Helical Piles and Anchors Support Pedestrian Bridges

Project

Chequamegon-Nicolet National Forest Pedestrian Bridges

Location

Ashland and Bayfield Counties, WI

CHALLENGE ▼

Located in the Wisconsin Northwoods, the Chequamegon-Nicolet National Forest covers more than 1.5 million acres of forest preserve across five counties. Severe storms and runoff damaged walking trails within two of the counties. This damage also included the total destruction of three pedestrian bridges located at stream crossings. It was anticipated that future storm events of similar or greater magnitude would occur more frequently, with higher levels of flooding. Therefore, the designs for the replacement bridges would need to consider the increased flood potential, with anticipated scour depths of 3 to 6 feet below the new abutments. The bridges were located in extremely remote areas, being several hundred yards to over a mile from any access roads, which restricted the use of concrete abutments. The construction for the new bridges would also require smaller equipment to limit disturbance to the protected forest and streams. Geotechnical investigations at the new bridge locations generally showed very loose sand to depths of about 2.5 to 5 feet with shallow refusal at some of the abutment locations and cobble formations at others. Given the potential for future flooding, the abutments would need to resist uplift and lateral loads in addition to supporting vertical compression loads.

Construction preparation at one of the three bridge locations

SOLUTION ▼

Helical piles and anchors were chosen as the most economical solution for supporting the bridge abutments given the unique challenges and environmental constraints. The final foundation design included two vertical helical piles and four helical anchors (installed at a 45-degree batter) for each abutment. The abutments and bridge superstructure would be constructed with timber and a custom timber bracket was designed to connect the helical piles and anchors to the timber abutments. The custom bracket incorporated the vertical piles and battered anchors into the same bracket.

Piles, anchors, and brackets installed

Timber abutments attached to the helical pile and anchor brackets

The vertical piles and anchors had design working loads of 10 kips and 3.2 kips, respectively. A factor of safety of 2.0 is generally considered for helical pile and anchor design; however, due to uncertainties in the soil profile and the anticipated installation challenges, higher factors of safety were specified. The minimum required ultimate capacities were 27 kips for the vertical piles and 10 kips for the anchors. Pile buckling analyses were performed for the vertical piles given the varying potential scour depths. The deep foundation design included the Model HP288 (2.875-inch O.D. by 0.276-inch wall thickness) shaft with a 10”-12” helix plate configuration for the vertical piles and the Model HA150 shaft (1.5-inch solid square shaft) with an 8”-10” plate configuration for the battered anchors. Hot-dip galvanized material was specified for additional corrosion protection.

Continue ►

Helical Piles and Anchors Support Pedestrian Bridges

Project	Location
Chequamegon-Nicolet National Forest Pedestrian Bridges	Ashland and Bayfield Counties, WI

► *Continued*

Helical pile shafts with greater torsional capacity than required for the service loads were selected to resist impact loading and assist penetration through the shallow cobble formations. A mini-excavator installed the vertical piles to lengths from 11 to 16 feet and the battered anchors to lengths from 20 to 21 feet, while achieving the required torque-correlated ultimate capacities.

The helical piles and anchors at the three bridge locations were installed over the course of four weeks. During the installation, large boulders up to several feet in diameter were encountered, which created a challenge to installing the piles in the precise locations required. In these instances, the boulders were removed, or the bridge was slightly re-aligned. After the piles and anchors were connected to the timber abutments, the general contractor was able to immediately place the bridge structure, which had been assembled on site.

Bridge completed

Bridge completed

PROJECT SUMMARY ▼

Architect/Engineer:	WSP
Geotechnical Engineer:	Coleman Engineering Company
General Contractor:	M. Jolma, Inc.
Helical Pile Designer:	SFA Design Group
Pile Installer:	DBS
Products Installed:	(12) Foundation Supportworks® Model 288 Helical Piles, 10”-12” Plate Configuration, Design Working Compression Load of 10 kips, Installed Lengths of 11 to 16 feet; (24) Model 150 Helical Anchors, 8”-10” Plate Configuration, Design Working Tension Load of 3.2 kips, Installed Lengths of 20 to 21 feet.

For additional case study and technical information please visit Commercial.Supportworks.com.

DBS RESIDENTIAL SOLUTIONS

Foundation Supportworks