



GUIDE TO MODEL SPECIFICATION – CHANCE® Civil Construction HELICAL TIEBACK ANCHORS FOR EARTH RETENTION

TYPES OF SPECIFICATIONS

The three types of specifications that are used for HELICAL TIEBACK ANCHOR projects are:

Open Specifications: The Contractor is given the responsibility for the scope and design of the helical tieback anchor installation. In addition, the construction, capacity, and performance of the helical tieback anchor are the sole responsibility of the Contractor. This specification assumes that the Owner or Designer has provided the required structural loads. This specification type is most common for securing bids on temporary projects, and is not recommended for permanent applications.

Performance Specifications: The Contractor is given the responsibility for certain design and/or construction procedures, but must demonstrate to the Owner through testing and/or mutually agreed upon acceptance criteria that the production helical tiebacks meet or exceed the specified performance parameters. This specification assumes that the location and the required loads of the helical tieback anchor have been specified. The Contractor and Owner share the responsibility for the work.

Prescriptive Specifications: The Owner has the sole responsibility for the scope and design of the helical tieback anchor installation and specifies the procedures that must be followed. Prescriptive specifications mandate the Owner to be responsible for the proper performance of the production helical tieback anchors. The Contractor is responsible for fulfilling the obligations/details as specified in the construction documents.

Performance specifications are the most common and allow Contractors to use their unique installation methods and experience for any given site conditions. Owners receive the benefit of value engineering, which can result in lower costs.

The Owner, Designer, and Contractor will be jointly responsible for the design, installation, acceptance, and performance of the helical tieback anchor. The installation of a helical tieback requires specialized

equipment, techniques, and trained work crews. Every detail of the work cannot be specified, and every potential problem cannot be anticipated. Therefore, a contractor trained in the proper methods of design and installation of screw anchor tiebacks must be selected.

A list of the major tasks to be performed on a helical tieback anchor project is shown in Table-1 of the Model Specifications. The Owner or his representative should select the type of specification and procurement method. The responsible party for each task must be identified and mutually agreed upon at the earliest point in the contracting process. The completed Table-1 should be included in the construction documents. The process of continuous communication between all the parties involved is essential to achieve a satisfactory result. Clear communication and close cooperation are particularly important in the start-up phase and in testing. In addition, a timely preparation and review of all submittals is critical.

This model specification can be adapted to each of the three types of specifications. However, it is primarily written for the performance type. The identity of the “Contractor” and the “Owner” is always well defined, unlike that of the “Designer” or “Engineer”. For example, the “Engineer” may be an employee(s) of the Contractor, or a third party consultant hired to secure a lower cost alternative during the bidding process. In contrast, the “Engineer” may be the Owner, an employee(s) of the Owner, or a representative hired by the Owner. It is recommended that the Engineer be a third party agency employed by the Owner to serve in the owner's best interests during the various stages of the contract.

For purposes of this Model Specification, the subject is a high capacity HELICAL TIEBACK ANCHOR manufactured by CHANCE Civil Construction. The helical tieback anchor consists of one or more helical bearing plates attached at the tip of a high strength central steel shaft. The central steel shaft consists of solid square shaft of various sections. Said shaft is connected to the wall face via thread-bar, bearing plate, and load nut.

It is suggested that the specification writer accurately and completely modify this model to suit his/her particular case.

Items in italics as such may be considered as “Commentary” and as such may be deleted or retained to suit the needs of the specification writer.

The following is list of general references that will provide additional background to HELICAL TIEBACK ANCHOR technology:

A. B. Chance Company, *HELICAL PIER® Foundation Systems, Technical Manual*, Bulletin 01-9601, Copyright 2000 Hubbell, 210 North Allen St., Centralia, MO 65240

Atlas Systems, Inc., *Technical Manual, 2005*, Copyright 2004 – Atlas Systems, Inc, 1026-B South Powell Road, Independence, MO 64056

Bobbitt, D.E., and Thorsten, Richard, *The Use of Helical Tieback Anchors for a Permanent Retaining Wall*, Bulletin 31-8902, Presented at the 1989 Foundation Congress – Northwestern University – Evanston, Illinois

Seider, Gary L., and Smith, Walter P., *Helical Tieback Anchors Help Reconstruct Failed Sheet Pile Wall*, Bulletin 31-9502, Presented at the 1995 46th Highway Geology Symposium – Charleston, West Virginia

Hoyt, R.M. and Clemence, S.P., 1989. Uplift Capacity of Helical Anchors in Soil. *Proceedings of the 12th International Conference on Soil Mechanics and Foundation Engineering*, Vol. 2, pp. 1019-1022.

Clemence, S.P., Thorsten, Richard E., and Edwards, Bill, *Helical Anchors: Overview of Application and Design*, Bulletin 31-9001, reprinted from ADSC *Foundation Drilling Magazine*, Copyright 1990 A. B. Chance Company, 210 North Allen St., Centralia, MO 65240

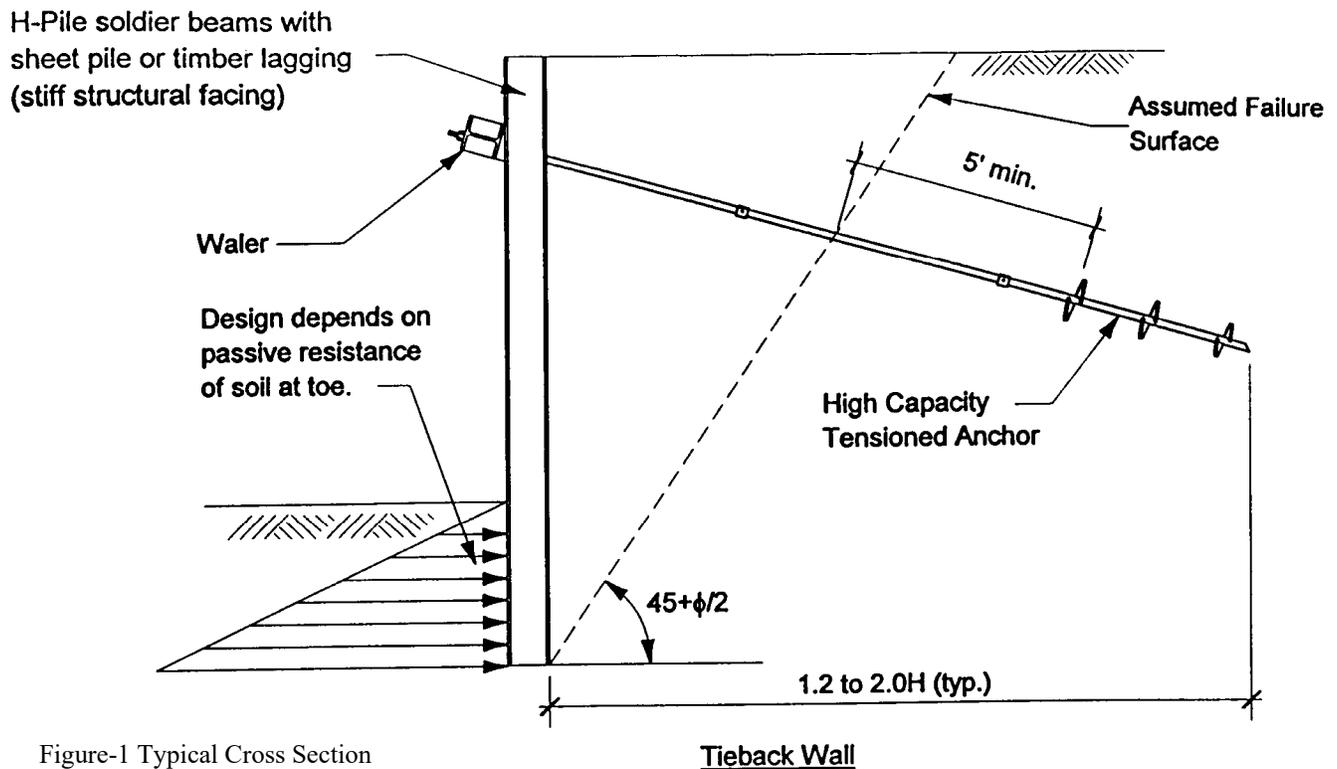


Figure-1 Typical Cross Section

CHANCE[®] Civil Construction HELICAL TIEBACK ANCHORS

MODEL SPECIFICATION

1. GENERAL

1.1 Purpose of Specification

The purpose of this specification is to detail the furnishing of all designs, materials, tools, equipment, labor and supervision, and installation techniques necessary to install HELICAL TIEBACK ANCHORS as detailed on the drawings, including connection details. This shall include provisions for load testing that may be part of the scope of work

Specifier Note: This specification may require modification to account for unusual and/or unforeseen site and subsurface conditions and the particular circumstances of the project.

1.2 Scope of Work

This work consists of furnishing all necessary engineering and design services (if required), supervision, labor, tools, materials, and equipment to perform all work necessary to install the HELICAL TIEBACK ANCHORS, at (location, City, State/Province) for (Company, State or Private Authority) per the specifications described herein, and as shown on the drawings. The Contractor shall install a helical anchor that will develop the load capacities as detailed on the drawings. This may also include provisions for load testing to verify tieback capacity and deflection, if part of the scope of work. The responsibilities and duties of the respective parties for this project are summarized in Table-1.

Table-1. Tasks and Responsibilities to be Allocated for Helical Tieback Anchor Work

TASK		RESPONSIBLE PARTY*
1	Site Investigation, Geotechnical Investigation, Site Survey, and potential work restrictions	
2	Type of specification, requirement for a pre-contract testing program, and procurement method	
3	Obtaining easements	
4	Overall scope of work, design of the anchored structure – including design loads (vertical, horizontal, etc.), anchor locations, and anchor spacing and orientation	
5	Definition and qualification of safety factors	
6	Calculation/estimation of allowable structural and/or anchor movement in service (acceptance criteria)	
7	Definition of service life (temporary – months or permanent - years) and required degree of corrosion protection based on site conditions	
8	Type and number of tests (pre-contract, pre-production and production)	
9	Minimum total anchor length, depth to bearing stratum	
10	Helical Tieback Anchor components and details	
11	Details of corrosion protection, if required	
12	Details of anchor connection to structure (e.g., for static and seismic conditions)	
13	Preparation of Drawings and test reports	
14	Evaluation of test results	
15	Construction methods, schedule, sequencing, and coordination of work	
16	Requirements of field production control, including logging of installation torque vs. installed depth	
17	Supervision of work	
18	Long-term monitoring	

* To be filled in by specification writer.

1.3 Qualifications of the Helical Tieback Anchor Contractor

The helical anchor Contractor shall be experienced in performing design and construction of helical tieback anchors and shall furnish all materials, labor, and supervision to perform the work. The Contractor shall be trained by CHANCE® Civil Construction in the proper methods of design and installation of screw anchor tiebacks. The Contractor shall provide names of on-site personnel materially involved with the work. At a minimum, these personnel shall include foreman, machine operator, and project engineer/manager.

The helical tieback anchor Contractor shall not sublet the whole or any part of the contract without the express written permission of the Owner.

1.4 Related Project Specifications

To be determined by the specification writer.

1.5 Definitions

A partial list follows. *The Owner may wish to add other specific, project-related items.*

Bearing Stratum: Soil layer(s) of sufficient strength capable of resisting the applied axial load transferred by the helical tieback.

Contractor: The person/firm responsible for performing the helical tieback anchor work.

Coupling: Central steel shaft connection means formed as integral part of the plain extension shaft material. For Type SS anchors, couplings are external cast sleeves, or hot upset forged sockets.

Coupling Bolt(s): High strength, structural steel fasteners used to connect helical anchor segments together. For Type SS segments, the coupling bolt transfers axial load only.

Design Load (DL): Maximum anticipated service load applied to the helical anchor. A.k.a. Working Load (WL).

Free Length: Length of plain extension acting as a tendon, which is free to elongate elastically. A.k.a. unbonded length or stressing length. Helix plates shall not be located in free length section of tieback. Minimum free length shall be specified on a project specific basis.

Helical Extension: Helical tieback anchor component installed immediately following the lead or starter section, if required. This component consists of one or more helix plates welded to a central steel shaft of finite length. Function is to increase bearing area.

Helical Tieback Anchor: Bearing type anchor used to transfer tensile loads to soil. Helical tieback anchors consist of a central steel shaft, helix bearing plates, coatings, corrosion protection, and a wall connection.

Helix Plate: Generally round steel plate formed into a ramped spiral. The helical shape provides the means to install the helical tieback anchor, plus the plate transfers load to soil in end-bearing. Helix plates are available in various diameters and thicknesses.

Lead Section: The first helical tieback anchor component installed into the soil, consisting of single or multiple helix plates welded to a central steel shaft. A.k.a Starter Section.

Performance Test: Similar to a Proof Test except a cyclic loading method is used to analyze total, elastic, and net movement of the helical anchor. Often used for pre-contract or pre-production load tests, in addition to a specified percentage of production anchors.

Plain Extension: Central steel shaft of finite length without helix plates. It is installed following the installation of the lead or starter section or helical extension (if used). The units are connected with couplings and bolts. Plain extensions are used to extend the helix plates beyond the specified minimum free length and into competent load bearing stratum.

Proof Test: Incremental loading of a helical anchor, holding for a period of time, and recording the total movement at each load increment.

Safety Factor: The ratio of the ultimate capacity to the working or design load used for the design of any structural element.

Square Shaft (SS): Solid steel, round-cornered-Square central Shaft elements ranging in size from 1-1/4" to 2-1/4". A.k.a. Type SQ.

Thread Bar Adapter: Section of central steel shaft used to connect the helical anchor to the wall face via a high tensile strength pre-stressing thread bar.

Torque Strength Rating: The maximum torque energy that can be applied to the helical tieback anchor during installation in soil, a.k.a. allowable, or safe torque.

1.6 Allowable Tolerances

The tolerances quoted in this section are suggested maximums. The actual values established for a particular project will depend on the structural application.

- 1.6.1 Centerline of helical tieback anchor shall not be more than 6 inches from indicated plan location.
- 1.6.2 The angular tolerance between installed tieback anchor angle and design angle shall be $\pm 3^\circ$ as shown on the drawings.

1.7 Quality Assurance

- 1.7.1 Contractors authorized by CHANCE Civil Construction shall install helical tieback anchors. These Contractors shall have satisfied the requirements relative to the technical aspects of the product and installation procedures as therein specified.
- 1.7.2 The Contractor shall employ an adequate number of skilled workers who are experienced in the necessary crafts and who are familiar with the specified requirements and methods needed for proper performance of the work of this specification.
- 1.7.3 All helical tieback anchors shall be installed in the presence of a designated representative of the Owner unless said representative informs the Contractor otherwise. The designated representative shall have the right of access to any and all field installation records and test reports.

- 1.7.4 Screw anchor components as specified therein shall be manufactured by a facility whose quality systems comply with ISO (International Organization of Standards) 9001 requirements. Certificates of Registration denoting ISO Standards Number shall be presented upon request to the Owner or their representative.
- 1.7.5 CHANCE Civil Construction provides a standard one-year warranty on materials and workmanship of the product. Any additional warranty provided by the Contractor shall be issued as an addendum to this specification.
- 1.7.6 Design of helical tieback anchors shall be performed by an entity as required in accordance with existing local code requirements or established local practices. This design work may be performed by a licensed professional engineer, an authorized CHANCE Civil Construction Contractor, or designer depending upon local requirements or practices.

1.8 Design Criteria

- 1.8.1 Helical tieback anchors shall be designed to meet the specified loads and acceptance criteria as shown on the drawings. The calculations and drawings required from the Contractor or Engineer shall be submitted to the Owner for review and acceptance in accordance to Section 3.1 “Construction Submittals”.

- 1.8.1.1 The allowable working load on the helical tieback anchor shall not exceed the following values:

$$P_{allowt} = S_{ut} / FS$$

Where: P_{allowt} = allowable working load in tension (kip)
 S_{ut} = Min. ultimate tensile strength of central steel shaft segment (at coupling joint) (kip)
 FS = factor of safety suitable for application, i.e. temporary or permanent structures

For permanent applications, it is recommended to use a factor of safety of two (2). For temporary applications, factor of safety typically ranges between 1.25 and 1.5.

It is recommended to use the minimum ultimate tensile strengths as published by CHANCE Civil Construction (shown in Table-A of the Appendix). The ultimate tensile strength may be reduced by the ultimate capacity per helix plate(s) – depending on the number of helix plates specified and type of shaft product used. The ultimate tensile strength may also be reduced by the torque limited ultimate capacity – depending on the type of shaft product used.

- 1.8.1.2 The ultimate structural capacity shall be determined as:

$$P_{ultt} = S_{ut}$$

Where: P_{ultt} = Ultimate structural capacity in tension (kip)

S_{ut} = Minimum ultimate tensile strength of central steel shaft (kip)

It is recommended to use the minimum ultimate tensile strengths as published by CHANCE Civil Construction (shown in Table-A of the Appendix). The ultimate tensile strength may be reduced by the ultimate capacity per helix plate(s) – depending on the number of helix plates specified and type of shaft family used. The ultimate tensile strength may also be reduced by the torque limited ultimate capacity – depending on the type of shaft family used.

The minimum yield strength of the central steel shaft is as follows: Type SS5: 70 ksi; Type SS125, SS1375, SS150, SS175, SS200, SS225: 90 ksi.

- 1.8.2 Individual helical tieback anchors shall be designed so that the maximum test load will not exceed 90 percent of the minimum ultimate tension capacity of the central steel shaft material. The Contractor shall select the type of thread bar to be used. The thread bar shall be sized so the design load does not exceed 60 percent of the guaranteed ultimate tensile strength of the thread bar. In addition, the thread bar shall be sized so the maximum test load does not exceed 80 percent of the guaranteed ultimate tensile strength of the thread bar.
- 1.8.3 Helical tieback anchor capacity in soil shall not be relied upon from the following soil layers as defined in the geotechnical reports:

The overall length and installed torque of a helical tieback anchor shall be specified such that the required in-soil capacity is developed by end-bearing on the helix plate(s) in an appropriate strata(s).

It is recommended that the theoretical end-bearing capacity of the helix plates be determined using HeliCAP[®] Engineering Software or equal commercially available software. The required soil parameters (c , ϕ , γ , or N-values) for use with HeliCAP[®] or equal shall be provided in the geotechnical reports. The Owner shall determine the allowable response to axial loads.

Helical anchors are not suited for solid, competent rock, but the helix plates can penetrate into dense bearing soils. Appropriate and repeatable installation techniques and helical anchor termination criteria must be identified and verified in the field.

1.8.4 Corrosion Protection

This section is optional (see below). Provisions of this section and Section 4.7 below may not be required in the Specification. If this section is not used, then Section 4.7 should likewise be deleted. The degree and extent of corrosion protection must be specified by the Owner (Table-1).

Corrosion protection is a function of structure type, service life, and the overall aggressiveness of the project soils. The need for corrosion protection of helical tieback anchors must be carefully determined and specified as necessary.

Corrosion resistant coatings (i.e. epoxy, plastic sheath) on the lead/starter section are impractical due to abrasive action wearing off the coating as the soil flows over the helix plates and around the central steel shaft. Hot dip galvanization is the only practical means to provide a corrosion resistant coating capable of withstanding the rigors of installation. Extension sections are typically hot-dip galvanized, but other coatings can be specified.

The following requirements are typical. The specifier should review and edit as appropriate for the project.

Structure Type: _____ (e.g. temporary, permanent) with a temporary structure being defined within a specified time frame (i.e. months rather than years). In general, permanent structures have a service life greater than 24 months.

Temporary structures do not require corrosion protection.

Service Life: _____ (years) a typical service life of 50 years should be used unless otherwise specified. If the service life of a temporary helical tieback anchor is likely to be extended due to construction delays, it should be considered permanent.

For a service life of less than 20 years in non-aggressive soil, corrosion protection is not recommended.

Corrosion protection requirements for the various helical tieback anchor elements shall be provided meeting the requirements of Table-B in the Appendix for:

Soil: _____ Aggressive or Non-Aggressive with optional location and elevation limits defined by the Specifier.

For guidance on aggressiveness classification, see Table-B in the Appendix. It is recommended to retain the services of a corrosion design professional for very aggressive soils.

TABLE-2

CORROSION PROTECTION		
SOIL	AGGRESSIVE	NON-AGGRESSIVE
CENTRAL STEEL SHAFT (Lead Section)	1. Galvanization OR 2. Minimum 1/8” corrosion loss on outside	1. Bare steel OR 2. Galvanization
CENTRAL STEEL SHAFT (Extension Section)	1. Galvanization OR 2. Epoxy coating OR 3. Minimum 1/8” corrosion loss on outside	1. Bare steel OR 2. Galvanization OR 3. Epoxy coating
ANCHORAGE	1. Trumpet – corrosion inhibitor or grout filled AND 2. Cover, if exposed	1. Bare Steel OR 2. Trumpet – corrosion inhibitor or grout filled

NOTES:

Numbered items are options.

For guidance on aggressiveness classification, see Table-B of the Appendix.

1. Trumpet typically extends 3’-0 to 5’-0 beyond the anchorage.

The most critical area to protect from corrosion is in the vicinity of the anchorage and the portion of the thread bar immediately behind the wall. The vulnerability of this area is demonstrated by the fact that most ground anchor failures occur within a short distance of the anchorage device. Care is required in order to ensure that the thread bar and central steel shaft is protected in this area. Grout-filled trumpets require a short term seal until the grout sets and are typically filled with grout after the helical anchor has been stressed. Grease-filled trumpets require a long-term watertight seal that can be difficult to maintain.

1.9. Ground Conditions

The Geotechnical Report, including logs of soil borings as shown on the boring location plan, shall be considered to be representative of the in-situ subsurface conditions likely to be encountered on the project site. Said Geotechnical Report shall be the used as the basis for helical tieback anchor design using generally accepted engineering judgement and methods.

If soil borings are not available, it is suggested to install a helical anchor at various locations on the project site. Using the well-known installed torque vs. capacity attribute of helical anchors, a presumptive soil profile can be generated.

The Geotechnical Report shall be provided for purposes of bidding. If during helical tieback anchor installation, subsurface conditions of a type and location are encountered of a frequency that were not reported, inferred and/or expected at the time of preparation of the bid, the additional costs required to overcome such conditions shall be considered as extras to be paid for.

All available information related to subsurface and general site conditions should be made available to all bidders at the time of bid preparation. It is not reasonable to expect bidders to conduct supplemental site investigations at their own risk and cost prior to bidding, unless the specific contract requirements call for it (Table-1) and provide for appropriate compensation. A mandatory site visit and pre-bid meeting should be held so that the details of the project and the specifications can be thoroughly discussed. These steps will help avoid technical and contractual problems developing during the execution of the work, and will help all parties manage their respective risk.

2 REFERENCED CODES AND STANDARDS

Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation. In case of conflict, the particular requirements of this specification shall prevail. The latest publication as of the issue of this specification shall govern, unless indicated otherwise.

2.1 American Society for Testing and Materials (ASTM):

- 2.1.1 ASTM A29/A29M Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished.
- 2.1.2 ASTM A36/A36M Structural Steel.
- 2.1.3 ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- 2.1.4 ASTM A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- 2.1.5 ASTM A252 Welded and Seamless Steel Pipe Piles.
- 2.1.6 ASTM A775 Electrostatic Epoxy Coating
- 2.1.7 ASTM A193/A193M Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.
- 2.1.8 ASTM A320/A320M Alloy-Steel Bolting Materials for Low Temperature Service.
- 2.1.9 ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- 2.1.10 ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- 2.1.11 ASTM A536 Standard Specifications for Ductile Iron Castings
- 2.1.12 ASTM A572 HSLA Columbium-Vanadium Steels of Structural Quality.
- 2.1.13 ASTM A615 Standard Specification for Deformed and Plain Steel Bars for Concrete Reinforcement
- 2.1.14 ASTM A656 Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability.
- 2.1.15 ASTM A958 Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Wrought Grades.

- 2.1.16 ASTM A1018 Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability.
- 2.1.17 ASTM D1784 Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
- 2.1.18 ASTM D1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- 2.1.19 ASTM D3034 Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- 2.1.20 ASTM D3689 Method of Testing Individual Piles Under Static Axial Tensile Load.

2.2 American Welding Society (AWS):

- 2.2.1 AWS D1.1 Structural Welding Code – Steel.
- 2.2.2 AWS D1.2 Structural Welding Code – Reinforcing Steel.

2.3 American Society of Civil Engineers (ASCE):

- 2.3.1 ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations.

2.4 Association of Drilled Shaft Contractors (ADSC) The International Association of Foundation Drilling:

- 2.4.1 GEC No. 4 - Ground Anchors and Anchored Systems
- 2.4.2 ADSC Mechanical Anchor Product Data

2.5 Post Tensioning Institute (PTI):

- 2.5.1 *Recommendations for Prestressed Rock and Soil Anchors*, Third Edition, Copyright 1996 By the Post-Tensioning Institute.

2.6 Society of Automotive Engineers (SAE):

- 2.6.1 SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners.

3 SUBMITTALS

3.1 Construction Submittals

- 3.1.1 The Contractor or Engineer shall prepare and submit to the Owner, for review and approval, working drawings and design calculations for the helical tieback anchor intended for use at least 14 calendar days prior to planned start of construction (but note also Paragraph 3.1.8). All submittals shall be signed and sealed by a Registered Professional Engineer currently licensed in the State/Province of _____.
- 3.1.2 The Contractor shall submit a detailed description of the construction procedures proposed for use to the Owner for review. This shall include a list of major equipment to be used.
- 3.1.3 The Working Drawings shall include the following:
 - 3.1.3.a Helical anchor number, location and pattern by assigned identification number
 - 3.1.3.b Helical anchor design load

3.1.3.c Type and size of central steel shaft

Type SS125 1-1/4" RCS, Type SS1375 1-3/8" RCS, Type SS5/SS150 – 1-1/2" RCS, Type SS175 – 1-3/4" RCS, Type SS200 – 2" RCS, Type SS225 – 2-1/4" RCS.

- 3.1.3.d Helix configuration (number and diameter of helix plates)
- 3.1.3.e Minimum effective installation torque
- 3.1.3.f Minimum overall length
- 3.1.3.g Inclination of helical anchor
- 3.1.3.h Type and size of thread bar

If the number of helix plates per helical tieback anchor required for the project is not shown on the Working Drawings, the Contractor shall have the option of performing subsurface tests using methods subject to the review and acceptance of the Owner. The data collected along with other information pertinent to the project site shall be used to determine the required helix configuration.

- 3.1.4 The Contractor shall submit shop drawings for all helical tieback anchor components and anchorage details to the Owner for review and approval. This includes helical tieback anchor lead/starter and extension section identification (manufacturer's catalog numbers).

Shop drawings for helical tieback anchor components and standard anchorage connection details can be obtained from CHANCE Civil Construction, their certified Distributors and Installing Contractors, or directly from www.abchance.com or www.atlassys.com.

- 3.1.5 If required, the Contractor shall submit certified mill test reports for the central steel shaft, as the material is delivered, to the Owner for record purposes. The ultimate strength, yield strength, % elongation, and chemistry composition shall be provided.
- 3.1.6 The Contractor shall submit plans for pre-production (optional) and production testing for the helical tieback anchors to the Owner for review and acceptance prior to beginning load tests. The purpose of the test is to determine the load versus displacement response of the helical tieback anchor and provide an estimation of ultimate capacity.

It is the responsibility of the structural engineer of record to establish acceptance criteria for helical tieback anchor performance tests, which can be incorporated into the project specific specification. Load testing also provides the means to verify the empirical ratio between the ultimate capacity and the average installing torque of the helical tieback anchor for a specific project site.

- 3.1.7 The Contractor shall submit to the Owner copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within forty five (45) working days of the date submitted. Helical tieback anchor installation and testing shall not proceed until the Owner has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:

- 3.1.7.a Name of project and Contractor
- 3.1.7.b Name of testing agency
- 3.1.7.c Identification (serial number) of device calibrated
- 3.1.7.d Description of calibrated testing equipment
- 3.1.7.e Date of calibration
- 3.1.7.f Calibration data

Load test equipment includes load cylinders, pressure gauges, and load transducers. A. B. Chance Mechanical Dial Torque Indicator (SKU C303-1340) is calibrated prior to final assembly. Its torsion bar design eliminates the need for annual re-calibration.

- 3.1.8 Work shall not begin until all the submittals have been received and approved by the Owner. The Contractor shall allow the Owner a reasonable time to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

3.2 Installation Records

The Contractor shall provide the Owner copies of helical tieback anchor installation records within 24 hours after each installation is completed. Records shall be prepared in accordance with the specified division of responsibilities as noted in Table-1. Formal copies shall be submitted on a weekly basis. These installation records shall include, but are not limited to, the following information.

- 3.2.1 Name of project and Contractor
- 3.2.2 Name of Contractor’s supervisor during installation
- 3.2.3 Date and time of installation
- 3.2.4 Name and model of installation equipment
- 3.2.5 Type of torque indicator used
- 3.2.6 Location of helical anchor by assigned identification number
- 3.2.7 Elevation of anchorage
- 3.2.8 Actual helical tieback anchor type and configuration – including lead/starter section (number and size of helix plates), number and type of extension sections (manufacturer’s SKU numbers)
- 3.2.9 Helical tieback anchor installation duration and observations
- 3.2.10 Total length of installed helical anchor
- 3.2.11 Inclination of helical anchor
- 3.2.12 Installation torque at one-foot intervals for the final 10 feet
- 3.2.13 Comments pertaining to interruptions, obstructions, or other relevant information
- 3.2.14 Rated load capacities

3.3 Test Reports

The Contractor shall provide the Owner copies of field test reports within 24 hours after completion of the load tests. Records shall be prepared in accordance with the specified division of responsibilities as noted in Table-1. Formal copies shall be submitted within a reasonable amount of time following test completion.

These test reports shall include, but are not limited to, the following information (note Section 6 – Helical Anchor Load Tests).

- 3.3.1 Name of project and Contractor
- 3.3.2 Name of Contractor’s supervisor during installation
- 3.3.3 Name of third party test agency, if required
- 3.3.4 Date, time, and duration of test
- 3.3.5 Location of helical anchor by assigned identification number
- 3.3.6 Type of test (performance, proof)
- 3.3.7 Description of calibrated testing equipment and test set-up
- 3.3.8 Actual helical tieback anchor type and configuration – including lead/starter section, number and type of extension sections (manufacturer’s SKU numbers)
- 3.3.9 Steps and duration of each load increment
- 3.3.10 Cumulative anchor-head movement at each load step
- 3.3.11 Comments pertaining to test procedure, equipment adjustments, or other relevant information
- 3.3.12 Signed by third party test agency rep., registered professional engineer, or as required by local jurisdiction

3.4 Closeout Submittals

- 3.4.1 Warranty: Warranty documents specified herein
 - 3.4.1.a Project Warranty: Refer to Conditions of the Contract for project warranty provisions

Coordinate the warranty period stated herein with the project warranty as stated in the Contract documents.

Warranty Period: (*Specify Term*) years commencing on date of Substantial Completion

- 3.4.1.b Manufacturer’s Warranty: Submit, for Owner’s Acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights the Owner may have under Contract Document.

4 PRODUCTS AND MATERIALS

4.1 Central Steel Shaft:

The central steel shaft, consisting of lead sections, helical extensions, and plain extensions, shall be Type SS as manufactured by CHANCE Civil Construction (Centralia and Independence, MO).

- 4.1.1 *SS5 1-1/2” Material:* Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting dimensional and workmanship requirements of ASTM A29. The bar shall be modified medium carbon steel grade (similar to AISI 1044) with improved strength due to fine grain size.

- 4.1.1.a Torsional strength rating = 5,700 ft-lb

4.1.1.b Minimum yield strength = 70 ksi

4.1.2 *SS125 1-1/4"*; *SS150 1-1/2"*; *SS175 1-3/4"*; *SS200 2"*; *SS225 2-1/4"* *Material:* Shall be hot rolled Round-Cornered-Square (RCS) solid steel bars meeting the dimensional and workmanship requirements of ASTM A29. The bar shall be High Strength Low Alloy (HSLA), low to medium carbon steel grade with improved strength due to fine grain size.

4.1.2.a Torsional strength rating: SS125 = 4,000 ft-lb; SS150 = 7,000 ft-lb; SS175 = 10,500 ft-lb; SS200 = 16,000 ft-lb; SS225 = 21,000 ft-lb

4.1.2.b Minimum yield strength = 90 ksi

4.2 Helix Bearing Plate:

Shall be hot rolled carbon steel sheet, strip, or plate formed on matching metal dies to true helical shape and uniform pitch. Bearing plate material shall conform to the following ASTM specifications.

4.2.1 *SS5 Material:* Per ASTM A572, or A1018, or A656 with minimum yield strength of 50 ksi. Plate thickness is 3/8".

4.2.2 *SS125 Material:* Per ASTM A572 with minimum yield strength of 50 ksi. Plate thickness is 3/8" or 1/2".

4.2.3 *SS150 and SS175 Material:* Per ASTM A656 or A1018 with minimum yield strength of 80 ksi. Plate thickness is 3/8".

4.2.4 *SS200 and SS225 Material:* Per ASTM A656 or A1018 with minimum yield strength of 80 ksi. Plate thickness is 1/2".

4.3 Bolts:

The size and type of bolts used to connect the central steel shaft sections together shall conform to the following ASTM specifications.

4.3.1 *SS125 1-1/4" Material:* 5/8" diameter bolt (2 per coupling) per SAE J429 Grade 8.

4.3.2 *SS5 and SS150 1-1/2" Material:* 3/4" diameter bolt per ASTM A325 or A320 Grade L7.

4.3.3 *SS175 1-3/4" Material:* 7/8" diameter bolt per ASTM A193 Grade B7.

4.3.4 *SS200 2" Material:* 1-1/8" diameter bolt per ASTM A193 Grade B7.

4.3.5 *SS225 2-1/4" Material:* 1-1/4" diameter bolt per ASTM A193 Grade B7.

4.4 Couplings:

For type SS125, SS5, SS150, SS175, SS200, and SS225 material, the coupling shall be formed as an integral part of the plain and helical extension material as hot upset forged sockets.

4.5 Thread bar:

Helical tieback anchor thread bar shall be either a threaded stud adapter, or a combination of pre-stressing steel tendon and ductile iron or forged steel adapter, both of which are attached to the previously installed central steel shaft via an integrally forged socket or cast steel socket and coupling bolt. Tendon shall be a continuous thread steel bar of specified diameter and length depending on the application and load, per ASTM A615 (Dywidag bar or Williams All-Thread Rebar).

4.6 Anchorage:

Stressing anchorages shall be a steel bearing plate with a threaded anchor nut. Anchorage devices shall be capable of developing 95 percent of the guaranteed ultimate tensile strength of the thread bar.

- 4.6.1 Anchor nuts, bevel washers, and other threadable hardware shall be designed to comply with the load carrying requirements of the anchorage.
- 4.6.2 The bearing plate shall be fabricated from steel conforming to ASTM A36, A588, A709 or A572 specifications, or suitable equivalent.
- 4.6.3 The trumpet shall be fabricated from a steel pipe or tube conforming to the requirements of ASTM A-53 and A252 for pipe and ASTM A500 for tubing, or from a PVC pipe conforming to the requirements of ASTM D1785.
- 4.6.4 Anchorage covers shall be fabricated from steel or plastic with a minimum thickness of 0.10". If grease filled, the joint between the cover and the bearing plate shall be watertight.

4.7 Corrosion Protection (Optional)

The corrosion protection requirements, if any, are identified in Section 1.8.4. The Specifier may elect to delete this section entirely if no corrosion protection materials are required such as for helical anchors in non-aggressive ground.

- 4.7.1 Epoxy Coating: If used, the thickness of coating applied electrostatically to the central steel shaft shall be 7-12 mils. Epoxy coating shall be in accordance with ASTM A775. Bend test requirements are not required. Coupling bolts and nuts are not required to be epoxy coated.
- 4.7.2 Galvanization: If used, all Hubbell Power Systems, Inc./A. B. Chance Type SS material shall be hot-dipped galvanized in accordance with ASTM A153 or A123 after fabrication.

5 EXECUTION

5.1 Site Conditions

- 5.1.1 Prior to commencing helical anchor installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where helical tieback anchors may commence without restriction.
- 5.1.2 The Contractor shall verify that all helical tieback anchors may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

5.1.3 In the event of a discrepancy, the Contractor shall notify the Owner. The Contractor shall not proceed with helical tieback anchor installation in areas of discrepancies until said discrepancies have been resolved. All costs associated with unresolved discrepancies shall be the responsibility of the Owner.

5.2 Installation Equipment

5.2.1 Shall be rotary type, hydraulic power driven torque motor with clockwise and counter-clockwise rotation capabilities. The torque motor shall be capable of continuous adjustment to revolutions per minute (RPM's) during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed.

Helical tieback anchors should be installed with high torque, low RPM torque motors, which allow the helical screw plates to advance with minimal soil disturbance.

5.2.2 Equipment shall be capable of applying adequate down pressure (crowd) and torque simultaneously to suit project soil conditions and load requirements. The equipment shall be capable of continuous position adjustment to maintain proper helical anchor alignment.

5.3 Installation Tooling

5.3.1 Shall consist of a Kelly Bar Adapter (KBA) and Type SS drive tool as manufactured by CHANCE Civil Construction and used in accordance with the manufacturers written installation instructions.

Installation tooling should be maintained in good working order and safe to operate at all times. Flange bolts and nuts should be regularly inspected for proper tightening torque. Bolts, connecting pins, and retainers should be periodically inspected for wear and/or damage and replaced with identical items provided by the manufacturer. Heed all warning labels. Worn or damaged tooling should be replaced.

5.3.2 A torque indicator shall be used during helical tieback anchor installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling. Torque indicators are available from CHANCE Civil Construction.

5.3.2.a Shall be capable of providing continuous measurement of applied torque throughout the installation.

5.3.2.b Shall be capable of torque measurements in increments of at least 500 ft-lb

5.3.2.c Shall be calibrated prior to pre-production testing or start of work. Torque indicators which are an integral part of the installation equipment shall be calibrated on-site. Torque indicators which are mounted in-line with the installation tooling shall be calibrated either on-site or at an appropriately equipped test facility. Indicators that measure torque as a function of hydraulic pressure shall be calibrated at normal operating temperatures.

- 5.3.2.d Shall be re-calibrated, if in the opinion of the Owner and/or Contractor reasonable doubt exists as to the accuracy of the torque measurements.

5.4 Installation Procedures

5.4.1 Central Steel Shaft:

- 5.4.1.a The helical tieback anchor installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project.
- 5.4.1.b The lead section shall be positioned at the location as shown on the working drawings. The lead section may be started perpendicular to the wall face to assist initial advancement into the soil. After initial penetration, the required inclination angle shall be established. The helical tieback anchor sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 20 RPM's. Extension sections shall be provided to obtain the required minimum overall length and installation torque as shown on the working drawings. Connect sections together using coupling bolt and nut torqued to 40 ft-lb.
- 5.4.1.c Sufficient down pressure shall be applied to uniformly advance the helical tieback anchor sections approximately 3 inches per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths.

5.4.2 Thread Bar:

- 5.4.2.a After the termination criteria as detailed in Section 5.5 has been met, the central steel shaft is connected to the anchorage via the threaded stud adapter or via the combination of pre-stressing steel tendon and adapter.

5.5 Termination Criteria

- 5.5.1 The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.
- 5.5.2 The minimum installation torque and minimum free-length criteria as shown on the working drawings shall be satisfied prior to terminating the helical tieback anchor installation. In the event any helical anchor fails these production quality control criteria, the following pre-qualified remedies are authorized:
- 5.5.3 If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum free-length required, the Contractor shall have the following options:
 - 5.5.3.a Terminate the installation at the depth obtained subject to the review and acceptance of the Owner, or:
 - 5.5.3.b Remove the existing helical tieback anchor and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new helical

tieback anchor shall be terminated at least (3) three feet beyond the terminating depth of the original anchor without exceeding any applicable maximum embedment length requirements, or:

- 5.5.3.c Replace the existing helical tieback anchor with one having a shaft with a higher torque strength rating. The new shaft size/type shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new helical tieback anchor shall be terminated at least (3) three feet beyond the terminating depth of the original anchor without exceeding any applicable maximum embedment length requirements.

It is generally not recommended to re-use helical tieback anchor shaft material after it has been permanently twisted during a previous installation.

- 5.5.4 If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, the Contractor shall have the following options:

- 5.5.4.a Install the helical tieback anchor deeper using additional extension sections until the minimum installation torque criterion is met, provided that, if a maximum length constraint is applicable, continued installation does not exceed said maximum length constraint, or:
- 5.5.4.b Remove the existing helical tieback anchor and install a new one with additional and/or larger diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new helical tieback anchor shall be terminated at least (3) three feet beyond the terminating depth of the original anchor provided that, if a maximum length constraint is applicable, continued installation does not exceed said maximum length constraint, or:
- 5.5.4.c De-rate the load capacity of the helical tieback anchor and install additional helical anchors as necessary. The de-rated capacity and additional anchor location shall be subject to the review and acceptance of the Owner.

- 5.5.5 If the minimum installation torque as shown on the working drawings is not achieved before reaching a specified maximum embedment length, the Contractor shall have the following options:

- 5.5.5.a If allowed by the Owner's representative, remove the existing helical tieback anchor and reinstall at a position at least three times the diameter of the largest helix away from the initial location. Original embedment length and installation torque criteria must be met. Repositioning may require the installation of additional helical tieback anchors with design loads adjusted for spacing changes, or:
- 5.5.5.b Demonstrate acceptable helical tieback anchor performance through proof testing, or:
- 5.5.5.c De-rate the load capacity of the helical tieback anchor and install additional helical anchors as necessary. The de-rated capacity and additional anchor location shall be subject to the review and acceptance of the Owner.

- 5.5.6 If the helical tieback anchor is refused or deflected by a subsurface obstruction, the installation shall be terminated and the anchor removed. The obstruction shall be removed, if feasible, and the helical

tieback anchor re-installed. If obstruction can't be removed, the helical tieback anchor shall be installed at an adjacent location, subject to review and acceptance of the Owner.

- 5.5.7 If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the anchorage, the Contractor may remove the last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension to the correct length and field drill a hole in cut-off shaft. The Contractor shall not reverse (back-out) the helical anchor to facilitate extension removal.
- 5.5.8 The average torque for the last three feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the working drawings. The average torque shall be defined as the average of the last three readings recorded at one-foot intervals.

The average torque can be empirically related to the helical tieback anchor's ultimate capacity in end-bearing. This well-known attribute of helical anchors can be used as a production control method to indicate the tieback's end-bearing capacity.

6 HELICAL TIEBACK ANCHOR LOAD TESTS

The Contractor shall submit for review and acceptance the proposed helical tieback anchor load testing procedure. Production and pre-production test procedures shall be in conformance with the helical anchor test procedures as detailed below, and shall provide the minimum following information:

- ◆ Type and accuracy of load equipment
- ◆ Type and accuracy of load measuring equipment
- ◆ Type and accuracy of anchor-head deflection equipment
- ◆ Calibration report for complete load equipment, including hydraulic jack, pump, pressure gauge, hoses, and fittings.

6.1 Pre-Production Tests (Optional)

Load tests shall be performed to verify the suitability and capacity of the proposed helical tieback anchor, and the proposed installation procedures prior to installation of production anchors. _____ sacrificial test anchors shall be constructed immediately prior to the start of work on the production tieback anchors. The Owner shall determine the number of pre-production tests, their location, and acceptable load and movement criteria. Additional purpose of pre-production tests is to empirically verify the ultimate capacity to the average installing torque of the helical tieback anchor for the project site.

Pre-production helical anchor installation methods, procedures, equipment, and overall length shall be identical to the production anchors to the extent practical except where approved otherwise by the Owner. Such tests shall be based, as a minimum, on the principles of the performance test.

If the pre-production test fails to meet the design requirements, the Contractor shall modify the helical tieback anchor design and/or installation methods and retest the modified anchor, as directed by the Owner. *For prescriptive specifications, the Engineer will define the appropriate modifications.*

6.2 Load Test Equipment

- 6.2.1 The hydraulic jack shall be positioned at the beginning of the test such that the unloading and repositioning of the jack during the test shall not be required. The jacking system shall be capable of applying a tension load not less than eighty percent (80%) of the guaranteed ultimate tension capacity of the thread bar. The pressure gauge shall be graduated in 100 psi increments or less. The stroke of the jack shall not be less than the theoretical elastic elongation of the total helical anchor length at the maximum test load.
- 6.2.2 The load test equipment shall be capable of increasing or decreasing the applied load incrementally. The incremental control shall allow for small adjustments, which may be necessary to maintain the applied load for a sustained, hold period.
- 6.2.3 The reaction system (or retaining structure itself) shall be designed so as to minimize its movement under load and to prevent bending of the thread bar. If the reaction system is the retaining structure, then said structure and connections shall be checked to determine if they have sufficient strength and capacity to distribute the test loads to the ground. Test loads are normally higher than the design loads on the structure. The direction of the applied load shall be collinear with the helical anchor at all times.
- 6.2.4 A dial gauge shall be used to measure anchor movement. The dial gauge shall have an accuracy of at least ± 0.001 -in. and a minimum travel sufficient to measure all anchor movements without requiring resetting the gauge. The dial gauge shall be positioned so its stem is coaxial with the axis of the anchor. The stem may rest on a smooth plate located at the end of the anchor. Said plate shall be positioned perpendicular to the axis of the anchor. The dial gauge shall be supported by a reference apparatus to provide an independent fixed reference point. Said reference apparatus shall be independent of the reaction system and shall not be affected by any movement of the reaction system.
- 6.2.5 The load test equipment shall be re-calibrated, if in the opinion of the Owner and/or Contractor reasonable doubt exists as to the accuracy of the load or deflection measurements.

6.3 Testing Program

- 6.3.1 The anchor testing program shall consist of two parts, namely, performance tests and proof tests. The testing procedures are as described in Sections 6.3.4 and 6.3.5 respectively.
- 6.3.2 The Owner shall select the helical tieback anchors to be performance tested within each wall area or tier. One anchor per wall area or tier shall be tested in accordance with the performance test procedures. These anchors should be located in the area of soil borings if possible. These anchors

are to be installed, tested, and approved by the Owner prior to the installation of production anchors within that area or tier. All anchors, which are performance tested, shall be used as production anchors and incorporated into the retention structure. Upon completion and approval of the performance tests, the installation of production anchors may proceed.

6.3.3 Proof tests shall be performed on all production helical tieback anchors which are not performance tested. Proof tests results are subject to the approval of the Owner.

6.3.4 Performance Test Procedures

6.3.4.a Two (2) percent of the helical tieback anchors or a minimum of two (2) anchors, which ever is greater, shall be performance tested in accordance with the following procedures.

6.3.4.b The helical anchors which are performance tested may be completely unloaded prior to adjusting to the lock-off load, if so warranted by the construction sequence. Final loading to the lock-off load does not require further movement readings.

6.3.4.c Helical tieback anchors shall be performance tested by incrementally loading and unloading the anchor in accordance with the following schedule. The load shall be raised from one increment to another immediately after recording the anchor movement. The anchor movement shall be measured and recorded to the nearest 0.001 inches with respect to an independent fixed reference point at the alignment load and at each increment load. The load shall be monitored with a pressure gauge. At load increments other than the maximum test load, the load shall be held just long enough to obtain and record the movement reading.

PERFORMANCE TEST SCHEDULE				
CYCLICAL LOAD INCREMENTS (%DL/100)				
AL 0.25DL*	AL 0.25DL 0.50DL*	AL 0.25DL 0.50DL 0.75DL*	AL 0.25DL 0.50DL 0.75DL 1.00DL*	AL 0.25DL 0.50DL 0.75DL 1.00DL 1.25DL* Reduce to lock-off load [#]

* - See Section 6.3.4.e

- Except as noted in Section 6.3.4.b

AL = Alignment Load (10%-15% DL); DL = Design (Working) Load

A test load higher than 1.25 DL may be specified by the Owner under special conditions. Such special conditions may arise if fixed reference points cannot be practically established, against which to directly measure anchor head movement, for example.

6.3.4.d The 1.25DL load increment shall be held for ten (10) minutes. The ten minute observation period shall commence as soon as the 1.25DL load is applied to the anchor. Movements shall be recorded at 0.5, 1, 2, 3, 4, 5, 6, and 10 minutes. If the anchor movement between the one (1) minute and ten (10) minute readings exceeds 0.05 inches, then the 1.25 DL test load shall

be maintained for an additional 20 minutes. Movements shall be recorded at 15, 20, 25, and 30 minutes. If the acceptance criteria given in Section 6.4.1 is not satisfied, then the anchor test shall be continued for an additional 30 minutes. Movements shall be recorded at 45 and 60 minutes. If the acceptance criteria is not satisfied after this extended observation period, then the contractor shall exercise one of the options as referenced in Section 6.4.2.

- 6.3.4.e The Contractor shall plot the helical anchor movement versus load for each load increment marked with an asterisk (*) in the performance test schedule and plot the residual movement at each alignment load versus the highest previously applied load.
- 6.3.4.f Throughout the 1.25DL observation period, the load shall be held constant by adjusting the hydraulic pressure. Care must be taken so as not to exceed the 1.25DL test load.

6.3.5 Proof Test Procedures

- 6.3.5.a All anchors which are not performance tested shall be proof tested.
- 6.3.5.b Anchors which are proof tested may be completely unloaded prior to adjusting to the lock-off load, if so warranted by the construction sequence. Final loading to the lock-off load does not require further movement readings.
- 6.3.5.c The proof test shall be performed by incrementally loading the helical anchor in accordance with the following schedule. The load shall be raised from one increment to another after an observation period. The anchor movement shall be measured and recorded to the nearest 0.001 inches with respect to an independent fixed reference point at the alignment load and at each increment load. The load shall be monitored with a pressure gauge. At load increments other than the maximum test load, the load shall be held for a period not to exceed two (2) minutes. The two minute observation period shall begin when the pump begins to load the anchor to the next load increment. Movement readings shall be taken at the end of the two minute observation period.

PROOF TEST SCHEDULE	
LOAD TEST SCHEDULE (%DL/100)	OBSERVATION PERIOD (MIN.)
AL	0.0
0.25DL	2.0
0.50DL	2.0
0.75DL	2.0
1.00DL	2.0
1.25DL*	5.0
Reduce to lock-off load [#]	

* - see Section 6.3.5.e
 # - except as noted in Section 6.3.5.b
 AL = Alignment Load (10%-15% DL)
 DL = Design (Working) Load

- 6.3.5.d The 1.25DL test load shall be maintained for five (5) minutes. This five minute observation period shall commence as soon as the 1.25DL is applied to the anchor. Movement readings shall be recorded at 0.5, 1, 2, 3, 4, and 5 minutes. If the movement between the 0.5 and 5

minute reading exceeds 0.05 inches, then the 1.25DL test load shall be maintained for an additional five (5) minutes. Movement readings shall be recorded at 6 and 10 minutes. If the acceptance criteria given in Section 6.4.1 is not satisfied, then the anchor test shall be continued for an additional twenty (20) minutes. Movement readings shall be recorded at 15, 20, 25, and 30 minutes. If the acceptance criteria is not satisfied after this extended observation period, then the contractor shall exercise one of the options as referenced in Section 6.4.2.

- 6.3.5.e The Contractor shall plot the helical anchor movement vs. load for each load increment in the proof test.
- 6.3.5.f Throughout the 1.25DL observation period, the load shall be held constant by adjusting the hydraulic pressure. Care must be taken so as not to exceed the 1.25DL test load.

6.4 Acceptance Criteria

- 6.4.1 The net movement for the performance and proof tests shall not exceed 0.10 inches during the final log cycle of time (examples, 3-min. to 30-min. for performance tests; 1-min. to 10-min. for proof tests).
- 6.4.2 If the above criteria is exceeded, then the test shall be continued for an extended period of time as defined in Section 6.3.4.d for the performance test and in Section 6.3.5.d for the proof test. If the final log cycle of time movement at the end of the extended observation period exceeds 0.10 then the contractor shall have the following options:
 - 6.4.2.a Extend the observation period for an additional 60 minutes for the performance test with movement readings taken at 80, 90, 100, and 120 minutes. Extend the observation period for an additional 30 minutes if the proof test is involved with movement readings taken at 45 and 60 minutes. The net movement shall not exceed 0.10 inches during the final log cycle of time.
 - 6.4.2.b Install the helical anchor deeper so as to increase its average installation torque, provided that the maximum torque capacity of the anchor and the maximum length constraint, is not exceeded. This anchor shall be proof tested.
 - 6.4.2.c Remove the helical anchor and reinstall an anchor with larger diameter and/or additional helices. If this anchor is reinstalled at the same location, then the last helix of this reinstalled anchor shall penetrate at least five (5'-0) feet beyond the length of the original anchor, provided the maximum length constraint is not exceeded. This anchor shall be proof tested.
 - 6.4.2.d Reduce the design load of the helical anchor. This anchor shall be performance tested at the reduced design load. This option will require one or two additional anchors be installed adjacent to this reduced design load anchor. The number of additional anchors to be installed is a function of the reduced design load. Adjacent anchor(s) shall be installed at least three diameters, based on the largest helix, away from the reduced design load anchor. Design loads on adjacent anchor(s) shall be adjusted accordingly based on the revised horizontal spacing.

7 MEASUREMENT AND PAYMENT

Helical tieback anchor work can be paid for in different ways, reflecting the relative risk to be accepted by the Owner and the Contractor. However, the following items are common and standard.

QUANTITY	DESCRIPTION	UNIT
1	Mobilization/Demobilization	Lump sum
As required	Conduct pre-production test anchor program of declared scope	Lump sum
As required	Performance Test Production Helical Anchors	Per anchor
-	Obstructions	Per hour or Force Account
As required	Helical Anchor Installation	As below

- ◆ Per Unit Length: Helical tieback anchors meeting the design capacity shall be paid for per lineal foot below grade.
- ◆ Per Helical Anchor: Helical tieback anchors meeting the design capacity shall be paid for on a “per anchor” basis (no allowance for changes in length relative to that originally bid).
- ◆ Per Helical Anchor with Add/Deduct: Helical tieback anchors meeting the design capacity shall be paid for on a “per anchor” basis, with a predetermined length, and an add/deduct amount per lineal foot to accommodate field changes.
- ◆ Lump Sum: The whole helical tieback anchor project shall be paid for on a “lump sum” basis (no allowance for changes due to additional anchor length relative to that originally bid).

END OF SPECIFICATION

APPENDIX

TABLE-A

CHANCE Civil Construction

MECHANICAL STRENGTH RATINGS – Type SS HELICAL ANCHORS

RATING TYPE	CENTRAL STEEL SHAFT PRODUCT FAMILY					
	SS125 1-1/4” RCS	SS5 1-1/2” RCS	SS150 1-1/2” RCS	SS175 1-3/4” RCS	SS200 2” RCS	SS225 2-1/4” RCS
Torque Strength Rating (ft-lb)	4,000	5,700	7,000	10,500	16,000	23,000
Ultimate Strength Per Helix (kip) (Tension/Compression)	*30	*40	*40	*50	60	60
Tension Capacity Limit¹ (kip)	40	55	70	#105	#160	#230
Ultimate Tension Strength² (kip)	60	70	70	100	150	200

* For 14” Dia. 3/8” Thick Helix Plates, Reduce the Ultimate Capacity by 20%

1 - Based on torque rating – Tension Capacity Limit = Torque Rating x Kt; “Default” Kt for Type SS = 10

2 – Based on mechanical strength of coupling

- Limited by mechanical strength of coupling bolt

Actual installed capacities are dependent on site specific soil conditions.

APPENDIX

TABLE-B

GUIDANCE OF GROUND AGGRESSIVENESS CLASSIFICATION

Soil tests may be performed to measure the aggressiveness of the soil environment, especially if field observations indicate corrosion of existing structures. The most common and simplest tests are for electrical resistivity, pH, chloride, and sulfates. The designation for these tests and the critical values defining whether an aggressive soil environment exists, are as shown below. Per FHWA-RD-89-198, the ground is considered aggressive if any one of these indicators shows critical values.

Property	Test Designation	Critical Values
Resistivity	ASTM G 57 AASHTO T-288	below 2,000 ohm-cm
pH	ASTM G 51 AASHTO T-289	below 5
Sulfate	ASTM D 516M ASTM D 4327	above 200 ppm
Chloride	ASTM D 512 ASTM D 4327 AASHTO T-291	above 100 ppm
Organic Content	AASHTO T-267	1% max