

FROST HEAVING OR EXPANDING SOILS

Soils around the country will freeze to varying depths during the winter months, but they may not cause any harm to foundations if they don't also heave. *Frost heave* will only occur where and when the right conditions are in place—fine grain soils such as silts, high water saturation, and just the right rate of temperature drop—usually where there is minimal snow cover to provide ground insulation.

Most soils in colder climates are categorized as having either low or moderate risk of heave. The smaller Diamond Pier foundations are designed to resist soil movement in these areas. In properly drained sites with sound soils, the spread pin configuration works like a bell-shaped footing to hold down the concrete head, which is pointed at its base and designed to cleave the heaving soils around it. As long as there is enough pin length to counteract these upward forces, the surface soils will move up (and down) past the fixed pier. Typically, the pin length, in inches, matches the vertical dimension of the local frost depth.

Example: For a 48-inch frost depth, a 50-inch pin is recommended.

Where severe heave is well known—in parts of New Hampshire, Vermont, Minnesota, and Alaska, for instance—all types of foundations are at risk for displacement, including deep straight cylinder-style piers. In these locations, heave pressures may exceed the pin uplift resistance for a time, but the concrete head will continue to stay centered and locked on the pin cluster. Like a pressure relief system, the pins may be left slightly higher out of the pier at the end of a hard winter, but they can be reset in the spring without losing the pier position or bearing strength. In the most extreme conditions, larger Diamond Piers foundations, with a larger pier diameter and deeper pins, may be necessary. Depending on the drainage conditions and the height of the superstructure, these larger piers may also be installed with a rounded pea gravel backfill to enhance the drainage and soil movement around the concrete head.

Soils can also heave in warm climates due to the *expansive swelling of clays*. As with freezing soils, not all clays are subject to heave or swell, and those that are may only heave near the surface, while others experience “deep swell.” Clays that do not typically heave at all, or heave only a small amount, are called *lean clays*, and they dominate the northern Midwest. Where more plastic clays are abundant—Colorado and Texas, for instance—the soils will swell (and shrink again) according to wet and dry periods.

The smaller Diamond Pier models are designed to work in lean and low to moderate swelling clays. Again, the pins provide anchoring resistance for the concrete head and, as long as there is enough pin length to counteract these upward forces, heaving soil is forced to cleave past the pointed base of the fixed pier. This upper heaving soil layer is known as the *saturation zone*. Its heave is caused by infiltrating rainfall or irrigation, and it is typically only a foot or two deep. Diamond Pier pin lengths should be a minimum of this depth, in inches, plus an additional 12 inches in length. For more forceful or deeper expansive soils, larger Diamond Pier models with larger deeper pins may be necessary, and rounded pea gravel backfill may be added around the concrete portion of the pier to enhance drainage and soil movement.

Deep swelling clays, however, like severe frost heave, can be a problem for all types of foundations. They are generally the result of the movement of deep subsurface waters, often caused by man-made excavations and/or off-seasonal irrigation, which can cause otherwise dormant deep clays to expand. One of the benefits of the Diamond Pier foundation is that its low-impact installation avoids the kind of excavation in these unique soils that can often lead to deep swell problems.