DriveTech Helical Foundation SystemsDriveTech Helical Foundation Systems
248-666-4741 Ext 2
drivetechsystems.com
Waterford, Mi

Potential Advantages and Limitations of Screw-Piles and Helical Anchors

Engineers sometimes ask “What are some of the potential advantages to using screw-piles or helical anchors on my project and what are some of the limitations?” These are great questions and it seems that this might be a good place to provide some short and simple answers.

Potential Advantages of Using Screw-Piles and Helical Anchors

A1. Rapid Installation

Screw-piles and helical anchors are usually installed using conventional construction equipment such as a track excavator or a mini-excavator equipped with an appropriately sized low speed high torque hydraulic motor. There is no need to mobilize special equipment, such as a crane with a pile hammer or a large drilled shaft rig. This makes for fast and inexpensive mobilization; Contractors can respond and be on site quickly. Typically only an operator and one laborer are needed. Large load capacities can be obtained using relatively small installation equipment.

Installation rates typically are on the order of 6 to 10 rpm, which means that it only takes about 30 sec. to advance a screw-pile or helical anchor a foot, or about 5 min. per 10 ft. of

length. Depending on the extension section being used, the crew can attach a pipe or square-shaft extension in about a minute, so a 50 ft. installation should only take about 30 to 40 min. The installation is not dependent on weather conditions with most installations proceedings even in marginal conditions.

A2.Immediate Load Carrying Capability

Screw-piles and helical anchors are unique among most other types of foundations or anchoring systems in that they can be loaded immediately after installation. There is no need to wait for concrete or grout to harden, or in the case of driven piles, no need to wait for excess pore water pressures to dissipate. This can be important on some projects, for example emergency response where the construction schedule is short and the rest of the project depends on installation of the foundations or anchors.

In most soil conditions the ultimate capacity of screw-piles and helical anchors will increase with time as a result of aging effects and thixotropy. This means that the capacity immediately after installation may actually be somewhat lower that the long-term aged capacity, which is conservative.

A3. Minimal Site Disturbance

Relative to most other types of construction activity involving the installation of driven piles, drilled shafts or other anchoring systems, the installation of screw- piles and helical anchors produces little to no disturbance of the site. Specifically, the installation of screw-piles and helical anchors typically produces no soil cuttings. This keeps the site clean, requires minimal cleanup at each installation location after installation, and usually means lower project costs. An additional advantage is the low noise level associated with installation. Installation also produces minimal vibrations which can be important on some projects that are sensitive to construction vibrations. Since screw-piles and helical anchors have a small work footprint they also produce minimal disruption to adjacent structures. In cases of retrofitting or restoration, existing structures can often still be used while screw-piles or helical anchors are being installed. Since they produce no soil cuttings they can also be used efficiently at sites where contaminated soils may be encountered since the soils do not come to the ground surface.

A.4 Installation Monitoring and Verification of Load Capacity During Installation

One of the most important features of screw-piles and helical anchors is the verification of load capacity during installation. In some respects this is similar to monitoring the installation of driven piles by using a Pile Driving Analyzer during installation. This is possible by using a direct in-line torque measuring device that measures the installation torque as the pile/anchor advances into the ground. Many studies have shown that there is a relationship between installation torque and load capacity, which means that engineers can verify capacity immediately. On most projects this torque-to-capacity relationship is verified with on-site load tests.

Monitoring the installation torque also means that the soil conditions at every installation location can be verified and the subsurface variability can be assessed. By monitoring installation torque, the required load capacity can be developed by going deeper into better soil or by using a different pile/anchor geometry. Installation torque is often used as part of the allowable termination criteria given in the project specifications.

A5. Installation at Remote Locations or at Sites with Limited Access

Screw-piles and helical anchors are well suited to projects located in remote areas where mobilization costs tend to be high and other construction support services are limited or may not be readily available. Some project sites are congested or have limited access for construction equipment. Projects that involve retrofitting may have low headroom spaces to perform the work, such as inside existing structures. Since screw-piles and helical anchors can be fabricated as modular systems, consisting of lead sections and extension sections, they are ideal for low headroom or limited access situations.

A6. Installation in High Groundwater Conditions

Screw-piles and helical anchors typically do not require an excavation for installation. In cases where they are being used for underpinning of an existing structure, a shallow excavation may be needed to expose the existing foundation. Difficulties often encountered with shallow groundwater conditions at construction sites generally have little to no impact on the installation of screw-piles and helical anchors. This speeds up construction and eliminates the needs for pumps or other methods to handle groundwater and reduces costs.

A7. Easy Installation on a Batter

While it’s common to install screw-piles and helical anchors vertically, in fact they can be installed at almost any orientation to suit the needs of a project. Installation on a batter, for example to provide additional resistance for lateral loading, is simple. For earth retaining

projects, even the installation of helical anchors horizontally can be accomplished with no particular difficulty.

A8. Simple Field Modifications to Increase Load Capacity

One of the other unique features of screw-piles and helical anchors that makes them highly versatile is the ability to quickly modify the configuration of the helical elements to increase load capacity. This is achieved in part by the modular nature of the technology. Adding extension sections with additional helical plates and/or helical plates of larger diameter is easy and means that the engineer can quickly develop a solution without requiring the fabrication of an entirely new foundation or anchor. This again shows the versatility of the technology.

A9. Wide Range of Soil and Load Applications

Screw-piles and helical anchors can be installed in a wide range of subsurface conditions, from very soft to very stiff clays, from loose to very dense sands. Design loads have a very wide range depending on the needs of the project and can be as high as 650 kips!

A10. Low Carbon Footprint – Sustainable Technology

Many manufacturers of screw-piles and helical anchors use high quality recycled steel to in their fabrication. This conserves natural resources and energy and reduces the overall carbon footprint. Screw-piles and helical anchors are especially useful for support of temporary structures since they can be removed and reused with little to no change in structural integrity. This is very different that a driven pile or drilled shaft or a grouted anchor which are often just abandoned. Some screw-piles have been in place for several years, have been removed and reused at another site.

A11. Modular Construction

Screw-Piles and Helical Anchors are fabricated in sections giving a modular type of construction. This means that it is easy to extend or reduce the length of installation as needed to suit the site conditions and the design requirements.

Potential Limitations of Using Screw-Piles and Helical Anchors

Screw-piles and helical anchors provide the engineer with another tool in their toolkit for developing alternative solutions for solving problems and like every other technology available they are not without some limitations.

L1. Limiting Soil Conditions

Screw-piles and helical anchors are generally limited to installation in soils that have a maximum grain size less than about 60% of the pitch of the helices. For a typical pitch of 3 in. this means a maximum grain size of about 1 ¾ in, or medium gravel. Screw-piles and helical anchors will generally not advance correctly in gravel and cobble deposits; they simply should not be used. They are also not suited to rock, although it may be possible in some cases to advance a lead helical plate to bear within the first few inches of weathered rock, such as in residual soil profiles.

L2. Equipment Limitations

Proper installation of screw-piles and helical anchors is essential to performance. The equipment used by the Contractor should be selected to meet the expected soil conditions on a project, the specific geometry selected for the work and the expected maximum installation torque. Undersized equipment will limit the proper advance and final installation. A general rule of thumb is that the weight of the machine should be about 1/2 ton per 1000 ft.-lbs. of installation torque needed. So if the maximum torque expected on a project is 6500 ft.-lbs, the machine should have a minimum weight of about 3 ¼ tons.

L3. Structural Limitations

Every screw-pile and helical anchors has a structural limitation that is identified by the manufacturer. This is sometimes referred to as the “torque rating”. It means that there is a limit to the amount of torque that should be applied to the screw- pile or helical anchor before the structural integrity is compromised. During installation, this limit should not be exceeded even though perhaps the equipment being used for installation has a much higher torque capability. In case where repeated limiting torque is being reached during installation and the installation specifications are not being met, a different configuration of screw-pile or helical anchor needs to be used.