Screw Pile Engineering and Design

Figure 1 Compression Loading Forces Acting on a Multi-helix Screw Pile

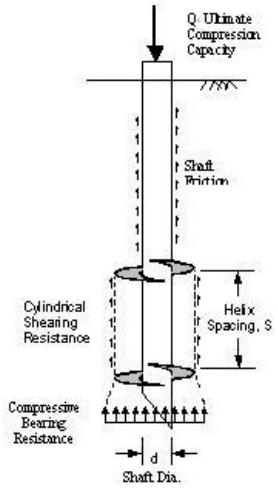
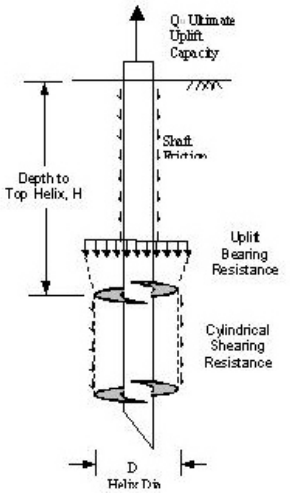


Figure 2 Tension Loading Forces Acting on a Multi-helix Screw Pile



Screw Piles are widely used in engineering applications to provide structural stability against axial compression, uplift force, overturning moment and lateral forces. There are two basic models that are used to determine the Screw Pile capacity; the individual plate bearing method and the shear cylinder method. Helical Pier Systems uses the Shear Cylinder Method.

BEARING AND UPLIFT CAPACITIES:

During loading, the force applied onto the pile is transferred to the surrounding soil. The ultimate capacity of the screw pile is dependant upon the strength of the soil. The load capacity of soils are derived from several characteristics like the internal friction angle (ϕ), the adhesion factor (α), the effective unit weight of the soil (γ) and the undrained shear strength of the soil (S_U).

The load is transferred to the soil partly through the pile shaft (adhesion between shaft and soil) and partly through the helix (bearing). Where there is more than one helix then the bearing load is transferred to the soil through the cohesion between the column of soil between the helices and the surrounding soil. Above, figures 1 and 2 show loading forces acting on screw piles. Equation 1 summarizes the three elements in the screw pile formula.

Note: A suction force is present in cohesive soils, when piles are subjected to uplift, (this increases the Screw pile's uplift capacity) but this term is general

$$\mathbf{Q_{ULT} = Q_{BEARING} + Q_{SHAFT} + Q_{HELIX}}$$

Where:

Q_{ULT} = Ultimate Screw Pile Capacity
$Q_{BEARING}$ = Bearing Load
Q_{SHAFT} = Shaft Resistance
Q_{HELIX} = Interhelix Resistance

Steps in Screw Pile Selection

1. Determine all applied loads on each screw pile; including Vertical, Lateral, Moments, Safety Factors and Maximum acceptable pile movement criteria.
2. Minimum screw pile spacing ‘rule of thumb’ is said to be 3 helix diameters or group effects will be sustained.
3. Collect soils information: Soil Type, Soil Description, Soil Classification, Water Table Levels and Depth of Frost Penetration.
4. Design screw pile – Screw Pile Geometry (The helix diameter and number of helices are selected based on soil parameters and the pile load) Select: Pile Shaft, Helix Diameter and Thickness, Number of Helixes and Embedment Depth of the pile.
5. Estimate installation Torque. The central steel pipe shaft transmits the applied torque during installation and transfers the axial compressive or tensile loads to the helixes during loading.
6. Check to see if available installation equipment has sufficient power to apply the design torque.
7. Repeat Steps 4 & 5 as required.
8. Calculate ultimate screw pile capacity and check Safety Factors (Minimum S.F. = 2.0).

S.F. = (Ultimate pile Capacity)/(Applied Load)

These steps are to be used as a guide in the pile design process; other factors may come into play when designing a screw pile (ie.seismic considerations, soil chemistry, etc.).