THE "AMERICAN WAY": TRADE ASSOCIATIONS, SOCIETIES AND INSTITUTES

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KEY STEPS TO PROFITABLE FOUNDATION DRILLING

WITH MINCON GROUP PLC

Photo courtesy of Doublestar Drilling

PLUS

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Built by MG Construction

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By Ruta Johnson

A WIN FOR DUCTILE IRON PILES OVER H-PILES AT NEW CANDLEWOOD SUITES

North Hartford, CT

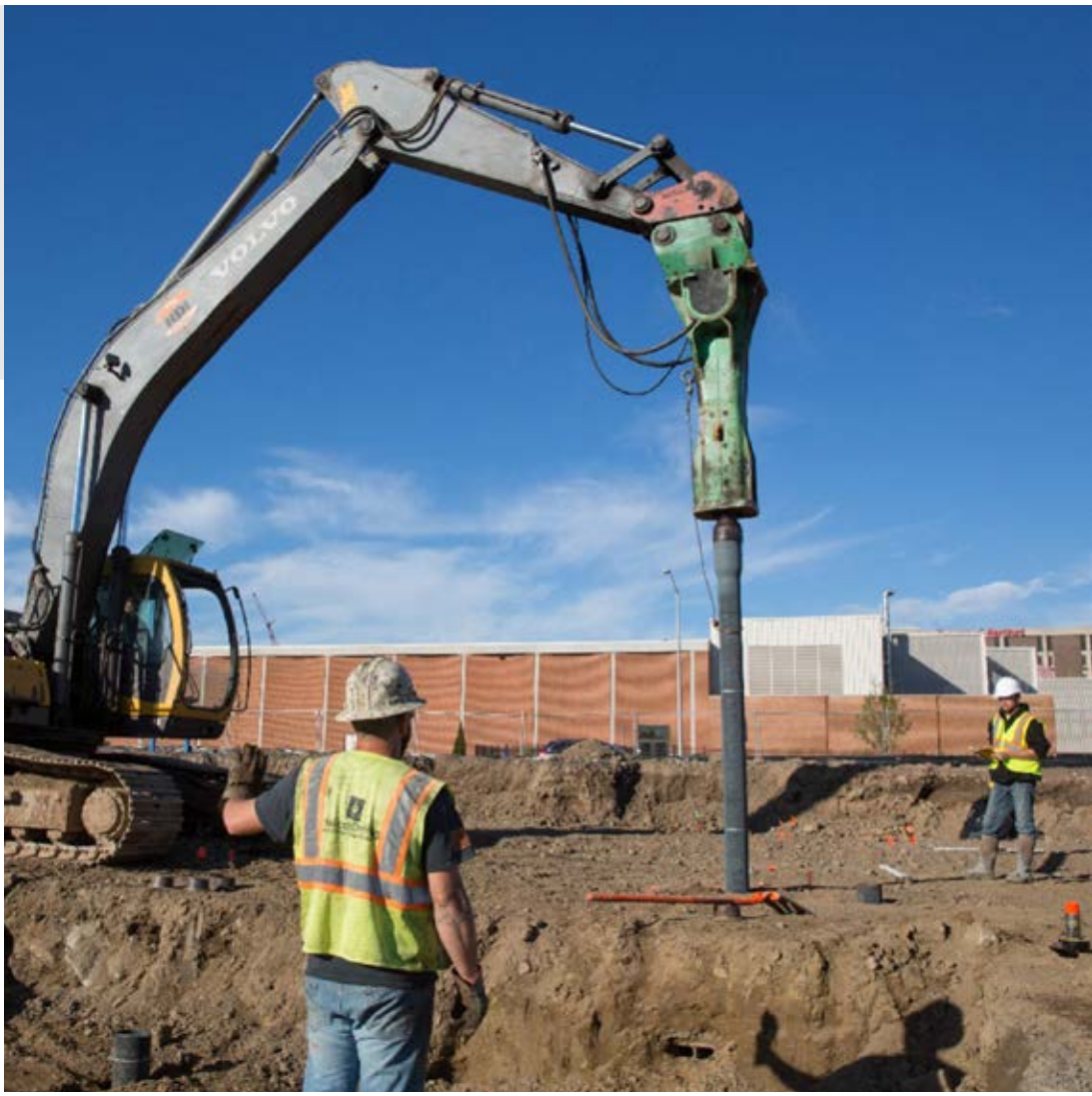
PROJECT TEAM MEMBERS

DIP DESIGN/BUILD PARTNER:
Helical Drilling, Inc.

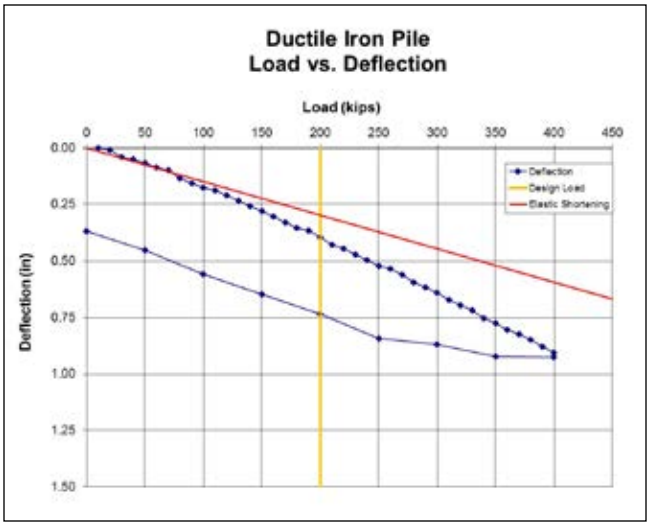
GEOTECHNICAL ENGINEER:
Clarence Welti Associates, Inc.

GENERAL CONTRACTOR:
PM Construction Company

STRUCTURAL ENGINEER:
Structural Design Associates, Inc.



Hartford, CT is the home of the new double-A minor league baseball team — the Hartford Yard Goats. The introduction of a new team is spurring substantial development including a new Downtown North Hartford Baseball Stadium and various projects around the site. One of these projects includes the new 8-story, 53,400 square foot Candlewood Suites hotel to house many of the out-of-town guests catching a game. Foundation loads for the steel-framed structure range from 400 to 800 kips with areas of isolated



tension demand on braced frame footings.

Steel H-piles, like many areas of the country, are still a commonly-used foundation system. Initial recommendations and design for the project were no different and utilized traditional 100 ton driven H-piles consisting of either HP 12x74 or HP 14x73 sections to support the building loads. However, Ductile Iron Piles (DIPs) proved to be more cost-effective and better for the schedule.

Subsurface conditions at the site included up to 8 feet of variable, debris fill underlain by soft to stiff silt and sandy silt to a depth of about 22 feet. A medium dense to dense sand layer was encountered below the silt until shale bedrock was encountered at depths of 25 to 32 feet below grade. Groundwater was about 15 feet below grade. The fill and soft silt posed an expensive challenge for the project team. With the shallow foundation option resulting in excessive total and differential settlement, engineers turned to deep foundations to meet the performance needs.

After reviewing the project plans and discussing with the design team and General Contractor, PM Construction of Saco, Maine, Helical Drilling proposed a value engineered alternative utilizing Ductile Iron Piles as a replacement to the specified H-piles. The driven Ductile Iron Piles solution provided a 1:1 replacement with the 100 ton allowable capacity piles. The advantages of the Ductile Iron Piles included: reduced cost, rapid installation, lower vibrations during installation, easily adapting to variations in subsurface conditions and lengths and improved safety with less overhead activity.

The Ductile Iron Pile system has been used in Europe for nearly thirty years, but only in limited markets in the U.S. until recently. Ductile Iron Piles are a modular, cost-effective small-diameter piling system. Piles are manufactured in standard 16.4 ft (5 m) lengths to allow ease of installation in constrained sites. The system features a specialized Plug and Drive connection system that allows for rapid field connections from the driving energy without the need for splicing or welding. The system is installed using a medium-sized excavator and a hydraulic breaker hammer. The breaker hammer uses a modified shank that allows it to seat to the piles and drives them into the ground using the percussive energy of the breaker hammer. While typical pile driving equipment using high-impact, low-frequency hammers results in vibrations that radiate out over great distances, the high frequency of the breaker hammer and the low impact energy create only minimal vibrations, well-below the tolerance for most projects. This allows the system to be used within a couple of feet of existing buildings.

Ductile Iron Piles have the flexibility to be installed to develop capacity in either end bearing or in friction. End-bearing DIPs generate the load-carrying capacity through bearing on very dense soil or rock like traditional piles. Alternatively, friction DIPs create a bond zone within a competent soil near the base of the pile by

continuously pumping pressurized sand-cement grout during pile installation. The grout fills the interior of the DIP and the annular space between the soil and pile, created by driving an oversized conical grout cap at the base of the pile, to form a grouted bond zone capable of achieving high bond strengths.

After reviewing proposals for the specified H-piles and the Ductile Iron Pile value engineering proposal, DIPs were selected to save foundation costs and schedule. The 100 ton Ductile Iron Piles consisted of a 170/9.0 (170 mm diameter with 9 mm wall thickness) with 4,000 psi neat cement grout to fill the hollow pile. A high-strength #9 reinforcing bar was installed in the center of the pile to provide additional compression strength in the moderately corrosive environment. In areas where tension loads of up to 36 kips were required, an oversized 270 mm conical grouting cap was installed on the 170/9.0 piles. During installation, sand cement grout was pumped to fill the annular space created by the oversized cap and develop a friction bond zone in the sand and silt layers. The same #9 reinforcing bar was inserted to create a structural tension connection for uplift resistance.

Compression load testing was performed to 200% of the design load (400 kips) to verify performance. Results showed about 0.4 inches of movement at the 100% design load (200 kips) and about 0.9 inches at the 200% design load (400 kips). Permanent deformation of less than 0.4 inches was recorded. The pile was then tested to more than 500 kips to evaluate the response at higher loads. Reactions for the test consisted of 8 friction DIPs that were instrumented to verify the tension capacity and response.

A total of 124 piles were installed on the project with 32 of the piles developing tension resistance with an oversized conical grout shoe. All piles were installed through the silt and sand to bear on the rock. Termination of the piles occurred when a "set" criteria of less than 1 inch of penetration in 50 seconds was achieved. The piles were installed by Helical Drilling in 12 working days on the site including time for mobilization, demobilization and load testing. The cost and schedule savings on the project, combined with the tested performance of the system, was a home run for the project and the continued redevelopment of the ballpark area. ■