FOUNDATION SUPPORTWORKS®

CASE STUDY Commercial

Helical Piles and Anchors

Project: Montgomery Tower Support
Location: St. Louis, MO
Date: November 2011

Challenge:

The Montgomery tower is a 240-foot high communication tower supported with guy wires attached to three 16-foot high reaction guy poles. The tower load at each guy pole is then resisted with two helical anchors. The southwest guy pole support and main tower experienced excessive movement which required emergency temporary restraint to prevent tower failure. Additional helical anchors were then planned to increase the guy support capacity at all three guy pole foundations. When the field work started, it was discovered that a redesign was required for the proposed helical anchor system at two of the three guy pole supports. Helical anchors battered out from the tower could not extend into the railroad easement at the northeast leg and fiber optic and gas line utilities would obstruct anchor installation at the northwest leg. The geotechnical investigation provided limited deep soil information for the northeast and northwest guy pole locations so the anchor design was based on a deeper boring completed southwest of the tower base. Installation of the anchors would also be a challenge as equipment access was obstructed by existing guy wires and the temporary restraint system at the southwest guy pole.

Solution:

The original retrofit anchorage design consisted of two additional helical anchors per guy pole support battered at 40 degrees from vertical (away from tower) with ultimate axial tension loads of 45 kips. The Model 150 square shaft (1.5-inch round corner square bar) helical anchor with an 8”-10”-12” triple-helix lead configuration was selected to provide the 45 kip ultimate tension capacity. The Model 150 anchors were installed at the southwest guy pole support to lengths of 27 and 37 feet (depths of 21 and 28 feet) to meet the termination torque criteria. For the northeast and northwest guy pole locations, engineers with Foundation Supportworks, Inc. worked with Vertical Structures to design a system consisting of two vertical and two battered (45 degrees toward tower) helical piles. With this geometry, the battered piles would have ultimate compression loads of 32.6 kips and the vertical piles would have ultimate tension loads of 59 kips. The Model 288 round shaft (2.875-inch OD by 0.276-inch wall) helical pile was selected for both loading conditions. The tension piles were installed to depths ranging from 11 to 24.5 feet and the compression piles were installed to lengths ranging from 11 to 26.5 feet (depths ranging from 7.8 to 18.7 feet) to meet the termination torque criteria. Due to variable soil conditions, helix plate configurations varied from 8”-10”-12” to 8”-10”-12”-14”-14”. The Model 288 piles were fitted with new construction brackets/caps and cast into an above-grade reinforced concrete beam. All tension piles and anchors were proof tested to above the design working loads with recorded deflections of 0.25 to 0.375-inch.

Project Summary

Structural Engineer: Vertical Structures
Geotechnical Engineer: GeoTechnologies, Inc.
General Contractor: Midwest Underground Technologies, Inc.
Certified Pile Installer: Foundation Supportworks® by Woods
Products Installed: (2) FSI Model 150 Helical Anchors, (8) FSI Model 288 Helical Piles, Helix Plate Configuration from 8"-10"-12" to 8"-10"-12"-14"-14", Installed to Depths of 7.8 to 28 feet

Tower with northeast guy pole on right

Northeast guy pole and adjacent railroad easement; prior to retrofitting

Compression and tension pile system installed at the northwest guy location

Concrete grade beam reinforcement

Finished grade beam reaction system at the northwest guy location