An Introduction to Retrofit Push Piers

Kyle Olson, P.E. Senior Structural Engineer

Design professionals are becoming confident with utilizing helical piers on their retrofit foundation stabilization or repair projects. There is, however, another solution that can often achieve similar results. For certain projects, "push piers" (occasionally referred to as "resistance piers"), may offer a more practical solution for areas of even tighter access. Push piers can also commonly be more economical in many soil profiles.

What is a Push Pier?

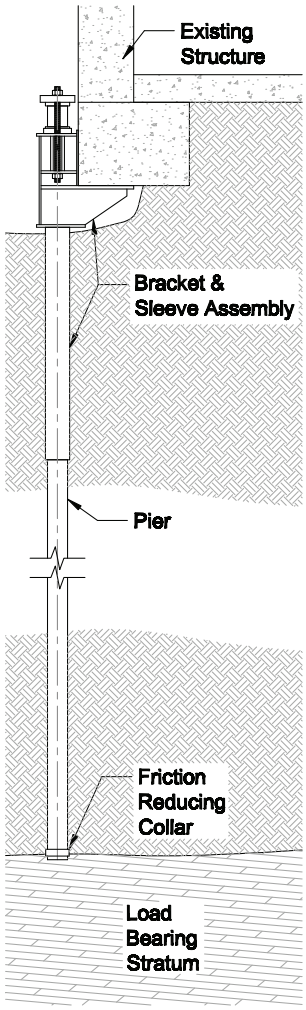
As the name suggests, push piers have a blunt end and are simply "pushed" into the ground until a suitable bearing stratum is reached (Figure 1). They are not to be confused with driven piles that utilize the impact of a falling hammer. Push piers are assembled from three foot pier segments that couple together and utilize hydraulics to advance them into the ground at a steady rate, usually between three to five feet per minute. Push piers are strictly intended for retrofit applications since in order for the hydraulics to push down against the pier, the system needs to push up against an object substantial enough to provide a sufficient reaction. The existing structure is what provides this reaction.

One significant advantage that push piers have is their ability to penetrate various layers and strengths of soil to achieve great depths. An important feature that makes this possible is called a friction reducing collar which is simply a ring that is welded to the first pier segment (Figure 1). This slightly enlarged end creates a small annular space around the pier shaft that can dramatically reduce skin friction as the pier is advanced through the soil. This results in a pier that generates most of its capacity in end bearing. Over time, the soils surrounding the pier will relax and heal back against the pier shaft and provide an additional skin frictional component to the pier's capacity. This can begin to happen in a matter of hours or days. This frictional resistance in some cases can be significant, but since it is impossible to quantify and is highly variable between jobsites, it is conservatively neglected in the determination of the pier's factor of safety against pier settlement.

When should I consider push piers over retrofit helical piers?

Helical piers are installed through the application of torque and their capacity is directly related to the level of torque that they can achieve. We often say that a helical pier needs more steel to get itself into the ground than it needs to resist the axial loads it will experience once the pier is in service. Push piers do not have to resist torque and therefore utilize thinner-walled pipe than their helical counterparts of similar diameters. This is also one reason that a push pier benefits from having a longer external sleeve. At similar pier depths, the thin-walled push pier will have lower material costs. It's important to understand, however, that a push pier will tend to achieve greater depth than a helical pier but most often the push pier remains more economical. An evaluation should be done for each site to determine if the difference in depth can be significant enough to eliminate the push pier's economical advantage.

Figure 1: Retrofit Push Pier Installation



FOUNDATION SUPPORTWORKS®

One particular circumstance where push piers have a distinct advantage is when a highly compressible soil layer has been identified below a layer of material that has much higher strength and density such as an engineered fill. A helical pier will tend to develop its torque in the denser material. A push pier will have much more success in penetrating through the dense layer and beyond the compressible material to develop its resistance from below the problem soils.

Factor of Safety

Push piers develop a factor of safety against pier settlement by utilizing a larger force to drive the piers into the ground than is used to lift the structure. A common concern for individuals first becoming familiar with push piers has to do with the feasibility of developing the larger drive forces since a structure cannot provide a reaction beyond its own weight. Although this is true, these concerns are soon dismissed once more is learned about the sequence of the installation. Push piers are advanced one at a time and are therefore gathering their reaction from a larger tributary area of the structure during installation. After all of the individual installations, the piers are connected hydraulically in series to be re-loaded to stabilize or lift the structure. The combined resistance of all of the piers working together allows the structure to be lifted at loads much lower than the piers experienced during installation. Typical minimum specified factors of safety commonly range from 1.5 to 2.0, but in the field, observed factors of safety can be as high as 3.0. Because of this relationship between installation forces and lift forces, it's common to promote push piers by stating that each pier is essentially load tested during installation.

Foundation Supportworks® has push pier products with diameters of 2-3/8, 2-7/8, 3-1/2, and 4 inches and can achieve allowable capacities up to 44,000 pounds per pier. Contact Foundation Supportworks® or a local Foundation Supportworks® installing contractor to assist you with your next potential push pier project.

Hydraulic cylinder installing a 2-7/8 inch push pier.

Kyle Olson, P.E. Senior Structural Engineer

Kyle focuses on the development and verification testing for many of FSI's products and equipment. He provides technical support to installing contractors and their consultants. Kyle is often involved in unique projects, especially those that include specialty connections, brackets or other custom products. Kyle also assists with the development of technical documents and presentations.

FOUNDATION SUPPORTWORKS®