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Cost-Effective High Capacity Piles through Soil Set-Up

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The Marquette Interchange in Milwaukee, WI built in the 1960s, is known for its many ramps, tight radii, and greater-than-capacity traffic. Designed for 130,000 vehicles per day, it now has to handle 300,000. The Wisconsin Department of Transportation (WisDOT) therefore decided on a major reconstruction of this system, which will make this project the most expensive ever for the State of Wisconsin.

The geology in the interchange area is made up of alluvial and estuarine (organic) deposits over glacial till sheets with interbedded lacustrine deposits. Bedrock in the core interchange area is at least 60 m (200 ft) below surface. Experience (e.g. Fellenius et al., 1989 and Komurka, 2004) with deep foundations in these soils have shown that relatively small driven piles can achieve high capacities if soil set-up is assessed and verified by testing. For example, at the adjacent 6th St. Viaduct in Milwaukee, an attractive cable-stayed structure, 324 mm (12.75 inch) diameter piles of up to 38 m (125 ft) length reached ultimate capacities of 380 tons and were installed for design loads of up to 190 tons.

During the summer of 2003, WisDOT and the interchange designer Milwaukee Transportation Partners (MTP) conducted a test program which involved 6 static load test sites and 43 indicator pile sites throughout the interchange area. Dynamic monitoring was

performed during pile installation, and again during multiple restrrike tests typically performed at 2.5 hours, 1 day, 10 days, and 4 weeks after installation. The later tests were conducted after the piles were filled with concrete since the high capacities could not be mobilized without damaging an unfilled steel pipe pile section. Since activating the high set-up capacities with the pile driving hammers used for installation was economically unfeasible (multiple driving rig moves) and technically problematic (lack of full activation), GRL's 133 kN (15 ton) APPLE system was used to conduct the longer-term dynamic restrrike tests.

Wagner Komurka Geotechnical Group, Inc. of Cedarburg, WI and MTP, in concert with the GRL Chicago office, performed the static

and dynamic testing during this extensive initial pile test program. Van Komurka conducted the internally instrumented static load tests, and Pat Hannigan was in charge of Pile Driving Analyzer[®] testing and CAPWAP[®] analyses. The team worked closely together to develop soil set-up vs. depth profiles for all 89 test piles. With this information, it will be possible during production pile driving to install the piles to end of drive capacities much smaller than required long-term, and to predict how much long-term capacity will be available as a result of set-up. Test-program capacity determinations indicate unit set-up of up to 239 kPa (5 ksf), and total set-up of up to 5338



APPLE Testing near the 6th St. Viaduct

kN (600 tons) on a 324 mm (12.75 inch) diameter, 32m (104 ft) long pile. As a result, the project will utilize 324, 355 and 406 mm (12.75, 14 and 16 inch) diameter piles with allowable loads of up to 1335, 1779 and 2224 kN (150, 200 and 250 tons), respectively.

References

Fellenius, B.H., Riker, R.E., O'Brien, A.J. and Tracy, G.R. (1989). "Dynamic and Static Testing in a Soil Exhibiting Set-up," *Journal of Geotechnical Engineering*, Vol. 115, No. 7, pp 984-1001, American Society of Civil Engineers (ASCE), Reston, VA.

Komurka, V.E. (2004). "Incorporating Set-Up and Support Cost Distributions into Driven Pile Design," *Current Practices and Future Trends in Deep Foundations*, Geotechnical Special Publication No. 125, 0-7844-0743-6, pp. 16-49, ASCE/Geo-Institute, Reston, VA.

2005 Calendar of Events

February 17-19, Charleston, SC: The Pile Driving Contractors Association (PDCA) presents the 2005 Winter Roundtable. Visit www.piledrivers.org/newwin.php.

March 2, Orlando FL: Pile Dynamics presents General Seminar on Foundation Testing. Visit www.pile.com/events/pdievents or email info@pile.com.

March 3-4, Orlando FL: Pile Dynamics presents PDA, CAPWAP and GRLWEAP Workshops. The Foundation QA exam for certification of PDA testers will be offered. Visit www.pile.com/events/pdievents or email info@pile.com.

March 3-4, Elmwood Park, NJ: Deep Foundations Institute (DFI) presents Driven Pile Foundations - Construction Monitoring. Pat Hannigan will present. Visit www.dfi.org/conferencedetail.asp?id=

March 17-18, Boston, MA: The American Society of Civil Engineers (ASCE) presents Deep Foundations: Design, Construction & Quality Control. Mohamad Hussein, Joe Caliendo, Jerry DiMaggio and James Long will present. For information visit www.asce.org/conted or call 1-800-548-2723.

March 23-25, Hershey, PA: ASCE presents 21st Central Pennsylvania Geotechnical Conference. Visit www.asce-pa.org/asce-cpa.htm.

May 11-13, Riga, Latvia: The Geotechnical Societies of Latvia, Estonia and Lithuania present the X Baltic Conference devoted to problems of Geotechnical engineering for harbors, onshore and near shore structures. Visit www.balticgeotechnics.lv or email info@balticgeotechnics.lv

May 13th, Milwaukee, WI: The University of Wisconsin-Milwaukee, Wisconsin Department of Transportation, Milwaukee Transportation Partners, and ASCE-Wisconsin Section present The 13th Annual Great Lakes Geotechnical and Geoenvironmental Conference. Visit www.uwm.edu/CEAS/GLGGC.

June 2-5, Pittsburgh, PA: The American Society of Highway Engineers presents The ASHE National Conference: Transportation Choices & Challenges. Visit www.ashe2005.org

June 19-24, Logan, UT: PDCA presents The PDCA Professor's Institute. Visit www.piledrivers.org/events.php?EID=20.

PD I announces three new International Representatives

Pile Dynamics welcomes GC-X (Mr. Ignacio Zuloaga) as its new Sales Representative for Spain, Portugal and Andorra and J. Tech Co. Ltd (Mr. J. S. Choi and Mr. Hiraoka Fumitoshi) as its new Sales Representative for Japan.



In Brazil, we welcome our new Sales Representative, Mr. Oscar Fusconi of Carmix do Brasil Ltda. Mr. Jorge Beim of PDI Engenharia will now assume the role of Technical Representative for all PDI products and assist with training and technical support. We thank Jorge for his past sales efforts and are looking forward to a continuing collaboration in his new role.

News from Sweden

Carl-John Gravare, PDI's representative in Sweden, was elected chair of the Swedish Piling Commission. This commission and the Federation of Piling Specialists organized PILE DAY 04 at the Europile precast pile factory. During the conference, a steel pile was driven outside the conference room. The remote Pile Driving Analyzer® PAL-R monitored the installation, and a computer inside the factory building received the cell phone transmitted data and processed it in real time with the PDA-W software. Conference attendants in the lecture hall could hear the hammer drop and see the curves projected on a large screen. Carl-John believes that the number of people – 150 – that participated in this live stress wave measurement event was a record. A lighthearted part of PILE DAY 04 was a contest to determine which participant could hit a pile the hardest with a sledgehammer. The PDA measured the maximum force (FMX) and determined the winner.



Conferences participants observe data from remote pile driving monitoring

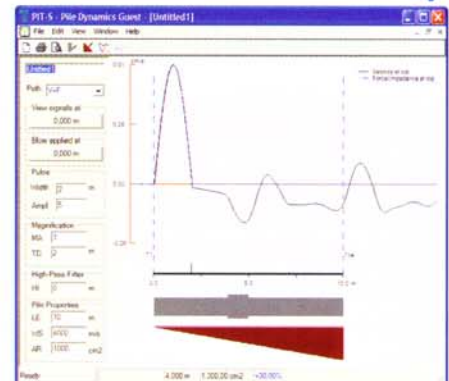
PDI Workshops

Pile Dynamics held a one-day seminar followed by a two-day workshop on dynamic pile testing in York, England, this past November. The workshops gave participants the opportunity to take both the Foundation QA examination for High Strain Pile Testers and a new examination for integrity testers administered by engineering consultant GSP. The next set of workshops and seminars will take place in Orlando, Florida, USA on March 2-4, 2004. Visit <http://web.pile.com/events/pdievents/default.asp?company=> for information including a complete program and registration form.

Pile Dynamics develops software for Pile Integrity Testing simulation

The PIT-S software for low strain integrity testing simulation will help education and training of new Pile Integrity Tester™ (PIT) users and will assist existing PIT users with record evaluation. PIT-S is available as shareware at www.pile.com

Users of PIT-S input pile shape, realistic soil layer properties and characteristics of the low strain hammer impact, including point of impact. PIT-S then displays the resulting velocity reflections vs. time and pile length. PIT-S also offers the option of displaying force and velocity curves or two velocity curves, simulating the capabilities of the PIT model FV, and shows acceleration and displacement data. A slow motion animated display of



Sample screen of PIT-S software

the wave transmission and reflections is particularly educational. Current PIT users may overlay the curves simulated by PIT-S over measured curves for a simple signal matching process and a simplified investigation of the cause of observed reflections.

Visit us at WWW.PILE.COM

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