

Models 350 and 450 Helical Piles

Project: Tower Crane Foundation

Location: Bismarck, ND

Date: November 2013

Challenge:

Saint Alexius Hospital planned several building improvements including the placement of large mechanical equipment on the roof of a four-story wing. A Wolffkran 325 SL tower crane was proposed to install the mechanical equipment. The crane would be erected immediately adjacent the hospital with its footprint extending into a busy three-lane, one-way street. The tower crane would be supported by four legs with each leg attached to a 7-foot square by 3.5-foot thick concrete pad. A soil boring completed at the proposed tower location identified a soil profile consisting of soft clay fill to a depth of four feet, very loose sand to ten feet, stiff clay and claystone to 35 feet, and dense to very dense sandstone to 50 feet. A deep foundation system was therefore required to temporarily support the tower crane during placement of the mechanical equipment.

Solution:

Helical piles could be installed within the tight working space with smaller installation equipment and achieve the pile capacities required for this project. The original foundation design included four helical piles arranged in a four-foot, center-to-center grid to support each concrete pad (pile cap). Individual pile service loads were given as 42.5 kips compression and 2.25 kips lateral. However, the excavation made for one of the concrete pad locations uncovered a fiber optic cable running closer to the proposed work than originally expected. As a result, two of the proposed helical pile locations were revised, increasing their compression service loads to 55 kips. Fourteen (14) Model 350 (3.50-inch OD by 0.313-inch wall) round shaft helical piles with a 10"-12"-14" helix plate configuration and two (2) Model 450 (4.50-inch OD by 0.337-inch wall) round shaft piles with a 10"-12"-14"-14" helix plate configuration were installed to support the tower crane. The helical piles were advanced to embedment depths from 36 to 49 feet to achieve torque-correlated ultimate capacities of at least twice the design working loads ($FOS \geq 2$). A "V-style" leading edge was used on the 10-inch and the 10 and 12-inch helix plates for the three and four-plate configurations, respectively, to better penetrate the dense to very dense sandstone. Prior to production pile installation, a load test was performed at the site on a sacrificial helical pile consisting of the Model 350 configuration. The measured total deflection was only 0.237 inch at the design working load of 42.5 kips, less than the specified maximum deflection of 0.5 inch. Finite element analysis software also confirmed that the proposed piles could resist the design lateral loads within allowable deflection limits.

Project Summary

Structural Engineer: CW Structural Engineers, Inc.

Geotechnical Engineer: Braun Intertec

General Contractor: Capital City Construction, Inc.

Certified Pile Installer: Innovative Foundation Supportworks®

Products Installed: (14) FSI HP350 Helical Piles, 10"-12"-14" Helix Plate Configuration, Design Working Load of 42.5 kips; (2) FSI HP450 Helical Piles, 10"-12"-14"-14" Helix Plate Configuration, Design Working Load of 55 kips; Pile Depths from 36 to 49 feet



Compression load test performed on a sacrificial pile



Helical piles installed within crowded work space



HP450 lead section being aligned prior to advancement



New construction bracket installed



Completed tower crane foundations