THE OFFICIAL PUBLICATION OF THE
PILE DRIVING CONTRACTORS ASSOCIATION

Q1 2016 | Volume 13, No. 1

# PILEDRIVER

"A Driven Pile… Is a Tested Pile!"

Pacific Pile & Marine, LP:

## Pier 54 Piling and Apron Replacement Project in Seattle

- PDCA 20th Annual International Conference & Expo 2016 – Full Conference Brochure
- Key Construction Contract Provisions for Contractors and Subcontractors

# The Wayzata Bay Center **Redevelopment Project**

## Unique collaboration between pile contractor and engineering consultant successfully support high-end project in difficult ground

*By William Cody, P.E., L.H. Bolduc Co. and Gregory Reuter, P.E., D.GE, American Engineering Testing, Inc.*

It was winter in Minnesota, 1984. The temperature was right at the cut-off to cancel work that morning: -10˚F. It was somewhat surreal to see, with frost on the seven-inch diameter pipe piles that were long overdue in supporting a 200-foot long run of sidewalk that had been settling away from the Wayzata Bay Shopping Center (WBSC) for over 20 years. The WBSC owners had invested many thousands of dollars since the mid-1960s: mud jacking stoops and sidewalks and overlaying driveways and parking areas to keep them in service. Now they had decided to tackle the biggest problem areas to "stop the bleeding." The new perimeter sidewalks weren't going anywhere. They were going to be supported on piling.

Piling had served them well to this point. Several hundred timber and steel pipe piles had been driven in 1964 during the original construction to support the more than three-acre size building, and they had not yielded to the loads imposed by the building or soils settling around them. The settlement beneath and surrounding the shopping center ranged from one to five feet. Where crews were rebuilding sidewalks, annual bituminous overlays had an accumulated thickness of as much as four-and-a-half feet. Settlement under the building was so extreme that an unintended crawl space was created; however, crawling

Continued on page 75

A "forest" of piling awaits final driving

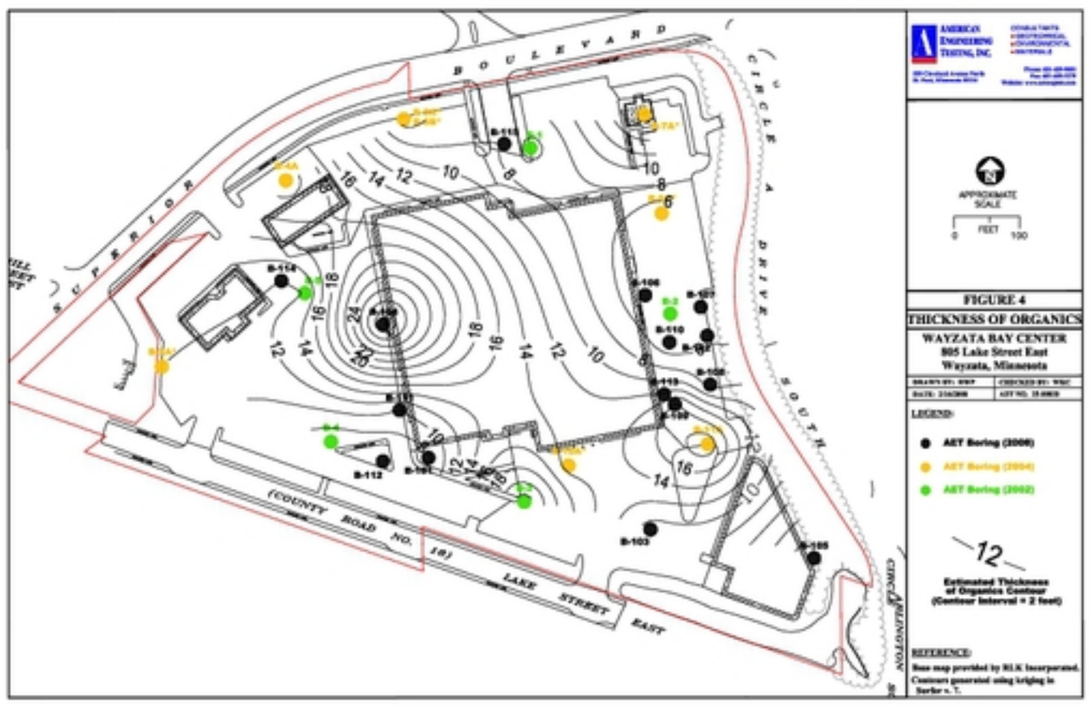
A brutal 2013 winter barely slowed production

Snow-melt tubing was placed in sidewalk and driveway areas

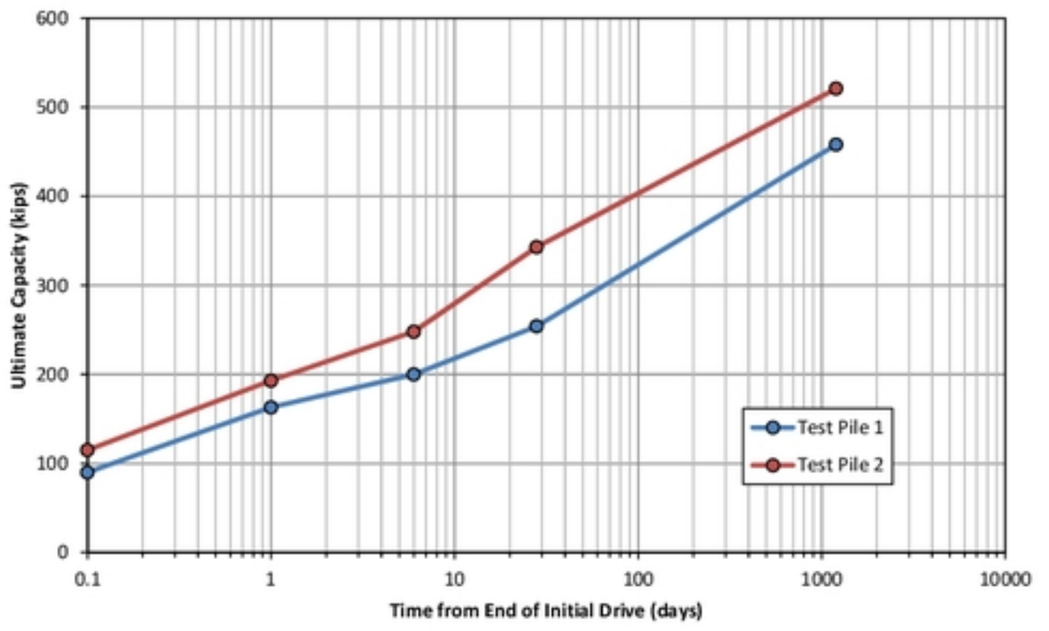
wasn't necessary, you could walk within most of the space below the structural slab and grade beams. Piles that were once below grade were visible and exposed to occasional crawlspace flooding and fluctuating air temperatures.

By 2008, the economy and other factors brought the WBSC to its knees. It had become a blighted property with only about 30 percent of its retail space occupied. Redevelopment planning got serious as the new owners assembled a team of engineers and contractors well equipped to remedy the many challenges the site had to offer.

The redevelopment concept that took shape during nearly two years of intensive planning is a $160-million, mixed-use project located in Wayzata, Minn. The redevelopment includes a walkable district of multi-story senior housing, retail, office space, a hotel and a public plaza. The WBSC was razed to make way for the new redevelopment. The development team knew going in that all new structures would require deep foundation support. Given the depth of the poor soils at this site, the new foundations would be an expensive part




Thickness of organic soils in the project area




Example of test pile set-up; note the continual gain over nearly four years

of the project, so the owner, Presbyterian Homes and Services, Inc., authorized a "pre-design" test pile program two years before ground breaking, in order to evaluate the performance of different pile types, and soil setup characteristics. Experience had shown that the glacial soils below the fill, buried swamp deposits and sporadic compressible lacustrine layers that occupied the site were favorable for friction pile usage due to their setup potential. The test pile program was carried out in a manner to quantify the pile's capacity gain at various pile penetrations and time intervals. The goal was to develop an understanding of the minimum safe pile penetration and end of initial drive capacity required to assure that set-up would provide the remainder of the individual design load before it was needed. It was the desire of the design team to save foundation costs by shortening otherwise conservative pile length estimates and to optimize pile design capacities.

The city of Wayzata (pronounced Why-zet-tah) is a western suburb of Minneapolis, located on the north shore of Lake Minnetonka. Lake Minnetonka is the largest of many lakes that occupy the area, and are the result of the most-recent glacial advance and retreat in the region some 10,000 years ago. The retreating glacial ice deposited till soils within which formed many "kettle" lakes – lakes that formed by the melting of remnant ice blocks. Many of the kettle lakes slowly filled with organic matter and eventually became peat bogs. One such peat bog is located at the site of the Wayzata Bay Center, where borings and piezocone (CPTu) soundings found very soft organic soils that occupied the entire approximately 14-acre site, and which extended to a depth of as much as 60 feet.

The test pile program, designed by the project geotechnical engineer, American Engineering Testing, Inc. (AET) and performed by the piling contractor, L.H. Bolduc Company, was carried out during the winter of 2009, well before final design for the building foundations had been completed. The test pile program was intended to provide information that would lend toward economical pile type selection, pile capacities for design and estimated lengths for cost analyses. Three separate test sites were chosen on the property. Six test piles were driven at each of the test sites, consisting of three 7-inch diameter steel pipe piles, and three 9.625-inch diameter steel pipe piles. Each set of three piles were driven to depths of 75 feet, 90 feet and 125 feet below grade. An additional pile was also driven at each test site to essential refusal for the purpose of analyzing geothermal properties.

The piles were tested during initial driving by the high strain dynamic test method with a Pile Driving Analyzer® (PDA), and the data were evaluated by signal matching analyses. Each of the test piles was then tested again during restrike after setup periods of approximately one, three, seven and 30 days. (Interestingly, during construction of the new Wayzata Bay Center, some of these original test piles were exposed and again tested in restrike after setup periods of about 3.5 and 4.5 years, which provided unusual insight into long-term soil setup behavior).

The test pile program found that piles bearing within the cohesive glacial till soils located below the peat and swamp-deposited soils experienced a sig-

**Thanks to the use of driven piling, the new owners are not going to be faced with the long-term settlement ramifications that diminished profits that the previous owners were burdened with.**

nificant amount of capacity increase with time due to soil setup. In fact, capacities measured at 30 days found an increase of as much as 360 percent when compared to the pile capacity at the end of initial driving (EOID).

Realizing that the actual structural loads applied to the foundation piles would not be fully applied until many weeks after initial pile installation, the design team was able to take advantage of the higher pile capacities through the time-dependent soil setup, while saving money on shorter pile installation lengths. Thus the piles were not designed for lower EOID capacities, nor from short-term one- to three-day restrike capacities, but rather from the projected longer-term setup capacities achieved at one month after piles were initially installed.

The foundation design approach on this project was somewhat unusual in that the pile driving contractor was an integral participant in the design team, forming a true "design-build" approach to the foundation construction. L.H. Bolduc Co., Inc. worked closely with AET to develop a plan for production pile installation that not only was efficient for the pile driving contractor, but also insured that the piles were being installed to their correct load-carrying capacities.

Construction of the first phase of the multiple-phase Wayzata Bay Center project began in fall of 2012, under the direction of the general contractor, Adolfson & Peterson Construction. To further economize the foundation design, the structural engineer, Ericksen Roed & Associates, did not design the building foundations for a single pile capacity, but rather for differing capacities, ranging from 40 to 120 tons per pile. This permitted use of varying pile wall thicknesses that better matched the loads they were designed to carry.

Compared to other foundation types considered for the project, "a steel pile foundation system was ultimately selected due to lower cost and flexibility," said Dave Herzberg, senior project manager with Adolfson & Peterson Construction. "[The design team] provided valuable constructability advice and was able to create a customized piling system based on loading conditions at each pile cap. This saved several hundred thousand dollars."

Multiple production pile driving criteria had to be established to consider the two different pile sizes and three different pile driving hammers used for installation. Periodic "proof" testing of piles during short-term (generally one to six days) restrike testing with and without the PDA were performed during production pile installation to verify that soil setup was occurring at comparable rates to those observed during the pre-design test pile program.

The target bearing layer was the cohesive glacial till which lay below the swamp-deposits and alluvial sands. Numerous borings and CPTu soundings that were performed at the site provided information that allowed for a reasonable assessment of the depth to the top of the glacial till stratum. The piles were driven to bear approximately 40 to 65 feet into the glacial till, at which point the pile driving ceased, whether design capacity was reached or not. The production piles were driven to depths generally ranging from 100 to 125 feet. In most cases,

CPT soundings confirmed conditions in uninvestigated areas during construction

Production pile installation

**The development team knew going in that all new structures would require deep foundation support.**

the piles ended at initial drive capacities that were far short of the required design capacities, but proved acceptable from numerous quality assurance restrike assessments.

The pile installation for the last phase of the project will be completed in January 2016. Approximately 70 miles of piling will have been driven to support all of the buildings and infrastructure. We judge that the average pile length was about 15 feet shorter than what would have been required if the piles were driven to the required structural capacity during initial driving. Because there were almost 3,000 piles driven on this project, it is estimated that over $1.1 million in cost savings was realized by incorporating soil setup in the pile design and installation. Thanks to the use of driven piling, the new owners are not going to be faced with the long-term settlement ramifications that diminished profits that the previous owners were burdened with. In fact, about 30 percent of the piles driven are delivering some payback in the form of "energy piles."

"The collaborative process [between the contractor and the engineers] yielded a very unique structural system that not only provides a stable foundation for the improvements above, but also serves as a geothermal well field contributing the heat and air conditioning needs for several of the buildings," said John Mehrkens, vice president of Senior Housing Partners and Presbyterian Homes.

The geothermal contribution helps defray the cost of the hydronic snowmelt system that keeps about five acres of roadway and sidewalk ice-free during the winter.

The Wayzata Bay Center project proved that "a driven pile is a tested pile" and so much more. ▼

Photos and images courtesy of authors