

GroundED

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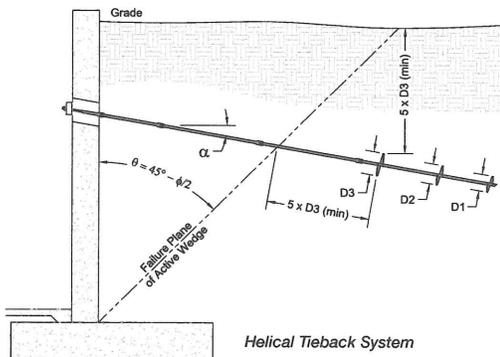
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Understanding the Differences between Helical Tiebacks and Helical Soil Nails

Helical tiebacks are commonly used to provide additional lateral support for poured concrete retaining walls, sheet pile walls, soldier pile and lagging walls or other earth retention systems. Helical soil nails are also used on earth retention projects, but there are fundamental differences in the design and performance of a soil nail compared to a tieback. Unfortunately, the two systems are occasionally confused and incorrectly specified, which can lead to design changes, schedule delays and change orders.

Helical Tieback Systems

A helical tieback is an end-bearing element that includes one or more helix plates welded to the lead section or the lead and first extension sections. Multi-helix tiebacks generally consist of increasing plate sizes from the tip. Tiebacks are advanced to a specified torque-correlated capacity, but also to a length to extend the helix plates beyond the active soil zone. The active zone is defined by an assumed linear failure plane with an angle of inclination dependent upon the retained soil type and strength. The soil within the active zone puts lateral load on the wall. For helical tiebacks used in conjunction with a retaining wall system, Supportworks recommends that the helix plates be advanced a minimum distance of five times the diameter of the trailing helix plate beyond the failure plane. This is to prevent an influence of soil stress from the helix plates overlapping into the active zone. We further recommend that the helix plates be at least five diameters below the surface to prevent a shallow anchor condition and allow use of the deep foundation bearing capacity equations. The figure to the right illustrates a typical helical tieback retaining wall with an assumed failure plane and the embedment and depth criteria.



After a helical tieback is installed, it is pretensioned to remove any slack from the system and to mobilize the soil strength at the helix plates. It is then locked off at a specified load which is usually around the service load of the tieback. Subsequently, the wall no longer has to deflect before the tiebacks are put into service, thereby limiting future wall movement.



Pretensioning a Helical Tieback

The tension capacity of a helical tieback is generated through end bearing of the helix plates embedded in the soil. This tension force is then transferred through the shaft to the wall connection. This tieback tension force must be considered in the strength evaluation of existing walls, or in developing details for new construction. Typically, a more substantial wall detail is required for use with tiebacks.

There are fundamental differences in the design and performance of a soil nail compared to a tieback.

Helical Soil Nail Systems

A helical soil nail typically consists of a solid square shaft with helix plates spaced evenly along the entire shaft length. This helix spacing is one of the primary differences between a helical soil nail and a helical tieback and, as a result, the two systems behave differently upon loading. The helix plates are either 6 or 8 inches in diameter with the same diameter helix plate used along the entire soil nail shaft. An 8-inch helix may be preferable when wall loads are high or soils are weak, and the 6-inch helix may be preferred for more lightly-loaded applications or within higher strength soils. The soil nails are typically installed at a downward batter angle of 10 degrees from horizontal or less. The soil nails are installed in a grid pattern with typical vertical spacings of about 3 to 5 feet and horizontal spacings of about 4 to 7 feet. The grid of soil nails essentially creates an internally-stabilized soil mass that acts similar to a gravity retaining wall system.



Installation of helical soil nails

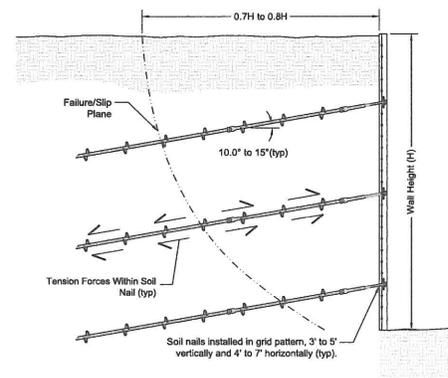
Helical soil nails are considered passive elements because they rely on soil and wall movement to mobilize the nail strength. They are designed to have helix plates on both sides of the failure plane and, therefore, generate the maximum tensile force along the length of the nail rather than at the wall facing. As you can see in the figure to the right, the tension forces act in different directions along the nail depending upon which side of the failure plane the helix plates are located. You may also notice that the failure plane geometry is curvilinear rather than the linear failure plane of a tieback.

Since the maximum tensile force in the helical soil nail is along the nail length rather than at the wall facing, a rigid wall facing is typically not required and a shotcrete wall with minimal reinforcement can be considered. It is important to understand that for similar wall heights



Application of shotcrete facing

and retained soil properties, the same shotcrete wall facing used for a soil nail system cannot be used in a helical tieback system. Pretensioning a soil nail to design loads following installation would likely cause localized wall deflection and cracking. A soil nail wall system relies on wall movement to mobilize the nail strength, so there is more lateral movement at the wall face for a soil nail wall than a tieback wall of similar height and retained soil properties. The majority of the movement occurs at the top of the wall, where you can expect about $\frac{1}{8}$ to $\frac{1}{4}$ inch of lateral wall movement for every 5 feet of soil nail wall height. So for a 20-foot high wall you might expect about $\frac{1}{2}$ to 1 inch of lateral movement at the top of the wall. This may also result in soil movement near the failure plane which can impact nearby structures unless they are underpinned prior to construction of the soil nail wall. Helical soil



Helical Soil Nail System

nail walls are often selected when equipment access is limited, when top down construction is preferred and/or when driving soldier piles or sheet piles would result in excessive vibration and possible damage to nearby structures.

For more information about helical tieback or helical soil nail systems, see the *Supportworks Technical Design Manual* at OnStableGround.com or reach out to the Supportworks engineering staff.

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Upcoming Webinar Opportunities

- An Introduction to Helical Foundation Systems

1st Wednesday of every month 11:30 am (CT) and 1:30 pm (CT)

- An Introduction to Polyurethane Foam Injection

2nd Wednesday of every month 11:30 am (CT) and 1:30 pm (CT)

- An Introduction to Hydraulically Driven Push Pier Systems

3rd Wednesday of every month 11:30 am (CT) and 1:30 pm (CT)