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Approved with Conditions
Date: 10/27/17

PILE FOUNDATIONS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. RELATED DOCUMENTS: Drawings and general provisions of the contract, including General and Supplementary Conditions.

B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.

C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.02 DESCRIPTION OF WORK

A. The work covered by this Section, without limiting the generality thereof, consists of all labor, equipment, and material and performing all operations in connection with the furnishing and installing 80-ton capacity piles at the locations and to the lines and grades shown on the drawings. The piles will be driven to end bearing on the naturally deposited dense silty sand and/or bedrock. Based on the borings and probe results,

B. Suitable pile shall be steel H-section piles or steel pipe piles with concrete fill, ASTM A36/A36M, ASTM A572/572M, ASTM A992, or ASTM A252 Grade 2 or Grade 3, driven to an ultimate capacity of 360 kips.

C. Related Work Specified Elsewhere

1. Section 03300: Concrete

1.03 DEFINITIONS AND REFERENCE STANDARDS

A. ASTM: Specifications of the American Society for Testing and Materials.

B. AWS: Standard Code for Welding in Building Construction, of the American Welding Society,

C. AISC: Specification of the American Institute of Steel Construction.

D. CODE: International Building Code, 2009 Edition.

1.04 QUALITY ASSURANCE

A. Comply with all rules, regulations, laws and ordinances of the City of Portland, and of all other authorities having jurisdiction, Including State and Federal laws including OSHA. All labor, materials, equipment and services necessary to make work comply with such requirements shall be provided without additional cost to Owner.

B. All welding shall be performed by operators who have been previously qualified by tests as prescribed in the AWS D1.1 “Standard Code for Welding in Building Construction". Evidence that welders meet qualification requirements shall be submitted to the Owner's Representative before welding has begun. The Owner's Representative may require a. weld test for each operator.

C. Field Monitoring and Testing

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1. Periodic monitoring of pile driving operations will be provided by the Owner's Representative. The Contractor shall fully cooperate with the agency to facilitate inspection, notifying it in advance when welding operations are to be performed.

2. From time to time, monitoring of welding and welds will be performed by an independent testing agency employed by the owner. The Contractor shall fully cooperate with the agency to facilitate inspection, notifying it in advance when welding operations are to be performed. Welds which do not conform to applicable specifications shall be repaired as directed by the Owner's Representative.

3. Certification of quality of pile materials to be used in the work shall be furnished, in a form acceptable to the owner's Representative at the time of delivery of materials to the site. Pile materials shall also be subject to on-site observation for conformance with specifications.

4. Approvals given by the Owner's Representative or by testing agencies shall not relieve the Contractor of his responsibility for performing the work in accordance with the Contract Documents.

5. Instrumentation for Pile Installation

    a. Diesel Hammers: Open-type diesel hammers shall be equipped with a gauge for measuring ram height at the top of the stroke. Closed-type diesel hammers shall be equipped with an output energy gauge, calibrated for measurement of the total hammer energy. One spare output gauge shall be maintained at the site.

6. Where the design compressive loads exceed those allowed by the 2009 IBC Code (Section 1810), controlled test elements shall be tested in accordance with ASTM D1143 or ASTM D4595. At least two elements shall be load tested following the guidelines in Section 1810 of the 2009 IBC and the applicable ASTM Specification.

1.05 SUBMITTALS

A. General

1. The Contractor shall submit the information specified herein to the Engineer for review. Unless otherwise specified, submittals shall be received by the Engineer not less than two weeks before the start of the work to provide adequate review time.

2. The Contractor shall have received and approved all submittals prior to review by the Engineer. All review by the Architect, Engineer, and Contractor of submittals shall be completed prior to fabrication and installation of any material or product.

B. Shop Drawings

1. Shop Drawings showing sizes, tip details, and details for splice and shear connections, and other items pertinent to pile design.

2. Information on proposed pile driving system for review by the owner’s representative prior to equipment mobilization. The system should be capable of installing the piles to the specified minimum ultimate geotechnical capacity without exceeding the allowable driving stresses.

3. Details of equipment and procedures.

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C. Manufacturer's literature, including technical and performance literature for pile driving hamm cushions, driving tips and other equipment for piles.

D. Mill certificates stating the chemical composition, yield point and ultimate strength of the steel.

E. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS D1.1 “Standard Qualification Procedure.”

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.

2. If re-certification of welders is required, retesting will be the Contractor’s responsibility.

F. Submit a Wave Equation Analysis which indicates the selected pile hammer can drive the piles to the required minimum ultimate capacity without overstressing or damaging piles.

G. As-Driven Pile Location Data:

1. Submit pile location two days after individual pile or pile cluster is completed.

2. At the completion of pile driving, submit final as-driven pile location plan with tabulated lengths, certified by a Registered Land Surveyor or Registered Professional Engineer.

1.06 JOB CONDITIONS

A. Site and Subsurface Conditions

1. Subsurface investigation data are available from the Owner in the report “Geotechnical Report Addendum, Proposed Wex Building, Corner of Hancock and Thames Street, Portland Maine,” prepared by summit Geoengineering Services, Inc. dated September 5, 2017. Prior to submitting a bid, the Contractor shall review and understand the information contained in the report. The geotechnical investigation report is made available to the Contractor for information on factual data only and shall not be interpreted as a warranty for subsurface conditions whether interpreted from written text, boring logs, or other data.

2. The contractor shall protect adjacent property, public utilities and structures, and completed work, from damage associated with the pile driving operation. All damage due to any pile driving operations shall be repaired by the Contractor at the Contractor's own expense.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall deliver piles at times and in sequence to assure continuity of pile driving.

B. Piles shall be handled, transported, stacked and protected to prevent damage to piles.

1.08 LINES AND GRADES

A. The-Contractor shall stake the pile locations and establish all elevations required. A baseline and benchmark located on or close to the site will be provided by the Owner. The Contractor shall be responsibe for the maintenance and protection of the baseline and benchmark, and all pile location stakes.

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B. The Contractor shall employ a licensed Registered Land Surveyor or a Registered Civil Engin familiar with pile installation, who shall establish lines and levels. Contractor shall be responsible for the correct location of piles, as well as keeping up-to-date records of the amount of uplift of individual piles, and establishing actual pile locations. Locations of the centers of as-driven piles shall be shown on a drawing in relation to the design location and submitted to the Owner within two days after the individual pile or pile group is completed. Drawings shall include the following:

1. Base line and north arrow.

2. Each pile identified by a separate number.

3. Elevation of each top of pile prior to cutting, to nearest 0.1 foot.

4. Deviation in inches, to the nearest one-fourth inch, from plan location at cutoff elevation.

C. Within two weeks after the completion of all pile driving, the Contractor shall provide to the Architect a plan, certified by said Surveyor or Engineer, showing the as-driven location of all piles. Plan shall be distributed to Structural Engineer and Owner.

PART 2 PRODUCTS

2.01 STEEL H-SECTION

A. Steel H-piles shall be new rolled H-sections of structural steel conforming to the ASTM A572 or ASTM A992 specifications for structural steel.

B. Steel H-pile sections shall be a HP 8X36 shape and weight as a minimum.

C. Deformations, defects, camber, sweep of piles placed in the leads of pile driving rigs shall be no more than allowed by ASTM A 572 or ASTM A992.

D. Steel H-Pile sections shall be fitted with APF HP 77600 "Hard-Bite" points, as manufactured by Associated Pile and Fitting Corporation or approved equal, prior to installation. APF HP 77600 points, or equal, shall be installed per manufacturer's recommendations.

E. Piles shall be furnished in sufficient lengths to meet specified driving requirements.

2.02 STEEL PIPE SECTION

A. Steel pipe piles shall consist of steel pipe conforming to the following Standard Specification of the American Society for Testing and Materials:

B. ASTM A252 Grade 2 or Grade 3 – Standard Specification for Welded and Seamless Steel Pipe Piles

C. Minimum Dimensions:

1. Pipes shall have an outside diameter of 8 inches or 10 inches and a minimum nominal wall thickness as required to meet the driving stresses and ultimate loads.

2. Ends of closed-ended pipe piles shall be closed with a flat plate or a forged or cast steel conical point, or other end closure of approved design. End plates shall have a minimum thickness of 0.75 inch.

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D. Concrete Fill:

1. Prior to the placing of concrete in a closed end pipe pile, the pile shall be inspected by an acceptable method to confirm the full pile length and dry bottom condition. If accumulations of water in pipes are present for either closed end or open end pipes, the water shall be removed before the concrete is placed.

2. The concrete for concrete filled pipe piles shall have a minimum compressive strength of 2.5 ksi and a slump of not less than 6 inches andnot more than 10 inches.

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PART 3 EXECUTION

3.01 SEQUENCE OF OPERATIONS AND EQUIPMENT REQUIREMENTS

A. The pile contractor shall provide equipment to maintain the schedule as developed by the Contractor, and shall mobilize additional equipment, if necessary, to complete the work on schedule.

B. Where the design compressive loads exceed those allowed by the 2009 IBC Code (Section 1810), controlled test elements shall be tested in accordance with ASTM D1143 or ASTM D4595. At least element shall be load tested following the guidelines in Section 1810 of the 2009 IBC.

C. When piles are located in an area where excavation is to be made, the piles shall not be driven until the excavation has been completed.

D. The Contractor shall coordinate his pile driving operations with other work on the project.

3.02 EQUIPMENT

A. Piles shall be installed with modern equipment as approved by the Owner's Representative. Approval shall be obtained from the Owner's Representative by the contractor a minimum of one week prior to commencement of pile driving.

B. The leads of the pile driving rig shall be fixed at two points; the points shall be at least half the length of the leads apart in order to maintain the pile and hammer in axial alignment at the correct plan location during the entire driving operation. The leads shall extend down to the lowest point at which the hammer must operate.

C. Piles may be driven with a single acting, double acting, or differential acting hammer capable of delivering the rated energy as necessary to drive the piles to the resistance required to meet the ultimate design capacity.

D. In the case of diesel hammers, the Contractor will be required to provide an apparatus, approved by the the Owner's Representative, to measure gas pressures inside the hammer for closed hammers or ram bounce height in the case of open hammers.

E. An aluminum micarta cushion block, or other cushion material approved by the Owner's Representative, shall be used in the hammer for driving piles. The cushion shall be replaced when, burned or otherwise worn.

F. Hammers used to drive permanent piles shall be of the same type and have the same rated energy as the hammer used to drive test piles for the pile load test program.

G. The use of followers will not be permitted unless authorized in writing by the Owner’s Representative.

3.03 OBSTRUCTIONS

A. The Contractor shall make reference to the test boring and test pit logs and available plans showing the site conditions.

B. Piles abandoned because of obstructions encountered shall be cut off or pulled out at the discretion of the Owner's Representative and the hole filled with sand.

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C. Removal of obstructions by spudding, augering, drilling, etc. is not recommended, however, m be allowed in certain conditions with the approval of the Owner's Representative.

3.04 INSTALLATION

A. Driving

1. As part of the preparation for driving, each pile shall be marked at one-foot intervals along the upper 30 percent of the pile length. In addition, the footage shall be marked and designated at five-foot intervals, starting from the tip of the pile.

2. All Piles shall be driven at the locations and orientations shown on the drawings. Pile location shall be checked during driving and appropriate measures taken, as necessary, to maintain the correct pile position.

3. Each pile shall be driven to refusal to a minimum ultimate design capacity of 200 tons (SF=2.5) in compression. Pile driving shall be continuous and without interruption for the final 20 feet of penetration. If an abrupt increase in driving resistance is encountered, the driving shall be terminated when the pile penetration is less than 1/2 inch in eight successive blows. These driving criteria may be revised by the Geotechnical Engineer based on the hammer proposed by the contractor and their associated wave equation analysis.

4. Piles in a group shall be driven commencing in the center of the group and working toward the edge. All piles in any one group shall be driven before moving to other locations.

5. Immediately after a pile in a pile group is driven, the Contractor shall establish a reference point and its elevation on the pile for the purpose of checking uplift of the pile tip.

6. After all piles within the radius of uplift have been driven, the Contractor shall determine the elevation of the reference points on each of the piles in the group. If uplift of 0.04 feet or more has occurred, the pile shall be re-driven to its original elevation, and deeper if necessary to the specified final driving resistance. After re-driving each pile, the Contractor shall re-establish the elevation of the reference point. Re-driving shall be repeated as often as necessary until the measured uplift on any pile is less than 0.04 feet.

7. The radius of uplift is defined as the maximum distance between piles such that pile driving causes uplift of 0.04 feet or more in the affected pile. Survey instruments used to establish the reference elevations shall be carefully checked and adjusted as necessary to insure accurate readings. Uplift measurements shall be submitted to the Engineer.

B. Splicing

1. A maximum of 1 pile splices shall be allowed for all piles.

2. No splices will be permitted in the upper 10 feet of the embedded portion of the pile.

3. The strength of all splices, in compression, tension, and bending, shall be equal to or greater than the ultimate capacities of the pile section.

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4. Piles may be spliced in the leads. The sections of piles to be spliced shall be secured alignment such that there is no eccentricity between the axes of the two spliced lengths, or angle between them, after the splice has been completed.

5. Steel pile sections shall be spliced by continuous, butt-joint, 45 degree bevel; or vee, complete penetration, arc welding around the entire circumference, to produce joints developing 100 percent of the pile section strength.

    a. Electrodes conforming to ASTM A233, E-70 series, shall be used.

    b. Welds which do not conform to specifications shall be gouged and repaired as directed by the inspector.

    c. Mechanical drive-fit splices shall not be used.

C. Cutting off Piles

1. Pile tops shall be cut off square within one inch of the elevations shown on the drawings. The pile cut-offs shall become the property of the Contractor and shall be removed from the site.

2.. When piles are driven below the design cut-off grade, due to unexpected penetration, a limited number of build-ups will be permitted in accordance with designs provided by the Contractor and approved by the Engineer. Build up costs shall be the responsibility of the Contractor.

D. Concrete Fill for Pipe Piles

1. Concrete shall be placed in each pile in a continuous operation. No concrete shall be placed until all driving within a radius of 15 feet of the pile has been completed, or all driving wihin the above limits shall be discontinued until the concrete in the last pile cast has set for at least two days.

3.05 TOLERANCES AND CRITERIA FOR ACCEPTANCE

A. Piles shall be driven as close as practicable to the plan location. Allowable maximum deviations shall be as follows:

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1. Lateral deviation from column centerline and centroid of pile or pile group for single p two piles: 1 inches.

2. Lateral deviations from column centerline and centroid of pile group for groups of three or more piles: 3 inches.

3. Design cut off elevations: 1 inch.

4. Plumbness of a driven pile measured on the projection above ground : 6 inches in 10 feet.

B. Piles that are damaged below cutoff elevation during driving will be rejected. The engineer will determine if a pile has been unacceptably damaged based on his knowledge of the subsurface conditions and comparison of the subject piles driving performance with that of other driven piles.

C. Piles indicating sudden or peculiar decrease in penetration resistance during driving will be assumed to be broken and will be rejected unless Engineer's review of available data indicates that sudden decrease in driving resistance is due to natural, subsurface conditions and continued acceptable driving behavior is observed.

D. Except as specified under "Obstructions". piles that are rejected because of damage, mis-location or misalignment, or failure to meet the driving criteria, shall be cut off below the limits of the structure and abandoned, and additional piles shall be driven as directed by the Engineer.

E. When otherwise acceptable, the Contractor shall provide an accurate survey to the Engineer of installed piles exceeding the specified tolerances as specified. The maximum compressive load on any pile due to mis-location shall not exceed 110 percent of the allowable design load. If the load on any pile exceeds 110 percent of the specified load capacity, corrections shall be made in accordance with a design provided by the Engineer.

F. The installation of replacement piles and other corrective measures shall in all cases be in accordance with designs provided by the Engineer.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Piles will be measured for payment on the basis of length along the axis of the pile in place below the design cutoff elevation.

4.02 BASIS OF PAYMENT

A, Work included under this contract shall include installation of the end bearing piles. The amount of such work shall include furnishing and driving the piles, splicing, pile tips, concrete fill and all work incidental thereto, and mobilization and demobilization which shall include job set-up, moving, equipment including pile driving rigs on and off the project, establishing and dismantling the Contractor's field administration forces and equipment, and all other work incidental thereto.

B. The footage of foundation piles for payment shall be the sum of the lengths of the piles below design cutoff grade actually driven and accepted.

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C. Piles rejected in accordance with the provisions of these Specifications and which result in judgment of the Engineer, from the Contractor's violation of the Specifications or his other error, will not be paid for. If one or more replacement piles are required by the Owner's Representative to compensate for a rejected pile, the Contractor will be paid at the Contract unit price per foot for only the longer of the replacement piles. Additional piles required to compensate for production piles or replacement piles driven out of design location due to Contractor error will be installed at no additional cost to the Owner.

D. Piles rejected, in the judgment of the Owner's Representative due to causes other than the Contractor's violation of the Specifications or his other error, will be measured and included in the aggregate footage of piles for payment.

E. Whenever, in the judgement of the Owner's Representative, misalignment or rejection of a pile or piles caused by the Contractor's violation of the specifications or his other error necessitates structural redesign of the pile cap, and the redesigned pile cap requires greater quantities of concrete and reinforcing steel, the quantities required shall be compared with quantities required for the pile cap for the design pile group configuration, and the additional cost for pile cap concrete, reinforcing steel and form work shall be deducted from the contract price, in addition to redesign cost. Whenever, in the judgement of the Owner's Representative, misalignment or rejection of a pile or piles caused by the Contractor's violation of the specifications or his other error necessitates structural redesign, the cost of such redesign shall be deducted from sums otherwise due to the Contractor under the contract.

F. No payment will be made for pile cut-offs, splices and pile buildups.

G. Payment for the two load tests and additional tests, should they be required, shall be made as a lump sum per test. The pile load test unit price shall include constructing and supporting the test load or reaction system, driving and removing temporary piles and supports, furnishing and operating jacks and gauges and related equipment, tools, personnel, and incidentals necessary for the proper execution of the pile load test as specified. If a load test is unacceptable due to the contractor's lack of conformance with the specification, an additional load test shall be made and the expense of the additional load test shall be borne by the Contractor.

END OF SECTION