PILEDRIVER

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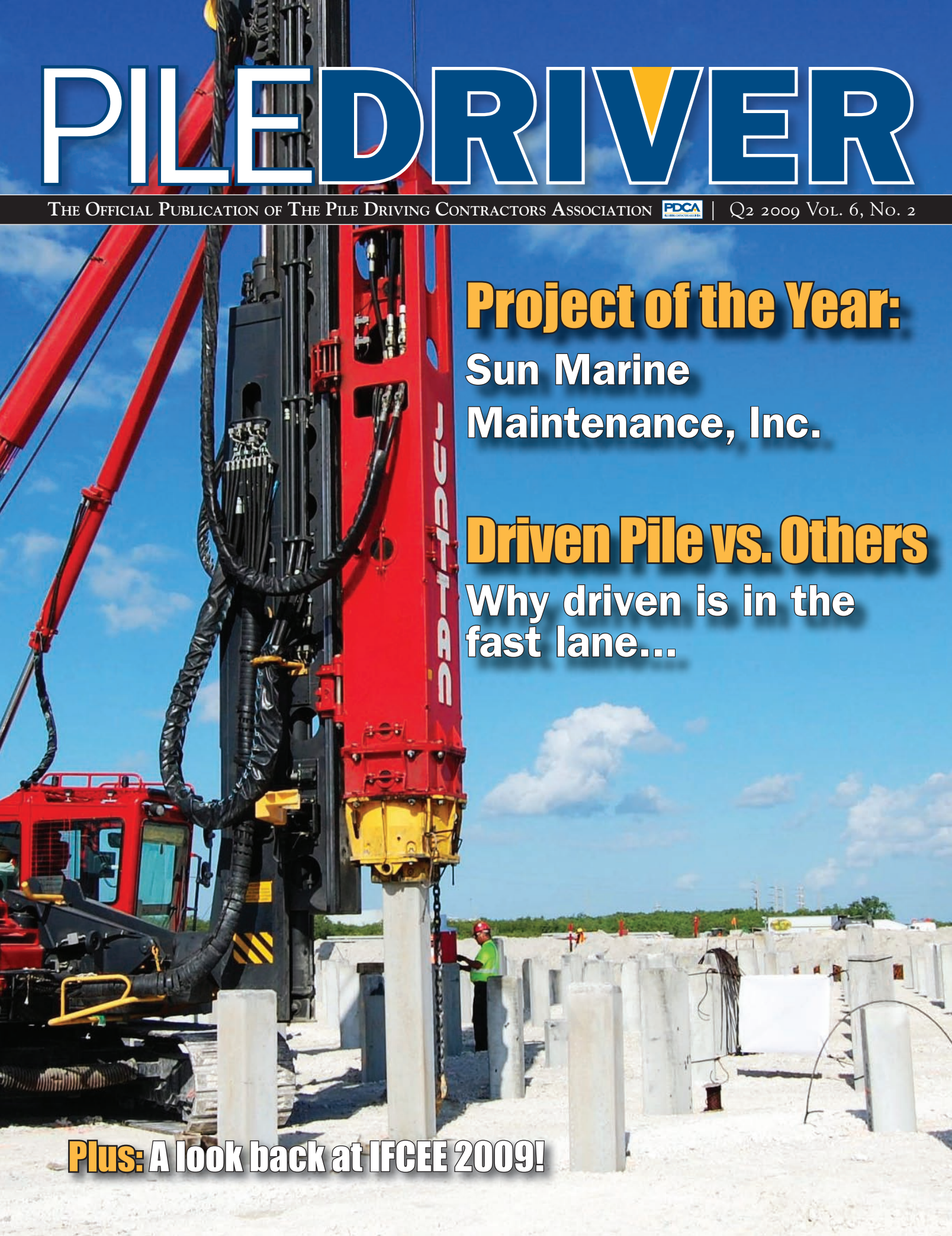

Project of the Year:
Sun Marine Maintenance, Inc.

Driven Pile vs. Others
Why driven is in the fast lane...

Plus: A look back at IFCEE 2009!

Project Of The Year

By Michael R. Jahnigen, Cyril N. Okoye, Mike McClung and Kati Niskanen

Sun Marine Maintenance, Inc. of Frankford, Del. brought together recent technological advances that included a new Emeca/SPEUSA mechanical splice joint, two Juntan hydraulic impact hammers and pile driving rigs in the execution of the major long precast concrete pile project at Seaport Canaveral Tank Farm, Fla. The project involved design and construction of pile foundations for support of above-ground fuel storage tanks, and included driving in excess of 6,100 production piles for tanks and manifolds on land. The pile driving for this project took place during the period of late April 2008 through mid-November 2008.

Site Subsurface Conditions and Pile Selection

With groundwater table at a depth of about five feet below grade, the site is underlain by sequences of soft clay and loose- to medium-dense granular soils with occasional inter-layering of soft coquina rock to the depth 90 feet to 95 feet. Below the inter-layered strata of weathered coquina rock and granular soils graded between medium dense and very dense conditions to the depth 130 feet. Based on feasibility evaluation performed by the client's (Seaport Canaveral, LLC) geotechnical engineer, 100-feet long, 18-inch square precast concrete pile was selected for 90-ton allowable compression load. The reason for such a large 18-inch square cross section for the pile was primarily stiffness requirement for a 100-foot pick-up length. Based on a value-engineering option, Sun Marine Maintenance won the bid with significant cost savings by re-designing the foundation for 100-foot long, 12-inch square precast, pre-stressed concrete piles that were jointed at the 50-foot mid-point with Emeca/SPEUSA mechanical splices (pile joints) for 120-ton allowable compression load per pile.

For this project, the allowable structural compression capacity of the 12-inch square precast concrete pile was calculated to be 128.84 tons, while the allowable design compression load selected for the pile was 120 tons. With such tight ratio of 0.93/1.00 for the ratio of Allowable Design Load / Allowable Structural Capacity, the subject project enjoyed a remarkable optimization of pile load design; there was practically no design waste for the project pile material. The client engaged Atlantic Metrocast, Inc. to cast the piles on site for cost savings.

Long-Term Load Test Results

Both dynamic and static load tests were performed on the selected piles for capacity verification. In anticipation of this project, test piles were driven and tested two years in advance in 2006. Because of the short duration of soil freeze (dissipation of excess pore pressure after pile driving) in 2006, which

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typically ranged from two days to two weeks, the dynamic test capacities were consistently greater than the static test capacities for the same test piles. Based on a correlation developed from the 2006 static and dynamic test results, the safety factor requirement for production piles monitored with only dynamic testing (using the Pile Driving Analyzer and the Case Pile Wave Analysis Program) was initially set to be 2.27. This would make more stringent criteria than the International Building Code (IBC), which calls for safety factor of only 2.0 for dynamic or static load testing.

In an attempt to improve the previous correlation and hence reduce the safety factor, another round of static and dynamic load tests were performed in 2008 on the same test piles from 2006. The results of the 2008 test indicated a correlation factor of close to unity between the static and dynamic test capacities. This showed that for the soils of the subject project site, comparison of static and dynamic pile capacities should be based on long-term conditions instead of short-term conditions. Therefore a safety factor of 2.0 was used for production pile capacity monitoring using the dynamic method with a requirement of soil freeze duration of typically six to eight weeks for the tests. Based on this approach, unnecessary over driving of production piles into deeper strata for a safety factor of 2.27 was avoided.

Emeca/SPEUSA Mechanical Splice Used

Historically, long precast concrete piles have had shortcomings that put them at a disadvantage in competition against other pile alternates, especially drilled piles. One disadvantage is length and weight of long precast concrete piles, which translate to considerable costs in association with the need for special handling of the piles, and high-capacity cranes that may require special rigging and working surface or splice joint hardware that is often expensive and may include field splicing delays. These potential cost factors were eliminated by the use of the Emeca/SPEUSA mechanical splice for the Seaport Canaveral Tank Farm project, which was reasonably priced with field installation time of less than five minutes per pile.

A concern that is often associated with the use of mechanical splices is with respect to the ability of the splice to transmit stress waves of the impact hammer, and not hinder pile integrity and capacity evaluation performed using the Pile Driving Analyzer (PDA). The results of the PDA tests on the spliced piles of the subject project indicated that the presence of the splice did not impede adequate transfer of wave stresses through the joint. By design, the diameter of the locking pins of the Emeca/SPEUSA splice joint is slightly larger than that of the side holes. As a result, when driven into the side holes, the pins induce some compression loading on the adjoining base plates. This positive compression is responsible for the ability of the Emeca/SPEUSA splice to conduct adequately stress waves of hammer impact across the jointed pile during driving.

Equipment Used

Equipment used for the subject project was two Junttan PM 20 purpose-built pile driving rigs mounted with the Junttan HHK 5A hydraulic impact hammers. Prior to production the client requested three pile driving rigs, but with the efficiency of the Junttan rig three rigs were not necessary. The two Junttan rigs drove on average 30 100-foot piles per rig per eight-hour day. The two-man crew (operator and ground man) per rig dramatically reduced the risk of injuries, and the labor, overhead and insurance costs. The telescopic leader, hydraulic pile arms and many other Junttan unique features ensured fast and accurate pile driving. And, best of all, the data of each pile was recorded on the energy measuring device, so that at the end of the day, the piling data was given to Seaport Canaveral's engineers.

Pile driving in the U.S. has been traditionally dominated by diesel and air hammers, which can be ineffective for long

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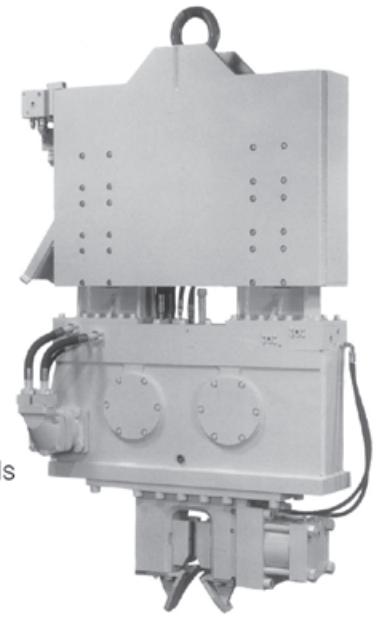

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precast concrete piles installed through soft soils, as was the case for this project site. Therefore, Sun Marine Maintenance chose to use the Junttan HHK 5A hammer. This hydraulic impact hammer with relatively heavy ram weight and versatile energy delivery system presented in a single package effective solutions to the inherent problems of both the diesel and air hammers vis-à-vis detrimental high-tensile stresses in precast concrete piles driven through soft soils.

For this project, Sun Marine Maintenance used the gumwood cushion material as for all other concrete pile projects. Due to its more conducive heat absorption properties, which accounts for its durability, gumwood outlasts plywood by a margin of five to six for precast pile driving with the hydraulic hammers.

Cost and Environmental Savings

The use of a cost-effective Emeca/SPEUSA mechanical splice allowed the application of the 12-inch square pile, which would have been ordinarily too slender for 100-foot-long pick-up length. When the cross sectional area of 144 square inches for the value-engineered 12-inch square precast concrete pile is compared to the cross-sectional area of 324 square inches of the originally design 18-inch square precast concrete pile, the material savings is about 125 percent.

In addition to material cost savings, we believe that significant cost savings can be attributed to the high production pile driving rate of this project, which was about 3,000 linear feet of piling per rig per day. These cost savings were realized by the client in terms of completion schedule and by Sun Marine Maintenance in terms of profit margin.

Using the Junttan pile driving rigs for this project did not only save money but also left a smaller eco-footprint behind. These rigs generate less noise, vibration and harmful emissions as well as use less fossil fuel than conventional diesel hammers and mechanical piling rigs.

Project Completion

It was eight months through tropical hurricanes; a lot of rain and thunderstorms, and very hot sun at times, being away from the family and loved ones, however, the crew still stayed focused day in and day out, ending the project safely and successfully with no injuries, and in record time. Now that the project is completed, if all the driven piles were laid end to end, they would extend from Florida's east coast to west coast.

All of this made possible by the Emeca/SPEUSA mechanical splice, two Junttan rigs and a crew of seven hard-working professionals (two operators, two ground men, two forklift operators and job-site manager), and the help of a great support team in Delaware. It was definitely a team effort that made this an award-winning project. ▼

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