SECTION 31 00 00

EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Perform excavation, filling, compacting and grading operations both inside and outside building limits as required for below-grade improvements and to achieve grades and elevations indicated. Provide trenching and backfilling for mechanical and electrical work and utilities.
B. Provide subbase materials, drainage fill, and common fill materials for slabs, pavements, and improvements.
C. Provide suitable fill from off-site if on-site quantities are insufficient or unacceptable, and legally dispose of excess fill off-site.
D. Provide rock excavation without blasting, unless specifically authorized, in unit prices on Bid Proposal and as defined herein.

1.02 PROJECT CONDITIONS

A. If a boundary and topographical survey have been prepared for this site, refer to Section 00 31 00.
B. If a geotechnical analysis has been prepared for this site, refer to Section 00 31 00.
C. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for the convenience of Contractor. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
D. Locate existing underground utilities in the area of work. Provide adequate means of protection during earthwork operations. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of operating authority.

1.03 TESTING AND INSPECTION

A. Comply with Section 01 45 16 – Quality Control Procedures.
B. Testing Laboratory and Reporting: Owner shall provide the services of a qualified independent geotechnical testing laboratory to perform soil testing and inspection service during earthwork operations.
C. Test and analysis of fill material will be performed in accordance with ASTM D698-12 or ASTM D1557-12 “Standard” Proctor Density as recommended by testing laboratory
D. Frequency of test: One in-place compaction test should be performed for each 2,500 square feet of fill placed, per lift, with a minimum of three tests per lift, unless otherwise recommended by testing laboratory.
E. Sub-grade shall be approved by testing lab before backfilling begins.
F. Non-conforming work shall be corrected as directed by testing laboratory.
G. Testing laboratory shall submit approved final field density test reports within 7 days of obtaining data. Reports shall identify project, date of testing, test locations, materials, and Contractor’s equipment and methods used.

1.04 SUBMITTALS

A. Comply with Section 01 33 00.
B. Upon request, submit for approval list of materials and gradations proposed for use.

1.05 QUALITY ASSURANCE

A. Compaction (Unless otherwise indicated in Geotechnical Analysis or as recommended by Testing Laboratory):
   1. Under structures, building slabs, steps, pavements, and walkways, 95% minimum density per ASTM D698-12 or ASTM D1557-12, at moisture content range of 1% below to 3% above optimum moisture content.
   2. Under lawns or unpaved areas, 90% minimum density, ASTM D698-12, at moisture content range of 3% below to 3% above optimum moisture content.
B. Grading Tolerances Outside Building Lines:
   1. Lawns, unpaved areas, and walks, plus or minus 1-inch.
   2. Pavements, plus or minus ½-inch.
C. Grading Tolerance for Fill Under Building Slabs: Plus or minus ½-inch measured with 10-foot straightedge.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Subbase material: Material acceptable for intended use as subbase for paving specified unless noted on the drawings.
   1. Naturally or artificially graded mixture of natural or crushed gravel.
   2. Crushed limestone graded from 1" to dust.
   3. Crushed slag.
   4. Natural or crushed sand, free of silt, clay, loam, friable or soluble materials, and organic matter.
   5. Cohesive subgrade: Subgrade soils may be stabilized with hydrated lime, cement, or flyash, or chemical treatment in accordance with AASHTO standards. The quantity of additive required should be determined after the site is stripped of the loose topsoil and the subgrade soils exposed. Actual percentage required shall be determined by independent laboratory tests provided by Contractor and approved by Geotechnical Engineer.
   6. Substitute materials may be utilized with prior approval from Geotechnical Engineer.
B. Drainage fill: Washed gravel or crushed stone, ¼" to ¾" size; ASTM C33, Size 67.
C. Common fill: Mineral soil substantially free from organic and unsuitable materials, and free from rock or gravel larger than 2" in diameter, 80% passing No. 40 sieve and not more than 50% passing No. 200 sieve.
D. Structural fill:
   1. Inactive silty or sandy clay, with a plasticity index less than 20 and a liquid limit less than 45, free of rocks greater than 6" in diameter.
   2. Gravel or sandy gravel free of organic and unsuitable materials and within the following gradation limits: 4" sieve, 100 percent finer by weight; 1" sieve, 60 to 100 percent; No. 4 sieve, 25 to 85 percent; No. 20 sieve, 10 to 60 percent; No. 50 sieve, 4 to 35 percent; No. 200 sieve, 0 to 5 percent.
   3. Substitute materials may be utilized with prior approval from Geotechnical Engineer.

PART 3 – EXECUTION

3.01 EXCAVATION

A. Excavation classification: Excavation classifications shall be defined herein and includes removal and disposal of any material encountered to obtain required subgrade elevations, including pavement, obstructions visible on ground surface, underground structures and utilities indicated to be removed, boulders, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.
B. Unauthorized excavations (removal of materials beyond indicated subgrade elevations and dimensions) shall be corrected as follows:
    1. At structure:
        a. Extend the indicated bottom elevation of footing to the lower elevation.
        b. Provide concrete or lean concrete mix approved by Architect or Engineer.
        c. Compacted structural fill.
    2. Elsewhere: Backfill and compact as directed.
C. Excavation for structure: Excavate for structure to elevations and dimensions shown, extending excavation a sufficient distance to permit placing and removal of concrete formwork, installation of services, other work, and for inspection. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottom to required lines and grades to provide solid base to receive concrete.
    1. Arrange for observation of completed excavation by geotechnical engineer prior to fill placement or footing construction.
D. Excavation for pavements: Cut surface under pavements to comply with cross-section, elevations and grades as indicated
E. Excavation for trenches: Dig trenches to the uniform width required for the particular item to be installed, sufficiently wide to provide ample working room, and to the depth indicated or required. Trench width for piping shall be cut to provide 6” –12” of clear space between the pipe O.D. and trench wall. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations with a minimum of 4” of granular bedding below the pipe. Beyond the building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups. Where rock is encountered, carry the excavation 6” below the required elevation and backfill with a 6” layer of crushed stone or gravel prior to installing pipe. Grade bottoms of trenches as indicated, notching pipe bells to provide solid bearing for the entire body of pipe. Backfill trenches with concrete where trench excavations pass within 18” of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place backfill to level of bottom of adjacent footing. Do not backfill trenches until tests and inspections have been made and backfilling authorized by Geotechnical Engineer. Use care in backfilling to avoid damage or displacement of pipe system.
F. Excavation of rock: If rock, as defined below, which requires for its removal the continuous use of pneumatic tools or drilling and blasting, is encountered, Contractor shall cease all excavation and trenching work in associated area and notify Owner in accordance with General Conditions. Provide rock excavation unit price basis as set forth in Contractor’s Bid Proposal defined as follows:
    1. Solid rock excavation is defined as rock in solid bed or masses in its original or stratified position including boulders and detached masses of rock, portions of which projecting into the lines of excavation and necessary to be removed exceed in any one bed, mass or boulder one (1) cubic yard, and which is not, in the opinion of the Geotechnical Engineer, practicable to except after drilling and blasting.
    2. Trench rock excavation is defined as excavation of a continuous nature, narrow in width such as excavation for foundation walls, foundation wall footings, plumbing, heating and sewer lines, drain tile and excavation of a similar nature.
    3. Pit rock excavation is defined as excavation of an isolated nature, such as piers, footing for piers, shafts, tanks and other excavation of a similar nature.

4. Solid rock occurring in any excavation shall be uncovered by Contractor and measured by the Geotechnical Engineer before its removal by the Contractor. Any rock removed before Geotechnical Engineer's inspection and measurement shall be treated as earth excavation and the Contractor shall not be entitled to additional compensation for its removal.
5. Unless rocks comply with the requirements above, closely packed strata or flint or other rock separated by clay or earth seams shall be classed as earth excavations and the Contractor shall not be entitled to additional compensation for its removal; provided, however, that bedded deposits, unstratified masses, and other rock deposits so firmly cemented as to present the characteristics of solid rock shall be deemed to be solid rock within the provision above when Geotechnical Engineer so certifies.
6. Blasting: No blasting of rock will be allowed unless specifically authorized.
    a. Contractor shall comply with all local, state, and federal laws, ordinances, applicable safety code requirements and regulations relative to handling, storage, and use of explosives and the protection of life and property.
    b. The Contractor shall be responsible for all damages caused by his blasting operations. Suitable methods shall be employed to confine all materials lifted by blasting within limits of the excavation or trench.
    c. No blasting of rock will be allowed in foundation wall lines or general areas that are within twenty (20) feet of adjacent structures unless specifically authorized.
    d. All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.

3.02 SHORING AND BRACING

A. Sheeting, bracing and shoring shall be the responsibility of the Contractor and be designed by a professional engineer licensed in the jurisdiction of the project and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining shape and position under all circumstances. Design and construction shall be in compliance with codes and ordinances of governing authorities having jurisdiction.
B. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent caving or sliding; to provide protection for workmen and the work; and to provide protection for existing structures and facilities.

3.03 BACKFILL AND FILL

A. Place and compact acceptable soil material in layers to required elevations. Do not place materials on surfaces that are muddy, frozen, contain ice, or frost. Backfill excavations as promptly as work permits.
B. Place acceptable materials in layers not more than 8" loose depth for materials compacted by heavy equipment and not more than 4" loose depth for materials compacted by hand equipment to subgrades indicated as follows:
    1. Structural Fill: Use under foundations, slabs on grade in layers as indicated.
    2. Drainage Fill: Use under designated building slabs, at foundation drainage and elsewhere as indicated.
    3. Common Fill: Use under unpaved areas. Note, where post-tension type foundation systems are indicated or when recommended in Geotechnical Analysis for other foundation system types, provide 12" of high plastic index type clay soil "plug" surrounding unpaved building perimeter for a minimum of five (5) feet extension from building properly compacted to minimize infiltration of surface water for gaining access to subgrade beneath structure.
    4. Subbase Material: Use under pavement, walks, steps, piping and conduit.

5. Pipe Embedment: Pipe embedment shall extend from the pipe bedding to 12” above the top of pipe for plastic pipe and to the centerline of the pipe for reinforced concrete pipe. Pipe embedment shall consist of gravel or sand compacted to 90% density.

3.04 PAVEMENT SUBBASE COURSE

A. Place specified subbase material in layers of indicated thickness, over subgrade surface to support pavements. Place in a single layer not to exceed 6” in thickness and in equal layers of 6” or less for thickness greater than 6”.

3.05 BUILDING SLAB DRAINAGE COURSE

A. Place drainage fill material on prepared subgrade in a single layer not to exceed 6” in thickness and in equal layers of 6” or less for thickness greater than 6”.

3.06 GRADING

A. Subgrade elevation to be 4” below finish indicated for placement of topsoil specified in Section 32 90 00. Grade areas indicated with uniform levels or slopes between finish elevations. Shape surface of areas to 0.10 ft. above or below required subgrade elevation, compacted as required. Where in-situ soil is used as subgrade, soil shall be scarified, moisture conditioned and recompacted to a depth of 6-inches unless otherwise noted.

3.07 MAINTENANCE AND DISPOSAL

A. Dewatering: Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrade and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other de-watering systems components necessary to convey water away from excavations. Convey water removed from excavations and rainwater to collection or runoff areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
B. Material storage: Stockpile excavated materials in such a manner not to impede construction activities, encumber adjacent property, or within drip line of trees to remain. Place, grade, and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations.
C. Protect existing structures, planting, utilities, and conditions designated to remain.
D. Protect newly graded areas from traffic and erosion. Recompact and regrade settled, disturbed and damaged areas as necessary to restore quality, appearance, and condition of work
E. Control erosion to prevent runoff into sewers or damage sloped or runoff areas.
F. Control dust to prevent hazards to adjacent properties and vehicles. Immediately repair or remedy damage caused by dust, including air filters in equipment and vehicles. Clean soiled surfaces.
G. Dispose of waste and unsuitable materials off-site in a legal manner.

END OF SECTION

SECTION 31 31 16

TERMITE CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. Provide soil treatment for termite control, complete.

1.02 SUBMITTALS

A. Comply with Section 01 33 00.
B. Upon request, submit for approval product data.
C. Submit warranty.

1.03 QUALITY ASSURANCE

A. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
B. Regulatory Requirements
   1. Comply with governing codes and regulations.
   2. Conform to applicable requirements of authorities having jurisdiction for application licensing and authority to use toxicant chemicals.
C. Qualifications:
   1. Use only state licensed pest control operator.
   2. Toxicant qualifications:
      a. Meet requirements of Federal Insecticide, Fungicide and Rodenticide Act; 7USC 136-136y for use in controlling termite infestation of buildings, without being injurious.
      b. Contain current Environmental Protection Agency (EPA) registration number.

1.04 WARRANTY

A. Provide written warranty agreeing to re-treat soil and repair damage caused by termite infestation, carpenter ants and other pests during 5 year period from date of substantial completion.

PART 2 - PRODUCTS

2.02 MATERIALS

A. Soil treatment materials which bear Federal registration number of U.S. Environmental Protection Agency and acceptable to authorities having jurisdiction. If acceptable, products may include chloropyrifos, permathrin, cypermethrine, fenvalerate, isofenphose.
B. Toxicant Chemical: Water based emulsion, uniform composition, synthetic dye to permit visual identification of treated soil, of the following chemical element and concentrations.
   1. Chloropyrifos: DowElanco “Dursban TC”, 1% solution.
   2. Permathrin: FMC “Dragnet” or ICI Americas “Torpedo”, 0.5 percent in water emulsion.
C. Mix Dilution: Dilute toxicant chemical as recommended by manufacturer for project conditions.

PART 3 - EXECUTION

3.01 INSPECTION / PREPARATION

A. Verify the soil surfaces are unfrozen, sufficiently dry to absorb toxicant, ready to receive treatment. Do not apply treatment to frozen or excessively wet soils.
B. Do not apply emulsion until location of air ducts, vents, water, and sewer lines are known and identified. Take extreme caution to avoid contamination of these elements and airways.
C. Protection:
    1. Allow no disturbance of treated soil between application of poison and placing of concrete. Reapply soil treatment solution to areas disturbed by subsequent excavation, other construction activities, or heavy rain following application.
    2. Protect neighboring property, water sources, and personnel on site from contamination.
        a. Use anti-backflow equipment or procedures.
        b. Do not treat soil beneath structures that contain wells or cisterns.
        c. Take extreme care to avoid runoff.
    3. Maintain, on job site, empirical name of chemical, Manufacturer's precautions, and phone numbers of proper authorities to notify in case of spillage or other accident.

3.02 RATES

A. General use, application, rates, and locations: Follow Federal Insecticide, Fungicide and Rodenticide Act; 7USC 136-136y published regulations.
B. Along foundation wall side at backfill and foundation base: Four gallons per ten lineal feet per foot of depth.
C. Under concrete floor slab and flatwork on grade:
    1. Fill dirt: One gallon per ten square feet.
    2. Wash gravel or other coarse material: 1 ½ gallons per ten square feet.
D. Gravel or coarse material used under footings, slabs, or other flatwork: 1 ½ gallons per ten square feet.
E. Other area applications including penetrations:
    1. Slabs on grade adjacent to building, i.e., front and rear entry, condenser pads, stair exit slabs.
    2. Follow manufacturer's instructions and indicated regulatory agencies rules and regulations.
F. Final termite treatment upon completion of finish grading in accordance with manufacturer's instruction.

3.03 INSTALLATION

A. Treat soil in strict compliance with National Pest Control Association standards and with manufacturer's printed instructions and recommendations.
B. Apply chemical in low pressure spray water solution, maintain continuous agitation procedures in mixture to prevent chemical separation. Follow manufacturer's written instruction for protection of treated surfaces prior to cover.
C. Treat areas under floor slabs 12 hours prior to installation of vapor barrier and placement of concrete if possible to avoid drilling. Treat areas outside foundation walls after excavation, filling and grading are complete.
D. Post signs and other warnings indicating that soil poisoning has been applied. Protect persons and property from injury or damage from soil treatment work.

END OF SECTION

SECTION 31 40 10

HELICAL SCREW FOUNDATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide helical screw foundation system, complete. Work consist of providing required helical screw engineering, supervision, labor, tools, materials, equipment, means and methods to perform the work that will support the structural loading criteria indicated on the drawings.

1.02 SUBMITTALS:

A. Comply with Section 01 33 00.
B. Submit for approval shop drawings, product data, and test reports.
   1. Perform helical screw design under direct supervision of a professional engineer licensed in the state where the project is located. Shop Drawings shall be sealed, signed and dated.
   2. Shop drawings shall include the following:
      a. Helical Screw number, location and pattern by assigned identification number.
      b. Helical Screw design load.
      c. Type and size of central steel shaft.
      d. Helix configuration (number and diameter of helix plates).
      e. Minimum effective installation torque.
      f. Minimum overall length.
      g. Inclination of Helical Screw.
      h. Cut-off elevation.
      i. Helical Screw attachment to structure relative to grade beam, column pad, pile cap, etc.
   3. Installation Records and Test Reports shall include the following:
      a. Name of project and Contractor.
      b. Name of testing agency.
      c. Date and time of installation.
      d. Name and model of installation equipment.
      e. Type of torque indicator used.
      f. Location of Helical Screw by assigned identification number.
      g. Cut-off elevation.
      h. Installation torque at one-foot intervals for the final 10 feet.
      i. Type of test (tension or compression).
C. Warranty:
   1. Project Warranty and Period: Refer to Conditions of the Contract for Construction for provisions.
   2. Manufacturer's Warranty: Submit Helical Screw Manufacturer's standard 50 year warranty document executed by authorized company official.

1.03 PROJECT CONDITIONS:

A. A geotechnical analysis has been prepared for this site, (refer Section 00 31 00).
   1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for the

convenience of Contractor. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

1.04 DESIGN CRITERIA:

A. Refer to Project Structural Engineer's drawings for applicable building codes and structural design loading requirements. Helical screw foundations shall be designed to meet the specified loads, project conditions as defined in geotechnical analysis, and following specifications:
   1. Structure Type: Permanent
   2. Service Life: 50 years minimum.
   3. Soil Type: Aggressive.

B. Geotechnical Engineer and Helical Screw Foundation Engineer shall determine the following, if not provided in geotechnical analysis, to meet the specified design criteria.
   1. Ground Conditions.
      a. Soil layers not to be relied upon.
      b. Expansive soil conditions.
   2. Lateral Load and Bending Criteria.
   3. Critical Buckling Load.
   4. Down-Drag / Negative Skin Friction.
   5. Helical Screw Attachment (Pile Cap).
   6. Corrosion Protection.

C. The allowable working loads shall not exceed the following values:
   1. Compression Loads:
      Pallowc = 0.4 * fyshaft * Ashaft
      Where:
      Pallowc = allowable working load in compression (kip)
      fyshaft = minimum yield strength of central steel shaft (ksi)
      Ashaft = area of central steel shaft (with corrosion allowance) (in.2)
   2. Tension Loads:
      Pallowt = Sut / FS
      Where:
      Pallowt = allowable working load in tension (kip)
      Sut = Min. ultimate tensile strength of central steel shaft segment (at coupling joint) (kip)
      FS = factor of safety suitable for application (2 for permanent structures)

D. The ultimate structural capacity shall be determined as follows:
   1. Compression Loads:
      Pultc = fyshaft * Ashaft
      Where:
      Pultc = ultimate structural capacity in compression (kip)
      Fyshaft = minimum yield strength of central steel shaft (ksi)
      Ashaft = area of central steel shaft (with corrosion allowance) (in.2)
   2. Tension Loads:
      Pultt = Sut
      Where:
      Pultt = Ultimate structural capacity in tension (kip)
      Sut = Minimum ultimate tensile strength of central steel shaft (kip)

1.05 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Standards: Comply with the following:
   1. ASTM A36/A36M Structural Steel.
   2. ASTM A153 Zinc Coating (Hot –Dipped) on Iron and Steel Hardware.
   3. ASTM D1143 Method of Testing Piles Under Static Axial Compressive Load.
   4. ASTM D3689 Method of Testing Individual Piles Under Static Axial Tensile Load.
   5. AWS D1.1 “Structural Welding Code”.
   6. ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations.

1.06 HELICAL SCREW LOAD TESTING

A. General:
   1. Comply with Section 01 45 16 – Quality Control Procedures.
   2. Verify requirements for Helical Screw load testing procedures, standards and submittals with local governing agencies having jurisdiction.
   3. The Owner shall provide testing services conducted by independent testing laboratory. Contractor shall be responsible for communications, scheduling and coordinating work with the independent testing laboratory.
   4. Load tests shall be performed to verify the suitability and capacity of Helical Screw piles for project conditions. Unless otherwise required by local governing agencies, independent testing laboratory shall stipulate testing requirements.
   5. Installation Records and Test Reports shall include the following:
      a. Name of project and Contractor.
      b. Name of testing agency.
      c. Date and time of installation.
      d. Name and model of installation equipment.
      e. Type of torque indicator used.
      f. Location of Helical Screw by assigned identification number.
      g. Cut-off elevation.
      h. Installation torque at one-foot intervals for the final 10 feet.
      i. Type of test (tension or compression).
   6. <u>Pre-Production Testing is Contractor’s option. Production Testing is required regardless if Pre-Production Testing is performed.</u>

B. Pre-Production Testing:
   1. Load tests to verify the suitability and capacity of the proposed Helical Screw, and the proposed installation procedures prior to installation of production helical piles. Sacrificial test helical piles shall be constructed immediately prior to the start of work on the production piles. The Owner and independent testing agency shall determine the number of pre-production tests (4 minimum), their location, acceptable load and movement criteria, and the type(s) of load direction (i.e., tension, compression, or both). Additional purpose of pre-production tests is to empirically verify the ultimate capacity to the average installing torque of the Helical Pile for the project site.
   2. Pre-production Helical Pile installation methods, procedures, equipment, and overall length shall be identical to the production Helical Piles to the extent practical except where approved otherwise by the Owner.
   3. The pre-production testing shall be in general conformance with ASTM D1143 and/or D-3689, and shall provide the minimum following information:
      a. Type and accuracy of load equipment.
      b. Type and accuracy of load measuring equipment.
      c. Type and accuracy of pile-head deflection equipment.
      d. General description of load reaction system, including description of reaction anchors.
      e. Calibration report for complete load equipment, including hydraulic jack, pump, pressure gauge, hoses, and fittings.

4. If the pre-production test fails to meet the design requirements, the Contractor shall modify the Helical Pile design and/or installation methods and retest the modified anchor, as directed by the Helical Screw Foundation Engineer.

C. Production Testing:
   1. The independent testing agency shall perform proof tests on a minimum of 10% of the total production Helical Piles. The Helical Piles to be tested will be selected by the independent testing agency. Tension tests may be performed in lieu of compression tests up to 1.00 DL for Helical Screws with sufficient structural tension capacity.
   2. The acceptance criteria for production Helical Screws specified shall apply.
   3. If a production Helical Pile that is tested fails to meet the acceptance criteria, the independent testing agency shall proof test another Helical Pile in the vicinity. For failed Helical Screws and further construction of other foundations, the Contractor shall modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement Helical Screws, modifying the installation methods and equipment, increasing the minimum effective installation torque, changing the helix configuration, or changing the Helical Screw material (i.e., central steel shaft). Modifications that require changes to the structure shall have prior review and acceptance of the Owner. Any modifications of design or construction procedures shall be at the Contractor's expense.

D. Load Testing Equipment:
   1. 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.
   2. The reaction system shall be designed so as to have sufficient strength and capacity to distribute the test loads to the ground. It should also be designed to minimize its movement under load and to prevent applying an eccentric load to the pile head. Test loads are normally higher than the design loads on the structure. The direction of the applied load shall be collinear with the Helical Pile at all times.
   3. Dial gauge(s) shall be used to measure Helical Pile movement. The dial gauge shall have an accuracy of at least +/-0.001-in. and a minimum travel sufficient to measure all Helical Pile movements without requiring resetting the gauge. The dial gauge shall be positioned so its stem is parallel with the axis of the Helical Pile. The stem may rest on a smooth plate located at the pile head. Said plate shall be positioned perpendicular to the axis of the Helical Pile. 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.
   4. 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.

E. Testing Program:
   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 jack shall also be positioned co-axial with respect to the pile-head so as to minimize eccentric loading. The hydraulic jack shall be capable of applying a load not less than two times the proposed design load (DL). 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 shortening of the total Helical Screw length at the maximum test load.
   2. An alignment load (AL) shall be applied to the Helical Screw prior to setting the deflection measuring equipment to zero or a reference position. The AL shall be no more than 10% of the design load (i.e., 0.1 DL). After AL is applied, the test set-up shall be inspected carefully to ensure it is safe to proceed.
   3. Axial compression or tension load tests shall be conducted by loading the Helical

Screw in step-wise fashion at increments and duration as determined by testing agency. Pile-head deflection shall be recorded at the beginning of each step and after the end of the hold time. The beginning of the hold time shall be defined as the moment when the load equipment achieves the required load step.

4. Test loads shall be applied until continuous jacking is required to maintain the load step or until the test load increment equals 200% of the design load (DL) (i.e., 2.0 DL), whichever occurs first. The observation period for this last load increment shall be 10 minutes. Displacement readings shall be recorded at 1, 2, 3, 4, 5 and 10 minutes (load increment maxima only).
5. The applied test load shall be removed in four approximately equal decrements at increments and duration as determined by testing agency. The hold time for load decrements shall be 1 minute, except for the last decrement, which shall be held for 5 minutes.

F. Acceptance Criteria for Verification Load Tests:
   1. Both of the following criteria must be met for approval:
      a. The Helical Pile shall sustain the compression and tension design capacities (1.0 DL) with no more than 1/2 in. (mm) total vertical movement of the pile-head as measured relative to the top of the Helical Pile prior to the start of testing.
      b. Failure does not occur at the 2.0 DL maximum compression and tension test loads. The failure load shall be defined by one of the following definitions – whichever results in the lesser load:
         1). The point at which the movement of the Helical Pile tip exceeds the elastic compression/tension of the pile shaft by 0.08 B, where B is defined as the diameter of the largest helix.
         2). The point at which the slope of the load versus deflection (at end of increment) curve exceeds 0.05 inches/kip.
   2. The independent testing agency shall provide the Owner copies of field test reports confirming Helical Pile configuration and construction details within 24 hours after completion of the load tests. This written documentation will either confirm the load capacity as required on the working drawings or propose changes based upon the results of the pre-production tests.
   3. When a Helical Pile fails to meet the acceptance criteria, modifications shall be made to the design, the construction procedures, or both. These modifications include, but are not limited to, de-rating the Helical Pile load capacity, modifying the installation methods and equipment, increasing the minimum effective installation torque, changing the helix configuration, or changing the Helical Pile material (i.e., central steel shaft). Modifications that require changes to the structure shall have prior review and acceptance of the Owner. The cause for any modifications of design or construction procedures shall be decided in order to determine any additional cost implications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturers: Products as manufactured by Chance Civil Construction, Helical Pier Systems, Inc., or approved equal by Project Structural Engineer.
B. Central Steel Shaft: Consisting of lead sections, helical extensions, and plain extensions, shall be Type SS (Square Shaft) or RS (Round Shaft) or a combination of the two (SS to RS Combo Pile).
   1. Material: Hot rolled Round-Cornered-Square (RCS) solid steel bars meeting dimensional and workmanship requirements of ASTM.
   2. Size, Torque Strength Rating, and Minimum Yield Strength: Design as determined by Helical Screw Foundation Engineer for project conditions.

C. Helix Bearing Plate:
   1. Material: 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 applicable ASTM specifications.
   2. Size, Configuration, and Minimum Yield Strength: Design as determined by Helical Screw Foundation Engineer for project conditions.

D. Bolts: The size, type and configuration of bolts used to connect the central steel shaft sections together shall conform to ASTM specifications as determined by Helical Screw Foundation Engineer for project conditions.

E. Couplings: Shall be formed as an integral part of the plain and helical extension materials as hot forged sockets, expanded sockets, or as internal sleeve wrought steel connectors. Connectors may be cast steel sleeve, steel tubing, or solid steel bar with holes for connecting shaft sections together.

F. Plates, Shapes, or Pipe Caps: Pipe cap shall be welded assembly consisting of structural steel plates and shapes designed to fit the pile and transfer the applied load. Structural steel plates for helical screw top attachments shall conform to ASTM A36 or ASTM A572 Grade 50.

G. Corrosion Protection: Hot-dipped galvanized in accordance with ASTM A153 or ASTM A123 after fabrication.

PART 3 - EXECUTION

3.01 SITE CONDITIONS:

A. Prior to commencing Helical Screw Foundation installation, Contractor shall inspect the work of all other trades and verify that all work is completed to the point where Helical Screw Foundation may commence without restrictions.

B. Contractor shall verify that all Helical Screw Foundations may be installed in accordance with approved shop drawings, codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

C. In the event of a discrepancy, Contractor shall notify the Owner and Project Structural Engineer.

3.02 INSTALLATION EQUIPMENT:

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

B. 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 adjustments to maintain proper Helical Screw alignment.

3.03 INSTALLATION PROCEDURES:

A. Central steel shaft installation technique shall be such that is consistent with geotechnical, logistical, environmental, and load carrying conditions of the project.

B. The lead section shall be positioned at the location as shown on the shop drawings. Battered helical screw piles can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required batter angle shall be established. Helical screw 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 approved shop drawings. Connect sections together using coupling bolt(s) and nut torqued to 40 ft-lb.

C. Sufficient down pressure shall be applied to uniformly advance the Helical Screw sections approximately 3 inches per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths.

3.04 TERMINATION CRITERIA:

A. The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.

B. The minimum installation torque and minimum overall length criteria as shown on the working drawings shall be satisfied prior to terminating the Helical Pile installation.

C. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:
   1. Terminate the installation at the depth obtained subject to the review and acceptance of the Testng Agency and Project Structural Engineer, or:
   2. Remove the existing Helical Pile 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 Testing Agency and Project Structural Engineer. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.

D. If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:
   1. Install the Helical Pile deeper using additional extension sections, or:
   2. Remove the existing Helical Pile 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 Testing Agency. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.
   3. De-rate the load capacity of the Helical Pile and install additional Helical Pile(s). The de-rated capacity and additional Helical Pile location shall be subject to the review and acceptance of the Testing Agency and Project Structural Engineer.

E. If the Helical Pile is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile removed. The obstruction shall be removed, if feasible, and the Helical Pile re-installed. If the obstruction can't be removed, the Helical Pile shall be installed at an adjacent location, subject to review and acceptance of the Testing Agency or Project Structural Engineer.

F. 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 final elevation, 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 shaft to the correct elevation. The Contractor shall not reverse (back-out) the Helical Pile to facilitate extension removal.

G. 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.

END OF SECTION

SECTION 31 62 00

DRIVEN PILES

PART 1 – GENERAL

1.01 SUMMARY

A. Provide driven piles for cast-in-place foundation structural support.
B. Refer to structural drawings for driven pile locations, sizes, depths and loading criteria.

1.02 SUBMITTALS

A. Comply with Section 01 33 00.
B. Submit for approval timber pile product data and material test reports.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.04 PROJECT CONDITIONS

A. A geotechnical report has been prepared for this site, (refer section 00 31 00).
B. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for the convenience of Contractor. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
C. Locate existing underground utilities in the area of work. Provide adequate means of protection during earthwork operations. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
D. Contractor shall inspect and document conditions of adjacent construction prior to beginning driving operations. Care shall be taken to assure potential vibrations from driving and pile installation be achieved without damage to existing construction. Contractor shall be responsible for all damages caused by driven pile operations.

1.05 TESTING AND INSPECTION

A. Comply with Section 01 45 16 – Quality Control Procedures.
B. Owner shall provide the services of a qualified independent geotechnical testing laboratory to perform testing and inspection service during driven pile operations. Owner shall provide the services of registered land surveyor or engineer to record actual location of piles and top of pile elevations.
C. Test and analysis of driving operations and material shall be performed in accordance with ANSI/ASTM standards and in sufficient number as recommended by qualified geotechnical testing laboratory.
D. Notify Owner 48 hours prior to driving initial pile. Do not commence pile driving without testing laboratory being present.

E. Test Pile Program.
   1. Exploratory Piles:
      a. Furnish and drive five piles at permanent locations recommended by geotechnical engineer and approved by Architect. Exploratory piles shall be part of permanent foundation and meet requirements of piling specified.
      b. Drive exploratory piles prior to ordering permanent piles.
   2. Load Test:
      a. Load test one exploratory pile and test with compression as outlined by ASTM D1143. Apply load with hydraulic jack acting directly on head of pile. Furnish and install materials required for testing, with exception of hydraulic jack.
      b. Load test piles to yield point of soil in accordance with requirements of local code authorities and geotechnical engineer recommendations.
      c. Pile design loads: Refer to structural drawings.
      d. Loading:

Applied load in Tons	Time of Hold-Free of Movement
2 through 16	One hour

F. Keep accurate records showing each pile location, depth of placement, tip elevation and driving resistance.
G. Pile installation conditions shall be approved by geotechnical engineer before proceeding with subsequent work.
H. Non-conforming work shall be corrected as directed by testing laboratory.
I. Testing laboratory shall submit approved final test reports within 7 days of obtaining data. Reports shall identify project, date of testing, test locations, materials, and Contractor's equipment and methods used.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Timber Piles:
   1. Friction-type timber piles.
   2. Round, one-piece timbers, ASTM D 25, pressure preservative treated. Refer to structural drawings for sizes and depths.
   3. Steel plate driving shoes and steel strapping.
   4. Field applied wood preservative for cuts and penetrations in accordance with AWPA Standard M4.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Select pile driving hammer according to pile type, length, size, and weight of pile, as well as potential vibrations resulting from pile driving operations. Hammer selection to be capable of achieving desired penetration without causing damage to piles or causing excessive vibrations and damage to existing structures.
B. Drive piles only after earthwork operations in immediate area are completed. Drive piles continuously to specified depth and resistance. Drive piles to performance required by project conditions.
C. Piles arranged in clusters to have center piles driven first.
D. Tolerance: 1" deviation for center of gravity for piles under walls. 1" in 10' in plumb and angle.
E. Reseat piles significantly displaced by heaving.
F. Cut pile ends and apply wood preservative for cuts and penetrations in accordance with AWPA Standard M4 where required.
G. Remove and replace defective or non-conforming piles.

END OF SECTION

SECTION 31 63 00

BORED AND BELLED CONCRETE PIERS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide bored and belled piers for cast-in-place foundation structural support.

1.02 PROJECT CONDITIONS

A. A geotechnical report has been prepared for this site, (refer section 00 31 00).
B. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for the convenience of Contractor. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
C. Locate existing underground utilities in the area of work. Provide adequate means of protection during earthwork operations. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

1.03 SUBMITTALS

A. Comply with Section 01 33 00.
B. Submit for approval shop drawings, product data, and list of materials proposed for use.

1.04 QUALTIY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for five years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
B. Construction Tolerances:
    1. Location, not more than L/24 of shaft diameter or 3-inches, whichever is less.
    2. Shafts out of plumb, not more than 1.5% of length nor exceeding 12.5% of shaft diameter or 15%, whichever is less.
    3. Concrete cut-off elevation, plus 1-inch to minus 3-inches.
    4. Construction not meeting these requirements shall be rejected.

1.05 TESTING AND INSPECTION

A. Comply with Section 01 45 16 – Quality Control Procedures.
B. Owner shall provide the services of a qualified independent geotechnical testing laboratory to perform soil testing and inspection service during piering operations.
C. Test and analysis of material will be performed in accordance with ANSI/ASTM standards and as recommended by qualified geotechnical testing laboratory.
D. Frequency of test: Shall be of sufficient number as recommended by geotechnical testing laboratory.

E. Pier soil conditions shall be approved by geotechnical engineer before steel and concrete placement begins.
F. Testing laboratory shall submit testing data and final reports within 7 days of obtaining data.
G. Concrete Testing and Sampling Reports:
    1. Comply with requirements of Section 03 30 00.
H. Piering Reports shall include the following:
    1. Identify project and Contractor.
    2. Date of inspection.
    3. Pier locations, sizes, depths, material used, amount of material in each pier.
    4. Contractor's equipment and methods used.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel: Conform to requirements of Section 03 30 00.
B. Concrete: Conform to requirements of Section 03 30 00.
C. Casings: Steel pipe, ASTM A252-10, Grade 2 or ASTM A36-12.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Placement, Site Tolerances, Testing and Inspection:
    1. Placement: Refer structural drawings for location, size, reinforcing and depth of piers.
    2. Site Tolerances: Refer to QUALITY ASSURANCE this section.
B. Equipment: Drill pier holes with power auger foundation drilling rig especially designed for that purpose.
C. Placing Concrete:
    1. After pier holes have been drilled to proper depth and cutting edge of casing is seated if casings are necessary, pump all water out. Wherever water is present in pier holes, provide temporary castings and leave casings in place until concrete is poured in respective piers.
    2. Clean bottoms of pier excavations of loose material and foreign matter and receive approval of Geotechnical Engineer before allowing concrete to be placed.
    3. Block up reinforcement in concrete piers 3-inches from pier bottom and secure in place, free of contact with unformed sides. Provide steel dowels, as detailed or scheduled, in concrete piers.
    4. Place concrete in each pier hole within two hours after completion of drilling. Use tremie to place concrete and vibrate as required to fully embed reinforcing steel and eliminate voids but not so much as to separate aggregate. Pour concrete in piers up to one inch above soffit of deepest intersecting beam or column at least 24 hours before beginning to pour concrete for such beams or columns.
    5. Do not leave pier holes open overnight.
D. Casings:
    1. Casings will be required in event of excessive water or non-cohesive soils.
    2. Seat and seal casing bottom before removing water or completing drilling of hole to depth required and under-reaming.
    3. Withdraw casing in short lifts, making certain concrete is always well above bottom of casing to assure seal against water penetration or entry of loose soil.
    4. If seal is lost during withdraw of casing or if reinforcing is displaced, remove reinforcing immediately, drill out wet concrete, and re-case hole.
    5. If pier is lost entirely due to inability to remove concrete, steel, etc., cost to add additional piers, pier caps, etc., and cost to design replacement piers as well as

necessary removal of portions of misplaced piers, shall be at no additional cost to Owner. Corrective work shall be as directed by Structural Engineer..

E. Casing Removal:
   1. Prior to breaking temporary casing seal, static head of plastic concrete shall be sufficiently above ground water head to prevent water and caving soils from entering holes during casing removal. Once seals have been broken, temporary casings may be slowly removed vertically (no rotation permitted) while additional concrete is placed in casing tops.

END OF SECTION