

by Greg DiBernardo

# Working With Helical Piers

Steel piles are an affordable foundation option for small jobs and tricky sites



**M**y deck company builds about 50 projects a year. That's a lot of footings, especially when you hate digging footing holes and mixing up concrete as much as I do. Since I began building with helical piers, I've stopped wearing out shovels and posthole diggers. I no longer worry about the inspector arriving on schedule to look at my footing holes — or about watching them fill up with water if

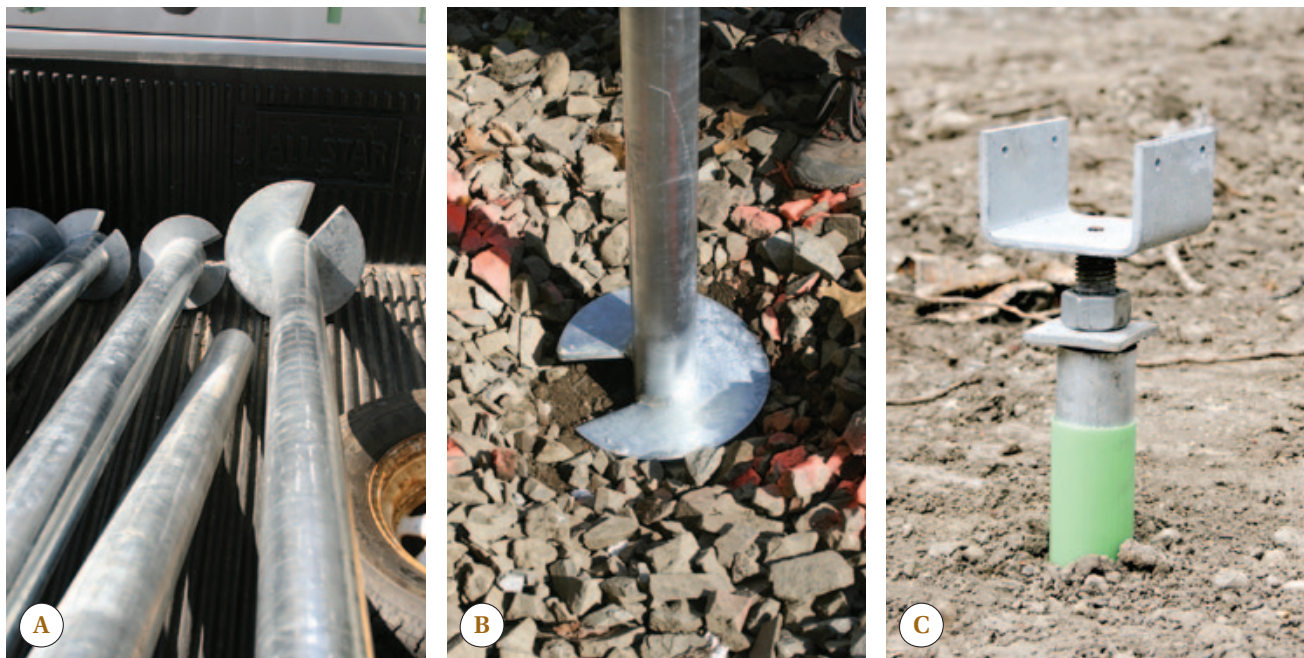
he doesn't. And once a pier is installed, I know exactly how much weight it can support.

## Steel Foundation

A helical pier is a manufactured steel foundation pin that is driven into the soil to a depth below frostline using hydraulic machinery (see **Figure 1**, next page). Helical piers are primarily used in heavy

commercial work, but they're also well-suited for backyard decks, additions, and foundation repairs.

Two years ago, I bought a franchise with Techno Metal Post (see "Dealership" sidebar, page 54). Now a big part of my business volume comes from installing piers for other contractors. Most helical piers are driven with a skid-steer or excavator, but Techno Metal Post uses a proprietary



**Figure 1.** Helical piers have a screw-shaped plate welded to a zinc-coated steel shaft, and are made in different sizes for different soils and applications (A). As the driver turns the pile, it simply screws into the ground until the installer is confident it's below the frostline and in soil with sufficient bearing capacity (B). Several types of caps are available to attach piers to framing; some are adjustable in order to fine-tune the elevation (C).



**Figure 2.** A pier's bearing capacity usually relates to the torque required to drive it. A gauge on the machine measures the hydraulic pressure, which correlates to the torque.

machine that's small enough to fit through a gate and go places larger machines can't. I can actually drive the rig right onto an existing deck if I need to retrofit additional footings to support a new hot tub.

Typical piers have a 7-foot shaft with a helical bearing plate welded to the end and a cap on top that attaches to the framing. Most piers intended for residential use are hot-dipped galvanized steel. If the soil is particularly corrosive, sacrificial anodes (similar to those used to protect underground LPG tanks) can be added. In most commercial and industrial applications, however, the piers aren't even galvanized.

The diameter of the helix varies based on soil conditions. Generally, the installer selects a smaller helix for rocky soils and a larger one for marshy and clay soils. Once the pier is set, a variety of caps are available to tie the pier to the framing; some of them have a screw assembly that allows fine-tuning of the elevation.

### Bearing Capacity

The load-bearing capacity of a helical pier usually relates to the amount of torque re-

quired to install it, a function of both the size of the helix and the soil's bearing capacity. A pressure gauge on the installation machine reads the torque as the pier is rotated into the ground (**Figure 2**).

In weaker soil, the pier will be driven deeper to reach stronger soil. (If greater bearing or uplift capacity is required at shallower depths, the project engineer may specify multi-helix piers.) When the helix is below frostline and the pressure gauge hits a high enough number relative to the loading requirements of the structure, the installation is complete. To calculate the actual bearing capacity of the pier, the pressure reading is plugged into a formula called a torque correlation.

When poor soil conditions mandate going deeper than the standard 7-foot-long shaft, we weld on an extension (**Figure 3**). Sometimes all it takes is a foot more depth to go from terrible soil to firm material. This is particularly relevant if we're building a freestanding deck where the piers close to the house might start out in back-fill. If we were excavating to install a conventional concrete footing, we'd have to dig



**Figure 3.** Shaft extensions are welded on and the pier driven as deep as needed to reach soil with adequate bearing capacity (A). The pier can be steered around a below-grade rock by moving the driver's boom; once the obstruction is passed, the boom pulls the shaft plumb again (B). Even though this pier penetrates about 13 feet into the ground, there's no pile of excavated soil as there would be with a conventional footing (C).

down to virgin ground at the house foundation level — as much as 7 feet or 8 feet if the house had a basement. It's far easier to drive a helical pier to this depth.

Also, with a traditional footing, you never really know what lurks an inch below the bottom of your footing excavation. Now that I am in the helical-pier business, I frequently see situations where seemingly good soil turns to mush inches below where I typically would have installed the footing.

**Rocks.** Normally, we just power through loose rock basketball-size and smaller. The installation machine generates sufficient torque for the helix to push rocks out of the way as it turns. Sometimes, the installer can actually steer the helix around a rock, then use the machine's boom to pull the pier back into plumb.

If we hit a large rock below frostline, the pile is parked on top of the rock and load-tested (see "Load-Testing" sidebar, right). Assuming it passes the load test — it usually does — we can be confident the pier will never move. If it doesn't pass the load test, the pier will have to be installed in a

## Load-Testing a Pile

**L**oad-testing a helical pile is far simpler than it sounds. The height of the pile above grade is measured (top photo, right). Next, a cap is inserted into the pile to protect its top. This cap is slammed five times with a sledgehammer (bottom photo, right), and the pile's height is measured again. The sledge's weight is specific to the size of the pile — a heavier hammer is used with bigger piles. The amount that the pile sinks indicates the soil bearing capacity, which an engineer will verify. The dynamic loading imposed by an impact load is surprisingly large and correlates to the static load a pile can handle.

Load-testing (instead of taking a torque reading) is used in several circumstances — such as when the pile bottoms out on a large rock or the soil is particularly slippery. With wet clay, for instance, the bearing capacity may be higher than torque readings would suggest because the soil is lubricating the helix and reducing the force required to turn it.





**Figure 4.** Above is a typical deck foundation using helical piers, which have greater bearing capacity than concrete piers and install with little disturbance to the landscape. At right, treated posts supporting a porch have been fastened to connector caps on the helical piers.

## Is a Helical Pile Dealership Right for You?

After discovering how useful helical piers were in my own deck-building and construction businesses, I realized other contractors in my area would probably love to use them, too. Residential helical piles are still not readily available around here, so I saw a huge market opportunity.

There are many helical-pile companies that specialize in commercial work, but they usually avoid smaller projects, partly because their hydraulic equipment (typically mini-excavators and larger machines) don't fit easily into tight places and tend to trample the landscape. There were several helical pile brands I could have affiliated with, but Techno Metal Post was the only company I found whose proprietary installation machines are portable enough and left a light-enough footprint for me to use on residential projects.

Because I was already running my own contracting businesses, I knew I would need some help getting a dealership off the ground. I found two partners with complementary skills, and together we went through the process of setting up in northern New Jersey. The startup costs included purchase of a protected dealership territory, an installation machine, a dedicated truck, hand and power tools, and a variety of incidentals we need for field operations. We also purchased about \$10,000 of initial pile inventory so we could hit the ground running with a variety of sizes and types. We earmarked additional funds for advertising — we knew we'd essentially have to create a market, since no one in our area was likely to have used helical piles.

Given our experience, I'd say the minimum needed to start a dealership is about \$50,000, though having more cash on hand would certainly not be a bad idea. Rather than requiring a single large buy-in at inception, Techno Metal Post charges its dealerships a small annual territory fee, which makes it easier to get started. The company does not offer financing.

different spot. On critical jobs, a soil test has often been done before we get there so we'll know where there's ledge or bedrock.

When we encounter a large rock above frostline, it can be drilled and the pier's shaft pinned to the rock. Occasionally, however, there is so much rock on the job helical piers just won't work. There are some locations where I don't even bother trying to install them because every lot on the street was blasted out of bedrock.

In average soil, driving a helical pier takes about 10 minutes, after which it's ready to build on. A P2 pier with a 2 $\frac{5}{8}$ -inch-diameter shaft — the smallest pier I install — will support a 6,800-pound load. A concrete pier would need to be bigger than 16 inches in diameter in verified 4,000-psi soil to achieve the same capacity. Because of the higher bearing capacity, most projects require fewer piers, although larger beams may be needed for the greater spans.

## Engineered Support

For small jobs, we can usually specify the right size helical piers based on the loading of the structure, though a Techno Post engineer is always available for design help. On additions and other large jobs, the architect or engineer typically provides the pier specs.

During the installation, we record pressure readings, pier depth, and load-test



**Figure 5.** Adding a vertical extension to the drilling rig makes it possible to drive piers into steeply sloped sites (A). The machine is also well-suited to foundation stabilization work, as it can fit in tight spaces around existing homes (B). Piers are typically installed every 6 feet along an underpinned foundation (C).

results for each pier in a field report. If required, a Techno Post engineer will then stamp the field report and send it directly to the building department. (Some departments don't require a stamp. Your local pier installer will know the acceptable way to proceed.) The cost of this engineering is built into the cost of every helical pier we install, though different pier manufacturers may charge separately for an engineering report.

With helical piers, the torque correlation combined with per-pier load testing also means there is no need to test the soil capacity or rely on guessing. Once the pier is installed, you will absolutely know its bearing capacity.

You may experience some pushback from your local building official the first time you propose helical piers. Chances are he or she has little or no experience with them, so you may have to provide supporting documentation along with your construction drawings. Ask your installer for this documentation to submit with your plans. Generally, most officials just need to understand how a helical pier works, but some can make life difficult. My experience is that once they see the finished product along with a stamped field report, they not only accept helical piers, they recommend them to other contractors.

## Applications

Helical piers can be substituted for traditional concrete piers on most additions (Figure 4). If the addition is close to grade, we bolt support beams directly to brackets welded to the piers, but for taller structures, we may use treated posts on top of the piers to reach horizontal beams.

**Difficult terrain.** When getting the machine to the base of an incline turns out to be nearly impossible, we try to install the foundation from above. Often, we can anchor the machine at the top of a cliff or incline and put an extension on

it to get the drive head over the installation location. This is a tricky install that requires skill and experience, so our customers can expect to pay a premium for it (Figure 5). Even so, helical piers are faster and cleaner than nearly any other method and may be the only way to get a foundation installed on difficult sites.

**Underpinning.** It is not uncommon for an existing structure's footing to be too small to carry the additional loads of a second- or third-story addition. Or sometimes the foundation may be sinking because it was installed in poor soils. Either way,



helical piers are a great alternative to traditional underpinning using concrete, because they can be installed much more quickly and cleanly.

Usually we start by excavating from the outside to expose the foundation footings, though we can sometimes also work from inside the structure. We bolt brackets to the foundation and drive the piers through them. After the structure is either stabilized or lifted as required, the piers and brackets are welded together, and backfilling can begin. With good site conditions, we can install four or five underpinning piers a day with a two-man crew.

**Structural deficiencies.** Our installing machine weighs less than 1,000 pounds and can fit through a 32-inch-wide doorway, so it can be driven and operated even in basements if the access is right. When we can't get the whole machine inside, we can remove the drive head and use a special mount that gets us into even tighter spaces (Figure 6). This allows us to quickly add a new pier under an existing beam or replace a failed footing. In spaces with tight overhead conditions, we'll use piers with shorter shafts and add extensions as the pier goes into the ground.

**Poor soils.** Installing a traditional foundation on a lot with poor soils can be expensive; it usually takes a lot of excavation and lots of compacted fill. And even then massive spread footings may still



**Figure 6.** The author's small rig excels at going places larger pile-driving equipment can't (A, B, C). When the machine won't fit into a tight area, the drive head can be mounted on a portable bracket that bolts to the structure (D).

be needed. But when helical piers are included in the foundation design, you can usually eliminate extra excavation and concrete. In such cases, the foundation is typically excavated to standard depth, and then we install helical piers in the centerline of the footing form at specified intervals down to good soil or bedrock. Before the concrete is placed, the pier caps are tied into the rebar of the traditional footing.

### Costs

While installed costs will vary regionally and with the size and depth of the pier, our typical residential helical pier costs \$150 to

\$250 installed. This includes pier, installation, engineering, and a cap bracket to connect the pier to the structure. (That's less than it costs me to install a concrete footing after factoring in all my labor and material costs.) The price for underpinning depends on factors like depth and the quality of the footing we are connecting to, but averages around \$1,800 per pier, not including excavation and backfill.

*Greg DiBernardo owns Bergen Decks in Waldwick, N.J., and is a partner in Techno Metal Post of Northern New Jersey. Photos are courtesy of the author and Techno Metal Post.*