HELICAL PILES & ANCHORS

HELICAL PILES & ANCHORS
A BASIC GUIDELINE FOR DESIGNERS
APPENDIX C

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DISCLAIMER

The information in this manual is provided as a guide to assist you with your design and in writing your own specifications.

Installation conditions, including soil and structure conditions, vary widely from location to location and from point to point on a site.

Independent engineering analysis and consulting state and local building codes and authorities should be conducted prior to any installation to ascertain and verify compliance to relevant rules, regulations and requirements.

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Helical Piles & Anchors:

A Basic Guideline for Designers

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I. INTRODUCTION

Helical piles and anchors have made tremendous gains in popularity and acceptance in the first part of the 21st century. They are used increasing more in varied applications such as underpinning settling foundations, new construction piles, tiebacks, guy anchors, pipe supports, solar panel foundations, thrust restraints, and street light foundations. They are gaining acceptance and are used in residential, commercial, industrial and heavy civil markets.

Many consulting engineers will not use helical products in their everyday design and application jobs. They may have gone through training or become familiar with design for a specific project but have lost that ability through infrequent use and choose to either not relearn and/or not use the helical products or to "leave it to the specialty contractor." This Guideline is to help shorten and refresh the process so engineers can efficiently design with helical piles and anchors to be profitable and add value for their clients.

The goal of this Guideline is to bring the design, selection, and procurement of helical piles and anchors into a practical perspective. This Guideline will not focus on academic theory, but will present practical solutions to problems involving helical piles and anchors. The intent is to provide this information to engineers to help them solve problems on projects that they are involved with in an effective manner.

II. DESIGN REQUIREMENTS

A. Shaft Type of Helical Pile/Anchor

There are 4 basic types of helical piles available. The following is a brief summary of the 4 different types of helicals.

- **Type 1 - Square Shaft**

Square shaft piles are more efficient than pipe shaft helical piles in regards to capacity derived from installation energy. A square shaft helical pile will have more axial capacity than a pipe shaft helical pile installed with the same amount of torsional energy into the same soil profile.

Square shaft helical piles are better at penetrating dense material than pipe shaft helical piles.

The square shaft piles have slender cross sections. Therefore, they do not have a large section modulus/stiffness to resist buckling under compressive loads without support from the surrounding soil. As long as there is sufficient passive soil pressure around the pile to prevent buckling, square shaft piles are suitable for compressive loads. As a general rule, if the soil profile has ASTM D1586 SPT N_{60} value of 5 or greater, there is sufficient passive soil pressure to prevent the square shafts from buckling at the compressive loads that they are rated for. If SPT N_{60} values are 4 or less, then buckling may be a concern and is a complex problem dependent on a number of variables. A rigorous analysis can be done if enough reliable soil data is available, but the problem can normally be more efficiently solved by selecting another shaft type with a larger section modulus.

- **Type 2 - Pipe Shaft**

Pipe shaft helical piles are not as efficient in regard to load capacity derived from installation energy, but have a larger section modulus when buckling of the square shafts or potential unsupported length is a concern.

Pipe shaft helical lead sections do not penetrate dense material as effectively as square shaft lead sections.

- **Type 3 - Combo Pile**

A combo pile (Combination Pile) is a helical pile that has both the advantages of square shaft and pipe shaft helicals. A combo pile has a square shaft lead section that is better at penetrating dense material and generating load capacity, and is then transitioned to a pipe shaft for the plain extensions where overburden soils are softer and a larger section modulus is desired for buckling resistance, or when lateral load resistance is required.

- **Type 4 – HELICAL PULLDOWN® Micropile**

A HELICAL PULLDOWN® Micropile is a square shaft helical foundation or anchor that has the plain extension sections encased in a small diameter grout column, typically 5” – 7” in diameter. Pipe shaft helical piles can also be encased in a grout column, but that is less common. Similar to the combo pile, it has the advantage of the square shaft lead section to penetrate dense material. The added grout column provides a larger section modulus for buckling resistance and lateral resistance in softer soils. Lateral load resistance with grouted shafts requires a steel case. The grout in contact with the soil will develop friction capacity via a bond zone in suitable soil stratum. This can greatly increase the total axial capacity of the pile (end-bearing and skin friction) as well as stiffen the load response of the pile. The grout column also provides additional corrosion protection to the steel shaft. The HELICAL PULLDOWN® Micropile is a patented technology exclusive to Hubbell Power Systems, Inc. installing contractors.

There are a minimum of 6 design considerations that should be taken into account when choosing the required shaft type. This is often the most important aspect of specifying a helical pile and too often receives the least amount of attention prior to installation.

A.1. Axial Capacity of Shaft **Reference: Section 5 Section 7**

Is the shaft section sufficient to carry the intended axial load? This will have a great deal to do with the selection of the shaft type. There are four basic types of helical piles. See above for brief description.

Type 1 - Square Shaft
Type 2 - Pipe Shaft
Type 3 - Combo Pile (Square shaft lead with pipe shaft extensions)
Type 4 - Grouted HELICAL PULLDOWN® Micropiles.

If SPT N_{60} values are 4 or less, the section modulus should be increased by choosing a pipe shaft or encasing the square shaft within a grout column, i.e. HELICAL PULLDOWN® Micropile. Another benefit of choosing a grouted shaft pulldown pile is that it is a composite pile rather than an end bearing only pile. It can generate capacity from both end bearing of the helical plates as well as friction capacity from the grout. Often the torque correlated axial capacities listed in Section 7 of the square shaft product family can be exceeded for compressive loads because of the enlargement of the section modulus and the addition of the friction capacity resulting from the addition of the grout column. Tension loads are controlled by the mechanical limits of the couplings. The increase in compression capacity can be verified with a load test. A further benefit of grouted shaft piles is they will have a stiffer load/deflection response than an end bearing only pile.

A.2. Penetration into Desired Geologic Strata **Reference: p. 5-52**

The helical plates must generate the thrust required to advance the shaft through the soil profile. The helical plate or screw thread is an inclined plane. Helical piles (i.e. screw piles) are displacement piles that have the advantage of no spoils. The soil that is displaced by the shaft during installation is displaced to the side. The smaller the shaft size relative to the size of the helical plates (low displacement pile), the more efficient the pile will be in regards to capacity derived from the same installation energy. A helical pile that has a smaller shaft size relative to the size of the helical plates will be better at penetrating dense soil than one with a larger shaft size relative to the size of the helical plates (high displacement pile). Displacing more soil will require more installation energy, i.e. additional installation torque. The greater the installation energy, the larger the required equipment to install the pile.

Square shaft helicals are better at penetrating dense material than pipe shaft helical piles. Where penetration into dense material is required, and a larger section is needed in the upper portions of the pile for buckling reasons, a Combo Pile or a HELICAL PULLDOWN® Micropile are good choices as the square shaft lead sections will penetrate into the dense material better than a pile with a pipe shaft lead. If a soil strata is too dense or the shaft too large relative to the size of the helical plates, the pile could "spin-out". "Spin-out" means that the pile is still being rotated but is not advancing, and installation torque drops dramatically. This is similar to "stripping" a screw. **The capacity-to-torque correlation is no longer valid for spun-out piles.** (Note: see Section 6 – Installation Methodology for a complete explanation of torque correlation for helical anchors and piles) Now, rather than having a helical pile where torque is used as an indicator of the pile capacity, it is just an end bearing pile that was advanced to depth via a screw mechanism. This does not mean that the pile has no capacity, but rather that the capacity cannot be estimated by the installation energy as is normally done for a low-displacement helical pile. The pile's capacity will depend on the type of material the helical plates are in, how much the soil was disturbed, and whether or not the shaft tip, or pilot point, contributes to the capacity in end bearing. High capacities can be possible if the shaft tip is sitting on rock.

A.3. Lateral Loading **Reference: p. 5-42 thru 5-47**

Helical piles, whether they be square shaft, pipe shaft or HELICAL PULLDOWN® Micropiles, are generally slender members (low displacement pile). Lateral capacity of piles is dependent on the flexural stiffness of the pile, and the resistance of the soil the pile shaft will be bearing against as it deflects. Due to their slender size, helical pile shafts have a small effective projected area for the soil to bear against. Therefore, low displacement helical piles do not have much lateral capacity at typical tolerances for allowable lateral displacement. Square shaft piles don't have any significant lateral capacity. Pipe shaft and HELICAL PULLDOWN® Micropiles have a limited amount. A grouted shaft HELICAL PULLDOWN® Micropile with a steel casing at the top of the pile will offer the stiffest pile section and the most resistance to lateral loads. Lateral capacity ranges from 2 to 4 kip for 3" to 4" diameter piles to 10 kip for 6" to 10" diameter helical piles at typical lateral displacement tolerances. The use of battered (inclined) piles can be utilized to resist lateral loads if needed and are discussed in Section 5 of this Manual.

A.4. Corrosion Potential **Reference: App. A**

There is extensive information on corrosion of steel piling in soils. In most conditions, corrosion is not a practical concern of either square shaft or pipe shaft helical piles. Corrosion is the oxidation of the steel members of a helical pile/anchor. There is typically little to no oxygen in undisturbed soils, especially below the water table. Driven steel piles have been installed with pile hammers for more than a century and are still commonly used today. The vast majority of interstate highway bridges in the Piedmont regions of the southeast United States are bearing on steel H-piles. If corrosion is a concern for a given project, then a square shaft helical pile is a solid cross section and has much less perimeter surface area for corrosion to occur compared to a pipe shaft; which is hollow and has much more perimeter surface area (inside and out) compared to the cross-sectional area of steel. A HELICAL PULLDOWN® Micropile, where the solid square shaft is encased in a very dense grout mixture, provides the most resistance to corrosion. Cathodic protection, or corrosion allowance (sacrificial steel) are also options in aggressive environments or applications.

A.5. Tension Only Loads.

For tension only members, square shaft (Type SS) is always the logical choice. As noted above, square shaft helicals are more efficient in regards to load capacity versus installation energy (torque correlation), are better at penetrating dense soils, and have less surface area for corrosion potential. There is more sacrificial steel (relative to total cross-sectional area) available when considering corrosion in square shafts. The size and strength of the shaft is governed by the required installation torque; there is more steel section available than is required to carry the rated axial tension load. The reason for this is because the steel in the shaft is subjected to more stress during installation than it will ever see while in service. Once the helical anchor is installed, the ultimate mechanical tension strength is governed by the shear strength of the coupling bolt. The square shaft has more available steel cross-section (compared to pipe shaft) that can be sacrificed before the tensile strength is reduced.

A.6. Reversing Loads.

For piles that are required to resist compression and tension loads, the designer must recognize that helical piles are a manufactured product with bolted connections. There is manufacturing tolerance in each connection. For example, most helical piles have up to 1/8" axial tolerance in each connection. If the manufacturer did not allow for that tolerance, connections would often not fit together in the field. If the load reverses, the top of the pile will displace (up or down) a distance equaling the sum of the bolt tolerance in all of the bolted connections before it can resist the reversed load. This may or may not be of concern to the designer and is dependent on the type of structure that is being supported with the piles. The grout column of a HELICAL PULLDOWN® Micropile fills those connections, thereby removing the bolt tolerance as well as stiffening the load response. That is why grouted shafts are often utilized for piles with reversing load conditions. Grouting the inside of pipe shaft helicals will also stiffen the coupling movements for reversing load conditions.

B. Shaft Size

There are a minimum of 2 design considerations that must be accounted for when choosing the required shaft size.

1. Torsional Capacity of Shaft — **Reference: Section 7**

Basic helical design methodology states that installation energy has a direct relationship to pile capacity. The shaft selected must be able to withstand the expected installation torque required for the pile to reach the intended capacity and the required depth or specific soil strata. If a dense layer must be penetrated prior to reaching the required termination depths, the shaft must have enough torsional capacity to pass through the dense layer. Otherwise pre-drilling through the dense layer may be required.

2. Axial Capacity of Shaft — **Reference: Section 7, Section 5**

The shaft section must be capable of withstanding the required axial load. This will have a great deal to do with the selection of the shaft type and size. If the torsional strength is sufficient to reach the required depth and torque-correlated capacity, the shaft section will be sufficient to carry the axial load. The load capacities listed in the Specifications Table for each Product Family in Section 7 of this Manual are limited by torque for compressive loads and by the coupling strength for tension. The exception to this are when there are soft or very loose soils that do not provide sufficient passive soil pressure via confinement to prevent buckling under compression loads, (SPT N_{60} values of 4 or less). A square shaft can be up-sized to a pipe shaft to prevent buckling for lighter loads, or a grout column may be added with a HELICAL PULLDOWN® Micropile to provide increased section modulus that would allow the axial capacities in the Product Family Specifications Table in Section 7 to be exceeded. See the increased compression load capacity tables for HELICAL PULLDOWN® Micropiles with various diameter grout columns in Section 7.

C. Helical Configuration

There is a minimum of 1 design element that must be considered when choosing the suggested/required helical configuration for a performance-based specification or 2 design elements if using a prescriptive-based specification.

1. Mechanical Capacity of Individual Helical Plates — **Reference: Section 7**

The mechanical capacity or strength of an individual helical plate is dependent on the thickness, grade of steel, and diameter; and strength of the weld that connects it to the pile/anchor shaft. In most cases, the mechanical capacity of a given diameter helix plate will increase with increasing shaft diameter. As a minimum, there must be enough helical plates so that the sum of their individual capacities can share the load that is required of the pile/anchor. A performance-based specification would only require that the minimum number of helical plates be provided that is necessary to share the load. The size of each plate would be left up to the installation contractor as long as the minimum number is provided and that other requirements are met, such as minimum depth and

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torque. For example, if 60 kips capacity is required, and the individual helix capacity is 40 kips, then a minimum of two helices would be required to share the 60 kip load. A prescriptive-based specification would be explicit on the exact number and size of the helix plates.

2. **Size of Helical Plates** **Reference: Section 7**

The size of helical plates can have a significant influence on the installation and performance of a helical pile/anchor. The helical configuration (smaller or larger diameter helix plates) required can change from pile to pile. If the specifier is not comfortable with a performance-based specification, (minimum number of helical plates, minimum torque capacity, minimum depth), then a more prescriptive approach can be given. This may also be required for comparative bid reasons and is fine as long as a payment mechanism for adjustment is provided. Typically, the denser the soil, the smaller the helical plates must be. Alternately, the softer or less dense the terminating soil strata, the larger the helical plates will need to be to generate the required torque/capacity.

Typical helical sizes range from 8” to 14” diameter. 16” diameter helix plates are available, but are not as common. It is important that the smallest helix be the first or penetrating helix. A multi-helix lead will then have subsequent helices increasing in size. Generally, the same size helix is not repeated until the largest size available is reached. For example, a typical three-helix configuration would be an 8”/10”/12” on all square shaft sizes (1.5” and larger), or a 10”/12”/14” helical configuration on smaller square shaft sizes (1.25” and 1.5”) or pipe shaft. Generally, larger square shaft sizes would only be used to generate larger load capacities; hence are generally not used unless being installed into dense material. Therefore, a smaller 8” helix is needed to better penetrate the dense material. A pipe shaft has a larger section/cross sectional area, which results in small remaining area of an 8” helix plate. Therefore, the smallest helix plate typically used on pipe shaft is generally a 10” diameter.

Helical plates are inclined planes and provide the driving mechanism for the rotational advancement of the pile/anchor. Helical configurations with multiple helical plates will drive straighter, and are more likely to advance properly than single helix configurations, and perform better. If too few helical plates are used, the most likely installation problem is “spinning out” (See above: Shaft Type, Penetration into desired geologic strata). This can be solved by adding more helix plates, larger helix plates, and/or more crowd pressure (downward force from installing equipment). Increasing crowd pressure may require a larger piece of equipment (excavator, backhoe etc.). Generally, adding more helical plates is more economical compared to upsizing to larger equipment. If too many helical plates are used, the likely installation problem is that the torque capacity of the shaft is reached prior to reaching the desired depth. Helical extensions can be removed by unscrewing the pile/anchor, taking them off and reinstalling the pile/anchor. If helical plates on the lead section need to be removed, it will require the installation contractor to supply a different helical lead or remove helical plates in the field with a torch or saw. Removal of helix plates in the field is done quite often, but for cost/time reasons the installing contractor would prefer not have to remove helical plates regardless of the method.

If there is limited risk in exceeding the torque capacity of the shaft prior to the required/desired depth, and that depth exceeds approximately 30’, it is more economical to have enough helical plates - either to generate the required capacity (in the case of soft to medium bearing strata) or to penetrate the bearing strata (in the case of dense bearing strata) in the beginning rather than run the risk of either not getting the capacity at a reasonable length or “spinning out” trying to penetrate something dense. Extracting a pile/anchor and then reinstalling it at those lengths, while very do-able, generally have time costs that far exceed the cost of providing a helical extension on the first attempt.

D. Pile/Anchor Length

There are a minimum of 2 design elements that should be considered when requiring/estimating a pile/anchor length, whether using a performance or prescriptive based specification.

1. <u>Minimum Length</u> **Reference: Section 5**

Compression Only Piles – For helicals used as compression piles, often there is a geotechnical reason that the piles be a minimum length to ensure that the pile is deep enough to achieve required capacity needed for the long term. For example, if it is known that a compressible peat layer exists between 15' and 20' depths, then it is important for the piles to have bearing capacity in soil strata below the peat layer. Therefore, a minimum depth should be required to ensure that the piles are bearing below the peat layer and will not settle over time as the peat consolidates.

If there is no geotechnical reason to require a deeper minimum length, the minimum length for the pile to behave as a deep foundation is that the upper-most helix (the plate closest to the ground surface) is a minimum depth of 5 diameters (5D) of the helix plate below grade or subgrade. If the helical plate is not installed to this depth, the failure mode will be similar to a shallow foundation. This could cause a rupture of soil at the surface if there is not enough confining pressure. For example, if a site has loose overburden sand that trends to medium-dense sand with varying depth, with little risk of the sand getting looser with depth, the minimum length requirement may be "the uppermost helix must be 5D below sub-grade". Most specifications simplify this to 5 feet below subgrade.

Tension Piles/Anchors – The 5D requirement over the uppermost helix for tension elements is extremely important. If this requirement is not met, there is not enough confining pressure and a wedge or plug of soil can erupt to the surface as the anchor fails. For helical tieback anchors, the 5D requirement is 5D beyond the active failure plane, which is dependent on the friction (φ) angle of the soil and the wall height. It is important that the helical plates are not stressing soil in the active failure wedge. If this happens, the wall could experience a global type failure. Again, most specifications simplify this dimension to 5 feet beyond the active failure plane. Therefore, the minimum length requirement for helical tiebacks should be "the uppermost helix must be 5 feet beyond the active failure plane". There should be a schedule, table, or formula for determining this in the field to ensure that the minimum length is achieved.

2. <u>Cost</u>

The total installed length has a direct impact on the cost of the pile/anchor in both material cost and installation time. The designer must always keep this in mind. The length defined (or undefined) by the bidding documents has enormous ramifications on the cost. Well written bidding documents should define the piles well enough to obtain the pile/anchor performance that the owner requires, as well as obtain competitive pricing from the installing contractor. If the piles are not well defined, the installation contractor that leaves the most out of his bid will likely get the job. This is not good for the owner as it increases the likelihood that the owner is not going to get the performance from the piles that is needed; or be presented with an expensive change order after construction has begun. Bidding should be based upon a minimum estimated bid length with some method for adjustment for differing lengths. This approach better utilizes the flexibility of helicals, which is one of their advantages. A thorough discussion of bidding and construction documents and strategies is discussed in Section III of this Appendix, titled "Construction Documents".

E. <u>Pile/Anchor Minimum Capacity or Installation Torque</u>

Whether using a performance or prescriptive specification, the pile/anchor capacity should be specified in order to ensure that the desired pile/anchor capacity is achieved and that one of the primary advantages of helicals is utilized, which is measuring installation energy (torque).

1. **Minimum Capacity**

All structural members, regardless of the method of determining the load capacity or strength that the member is designed to resist, are designed with a factor of safety to provide for possible overload conditions; or for the possibility that the member is understrength for some unknown or unforeseen reason. This normal use load is commonly referred to by names such as service, design, working, or un-factored load.

A factor of safety is applied to this load to provide a reserve load capacity beyond that which it is expected see under normal use. This safety factor may be prescribed by building code, but is often left up to the engineer-of-record. A proper factor of safety is a combination of economics and statistics. It is not typically economically feasible to design for zero probability of failure. Generally the more uncertainty, the higher the factor of safety applied. Conversely, the less uncertainty, the lower the factor of safety applied. The industry standard for helical piles is a factor of safety of 2 for permanent applications. Generally, for tieback anchors that are going to be individually post-tensioned and tested, a factor of safety of 1.5 is used. A lower factor of safety is justified since there is less uncertainty (the tieback is tested). This load that contains the safety factor is usually referred to as either the ultimate or factored load.

One of the biggest problems with construction documents regarding helical piles/anchors is clearly identifying the load required. The best method is to clearly define the loads as ultimate/factored loads on the construction documents. If not, then the loads should be clearly identified as (service/design/working/un-factored loads) and clearly state what the required factor of safety is.

OR

2. **Installation Torque**

Reference: Section 6
Section 7

Installation torque can also be specified as the minimum requirement as it relates to the pile/anchor capacity required. This should only be done for piles/anchors that will not receive a proof test. This should not be done for tieback anchors where each anchor will be post tensioned and proof tested. In that case, passing the proof test is the only criteria that matters and obtaining a minimum torque is really a convenience for the contractor to ensure that he does not fail the proof test.

If the minimum torque approach is utilized, the specifier should be aware that torque capacity correlations differ depending on the type and size of shaft used. Please refer to Section 6 for a full discussion of Torque/Capacity (K_t) relationships. Empirical Torque Factors are soil dependent. Unless on-site testing is performed to obtain a site specific Emperical Torque Factor, statically conservative default values are typically used. A table of recommended default values for K_t is provided for your convenience.

Shaft Type	Shaft Size	Kt
Square	1.25”	10 ft^{-1}
Square	1.5”	10 ft^{-1}
Square	1.75”	10 ft^{-1}
Square	2.0”	10 ft^{-1}
Square	2.25”	10 ft^{-1}
Pipe	2-7/8” OD	9 ft^{-1}
Pipe	3.5” OD	7 ft^{-1}
Pipe	4.5” OD	6 ft^{-1}

Also, tension capacities should correspond to the average torque measured over the last three average helix diameters of installed length. Most specifications simplify this to 3 feet. This is because in tension, the helical plates are bearing against the soil that they have already passed through. So depending on how fast the torque increased, this could have a significant impact on the capacity of the anchor. Obviously, it is virtually impossible to average a helical anchor/pile's maximum torque rating over the last three average helix diameters.

III. CONSTRUCTION DOCUMENTS

A. Construction Plans

The previous section defined the design elements that should be considered when electing to use helical piles/anchors. Each one of these should be defined in the construction plans on a well-engineered project.

- Shaft Type
- Shaft Size
- Helical Configuration
- Pile/Anchor Length
- Minimum Capacity or Torque

By defining the parameters that will be acceptable for each of these design elements, more favorable results will be obtained from both a pricing and performance perspective. It is the writer's experience that summarizing the pile/anchor parameters in a format similar as listed above works well.

For example; consider using the following format or similar plans:

Helical Pile Data Summary

Pile Type:	Square Shaft Helical Pile
Shaft Material:	SS175 (1.75"x1.75" solid square shaft)
Helical Configuration:	8"/10"/12" helices
Bid Length:	28'-0
Minimum Capacity:	80 kips ultimate capacity

Other parameters can also be added such as grout column diameter for grouted HELICAL PULLDOWN® Micropiles, minimum length (if different from bid length), termination type, angle of installation, or required casing.

The above summary provides enough information for bidders to aggressively bid on the same items as other bidders. It reduces their risk of being undercut by a contractor bidding with either lesser material or a lesser estimated length. This also gives the owner and the engineer a comparative basis for their bid analysis. A method for payment should also be established for deviations from the bid length and should be considered in the bid analysis.

B. Bidding Documents

Well-crafted construction documents will allow installation contractors to accurately bid and properly install piles to serve their intended purpose. It is in the owner's and engineer's best interest for contractors to have the proper information to be able to accurately bid and properly install the piles/anchors. Poorly-crafted construction documents with lack of definition will result either in high pricing because the contractor has to assume an inordinate amount of risk, less than desired performance from the piles/anchors, installation problems, or change orders from the contractor. None of these things make the engineer-of-record, or helical piles attractive to the owner for future projects.

Bid processes can be handled in several different ways, and are dependent on the particular aspects and needs of each project. No two projects are exactly the same. Therefore, different aspects of the project may be the driving force behind the bid process or bid structure. These could be price, speed, or function. Helical piles/anchors are used in design/build projects, lump sum bids and projects with a unit pricing structure. It is the writers experience that unless there is a wealth of geotechnical information that is available to the bidders, lump sum pricing is generally not in the owner's best interest. A pricing structure that shares some of the risk with the owner and the contractor tends to result in better overall pricing. One exception to this would be if the bidders are allowed access to the site to install probe or exploratory piles prior to bidding. Helical piles/anchors are well suited to exploratory installations because of the torque to capacity relationships, the pile/anchor material can be recovered, and there is minimal disruption to the site. The less risk the contractor assumes, the better pricing will be.

Generally, a pricing structure that allows for a per/pile price to a specified bid depth with unit pricing for additional/deductible length works best. For example, if the geotechnical information available indicated that the average pile/anchor depth to be between 25'-0 and 30'-0 then a bid length of 28'-0 might be established with unit pricing by the foot for piles that exceed or are short of that length. Unit pricing would likely be even better if it is in established in increments of 7'-0 rather than 1' increments since 7'-0 is the length of most common material plain extensions. This is because the same amount of material is likely to be used once the contractor has to add an additional piece. In other words, if the pile depth exceeds 28'-0, there is an additional unit cost per unit additional 7'-0 extension. Some situations may lend themselves to providing a unit price for helical extensions also. Many tieback projects have benefited by utilizing this approach.

Another unit pricing strategy that is used effectively is to have the bidders provide a unit price per foot for the entire length of piling or anchorage on the project and not have a price per pile/anchor. In other words, the construction plans might show 100 piles at an average 50' depth and the bid quantity would be set up for unit pricing by the foot, (or 7' increments) for 500 lineal feet (LF) of piling. Payment would be made by the unit price for the quantity of piling installed, whether it is 450 LF or 550 LF.

C. Technical Specifications

Technical Specifications are an important part of well-crafted construction documents and should further define the details regarding the helical piles or anchors. Technical Specifications should define anything that affects the pricing or performance of the piles or anchors. At a minimum, the following should be defined:

- Pile materials
- Installation tools and equipment
- Quality control methods
- Installation records required
- Installation tolerances and techniques
- Load testing requirements, procedures, and acceptance criteria (if any)

Model specifications for helical piles, anchors, and tiebacks that can be used as templates and edited for your specific project needs are included on www.abchance.com.

