Engineering designs for Executive Structural Piering LLC. Pile Power LLC Helical Pile Design:

Bearing capacity depends on:

Soil properties Geometry of the pier (pipe size, helix size, material thickness) Pier steel material Size of pier (cross- section, length) Pier embedment depth Pier installation (vertical, horizontal) Spacing between piers Installation torque.

Installation:

Installation of Pile Power helical piles should be completed by qualified installers only. Ultimate pier failure could occur if proper installation criteria is not followed. Installation of helical piers is to be completed using a torque head. Torque heads should be well maintained and serviced on a regular basis. Information from the manufacturer should be available to determine motor and gear efficiencies. Pressure gauges should be tested and or replaced on a regular basis. Gauge tolerances must be accurate with 1%. Torque will be continuously monitored and recorded throughout the installation of each pier. Each pier section shall be recorded reflecting pier section length and any additional notes regarding installation conditions. Pier location and identification shall be documented as piers are installed. Such information should include; project name and location, date, weather conditions, torque head used, a site map reflecting pier placement, starting psi and finishing psi and any notes regarding installation conditions. For small shaft piers, there is a direct relationship between installation torque and pier capacity. Continuous monitoring of torque during installation will provide the installer with a profile of the underlying soil conditions. Piers installed, for the purpose of compression, should be installed based on the hydraulic pressure curve of the torque head. During ideal installation, the torque values should be constantly increasing, indicating that the pier is being inserted into more dense soil. If a drop in torque is recorded, it is most likely that a soft layer (such as soft clay) was found. The pier must continue to be inserted past the soft layer until a more dense soil is found. Refusal will be determined by no vertical movement of pier depth. Auguring of pier may be required in order to penetrate very hard layers of clay stone. Vertical drop, even of only 1/8″ per rotation, shall continue for either a depth into hard clay stones of 2′ min or until refusal. An empirical method has been derived and used in the screw anchor industry for many years. Installation torque is used to calculate the ultimate capacity of the screw anchor. The average torque achieved during the last three to five feet of installation is directly proportional to the ultimate axial capacity of the pier. Colorado State University conducted a three-year study (1995-98) on the migration of water along helical piers shafts. The result indicates no more water penetration along the shafts of helical screw piles than along the sides of drilled concreted shafts. The starter section of the piers are cut to a 45 degree angle in order to assist the installer in targeting the pier during installation.

Installation Limitations:

Piers should not be installed closer than 3 diameters of the helix apart, at any time. Piers installed in clusters, where load requirements exceed individual pier capacities, should be battered not greater than 5 degrees, in order to achieve the minimum 3 diameters apart. Piers designed to be used in tension- use 70% of installed compression capacity. For piers subjected to uplift (for frost depth) the embedment depth of the helix shall be at least 5 helix diameters or deeper than the maximum frost penetration depth is in the area. Minimum pier depth not to be less than 5′.

Bearing and Uplift Capacity:

For a single helix pier, the total resistance is derived from shaft and bearing resistance. helical pier loading compression and tension Single Helix in cohesive soil ($\Phi = 0$ Condition) *Compression:* $Q_c = A_h C_u N_c + \pi d H_{eff} \alpha C_u$ Q_c = ultimate pile compression capacity (kN) C_u = undrained shear strength of soil (kPa) A_h = area of helix (m^2) N_c = dimensionless bearing capacity factors (due to pier diameter) d = diameter of the shaft H_{eff} = effective pier length, $H_{eff} = H - D$ α = adhesion factor*Tension:* $Q_t = A_h (C_u N_u + \gamma' H) + \pi H_{eff} \alpha C_u$ Q_t = ultimate screw pile uplift capacity (kN) γ'= effective unit weight of soil above water table or buoyant weight if below water table (kN/m^3) N_u = dimensionless uplift bearing capacity factor for cohesive soils H = embedment depth (m) Single helix on cohesion-less soil *Compression:* $Q_c = \gamma' H A N_q + \frac{1}{2} P_s H_{eff}^2 \gamma' K_s \tan\Phi$ K_s = coefficient of lateral earth pressure in compression loading Φ = the soil angle of internal friction, degree N_q = dimensionless bearing capacity factor for cohesionless soils P_s = the perimeter of the screw pile shaft The bearing capacity factor N_q, can be calculated using: $N_q = e^{\pi \tan\Phi} \tan^2(45^\circ + \Phi/2)$ or friction for cohesion-less soils *Tension:* For single helix screw piles installed in shallow condition $H/D < (H/D)_{cr}$ $Q_t = \gamma' H A_h F_q^* + \frac{1}{2} P_s H_{eff}^2 \gamma' K_s \tan\Phi$ K_q = dimensionless coefficient of lateral earth pressure in uplift for sands F_q = breakout factor for shallow condition F_q^* = breakout factor for deep condition Due to variations in the soil composition the exact mechanics and load capacity for any given soil condition can only be verified through actual load testing at each site. Above reflects guidelines only for the design of pier installation.*Coefficients* Shaft adhesion is based on the effective shaft length. The adhesion develops along the steel shaft as the pier reaches a sufficient installation depth. When the pier is used for shallow installation, and therefore doesn't reach a sufficient depth, the adhesion factor is considered insignificant. graphic of shear strength K_s / K_o varies based upon the density of the soil. The K_s / K_o ratio is 0.75-1.25 with K_o determined in the following manner: relative density and soil friction for piers K_u is dependent on the angle of the soil friction and can be estimated as: soil friction vs. angle for pier installation.