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PART 1 –GENERAL

1.01 DESCRIPTION OF WORK:

A. The extent and location of the Augered Concrete Piles Work is indicated on the Drawings. The Work includes the requirements for furnishing and installing augered concrete piles.

B. The soils investigation indicates the location of soil borings. This information on underlying earth strata is to be considered as indicative of soil conditions to be used by the Contractor at his discretion and is not guaranteed as factual. The Contractor shall acquaint himself with the subsurface conditions.

1.02 RELATED SECTIONS:

Section 01 33 10 - Submittals

Section 01 45 00 - Quality Control

Section 03 30 00 - Cast-in-Place Concrete

1.03 QUALITY ASSURANCE:

A. Inspection and Testing:

1. The Owner will retain the services of a recognized Soils Engineer, certified testing agency, and a firm specializing in pile integrity testing to ensure pile placement adheres to the Contract documents.

a) Soils Engineer: Will provide construction observation and geotechnical engineering services during construction of Augered Concrete Pile Work. Soils engineering services will include the following:

1) Observation of augered material to verify the nature of the soils and determination that pile bottoms are compatible with the specified pile capacity, as indicated on the Contract Drawings, prior to concrete placement.
2) Observe and approve the pile placement procedure, equipment, and materials. In the case of a dispute, the Soils Engineer's decision shall be final.
3) Other geotechnical considerations which may arise during the course of construction.

b) Testing Agency: Will furnish inspection and material testing services for quality control of pile placement.

1) Special Inspector: Testing Agency shall provide qualified Special Inspector who will perform the inspection services.

2) Tests and Inspections: Will include, but not be limited to, the following:

a. Inspection during installation: A Special Inspector shall be present to observe the procedure, equipment and materials during the installation of each pile.

b. Testing of Concrete Grout: A Special Inspector shall test grout in accordance with ASTM C 109. Two inch by 4 inch cylinders shall be used for nonrestrained specimens when standard admixtures conforming to ASTM C 494 are specified. Where expansive or gas forming admixtures are utilized, 2-inch by 2-inch cube molds shall be provided with a top plate so designed as to restrain grout expansion, and to prevent escape of grout and water. A minimum of three sets of four cubes or cylinders shall be required for each day's placement of grout or one set of four cubes or cylinders for each truck load of grout delivered, whichever is greater. One cube or cylinder shall be tested at 3 days, one at 7 days, and two at 28 days in accordance with DPD Director's Rule 26-87.

c. Testing of trial grout batch mixes, when necessary, in accordance with Section 03 30 00 - Cast-in-Place Concrete.

d. Flow cone testing of grout in accordance with ASTM C 939, "Standard Test Method for Flow of Grout for Pre-placed-Aggregate Concrete," except the flow cone shall be modified by the removal of the 1/2-inch orifice, allowing grout to pass through the 3/4-inch hole in the bottom of the cone. Conduct a test at the beginning of grout injection for each truckload whenever any question regarding the consistency of the grout arises, and as directed by the Engineer or Building Official. The efflux rate of the grout shall be not less than 8 seconds.

c) Pile Integrity Testing: Perform nondestructive pile integrity testing using the low strain pulse echo procedure in accordance with ASTM D 5882-00 Standard Method for Low Strain Integrity Testing of Piles. Pile integrity tests will be performed on piles at the discretion of the Owner.

B. The Contractor's Duties Relative to Inspection and Testing Services:

1. Notify the Engineer 24 hours in advance of beginning installation of each pile. Call the **SPR Inspection Request Line @ (206) 684-7034 or by email**

at parksconstruction.inspection@seattle.gov to make arrangements for inspections.

2. Records: Maintain a complete and accurate record of all auger-placed concrete piles. The record shall indicate the pile location, diameter, length, elevations of tip and top of pile, and the volume and strength of grout material used in each pile. The record shall also note unusual conditions encountered during pile installation. Records shall conform to the requirements of DPD Director's Rule 26-87.

C. Pile Location Survey: The Contractor shall locate all pile centers in accordance with the Drawings. If any pile cannot be drilled where required on Drawings, the Engineer shall be immediately notified so that a new location may be determined. Individual piles or pile groups shall be surveyed immediately upon completion and the results of the survey given to the Engineer. All pile location surveys shall be by a Surveyor, licensed in the State of Washington. The Surveyor shall develop a pile numbering system that is distributed to Project team members prior to pile installation.

D. Protection: Protect structures, underground utilities, and other construction from damage caused by piling operations. Damage shall be repaired at no cost to the Owner.

E. Inspection shall conform to DPD Director's Rule 26-87.

F. When grout acceptance testing reveals a potential deficiency, additional testing and inspection shall be conducted in accordance with Section 03 30 00 - Cast in Place Concrete. Costs for additional testing, inspection, analysis, and the associated delays shall be borne by the Contractor.

G. Tests and inspection shall be in conformance with Section 01 45 00 - Quality Control.

1.04 SUBMITTALS:

A. Submit records described under Section 1.3.B.2.

B. Submittals shall conform to DPD Director's Rule 26-87.

C. Submit test results described in Section 1.3.A.1.c.

D. Submit test reports described in Section 3.2.K.5.

E. Submit test reports described in Section 3.2.L.

F. Submittals shall be in conformance with Section 01 33 10 - Submittals.

1.05 PRODUCT HANDLING:

A. Protection: Protect materials before, during, and after installation. Protect installed Work and materials of other trades.

1.06 JOB CONDITIONS:

A. Existing Conditions: A foundation investigation has been made; refer to Section 1.1.A, Soils Investigation. The Contractor shall be aware of the conditions that may be encountered and install piles into bearing strata to the depths shown or as directed by the Engineer.

PART 2 –PRODUCTS

2.01 MATERIALS:

A. Concrete Grout for Augercast Piles (Concrete Class AP)

1. Portland Cement: Conform to ASTM C 150.
2. Mineral Filler: Finely powdered siliceous material which possesses the property of combining the lime liberated during the process of hydration of Portland Cement (approved pozzolanic materials conforming to ASTM C 618).
3. Fluidifier: Compound with characteristics which will increase the flowability of the mixture, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the high-strength cement mortar. Fluidifer shall conform to ASTM C 937.
4. Water: Fresh, clean, free from injurious amount of sewage, oil, acid, alkali, salts, or organic matter.
5. Fine Aggregate

a) Sand shall meet requirements of ASTM C 33, except that the gradation shall be as specified following.

b) Sand shall consist of hard, dense, durable, uncoated rock particles, and shall be free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances. If washed, the washing method shall be such as will not remove desirable fines and the sand shall subsequently be permitted to drain until the residual-free moisture is reasonably uniform and stable.

c) Sand shall be well-graded from fine to coarse, with fineness modulus between 1.40 and 2.10. When tested, all of the sand shall pass the No. 8 U.S. standard square mesh sieve. The fineness modulus is defined as the total divided by 100 of the cumulative percentages retained on U.S. Standard Sieve Nos. 16, 30, 50 and 100.

B. Reinforcing steel shall be deformed bars conforming to ASTM A 615, Grade 60.

2.02 PROPORTIONING:

A. Concrete Grout:

1. The concrete grout used to fill the holes shall consist of a mixture of Portland Cement, mineral filler, fluidifier, sand, and water. Proportion and mix the concrete grout to a consistency capable of maintaining the solids in suspension without appreciable water gain, yet which may be pumped without difficulty and which will penetrate laterally and fill voids in the foundation material.

2. The materials shall be proportioned as to provide a hardened grout having an ultimate compressive strength of 2,000 and 5,000 psi at 7 and 28 days, respectively.

3. Grout shall conform to DPD Director's Rule 26-87.

4. The efflux rate of the grout shall be not less than 8 seconds when tested in accordance with ASTM C 939. The ASTM C 939 cone flow test shall be modified by the removal of the 1/2-inch orifice, allowing grout to pass through the 3/4-inch hole in the bottom of the cone. The desired flow may be determined by tests run on the same mix on a previous Project or may be determined by tests run on laboratory trial mixes. The efflux rate shall be compatible with the pumping equipment, and shall be reviewed and approved by the Contractor.

2.03 EQUIPMENT:

A. Augering Equipment:

1. General: Drill shafts for piles with continuous flight hollow-shaft auger of sufficient length to drill shafts to indicated depths, of the type generally used for installation of auger-placed, grout injected piling.

2. The injection opening in the auger shaft shall be at the bottom of auger head below the cutting teeth. The minimum inside diameter of the hollow shaft of the auger flight shall be 1-1/4 inches. Concrete grout injection equipment shall be provided with a pressure gauge in clear view of the equipment operator.

3. Auger Mounting: The auger shall be mounted to ensure the accurate alignment of the auger flight at all times during the augering operation. Leads shall be arranged to prevent the twisting of the leads about the auger axis. At least two guides shall be provided. The lead guide shall be fixed at the lower end of the leads and the other shall slide on the leads midway in the above-ground portion of the auger flight.

4. The auger hoisting equipment shall be capable of withdrawing the auger smoothly and at a constant rate.

B. Pumping Equipment:

1. General: Use only approved pumping and mixing equipment for the preparation and handling of concrete grout. Remove all oil or other rust inhibitors and contaminants from mixing drums and grout pumps.

2. Pump: The grout pump shall be a positive displacement type capable of developing and maintaining sufficient pressure to completely fill all voids.

PART 3 –EXECUTION

3.01 SITE CONDITIONS:

A. The Contractor shall examine the areas and conditions under which piles are to be installed. The Contractor shall remedy any conditions detrimental to the proper and timely completion of the Work. The Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the Inspector.

3.02 PILES:

A. Location: Piles shall be located as shown on the Construction Drawings or as otherwise directed by the Engineer.

B. Tip Elevation: Piles shall be installed with pile tip at the elevation indicated on the Construction Drawings. Adjustments to final tip elevation may be made at the discretion of the Geotechnical Engineer's Inspector.

C. Cutoff Elevation: All piles shall be installed with top of the piles at the grade specified in the plans. If piles are installed with grade less than 1 1/2 feet below cutoff elevation, the piles shall have a metal collar set to protect the fresh grout at the top of the piles.

D. Obstructions: In the event that obstructions are encountered that prevent penetration of the auger to the required depth, the short hole shall be filled with grout and replacement pile(s) shall be installed. The Engineer shall determine the location of replacement pile(s).

E. Tolerances:

1. Cutoff elevation of the piles shall be level to plus 1 inch or minus 2 inches tolerance.

2. Pile shafts shall be placed with a variation of not more than 2 inches per 10 feet from vertical or batter and as shown on the Construction Drawings. The maximum variation of the top of the vertical piles from the position shown on the Drawings shall be not more than 3 inches for groups of six piles or more and 2 inches for groups of less than six piles. Battered piles shall be placed with a variation of the top of the piles at cutoff elevation from the position shown on the construction Drawings of not more than 6 inches.

F. Spacing: Adjacent piles shall not be placed closer than 5-pile diameters center-to-center until the grout in the piles has set for at least 12 hours.

G. Mixing and Pumping of Grout:

1. Only approved mixing and pump equipment shall be used in the preparation and handling of the grout.

   a) Materials shall be measured by weight as they are fed to the mixer, except water which may be measured by volume. The time of mixing shall be such as to produce a homogeneous grout of the desired consistency and shall be not less than 1 minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 90 minutes.

   b) The grout shall meet the compressive strength specified. At no time shall the Contractor use more water than the requirements as recommended by the manufacturer of the fluidifier agent. The Contractor shall check periodically each day the materials are being mixed.

   c) When hot weather conditions exist that would seriously impair the quality and strength of grout, grout should be placed in compliance with ACI 305R-77.

H. Pile Installation:

1. The Contractor shall be required to give the Engineer at least 3 days notice prior to the start of installation of piles. The Contractor shall submit a schedule for pile installation. Piles shall not be installed until the schedule is approved by the Engineer. At no time shall the Contractor install piles without the presence of the Geotechnical Engineer Inspector representing the Engineer. The Contractor shall provide full cooperation to the Inspector during installation of the piles for proper execution of his duties. If such cooperation is not forthcoming, the Inspector (Geotech) shall have the right to suspend further Work until the problem is remedied.

2. Piles shall be installed by the rotation of a continuous flight hollow shaft auger into the ground to the tip elevation established by the requirements specified in these specifications. Grout should then be injected through the auger shaft as the auger is being withdrawn in such a way as to exert pressure on the soil surrounding the grout-filled pile hole. While the mortar is still fluid, the steel reinforcements shall be placed as shown on the Construction Drawings.

3. The leads and auger shall be on a proper alignment in all directions before augering starts. A check of same should be made during augering and while retracting during the mortar placing process.

4. The Contractor shall establish an accurate method of determining the auger depth, including graduated scaled leads with clear depth marks on visible sides of the leads.

5. The hole in the bottom of the auger shall be plugged while the auger is advanced into the ground. Prior to grouting, the plug shall be removed by grout pressure. When this procedure is followed, the auger shall be rotated to its original depth to ensure that the grout is being placed at the bottom of the augered hole. At the bottom of the augered hole, grout shall be pumped until a minimum of 10 feet grout head in the hole is obtained. The auger shall remain rotating when the grout is being pumped and shall have a positive rotation throughout the pumping process. The grout shall be pumped with an initial pressure of approximately 250 psi at the pump as the auger is withdrawn. If there is a lapse in the operation of pumping, the grout shall be recirculated through the pump, or through the mixer drum and agitator and pump.

6. Rate of grout injection and rate of auger withdrawal from the soil shall be so coordinated as to maintain at all times a positive reading on the pressure gauge. The auger shall not be withdrawn from the hole if there is no positive return flow at the top of the augered hole.

7. The grout take and total pile installation shall be at least 15 percent greater than the theoretical volume of the pile or as instructed by the Inspector. If, in the opinion of the Inspector, less grout is placed than required for any 5 feet or greater interval, the pile shall be reinstalled by rotating the auger to a depth of 5 feet below the bottom of the interval followed by controlled removal and grout injection.

8. The auger shall not be raised such a distance or at a rate which exceeds the capacity of the pump. The desired lifts should be of a reasonably smooth nature. A grout head of at least 15 feet shall be maintained throughout the pumping process.

9. If the auger is raised in an erratic manner or a sudden drop in the pumping pressure is observed, the auger should be penetrated at least 5 feet below the depth where this occurred. The mortar pump will continue to pump while this auger is rotated to obtain this depth. When this operation is completed, the normal pumping and raising process may be continued.

10. The Contractor's Foreman shall read the depth of auger tip at the beginning of the fresh grout return at the top of the augered hole and shall relate this information to the Inspector.

11. Reinforcement steel shall be embedded in the piles as shown on the Construction Drawings while the grout is fluid. If reinforcement steel cannot be inserted full depth into the pile, the steel shall be removed and the pile shall be re-drilled and re-grouted at the Contractor's expense.

12. Centralizers and spacers shall be used to keep the reinforcing centered in the hole. At a minimum, the center bar shall have a centralizer at the bottom and the reinforcing cage shall have spacers located at no more than 12 feet on center vertically.

13. Should an obstruction be encountered which may prevent the advancement of penetration of the auger, the Engineer shall be informed. The hole shall be

filled with mortar so as to eliminate any voids and replacement pile(s) added, as directed by the Engineer.

I. Post Installation:

1. Immediately after pumping the pile and removing the auger, the pile shall be clearly marked and protected.

2. Piles shall be periodically checked by the Contractor to determine if the grout in the piles has settled. Grout shall be added to the top to maintain the proper elevation. Additional grout shall be added before the grout in the pile has reached its initial set. If the grout in the pile is allowed to settle more than 2 feet before grout is added, the Geotechnical Engineer Inspector will determine if the top portion of the grout in the pile will be purged.

3. If 6 inches or more of water is found on top of the grout, the water shall be purged out of the pile by placing a hose or pipe at least 3 feet below the grout elevation and pumping additional grout in accordance with the direction of the Inspector may be required.

4. The as-installed plan location and cutoff elevation of each pile shall be determined by a licensed surveyor employed by the Contractor and the results submitted to the Engineer. The survey shall show pile number, cutoff elevation as installed, and deviations from plan location. The Engineer can waive the as-installed survey requirement; if visual inspection by the Engineer indicates that piles are installed within the tolerable limits.

J. Unacceptable Piles:

1. Piles not meeting the preceding Specifications or which are damaged due to the Contractor's operations after installation shall be considered unacceptable. The Contractor shall install additional piles as directed by the Engineer to replace the unacceptable piles, all at the Contractor's expense. Redesign and enlargement of pile caps may be necessary. The Contractor shall pay for the redesign at a rate that is to be established between the Contractor and the Owner.

K. Pile Integrity Testing:

1. Test Personnel: The actual field testing may be performed by an experienced technician with at least 1 year experience in dynamic pile testing. The interpretation of the records, however, requires extensive experience by a Registered Professional Engineer with at least three years experience in dynamic pile testing.

2. Test Preparation: Integrity testing shall not be performed on a pile until the concrete has cured for a minimum of 7 days, unless otherwise approved by the Engineer. The pile head shall be free from water, dirt, or other debris. The concrete at the pile top surface must be flat or level, and have sufficient space for attachment of the sensing device and impact area.

3. Result Presentation: The Geotechnical Testing Engineer will have a maximum of 4 Working days after performing a test to provide the final test results and integrity evaluation.

4. Acceptance and Rejection: Shafts with only insignificant reflections from locations other than the pile toe and with a clear pile toe reflection may be accepted. Where no clear toe reflection is apparent, the experienced Test Engineer shall state to which depth the test appears to be conclusive. Where significant reflections from locations above the pile toe are observed, a quantification of the irregularity must be attempted by the Test Engineer. If such reflection indicates a significant pile impedance reduction, the pile must be rejected. If the record is complex, the results may be deemed questionable. Construction records (concrete usage, grout pressure records, soil borings) may be valuable in results interpretation or additional numerical analysis modeling may be used to quantify the record.

5. Remedial Action: Rejected or questionable piles may be replaced. Questionable piles may also be subjected to further testing (e.g., static load testing, dynamic load testing, core drilling, beta-ray logging, ultrasonic logging, etc.). Remedial action may include pressure grouting through core holes. If the pile top appears questionable, further pile top cut-off and retesting may be advisable. If a majority of piles diagnose as "questionable," complete pile excavation or another test method may be necessary for pile acceptance.

L. Load Testing:

1. Pile load tests required by the Contract shall be performed in accordance with ASTM D 1143, ASTM D 3689, and ASTM D 3966 standard procedures, and these specifications. The test piles shall be installed with the same equipment and placement conditions as will be used for the production piles.

2. All readings, measurements, and records of the load test will be made by the Geotechnical Engineer's Inspector. Unless otherwise specified herein, compression tests shall comply with applicable section and paragraphs of ASTM D 1143 as outlined below. Section and paragraph numbers referenced herein refer to those of ASTM D 1143, unless otherwise stated. The apparatus for applying loads shall comply with Paragraph 3.1. The equipment shall comply with Paragraph 3.2. The load shall be applied to the test piles as given in Paragraphs 3.3 or 3.4. The apparatus for measuring movements shall comply with Paragraphs 4.1 and 4.2. The primary butt movement measuring system shall be dial gauges as in Paragraph 4.2.1; and the secondary system shall be wire, mirror, and scale or surveyor's level as in Paragraphs 4.2.2 or 4.2.3. Additionally, compression test piles shall be instrumental with Geokon VCE 4200 vibratory wire strain gauges per Section 4.4 at four separate depth intervals as specified by the Geotechnical Engineer. The loading procedure for the test pile shall comply with Paragraph 5.1, except that the pile shall be loaded to 2.5 times the design load. Pile movements shall be taken and recorded according to Paragraphs 6.1 and 6.2. All safety requirements in Paragraph 7 shall be met. Load test

records for each shall be submitted as set forth below. Test piles will be considered as having passed the axial load test if, when subject to a load of 2.5 times the design load, the gross butt settlement of the pile at the design load is not more than the elastic deformation of the pile (PL/EA) plus 0.25 inches. Additionally, the load settlement characteristics (PL/EA) of the pile must be approved by the Geotechnical Engineer. The net butt settlement is defined as the gross butt settlement minus the calculated elastic shortening of the pile due to the design load. The pile also must support 2.5 times the design load without exhibiting a plunging type failure.

3.03 EXCAVATED MATERIAL SEPARATION AND DISPOSAL:

A. The Contractor shall separate any contaminated soil from natural soil at the direction of the Geotechnical Engineer. Temporary stockpiles of contaminated material shall be piled on plastic liners and shall be kept covered with plastic, except when soil is moved.

B. Removal of contaminated soil off site is under separate Contract and not included as part of this Work.

END OF SECTION