



COVER ARTICLE

Boardwalks, Pedestrian Bridges & More: Ideal Applications for Helical Piles

“Many clients with trail and boardwalk projects want the construction methods to have minimal impact on the project site and the surrounding areas.”



Boardwalk supported on 2.375" O.D. vertical and battered helical piles.

FEATURED CASE STUDIES:

- Jordan Park Wall - Portland, OR
- Clear Creek Trail - Tiffin, IA
- Carriage House Boardwalk - Lake Delton, WI
- Boat Dock - Aspen, CO

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UPCOMING WEBINAR OPPORTUNITIES

- An Introduction to Helical Foundation Systems**
1st Wednesday of every month 11:30am(CST) and 1:30pm(CST)
- An Introduction to Polyurethane Foam Injection**
2nd Wednesday of every month 11:30am(CST) and 1:30pm(CST)
- An Introduction to Hydraulically Driven Push Pier Systems**
3rd Wednesday of every month 11:30am(CST) and 1:30pm(CST)

To sign up email Kimberly at kimberly.hancock@foundationsupportworks.com with the following information:

- Name of the firm
- Location of firm
- Approximate number of engineers/architects/GCs that will be in attendance

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FOUNDATION NATION

FSI NEWSLETTER FOR DESIGN PROFESSIONALS BOARDWALKS, PEDESTRIAN BRIDGES & MORE: Ideal Applications for Helical Piles



Jeff Kortan, P.E. • Director of Engineering

Even smaller diameter helical piles can develop relatively high capacities, yet be installed with hand held equipment and smaller machines such as mini-excavators and skid steers. This makes helical piles well-suited for projects with limited or tight access and for sites that would be sensitive to disturbance under typical, larger construction vehicles such as pile-drivers, drill rigs and concrete trucks. Pedestrian bridges and boardwalks along cart paths at golf courses and along park trails are specific examples of structures often planned in limited access, sensitive areas. For these projects, considering all factors from soil conditions to design loads to site access, helical piles are more often viewed as the ideal deep foundation option.

Boardwalk construction over wetlands can be a challenge if deep water and soft soil exists, or if the goal is to simply prevent disturbance to the wetlands. In these cases, foundation installation would have to be completed during dryer periods or in the winter over ice or frozen ground. When this is not possible, or if the construction schedule does not allow it, the boardwalk can be designed to support the helical pile installation equipment. Helical piles can then be installed in pairs or groups reaching out ahead of the constructed boardwalk. Proper design and sequenced construction allows pile installation and boardwalk construction in sections without ever disturbing the wetlands below. The tops of the helical piles are advanced or cut to design elevation and fitted with custom saddle brackets to accept the timber girders. Battered piles typically provide lateral support to the boardwalk.



Custom saddle bracket connected with clevis to battered helical pile.

Smaller installation equipment means there is less site disturbance. Many clients with trail and boardwalk projects want the construction methods to have minimal impact on the project site and the surrounding areas. They want to maintain as narrow a construction corridor as possible by clearing only those trees necessary to grade trails and provide access for materials and equipment. Helical foundation systems are therefore a great option. Helical pile installation also does not auger soil to the surface so no spoils are generated as the piles are advanced into the ground. This again minimizes site disturbance since spoils do not have to be spread across the site or hauled away.



Boardwalk supported on 2.375" O.D. vertical and battered helical piles.

Three case studies presented within this newsletter are of projects where helical piles were used to support boardwalks, pedestrian bridges and a boat dock on a private lake. One case study also highlights how helical tiebacks were used in conjunction with gabion baskets to laterally support a hillside cut above a walking trail. To view the full case studies with additional project photos, visit www.fsicommercial.com and click on the "Case Studies" tab.



- New Construction and Retrofit Helical Piles
- Helical Tiebacks
- Helical Soil Nails
- Hydraulically Driven "Push" Piers
- Wall Stabilization Systems
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CASE STUDIES

Model 150 Helical Tiebacks

Project: Jordan Park Gabion Basket Wall ● **Location:** Portland, OR
Foundation Supportworks® Dealer/Installer: TerraFirma Foundation Systems

Challenge: A new 250-foot long gabion basket retaining wall was proposed along a wooded hillside. The retaining wall would support excavations made into the slope for the purposes of constructing and then maintaining a walking trail below. The tallest section of wall would consist of two tiers of stacked gabion baskets with each tier of three baskets being five feet high above grade (one foot buried). The proposed gabion baskets were three feet wide and either 1.5 feet or three feet tall, filled with six to ten-inch crushed stone. The preconstruction hillside conditions disallowed access to the project site with traditional track or truck-mounted drill rigs. Hand auger borings completed to depths of about nine feet at the base of the wall and within the proposed retained soils encountered medium stiff to very stiff clayey silt. With the sloped hillside conditions and the soils encountered, the taller sections of wall would require tiebacks or anchors to provide lateral stability.

Solution: The gabion wall design incorporated 73 helical tiebacks to support design working loads of 5, 10, 15 and 20 kips. The tiebacks consisted of the Model 150 (1.5-inch round corner square bar) with 10" single-helix, 8"-10" double-helix, and 10"-12" double-helix lead sections. The tiebacks were installed at a downward angle of six degrees from horizontal and at a spacing of five or ten feet. Standard extensions were used to advance the tiebacks to lengths of 17 to 37 feet, which corresponded to the greater of the design length or the length where the minimum required installation torque (1,000 to 4,000 ft-lbs) was achieved. The tiebacks were advanced to torque-correlated ultimate capacities of at least twice the design working loads (FOS ≥ 2). Two verification tests and five proof tests were completed to maximum test loads of two times and 1.5 times the design working loads, respectively. Creep measurements were taken at the maximum test loads over ten minute hold periods. The maximum creep movement for each test was 0.007 inch or less, which was less than the specified maximum allowable creep of 0.04 inch. The helical tiebacks were connected to wide-flange beam and C-Channel walers within the gabion baskets. Crushed stone was then placed and compacted around the tiebacks and walers.

Commercial



Residential



Model 350 Helical Piles

Project: Carriage House Boardwalk ● **Location:** Lake Delton, WI
Foundation Supportworks® Dealer/Installer: Foundation Supportworks® of Wisconsin

Challenge: A new carriage house was constructed to include a workshop, lounge, indoor racquetball court and rooftop pool. The carriage house was located approximately 200 feet behind the main home and at the base of a wooded slope. There was approximately 40 feet of elevation change from the flat rear yard of the main residence to the floor elevation of the carriage house. A 120-foot long elevated boardwalk was proposed to provide a more convenient and direct passageway between the two buildings. The original foundation design for the boardwalk included drilled shafts installed to depths up to eight feet. However, augering the holes, setting sonotube forms and placing concrete on the steep slope would not only be extremely difficult, but also potentially dangerous. In addition, the client wanted a foundation solution that would have minimal impact on the slope and preserve as many trees along the boardwalk as possible.

Solution: The design included twenty-one (21) Model 350 (3.5-inch OD by 0.313-inch wall) hollow round shaft helical piles with 8"-10" double-helix lead sections to support a design working load of ten kips per pile. The larger, more rigid shaft size was also selected to provide lateral stability at the base of the boardwalk columns. With roots and cobbles anticipated during installation, a V-style leading edge was utilized on the 8-inch helix plate and both plates were Grade 50, ½-inch thick steel. The helical piles were advanced to an average depth of approximately ten feet below the ground surface to achieve torque-correlated ultimate capacities of at least twice the design working load (FOS ≥ 2). Five of the helical piles at the base of the slope were installed with a skid steer. The remaining piles located on the steeper part of the slope were installed with a Lull material handler with a 45-foot extendable boom. A custom drive head mount was fabricated for the forklift attachment. For either equipment option, the drive head was operated off the hydraulic system of the skid steer. Custom saddle brackets were field welded to the tops of the piles to accept the 8-inch square wood columns of the boardwalk. Installation of the 21 helical piles was completed in two days.

Model 150 Helical Piles

Project: Johnson County Clear Creek Trail ● **Location:** Tiffin, IA
Foundation Supportworks® Dealer/Installer: MidAmerica Basement Systems

Challenge: Two pedestrian bridges and two boardwalks were proposed along a new walking/bike trail. The bridges, 38 and 40 feet long, would span an existing creek while the boardwalks, 11 and 55 feet long, would extend the trail over low-lying, marshy areas. Test borings completed along the proposed 1 ½-mile trail generally encountered soft to stiff alluvial silty clays to depths of five to ten feet over very loose to medium dense sand to the explored depth of 11 feet. With weaker soils sampled within the upper several feet of the profile, the structures were designed with a deep foundation system consisting of helical piles. Helical piles were selected as the ideal foundation system given the limited access, the ability to utilize smaller installation equipment and minimize site disturbance, and the ability to correlate pile capacity to the installation torque.

Solution: The foundation design for the bridge abutments included 24 Model 150 (1.5-inch round-corner square-bar) helical piles with an 8"-10"-12" triple-helix lead section to support a design working load of ten kips per pile. Each abutment included six piles arranged in two rows. The three piles furthest from the top of the bank were battered at 14 degrees toward the creek. Standard extensions advanced the piles to depths of 14 to 17 feet below the bottoms of the abutments. The piles were fitted with new construction brackets to be cast into the concrete. The two boardwalks were designed with 16 vertical and eight battered piles with the same shaft size and lead configuration as the bridge abutment piles. A design working load of ten kips (compression only) was specified for the vertical piles and a design working load of five kips (tension and compression) was specified for the battered piles. The vertical piles were advanced to depths of 14 to 17 feet below grade. The battered piles were installed at 45-degree angles and to depths of 7.5 to 12.5 feet (lengths of 10.5 to 17.5 feet). The vertical piles were fitted with saddle brackets to capture the timber girders. Eight of the saddle brackets included a gusset plate to connect to the battered piles via a thread rod and clevis. The 48 helical piles were installed in just four days; four separate mobilizations, one day per structure. All piles were installed to torque-correlated ultimate capacities of at least twice the design working load (FOS ≥ 2).

Commercial



Residential



Model 288 Helical Piles

Project: Boat Dock at Private Lake ● **Location:** Aspen, CO
Foundation Supportworks® Dealer/Installer: Foundation Repair of Western Colorado

Challenge: A new boat dock was planned along the shoreline of a small manmade lake that formed within the limits of an abandoned gravel pit. The proposed dock would extend out into the lake from a stone paver terrace surrounded on three sides by poured concrete retaining walls and stepped walkways. The dock would be eight feet wide and 32 feet long and extend into water as deep as 12 feet. Helical piles were selected to support the dock by advancing through the soft and loose soils at the lake bottom to deeper, more competent materials below. Specific challenges of the project included accurate layout and installation of the piles, reaching out with the drive head to the proposed pile locations, and providing a stable working platform for the installation crew.

Solution: The hydraulic fluid system of a skid steer was used to power a Pengo 12K drive head fitted with a custom hanger and attached to the boom of a large rubber-tired forklift. The forklift had an extendable boom capable of reaching out 40 feet. The hydraulic connections were fitted with "leak kits" and wrapped with oil absorbing mats to prevent oil leaks from contaminating the lake. A 20-foot long pontoon boat ferried the pile materials to their proposed locations and provided a working platform for the installation crew. A three-point anchoring system was used on the pontoon boat to maintain stability during installation. A combination of a 100-foot vinyl measuring tape and a laser level were used to ensure accurate pier locations during installation. The two piles located farthest from the shore were driven first and were used as benchmarks to accurately locate the remaining piles.

Eight Model 288 (2.875-inch OD by 0.276-inch wall) helical piles with an 8"-10"-12" triple-helix lead section were installed. The piles were advanced to depths ranging from 15 to 18 feet below the mud line and to torque-correlated ultimate capacities exceeding the design working load of ten kips by factors of safety greater than two. The pile components were hot-dip galvanized for corrosion protection. Despite the unique challenges associated with this project, the helical piles were installed in just two days.