

CASE HISTORY

ECP HELICAL TORQUE ANCHORS™



Helical Torque Anchors™ Support Heritage Hall Duluth, Minnesota

The City of Duluth planned capital improvements to convert a vacant and deteriorating warehouse into part of a new ice skating rink complex. Northland Engineering was commissioned to prepare the plans and specifications for the conversion of this building and adjacent structures. Part of the planned renovation and conversion included adding a second floor on the interior of this structure. The engineer called for supplemental foundation support for the existing reinforced concrete footing and stem wall foundation system.

The geotechnical soil report found extremely different soil profiles on opposite sides of the building, which required



| Project Summary | |
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| Project: | Heritage Hall, Building 6, Duluth, Minnesota |
| Engineer: | Northland Engineering, Duluth, Minnesota |
| Installing Contractor: | Lipe Brothers Construction, Inc. 5116 Jean Duluth Road, Duluth, Minnesota |
| Products Installed: | TAF-350-84 8-10-12 Torque Anchor™ Piles TAF-288-84 10-12-14 Torque Anchor™ Piles TAB-LUB Utility Foundation Bracket |
| Number of Placements and depth to bearing: | 20 – 3-1/2" Dia. Piles with Bracket – 23 to 35 ft 26 – 2-7/8" Dia. Piles with Bracket – 8 to 13* ft 6 – 2-7/8" Dia. New Const. Piles – 40 to 43 ft |
| Ultimate Capacity: | 40,000 lb |
| Average Working Load: | 20,000 lb |
| Factor of Safety: | 2.0 : 1 Ultimate To Working Load |

* Two piles were installed to 87 and 92 feet. See text for information.

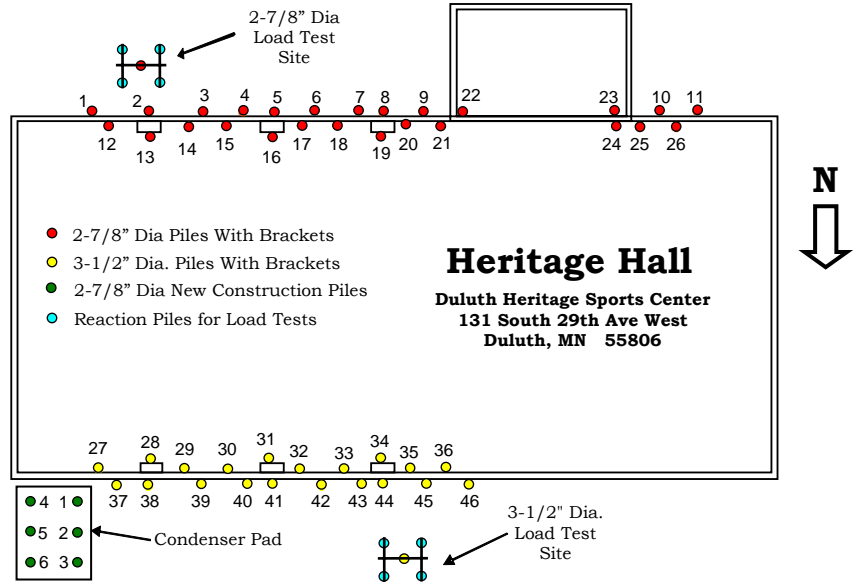
Photographs

Top Right: A small excavator installs piles inside of Heritage Hall;
Middle: The piles and brackets are shown supporting the foundation;
Right: A Torque Anchor™ is ready for installation on the exterior.

different helical pile designs for each side. In addition, some soil boring logs reported very soft clay between 35 to 50 feet below grade and to beyond the boring depths.

On the north side of the building the geotechnical investigation discovered very soft clay just below the surface to about 30 feet deep. Due to expected lower lateral soil support for the pile shafts at full load, 3-1/2 inch diameter tubular pile shafts were specified in areas where very soft clay was reported. On the south side the soil profile revealed 25 to 35 feet of silty sand allowing the smaller 2-7/8 inch diameter pile shaft configuration to be used.

The project also called for six new construction helical piles to support a new concrete pad near the northeast corner of the structure. The pad will support a proposed condenser unit.



Installation torsion on a helical pile shaft is an indication of the ultimate capacity of the pile. The 2-7/8 inch diameter piles were installed to torques between 5,000 and 10,700 ft-lb with the larger torsion readings generated from the piles encountering cemented sands.

Photographs & Illustrations

Top: The project plan shows the scope of work and the pile locations.

Top Left: The piles along the exterior are installed and have been attached to the foundation brackets. The Torque Anchors™ are ready for loading.

Left: This photo shows how the load is transferred from the soil to the pile shaft. A hydraulic ram applies the design load capacity to the footing.

Below: The new construction piles for the condenser pad have been installed the specified elevation and the pile caps have been attached.



The 3-1/2 inch diameter piles were installed to shaft torsions of 6,300 to 7,800 ft-lb. These piles were designed to provide support at target elevations between 15 and 35 feet below grade depending upon the pile locations relative to the soil boring logs. There was concern that a pile may not properly demonstrate sufficient installation torsion to seat into the target soil stratum to provide sufficient support for the load. Under such circumstances, the next area of support would likely be well below the 50 foot termination depth of the soil borings.



Photo above: A technician records the pile deflections as the test pile is loaded.

This concern materialized when pile numbers 23 and 24 achieved suitable torsion only after reaching depths of 92 feet and 87 feet respectively. Specific concerns about the strength of these piles were satisfied by Lipe Brothers Construction. After installation, these piles were test loaded to 62,000 pounds and monitored for creep over a period of 80 minutes. Once accomplished, support was verified and the engineer approved the piles.

The installation of the piles was observed by EPC Engineering & Testing of Duluth. Reports were filed with the general contractor. Load tests were performed on site to demonstrate the capacity of the Torque Anchors™. The piles were tested using ASTM D1142 "Optional quick load test method for individual piles" also under the direct supervision of EPC Engineering and Testing. The results from the testing confirmed that the piles exceeded the ultimate load capacity requirement of 40,000 pounds.

| TORQUE ANCHOR™ LOAD TEST RESULTS | | |
|----------------------------------|-------------|-------------|
| Test Location | South | North |
| Date | 8/29/07 | 9/11/07 |
| Pile Size | 3-1/2" dia | 2-7/8" dia |
| Installation Torque | 9,000 ft-lb | 6,000 ft-lb |
| Depth to Bearing | 9 ft | 35 ft |
| Test Load | 40,000 lb | 40,000 lb |
| Full Load Deflection | 0.448 in | 0.306 in |
| Rebound | 0.176 in | 0.265 in |
| Permanent Deflection | 0.273 in | 0.041 in |

