The Importance of Properly Manufactured Helix Plates for Helical Pile Performance

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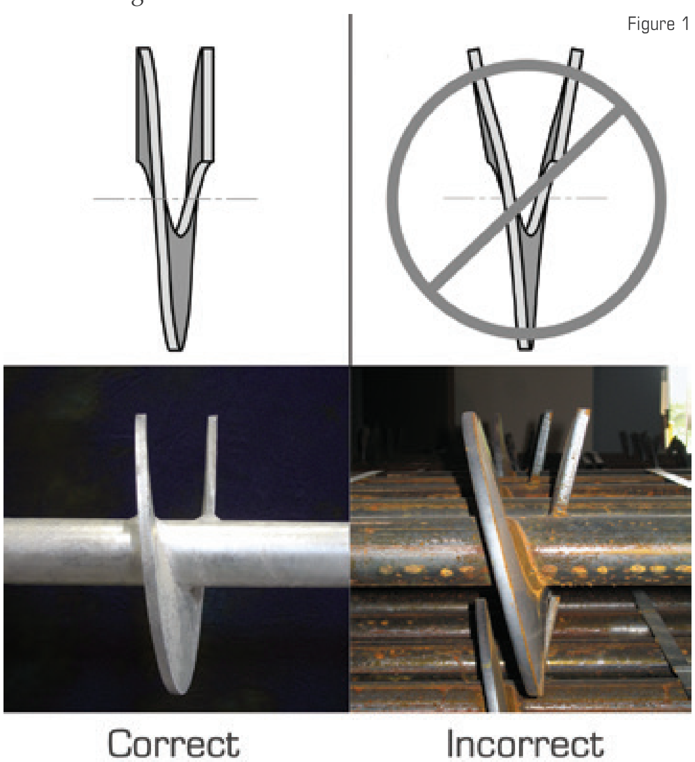
The initial installation of a helical pile is performed by applying a downward force (crowd) and rotating the pile into the earth via the helix plates; a.k.a, helix blades or helix flights. Once the helix plates penetrate to a depth of about 2 to 3 feet, the piles generally require less crowd and installation is accomplished mostly by the downward force generated from the helix plates, similar to the effect of turning a screw into a block of wood. Therefore, the helix plate performs a vital role in providing the downward force or thrust needed to advance the pile to bearing depth. The helix plate geometry further affects the rate of penetration, soil disturbance and torque to capacity correlation. The consequences of a poorly-formed helix are twofold; (1) the helix flight severely disturbs the soil with an auguring effect which (2) directly results in more movement upon loading than a pile with well-formed helices. The differences between a well-formed helix and poorly-formed helix are visually obvious and are shown in Figure 1 below.

Figure 1



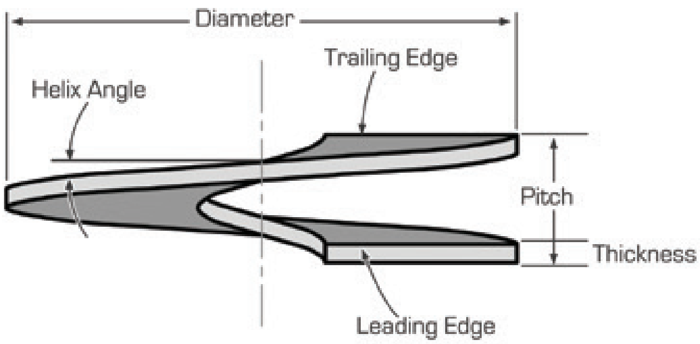
A true helix shape can be described as a three-dimensional curve that travels along and sweeps around an axis where any radial line remains perpendicular to that axis. Given the realities of manufacturing, a true helix shape is not quite possible for all regions of the helix plate. In general, a helical plate can be separated into three regions, designated as Regions I, II and III. The transitions between regions will vary among manufacturers but can be roughly estimated as follows:

- Region I extends from the leading edge to Pi/2 radians (0 to 90 degrees)
- Region II extends from Pi/2 to 3Pi/2 radians (90 to 270 degrees)
- Region III extends from 3Pi/2 to the trailing edge (270 to 360 degrees)

As the helix angle trends toward zero at the leading and trailing edges, Regions I and III depart slightly from the definition of a true helix.

A helix plate is further defined by geometric parameters including diameter, thickness, pitch, helix angle and edge geometry (See Figure 2). Helix plate diameters can vary from 6 to 16 inches for most commonly used shaft sizes. The majority of helix flights have thicknesses of either 3/8 or 1/2 inch, however, thicker plates are used for large diameter piles. The pitch is the distance or separation between the leading and trailing edges and controls the depth of installation per revolution of the helix plate. The helix angle is the blade angle formed relative to the shaft (in Region II) and will vary within the blade for any given radius. The edge geometry refers both to the perimeter geometry of the helix and the shape of the leading and trailing edges. Most helix flights are manufactured with a perimeter geometry that is generally circular. The leading edge can have varying cuts and shapes including blunt (flat), sharpened, sea-shell cut, V-style cut, etc. to provide options for changing soil conditions. The trailing edge is generally either blunt or sharpened and has no effect on installation in varying soils.

Figure 2: Helix Plate Geometry



A helix plate is formed by cold pressing the steel plate with matching machined dies. Both the shape of the die press and the amount of applied force during the press operations is important to ensure parallel leading and trailing edges and the required pitch tolerances. The amount of die press force must also be adjusted for changing plate thickness or steel grades.

The International Code Council (ICC) has approved the Acceptance Criteria for Helical Piles and Systems (AC358) which establishes design and manufacturing criteria for helical piles evaluated in accordance with the International Building Code. Specifically, AC358 has the following requirements for helix plates:

- Shall be true helix shaped plates that are normal with the shaft such that the leading and trailing edges are within 1/4 inch of parallel.
- Helix plate diameters may be between 8 and 14 inches with thicknesses between 3/8 inch and 1/2 inch.
- Helix plates and shafts are smooth and absent of irregularities that extend more than 1/16 inch from the surface excluding connecting hardware and fittings.
- Helix spacing along the shaft shall be between 2.4 to 3.6 times the helix diameter.
- The helix pitch is 3 inches ± 1/4 inch.
- All helix plates shall have the same pitch.
- Helical plates are arranged such that they theoretically track the same path as the leading helix.
- For shafts with multiple helices, the smallest diameter helix shall be mounted to the leading end of the shaft with progressively larger diameter helices above.
- Helical foundation shaft advancement shall equal or exceed 85% of the helix pitch per revolution at time of final torque measurement.
- Helix plates shall have generally circular edge geometry.

These ICC requirements are a good starting point for evaluation of helical pile design and manufacturing of helix plates. Please contact FSI if you have any questions about the above content or other topics regarding helical piles.

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Don provides preliminary design assistance for installing contractors, engineers, architects and other design professionals. He specializes in large and challenging commercial and industrial applications involving helical piles, helical tiebacks, soil nail walls or hydraulically-driven push pier systems. Don has performed over 1,100 helical or push pier designs during his tenure as a helical design professional. With his industry knowledge and research experience, Don also assists with product development and verification testing, and the development of technical documents and presentations.

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