) when interlocking two PZ sheets via the connector.



V20

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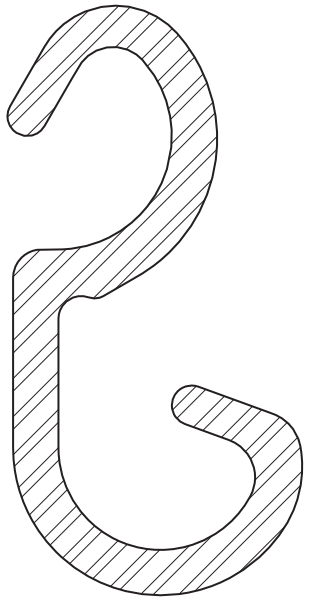
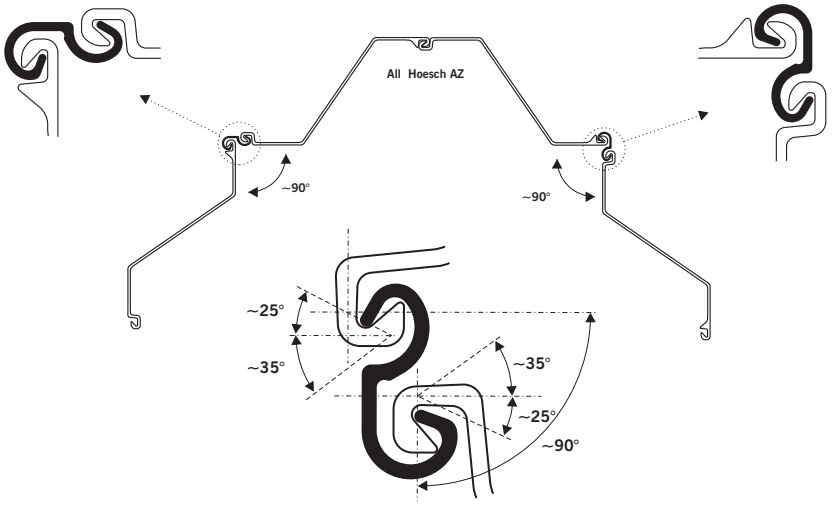
Applications: 90° corner (~25° to ~155°)



Weight: 8.9 lbs/ft (13.2 kg/m)

Steel grade: Astm A572 Grade 50 (S 355 GP)



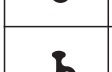
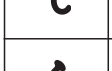
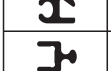
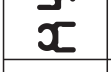
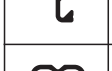
Installation Guidelines:

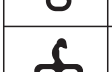
1. Thread the connector into the interlock while the sheet pile is out of the ground.

2. Adjust the connector to the appropriate position.

3. Tack or spot-weld the connector in place (typically a 10" weld attaching the connector to the sheet pile at the top is sufficient.)

4. Drive/extract the sheet (with the connector attached) as you would normally.

	For PZ and PZC (Ball + Socket)		
	**PZ 90**	Corner (~50° to ~130°)	**Page 3**
	**PZ Tee**	Tee Corner (~50° to ~130°)	**Page 4**
	**Joker**	Tee Corner (~50° to ~130°)	**Page 5**
	**Bullhead**	Tee Corner (~50° to ~130°)	**Page 6**
	**CBF**	Tee Corner (~50° to ~130°)	**Page 7**
	**Colt**	Corner (~25° to ~65°)	**Page 8**
	**Cobra**	Corner (~115° to ~155°)	**Page 9**
	**PBS-M/ PBS-F**	PZ / PZC + Peiner Beam	**Page 10**
	**BBS-M/ BBS-F**	PZ / PZC + Domestic Beam	**Page 11**
	**WOM/ WOF**	PZ / PZC + Pile Pipe Weld-on	**Page 12**
	**For All AZ and Hoesch 1706, 1806, 1856 and 1906 (U-Piles/Larssen)**		
	**V 20**	Corner (~25° to ~155°)	**Page 13**
	**VTS**	Tee Corner (~45° to ~135°) Circular driving	**Page 14**
	**VT**	Tee Corner (~45° to ~135°) Omega corner	**Page 15**
	**Omega 12**	Omega corner Jagged U-Walls	**Page 16**
	**V 22**	Larssen Interlock + Pipe Pile Weld-on	**Page 17**
	**PL**	Larssen Interlock + Peiner Beam	**Page 18**
	**PLZ I/ PLZ II**	Peiner Beam + Larssen-Z Piles	**Page 19**

	For Hoesch-Z Piling (with a width of 22.64 inches or 575 mm)		
	**HZ 90**	Corner (~45° to ~135°)	**Page 20**
	**HZT**	Tee Corner (~45° to ~135°)	**Page 21**
	**HZ**	Variable weld-on	**Page 22**
	**PHZ-Claw (PZL)**	Hoesch-Z + Peiner Beam	**Page 22**
	**PHZ-Knob (PZR)**	Hoesch-Z + Peiner Beam	**Page 23**
	**For Hoesch-Z Piling (with Hoesch Interlock and a width of 30.15 inches or 675 mm)**		
	**HZn 90**	Corner (~45° to ~135°)	**Page 24**
	**HZTn**	Tee Corner (~45° to ~135°)	**Page 25**
	**HZn Knopf**	Weld-on	**Page 26**
	**HZn**	Variable weld-on	**Page 27**
	**For PS-Flat Sheet**		
	**SWC 120**	120° Y Pile	**Page 28**
	**SWC 90**	90° Tee Pile	**Page 29**
	**SWC 60**	60° Y Pile	**Page 30**
	**SWC 30**	30° Y Pile	**Page 31**
	**SWC**	Weld-on	**Page 32**
	**Sealing sheet piling**		
	WADIT®	Non-toxic hot cast interlock sealant impervious to weather	**Page 33**

PDCA Member

Rusty Signor of Signor Enterprises

By Lindsay Williams

1979 was a very good year indeed. For Rusty Signor, it meant the start of Signor Enterprises in Austin, Texas. With wife Beth Ann by his side, Signor launched his company with the prospect of serving America with marine installations of pilings, boat docks, bulkheads, and driven piling foundations for residential homes and commercial buildings.

"About half of my jobs are driving pilings for large custom homes," Signor says. "And then the other part we do marine installations. We're very mobile. We use our mobile barges for drillings, test holes, repairing dams and bridges, geotech analysis and disaster response." "We're constantly getting bigger equipment and better equipment. We just bought a new air-driven pile driving machine from Pileco, which we found out at the [PDCA] convention. Our capacity for production has gone up about 40 percent, and that's been real beneficial."

Signor is at the top of his game. Yet he would not be there without the aid of his remarkable employees. With about a dozen full-time employees on staff, Signor believes that their talent and reliability is the foundation for his success. "Employees, employees, employees," Signor says. "They'll take care of your customers."

When it comes down to a typical project, Signor makes the initial contact and assumes care of the sales. Then the staff takes over from there. Signor has called himself merely the figurehead for the operations, claiming that the quality of his staff is what decides how the client relations will be handled.

"We get a lot of compliments every month [for the employees]. While receiving a check from any client is gratifying, frequent follow-up compliments from customers always overwhelm me," he says. The staff of Signor Enterprises tend to become long-term employees, working their way to the top from the bottom-up. Opportunity presents itself so consistently for his employees because Signor chooses to not micro-manage.

Signor used to be on every job, driving the tug boats, operating the tractors and more. However, over time he has come to realize that he gets better development and employees come up through the ranks much faster should he step back a little. "I'm not holding anyone down," he says. Applying this knowledge to many sites, he's used value engineering to lower the costs. "Value engineering is probably my biggest forte," Signor says

On one project Signor is particularly proud of, his company saved a client $130,000 and resurrected a dead job for an airport hangar though the use of value engineering. Although not an engineer, he has still managed to find different components that are economical.

After a budget for a job at San Marcus Airport was deemed too expensive due to complications associated with expansive clays, old taxiways, and buried concrete left behind by an old hangar that had burned down years before, Signor and his team came back with a cost-saving proposal to drill pilot holes through all of the anomalies and then drove pilings. They accomplished this in three days and managed to pour all of the foundation as flatwork. Instead of a structural foundation, costing $8.50 a square foot, they did it for $3.05 a square foot, saving a great deal of money for the customer and rendering the whole project viable. "And we did it expeditiously," Signor says. "You can save money or take a lot of time, but that's no good. It's got to be both [save time and money]."

When asked about the project of which he is most proud, Signor responded, "We built a boat dock that beat out close to 200 architectural entries, including a university, an airport, a country club, and a hotel. I was really tickled about that. The architect told me to do the structure how I wanted to do it and help him with the steel components. Then we had an engineer that sealed it all. I think they won nine national, international, awards for it. That was a really fun, fun project."

Considering the money and time Signor saved his client, it's no wonder he doesn't feel the need to advertise for his

company. Ninety-eight percent of our work is all referrals, he says. Signor Enterprises relies on a system of vertical operations. They own the equipment, complete of the sales, create the designs and produce the services. Very little is ever subcontracted out.

Therefore, it is in Signor's best interest to be a part of PDCA. As a member of this trade organization for the past four years, Signor attends conventions to keep abreast of technological issues and acquire mentors who dispense vital advice on the first ring of a phone call. Signor says, "I'm very sincere. If you're in the business it's absolutely stupid not to go [to conventions] to get solutions, to communicate pile driving problems, testing results, and mentoring from highly qualified individuals with pile driving experience."

Many customers commend Signor for his work, but he turns right around and gives all the praise to the PDCA. Upon joining PDCA, Signor breathed a sigh of relief, seeing that people from all over the nation, and the world were running into all the same problems. "People have forgotten how proven piles are and they are relying on drilled piers. And since I've gotten into PDCA, I can think of at least four customers that I was able to convince the structural engineers to change their techniques. I have a customer that we saved $30,000 on, another customer that we saved $130,000 on and another customer that called me and said, "Rusty, I have wasted time and $10,000 in engineering fees because these people kept saying 'drill piers, drill piers,' and I can't believe I didn't find you until now," and I am so tickled about this. All of these are the result of the information and education I've gotten from the PDCA."

When asked about the major benefits to using driven piles Signor responded, "…We can look at the inside of the pile [to confirm the] integrity of the pile. It just takes all those anomalies out of the equation." He considers one of his greatest challenges educating the engineering profession "about the advantages of piles and trying to get rid of any of the preconceptions that have lingered for years about pilings. For instance, about how noisy they are, how much they vibrate, how costly they are. These are all preconceptions that are erroneous."

When it comes to safety, Signor understands the need for the best trained employees. This is why Signor Enterprises employees take OSHA safety courses every two years and have safety meetings every week. "Insurance is a major problem and so safety is the safety net for that," Signor says.

Signor stressed quality control and process improvement as an important aspect of the job. "All of our equipment and personnel are trained and certified in everything they do. We keep up on the latest technology, information, and bulletins. Every job that I've worked on has had an architect and an engineer. The engineer monitors our job and certifies our job at the end. And that probably is the biggest learning process for me, because to listen to every engineer on every job, you can't help but pick up things."

Signor and his wife Beth Ann have three children, Jason, Celeste, and Clayton and a Granddaughter, Libby. His volunteer interests are the Boy Scouts; he serves as chaplain for a juvenile institution and he teaches writing clinics to a Christian youth organization, Adventures Unlimited. ▼

Precast Concrete Piles Provide **Durability, Versatility**

Precast, prestressed piles offer a range of advantages, particularly in corrosive environments, but proper installation is the key to maximizing the advantages

By John S. Dick, Structures Director
Precast/Prestressed Concrete Institute, Chicago, IL

Precast, prestressed concrete piles often are the preferred choice for durable and economical foundations, especially in marine environments, due to their excellent versatility and resistance to corrosion. A range of sizes and shapes are available, and the material's manufacturing process continues to create new techniques that expand its potential. But to maximize the benefits of precast piles, engineers and contractors must recognize the related handling and installation methods.

Smaller pile sizes, 10 to 14 inches, often are used for building projects such as convention centers, hotels, parking structures, and other large facilities. Larger piles, as big as 66-inch-diameter hollow cylinder piles, are used for bridges and as columns at bents in marine applications. Prestressed concrete piles can be designed to safely support the heavy vertical loads imposed by these types of structures as well as the horizontal loads caused by the range of factors, from traffic, wind, and earthquakes to waves and vessel impact.

Prestressing Is Key

The key to precast concrete piles' strength lies in the use of prestressing techniques applied during manufacture. Typically, prestressing is applied to piles using pretensioning steel strands in long line casting beds. In most cases, the prestressing strands are the only longitudinal reinforcement in the piles. The prestressing process introduces compression into the pile, which counteracts the tensile stress resulting from handling, driving eccentricity, and stress waves generated during driving. Under service conditions, this compression allows piles to resist axial tension and bending stresses.

Concrete strength for precast piles is usually a minimum of at least 5,000 psi. Precast piles can be fabricated with high-strength concrete that can reach strengths as high as 8,500 if needed. Higher strengths, up to 15,000 psi, can be accomplished but is not recommended due to economy and the extra time required to produce the piles.

Precast concrete piles have been used for more than 50 years. In fact, one of the most significant projects to use precast piles will celebrate its 50th birthday in 2006: the 24-mile-long Lake Pontchartrain causeway connecting New Orleans on the south with Saint Tammany Parish on the north. The precast bridge used 54-inch-diameter hollow piles with a 4.5-inch wall cast in 16-foot sections, which were then post-tensioned. The bridge will celebrate its half-century despite the impact of Hurricane Katrina—an indication of precast's durability and strength.

Photo courtesy of Atlantic Metrocast Inc.

Square precast, prestressed piles typically are used with building projects.

Key Pile Shapes

In the 1950s, one of the most common shapes was an 18-inch-square section. As demand increased, new shapes, including circular and octagonal, were produced. Larger, hollow designs in these shapes also appeared. Today, a wide range of designs and types of piles are available, varying by region and manufacturer. Most piles, however, are square, octagonal or round (cylindrical) in cross-section.

Photo courtesy of Atlantic Metrocast.

A precast, prestressed pile is hoisted into position for driving at the site.

Photo courtesy of Atlantic Metrocast.

Precast piles are easy to work with, but they require a different driving approach than steel piles.

Square piles are the simplest to manufacture and are generally available throughout the United States. The larger sizes of square piles may be cast with circular internal voids to reduce the pile weights. The voids also will reduce the number of strands necessary to achieve the same effective prestress, but that in turn reduces the bearing capacity if flexural capacity is needed. This shape requires fewer strands to obtain the same effective prestress and reduces the weight of the pile for shipping and handling.

Octagonal piles are popular in most areas due to code changes that make ductility more of a governing requirement for seismic design. Strands typically are positioned in a circular pattern confined within a circular spiral. These piles often are more economical than square piles because of the material savings that can be achieved. They can also be made with circular internal voids.

Cylinder piles often are used with bridges and other marine structures where foundation members require exceptionally large axial, buckling or bending capacities. They also can be extended into pile bents at the superstructure level, eliminating the need for a separate column. In some cases, cylinder piles are spun-cast in segments that are joined together and post-tensioned to form the completed pile.

Another method of producing cylinder piles is with a collapsing coreform, which is placed in the form and held in place during the concrete pour. After the concrete has reached

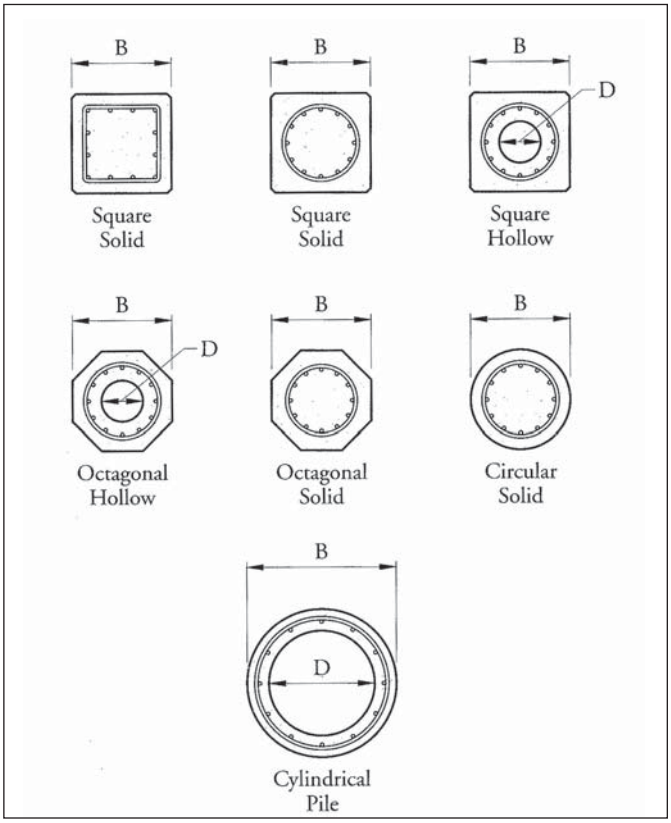


Photo courtesy of Precast/Prestressed Concrete Institute.

Precast, prestressed concrete piles are available in a wide range of shapes.

Photo courtesy of Davis & Floyd Inc.

This 12-inch, 85-foot-long precast, prestressed pile is being driven with a hydraulic hammer that includes an auger on the side so the pile can be dropped into a 55-foot-deep hole prior to driving it.

Photo courtesy of Bayshore Concrete Products.

In some cases with bridge projects, transporting the precast piles by barge creates an efficient approach.

Photo courtesy of Bayshore Concrete Products.

Even precast piles of considerable length can be transported easily to the site.

sufficient transfer strength, the core is collapsed and extracted, leaving the necessary void. This method is favored in high-seismic zones where continuous rebar is required.

Precast concrete piles can be spliced together to create longer piles. They are used primarily where longer piles are required but transportation needs make the longer lengths more difficult or costly to handle due to escort needs and the need for specialized rigs. Transportation limitations vary by region. In some areas, 12-inch piles as long as 115-feet can be transported with no difficulty, and piles up to 135 feet can be hauled with special rigs. When large piles are used on bridge projects, it may be possible to transport the piles to the site on barges, eliminating highway restrictions.

Many Benefits Result

Piles benefit from many of the advantages generally provided by precast, prestressed concrete components. These include economy and reduced energy costs from using local materials and manufacturing, fast, easy and reliable availability, plant-controlled quality of finish and tolerances, and reduced fabrication and construction times. Precast concrete piles offer additional specific advantages:

- High load capacity. Prestressed concrete piles provide high axial load-carrying capacities. With a higher allowable load per pile, fewer piles are needed, which may result in smaller footings and generally lower costs per unit of weight supported. In many cases, the key limitation on the axial capacity of prestressed concrete piles is soil condition.
- High durability. The combination of dense, high-quality concrete and permanent axial compressive stress along the length of the pile results in a product with minimal cracking and high resistance to moisture penetration. Both experience and accelerated corrosion tests have proven that prestressed concrete piles are extremely durable, even under the most severe conditions of exposure.
- High adaptability. Precast piles are highly engineered, manufactured products. As a result, their composition can be adjusted in the fabrication process to include more prestress rebar, higher-strength concrete with more capacity, specific or

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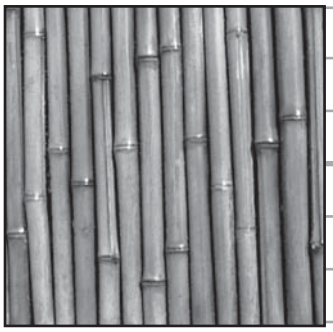

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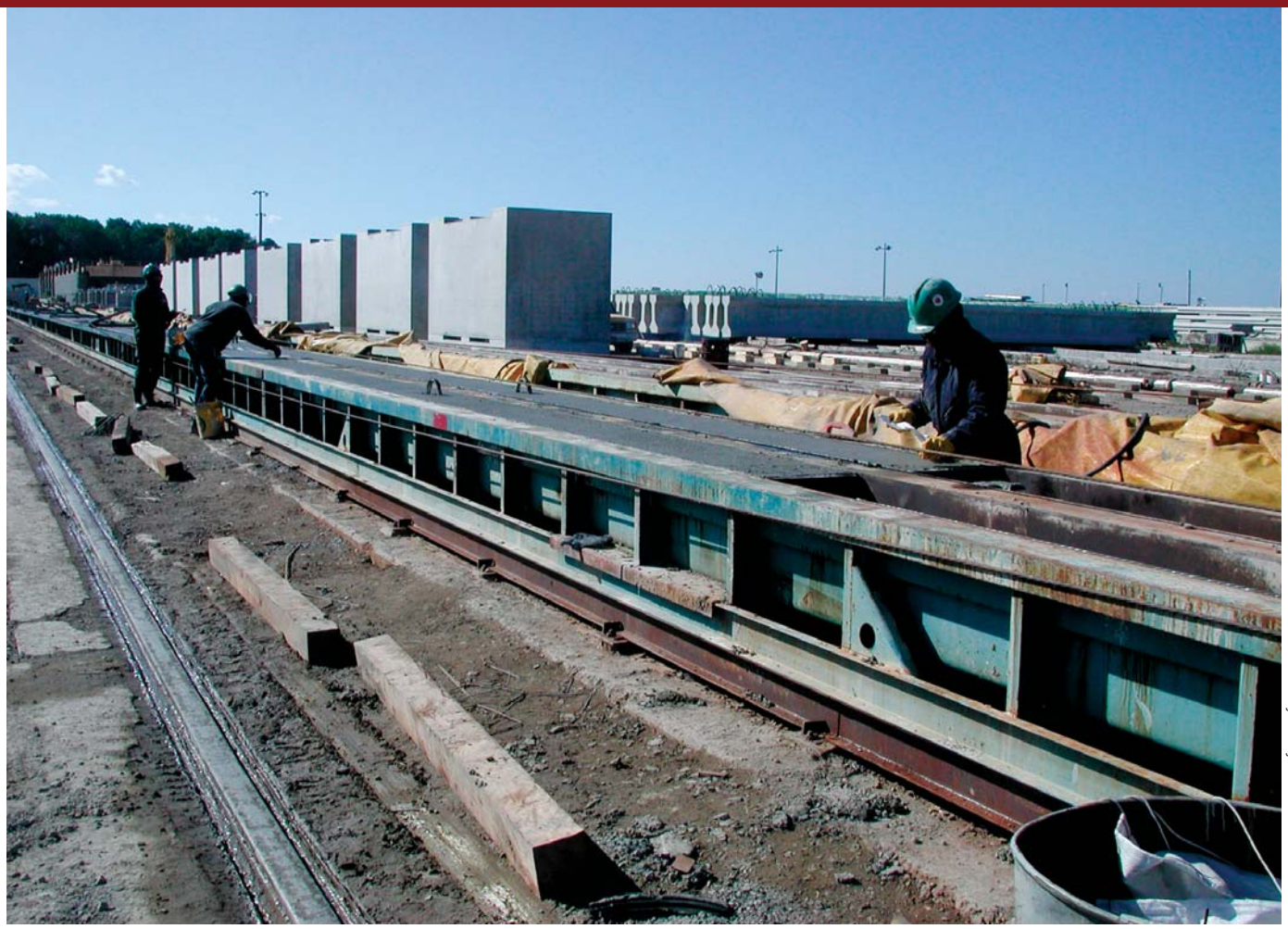


Photo courtesy of Bayshore Concrete Products.

Because precast piles are cast under controlled conditions in the plant, they offer a consistent, high quality of fabrication.

unique connections to bridge caps and corrosion inhibitors. Designers can control and adapt the material to ideally suit the specific environment and construction situation into which the piles will be placed.

- Ease of handling, transporting and installing. The uniform axial compression, overall strength and increased lateral stiffness in any direction means that fewer lift points are required. This facilitates transportation and handling and contributes to lower overall installation costs.
- Ability to resist hard driving stresses. The overall strength of the precast concrete piles, together with the axial compression induced by prestressing, permits them to undergo hard driving through loose or dense soils using high-energy hammers. In extremely hard driving conditions, the pile's ability to resist high tension waves may be improved by increasing the effective prestress.
- Increased capacity and column strength. The relatively large tip area allows prestressed

concrete piles to resist substantial loads in end bearing to supplement resistance provided by skin friction along the piles' surfaces. The bending resistance of piles subject to eccentric or lateral loads can be improved by increasing the effective prestress in the pile.

- Resistance to uplift. Prestressed piles can be used effectively in tension for bridge projects. A high degree of uplift generally can be resisted by the weight of the pile and by the transfer of tension forces from the pile to the soil across the pile-soil interface.
- Densification of surrounding soils. The vibration of granular soils during the driving process tends to compact the material surrounding the piles so that it becomes denser as successive piles are driven. This densification increases the available unit friction. Solid prestressed concrete piles displace a larger volume of soil during driving compared to shell or H types, which tends to compact the soil further.

Considerations When Using

The benefits that precast, prestressed concrete piles can provide make them a strong choice for many applications, but they are not always the specified choice. This is due in some cases to a lack of understanding about their capabilities and unfamiliarity by local contractors with installation methods. Steel piles are well-known, and steel's capabilities are taught in college engineering courses. As a result, graduates arrive in the field with a strong familiarity with those capabilities and load tables. Precast piles are discussed less often, making designers less familiar with how to convert load needs into a moment connection and to determine its location.

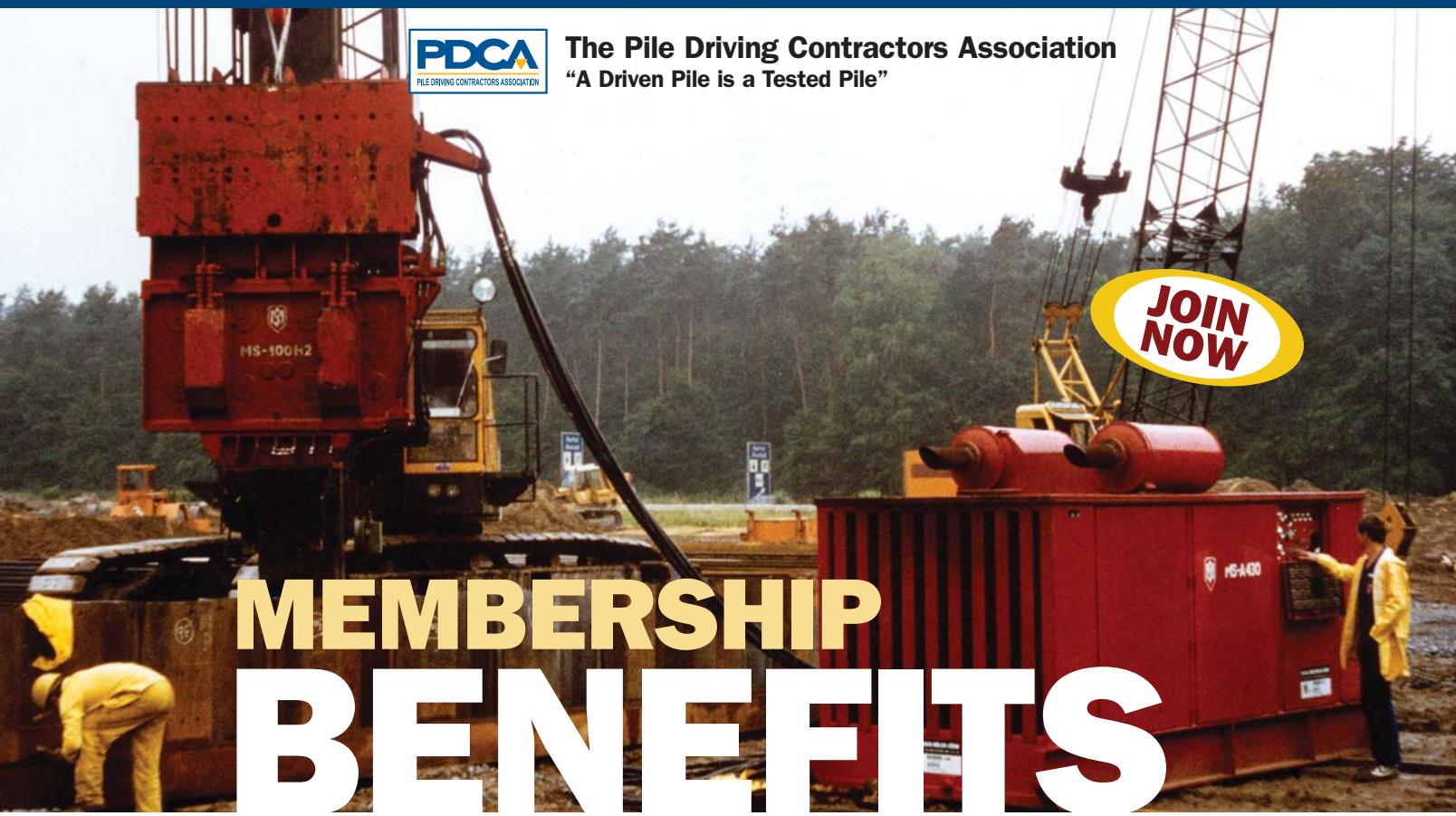
And indeed, precast piles require a different driving methodology than steel piles. Typically, a heavyweight hammer with a low impact velocity is used, with a 4- to 5-foot stroke, instead of the 12-foot stroke often used for steel piles. In some soils, high impact velocity, single-acting diesel hammers are used. It also works best to cushion the top of the precast, prestressed pile with 4 to 15 inches of plywood to keep the hammer in contact with the ram longer. This allows it to develop a longer stroke and increases the penetrating power of the pile.

Market Is Growing

The benefits provided by these piles, and the economics of today's construction market, make a strong case for designers and contractors to learn about the potential and specify them more frequently. Although cement prices have been rising, prices for other materials have risen considerably more, making precast concrete piles a strong economic competitor.

Precasters are reporting more and more designers and contractors are finding applications for precast, prestressed piles as contract budgets are strained. This leads to a wider use of the piles and a better, higher-profile understanding of the many benefits they provide.

Special thanks to the engineers at Atlantic Metrocast in Portsmouth, Va., Bayshore Concrete Products in Cape Charles and Chesapeake, Va., Davis & Floyd Inc. in Greenville, S.C. and Pomeroy Corp. in Perris, Calif., for their contributions to this article. ▼



PDCA
PILE DRIVING CONTRACTORS ASSOCIATION

The Pile Driving Contractors Association
"A Driven Pile is a Tested Pile"

MEMBERSHIP BENEFITS

General Membership Information

We are the premier association for pile-driving contractors

The PDCA was founded in 1996 to promote use of driven-pile solutions in all cases where they are effective. We strive to build and maintain working relationships among end users, manufacturers, government agencies, educational institutions, engineers and others involved in the design, installation and quality control of the driven pile.

We are dedicated to advancing the driven pile

As the only organization solely dedicated to pile-driving contractors, we know that you understand the superiority of the driven pile in most applications. We are the only association addressing the intrusion of non-driven solutions that take away business from the driven-pile contractor. The PDCA understands that to survive in today's competitive marketplace, a pile-driving contractor must strive to stay abreast of the latest trends and technologies in the industry. That is why we maintain close ties with the world's leading suppliers to the industry. It's why we provide a broad range of educational programs for university professors, practicing engineers and contractors. And, it's why more and more contractors, engineers and suppliers are realizing that the PDCA significantly increases their value in the marketplace.

We are a direct link to decision makers

Major manufacturers take an active role supporting the PDCA. At our conferences, we bring together the world's leading design manufacturers and technical application experts to assist you in advancing the driven pile as a superior product.

The PDCA works closely with the technical community to format design codes and installation practices. We offer seminars throughout the country for engineers and educators on the capabilities and advantages of the driven pile. We also work with agencies, such as the Federal Highway Administration and state DOTs, which develop specifications for highway building and other infrastructure project that use driven piles.

We offer timely, valuable services

The PDCA improves your company's bottom line, as well as your stature in the construction industry, through a variety of programs and services:

Job Referrals

We are the only organization that provides contractor referrals to end users of driven piles. You tell us where you will drive piles and we will refer you to end-users. We also provide referrals to our supplier and technical members.

Peer-to-Peer Opportunities

With more than 100 contractor members, networking opportunities abound at the PDCA. Whether at our Winter Roundtable, our regional seminars or by just picking up the phone, you'll develop long-lasting professional relationships and friendships in the industry.

Annual Membership Directory

As a member, you'll receive PDCA's annual membership directory of our contractor, supplier and technical members. Your company is listed along with the piling solutions you employ and states in which you work. This directory is provided throughout the year to construction users on a complimentary basis.

Educational Conferences and Meetings

The PDCA offers cutting-edge education for contractors, engineers, geotechs and anyone else interested in the driven pile and its applications at two major conferences annually. Members receive discounts on exhibit and registration fees.

- The Winter Roundtable, held each February since 1997, is a nationally recognized conference that brings together leading technical experts, suppliers to the piling industry and contractors. This conference focuses on the key issues faced by pile-driving contractors and features discussions and presentations as well as an extensive exhibit area.

- The Design and Installation of Cost-Efficient Driven Piles Conference (DICEP), held each September since 2000, is a nationally recognized two-day conference that brings together geotechnical and design engineers, college professors and contractors to discuss the latest trends in understanding, analyzing and controlling piling costs.

Industry Development

The PDCA continually strives to expand market share for the driven pile. The PDCA sponsors the College Professors Piling Institute, held at Utah State University in Logan, Utah. Up to 25 professors, from major engineering schools, are invited to participate in an intensive, week-long program that presents them with the latest concepts in driven-pile design, installation and quality control. Some of the leading faculty in the deep foundation field has attended the institute to date. The program supplies the educators with the tools and knowledge to be able to teach their students about the advantages of the driven pile. It promises to have a long-term impact on market share for the driven pile.

Publications and Reference Materials

As a PDCA member, you will receive our quarterly publication, "*Piledriver*," which presents articles on issues and trends of interest to our industry. As a member, you'll receive discounts on advertising in the magazine.

All PDCA members receive a complimentary copy of the PDCA's codebook, "*Recommended Design Specifications for Driven Bearing Piles*," now in its third edition. This book covers all required guidelines for driven piles and includes a suggested bid and payment schedule.

The PDCA also sells "*The Pile Design Manual*," an FHWA manual on the design and construction of driven piles. Order forms are available on the PDCA Web site.

"Through its programs and services, PDCA has presented our company with numerous opportunities to continue our business success. It is certainly a cornerstone for growth in a very competitive business."

D.R. Jordan, President and CEO, Jordan Pile Driving, Inc.

Connect Worldwide at www.piledrivers.org

The PDCA's newly redesigned Web site at www.piledrivers.org lets you research the latest trends in the industry and find direct links to manufacturers, suppliers, engineers and others. PDCA members receive a free listing in our member search area, which is being used by an increasing number of end users to find pile driving contractors and services. Our forums area makes it easy for you to connect with others to discuss issues and problems.

Leadership Opportunities

Membership in the PDCA provides opportunities for recognition and leadership. Positions are available on the PDCA board of directors and various committees that impact the industry. The PDCA recognizes noteworthy contributions to the industry with our "Driven Pile Project of the Year" award, giving opportunities for high profile recognition.

Membership is available to you

There is strength in numbers and we, at the PDCA, need to count your company when telling government agencies, engineers and suppliers that we are interesting in keeping your business viable and in growing market share for the driven pile. We need your ideas and efforts in working together toward a common goal: the use of driven-pile solutions. You can contribute your expertise and assist the Association in developing:

- A greater focus on safety
- The quality of driven pile products
- The formatting of codes and specifications for the driven pile
- Support for a program to help educate students in the use of driven piles

Join today. Be part of a growing and vibrant organization the will play a key role in the future of deep foundations. Support your industry by completing the membership application in this issue. You will immediately begin to enjoy benefits of membership. ▼

PDCA

PILE DRIVING CONTRACTORS ASSOCIATION

MEMBERSHIP APPLICATION

Step 1: Select Membership Type

I wish to apply for the following membership status (check one):

❑ **Contractor** ❑ **(Annual Gross Sales >$1 Mil./year: $725/year).**
❑ **(Annual Gross Sales <$1 Mil./year: $350/year)**

A Contractor Member is defined as a specialty subcontractor or general contractor who commonly installs driven piles for foundations and earth retention systems. Includes one primary membership. Secondary memberships are $75 each.

❑ **Associate ($725/year)**

Associate Members of the Association shall consist of firms or corporations engaged in the manufacture and/or supply of equipment, materials, testing or other services to the pile driving industry. Secondary memberships are $75 each.

❑ **Technical Affiliate ($95/year)**

Technical Affiliate Members of the Association shall consist of individuals who are involved with the design and installation of driven piles or in teaching the art and science of pile design and installation. They may be employed engineers, architects, government agencies, or universities. Employees of contractors are not eligible to become Technical Affiliate Members. Note: Technical Affiliate Membership category is for individuals only. For a company listing in the directory and on the Web site, you must join as an Associate Member.

❑ **Retired Industry Member ($50/year)**

A Retired Member shall be defined as any individual who has reached retirement age as defined by U.S. law, who has left active employment and who wishes to remain a member.

I am retiring as a: ❑ Contractor ❑ Associate ❑ Technical Affiliate

Step 2: Demographic Information

Company Name _____ Phone _____

Your Name _____ Fax _____

Address _____ Email _____

City/State/Zip _____ Home Page _____

Step 3. Method of Payment

Attached is my payment of $_____ for annual dues.

❑ I understand that dues are due annually on December 31 and, that if I joined PDCA after March 31, I may be entitled to a prorated dues amount for the subsequent year only.

I am making payment in full by

❑ Check # _____

❑ Credit Card: ❑ MasterCard ❑ Visa ❑ American Express

Card Number: _____ Expiration Date: _____

Name as it appears on card: _____ Signature: _____

Please send this completed application to: PDCA | P.O. Box 66208, Orange Park, FL 32065
Phone: (888) 311-PDCA (7322) | Fax: (904) 264-9531 | www.piledrivers.org

Applications Systems

❑ Aluminum Sheet Piles
❑ Coatings & Chemicals
❑ Structural Steel
❑ Synthetic Material Piles
❑ Other_____
❑ Steel Pipe Piles
❑ Steel Sheet Piles
❑ Vinyl Sheet Piles
❑ Other Structural Materials
❑ Timber Piles/Treated Lumber & Timbers
❑ Concrete Piles
❑ Composite Piles
❑ H-Piles

Equipment

❑ Air Compressors
❑ Cranes
❑ Drill Equipment
❑ Drive Caps & Inserts
❑ Hammers
❑ Hydraulic Power Packs
❑ Leads & Spotters
❑ Pumps
❑ Specialized Rigs & Equipment
❑ Other

Services

❑ Consulting
❑ Design
❑ Freight Brokerage
❑ Geotechnical
❑ Marine Drayage
❑ Surveying
❑ Testing
❑ Trucking
❑ Vibration Monitoring _____
❑ Other _____

General

❑ Rental ❑ Sales ❑ Other _____ ❑ Other _____

C. Technical Affiliate Only (check all that apply)

❑ Analysis
❑ Geotechnical
❑ Surveying
❑ Civil & Design
❑ Materials Testing
❑ Vibration Monitoring
❑ Consulting
❑ Pile Driving Monitoring
❑ Other
❑ Educational/Association

Step 4. Geographic Areas Where Contracting, Products and Services Available

(All applicants check all that apply)

❑ All States	❑ CT	❑ ID	❑ MD	❑ NE	❑ NY	❑ SD	❑ WI
❑ AK	❑ DC	❑ IL	❑ ME	❑ NC	❑ OH	❑ TN	❑ WV
❑ AL	❑ DE	❑ IN	❑ MI	❑ ND	❑ OK	❑ TX	❑ WY
❑ AR	❑ FL	❑ KS	❑ MN	❑ NH	❑ OR	❑ UT	❑ Canada
❑ AZ	❑ GA	❑ KY	❑ MO	❑ NJ	❑ PA	❑ VA	❑ Mexico
❑ CA	❑ H	❑ LA	❑ MS	❑ NM	❑ RI	❑ VT	❑ Europe
❑ CO	❑ IA	❑ MA	❑ MT	❑ NV	❑ SC	❑ WA	❑ Global

Step 5. Sponsorship: Who told you about PDCA?

Member Name_____

Step 6. Method of Payment

Attached is my payment of $_____ for annual dues.

❑ I understand that dues are due annually on December 31 and, that if I joined PDCA after March 31, I may be entitled to a prorated dues amount for the subsequent year only.

I am making payment in full by

❑ Check # _____

❑ Credit Card: ❑ MasterCard ❑ Visa ❑ American Express

Card Number: _____ Expiration Date:_____

Name as it appears on card: _____ Signature: _____

Please send this completed application to: PDCA | P.O. Box 66208, Orange Park, FL 32065
Phone: (888) 311-PDCA (7322) | Fax: (904) 264-9531 | www.piledrivers.org

PDCA New Member List

We would like to welcome the following new members. Please visit the PDCA Web site at **www.piledrivers.org** and click on Member Search for complete contact information on all members.

New Contractor Members

Ahrens Piledriving
Cheyenne, Wyoming
Contact: Mark Ahrens
Services provided: Bulkheads, deep excavation, marine, pile driving

Foundation Materials
New Orleans, Louisiana
Contact: Paul Tassin
Services provided: Pile driving, general contractor

Franks Casing Crew and Rental
Lafayette, Louisiana
Contact: Donnie Crain
Services provided: Marine, pile driving, off-shore, pipe sales, equipment sales & rental

Herlihy Mid-Continent Co.
Romeoville, Illinois
Contact: Arthur Haggerty
Services provided: Bridge building, docks & wharves, earth retention, general, highway & heavy civil, marine, pile driving

Kuhn Construction
Hokessin, Delaware
Contact: M. Lawrence Kuhn
Services provided: Docks & wharves, marine, pile driving

McDowell NW Piling, Inc.
Contact: Michael McDowell
Kent, Washington
Services provided: Pile driving contractor, earth retention, general contracting

Pilotes Y Entibamientos Ltda
Santiago, Chile
Contact: Roberto Born
Services provided: Pile driving

Saddlebrook Construction
Pickens, South Carolina
Contact: Don White
Services provided: Pile driving contractor, bridge building, earth retention, general contracting, highway & heavy civil

Sea & Shore Contracting
Boston, Massachusetts
Contact: Michael Lally
Services provided: Bulkheads, deep dynamic compaction, deep excavation, docks & wharves, earth retention, general contracting, marine, pile driving

Sun Marine Maintenance
Frankford, Delaware
Contact: Michael R. Jahnigen
Services provided: Pile driving contractor, bulkheads, docks & wharves, marine

Waterfront Marine Construction
Virginia Beach, Virginia
Contact: Ken Sutton
Services Provided: Bridge building, bulkheads, general contracting, highway & heavy civil, marine, pile driving

WH Engineering
Grand Junction, Colorado
Contact: Sandy Heley
Services Provided: Bridge building, earth retention, highway & heavy civil, pile driving

New Associate Members

Instantel
Ottawa, Ontario
Contact: Rob Lee
Services provided: Instrumentation for Vibration Monitoring

Kobelco Cranes
Houston, Texas
Contact: Jack Fendrick
Services provided: Cranes

PilePro
Rapid City, South Dakota
Contact: Rob Wendt
Services provided: Sheet piling accessories

Standard Concrete Products
Savannah, Georgia
Contact: Wayne McGowan
Services provided: Concrete piles

TA Services, Inc.
Mansfield, Texas
Contact: Lilli Schaefer
Services provided: Trucking

Trinity Products
O'Fallon, Missouri
Contact: Brad Mehrhoff
Services provided: Cutter heads & drill bits, pile points & splicers, steep pipe piles, structural steel

New Technical Members

Buster Blalock
Wahoo Enterprises
Folly Beach, South Carolina
Services provided: Trucking

John Collins
Collins Company
Camano Island, Washington
Services provided: Pile hammers

Shawn "Tiny" J. Etier
GS2 Engineering & Environmental Consultants, Inc.
Charleston, South Carolina
Services provided: Geotechnical engineering, pile driving monitoring, vibration monitoring

Daniel Ferron
Arcelor International
Singapore
Services provided: Sheet piling

Pat Flynn
Robertson & Hollingsworth
Charleston, South Carolina
Services provided: Dynamic pile testing, geotechnical engineering

Steve Kiser
MACTEC Engineering & Consulting, Inc.
Charlotte, North Carolina
Services provided: Analysis, civil & design, geotechnical, materials testing, pile driving monitoring, vibration monitoring

Ronald Lejman
GMU Geotechnical
Rancho Santa Margarita, California
Services provided: Consulting, geotechnical, materials testing, vibration monitoring

Jim McNance
Carpenters Training Union
Pleasanton, California
Services provided: Pile driving training

Randy Wirt
MACTEC Engineering & Consulting, Inc.
Richmond, Virginia
Services provided: Geotechnical

PILE DRIVING CONTRACTORS ASSOCIATION

THE PILE DRIVING CONTRACTORS ASSOCIATION (PDCA) IS ACCEPTING APPLICATIONS FOR THE

"Driven Pile Project of the Year" (2005)

As a means of recognizing noteworthy contributions to the industry, PDCA will recognize outstanding projects that utilized driven piles to solve foundation problems.

There are two award categories. The first category is for projects where the value of the piling work was $1,000,000 or less. The second category is for projects where the value of the piling work was over $1,000,000.

Qualification for nomination requires projects only to involve driven piles, that the piledriving be completed during 2004 or 2005, and that at least one participant was a PDCA member during the year as a contractor, technical affiliate or as associate member. Projects will be judged on qualities such as, but not limited to, uniqueness, timeliness, unusual aspects of piledriving or unusual solutions to foundation problems, value engineering or value to the public or industry.

The best way to promote the effectiveness and versatility of the driven pile is through your work!

To obtain entry forms or additional information, please visit **www.piledrivers.org** or contact:

PDCA
P.O. Box 66208
Orange Park, FL 32065

Phone: (888) 311-PDCA (7322):
Email: execdir@piledrivers.org

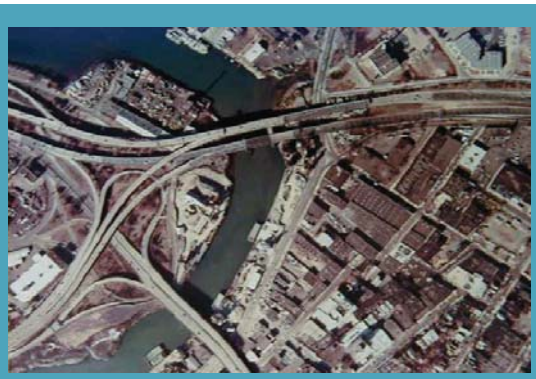
The winning projects will be recognized at the PDCA 2006 Winter Roundtable and featured in future editions of PILEDRIVER Magazine as well as our website, www.piledrivers.org.

Nominations will close January 1, 2006.

Large Diameter
Cast-in-Place Concrete Piles
Whitestone Expressway Project

By Steve Borg, New York State Department of Transportation

This project in New York City involves the replacement of the northbound Whitestone Expressway over the Flushing River at the Van Wyck Expressway interchange. Three fixed span structures over the river will replace a bascule bridge that was built in 1939. The three structures over the river include the northbound Van Wyck Expressway ramp, Astoria Boulevard approach along the mainline northbound Whitestone Expressway and a ramp to Linden Place. Reconstruction of the ramp to southbound Van Wyck Expressway is also included in this work. This New York State Department of Transportation (NYSDOT) project was awarded in 2003 at a cost of $177 M. Located in the Flushing Meadows section of Queens, the project is near LaGuardia Airport, Shea Stadium, the U.S. Tennis Center, and the site of the 1939 and 1964 World's Fairs.



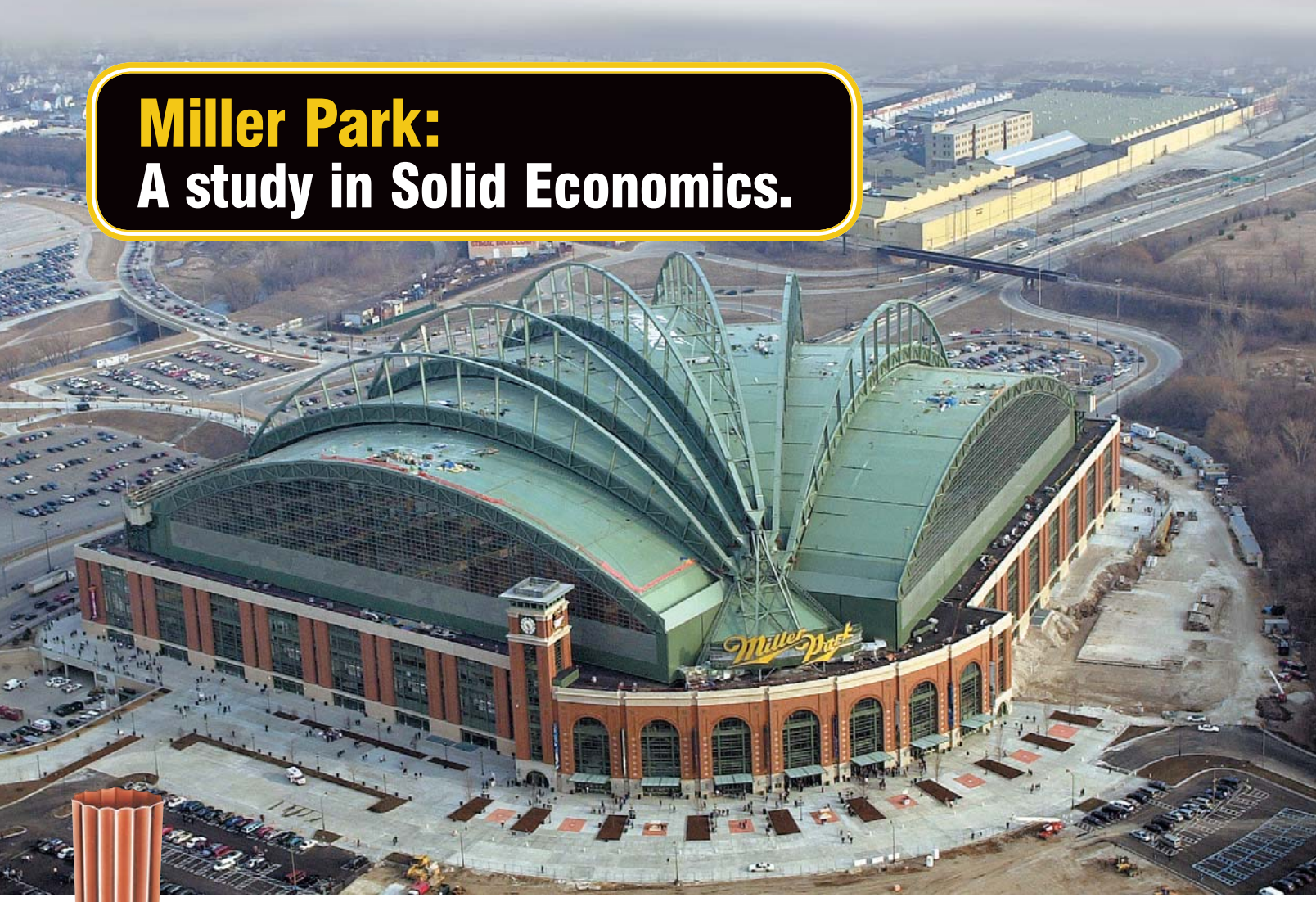
Aerial Photo of Project

During the design phase of the project, the challenge was to provide cost-efficient foundations that could resist high lateral loads in poor soil conditions. The project is located in a filled tidal wetland with Organic Silt deposits as thick as 50 feet. Below the Organic Silt are intermittent layers of Silty Clay underlain by Silty Sand with sporadic boulders. A requirement for the deep foundation design is the resistance of lateral loads from a seismic event including the transient loads induced by the soil. The foundation was also required to resist drag loads from consolidation of the Miscellaneous Fill and Organic Silt.

The objective was to find a deep foundation that provided efficient lateral stiffness, avoided soil clean-out, eliminated underwater concreting and was straightforward to inspect. It was also important to choose an installation method that could draw on local contractor experience in order to optimize competitive bidding. After weighing these considerations, large diameter cast-in-place (CIP) concrete piles became the foundation of choice. A new payment item for 18 inch and 24 inch CIP piles was created for this project since this was a first time use of these sizes on a NYSDOT project. CIP piles with a diameter of 14 inches were also used on this project.

The NYSDOT CIP pile is a steel pipe driven with a conical or flat plate shoe. The pipe is filled with concrete after it is driven and is connected to the footing with a partial length reinforcement cage. The 24 inch pile was designed to carry a maximum allowable load of 500 kips and the 18 inch pile 270 kips. An allowable lateral load was initially calculated for each pile size based on assumed pile layouts. The analyses

Miller Park:
A study in Solid Economics.



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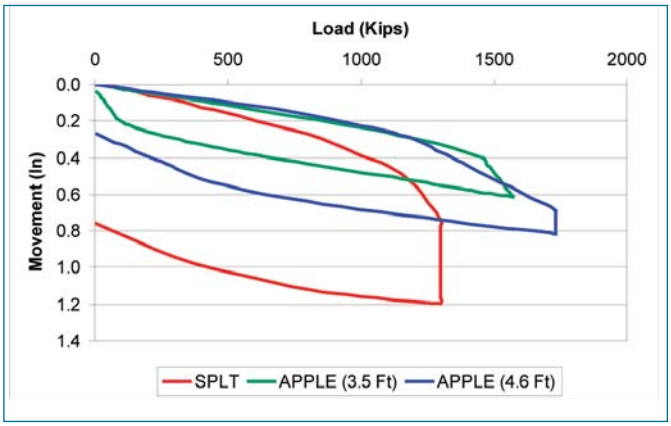
Apple Test

were later repeated using the final pile group configuration to verify that the movement and stresses were within acceptable tolerances.

Static Pile Load Test

The piles were driven with a Delmag D46-32 single acting diesel hammer which has a rated energy of 122 kip-ft at the maximum stroke. Pile Driving Analyzer (PDA) monitoring was used to evaluate hammer operation, measure driving stresses and establish pile driving criteria through capacity verification. A static pile load test (SPLT) was conducted on the first 24 inch diameter pile installed on the project. PDA



SPLT and Apple Load-Movement Plots

Static Pile Load Test

monitoring was also conducted on this pile during initial drive and restrike. The steel pipe did not have sufficient section to resist the expected failure load from the SPLT test therefore it was filled with concrete before the test. Consequently the diesel hammer was unable to sufficiently move the pile during the PDA restrike test that was performed after the SPLT. In order to determine the correlation between the SPLT and PDA results a restrike was done using the GRL Engineers' Apple system with a 40 kip drop weight.

Apple Test

Early in the foundation work, it became a challenge to find a location that was accessible to the pile driving equipment and with sufficient space to construct the SPLT frame. Locations with the deep Organic Silt deposits combined with a thin veneer of Fill were not desirable to set up wood cribbing or drive reaction piles. Therefore the 24 inch diameter SPLT pile was installed at a footing location for 18 inch piles where the Organic Silt layer is thin and the Fill layer substantial. Since the pile was utilized in the foundation, it was located in the center of the footing where it could have the least effect on the lateral stiffness of the pile group. The load reaction was provided by eight tapered Monotube piles and steel billets supported on wood cribbing. The SPLT was conducted one month after the pile was driven. The toe of the 74 foot deep pile was in Silty Clay and it achieved a plunging failure load of 1300 kips at a top movement of 0.75 inches.

Seven months after the SPLT an Apple test was run using a 40 kip weight dropped at heights of 2.0, 3.5 and 4.6 feet with standard PDA equipment used for the strain and acceleration measurements. A virtually frictionless free fall of the weight is obtained by cutting the steel support cable with a remote hydraulic device. All of the footing piles were driven one month prior to the Apple test. A simulated static load-set plot obtained from the CAPWAP analyses showed the pile achieved a plunging failure at a higher load but at the same movement as the SPLT. The higher measured load from the Apple test was likely due to the longer setup period and consolidation of the soil caused by driving the surrounding footing piles.

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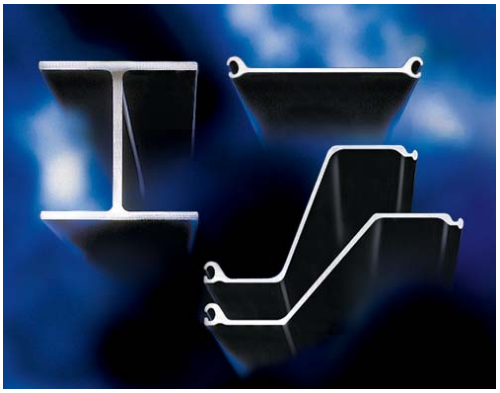

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HP12x53	HP12x63	HP12x74	HP12x84
HP8x36		HP10x42	HP10x57

SHEET PILING TECHNICAL DATA

Section Designation	AREA		WIDTH		HEIGHT		WEIGHT (MASS) PER SINGLE		WEIGHT (MASS) PER WALL		MOMENT OF INERTIA		SECTION MODULUS Per Single		SECTION MODULUS Per Wall		SURFACE AREA Total Area		SURFACE AREA Nominal Area*	
	in²	cm²	in	mm	in	mm	lb/ft	kg/m²	lb/ft²	kg/m²	in⁴	cm⁴	in³	cm³	in³/ft	cm³/m	ft²/ft	m²/m	ft²/n	m²/m
PZ22	11.9	76.6	22.0	559	9.0	228.6	40.3	60.1	22.0	107	151	6301	32.5	532	17.7	952	4.92	1.50	4.48	1.37
PZ27	12.1	78.2	18.0	457	12.0	304.8	40.5	61.3	27.5	134	282	11734	45.3	742	30.2	1622	4.93	1.50	4.48	1.37
PS27.5	13.4	86.6	19.7	500	—	—	45.1	67.9	27.8	136	5.02	209	3.19	52.2	1.94	104	4.58	1.40	3.88	1.18
PS31	15.2	98.2	19.7	500	—	—	50.9	77.0	31.5	154	5.51	229	3.35	55.0	2.04	110	4.58	1.40	3.87	1.18

*Note: Nominal coating area excludes socket interior and ball of interlock.

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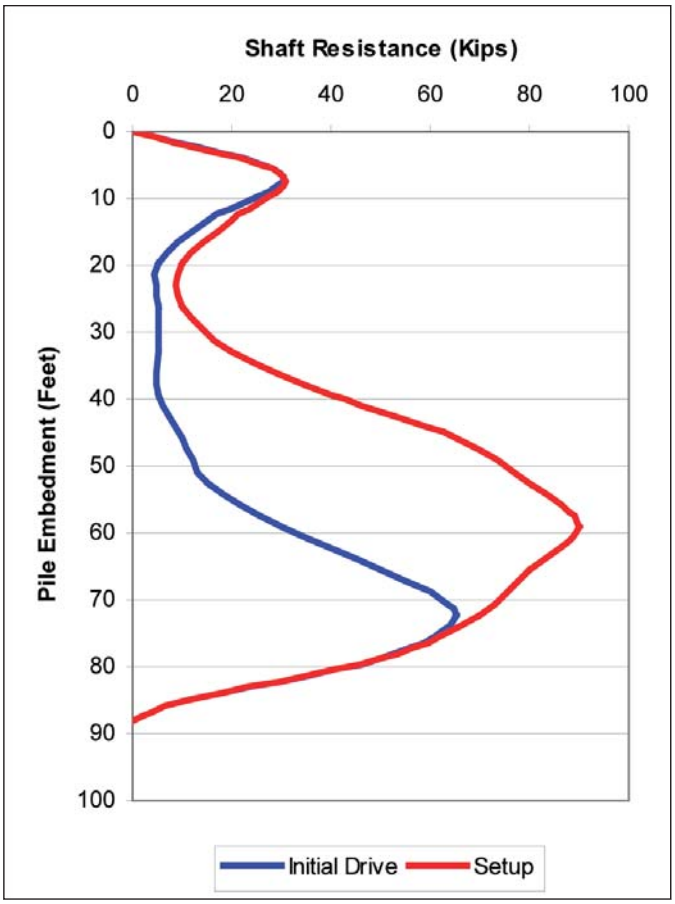

Completed Piers

Shaft Resistance for 18 inch Pile

Since the two independent test methods were in agreement, confidence was gained in the determination of capacity from the PDA measurements. The piles achieved capacity close to the estimated length for the entire project and the hammer proved to be compatible with the pile-soil system. Templates were required in the river cofferdams to maintain proper pile plan location. At one pier location, pile damage was caused by obstructions and at other locations from hard driving caused by soil consolidation in combination with unrelieved buoyant forces. The damaged piles filled with sediment and could not be removed therefore replacement piles were driven at adjacent locations.

Depth Below Grade (Feet)	Soil Resistance (Kips)			Percent Increase	Soil Profile	SPT Spoon Blows (BPF)	Moisture Content
	Initial Drive	Setup	Increase				
7	30	30	0	0%	Silty Sand Gravelly (Fill)	24	20
13	15	20	5	33%	Organic Silt	WOH	106
20	5	10	5	100%	Organic Silt	WOH	77
26	5	10	5	100%	Organic Silt	WOH	133
39	5	40	35	700%	Silty Sand Clayey Gravelly	7	59
46	10	65	55	550%	Silty Sand Gravelly	22	20
52	15	80	65	433%	Silty Sand Gravelly	29	18
59	30	90	60	200%	Silty Sand Clayey Gravelly	27	17
66	50	80	30	60%	Silty Sand Clayey Gravelly	23	18
72	65	70	5	8%	Silty Sand Gravelly	37	29
79	50	50	0	0%	Silty Sand Gravelly	66	14
85	10	10	0	0%	Clayey Silt Sandy Gravelly	57	15
TOE	125	240	115	92%	Clayey Silt Sandy Gravelly	46 20	
SUM	**420**	**815**	**395**	**94%**	**Percent of SUM**		

The data presented in the following table (page 50) and shown in the graph to the left is from PDA initial drive and restrike tests performed on an 18 inch diameter pile. The increase in soil shaft resistance after setup was most dramatic in the Silty Sand Clayey Gravelly layer with the setup increase for the entire pile almost 100 percent.

Large diameter cast-in-place concrete piles are a cost-efficient solution for foundations with high lateral and axial load demand especially where footing space is limited. Due to the lower redundancy of the group, it becomes more critical to maintain the specified pile alignment and to avoid damage. Careful attention should be paid to controlling driving stresses and where obstructions are likely pre-drilling should be considered. PDA monitoring played a valuable role in maintaining quality control on the pile driving throughout the project. ▼

PDCA Calendar of Events

March 2-4, 2006

10th Anniversary
Annual Conference
Hilton Palacio Del Rio Hotel
San Antonio, Texas

June 17-23, 2007

2007 PDCA Professors
Piling Institute
Utah State University

Other Industry Events

October 4-6, 2006

DFI 31st Annual Conference on Deep Foundations and Members Meeting
Omni Shoreham Hotel
Washington, D.C.

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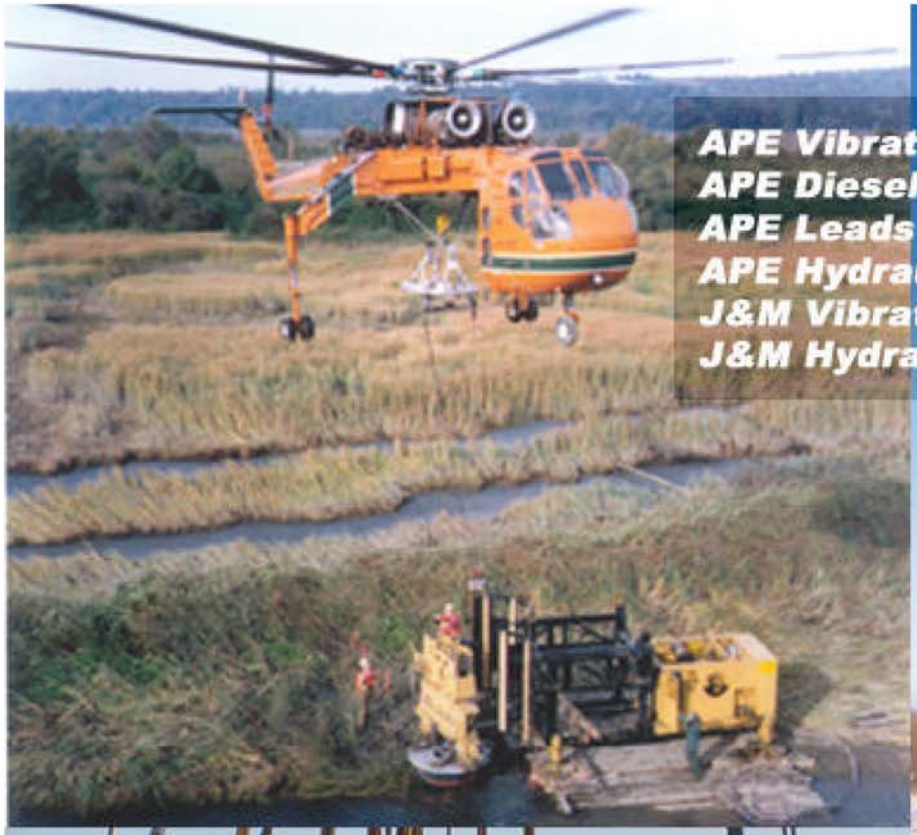

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