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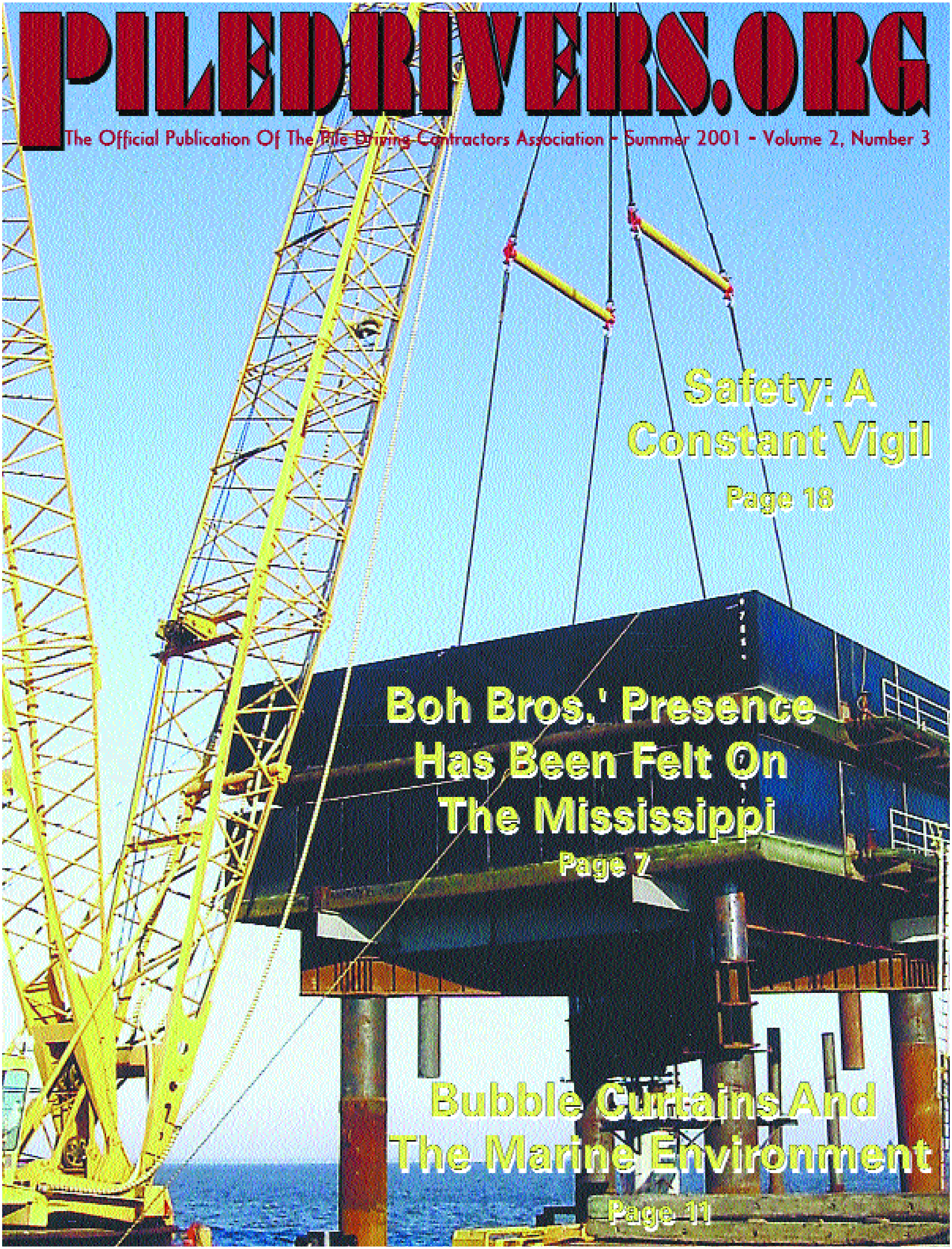

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We've Taken A Snapshot Of A Thriving Industry

It occurs to me that an overview of the contents of this edition of our organization's publication provides a snapshot of the diverse components that make up a thriving industry that is interacting and providing a means to achieve the needs of our society.

For a company to survive over time, management must embrace technological change, economic change, social change and many other constraints, in addition to opportunities in the form of new challenges.

Two of many companies that have steered a successful path are recognized in this issue. In addition, space is provided to present methodologies that yield the end result required by a means not yet universally in use.

In addition, the need to focus on job site safety is recognized as a very important aspect of the pile driving contractor's operations.

The question could be asked: Which is more important? Perhaps the question is best answered not by attempting to rank in order of importance but by suggesting that all must be considered and integrated into the final approach to the successful completion of a project.

Obviously, one issue of our magazine cannot recognize all participants, methods and solutions to all individual project challenges.

Hopefully, successful companies and individuals will be willing to share their history and job site safety observations. Meanwhile, identifying alternative methods will continue to spark the imagination of our readers.

Partnering for the purpose of steering a complex project to successful completion requires all parties involved to listen, reason and respect all aspects of the components of the job under consideration. Hopefully, over time, the contents of our publication will increasingly benefit our customers.

I sincerely thank the contributors for their willingness to participate in the exchange of information.

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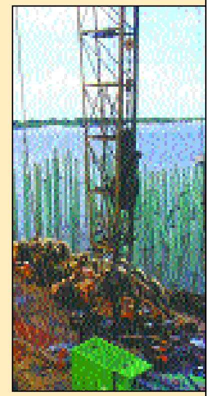
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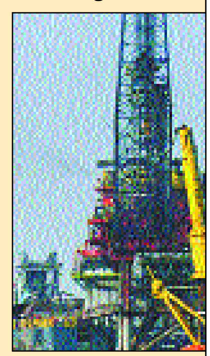
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Boh Bros. Construction's Presence Has Been Felt On The Mississippi

It is no secret that New Orleans has poor and mostly unstable soil construction. But in the early 1900s, Arthur Boh and brother Henry garnered the knowledge and expertise necessary to catapult Boh Bros. Construction Company to one of the leading pile-driving companies in Southeastern Louisiana. Since that time, Boh Bros. has grown into one of the largest and most diversified heavy-construction companies in the South.

Boh Bros. Construction Company, in business since 1909 and still based in New Orleans, has expanded from its Louisiana roots to other Gulf and Southern states, including Alabama, Florida, Georgia, Mississippi and Texas. Boh Bros. performs heavy construction for all types of industrial, commercial and public projects. The company is well known for its work in asphalt and concrete paving, bridge and overpass construction, marine, mechanical and industrial piping, excavation, site development and railroad construction.

A Boh Bros. Construction crew at work at the Energy Center parking facility in New Orleans.

Boh Bros. has done work at the Napoleon Ave. wharf at the port of New Orleans.

According to Dale Biggers, Piling and Marine Department manager, Boh Bros. maintains a modern pile driving fleet that includes Manitowoc 4000W and 4100 ringers on barges for marine construction. For land-based pile driving, Boh Bros. has American 5299 50-ton cranes, larger Manitowoc cranes and Lorain motor cranes.

Boh Bros. has experience in driving all types of piles. Its large inventory of more than 70 hammers allows Boh Bros. to work with timber piles, H-piles, concrete piles, pipe piles, drilled shafts and corrugated sheet metal.

Biggers calculated that 60 percent of Boh Bros.' pile driving is land-based, with the bulk of the work focused on highway, heavy and office building construction. One of its most well-known projects was the Audubon Aquarium of the Americas in New Orleans. Boh Bros. drove 240-foot long, 20-inch-diameter piles for the project and was also involved in driving more than 20,000 piles for various additions to the New Orleans Convention Center.

More recently, Boh Bros. completed a 115-foot wet-rotary predrill for the Westin Hotel in downtown New Orleans for installation of 60-foot, 14-inch-square prestressed concrete piles. Boh Bros. is currently working on the construction of the St. George Island Bridge in the Western panhandle of Florida, where the company will drive 54-inch cylinder piles about 80 feet long. Biggers estimated that the pile-driving portion of the bridge construction should take about nine months to complete.

The other 40 percent of Boh Bros.' pile driving is concentrated on marine projects. The company has been involved in countless wharf, dock and fendering projects from the mouth of the Mississippi River to north of Baton Rouge, La. The face of the Mississippi has been forever changed thanks to the work of Boh Bros. They have also worked on projects from the Port of Corpus Christi to the Port of Tampa.

With almost a century of experience under its belt, Boh Bros., which is still family owned and operated, continues to be one of

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Member Spotlight

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the most respected Southern construction companies. Biggers related the secret to the company's success.

"There are a nucleus of people within the company, from supervisors to craftsman, who have been with Boh Bros. for 15 to 25 years or more," he said. "It is unusual for this industry to have such low staff turnover. The experience gained from literally thousands of man-years of service translates into higher quality construction services for our customers."

Biggers noted that the third generation of the Boh family is involved in the day-to-day operations of the business, which helps promote a safe and efficient work environment. Biggers himself has 33 years of service with the company and has been involved in the Pile Driving Department his entire career.

The Westin Hotel in New Orleans was a Boh Bros. project.

Boh Bros. has stood the test of time through its long history in pile driving and heavy construction. Boh Bros. president and CEO Robert H. Boh summed up the company's philosophy by saying that the key is sticking to the basics. He emphasized that users of construction services will always have a place for good people who produce high quality work on time and in a safe manner.

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Course For Geotechnical And Structural Engineers
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6th Annual PDCA Winter Roundtable
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7th Annual PDCA Winter Roundtable
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8th Annual PDCA Winter Roundtable
Feb. 20-Feb. 21, 2004
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Altair Construction Has Been Working On The Railroad

When a road or highway needs repair, automobile drivers are sometimes inconvenienced by detours or different traffic patterns established to accommodate the contractor working on the road. But when a railroad is being repaired, there usually is no way to reroute the trains – work must be completed during lulls in the train schedules. Altair Construction faces this challenge daily.

Altair Construction, a railroad repair and replacement contractor based in Cincinnati, is one of two subsidiary companies owned by The Fenton Rigging Company. In business since 1898, Fenton Rigging is known as one of the premier rigging companies in the Midwestern United States. Fenton Rigging purchased Altair Construction in 1987.

Altair currently employs 35 people and uses an 80-ton Lima crawler crane and two pile driving hammers – an ICE 42S and an APE D30-32 – to repair and replace railroad bridges. Today, Altair Construction's staff spends most of its time performing bridge work in the Eastern part of the United States, but the company has done work from coast to coast.

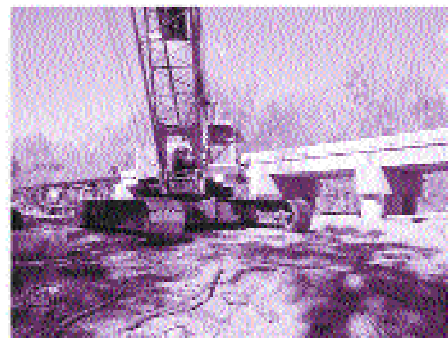
"Our geographic focus is based primarily on demand," said Butch Witte, project manager for Altair Construction. "We have done work in the Midwest for Union Pacific Railroad, but we are currently doing a great deal of bridge replacement and repair for CSX and Norfolk Southern Railroads. We also service short-line railroads throughout the United States."

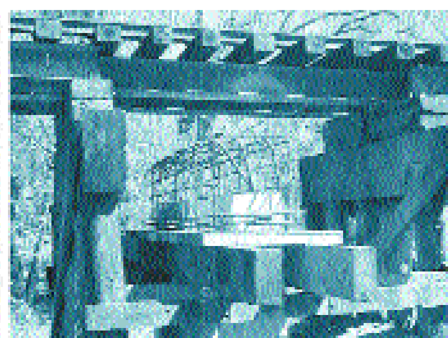
In Witte's 39-year career, he has worked for both of Fenton's subsidiary companies, as well as for The Fenton Rigging Company itself. Early on, he operated a crane used to clean up railroad wreckage. He worked in crane rentals for 16 years and has spent the remaining time involved in railroad bridge replacement and repair.

The railroad usually provides the plans for their projects, specifies the pile type, establishes a time frame and, in some cases, provides materials. Working around the train schedule can be a formidable task.

"Nothing stops the trains," said Witte. "There may be several trains a day traveling along the railroad on which we are working. Usually we try to work in between scheduled trains, but sometimes the schedule changes."

Witte continued: "We use a railroad flagman to alert us when a train is approaching. We have had to cut off a pile in the past to allow a train to pass through. After the train went by, we welded the pile back together and continued with our work."





One of Altair Construction's recent projects started in July 1999 at Zephyrhills, near Lakeland, Fla. Witte and his team replaced an existing 320-foot timber deck ballast bridge with concrete.

"For obvious reasons, replacing timber with concrete is fairly common in the railroad industry today," commented Witte. "We have started to see some steel piling with wood decks, but the majority of bridges are being replaced with concrete or steel."

At Zephyrhills, Altair Construction used 12-ton, 60-foot-long, 20-inch square concrete piles. They used precast concrete decks with cast-in-place concrete caps. About four to five trains passed by every day. Before each train, the track was set back down and the train went over the bridge. The project was completed in June 2000.

Altair Construction is a member of the Pile Driving Contractors Association and of the American Railway Engineering Maintenance of Way Association (AREMA).

Bubble Curtain Systems Help Protect The Marine Environment

High underwater shock wave overpressures created by pile driving with an impact style hammer are detrimental to the health of fish. In recent years, environmental agencies worldwide have been given more power to introduce stringent environmental protection regulations applicable to marine construction activities. Contractors, consultants and owners have been required to begin searching for a cost-effective way to mitigate high underwater shock wave overpressure to obtain permission to complete projects that include marine pile driving.

Background

The work discussed in this article was completed at the Canada Place Cruise Ship Terminal in the city of Vancouver, Province of British Columbia, Canada.

In 1999 the Vancouver Port Authority (VPA) began a revitalization project at Canada Place, the central cruise ship port in Vancouver. The marine work was to include modifications and seismic upgrades to the existing pier, an extension of the existing pier creating a third cruise ship berth and a new fender system. Fraser River Pile and Dredge Ltd. (FRPD) secured the prime contract for the marine portion of the work.

Work on-site began in March 2000 with densification of the seabed in the offshore area adjacent to and north of the existing pier. Simultaneously, FRPD began phase I pile driving, which included the installation of 24-inch diameter, .75-inch wall closed-ended steel pipe piles driven through the north apron area of the existing pier. These piles would support the refurbished terminal superstructure and were driven through previously imported fill and into glacial till using both an ICE 80S diesel impact hammer and an ICE 115 hydraulic impact hammer. This portion of the work was completed in early May 2000 and no negative impact to the marine environment was recorded.

Phase II pile driving started immediately with the installation of 36-inch diameter x .75-inch wall open-ended steel pipe piles along the interface between the existing dock and its new extension. These piles were driven through the previously densified overburden and down to glacial till using an ICE 66-80 vibratory hammer and then seated with the ICE 80S. This portion of the work was completed by mid-May 2000 and no negative impact to the marine environment was recorded.

Phase III pile driving began immediately with the installation of 36-inch diameter x .75-inch wall open-ended steel pipe piles driven in the offshore area immediately adjacent to and north of the existing pier. These piles were driven through previously densified overburden and into glacial till using a Delmag D80 diesel impact hammer. Native material was subsequently cleaned out from the inside of these piles and a tremmie plug was cast in place to provide additional bearing capacity. This phase continued

for 10 days, with no recorded impact to the marine environment until May 23, 2000, when the first fish mortalities on the Canada Place project were observed and recorded. The fish mortalities were attributed to extremely high underwater shock wave overpressures created during pile driving.

The Bubble Curtain System

Measures to mitigate the fish mortalities began immediately with deployment of a simple prototype bubble curtain on May 24, 2000, while pile driving continued. The initial design of the prototype bubble curtain was based on an extension of the theory behind the documented successful use of air curtains to reduce shock wave overpressures created by underwater blasting.

The prototype bubble curtain consisted of a circular or square shaped air distribution manifold made of rubber, plastic or steel tubing, which encircled the piling at various points below the water surface level. The Canadian government's Department of

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Bubble Curtain Systems (Continued From Page 11)

Fisheries and Oceans (DFO) monitored pile driving activities full-time at the site. Work continued throughout phase III, with DFO shutting down the work intermittently whenever a fish kill was recorded. FRPD continually made adjustments and refinements to the bubble curtain system, and a testing period followed each refinement. Work was allowed to proceed cautiously and the effects of each improvement were ascertained under close scrutiny and constant monitoring by DFO. FRPD was continually working toward the development of a cost-effective mechanical system that would successfully mitigate fish mortalities due to high underwater overpressures created during pile driving. This was the first time negative impacts on fish due to pile driving had been documented in British Columbia. DFO, in conjunction with FRPD and VPA, quickly recognized the significance of developing the bubble curtain system and exercised as much latitude as possible within the regulations to allow testing during pile driving to continue. Phase III continued in this manner and was completed by June 20, 2000.

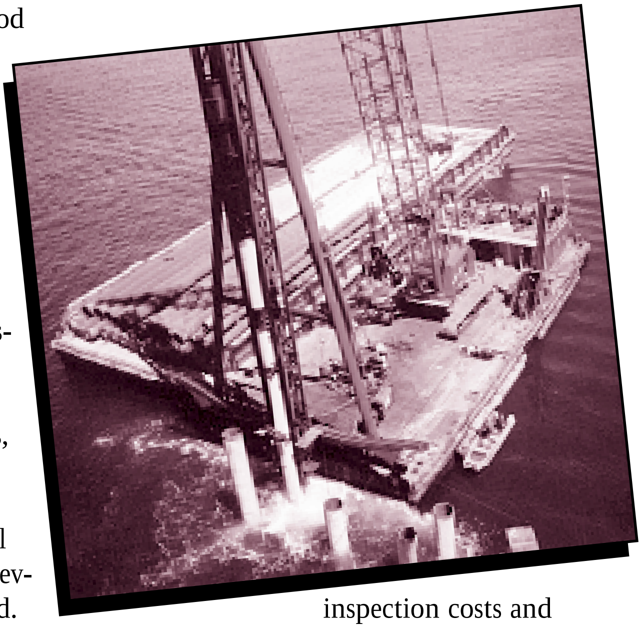
There was a scheduled three-week break from pile driving between the end of phase III and the beginning of phase IV. Phase IV pile driving included the installation of 36-inch diameter x .75-inch wall closed-ended steel pipe piles in the offshore area to the east of the phase III piles. A double bent separated the phase III and phase IV portions of the pier, with a seismic expansion joint being the only link between them.

These piles were driven through overburden and into glacial till using the D80 hammer. One third of the phase IV piles were inclined at 1h:3v and had a custom tip designed to keep native material from entering the pile while still allowing the installation and post-tensioning of drilled anchors installed through the piling and into the glacial till below after completion of the entire pier.

All parties thought driving closed-ended piling (as opposed to open-ended, as driven until this point) would have substantially greater negative impact on the marine environment. The testing and development period was now over and the project was required to refine the means of mitigating shock waves created by pile driving, as well as develop a means of testing the effectiveness of the mitigation without using fish as the indicator. FRPD utilized the scheduled break period between phases to refine the bubble curtain design based on tests completed so far and to construct new, improved physical components. FRPD initially used a recorded dive inspection of the bubble curtain system on the first pile of phase IV. The results of this inspection were disappointing because there was an obvious lack of air flow from the secondary distribution manifolds, there was less than complete air bubble coverage around the pile perimeter throughout the vertical depth of the water column and several deployment flaws were found. These factors rendered the existing semi-developed bubble curtain ineffective. All pile driving activity was immediately shut down pending redesign of the bubble curtain system or implementation of an alternate mitigation system.

FRPD channeled all available resources into searching for a more effective system. Experts from across North America and the United Kingdom were consulted and numerous proposals were investigated, such as acoustic or strobe light fish deterrent systems, temporary fixed or floating barriers, rubber or foam bladder wrapped around piling, changing the frequency of the shock wave generated during pile driving by filling the piling with dense material, use of an alternate hammer or cushion material between the hammer and pile, large-coverage-area bubble mats installed on the sea floor and an improved design (utilizing new information obtained during dive inspections) of the original bubble curtain. Several of these proposals worked well in theory, but the modified version of the original small manifold bubble curtain system continued to emerge at the top of the list of options when both performance and cost-effectiveness were considered.

Key factors used to assess the viability of a mitigation system were depth of coverage required (varying with tides), local currents, speed, ease and consistency of deployment, performance monitoring, capital costs, operating costs,



inspection costs and effectiveness.

FRPD decided to proceed with further development of the small manifold bubble curtain system, hoping to develop a mechanical device to mitigate underwater overpressure that was superior to any used before during the installation of marine piling.

The new bubble curtain system was designed in-house by FRPD staff and was constructed specifically to suit the equipment and materials being used on the Canada Place project. The design of the new system addressed all DFO concerns, with great regard to shock wave overpressure mitigation, effectiveness monitoring and consistency of deployment. FRPD received permission to conduct testing on July 14, 2000, which found minor flaws in the new system. Adjustments were made accordingly and a second round of testing was conducted on July 17, 2000. These tests showed that the new system functioned well and performed up to the full potential of its design expectations.

DFO gave permission for pile driving activities to proceed with full-time hydrophone monitoring and stringent reporting guidelines. Phase IV pile driving continued *(Continued On Page 13)*

Bubble Curtain Systems (Continued From Page 12)

until completion on Oct. 14, 2000, with only minor adjustments and repairs made periodically to the new system.

Phase V pile driving began at the end of September with the installation of 24-inch diameter x .75-inch wall closed-ended pipe piles driven through the existing pier under the existing building using an APE 7.5A super-low headroom hydraulic impact hammer. A scaled down version (for the smaller piles) of the new bubble curtain system was utilized to mitigate underwater overpressure, and no negative impact to fish was recorded. All pile driving was completed on the project by the first week of December.

A successful overpressure mitigation system had been developed and had become the new standard by which to measure protection of aquatic life during marine pile driving activities in Canada.

The Details

An effective bubble curtain system must distribute air bubbles around 100 percent of the perimeter of a pile over the full depth of the water column while it is being driven. Many small bubbles are preferable to fewer larger bubbles. Distribution manifolds must be deployed so that there are no gaps in the coverage area. This can be very difficult on inclined piles installed in areas where there are substantial currents.

The components of the system include:

✘ high volume air compressor and primary feed line;

✘ primary distribution manifold;

✘ medium volume secondary feed lines;

✘ secondary distribution manifolds;

✘ pressure gauges, flow meters and deployment hardware.

Selection Of Equipment/Materials

The secondary distribution manifolds are the key component of the system and therefore should be the first component of the system designed. These manifolds should:

✘ completely surround the piling to be driven;

✘ have sufficient self weight or be weighted appropriately so that they are negatively buoyant once charged with air (consider any attached air lines);

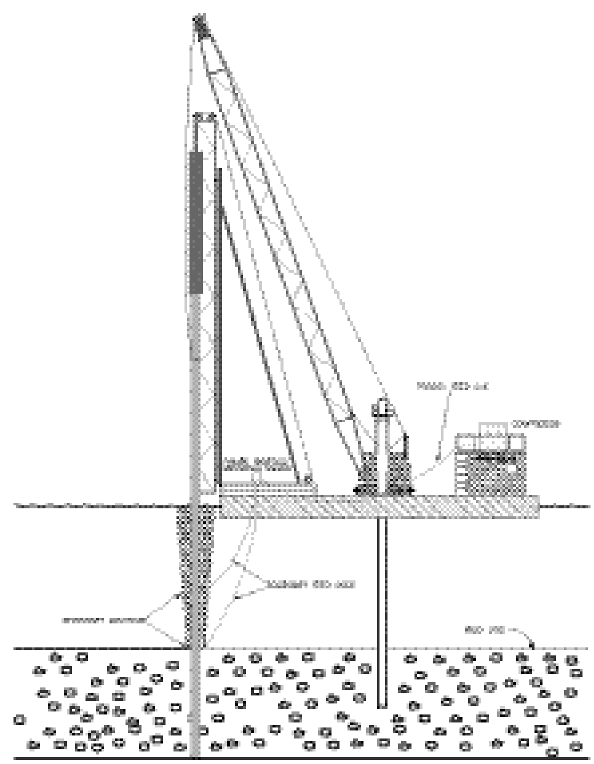
✘ have 1/16-inch diameter air release holes every 3/4-inch along their length.

If the pile is to be driven vertically in shallow water, one level of secondary distribution manifolds is sufficient. If the water is deeper than 35 feet, a second level is required. Similarly, add a third level if depth exceeds 70 feet, and so on.

Inclined piles present a new difficulty since bubbles, once released, rise only vertically. Larger manifolds or additional levels of manifolds are required to maintain 100 percent coverage on inclined piles. Secondary manifolds should be simple and light enough to be deployed and recovered cost-effectively multiple times within a single shift, yet durable enough to survive repeated use and abuse during pile driving.

The next step is to select secondary feed lines that are capable of carrying a sufficient volume of air at an appropriate pressure to the secondary distribution manifolds. When sizing these lines, allow for back pressure at the exit point, in-line friction losses and losses through fittings. If a .75-inch inside diameter line is used and the manifold release holes are as above, there must be at least one supply line for each 144 holes (nine lineal feet of manifold). Since they are the part of the system most vulnerable to wear and their failure results in downtime from pile driving, these feed lines should be of the highest quality available. They must be deployed and recovered numerous times while maintaining their resistance to twisting, kinking and stretching. Keep hose lengths to the minimum possible to reduce the likelihood of snagging and kinking during deployment and recovery.

Now that the number and size of secondary feed lines is known, the compressor and primary feed line can be selected. A 100+psi compressor, which supplies 150 cfm per each secondary feed line required, will be sufficient for most applications. Consider a higher supply pressure if water depth exceeds 100 feet or if there are other special site conditions. Consider excess supply volume to overcome unforeseen losses.



The components of a small manifold bubble curtain system.

Size the primary feed line so it can carry the full volume capacity of the compressor to the primary distribution manifold. Allow for line losses if the compressor is to be located a long distance away from the primary distribution manifold.

Design the primary distribution manifold so that it accepts air from the primary feed line and redirects it into the secondary feed lines. Set up this manifold at an easily accessible location near the pile driving work. This is the center point of the system where air flow to individual secondary manifolds is controlled and system operating status is monitored. Include valves for each feed line so that they can be controlled and adjusted individually.

Flow gauges and pressure meters must report system status at all times to the operator. Since the majority of the system components

(Continued On Page 16)

Register Now And Save!

The Design & Installation Of Cost Efficient Driven Piles

October 11-12, 2001 • Atlanta, Georgia

Why Should You Attend?

In the past 30 years, dramatic developments have occurred in piles and pile driving equipment. Quality control devices have improved the reliability of driven piles so lower factors of safety can be justified. Higher strength pile materials are available at little or no cost increase. The driven pile is now more cost-effective than ever.

What Will You Learn?

This one-and-a-half day seminar will present the technical basis for understanding, analyzing and controlling pile driving. Newly available pile materials will be discussed and their limitations described. Newly available hammers will be discussed and compared with traditional equipment by contractors experienced in their use. Examples of design applications and design loads will be presented and discussed and the potential for the use of high design loads and lower factors of safety in the PDCA code will be presented.

Who Should Attend?

This seminar is intended for geotechnical and structural engineers, college professors and contractors interested in taking advantage of opportunities in driven pile design and installation to reduce the cost of deep foundations.

Location

The seminar location offers attendees easy access to the airport on a free shuttle service provided by the hotel. The meeting will be held at the Crown Plaza Atlanta Airport Hotel, 1325 Virginia Ave. Reservations can be made by calling (404) 768-6660. The room rate is $99 per night single/double. The deadline for a guaranteed rate of $99 is Sept. 10, 2001. After that date the rate is available on a space-available basis only.

Registration And Fees

The fee is $250 if payment is received by Oct. 1, 2001, and $275 for on-site registrations. Registration includes an official Book of Proceedings with session handouts and a copy of the PDCA Code Book, "Recommended Design Specifications for Driven Bearing Piles," 3rd edition. Registration also includes breakfast, two breaks, lunch and a reception on Thursday, and breakfast and a break on Friday.

The Program Schedule

Thursday, Oct. 11, 2001

8:30 a.m. - 9 a.m. -Introduction to the Seminar-*Frazier*

9 a.m. - 10 a.m. - Load Transfer From Pile to Soil, with Emphasis on Soils of the Southeast U.S. - *Brown*

10 a.m. - 10:15 a.m. - Break

10:15 a.m. - 11:30 a.m. - Wave Mechanics and Wave Equation Analysis Fundamentals - *Rausche*

11:30 a.m. - 12:15 p.m. - High Strength Steels - *Weber*

12:15 p.m. - 1:15 p.m. - Lunch

1:15 p.m. - 2:15 p.m. - Pile Capacity Determination - *DiMaggio*

2:15 p.m. - 3:15 p.m. - Design and Installation of Steel Pipe Piles to High Design Loads - *Miner*

3:15 p.m. - 3:30 p.m. - Break

3:30 p.m. - 4:15 p.m. - High Strength Concrete - *Theobald*

4:15 p.m. - 5:15 p.m. - New Developments in Pile Hammers -*Birmingham, White*

5:15 p.m. - 6:15 p.m. - Reception

Friday, Oct. 12, 2001

8:30 a.m. - 9:30 a.m. - Opportunities for High Capacity Steel H-Piles in Weathered Soils - *Goble*

9:30 a.m. - 10:15 a.m. - Pile-Cap Connection for Prestressed Concrete Piles - *Petrou*

10:15 a.m. - 10:30 a.m. - Break

10:30 a.m. - 11:30 a.m. - Design, Fabrication and Installation of 54-inch Spun-Cast Cylinder Piles - *Ronald*

11:30 a.m. - 12:15 p.m. - Bidding and Payment for Driven Piles - *Ford*

12:15 p.m. - 12:30 p.m. - Wrap Up and Close - *Frazier*

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About The Speakers

Patrick Bermingham has worked for more than 18 years developing new technologies for the foundations construction industry. As president and head of research of Bermingham Construction and Berminghammer Foundation Equipment, he has conducted research and product development on a wide variety of equipment and foundation systems, including developing an underwater hammer for deep water applications. He has collaborated with Sheffield University in the United Kingdom and other universities for research on rapid load test methods, developing applications of the Statnamic load test for offshore use and lateral load testing and creating a high-efficiency drive cap for driving concrete piles.

*****

Dan Brown, PhD, is Gottlieb Professor of Civil Engineering at Auburn University. The author of numerous papers on deep foundations, he is a past recipient of the ASCE Huber Prize for his research on pile foundations. A past chairman of the ASCE Deep Foundations Committee, he currently serves as chair of the ASCE International Deep Foundations Congress, scheduled for 2002 in Orlando. He earned his PhD at the University of Texas.

*****

Jerry Dimaggio, PE, is principal geotechnical engineer with the Federal Highway Administration in Washington, D.C., and a member of the adjunct faculty at the University of Delaware. He has more than 25 years of experience in all phases of geotechnical practice and serves on numerous national committees related to the development of technical guidelines, specifications and testing standards.

*****

Woodrow Ford is the owner of Ford Pile Foundations, Inc., a pile driving contractor in Virginia Beach, Va. He is a founding member and past chairman of the Board of PDCA.

*****

Jim Frazier is manager of the pile driving division of Lawrence Construction in Littleton, Colo. He has more than 20 years experience in pile driving and bridge construction, including bidding and estimating. He currently serves as vice president of PDCA.

*****

George Goble, PhD, PE, is owner of George Goble Consulting, Inc. He has served on the faculty of Case Western Reserve University and the University of Colorado and as chairman of the Civil Engineering Department at both institutions. While at Case Western University he directed the research that produced the pile driving analyzer and associated methods for determining analytical capacities for dynamic pile testing and analysis.

*****

Rick Henry is president of MKT Manufacturing and Mississippi Valley Equipment Company. He has a bachelor's degree in Aerospace Engineering and a master of engineering degree from the University of Kansas. He has been working as a design engineer and executive in the pile driving equipment business since 1977.

*****

Robert Miner, PE, is the founder of Robert Miner Dynamic Testing, Inc., of Manchester, Wash. He was previously office manager for the GRL Washington office. He has been involved in dynamic testing using a variety of methods for more than 15 years.

*****

Michael Petrou, PhD, is an associate professor in the Department of Civil and Environmental Engineering at the University of South Carolina. He received his PhD from Case Western Reserve University in 1993. He has extensive experience in the area of civil engineering materials and the general area of bridge design. He is a member of several ASTM committees, the Prestressed Concrete Institute and Transportation Research Board technical committees. He is the author and co-author of 45 research publications.

*****

Frank Rausche, PhD, PE, president of GRL and Associates, Inc., of Cleveland, has more than 30 years experience in dynamic pile testing, wave equation analysis, foundation design and pile driving hammer design and evaluation. He participated in the Case Pile Project and was the author of both the WEAP program and CAPWAP. He currently supervises the work of a dozen field engineers involved in dynamic pile testing, both on land and offshore.

*****

Hugh Ronald, PE, is senior bridge engineer for Sverdrup, located in Jacksonville. He has broad and extensive experience in bridge design, project management, value engineering and design-build. In addition to his bridge design expertise, Ronald has performed extensive design work on water and wastewater treatment plants, marine structures, stadiums and buildings throughout the United States and overseas. He earned a bachelor of science in Civil Engineering at the University of Arizona and is a member of ASBI, IASBE and PCI.

*****

Don Theobald is vice president of engineering for Gulf Coast Pre-Stress, Inc., in Pass Christian, Miss. He has been in the prestressed concrete industry for 32 years. He serves as chairman of the Prestressed Concrete Pile Committee for the Prestressed Concrete Institute. He is an active participant in the PCI Bridge Producers Committee and is a member of the PCI Fast Team for the study of concrete girders. Theobald is a member of the Gulf South Prestressed Concrete Association and is on the Bridge Products Standardization Committee.

*****

Lucian Weber is general manager-technical assistance, long products with ProfilARBED in Luxembourg. A major part of his job at ProfilARBED is working with the design and installation of driven bearing piles and sheet piles. He has published extensively and is intimately familiar with piling practices worldwide.

*****

John White is president of American Pile Driving Equipment, one of the largest hammer manufacturers in the world. A former Marine, he started his pile driving career in 1977. He worked as a pile hammer serviceman at Pacific American Commercial Company, restoring pile driving equipment and setting up hammers. In 1983 he pioneered the Seattle branch for ICE. In 1990 he designed his own version of pile driving hammers and founded APE. In 1992 White received his first of many patents pertaining to pile driving hammers and equipment. He serves as a Board member of the DFI and the PDCA.

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Table-Top Exhibit (Includes 1 registration)	# Attending	Per Exhibit/Person
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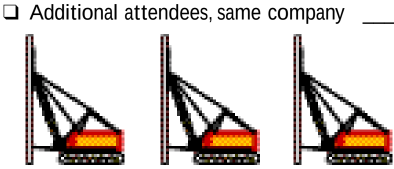
❑ Additional attendees, same company	_____	$125



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Bubble Curtain Systems (Continued From Page 13)

are underwater during driving the operator must rely on these gauges and meters to monitor the system's effectiveness. They should report the pressure as well as the flow in both the primary feed line and each of the secondary feed lines.

The deployment hardware must be specifically designed to suit individual applications. It must be capable of setting and maintaining the secondary manifolds in position around the pile so there are no gaps in coverage. It should be power driven and easy to use to minimize operating costs. Inspection and trouble-shooting are easier if the deployment system can be completely and easily removed from the water. Pile driving equipment to be used, type and size of piling to be driven, water depth, pile orientation and project schedules are all factors to be considered when designing the deployment hardware. It can be as basic or as intricate as required to get the job done while remaining within project budget and scheduling constraints.

A properly designed, constructed and deployed small manifold bubble curtain that provides complete coverage can reduce underwater overpressures by at least 85 percent. Hydrophone test data taken during the Canada Place pier extension project by FRPD and VPA showed that the bubble curtain reduced underwater overpressures during pile driving from in excess of 22 psi with no mitigation to less than 3 psi using the bubble curtain.

The overpressure level that is damaging to a specific marine environment will vary with the size, maturity and species of fish in the area. It is difficult to recommend a safe overpressure level without conducting testing in the immediate work area to determine the type of fish present and to obtain a measure of their resilience to overpressure waves. Canadian DFO guidelines limit overpressures created by blasting operations to 14.5 psi. Blasting typically consists of only a few, single shock waves and this limit was proven in Vancouver to be less than adequate to mitigate the effects of the multiple, high pressure shock waves created over an extended period of time during the driving of large diameter steel piles. At Canada Place, small fish were found to be resilient up to at least 4.5 psi, which became the accepted maximum for this project. A higher level might be acceptable (or a lower level required) in other areas. In the absence of existing government regulations, testing that considers the resident marine life should be conducted to establish a safe overpressure level for individual sites.

Though other systems might rival this one, the small manifold bubble curtain system is certainly an extremely effective method of mitigation that can cost-effectively protect marine life from the high underwater shock wave overpressures created during pile driving.

Craig Longmuir, AScT (engineering technologist) and Tom Lively, P.Eng. (professional engineer) are with Fraser River Pile and Dredge Ltd. They can be reached for comment at (604) 522-7971

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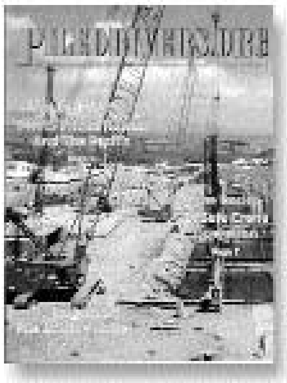

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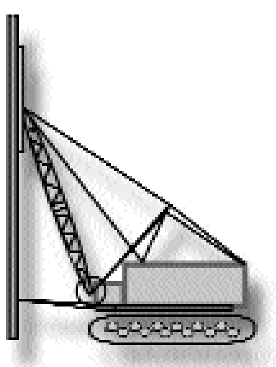

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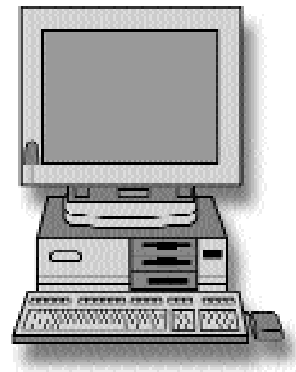

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Safety: A Constant Vigil

Four views of the results of side-loading a boom.

In 1992, there was talk about the Occupational Safety and Health Administration (OSHA) certifying riggers. At the time, Jim Czaja was teaching a class in Elk Grove Village, Ill., for the Chicago and Northeast Illinois District Council of Carpenters. Czaja set up the class on rigging for carpenters, pile drivers and millwrights, which was approved by the District Council.

Czaja's 27 years of rigging experience came from pile driving and form work, along with quite a bit of rigging with boilermakers and pipe fitters. In order to present a balanced course, he decided to tap into some of the great resources available in the Midwest, many of which were located in Chicago.

Czaja received a great deal of help from Local #150, Operating Engineers, which said, "We fully support any program which would make carpenters better riggers."

Local #1, Ironworkers, also gave some good advice and material. Hessville Cable in Gary, Ind., provided cable samples and material and hosted several field trips. The Crosby Group, Inc. provided overheads, slide presentations, videos and reams of technical information for the classes.

"It was really awesome to see how many people respond when you ask for just a little help," Czaja said.

The most significant thing Czaja discovered in preparing for the class was the effect of side-loading the boom.

"Consider for a moment the fact that a 3-degree tilt can reduce the capacity of the boom by more than 50 percent," said Czaja. "Then look at all the different elements and forces such as soil conditions, wind and floating equipment. Rig stability is of prime importance."

In the last eight years, Czaja has investigated some 16 to 20 mishaps, and he estimated that side-loading the boom caused 35 percent of these incidents. The cost of equipment, capital and delays were enormous, and a few incidents resulted in the loss of life.

In one of the incidents, in February 1998, a contractor was pulling pile in a Chicago harbor. After the extracted pile had been unloaded, the tug operator asked the mechanic to take a look at the screws on the tug because he had hit something and was experiencing a loss of power. Sending a diver in to take a look seemed simple enough, but this was February in Chicago and the water temperature was about 32 degrees Fahrenheit. Someone suggested slinging the rear end of the tug and raising it enough to view the screws.

"For two weeks prior to this, the crew had planned every operation they performed and was very successful," said Czaja. "The Bible says 'Pride cometh before a fall.' This crew had gotten too comfortable with what they were doing."

The crew's planning never went beyond getting the slings. The spuds had not been set on the scow. The deck on the tug side was littered. They did not take the time to clear a path for the crane to approach the tug.

The crane was boomed down to about 50 degrees when it lifted the rear end of the tug from the water. The mechanic was lying over the edge of the scow when a gust of wind sent the tug in an easterly direction. With the additional weight on its Northeast corner, the scow began to drift west. This caused a scissor effect on the boom, which suddenly collapsed. The first two 20-foot sections hit the deck and fractured. The point, block and remaining boom sections were in the water. Fortunately, by the grace of God, no one was hurt. The boom was lying on the deck of the scow about three feet from the mechanic.

Czaja was in the Chicago Loop when he got the call from the contractor about the boom coming down. He was on-site within a half-hour, taking photos and talking with those involved.

"Hindsight is always 20/20," said Czaja. "Should they have better secured the tug to the dock? Yes. Should they have set the spuds on the scow? Yes. Should they have cleared the deck to bring the crane and tug into closer proximity? Yes. Should they even have attempted this inspection? Yes. This is the type of thing that people who work with cranes are required to do on a regular basis."

Czaja continued: "We must never let our guard down.

(Continued On Page 19)

Safety (Continued From Page 18)

Every move must be planned thoroughly and supervised by competent personnel. Safety routines are habits that avoid incidents. Whenever there is a variance from the normal, safe work practices, red flags should start popping up everywhere."

Although some contractors favor angle boom as opposed to pipe boom, each system can be abused and lead to boom failure. Incidents can happen at any time and to any contractor. Czaja recommends weekly meetings with key personnel that emphasize the highest priority for safe practices. The worker out in the field who is trying to drive the pile, pour the concrete or build the bridge needs to know that the person who signs the check has safety as his or her highest priority. Sometimes a safety director, foreman, business representative or even a crew member has to make an unpopular call.

Another example of a safety call that should have been made occurred when a piling contractor was sticking 60-foot sheets at night on Solitary Drive in Chicago. The crane belonged to the general contractor, while all other material and equipment belonged to the piling contractor. The placement of the light plants was not effective. It was obvious that the crew should add a spotlight to the boom to help the operator see the top man interlocking the sheets. The foreman's position was that they did not have time to find a light for the boom, which was on loan to them in the first place. On top of this, the crew had a narrow window of operation time because of nearby Meggs Air Field. They needed to get two templates stuck during the night shift or there would not be enough work for the driving crew on the day shift.

"It was obvious that the crew should add a spotlight to the boom to help the operator see the top man interlocking the sheets."

Czaja said someone should have made the decision to shut the job down.

"It was dark and dangerous, but this was an experienced crew," related Czaja. "The company had a good, full-time pile driver safety man, and the crew had been working for a while under these conditions. At 2 a.m., the operator swung a sheet into the top man and broke his leg. The operator said he could not see him."

Czaja found out about the injury the next morning.

"I admonish everyone to please make the tough call. There is much at stake," Czaja said.

Czaja is currently working as a business representative for the Piledrivers and Commercial Drivers Local Union #578 of Chicago. He is president of the Pacific Coast Council of Piledrivers. He is also a member of the National Piledriver Advisory Committee for the United Brotherhood of Carpenters. Czaja can be reached for comment at (708) 846-2466 or by e-mail at jczaja@aol.com.

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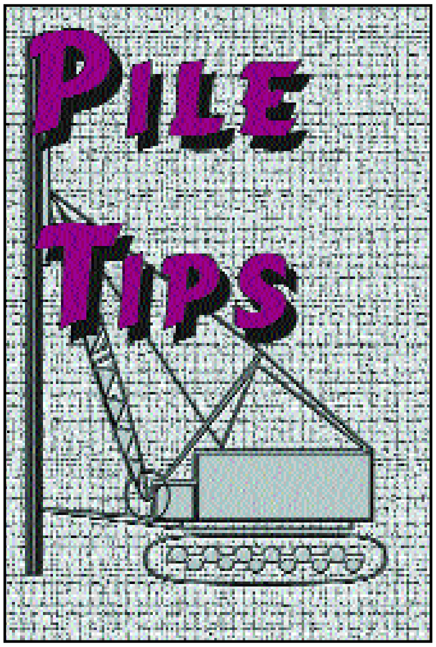


Cleaning Oil From Engine Cooling Systems

1. Prepare a mixture of Calgon (or equivalent) dishwasher detergent and water at the rate of two ounces (dry measure) to one gallon of water. Prepare enough solution for the vehicle you are working on and fill the entire cooling system.

2. Run the engine for five minutes, then drain the system and repeat the process with fresh solution until all traces of engine oil have been removed.

3. Fill the system with clean water and let the engine run for another five minutes, then drain the water and refill the cooling system with a 50/50 mix of fresh OEM-recommended coolant and water.

Radiator Reporter, December 2000

AGC Offers Safety Videos And Publications

The Associated General Contractors of America has an extensive variety of safety publications and videos available to AGC members. The newest publications and videos include topics such as Basic Safety Rules for Construction, Health Hazards in Highway Construction Safety; Environmental Hazards in Construction; and Silica Exposures. Most videos and publications are available in English and Spanish. Please call the AGC Office at (732) 738-9454 for a publication and video directory.

Hard Hat News, Dec. 8, 2000

80 Percent Is Flat

Every new tire manufacturer agrees that a steel radial tire that carries less that 80 percent of the recommended proper inflation pressure should be considered as a run flat. The retreadability of a premium casing can be seriously compromised by a tire that has been driven underinflated (run flat) over a period of time. The problem is that this condition is nearly impossible to observe by simply looking at the tire or thumping it with a stick or hammer. There is only one way to accurately determine how much air is in a tire and that is by using a properly calibrated tire gauge on a regular basis. Tires should be checked after the vehicle has been sitting for at least two hours (first thing in the morning before starting out for the day is always a good idea), or having been driven for no more than about one mile. The cost of labor to check air pressure will always be less than the savings achieved by maintaining a program to check tires and maintaining proper air pressure. The number of retreadable tires in your fleet will increase, leading to additional savings. For more information and a series of articles about the importance of maintaining proper air pressure, visit www.retread.org, send an e-mail to info@retread.org or call (888) 473-8732.

Hard Hat News, May 25, 2001

What Customers Demand In Corporate Web Sites

Many corporate Web sites are ineffective and a waste of money. Good Internet sites require a major commitment of resources, and only a few companies seem to know how to get the maximum return from this investment. Very little market research goes into planning these sites, so here are a few suggestions that might help. Customers will return to a Web site that:

1. Provides a concise summary of what the company does, office and plant or warehouse locations, key personnel, specifications of products and, most importantly, notice of any special incentives available through that site. And it must be easy for a customer to skip to the section that most interests him without being subjected to a blitz of advertising or information he doesn't need;

2. Allows them to take some useful action – to secure information, purchase products, make reservations, check schedules, compare competitive products, do market research or utilize links to other helpful Internet sites;

3. Has simple, clear, graphic designs that open up quickly using a standard computer modem connected to a regular telephone line. Computer geeks and Web designers often forget that the rest of the world doesn't have the high-speed Internet connections and computers that they have grown to believe are normal;

4. Shows how to communicate directly with appropriate company personnel by e-mail, telephone, fax and regular mail – with the reasonable expectation of receiving answers; and

5. Includes the opportunity to give input, ask questions and make comments about company products and services.

Companies without this seem to be missing a great opportunity to get inexpensive feedback from their customers.

Lubes & Greases, June 2001

Committee Chair Seeks Volunteers And Information For CD-ROM

Steve Whitty, chairman of PDCA's Public Relations Committee, needs volunteers and materials to publish a CD-ROM that promotes driven piles to the engineering and student communities.

He plans to produce a CD with photos and text that gives an overview of pile driving applications, from historic use through the present. An outline of the project has been developed and is available to interested members.

Photos of various common applications for driven piles as well as unique solutions to foundation problems would be appreciated, according to Whitty.

Anyone interested in participating in the project should contact Whitty at Specialty Piling Systems, Inc.: Phone/fax - (985) 643-0690; e-mail - SteveWhitty-SPS@att.net; or P.O. Box 1607, Slidell, La. 70459-1607.

Large Diameter Steel Tubular Piles Provide Optimum Seismic Performance

Large diameter steel tubular piles, installed vertically or on a slight incline, offer many advantages as the foundations of major over-water bridges in areas where earthquakes are common.

An optimum balance of stiffness and strength can be achieved with proper selection of diameter and wall thickness. Under strong seismic motion, the piles will deflect and bend, reducing the acceleration forces transmitted to the superstructure while limiting drift. A major advantage of this concept is that the mass of the footing block is significantly smaller than that of a conventional pier. The design of the footing block requires great care in order to transfer the high shears and moments.

In soils where the depth of sediments is significant, the kinematic interaction of soils, piles and structures must be considered. Moments will be at a maximum just under the footing block. Filling the top portion of the pile with concrete will prevent local buckling and assure ductile behavior even under overload.

Typically the piles will be long, with most or all of their support furnished by friction, and will require the use of very large pile hammers. Where the piles are founded on rock or in hardpan, sockets will be drilled and filled with reinforced concrete. For these piles, high moments can occur both at the head and just below the rock surface, so the concrete in-fill should extend the full length.

This article describes the use of tubular piles driven through the deep silty sands of the Jamuna River in Bangladesh and socketed into the near-surface rock for the main pylon pier of the new San Francisco-Oakland East Bay Bridge in California.

Introduction

Steel tubular cylinder piles with diameters of one or two meters (3.28 to 6.56 feet) have been used for a number of major bridges, including the Rio Niteroi Bridge in Brazil, the Parana Bridges in Argentina and the new bridge across the Tagus River in Portugal. They have proved to be an efficient and economical solution because they enabled the footing block to be constructed near the water line, eliminating the need for a deep cofferdam or caisson.

In recent years it has been recognized that tubular piles of even greater diameter, 2.5 to 4 meters, (8.2 to 13.12 feet) can provide lateral stiffness to the pier along with ductility for overload events such as earthquakes, sea ice and ship collision. Combined with an efficiently designed footing block that develops both moment and shear, they can be optimized for drift (lateral deflection) and strength.

These piles are typically thick-walled (D/t~70 to 80) to enable effective driving to deep penetrations, as well as to provide moment resistance and stiffness. The wall thickness can be varied along the length to suit the demands of both driveability and in-service stresses. Where piles are driven into deep sediments, the highest bending moment occurs in the 1 to 1.5 diameters just below the footing block. Filling the upper part of the pile with concrete, locked to the steel pile with shear rings, will give the pile increased stiffness and ductility. Stable hysteresis responses have been obtained in laboratory tests up to a ductility factor of 4.

Because many inclined piles in wharves have failed during earthquakes, the trend has been to use only vertical piles in seismic zones because they respond well to excitation from all directions. However, recently a slight incline has been used in soft sedimentary soils and deep water. The benefits are greater lateral stiffness under serviceability environmental loadings, reduced drift during a seismic event and, especially, reduced residual displacement.

The design of these piles for lateral forces such as those of an earthquake requires a full analysis of the soil-structure interaction. The free-field motions are modified by the kinematic interaction of the pile with the soil due to the pile's stiffness. In layered sediments, the load-deflection performance can be determined by the finite element method, with soil springs input along the pile length.


Tubular piles are driven on the Jamuna River in Bangladesh.

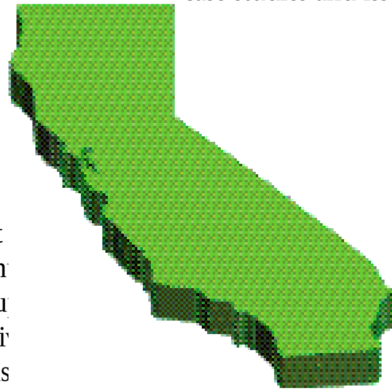
Group effects due to "shadowing" must be considered. For extreme deflections, the moments and deformations resulting from eccentric loading might be important.

The installation

(Continued On Page 23)

San Francisco Will Host PDCA Winter Roundtable

The next Pile Driving Contractors Association Winter Roundtable, scheduled for Feb. 21 through Feb. 23 in San Francisco, will focus on developing best practices for the driven pile contractor.



The Roundtable is an excellent mation source and networking ven contractors, engineers, geotechs, su and students in the field of pile dri Experts from the pile driving indus lead discussions on industry trends, project case studies and issues that affect pile ibit area is planned on the conference, ıle and space available mailed shortly. ınference venue, the Hopkins ıtercontinental Hotel on Nob Hill, promises to be as high quality as the Roundtable itself. Roundtable attendees will be able to enjoy a recently completed $51 million renovation to this 1926 historic hotel and the famous Top of the Mark Sky Lounge. The Mark Hopkins is 10 minutes from Fisherman's Wharf and is touted as a four-star, four-diamond Gold Key award-winning hotel. Room rates are only $179 per night.

For more information on the Winter Roundtable, contact PDCA at (970) 945-1231. A Roundtable schedule and list of seminars will appear in the Fall issue of *piledrivers.org*.

Steel Tubular Piles (Continued From Page 22)

of these large piles requires the use of very large crane barges and very heavy pile hammers. Templates are usually employed to position the piles accurately, especially when the piles are inclined. Because there will be only a few such piles in a footing, each will be highly loaded – to several thousand tons. Tolerances in the pile head location are critical.

The design of the footing blocks requires consideration of the demands for moment, shear and axial force transfer and also the practicality of construction. Precast concrete shells are often employed, temporarily supported on the piles. Both circumferential and axial shear keys are employed. Because of the high forces in moment and shear, post-tensioning might also be required.

> "Piles are usually designed for essentially elastic behavior in an earthquake, with ductility employed for possible overload during a few cycles."

It should be noted that if the piles are slightly inclined, the footing block could be reduced in size, thus reducing the mass, which is subject to high accelerations under earthquake. It has been found that the largest contributor to the shear under earthquake is usually the mass of the footing block. Piles are usually designed for essentially elastic behavior in an earthquake, with ductility employed for possible overload during a few cycles.

Large diameter steel tubular piles were utilized for the recently completed Jamuna River multipurpose bridge in Bangladesh, where very deep and unstable sediments, combined with variable river depths due to shifting channels as well as high monsoon floods, demanded a unique solution. The piles varied from 2.5 to 3.15 meters (8.2 to 10.33 feet) in diameter, were 80 meters (262.47 feet) long and had a wall thickness of up to 65 millimeters (2.6 inches). They were driven in three sections, using a Menck hydraulic hammer developing 1,800 KN-m of energy blow. The piles were driven through medium dense to very dense sand and founded in a gravel stratum at a depth of 80 meters (262.47 feet) below normal water level. Up to 12,000 blows per pile was required. The splicing of three sections were by full-penetration welding.

A hydraulic hammer developing 1,230,000 ft. lbs.

The 300-ton pile hammer and the pile sections were handled by a large offshore-type crane barge. Piles were installed at a rate of up to five per week and the work was completed on schedule.

Tubular piles are also an excellent solution for over-water bridge piers founded in rock or hardpan. In this case, vertical piles will usually prove best. They are cleaned out and a socket drilled into the rock. Past practice has been to install a reinforcing steel cage and to fill the pile with concrete. However, if there is inadequate overburden, the pile may develop high moments at or just below the rock line. In such cases, an oversized socket is drilled and the tubular pile lowered or driven into it, assuring that full moment capacity is provided at this critical region. The annular space is then grouted and the pile filled with concrete.

This concept has been adopted for the seismic retrofit of several major bridges across San Francisco Bay to develop greater stiffness and thus reduce drift deflection to acceptable values. Steel tubular piles, socketed into rock, have been selected as the probable design for the major pylon pier suspension span on the new San Francisco-Oakland East Bay Bridge while driven tubular piles, 2.5 meters (8.2 feet) in diameter and up to 100 meters (328.08 feet) long, will support the long approach viaduct.

Ben C. Gerwick Jr. is chairman of Ben C. Gerwick, Inc. Consulting Engineers for Marine Structures and Foundations. He is professor emeritus of Civil Engineering at the University of California, Berkeley. Robert Bittner is vice president at Ben C. Gerwick Inc. They can be reached for comment at (415) 398-8972.

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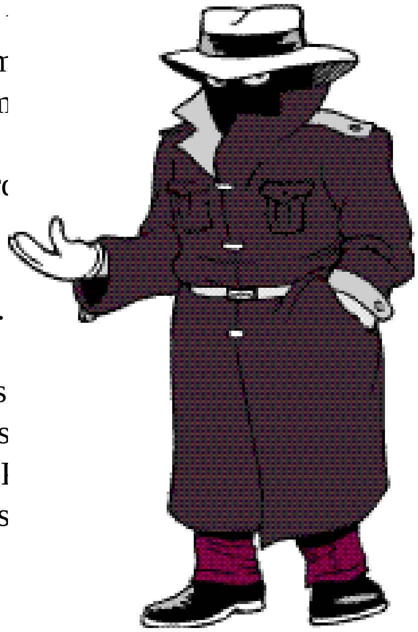

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Original Articles Wanted For Piledrivers.org

PDCA is arming members with information relevant to the pile driving industry. Topics of interest include but are not limited to noise, vibration, safety, human resources and management skills.

Description

PDCA is seeking original articles that meet the following specifications:

Length: Is 1,500 to 2,000 words and is a typed, clean copy.

Title: Has a title with an active verb, followed by a one-sentence or one-paragraph lead that explains the purpose of the article.

Content: Provides information that is important and relative to pile driving.

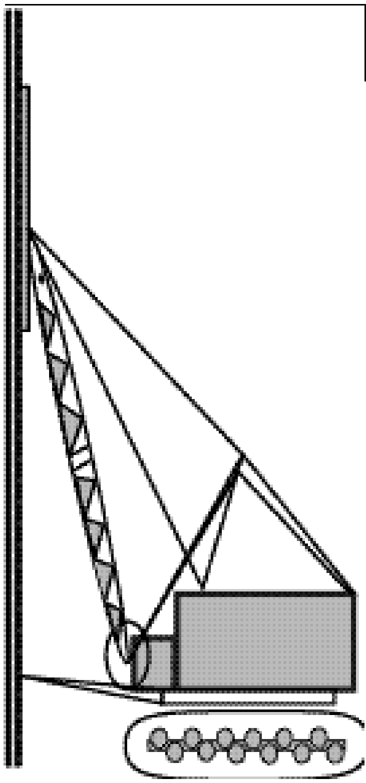
Byline: Includes a byline with a one-sentence description giving the author's full name, title, company or organization and contact number or e-mail address.

Artwork: Includes supporting charts, tables, photos or artwork in TIFF or JPG file format that are of proper clarity and relate to the article.

Accuracy: Is checked for accuracy.

Submission: Is submitted as a Microsoft Word attachment in an e-mail to membership@piledrivers.org or on a computer disk in Microsoft Word format to: PDCA, P.O. Box 1429, Glenwood Springs, Colo. 81602.

If you or someone in your office has an article or would like to write an article meeting the description above, please contact PDCA at membership@piledrivers.org or (970) 945-1231.



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(Continued on back)

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- ❏ Cushion Materials
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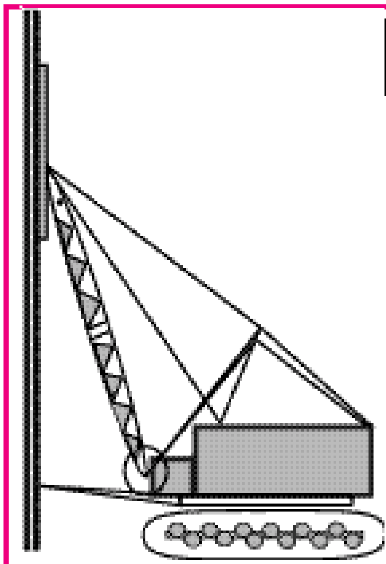

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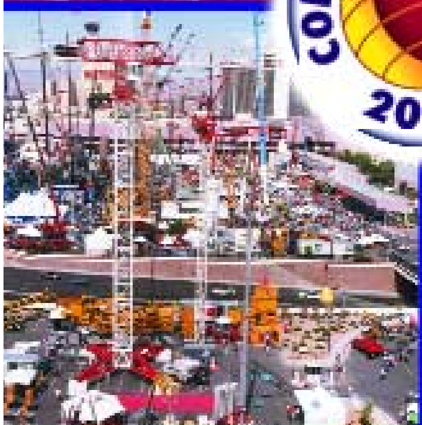

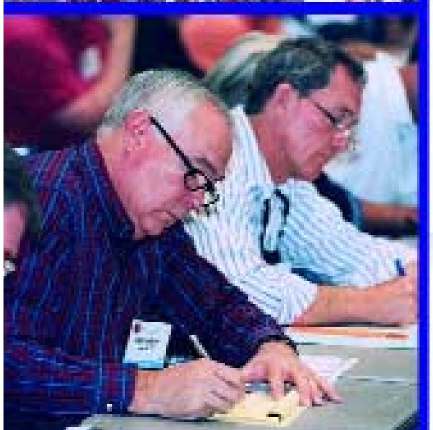

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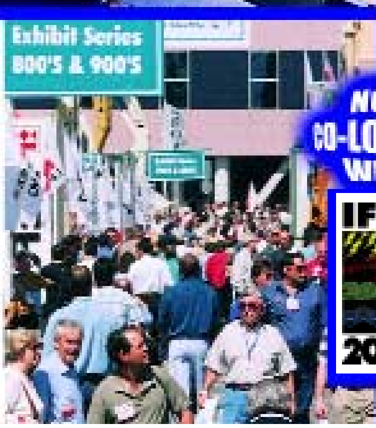

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