PILEDRIVER

The Official Publication of The Pile Driving Contractors Association PDCA | Q2 2010 Vol. 7, No. 2

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Contents

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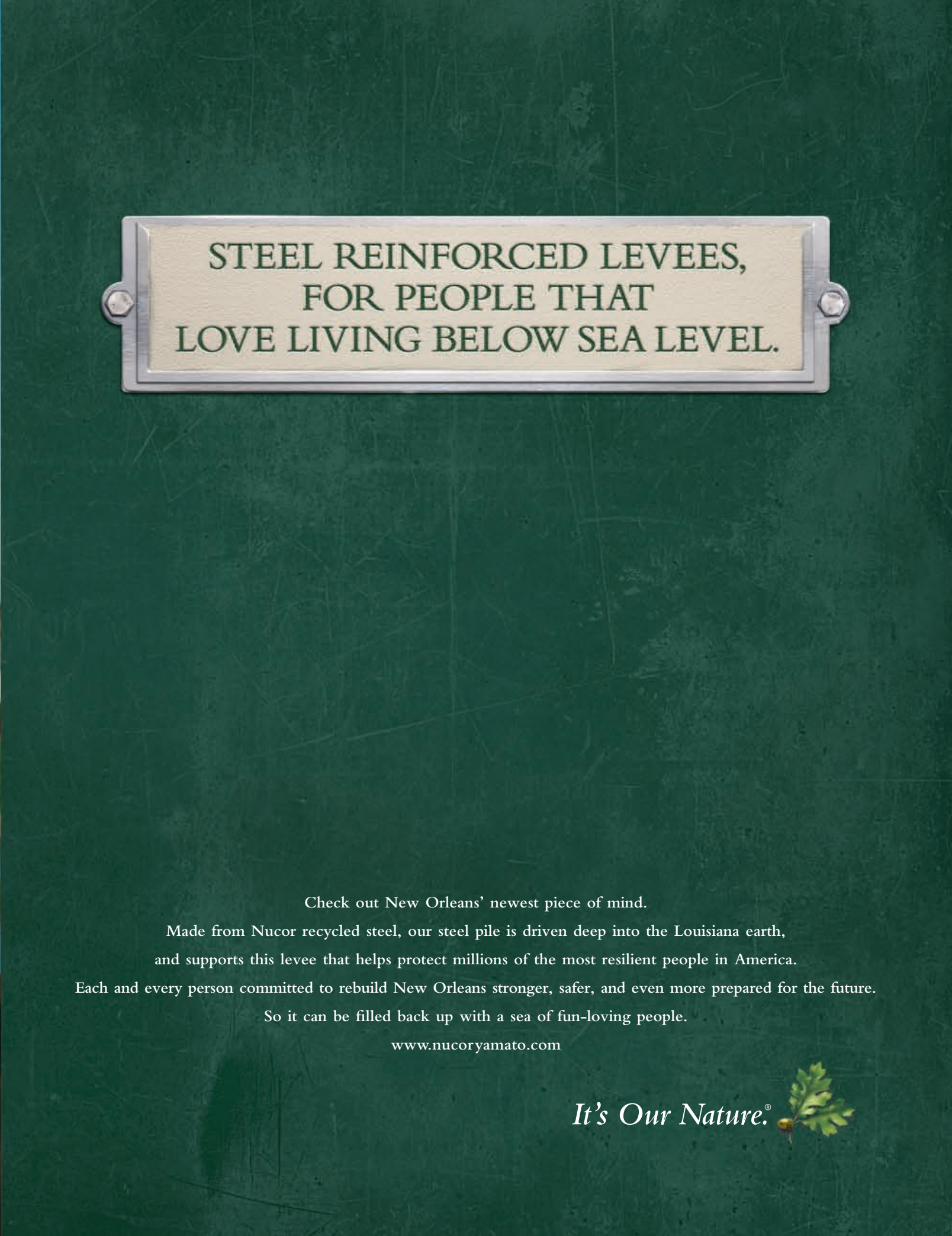

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One last thing before I say Goodbye and Thank You to the PDCA...

By John King

By the time you read this, Don Dolly will be your new PDCA President, so this is my final message to you as President of the PDCA. As President, I receive all the other trade magazines from our Geo partners. I see all the ads in their magazines, talking about the other wannabe deep foundation types. The ads *claim* their products are faster, cheaper and so on. Not in my lifetime, and not in yours. There is one thing I admire about their advertisements - they never claim their foundations are better than our driven piles! So my final word to everyone is, **"The best deep foundation is a Driven Pile!"** Case Closed!

There are a lot of people I need to thank for making my time on the Executive Committee and my term as President of the PDCA a rewarding and beneficial period in my professional life. First, I need to thank my wife and daughter, Debbie and Abigail, who have been my sounding board for ideas and complaints, put up with many late dinners and dealt with my crazy travel schedule. I love you both and would be lost without you.

Thank you to Kay and Michael at Pile Drivers, Inc. who never complained about all the time and travel expenses that are a collateral consequence of being President.

Everyone knows the power of networking and the long-term benefits and rewards that result from the relationships we make and foster along the way. During the PDCA conferences, I have met new friends within this industry that I love so much. I have had the privilege of getting to know them, working with them and the honor of calling them my "friend". Harry Robbins, Mark Weisz and Van Hogan are three such individuals. I am truly grateful to have had them as predecessors and mentors on the Executive Committee and Board of Directors. However, I am even more fortunate and lucky to be able to call them "friends"; and it all started with networking as a PDCA member.

For those members who don't take advantage of this great asset offered by your association – the ability to network – you need to start doing so today! Networking is why I need to thank Woody and Trey Ford, who I met at the first annual conference I ever attended. It was in Orlando, Florida and I believe the year was 2003. Woody was the first one to greet and welcome me to the PDCA and the annual conference. Over the last year, I have partnered with their company on four projects. These jobs have allowed my company to retain good pile driving employees and have potentially helped keep doors open.

This thank you comes from my time with the South Carolina Chapter. To these associates who never say no to a request for anything – Richard Gilbert, Skyline; Bill Crossman, Atlantic Wood; Andrea Edwards, Cox Industrial; and Jimmy Deemer and John White, APE.

Pollyanna Cunningham, ICE, who has taken our website to a new server, produced a better website and saved PDCA members money in doing so, and the PileDriver magazine that began with Van Hogan, Garland Likins, Steve Whitty and Doug Scaggs. The magazine has come a long way and I am grateful for the dedication and perseverance of these individuals who were there from the beginning.

To Professor Joe Caliendo, Utah State University for the great Professor Driven Pile Institute, which we hold every other summer. Since its inception, over 100 college professor have been educated on the benefits of driven piles. These professors have been taught by experts and advocates of the driven pile, so you know they have learned from the best. I am asking each PDCA member to nominate a professor for the 2011 PDPI, who

is already or could become a teacher of our industry. Sponsor his/her attendance and, if possible, their trip to Logan, Utah. I promise that you won't regret it. Don't forget your wooden tokens for ice cream!

I would also like to thank Mike Jahnigen and Miika Eskelinen for the wonderful group tour of Finland and the PM16.

And in closing, I begin to wonder what will happen to the Board when I leave? Will those who follow me be as dedicated to the association and love it as I have? I can tell you without hesitation that I leave this Board without fear and that it is in the most capable hands. PDCA is so lucky to have such dedicated members on the new Executive Committee, such as John Linscott who has been a rock on the Committee, serving as your Treasurer. New, insightful and enthusiastic Officers like Buck Darling and Dave Chapman will join Don Dolly new PDCA President and the PDCA. Once again, I tell you the PDCA is in great hands. PDCA also has a committed group of returning Board members. I want to welcome Crandall Bates (Balfour Beatty) as our newest Board member – welcome aboard, Crandall!

Last but not least, Steve Hall. One of my goals when I became President was to leave the PDCA in good shape and that Steve and I would still be good friends. While we have not agreed on everything, which I believe makes the PDCA better and stronger, this mission was accomplished. Steve- thanks for your friendship and guidance, but watch out for the next bus.

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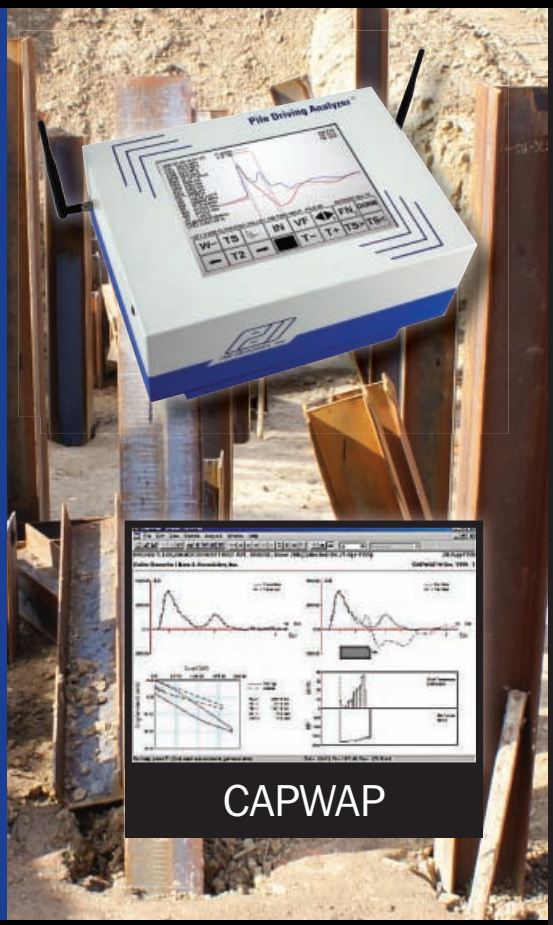

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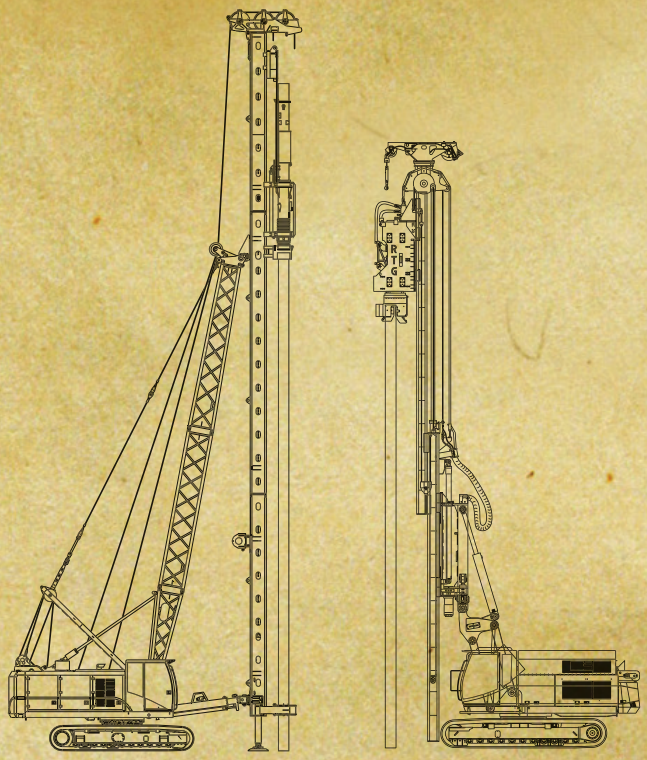

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Message from your new PDCA President

By Don Dolly

My thirty years long career in pile driving has taken me from a green pile driving hand to managing a pile driving company. During my career I have had the good fortune of working with many skilled craftsmen, gifted engineers, savvy construction managers, creative estimators, and focused executives. Their influence has resulted in my understanding and appreciation of the value individuals develop during their careers in our pile driving industry. That appreciation includes the executives responsible for long term success and financial statements with black ink, estimators developing rational bid day strategy for every project, project managers making costs and schedule come together while overcoming adversity, general superintendents considering innumerable details from many projects and making them constructible and pile driver foreman pushing production while ensuring everyone goes home without injury. Those individuals make companies successful, but only if there is a market for their services.

Enter the Pile Driving Contractors Association. Driven piles have been in use for literally thousands of years; the benefits of driven pile foundations did not need to be heralded to maintain continued use. Today is a different day and the driven pile market is being tested by many different sub-foundation alternatives – many of which are unproven. Through my involvement with the PDCA as a member, board member and officer, I have come to understand that the testing ground is not limited by geographic location nor project size or scope. Through conferences and seminars, as well as practical training, the PDCA is educating and reeducating the pile driving industry as to the advantages of the driven pile. Our association has been, and continues to, reach out to academia, design engineers and owners alike to make certain that driven pile are not overlooked. The PDCA, through the participation of many experienced construction professionals, has become the singular voice of the driven pile industry.

During these dire economic times the benefits of the PDCA must not be underestimated. On the contrary, our PDCA is the one advocate that is solely focused on the success of its members and their industry. When considering your business budget and how to trim fat, understand that our PDCA is muscle – not fat! The pile driving industry needs a strong PDCA more now than ever; therefore, I ask that you think of our PDCA as a partner in business and not just another association. We are all looking for a solid sign that our economy has turned the corner. Although economic recovery cannot entirely be defined; one thing is for sure – full economic recovery will happen. We just don't know when. While facing that unknown, I trust that the benefits of mem-

bership in the PDCA will out weigh the cost of your annual membership.

As incoming President, I would be remiss not to mention the hard work and dedication of our Immediate Past President Mr. John King. Mr. King has been an inspiration to me in content and approach to the advancement of the association. Mr. King understands that the members are the life blood of any association, and in particular the PDCA. Mr. King's stewardship of the PDCA manifested in his mentorship of committees and dogged commitment to member issues. I can only hope that during my term as President of the Pile Driving Contractors Association I will meet the standard set by Mr. King.

While President of the association it is my goal to make readily accessible the benefits of the PDCA. The PDCA website is a great place to start gaining the PDCA advantage. The PDCA website provides a great resource for owners and design engineers when considering options for sub-foundations. Contractors can be located by geographical area, scope of work performed or by name. Members can search the site for active committees committed to technical, environmental, and education issues related to pile driving. 'Ask PDCA' is a popular and effective way to ask questions to the association and take advantage of pile driving experience from across the country and beyond. The PDCA assures local effectiveness through its many chapters such as South Carolina, Mid-Atlantic, Gulf Coast, Pacific Coast, Florida and the Northeast. Each chapter is dedicated to their sphere of market influence and helps members realize the PDCA advantage. Also, a great feature of the PDCA website is the Publications page which allows members to review and download pile driving related article from prior publications.

The Coeur d'Alene conference was remarkable in that it provided an educational experience in a truly beautiful setting. Attendees were generally confident with regard to business, and conveyed a sense of industry success even in these difficult times. I enjoyed speaking with all of you and it was a particular pleasure hearing pile driving stories from around the country. The next big event is the annual program titled Design and Installation of Cost Efficient Pile or DICEP held in November. This year's DICEP program takes us to scenic Charleston, South Carolina. I look forward to seeing all of you in Charleston. ▼

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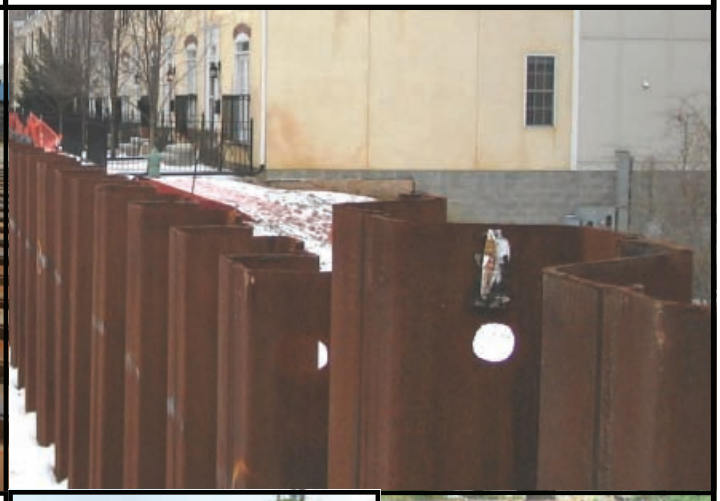

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Expo 2010 has come and gone

By Stevan A. Hall

The PDCA 14th Annual International Conference and Expo 2010 has come and gone. The event kicked off with the traditional Opening Reception sponsored by L.B. Foster Company on Thursday night in the exhibit hall. On Friday, May 7, the conference resumed with committee meetings, educational programs, and the PDCA 3rd Annual Golf Tournament, concluding with an evening cruise on Lake Coeur d'Alene. Saturday followed with the remaining committee meetings, educational programs, the Business and Awards Luncheon and the evening's annual dinner dance.

I want to thank all of the PDCA members who supported the conference, including the exhibitors, registered attendees, the ladies who participated in the Companion's Program, and our generous sponsors. Your support and participation made the conference a very enjoyable event.

I want to congratulate the following individuals who were recognized during the conference's Business and Awards Luncheon.

Harry Robbins (Palmetto Pile Driving, Charleston, SC) received the Presidential Award for Distinguished Service. Harry's support and involvement in the PDCA makes him a very deserving recipient of this prestigious award. Harry has served the PDCA in many capacities, including serving on the Board of Directors, Executive Committee and as President and Past President of the PDCA. However, he is probably most noted for his vision, perseverance and commitment to establishing PDCA chapters across the US, starting with his first and very successful chapter, the PDCA of South Carolina. With six PDCA chapters currently supporting the driven pile industry in their respective areas, Harry can be proud of the positive influence he has had on the PDCA.

President John King presented William M. "Billy" Camp III (S&ME, Charleston, SC) with the PDCA Professional Engineer's Service Award. This award recognizes Billy's outstanding contributions to the PDCA and the driven pile industry. Billy has been a champion of the driven pile industry for many years. He has been instrumental in supporting the PDCA, lending his engineering expertise to the PDCA at every request. As a member of the PDCA Technical Committee, Billy was instrumental in helping rewrite the AASHTO Design and Installation Specifications. He continues to add an engineer's perspective to technical content in PileDriver magazine, and has assisted the Education Committee in securing nationally renowned speakers for conferences and seminars and is steadfast in his support of national and local chapters.

Pollyanna Cunningham (ICE, Matthews, NC) was presented with the Committee Chair of the Year Award. Pollyanna received the award for her outstanding dedication and commitment to the Pile Driving industry and the exemplary leadership she displayed as Chair of the Communications Committee. In 2008, PDCA visited Pollyanna at the ICE facility in Matthews, NC, where she accepted the Chair of the Communications Committee for 2009, returning to that seat in 2010. Since then, she has facilitated the development of a new website, helped organize a website page for PDCA chapters, acquired two new domain names for PDCA international segment, improved and increased magazine content, supported all forms of PDCA communications to our members and guests and played a key role educating users on the PDCA website. Pollyanna's commitment outside of her committee duties has also been extraordinary. In 2009/2010, Pollyanna helped the PDCA review and acquire new server technology, allowing the PDCA staff to be more efficient and productive in our daily operations and she has accomplished all of this with a "What can I do for you and when do you need it!" attitude.

PDCA owes a great deal of gratitude to these outstanding PDCA recipients.

PDCA had a tremendous response to the Project of the Year Awards in 2010. All entries for 2010 clearly represented the pile drivers' ingenuity and commitment that goes into each project. Each project demonstrated the challenges, innovation, solutions, and cost-saving measures that are part of the business of pile driving. It is unfortunate that all entries could not receive awards because each entry is deserving of that recognition.

Congratulations to Bisson-PreTech, Driven Piers and

Leveling of the Centre Hospitalier Cloutier-du Rivage (Land - $500,000 - $2 Million), PND Engineers, Inc., Skagway Harbor Surge Control Breakwater (Marine – $500,000 - $2 Million), Taylor Bros. Marine Construction, Inc., Progress Energy Southport Nuclear Power Plant Diversion Structure (Marine – Greater than $2 Million) and GZA GeoEnvironmental, Inc., Brayton Point Closed Loop Cooling Towers (Land – Greater than $2 Million).

I want to welcome Don Dolly (Foundation Constructors, Oakley, CA) as the new PDCA President. I know his leadership skills and ability to identify opportunities for the PDCA while approaching issues with forethought, detail and strategic awareness will be an asset to advancing the PDCA goals and objectives in 2010 and 2011. I want to welcome Buck Darling (Herbert F. Darling, Williamsville, NY) and Dave Chapman (Blakeslee, Arpaia, Chapman, Branford, CT) as the incoming Vice President and Secretary, respectively. I also want to welcome Crandall Bates (Balfour Beatty, Fairfield, CA) as the newest member of the Board and to welcome back all of the returning Board members. I look forward to working with all of you in 2010 and 2011.

I cannot conclude this message without saying, "Thanks, John King!" As PDCA President since March 2009, John has provided the leadership vital for the PDCA to continue on the path of progress and success. As we all know, 2009 and into 2010 has not been easy with the current economy impacting us all one way or the other. This factor alone has created challenges for John and the Board that no other President has faced in a long time. John has kept us all upbeat, positive and has always offered valued suggestions, excellent guidance and effective resolution to all of the issues we have faced during his term. It is time for John to take a well-deserved break, but he won't go too far, remaining on the Board as the Immediate Past President. John, I am sure I speak for all of us when I say we are glad you are going to stick around for another year and we all look forward to your continued leadership and can-do attitude. It has been my pleasure and honor to work alongside of you as my President and to call you my friend. ▼

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 1995 to promote the 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 projects 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 120 contractor members, the PDCA offers many networking opportunities. Whether at our Annual Conference, DICEP conference, 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 Annual Conference, held in early Spring since 1997, is a nationally recognized conference that brings together leading contractors, technical experts and suppliers to the piling industry.
- The Design and Installation of Cost-Efficient Driven Piles Conference (DICEP), held each September since 2000, is a nationally recognized 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 Professors' Driven Pile Institute, held at Utah State University in Logan, Utah. Up to 25 professors from major engineering schools are invited to participate in an intensive, weeklong 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.

PDCA also offers the *Installation Specifications for Driven Pile-PDCA Specification 103-07* as a CD to all new members at no charge.

"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.

The PDCA also sells *Driven Pile Foundations, Volume I&II*, an FHWA manual on the design and construction of driven piles.

Connect worldwide at www.piledrivers.org

The PDCA's newly redesigned website 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 interested 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 that 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

MEMBERSHIP APPLICATION

Step 1: Company Information

Company Name: _____

Contact Name: _____

Address: _____

Phone: _____ Fax: _____

City / State / Zip: _____

Company Home Page: _____ E-mail: _____

Step 2: Select Membership Type

Important! Read carefully! The PDCA Bylaws define member classifications and qualifications. Dues are established by the PDCA Board of Directors and shown in ( ) for each type.

- ○ **Contractor Member** – General or Specialty contractor who commonly installs driven piles for foundations and earth retention systems.
  - ○ *Contractor I Member Company* – Annual volume > $ 2 million **($850.00)**
  - ○ *Contractor II Member Company* – Annual volume < $ 2 million **($425.00)**
- ○ **Associate Member** – Firms engaged in the manufacture and/or supply of equipment, materials, or services to the pile driving industry.
  - ○ Associate I Member Company – Annual volume > $ 2 million **($850.00)**
  - ○ Associate II Member Company – Annual volume < $ 2 million **($425.00)**
  - ○ *Local Associate Member Company* **($100.00)**
    Small Associate Company desiring membership in a single local chapter, who only serves that local market, and whose interest is to support the local chapter. Membership must be approved by PDCA Executive Committee.
- ○ **Engineering Affiliate** – Any Engineering company, firm, corporation, or individual (Structural, Geotechnical, Civil, etc) involved in the design, consulting, testing or other engineering aspect associated with driven piles, deep foundations or earth retention systems.
  - ○ *Engineering Affiliate – 1-5 offices* **($100 per office)**
    Listing up to 5 Individuals per office at no additional charge
  - ○ *Engineering Affiliate – 6-11 offices* **($90.00 per office)**
    Listing up to 5 Individuals per office at no additional charge
  - ○ *Engineering Affiliate – 12+ offices* **(80.00 per office)**
    Listing up to 5 Individuals per office at no additional charge
- ○ **Individual Member** – **($50.00)**
  An individual employed full-time by a university or college and teaching Undergraduate or Graduate courses in engineering; or an individual employed full-time by the government.
- ○ **Retired Industry Member** – **($100.00)**
  Individual who has reached retirement age, left active employment, and wishes to remain a member.
- ○ **Student Member** – **($20.00)**
  Full time students studying towards a bachelor, master or doctorate degree in a regular university program.
- ○ **Affiliate Labor Organization Member** – **($100.00)**
  Concerned with pile driving for the purpose of gathering and sharing information.
- ○ **Organization Member** – Non-voting membership category. Must be approved by the PDCA Executive Committee.

Step 3: Member Information

(complete only the category for which you are applying)

A. Contractor Members – check all services that your company provides:

- ❒ Bridge Buildings
- ❒ Bulkheads
- ❒ Deep Dynamic Compaction
- ❒ Deep Excavation
- ❒ Docks and Wharves
- ❒ Earth Retention
- ❒ General Contracting
- ❒ Highway and Heavy Civil
- ❒ Marine
- ❒ Pile Driving
- ❒ Other

B. Associate and Engineering Affiliates Members – check all products and/or services that your company provides:

Accessories

- ❒ Cutter Heads and Drill Bits
- ❒ Dock and Marine Supplies
- ❒ Hammer Cushions
- ❒ Other
- ❒ Hoses and Fittings
- ❒ Lubricants and Grease
- ❒ Pile Cushions
- ❒ Pile Points and Splicers
- ❒ Rigging Supplies
- ❒ Safety Equipment

Materials

- ❒ Aluminum Sheet Piles
- ❒ Coatings and Chemicals
- ❒ Concrete Piles
- ❒ Timber Piles/Treated Lumber
- ❒ Composite Piles
- ❒ H-Piles
- ❒ Steel Pipe Piles
- ❒ Other
- ❒ Steel Sheet Piles
- ❒ Structural Steel
- ❒ Synthetic Material Piles

Equipment

- ❒ Air Compressors and Pumps
- ❒ Cranes
- ❒ Drill Equipment
- ❒ Drive Caps and Inserts
- ❒ Hammers
- ❒ Hydraulic Power Packs
- ❒ Leads and Spotters
- ❒ Marine Equipment
- ❒ Specialized Rigs and Equipment

Services

- ❒ Consulting
- ❒ Design
- ❒ Freight Brokerage
- ❒ Analysis
- ❒ Pile Driving Monitoring
- ❒ Geotechnical
- ❒ Marine Drayage
- ❒ Surveying
- ❒ Civil and Design
- ❒ Other
- ❒ Testing
- ❒ Trucking
- ❒ Vibration Monitoring
- ❒ Materials Testing

General

- ❒ Rental
- ❒ Sales

Step 4: Geographic Areas Where Services and Products Are Available

(All applicants check all that apply)

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

Step 5: Method of Payment

I am providing payment in the amount of: _____

I am making payment in full by: ❒ Check ❒ Visa ❒ MasterCard ❒ American Express ❒ Discover

Card Number: _____ Expiration Date: _____

Name on Card: _____ CVV Code: _____

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Signature: _____

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Recap: Driven Pile – A Technical Seminar – Baltimore

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The Pile Driving Contractors Association (PDCA) and Deep Foundations Institute (DFI) jointly presented "Driven Pile – A Technical Seminar" on Friday, March 12, 2010 at the Marriott Baltimore Waterfront Hotel in Maryland. PDCA managed the full day of technical presentations and indoor exhibits at Baltimore's busy and beautiful Inner Harbor.

Technical presentations by university professors and practitioners covered a range of practical topics on driven piling technology and two challenging case histories. The attendees comprised 119 geotechnical and structural engineers, contractors and owners, who enjoyed technical sessions overlooking the waterfront and networking opportunities among the indoor exhibits provided by 13 equipment, material and instrumentation suppliers. The course qualified attendees for 7 professional development hours (PDHs) and a full set of bound notes was provided to each attendee.

Cost savings was a prevalent theme among the seven technical presentations. Prof. Paul Mayne, P.E. (Georgia Tech) identified driven pile design parameters that may be obtained quickly, economically and continuously through cone penetrometer testing. Dr. Van Komurka, P.E. (Wagner Komurka Geotechnical Group) presented an analytical procedure for comparing pile foundation costs normalized as cost of installed/constructed foundation element (including design and testing costs) per ton of allowable load. Michael Morgano, P.E. (GRL Engineers, Inc.) outlined pile testing techniques and highlighted how pre-production dynamic testing can be used to reduce construction costs by recognizing increased capacity due to set up. Prof. Ed Hajduk, P.E. (The Citadel) compared types and magnitudes of pile driving vibrations against common analytical criteria and provided recommendations for developing plans to reduce and monitor vibrations. Prof. George Filz, P.E. (Virginia Tech) reviewed a newly-developed spreadsheet to streamline settlement analyses for pile-raft foundations and calculate down drag on pile groups.

Two case histories highlighted the use and versatility of driven piles. Hiren Shah, P.E. (Mueser Rutledge Consulting Engineers) described the use of 1600 driven piles and 125 micropiles for The Edge, a river front urban development in New York City. Jay Erwin (Skanska USA Civil Southeast) and Richard Simon, P.E. (S&ME) described the design build process for the 2600-foot long (950-ft main span) cable stayed Indian River Inlet Bridge Project in Rehoboth Beach, DE. Both projects illustrated how design phase pile testing programs provided data to optimize pile types and maximize pile capacity.

The PDCA would like to express our sincere thanks to Billy Camp (S&ME) and Tom Nichols (Underpinning and Foundation Skanska) for selecting and organizing an outstanding line up of speakers for the conference. The PDCA would also like to thank our Education Committee for their input and support of this program. And finally, the PDCA would like to thank the DFI for their participation and support throughout the entire planning and implementation process. ▼

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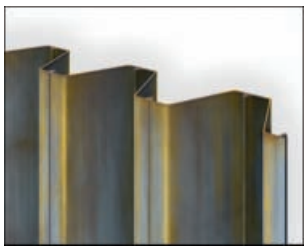

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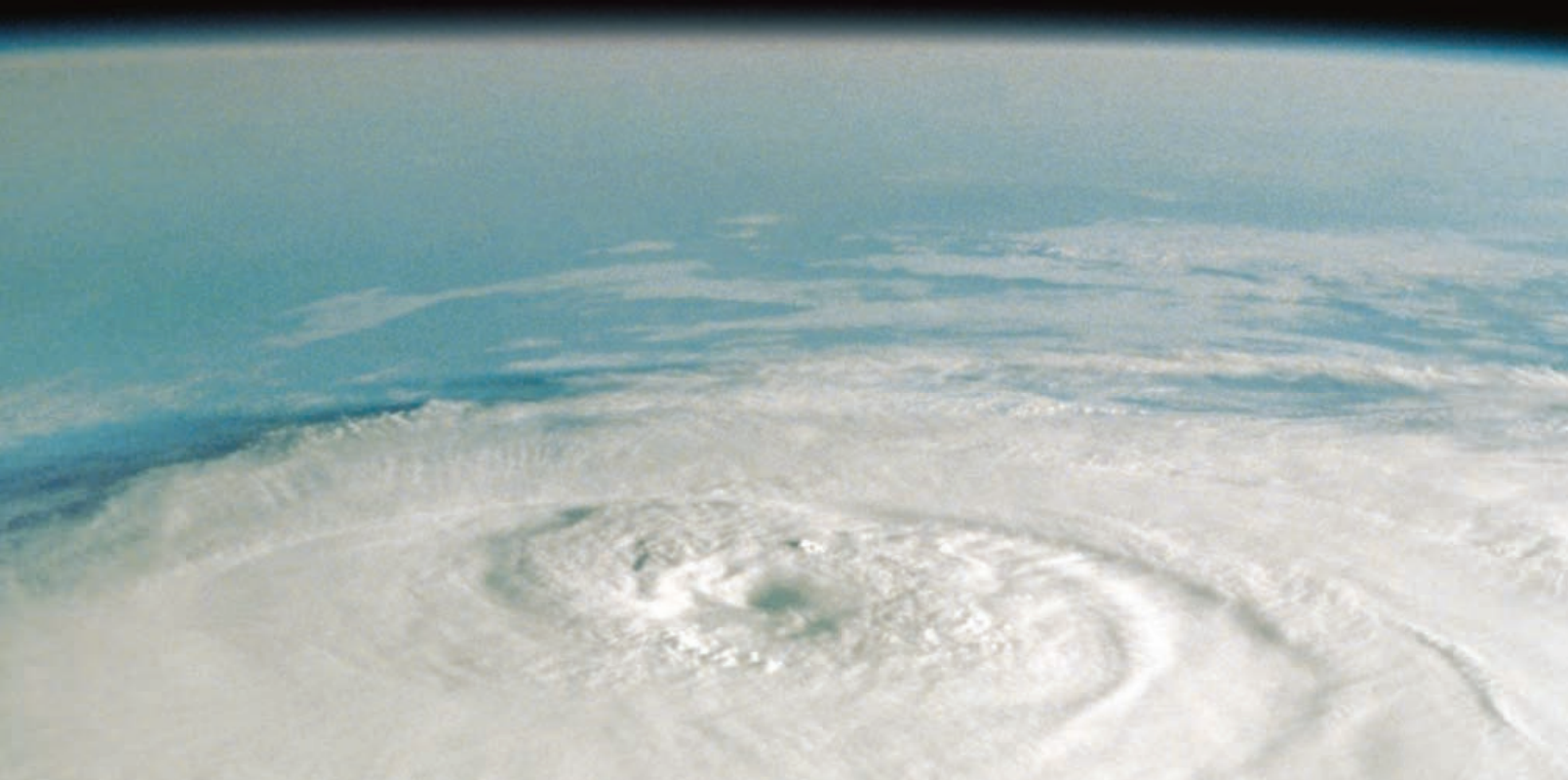
Thriving company rises from disaster

Hurricane Katrina offered new directions, greater success

By Heather Hudson



When the last violent wave propelled by an angry Hurricane Katrina washed over the devastated Louisiana shoreline, along with everyone else, Robert Baker surveyed the damage.

His company, Baker Pile Driving & Site Work, LLC, which specialized in marine work, had lost virtually all of their boats, including several barges. The rest of their equipment was badly beaten up. The price of oil instantly dropped, taking with it any hope of working on the oil fields that had comprised a large part of his business. If he was the kind of guy who was prone to despair, here was an ideal moment to let it take him down.

But he isn't and it didn't.

Before he knew it, he was fielding calls from all over looking for his crew's expertise on bridge repairs, salvaging hundreds of boats.

"After Katrina, there was a lot of salvage and repair work in the water and very little piling work because the city had pretty much been destroyed and nobody was building houses… We still maintained the oil platforms, doing repair work, piping and supplying them with goods, but we worked in water for quite awhile," said Baker.

"We developed over a dozen welding procedures and went in with a team of 40 divers. We stayed there for 88 weeks and repaired about seven miles of cracks."

Robert Baker

Emergency work

Some of the biggest jobs Baker Piling has ever taken on were born out of the natural disaster. One was the repair of a water-based casino that occupied a crew for almost two years.

Before the hurricane hit, five barges in the water beneath the casino were suppressed with huge, computerized hydraulic jacks.

"They were supposed to be hurricane-proof, every time a wave would come in, 20 feet of water would come in on top of a barge. When it retracted, it carried the water that would normally float these barges, sucking it out dry. The barges and casino would fall to the floor of the beach and this beating continued for some 14 hours."

The damage included fragmented barges, which could not be removed for repair because they were holding up the superstructure.

"We developed over a dozen welding procedures and went in with a team of 40 divers. We stayed there for 88 weeks and repaired about seven miles of cracks."

Another monumental job was replacing a span of one of the world's longest bridges. Katrina hadn't been kind to the Lake Pontchartrain Causeway, which runs 24 miles completely over water from New Orleans to Mandeville, LA.

For weeks, Baker and his team planned the replacement of a 250-ton section. The conditions had to be just right, with a thick fog that would ensure the water was calm and flat and no wind.

When the ideal day presented itself, crews closed the causeway at midnight and under a thick fog a 30-person crew made the swap with two barges and a tugboat.

Though Baker considers these jobs among some of his company's signature work, they also heralded a turning point in his business.

"After two years of every day is a 911 situation, it made us rethink a little bit. Once those situations went away we had a nice pool of funds to go in any direction we wanted to go in. We wanted to minimize risk and exposure and step in to the void left by the medium-sized companies that got huge."

New beginnings

Making some shrewd business decisions, Baker backed his business away from high-risk marine work and got into the industrial pile driving side of things. Travelling to Finland, he bought two state-of-the-art Junttan machines. After training with mechanics in Russia, he and his crew brought them back where they instantly fit the industrial needs with their mobilization and versatility.

"We felt that this land division of pile driving would take our company and almost make us bulletproof. Today, we can do anything; we can go work an oil spill in Texas, we can drive pylons on the coast of Florida, build foundations for high rises in New Orleans… we're versatile and extremely diverse with people who can do a lot of different things."

Along with his own commitment to offering supreme efficiency and one-on-one attention to clients, Baker says the company's success can also be found in his unique approach to staffing.

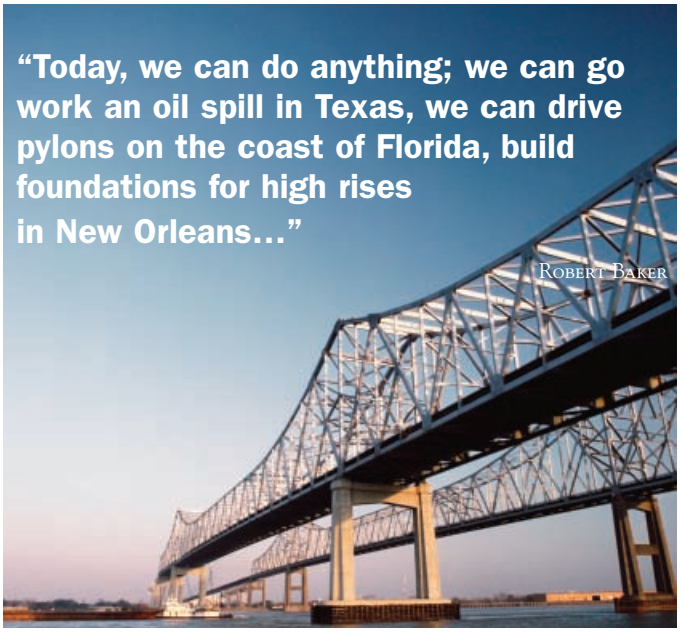
After working in the oil field for many years, Baker was impressed with the tremendous work ethic that can be found among the professionals there. He brought many of them with him to land work.

"We're probably the only company that has a goal of working seven days/week, 12 hours a day. Most of our crews come from the oil fields where they're used to working 84 hours a week in tough conditions. They thrive on challenge and can do any number of jobs," says Baker.

"This sets us apart in a lot of ways. Our truck drivers might also operate the crane on a job or the pile buck might be a trained mechanic and welder. This helps us cut costs by not having to bring in additional people for different jobs."

Though at one time Baker had ambitions of building an empire, today he's proud of his incredibly streamlined company that offers money-saving value engineering and a personal touch.

"We don't want to get much bigger because we might lose our biggest strength: our ability to take on a job instantly and with little set-up time. Everything about the company is diverse and versatile and that's the way I'd like it to stay." ▼



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PDCA and AASHTO – A Partnership

By Gerald Verbeek & Dale Biggers

The PDCA Technical Committee is composed of a diverse group from the driven pile industry. The present configuration of the committee consists of three contractors, two geotechnical engineers, two supplier industry representatives, two civil engineers and one legend.

The purview of the Technical Committee is to survey the landscape and propose changes to promote the use of driven piles in a manner consistent with good engineering practice, as opposed to saying, "drive piles because that's how we make money." The committee has accomplished this in several ways; to include producing specifications for private work, pamphlets for distribution to the general public about pile driving operations, and working with public agencies like AASHTO (American Association of State Highway Transportation Officials) and DOT (Department of Transportation) to improve design and installations specifications.

The Technical Committee has had two collaborative efforts with AASHTO in recent years. The first collaboration between the PDCA and AASHTO consisted of the rewrite of the Driven Pile Installation Specification. Upon conclusion of that joint effort, AASHTO adopted the revised version Installation Specifications for use by state highway departments; and as mentioned above, a derivative of the new AASHTO installation specification was a very similar private version that PDCA members can distribute to design engineers.

In 2005, PDCA began negotiations with AASHTO on possible improvements to the Design Specifications. The details of those revisions are covered by Garland Likins in this issue of PileDriver magazine. The T-15 Committee (Substructures and Retaining Walls) is composed of 11 representatives from state highway departments plus a one from FHWA. The chairman of T-15 is Jawdat Siddiqi, Ohio DOT and the Vice Chair is Tony Allen, Washington DOT;

the FHWA member was Jerry DiMaggio, who was later replaced by Silas Nichols when Mr. DiMaggio left his position with FHWA. Every region of the country supplies two or three members to T-15. It would be hard to overstate the dedication of the T-15 committee to their tasks, particularly these four leaders. Our initial discussions with T-15 were not very productive in regards to the design specifications, since AASHTO came to the table with long-standing ideas and practices intrinsic to their particular state. There were many debates over many issues as discussions proceeded between the PDCA and AASHTO. However, with perseverance we were able to learn from the other's perspective.

When Randy Dietel shanghaied me to join the technical committee, I didn't anticipate the effort or rewards that were in store for me. The opportunity to learn from associations with other pile drivers like Randy and Dave Chapman and from giants of their fields like Garland Likins, Billy Camp, Van Komurka, and George Goble was inspirational. To be able to listen to the PDCA team and T-15 discuss issues which showed how different disciplines and different states view problems made all the time spent worthwhile.

The Tech Committee had countless (perhaps 50 that were 1 and1/2 hours each over a more than two-year period) web conferences, led by Garland Likins and arranged by Steve Hall, where we viewed spec. paragraphs on our screens and simultaneously debated changes on a conference call. Subgroups of our committee met in person with T-15 in Columbus (twice), Park City, Omaha, Olympia, Washington D.C. and New Orleans, Louisiana. Contributions by past presidents, Harry Robbins, Wayne Waters, Mark Weisz plus Steve Hall helped demonstrate to T-15 how important we considered this code to be.

The main result of these endeavors is a revised design code that recognizes the advantage of "installation feedback". Only driven piles provide and removed the possibility of having safety factors as low as 1.53 or as high as 4.2. We thank AASHTO T-15 for their insights and their efforts. ▼

PDCA Technical Committee Members:

Dale Biggers, Chair
Billy Camp
Dave Chapman
Charlie Ellis
Randy Dietel
Dean Matthews
Van Komurka
Garland Likins
George Goble
Scott Whitaker
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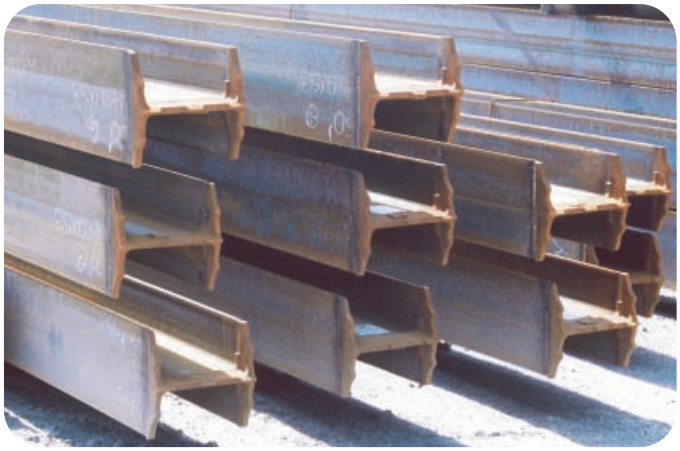

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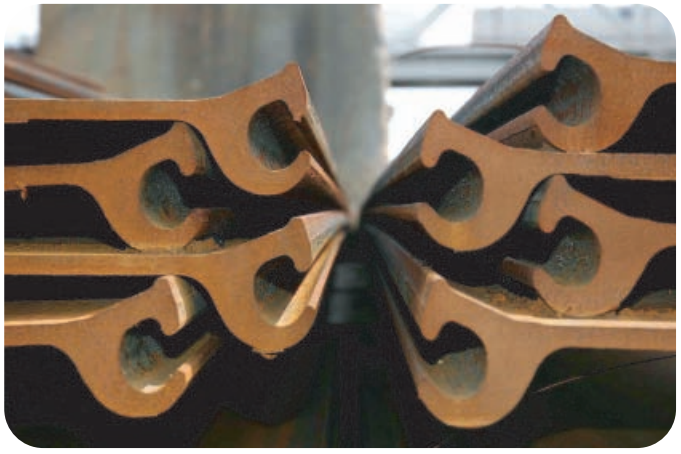

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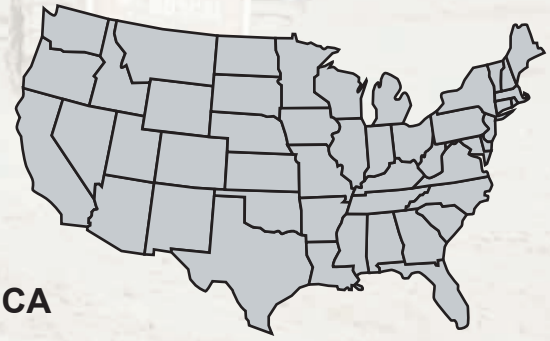

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The 2010 AASHTO LRFD Resistance Factors

By Garland Likins, P.E.

The American Association of State Highway and Transportation Officials (AASHTO) recently issued an updated Load and Resistance Factor Design (LRFD) design guide specification (AASHTO 2010). As the name implies, LRFD applies factors to both the loads and the resistances, reflecting their individual uncertainties, rather than a single global factor of safety as in the conventional Allowable Stress Design (ASD) approach. LRFD is replacing the ASD approach, and AASHTO has mandated that all bridge projects after October 2007 be designed with LRFD methods.

State Departments of Transportation can individually adopt this AASHTO guide specification, modify the guide specification, or create their own LRFD design specification. Technical Committee T-15 of the AASHTO Bridge Committee is responsible for the foundation sections governing driven piles, and specifically the resistance factors given in Section 10.5.5 of the code. Additional considerations such as scour, lateral loading, consolidation in compressible layers and downdrag loads are beyond the scope of this discussion, but are detailed in Section 10.7 of the 2010 AASHTO code.

Although AASHTO's first LRFD code was in 1991, the first LRFD version applied was in 1994 (Dasenbrock,

2009). After limited use of the early LRFD code, AASHTO announced in 2000 that after October 2007 bridge foundation design required LRFD methods. In anticipation of this mandate, a revised AASHTO LRFD code was produced in 2005 with some relatively minor edits in 2007. Based on industry review by PDCA, the resistance factors in Section 10.5.5 were substantially changed in 2010.

This article compares design from ASD (AASHTO, 1992) with the new 2010 version of AASHTO LRFD, with specific emphasis on changes to the resistance factors for the methods of capacity determination commonly available.

The pile's ultimate capacity is called "nominal resistance" in the AASHTO LRFD code (the term used in the remainder of this article). Let's first quickly list the nominal resistance determination methods for driven piles as specified by 2010 AASHTO which are in perceived order of increasing accuracy. They are:

- static analysis
- dynamic formula
- wave equation analysis
- dynamic load testing
- static load testing

Static Analysis estimates nominal resistance from site soil investigation information. While this is necessary to obtain a preliminary design for bidding purposes, rarely would static analysis be the only tool to estimate nominal resistance and govern installation. Because static analysis is statistically highly inaccurate, driven piles are almost always installed using a more accurate determination method (and the more accurate method will then control installation). Further, the 2010 AASHTO commentary of Section 10.5 mentions static analysis tend to significantly overestimate the nominal resistance for larger diameter piles, and recommends either static or dynamic testing for piles larger than 24 inch diameter.

Dynamic Formula, developed over a century ago to estimate nominal resistance, are very simplistic and have poor prediction accuracy, and thus the AASHTO resistance factors are relatively low. The Gates formula is the preferred formula currently recognized by AASHTO.

Wave Equation Analysis simulates the pile driving process using a numerical model of the hammer, the pile, and

(continued on page 47)

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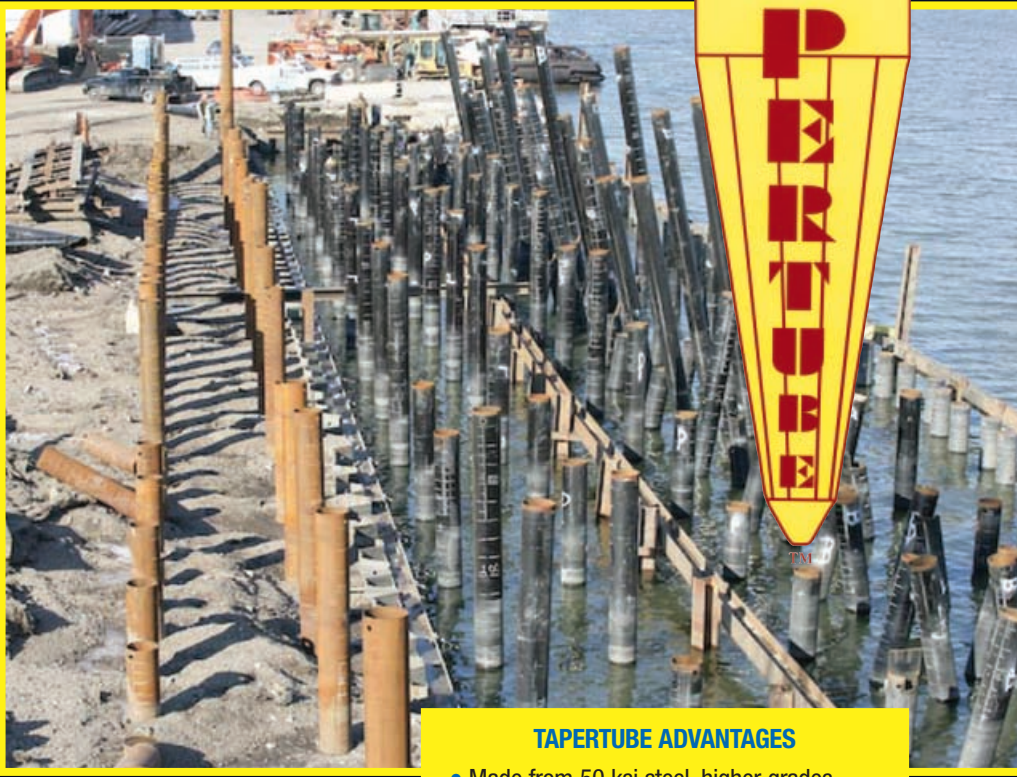

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the soil. For a series of assumed nominal resistances, the resulting blow counts are predicted, resulting in a "bearing graph" relating blow count to nominal resistance.

Dynamic Pile Testing routinely evaluates nominal resistance on DOT projects by measuring pile force and velocity during hammer impact and subjecting this data to a signal matching analysis to determine the soil behavior. For dynamic pile testing to mobilize the full soil strength, the set per blow should exceed 0.1 inch (2.5 mm). To account for time dependent soil strength changes, the pile should be tested after an appropriate waiting time. For the usual case with capacity increase with time, or "setup", the commentary notes nominal resistance at the end of drive will be conservative.

Static Load Testing has traditionally been the standard for evaluating nominal resistance. Prior to about 1970, only one static test, if any, was performed per typical site, often using a slow maintained load procedure over several days to only twice the design load. Since the test rarely failed, this established the traditional safety factor of 2.0, even though actual safety factors were often much larger. Promoted by the FHWA, the quick static test method taking only a few hours has become common, and the nominal resistance evaluation uses the relatively conservative Davisson offset yield line method. However, because of time and cost constraints, static testing is usually limited to a very small sample of piles on any site (typically 1% or less on large projects, or often only one per project, if any, for small projects).

For large projects, preconstruction test programs with static or dynamic testing are effective. On many projects, static testing may be replaced by more cost effective dynamic pile tests, allowing site variability to be better assessed. For smaller projects, the first production piles serve as "test piles" and some driving criteria adjustment and cost savings are possible if the piles can be shortened. Production piles are driven to the criteria of the successful test pile.

AASHTO past practice – ASD

Prior to 2007 most State DOT designed driven pile foundations with ASD with a single global factor of safety (F.S.) which depended on the method of nominal resistance determination. Methods perceived to be more accurate resulted in lower safety factors and therefore fewer piles required to support any given load. Table 1 lists F.S. for different determination methods (AASHTO, 1992), and the number of piles required for a hypothetical example of a 2000 ton structure and piles with 200 ton nominal resistance. The design load per pile is computed based on the determination method selected (e.g. for static testing and a F.S. of 2.0, design load is 200 / 2.0 = 100 tons, which then requires that 20 such piles are needed for the 2000 ton total load).

Determination method	F.S.	Design load Per pile	Number of Piles required
Dynamic formula	3.5	57	35
Wave equation	2.75	73	28
Dynamic testing	2.25	89	23
Static testing	2.0	100	20
Static & Dynamic testing	1.9	105	19

Table 1: pre-2007 AASHTO ASD factors of safety (F.S.), design loads (for a 200 ton nominal resistance) and number of piles required (for a 2000 ton structure)

No quantity of testing was specified for dynamic or static testing. But clearly when some testing was done, the number of piles is significantly reduced, and since the cost of the piles is generally significantly more than the cost of testing, a great economic savings was usually achieved when at least some piles were tested.

LRFD basic formulation

The general expression for LRFD design is

$$\sum \gamma_i Q_i \leq \Phi_k R_k$$

Where γ_i is the "load factor" for the load Q_i of the ith load type (e.g. AASHTO load factors for the generally governing Strength 1 case are 1.25 for the dead load Q_1, and 1.75 for the live load Q_2, reflecting the relative uncertainty of these loads), and Φ_k is the "resistance factor" for the resistance R_k determined by the kth determination method (e.g. AASHTO resistance factor is 0.75 for a static load test).

For any given set of load and resistance factors, an equivalent global factor of safety (F.S.) can be calculated from the weighted average load factor divided by the resistance factor. In the preceding paragraph example for the Strength 1 limit case, the equivalent F.S. is 1.83 for a common D/L = 3 distribution. The equivalent F.S. will be lower for higher D/L ratios, and higher for low D/L ratios, reflecting the uncertainty in loading conditions which is an advantage of the LRFD method. For D/L ratios above 7, the Strength 4 condition governs and has a single load factor of 1.5 on dead load only.

AASHTO 2007 LRFD design code

In October 2007 when LRFD was mandated, the then current AASHTO design code (AASHTO 2007) required assessment of site variability, generally determined from statistical analysis of SPT results, which seemingly ignored that piles are generally driven to a blow count to mitigate site variability. A 20% reduction in the resistance factor was required if the foundation unit had fewer than five piles, and a 40% reduction was applied for single pile foundation units. The generally low resistance factors for driven piles in this AASHTO 2007 code, often resulted in more piles even though there were no failures under the previous ASD code. There was also some concern about the allowance of a safety factor as low as 1.53 for a few situations. Therefore, the 2007 AASHTO resistance factors led to considerable concern in the driven pile industry, particularly among PDCA members, and confusion among some State DOTs on how to implement these requirements, and concerns of their effects on project costs.

Determination method	R.F.	Equivalent F.S.	factored resistance per pile	Number of Piles required
Dynamic formula (Gates)	.40	3.44	80	.5
Wave equation	.50	2.75	100	28
Dynamic testing (2% or 2#)	.65	2.12	130	22
Static testing or 100% dynamic testing	.75	1.83	150	19
Static & 2% Dynamic testing	.80	1.72	160	18

Table 2: 2010 resistance factors (R.F.), factored loads for the example case

2010 AASHTO LRFD design code

The PDCA technical committee, including both contractors and engineers, worked with the AASHTO T15 Committee in charge of the foundation code to institute a review of the 2007 code and tried to reflect the successful ASD past practice to the sections specifically addressing driven piles (10.5 and 10.7). Resistance factors in the LRFD code Section 10.5.5 that produce designs similar to previous ASD designs were considered a reasonable objective. After considerable discussion between PDCA and AASHTO T-15 committees, the PDCA recommendations were generally approved.

The 2010 AASHTO LRFD guide specification (AASHTO, 2010) is simplified from the 2007 version. The resistance factors in Section 10.5.5 now reflect the common practice that most all driven piles are driven to an installation criterion that includes a blow count. This blow count criterion accounts for site variations automatically; where the soil strengths are relatively low, the piles will be driven deeper until the blow count is sufficient (e.g. comparable to the test piles). Assessing site variability (Paikowsky, 2004) as in the 2007 code is still an option, as mentioned in the commentary. The resistance factor reduction due to limited redundancy was moved to the commentary with the

defined limit number of piles left to user judgment (with guidance of 2 to 5 piles as the limit) and the maximum reduction limited to at most 20% for driven piles.

Table 2 summarizes the recommended resistance factors. The same example is analyzed (200 ton nominal resistance piles and 2000 ton structure load - 1500 tons dead load and 500 tons live load for the given D/L ratio of 3, and with load factors of 1.25 dead and 1.75 live, resulting in a factored load of 2750 tons) and the nominal resistance is multiplied by the resistance factors (R.F.), allowing the required number of piles (rounded up to nearest integer) and the equivalent ASD factor of safety (assumes Strength 1 case) to be computed.

Specifically, the Gates dynamic formula for R.F. 0.40 is applicable to the end of drive condition only. The number of piles required is equivalent to the ASD case as shown in Table 1. The commentary suggests that, in general, dynamic testing should be conducted (during restrike) in lieu of using dynamic formula.

For the wave equation analysis, the resistance factor is 0.50. This results in an equivalent F.S. and identical number of piles to the ASD case as shown in Table 1. However, because of the uncertainty in actual hammer performance, the 2010 AASHTO code requires some field determination of hammer performance (e.g. direct measurement of stroke or kinetic energy) to use this best resistance factor. If hammer performance measurements are not made, the commentary recommends a resistance factor to 0.4, the equivalent of a dynamic formula.

Dynamic testing alone has a R.F. of 0.65, and specifically now states that 2% of all piles, but a minimum of 2 piles, be tested "per site condition". The code states geologically similar soil conditions define a "site condition", and states that in highly variable soils a site might consist of a single pier. The 2010 AASHTO code specifies that dynamic testing include "signal matching" (e.g. CAPWAP), and notes that best estimates of nominal resistance come from testing during a restrike (allowing soil strength changes of com-

mon setup or less frequent relaxation to have occurred). The commentary points out that dynamic testing results at end of driving are generally conservative, and notes that if relaxation is anticipated that these resistance factors should only be used with restrike results. The commentary further states that an increase in safety results if the most heavily loaded piles are selected for dynamic testing. The 2010 factors result in an equivalent global F.S. of 2.12 (for D/L = 3), and therefore a slight decrease in the number of piles is required for the example foundation compared with the former ASD code.

Static testing is assigned a R.F. of 0.75, and again requires a test for each site condition. Since the amount of static testing is generally limited, a more extensive discussion of site variability is provided in the commentary. Dynamic testing of 100% of all piles, the ultimate in assessing site variability, is assigned the same 0.75 resistance factor. The equivalent global F.S. is 1.83 and results in a 5% reduction in the number of piles required per site with static testing compared with the ASD code.

The reduced risk from the combination of static testing plus dynamic testing for each site condition allows an increase in the R.F. to 0.8. The same minimum testing requirements (one static test, plus dynamic testing of 2% of all piles, or two piles, whichever is greater) apply. The dynamic tests are to be calibrated to the static tests. The 0.80 R.F. is equivalent to a global F.S of 1.72, and results in a 5% reduction in number of piles required for our example case compared with the ASD code when the site has both static and dynamic testing. If dynamic tests are not employed during production pile installation then the commentary recommends reducing the R.F. to 0.75.

Further discussion

The changes to the resistance factors in the 2010 AASHTO code lead the code back toward designs consistent with previous ASD practice. Since the previous practice for driven piles over the past several decades was deemed successful (e.g. lack of failures), LRFD results that are consistent with ASD solutions are also deemed appropriate. Certainly there is no need to be more conservative, and thus more costly.

The AASHTO 2010 code lists specific resistance factors for the minimum 2% dynamic testing (0.65) and for complete 100% dynamic testing (0.75). The question could be raised as to what resistance factor would be appropriate for some intermediate yet significant percentage of dynamic testing (e.g. 10%, 25% or 50% dynamic testing of all piles). The PDCA had also recommended an intermediate category of 25% dynamic testing with an R.F. of 0.70 (20 piles would be required for our hypothetical example). Such a logical intermediate category could be adopted by any State DOT.

When faced with implementing LRFD, many State DOTs have relatively little experience or confidence in selecting the appropriate resistance factors for various nominal resistance determination methods. They will hopefully adopt the new 2010 AASHTO recommendation. These resistance factors are the maximum allowed. If a specific project is particularly sensitive or has particularly difficult soil conditions, the engineer may opt to reduce the resistance factor (and result in extra piles installed), but the normal site should not be penalized for the unusual condition. Resistance factors that produce a design more conservative than a design produced by the previous AASHTO ASD should be therefore rejected since there are no known failures for driven piles based on ASD provisions. With time and experience, perhaps future AASHTO recommendations will include even higher resistance factors for the well proven and conservative driven piles.

In conclusion, the conversion of AASHTO from ASD to LRFD has been a long process. Since the ASD method had served the industry well and produced no failed foundations for several decades, LRFD solutions need not result in more conservative designs that result in then more expensive foundations. The 2010 AASHTO recommendations remove the extra conservatism of the earlier LRFD codes and produce designs that are consistent with the well-proven ASD solutions. ▼

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AASHTO LRFD Bridge Design Specifications

Changes to Section 10, Article 10.7 Driven Piles

By William M. Camp, III, PE, D.GE

Section 10 of the AASHTO LRFD Bridge Design Specifications covers Foundations and Article 10.7 addresses Driven Pile Foundations. The PDCA Technical Committee began a review of Article 10.7 in 2007 and subsequently suggested improvements for consideration by AASHTO Technical Committee T-15: Substructures and Retaining Walls. The approved modifications, which are relatively minor, are summarized herein.

Most of the modifications were specific to a particular subsection but three issues or themes were addressed that resulted in slight changes within several portions of the text. These three issues can be broadly categorized as 1) dynamic testing results, 2) minimum tip elevation requirements, and 3) nomenclature.

With respect to dynamic testing, language was included within both the code and commentary to allow for better use of the results of dynamic testing with signal matching. In particular, the load distribution estimate that is generated by signal matching may be used to estimate side resistance for consideration of losses as a result of scour, for purposes of down drag estimation, and for evaluating the available uplift resistance. The signal matching results may be used in place of, or as a supplement to, instrumented static load tests and/or static analyses. Application guidance is provided in the commentary.

The use of a minimum tip elevation on plans without appropriate justification may cause difficulties during construction and modifications were made to help prevent the use of a minimum tip elevation unnecessarily. Lateral loading, uplift resistance, scour, settlement, and liquefaction considerations may all justify the use of a minimum tip elevation but a minimum pile penetration should not be required solely to obtain axial compression resistance. In other words, in the absence of any of the other design considerations, pile driving should be terminated when the required nominal bearing resistance is obtained, regardless of the pile penetration.

(continued on page 55)

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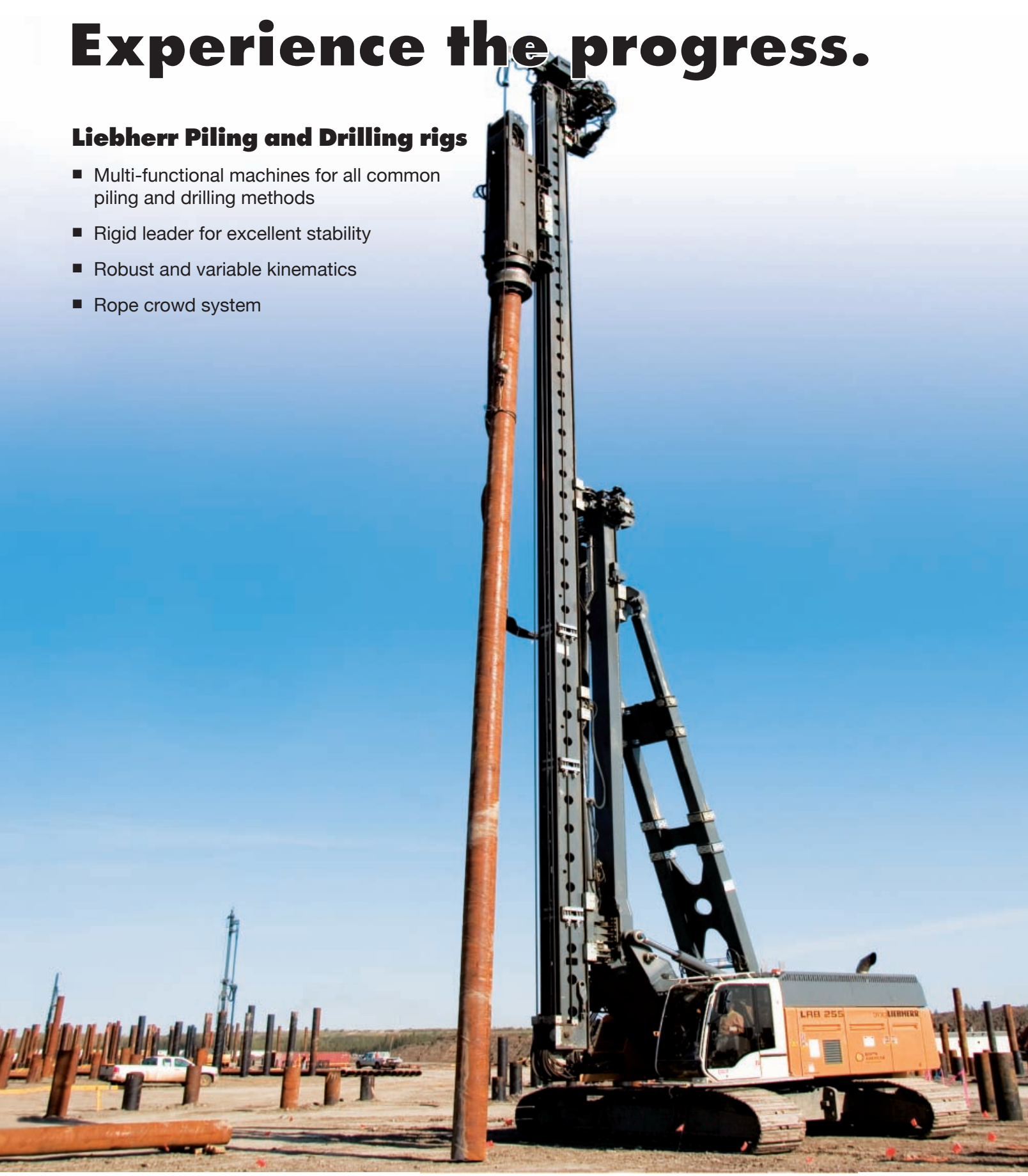

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Nomenclature was changed throughout Article 10.7. In particular, the terms "side resistance" and "nominal bearing resistance" are now used consistently throughout the text. Additionally, the term "probe pile" rather than "test pile" is now used for a pile that is driven for data gathering purposes without any subsequent pile load testing.

Numerous small modifications were made to individual subsections and some of the most significant included:

- Additional commentary on the suggested waiting period for restrikes of piles in various soil conditions. The waiting periods are necessary to properly account for the time dependent strength gain characteristics of the bearing strata.

- Additional recommendations in the commentary for piles driven to hard rock, which are intended to reduce the chance of over-driving or over-stressing a pile. The recommendations include the performance of a wave equation analysis to check driving stresses, the use of a variable energy or variable stroke hammer that is not too large, and the limitation of the number of hammer blows that are applied once rock is encountered.

- The use of wave equation analyses for the determination of nominal bearing resistance has been expanded to include both end-of-drive and beginning-of-restrike conditions and the commentary notes that the beginning-of-restrike condition is preferred. The beginning-of-restrike condition accounts for the time dependent changes in pile resistance. A "companion" addition to the commentary within the Dynamic Formula section notes that dynamic formulae should only be used for end-of-drive conditions since some degree of set-up or relaxation is inherently included in the development of driving formulas.

- Additional guidance on determining the pile length estimates for contract documents is included in the commentary. In particular, the importance of local experience or obvious bearing stratum is highlighted and caution is suggested when using static analysis methods to estimate lengths when field verification of nominal bearing resistance will rely on other methods (e.g., dynamic testing, driving formula, etc.). The intent of the commentary is to help prevent the use of unrealistic pile length estimates. ▼

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By Jeffrey H. Greenwald, P.E., CAE
Executive Director, North American Steel Sheet Piling Association

Hot-rolled steel sheet piling helped California's Freeport Regional Water Project (FRWA) economically construct a regional water supply facility on the Sacramento River. FRWA is a cooperative effort of the Sacramento County Water Agency (SCWA) and Oakland's East Bay Municipal Utility District (EBMUD). The goal of the partnership is to design and construct a regional water supply project (the FRWP) to provide water to SCWA's service area in normal water years and to EBMUD's customers during prolonged periods of drought, estimated to be three out of every 10 years, as a supplemental water source to complement existing conservation programs. The FRWP incorporates hot rolled steel sheet piling, a typical practice with water intake projects.

The FRWP encompasses a water intake facility and pumping plant on the Sacramento River, as well as new pipelines to deliver water to SCWA and EBMUD facilities. Construction of the new, 185 million gallons per day water intake structure and pumping plant located north of Freeport, CA began in early 2007 and is in the final stages of construction.

Figure 1: The FRWA project sited along the levee protecting Sacramento.

CH2M Hill was chosen to design the facility in 2004. Having experience with other water intake projects along the Sacramento River, CH2M Hill used hot-rolled steel sheet piling (SSP) to design the FRWP, incorporating a cofferdam and combination retaining wall structure. 3,200 tons of hot-rolled SSP were used to create a unique retaining wall system. For the FRWP, 85 to 87 foot long SSP sections were specified.

Unique Design Aspects

Some intake designs had previously called for coated SSP sections to provide corrosion resistance. Instead, the FRWA utilizes uncoated sections with a thicker cross-section than that required for the structural design. Rather than trying to prevent corrosion, as is the case with coatings, using a thicker section allows corrosion to occur, but ensures that the structure can perform as intended after loses of thickness due to corrosion.

(continued on page 60)

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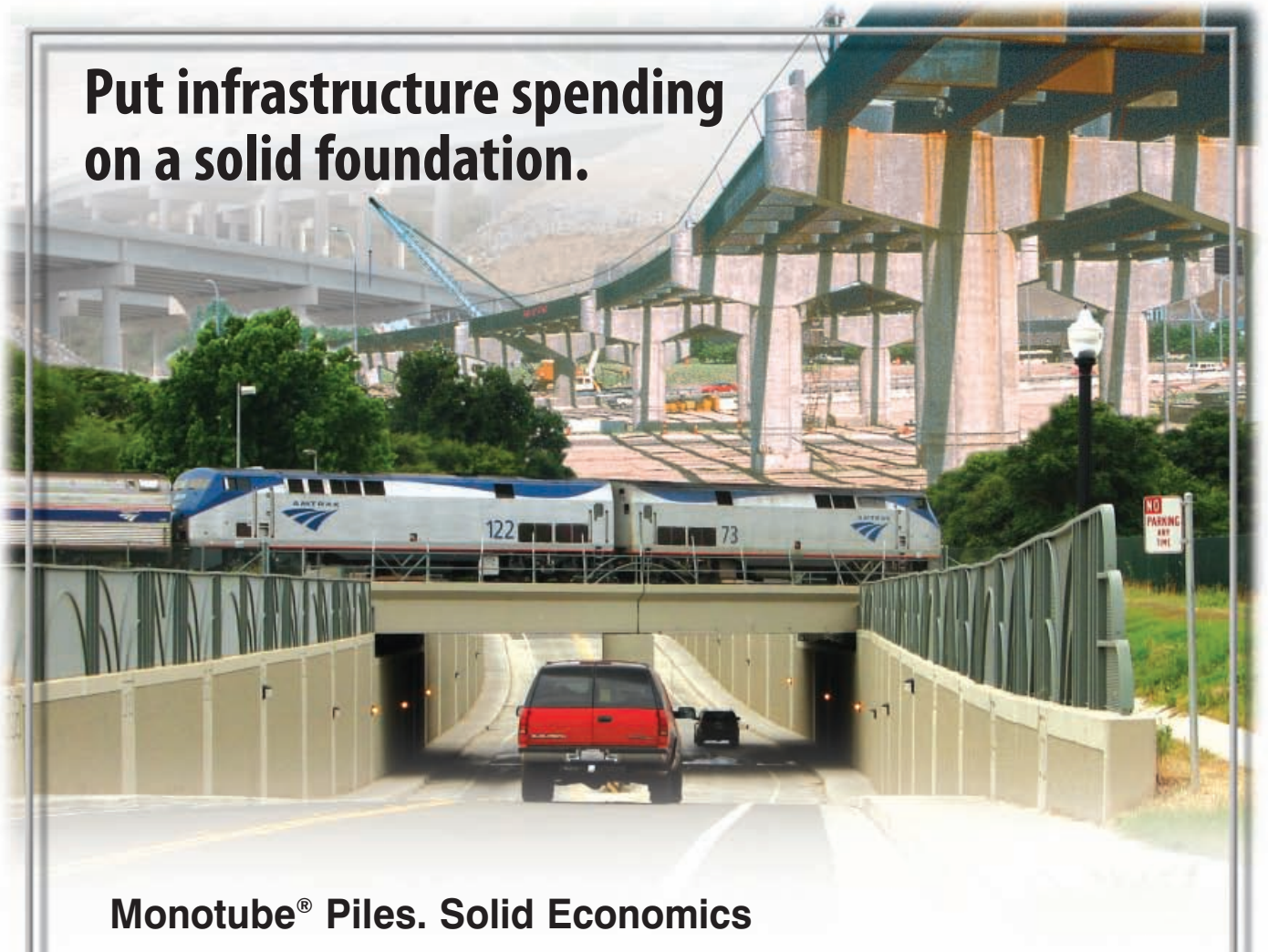

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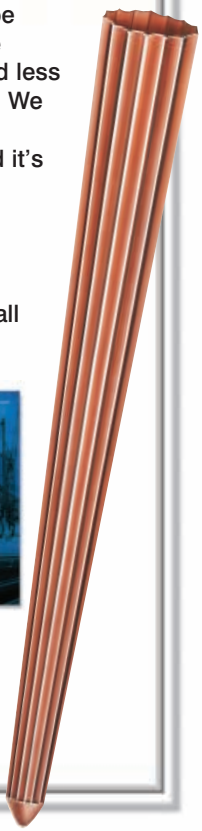

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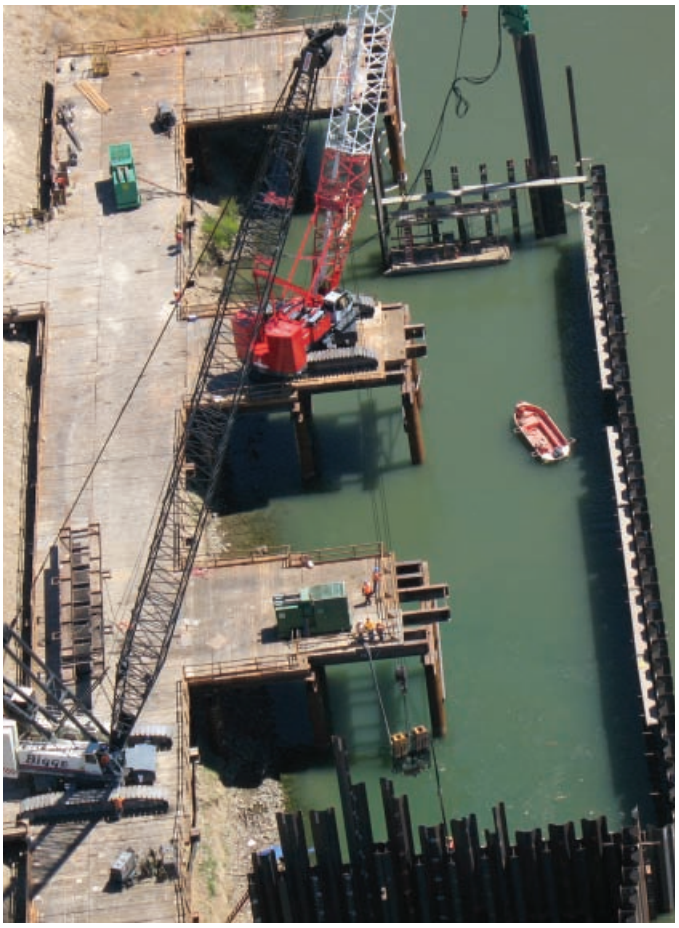

Figure 2: The project incorporated cofferdams constructed of hot-rolled steel sheet piling combi-walls.

Another unique element of the design was the use of hot-rolled steel sheet piling anchor walls. Because the structure was constructed within the levee protecting the city of Sacramento, SSP anchor walls were used to provide additional structural stability.

High section modulus SSP retaining wall systems are a combination of king piles and hot-rolled steel sheet piling, and are typically referred to as "combi-walls." King piles are typically steel columns that may or may not have a web tip to facilitate connections to the SSP. Extruded connectors are readily available to join the king piles to the SSP in many different configurations. The king piles were driven to a depth necessary to achieve the required passive toe resistance. Then, the hot-rolled steel sheet piling was installed to act as a barrier for the soils and grade separation of the site. Contractor Balfour Beatty worked closely with the design team to achieve a very efficient and cost effective system. According to the Project contractor, "The combi-wall is unique in nature. It provides superior strength and capacity as a wall system."

Construction: Curved Walls and a Tight Schedule

The FRWP also involved the construction of two curvilinear combi-wall systems on either side of the cofferdam/pump station structure to provide water flow control and

Figure 3: King piles were placed precisely to accommodate the hot-rolled steel sheet piling

support within the Sacramento River. The structure is comprised of three rows of combi-walls on each side: the combi-wall structure driven into the Sacramento River itself, plus two additional rows and wings driven behind the front combi-wall. The three combi-walls were tied together with connecting rods for structural support. The cofferdam structure measures approximately 666 lineal feet. Each combi-wall system on either side of the cofferdam measures approximately 490 lineal feet.

The piling contractor had a very tight construction timeline to build the cofferdam and combi-walls, from June through October 2007. All hot-rolled SSP was delivered to the site in May 2007. The contractor used two pile driving cranes for the construction of these wall systems.

To aid in the precise SSP driving that was required, four different templates were developed by the contractor. One template was used to ensure that the king piles were precisely spaced on six-foot centers so that the pair of SSPs driven between each king pile would be straight and plumb. The other three templates were used for each of the three combi-walls. Templates were an important part of the project—necessary to maintain the correct horizontal and vertical alignment of the steel sheet piling during installation.

According to the civil design engineer, "The use of high-strength sheet piles, combi-wall systems and dead man anchors for the cofferdams and training walls of the Freeport Regional Water Authority Intake Facilities Project enabled efficient in-river and in-levee construction of this major facility. This was accomplished while maintaining critical levee stability and providing suitable hydraulic conditions for this important intake facility."

Figure 4: The combi-walls support the construction of the treatment facilities concrete structure

About NASSPA

Founded in 2003, the North American Steel Sheet Piling Association (NASSPA) is dedicated to the promotion of hot-rolled steel sheet piling. The Association is dedicated to providing information and guidelines on a broad range of technical, research, marketing, education and communications activities. NASSPA also provides a forum where the users of steel sheet piling technology can interact and discuss best practices. ▼

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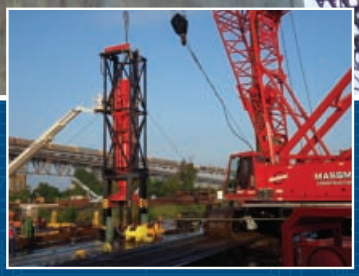

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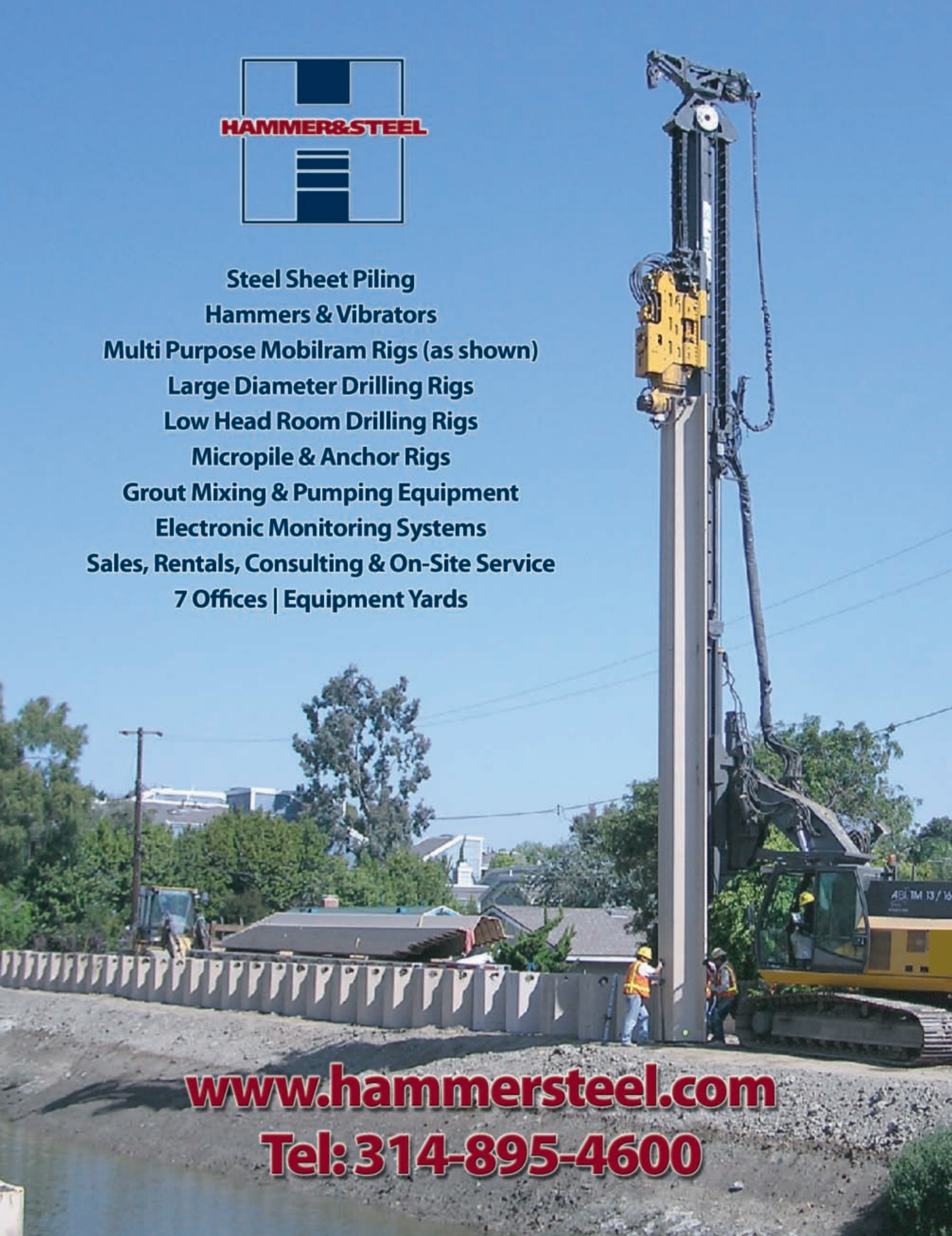
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