DESIGN MANUAL

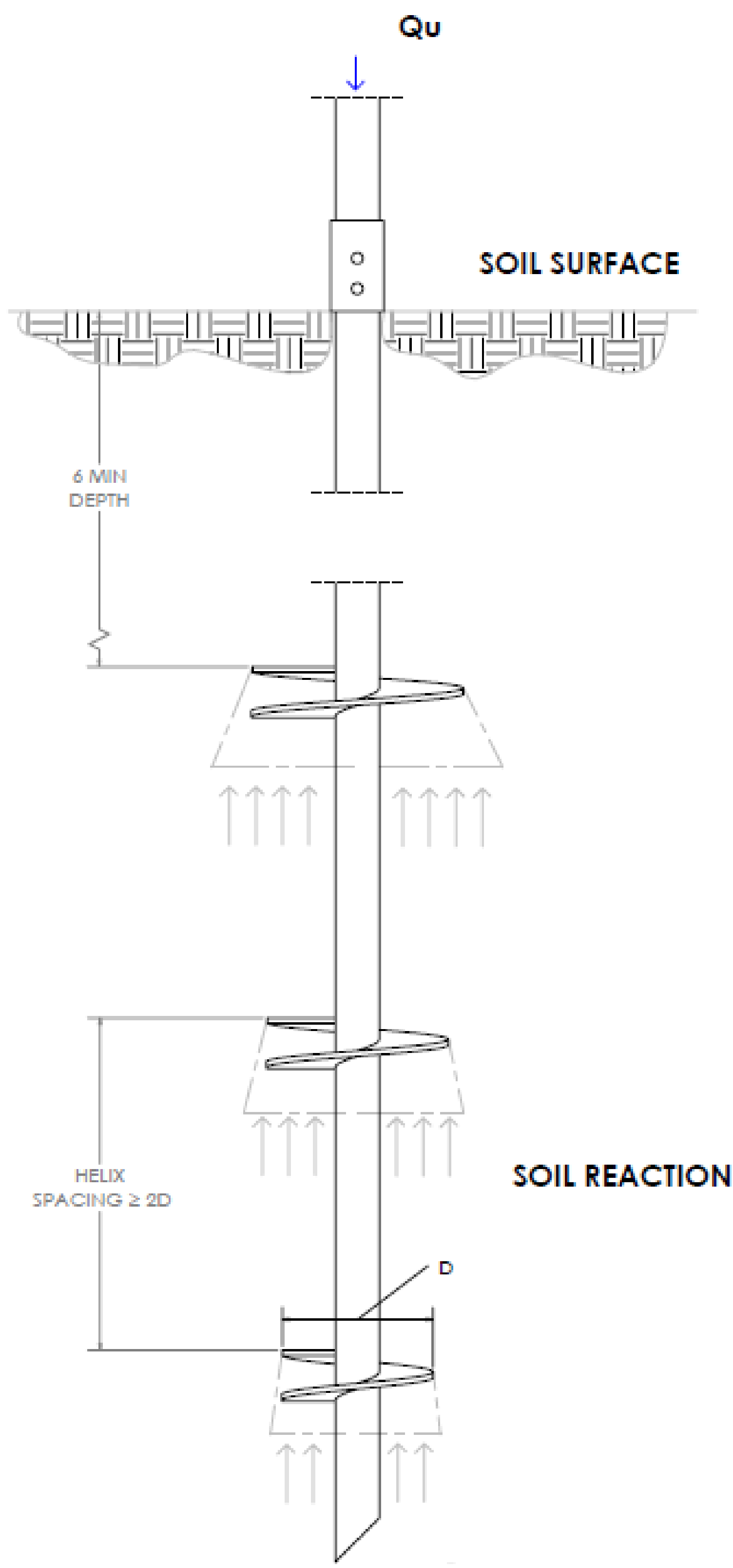
DESIGN

There are many different factors that go into designing and sizing the correct pile configuration for each job. Some of those factors include the properties of the soil(s), installation requirements and/or parameters, load on the pile(s), load type on the pile (compression, tension, shear), the helical pile design configuration, and other job/jobsite location factors.

BEARING CAPACITY

Calculating bearing capacity is used to determine the number and diameter of helical bearing plates and the strength of shaft required to support the intended design loads. When this is used in tandem with installation torque measurements and load tests, the helical pile capacity can be easily accomplished.

The spacing of the helical plates is extremely important, so that the capacity is being maximized and not wasting each helical bearing plates capacity. If the spacing between each helix is too close, the helixes start to act as a group, rather than individually. It has been determined that the helical plates must be placed two times or greater the average diameter of the lower helix apart from each other. An example of this is provided in the figure to the right.



INDIVIDUAL BEARING CAPACITY

The individual bearing method focuses more on the bearing capacities of the helix or helices, and the sizing/spacing that will be needed to support the given load. The factors that go into this method are: ultimate capacity (LBS), projected helical plate area (SF), soil cohesion (LB/SF), bearing capacity factor for cohesion, effective overburden pressure (LB/SF), bearing capacity factor for overburden, effective unit weight of the soil (LB/CF), footing width (FT), and bearing capacity factor.

The simplified calculation of bearing pressure for a single helical plate is:

$$q_{ult} = A_n (cN_c + q'N_q)$$

Where: q_{ult} is the ultimate bearing pressure (lbs)

A_n is the projected helical plate area (ft^2)

c is the soil cohesion (lb/ft^2)

N_c is the bearing capacity factor for cohesion

q' is the effective overburden stress at the bearing depth (lb/ft^2)

N_q is the bearing capacity factor for overburden

When calculating a helical pile that has multiple helical plates, the equation above will remain the same, but A_n will include all the projected areas of each helix.

NON-COHESIVE SOIL

To determine the ultimate bearing capacity in a non-cohesive or granular soil conditions, such as sand and gravel, on a jobsite, the following equation should be used:

$$Q_u = \Sigma (A_h q' N_q)$$

Where: A_h is the projected helix area

q is the effective overburden stress at the bearing depth (lb/ft^2)

N_q is the bearing capacity factor for overburden

COHESIVE SOIL

To determine the ultimate bearing capacity in a cohesive soil conditions, such as clay, on a jobsite, the following equation should be used:

$$Q_u = \Sigma A_h (cN_c)$$

Where: ΣA_h is sum of the projected helix area

c is the soil cohesion (lb/ft^2)

N_c is the bearing capacity factor for cohesion

The N_c bearing capacity factor when applied to helical piles is often taken as equal to 9. The design engineer has the option of overriding the default clay bearing capacity factor of 9.

TORQUE CORRELATION METHOD

The torque correlation method (torque vs. capacity method) is another commonly used method to determine the correct size and configuration of pile that is required. Engineers long ago discovered there was a relationship between the torque on the helical pile during installation and capacity of that pile based on its torque. The exact torque factor for each size pile can be determined by performing a load test(s) with each pile in the specific soils that the helical piers will be installed in. In most cases, this either cannot or will not happen due to project costs/time restraints. There is a common equation used to calculate torque vs. capacity:

$$Q_u = K_t * T$$

Where: K_t is the torque factor

T is the torsional resistance

There are common or "average" torque factors that have been calculated and determined several years of research from engineers. The table below shows industry standard torque factors. Factors may vary due to soil conditions.

Industry Standard Torque Factors

Shaft Diameter	**2 3/8"**	**2 7/8"**	**3 1/2"**	**4 1/2"**	**5"**	**5 1/2"**	**6 5/8"**	**7"**
Torque Factor	9 to 10	8 to 9	7 to 8	6 to 7	6 to 7	5 to 6	4 to 5	4 to 5

Helical Piers Inc. has performed tests to determine actual torque capacities on our different sizes of helical pile shafts which is shown below:

ADD SHAFT RATINGS

When determining pile size and configuration, be sure to consult with either Helical Piers Inc. or a licensed engineer who has expertise and knowledge in the helical pile industry to ensure the correctly sized/configured pile is being used on your project.