Helical Piles and Anchors

Commercial

Project: Montgomery Tower Support ● **Location:** St. Louis, MO
Foundation Supportworks® Dealer/Installer: Foundation Supportworks® by Woods

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, the design consisted 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.


Compression and tension pile system installed at the northwest guy location


Finished grade beam reaction system at the northwest guy location

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FSI NEWSLETTER FOR DESIGN PROFESSIONALS

HelixPro™ Design Software

Available Now!

HelixPro™ - "Helical Foundation Design Software for Professionals" was released on September 4, 2012 after nearly a year of design, development and programming efforts. We are proud and excited to now introduce the software to our nearly 4,000 subscribers to Foundation Nation for Design Professionals (FNDP). FSI engineers routinely travel throughout the United States and Canada to promote the use of helical foundation systems through engineering seminars and presentations. We heard loud and clear when you asked for an accurate, easy to use design tool for helical foundations.

What is HelixPro™?

HelixPro™ is a state-of-the-art, web-based software created by FSI. With the software being web-based, you never have to worry about having the current version. Updates are automatic. The program calculates bearing and uplift capacities of FSI helical piles as well as tension capacities of FSI helical tiebacks. HelixPro™ calculates pile and tieback capacities using the Individual Bearing Method. For more information about the Individual Bearing Method you can reference the latest edition of the FSI Technical Manual or the cover article of the Summer 2011 issue of this newsletter.

The program is ideal for analyzing both vertical and battered piles for deep foundations of new structures, seismic retrofitting applications, tension/uplift elements of guyed structures, tiedowns, and much more.

Why use HelixPro™?

HelixPro™ allows you to perform multiple trials with varying soil profiles and helix configurations, making it easy to select the most economical and practical solution for your project.

HelixPro™ provides a step-by-step "wizard" approach, making it easy to use and navigate. There are help menus and buttons along the way to further assist the user through the design process. The following two pages of this newsletter provide a design example to illustrate the software's layout and functionality. The example utilizes real soil and project information for a guyed tower project completed in St. Louis, Missouri. The tower supports were retrofitted with helical piles and anchors to provide additional support and stability. The example is for the design of the southwest guy support where two Model 150 square shaft helical anchors were installed at a 40 degree batter. The case study for this guyed tower project is presented on the back page of the newsletter.

Some of the many other features of the software include:

- Links to case studies, current and previous issues of FNDP, and technical content on the FSI website
- Ability to save and manage projects and sort these projects by date, application and project status
- Graphical representation of soil layers and helix plate depths
- Graphical representation of installation torque with depth along with boundary lines to represent the torsional rating of the shaft
- Pop-up warnings to alert the user when the torsional rating of the shaft is exceeded, when non-standard helix plate configurations are selected, when minimum depth or embedment criteria are violated, etc.
- Generation of a summary report with a graphical representation of the proposed installation
- **FREE** of charge to you

How can you get started using HelixPro™?

It's easy! Type the following URL into your web browser: www.helixpro.foundationsupportworks.com and click on the "Register Now" link. The software will walk you through some simple registration steps. Within two working days, you should receive an email stating that your account has been activated.

FSI engineers utilize HelixPro™ every day to prepare preliminary designs for our contractor network. We are confident that you will also find HelixPro™ to be a valuable tool for your design of helical foundations.

Don Deardorff, P.E.
Senior Application Engineer

HELIXPRO SOFTWARE GUIDE AND DESIGN EXAMPLE

HELICAL FOUNDATION DESIGN SOFTWARE FOR PROFESSIONALS

Following log-in, the program opens to the ***Home*** page where the user can create a new project or view saved projects. The top menu bar also allows access to ***My Profile*** where user information is input. User name and company name are automatically incorporated into the final report. The ***Home*** page also has links to FSI case studies, newsletters and other technical information.

For this example the "Create A New Project" button is selected.

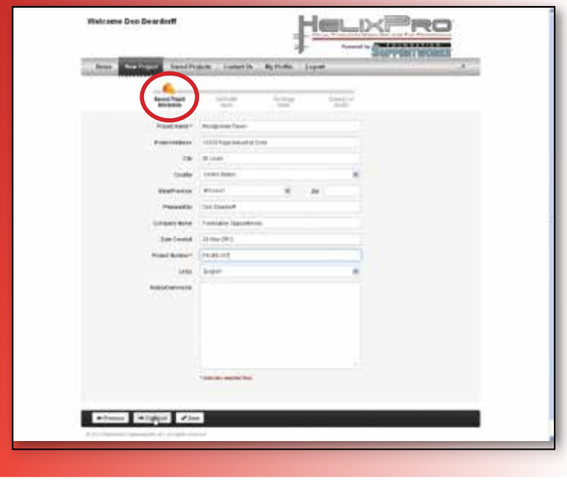
Required fields on the ***Soil Profile Inputs*** page include soil boring ID, depth to groundwater, critical depth and at least one soil layer. Seven soil types are available including sand, clay, mixed, organics, sand fill, clay fill and mixed fill. Soil strength parameter fields for clay, sand, clay fill and sand fill are populated automatically by correlation to SPT N-values; however, the user can manually override these values by entering new data. Selection of organic or mixed soils requires manual entry of the soil strength parameters. The soil profile is graphically displayed as the data is entered. Multiple borings can be entered and saved. The help menu is accessed by clicking on the question mark icons next to various entry fields. In this example, the user has entered and saved the information from Boring B-1 and is ready to continue to the next page.

The ***New Project*** page allows the user to choose between the "Helical Piles" or "Helical Tiebacks" modules. The helical piles module is selected to determine capacities of vertical and battered piles in both tension and compression. The helical tiebacks module allows the user to create multiple wall configurations, define the active zone (failure plane) for each wall and determine capacities for multiple rows of tiebacks.

The "Helical Piles" button is selected.

The ***Pile Design Inputs*** page requires input for boring ID, pile ID, pile shaft type, helix plate configuration and geometry, pile length, batter angle and pile head depth. After required fields have been filled, pile capacity is determined by the program by clicking the "Calculate" button. The ultimate tension and compression capacity, maximum installation torque, final installation torque and depth to maximum installation torque are calculated and displayed. Installation torque versus depth is displayed graphically next to the soil profile. Multiple pile types can be entered and saved.

An ultimate tension capacity of 45.9 kips is determined for the HA150 (1.5-inch round corner square bar) with an 8"-10"-12" helix plate configuration, a 40 degree batter, 37 feet of installed length and the soil conditions represented by Boring B-1.



The ***General Project Information*** page allows the user to enter project information and select either English or Metric units. The project name and project number are required fields for this page. The buttons at the bottom allow the user to save the information on this page, go back to the previous page or continue to the next page. Information has been entered for the Montgomery Tower project located in St. Louis, MO. For more information on the project, see the case study on the back page of this newsletter. Select "Continue" to navigate to the next screen of data entry.

Continuing to the ***Summary of Results*** page allows the user to select the boring/pile combinations to include in the final report, and also the order in which to present the results. Output reports are generated in PDF format for each boring/pile (pile module) or each boring/wall/tieback row (tieback module). The reports are formatted to include all of the input data, the calculated results and other design information needed for project submittals. A graphical representation of the soil profile, helical pile batter and depth, and installation torque with depth is created. For the tieback module, the graphical representation also includes the wall and failure plane geometry.

If you have any questions regarding the software, please feel free to contact FSI through the ***Contact Us*** page of the software.