

Understanding Helical Piers: Applications, Mechanics, and Installation

A Comprehensive Guide to Helical Pier Foundation Solutions

By Matthew Kromke, 2/2/26

Introduction

Helical piers—sometimes called helical piles—are a versatile and reliable foundation system widely used in residential, commercial, and industrial construction. Their ability to stabilize structures suffering from foundation settlement, especially in challenging soil conditions, makes them a preferred choice among engineers and contractors. This document will explore in depth what helical piers are, their typical construction, how they function, their installation methodologies, differences from push piers, and best practices for their use in various situations.

What Are Helical Piers?

Helical piers are deep foundation elements designed to transfer building loads to stable soil or bedrock well below the problematic surface strata. Their defining feature is the helical “flight,” a spiral-shaped plate welded to the shaft, which allows the pier to be screwed into the earth much like a giant screw. This unique geometry distinguishes them from other types of piles or push piers.

Construction and Materials

Helical piers are manufactured using several common shaft configurations and sizes. The main options include:

- Square bar: Usually 1-1/2 inch, 1-3/4 inch, or 2 inch, suitable for lighter loads or specific soil profiles.
- Round pipe: Common sizes include 2-7/8 inch, 3-1/2 inch, 4-1/2 inch, and even 8-5/8 inch diameters for heavy-duty applications.

Though nearly any steel section can theoretically be made into a helical pier, these sizes are considered standard, offering reliable performance and predictable engineering properties.

At the lower end of the pier, one or more helical plates—sometimes called flights or helices—are welded. These serve as the threads that cut into the soil, providing both anchorage and bearing capacity for the load above.

How Do Helical Piers Work?

Unlike push piers (which rely on resistance from an overhead structure to be driven into the ground), helical piers are installed by screwing them into the soil using hydraulic machinery. This method offers a controlled process with immediate feedback about soil conditions.

Installation and Depth Requirements

For helical piers to be effective, they must be installed deep enough to reach stable, load-bearing strata. Settlement problems typically arise due to poor or unstable surface soils, so the installer must drive the pier through this weak zone and into denser, firmer material below.

During installation, torque is measured continuously. The torque required to advance the pier is directly proportional to its load-bearing capacity. This relationship is captured by a formula:

- $Q_{ult} = K_t(T)$ = Ultimate axial tensile or compressive capacity, lb, of the helical pile.
- $Q_{all} = (Q_{ult})/(F.S.)$ = Allowable axial tensile or compressive capacity, lb, of the helical pile.
- F.S. = An appropriate factor of safety for the project, but not less than two (2).
- K_t = Maximum torque correlation factors of 9 ft^{-1} and 7 ft^{-1} should be used for compression and tension piles, respectively.
- T = Effective torsional resistance, which is defined as follows: For single-helix piles supporting axial compression loads, it is the installation torque measured when the pile reaches its final tip embedment; for all piles supporting axial tension loads and for multi-helix piles supporting axial compression loads, it is the average of the last three (3) installation torque measurements. Such torque measurements, in lb-ft, must be made at one (1) foot increments of tip embedment as the lead helix moves from a position, which is two (2) feet prior to the final tip embedment, to the final tip embedment.
- For example, a pier installed at 5,400 lb-ft torque would have an allowable capacity of $9 \text{ ft}^{-1} (5,400 \text{ lb-ft}) / 2.0 = 24,300 \text{ lb}$.

This direct relationship gives installers confidence in the real-world performance of each pier.

Vertical Load Solutions

Helical piers excel at solving vertical foundation problems—issues where the building is settling unevenly, sinking, or experiencing compression or tension forces. They are not inherently suited for addressing horizontal loads, such as lateral movement or sliding caused by unstable slopes or soil creep.

Battering Piers for Horizontal Loads

In cases where some resistance to horizontal forces is needed, installers can “batter” the pier, installing it at a slight angle (typically up to 30 degrees out from a vertical plane) to better counteract these loads. However, this solution is only partial and proportional to the angle of installation; for serious horizontal problems, other foundation solutions are recommended.

Helical Piers vs. Push Piers

Helical piers and push piers share the goal of stabilizing or lifting settled structures, but they work in fundamentally different ways:

- **Push Piers:** Driven into the ground by hydraulic force, relying on the building itself to provide resistance. As the pier encounters firmer strata, resistance increases, and the pier can lift or support the structure.
- **Helical Piers:** Screwed into the earth, independent of the building’s weight, reaching stable soils and offering immediate resistance via installation torque.

Push piers rely on both end bearing (at the tip) and friction along their length, whereas helical piers primarily depend on the bearing provided by the helical flights.

Installation Details and Foundation Repair Applications

Common Residential Problems

Most residential foundation issues arise from uneven settlement. Sometimes only part of the house—such as a corner or a chimney—needs stabilization. In rare cases, the entire structure may be affected.

Helical piers are ideal for these scenarios, providing targeted support where needed. Typically, foundation specialists install an L-shaped steel bracket at the top of the pier. This

bracket is positioned under the wall, often requiring some removal of the concrete footing to achieve proper placement. The bracket is adjustable via threaded bolts, allowing for precise, gradual lifting of the foundation (generally up to about 6 inches).

Capacity and Spacing

L-shaped brackets used with helical piers typically have a load capacity of about 25 kips, although the piers themselves can handle much higher loads (50 kips and up). For most residential applications, spacing piers no more than 6 feet apart ensures the foundation wall can span the distance without excessive stress, whether supported by the wall itself or the underlying footing.

Minimum spacing between piers is crucial. The rule of thumb is three times the diameter of the helix or three feet—whichever is greater. Installing piers too close together results in reduced load capacity.

Realistic Expectations for Structural Recovery

In many foundation repair projects, it is common to attempt lifting sunken portions of a structure after installing helical piers. However, expectations should be tempered, as buildings tend to resist fully returning to their original shape. Over time, the structure adapts to its new resting position—soil may migrate into cracks and prevent full closure, framing members shift, and nails or fasteners slip and may not return exactly to their initial locations. As a result, a realistic expectation is that only a portion of the original settlement will be recovered. For example, if a foundation has settled one inch, the installation of helical piers may only lift it approximately one-half of an inch.

Wall and Foundation Types

Helical piers are most effective when used with concrete and concrete masonry unit (CMU) walls. They are generally unsuitable for rubble or brick foundations, as these lack the continuous structure necessary for arching action between piers. Over time, lime-based mortar in old brick or rubble foundations can deteriorate, leaving only sand and undermining any support the piers might provide.

For walls built on crushed stone (instead of concrete), installers can use lengths of steel angle to spread loads across the wall. This approach involves digging pits and sliding angles beneath the foundation, ensuring support is maintained during installation.

Eccentricity Considerations

By nature, the L-shaped bracket introduces a small amount of eccentricity—the load does not sit perfectly centered over the pier. For light residential loads, this is manageable, as the soil and wall resist horizontal translation. For heavy commercial loads or thick walls, eccentricity can be problematic. Staggering piers (alternating inside and outside placement) can help mitigate these forces.

Push piers, in contrast, are typically installed perfectly vertically and are considered concentric. This makes them especially suitable for larger loads and thicker walls.

Site Conditions and Special Situations

Helical piers only address vertical settlement. For houses on unstable slopes—such as near creeks, rivers, or hillsides—a vertical solution alone is insufficient. The horizontal component of foundation movement must be countered first, usually by installing a properly designed retaining wall before the piers are added. Riprap may suffice for minor soil stability issues, but a retaining wall is essential for severe cases.

Special care must be taken when installing helical piers on the low side of a slab or wall that is not restrained at the top. Removing soil in one go during installation, especially in garages or areas with uneven ground levels, can lead to wall collapse due to a lack of restraint. Installers should be mindful of staging soil removal and maintaining support throughout the process.

Summary and Best Practices

- Helical piers are screw-like foundation supports installed in stable soil, suitable for vertical load problems.
- They come in standard sizes (square bar or pipe), with helical flights at the tip to anchor into the earth.
- Their capacity is directly related to installation torque; proper depth and torque ensure reliable support.
- L-shaped brackets allow controlled lifting of settled structures; however, structural recovery is typically partial because buildings adapt to their deformed shape over time. Soil fills cracks, framing shifts, and fasteners move, so only a portion—often about half—of the original settlement is recoverable.
- Effective for concrete and CMU walls; not recommended for rubble or brick due to lack of structural continuity.

- Minimum spacing between piers is three times the diameter of the helix or three feet.
- For sites with both vertical and horizontal movement, address horizontal stability first (retaining wall) before installing piers.
- Take care with unrestrained walls during installation to avoid collapse.

Helical piers offer a robust, proven solution for many foundation repair scenarios. When properly installed and engineered, they restore stability and safety to buildings suffering from settlement, ensuring longevity and peace of mind for property owners. As with any foundation system, understanding site-specific conditions and adhering to best practices is key to a successful outcome.