

SECTION 31 63 16
AUGER CAST GROUT PILES

SPEC WRITER NOTE: Use this section only
for NCA projects. Delete text between
// _____ // not applicable to project.
Edit remaining text to suit project.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation and concrete required for construction of auger-placed concrete piles.

1.2 RELATED REQUIREMENTS

- A. Contract Time and Price Adjustment: Section 01 00 01, GENERAL REQUIREMENTS, Clause FAR 52.243-4.
- B. Surveyor Qualifications: Section 01 00 01, GENERAL REQUIREMENTS, Article, PROFESSIONAL SURVEYING SERVICES.

1.3 DEFINITION

- A. Auger-Placed Concrete Pile (ACP): Pile formed by rotation of continuous flight hollow-shaft pile augured into ground to indicated depth. Grout is injected through auger shaft as auger is being withdrawn in such a way as to exert removing pressure on withdrawing earth-filled auger as well as lateral pressure on soil surrounding hole.

1.4 CONTRACT BASIS

- A. Contract price for ACP's will be based upon total length of piles shown on drawings. Length of piles will be measured as shown.
 1. Adjustment of contract price will be based upon total length of piles placed, and not on length of individual piles placed. When total length of completed piles is greater or less than length shown, contract price adjustment will be made according to Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.
 2. Contract price and time will be adjusted according to Clauses of Section 01 00 01, GENERAL REQUIREMENTS, as applicable when artificial materials not shown on drawings are encountered.

1.5 TOLERANCES

- A. Install piling with 75 mm (3 inches) maximum variation of center of pile from location shown on drawings. Piles out of plumb more than 2

percent will not be acceptable. (Check with hand level before start of drilling).

1.6 DESIGN MODIFICATIONS

- A. Where installed piles exceed specified tolerances for plumb or location, foundation design will be analyzed by // Contracting Officer's Representative (COR) // Government // and, if necessary, redesigned by // COR // Government //.
- B. Provide additional piles and pile cap modifications necessitated by redesign.

1.7 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American Concrete Institute (ACI):
 - 1. 305R-10 - Guide to Hot Weather Concreting.
 - 2. 306R-10 - Guide to Cold Weather Concreting.
 - 3. 318-14 - Building Code Requirements for Structural Concrete and Commentary.
- C. American Welding Society (AWS):
 - 1. D1.1/D1.1M: 2015 - Structural Welding Code - Steel.
 - 2. D1.4/D1.4M: 2011 - Structural Welding Code - Reinforcing Steel.
- D. ASTM International (ASTM):
 - 1. A615/A615M-16 - Deformed and Plain Carbon-Steel Bar for Concrete Reinforcement.
 - 2. A722/A722M-15 - High-Strength Steel Bars for Prestressed Concrete.
 - 3. C33/C33M-16 - Concrete Aggregates.
 - 4. C88-13 - Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
 - 5. C109/C109M-16a - Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens).
 - 6. C150/C150M-16 - Portland Cement.
 - 7. C404-11 - Aggregates for Masonry Grout.
 - 8. C618-15 - Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - 9. C937-16 - Grout Fluidifier for Preplaced-Aggregate Concrete.
 - 10. C942-15 - Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
 - 11. C989/C989M-14 - Slag Cement for Use in Concrete and Mortars.

12. C1017/C1017M-13e1 - Chemical Admixtures for Use in Producing Flowing Concrete.
13. C1077-16 - Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
14. D1143/D1143M-07(2013) - Deep Foundations Under Static Axial Compressive Load.
15. D3689/D3689M-07(2013)e1 - Deep Foundations Under Static Axial Tensile Load.
16. D3966/D3966M-07(2013)e1 - Deep Foundations Under Lateral Load.
17. E329-14a - Agencies Engaged in Construction Inspections, Testing, or Special Inspection.

1.8 PREINSTALLATION MEETINGS

- A. Conduct preinstallation meeting at project site minimum 30 days before beginning Work of this section.

SPEC WRITER NOTE: Edit participant list to ensure entities influencing outcome attend.

1. Required Participants:
 - a. COR.
 - b. // Architect/Engineer. //
 - c. // Inspection and Testing Agency. //
 - d. Contractor.
 - e. Installer.
 - f. // Manufacturer's field representative. //
 - g. Other installers responsible for adjacent and intersecting work, including // _____ //.

SPEC WRITER NOTE: Edit meeting agenda to incorporate project specific topics.

2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
 - a. Installation schedule.
 - b. Installation sequence.
 - c. Preparatory work.
 - d. Protection before, during, and after installation.
 - e. Installation.
 - f. Terminations.

- g. Transitions and connections to other work.
 - h. Inspecting and testing.
 - i. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.9 SUBMITTALS

- A. Submit according to Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
- 1. Complete ACP pile installation method with pile layout plan referenced to structural drawings, including numbering system identifying individual piles, pile sizes, pile length and tip elevations, reinforcing steel, and waterproofing details. Provide detailed description of construction procedures, including steel shells, when used, and auguring methods.
 - 2. Upon completion of ACP installations, submit five copies of drawings indicating actual in-place pile locations. Pay for all surveying costs. Drawings must be submitted before any pile cap or mat installation. Submit drawings in AutoCAD DWG format on CD-ROM.
- C. Manufacturer's Literature and Data:
- 1. Description of each product.
 - 2. Fly Ash or Ground Granulated Blast Furnace Slag: ASTM C618, Class C or F and ASTM C989/C989M, Grade 100 or 120, respectively.
 - 3. Plasticizing admixture: ASTM C1017/C1017M, Type II.
 - 4. Grout Fluidifier: ASTM C937.
 - 5. Aggregate sieve analysis: ASTM C33/C33M.
 - 6. Aggregate sodium sulfate soundness tests: ASTM C88.
 - 7. Portland cement: ASTM C150/C150M, Type I, Test Piles Type III.
 - 8. Reinforcing Steel: ASTM A615/A615M, Grade 60 // ASTM A722/A722M //, Type II, Thread Bar Type.
 - 9. Description of pile drilling equipment.
 - 10. Description of grout pump and pressure gage calibration reports.
 - 11. Pile Installation Recorder (PIR) calibration reports.
 - 12. Manufacturer's certified reports of mill tests for reinforcing steel and anchorage devices, including physical and chemical analysis.
- D. Test Reports:
- 1. Submit 3 copies of the laboratory testing reports to COR, Government's Geotechnical Consultant, and other pertinent parties.

- a. Submit report and certification of aggregate.
 - b. Laboratory Test Reports: Submit for evaluation grout materials and mix designs.
2. Pile Load Testing:
- a. Schedule and sequencing plan for pile testing and installation.
 - b. Pile Installation Recorder (PIR) details.
 - c. Pile Installation Recorder (PIR) reports.
3. Pile Load Test Work Plan:
- a. At least two weeks before commencing pile load testing work, submit pile load test work plan describing equipment, apparatus, procedures, and schedule for testing ACP's according to ASTM D1143/D1143M // ASTM D3689/D3689M // ASTM D3966/D3966M // and as specified herein, to verify design pile capacity. Include proposed instrumentation of test pile indicating depth, location, and details of pile.
 - b. Submit shop drawings and other information describing loading and test monitoring arrangement for pile load tests, including the following:
 - 1) Structural design of test load support/reaction frame.
 - 2) Details of equipment and apparatus to be used for monitoring load and pile movements.
 - 3) Testing and measuring equipment data, including required jack, load cell and/or gauge calibrations.
 - 4) Sample field data recording sheets or examples of automated data acquisition records proposed for recording load test data.
- E. Welding Certificates.
- F. Certification: Before beginning Work, submit signed copy of certification in acceptable form, stating careful examination has been made, existing structures, records of utility lines, test boring records, soil samples, and subsurface exploration reports by Government's Geotechnical Engineer, drawings, and specifications.
- G. Qualifications: Substantiate qualifications comply with specifications.
- 1. Installer // with project experience list //.
 - 2. Welders and welding procedures.
 - 3. Land Surveyor.
 - 4. Independent Testing and Inspection Agency.
 - 5. Grout Mix Designer.

- H. Delegated Design Drawings and Calculation: Signed and sealed by responsible A/E.
 - 1. Include detailed fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement complying with ACI 318.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Regularly installs specified products.
 - 2. Installed specified products with satisfactory service on five similar installations for minimum five years.
 - a. // Project Experience List: Provide contact names and addresses for completed projects. //
- B. Welders and Welding Procedures Qualifications: AWS D1.1/D1.1M and AWS D1.4/D1.4M.
- C. Delegated Design: Professional engineer licensed in State where project is located.
- D. Preconstruction Testing:
 - 1. Engage independent testing laboratory and inspection agency to perform tests and submit reports.
 - 2. Include consultation services when problems are encountered during execution.
- E. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements, record actual location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
- F. Grout Mix Designer: Employ testing laboratory to design grout mixes, conduct tests and submit reports for design mixes. Grout Mix Designer qualified according to ASTM C1077 and ASTM E329 to perform material evaluation tests and design concrete mixes.
- G. Quality Control Program: Submit quality control program at least two weeks before commencement of work.

SPEC WRITER NOTE: Retain below when Government requires Geotechnical Consultant.

- H. The Government retain services of a Geotechnical Consultant (Consultant) to provide general observation of all pile operations and to provide technical advice to COR on pile operations and performance.
1. Project Experience: Minimum eight different ACP projects in last five years, and have experience in recommending, testing, and specifying ACP's for similar subsurface conditions.
 2. Consultant will in no way relieve Contractor of obligations to perform pile installation according to drawings and specifications.

1.11 DELIVERY

- A. Deliver steel reinforcement to prevent damage.
- B. Before installation, return or dispose of distorted or damaged steel reinforcement.
- C. Bulk Products: Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.
- D. Except for probe pile, pile load test and test pile purposes, do not order or deliver pile materials until required load tests have been made and acceptable to COR.
- E. After pile lengths are verified by pile load test program, deliver materials to project site in quantities and times to ensure continuity of pile augering operations as scheduled.
- F. Clearly mark pile leads in 300 mm (1 foot) increments.

1.12 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

1.13 FIELD CONDITIONS

- A. Hot Weather Concreting Procedures: ACI 305R.
- B. Cold Weather Concreting Procedures: ACI 306R.

1.14 WARRANTY

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS**2.1 SYSTEM PERFORMANCE**

- A. Delegated Design: Prepare submittal documents including design calculations and drawings signed and sealed by registered design professional, licensed in state where work is located.
 - 1. Minor deviations to details shown on drawings to accommodate manufacturer's standard products may be accepted by COR when deviations do not affect design concept and specified performance.

2.2 MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I, Test piles Type III.
- B. Grout Fluidifier: ASTM C937.
- C. Plasticizing Admixture: ASTM C1017/C1017M, Type II.
- D. Ash or Ground Granulated Blast Furnace Slag: ASTM C618, Class C or F and ASTM C989/C989M, Grade 100 or 120, respectively.
- E. Water: Fresh, clean, and potable.
- F. Aggregate: ASTM C404, Size No. 1 or Size No. 2.
- G. Reinforcing Steel: ASTM A615/A615M, Grade 60.
- H. Fine Aggregate: ASTM C33/C33M.
- I. High Strength Reinforcing Steel: ASTM A722/A722M, Type II, Thread Bar Type.

2.3 CONCRETE MIXES

SPEC WRITER NOTE: Coordinate with Government's geotechnical engineer for concrete mixture requirements.

- A. Concrete: Pump concrete mixture and fill voids in foundation material. The Government's geotechnical engineer will specify mixture proportioned to yield // _____ // MPa (// _____ // psi) minimum compressive strength at 28 days.

- B. Mix Design: Engage Concrete Testing Laboratory to design concrete mix specified and perform tests as required. Submit certified test reports in duplicate, including design mix proportions.
- C. Concrete-mix design adjustments may be considered when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant. Resubmit and obtain approval from COR of proposed changes.
- D. Improper Mix: Immediately notify Concrete Testing Laboratory and COR when accepted mix design is unsatisfactory. Concrete Mix Designer will modify design, subject to review of COR, until satisfactory mix is obtained.

2.4 EQUIPMENT

- A. Augering Equipment:
 - 1. Continuous-flight, hollow-shaft auger rotated into ground to required pile depth established by pile load tests. Inject cement grout through auger shaft as auger is withdrawn. Measure and maintain grout pumping pressures high enough to offset hydrostatic and lateral earth pressures. Rotate auger in positive direction and withdraw in steady continuous motion.
 - 2. Auger Flighting: Continuous from auger head to top without gaps or other breaks, of diameter no more than 3 percent less than pile diameter.
 - 3. Locate hole through which high-strength grout is pumped during pile placement at bottom of auger head below cutting teeth.
 - 4. Provide middle guide on augers over 12000 mm (40 feet) long.
 - 5. Provide stabilizing arm to prevent piling leads from rotating or firmly place bottom of leads into ground or provide other acceptable means. Mark l at 300 mm (1 foot) intervals to facilitate measurement of auger penetration.
- B. Mixing and Pumping Equipment:
 - 1. Screen: Provide screen to remove over-size particles at pump inlet. Remove oil or rust inhibitor from mixing drums and grout pumps. Produce homogeneous grout of desired consistency.
 - 2. Grout Pump: Positive displacement piston type capable of developing displacing pressures minimum 2.5 MPa (350 psi). Include pressure gauge in clear view of equipment operator. Calibrate pump at beginning of work to determine volume of grout pumped per stroke.

Count grout pumping strokes by digital or mechanical stroke counters or other acceptable methods.

SPEC WRITER NOTE: Coordinate with
Government when Geotechnical Consultant
is required.

- C. Pile Installation Recorder (PIR): Record information during augering phase and grouting phase of installation to ensure minimum grout volume pumped per unit depth increment, immediately print results upon completion of each pile.
 - 1. Provide for used by Testing Agency and Geotechnical Consultant during pile installation for piling rig.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Survey: Lines and levels established and pile locations staked by Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 01, GENERAL REQUIREMENTS.
- B. Before installing piles adjacent to existing utilities, notify utility owner to ensure protective Work will be coordinated and performed according to requirements. Protect from damage and provide support when existing service lines, utilities and utility structures to remain in service are encountered during operations.
- C. When uncharted or incorrectly charted piping or other utilities are encountered during piling operations, immediately notify COR and utility owner. Cooperate with utility owner in keeping their respective services, utilities and facilities in operation.

3.2 ALLOWABLE LOAD ON PILES

- A. Probe Piles:
 - 1. Install minimum ten probe piles before installation of production piles utilizing same equipment, methods, and materials for all piling.
 - 2. Use probe piles to refine equipment operations. Do not install probe piles at production pile locations.
 - 3. Submit probe pile locations to COR before installation. When probe pile locations shown are not representative, COR will provide alternative locations.

4. Reaction piles for load test pile // may // may not // be used as probe piles.

B. Load test piles:

1. Perform probe pile load tests on minimum number as follows:
 - a. Piles under 45 cm (18 inches) diameter: Test 5 percent of piles.
 - b. Piles between 45 and 100 cm (18 and 40 inches): Test 10 percent of piles.
 - c. Piles over 100 cm (40 inches): Test 25 percent of piles.
2. Conduct load tests according to // ASTM D1143/D1143M // ASTM D3689/D3689M // ASTM D3966/D3966M // standard loading procedure. Do not install additional piles until test pile reports are received and approved by COR.
3. Additional load tests or increase in production pile length may be required if test pile fails load test.

3.3 INSTALLATION

- A. COR will determine production pile length and drilling criteria from probe pile installation, reaction piles, test piles, and pile load tests. Perform installation in orderly sequence.
- B. Advance auger at continuous rate that prevents removal of excess soil. Stop advancement after reaching required depth or refusal criteria.
 1. Auger Refusal: Rate of auger penetration less than 300 mm (1 foot) per minute of drilling.
- C. Provide plug to close hole in bottom of auger while being advanced into ground. Remove plug by grout pressure or with reinforcing bar.
- D. Place continuous center reinforcing through hollow-stemmed auger before grout placement. Tie top of reinforcing in place after auger removal. Use bar spacers to center reinforcing bars.
- E. At start of pumping grout, raise auger from 150 to 300 mm (6 to 12 inches) and after grout pressure builds sufficiently, redrill auger to previously established tip elevation.
- F. Maintain minimum 3000 mm (10 feet) of grout on auger flighting above injection point during auger raising. Maintain positive auger rotation throughout grout placement. Coordinate rate of grout injection and rate of auger withdrawal to maintain minimum grout head at all times and positive pressure on gauges. Total grout volume to be minimum 115 percent of theoretical volume for each pile, except, after grout is flowing at ground surface from auger flighting, coordinate grout injection and auger withdrawal rates so there is constant grout flow at

surface. If grout pumping is interrupted for any reason, reinsert auger minimum 1500 mm (5 feet) into pile and regrout.

- G. Minimum volume of grout placed in hole: Plus 15 percent.
- H. Volume of grout per linear meter (linear foot) of pile: Minimum volume of grout per meter (grout per foot) of load test pile. Make volume measurements in COR's presence.
- I. Provide auger hoisting equipment to enable auger to be rotated while being withdrawn smoothly and steadily. If auger jumps upward during withdrawal, reinsert auger and decrease withdrawal rate to prevent further jumping.
- J. Clear spoil that accumulates around auger during grout injection upon installation completion.
- K. Provide OSHA protective caps on all projecting reinforcement.
- L. Accurately measure materials by volume or weight fed into mixer. Place materials in mixer in the following order: (1) water, (2) fluidifier, and (3) other solids in order of increasing particle size. Provide grout injection equipment with pressure gage in clear view of equipment operator. Locate second pressure gage near auger rig where it can be observed. Coordinate injection rate and auger withdrawal rate from soil to maintain positive pressure on gage which will indicate existence of removing pressure on bottom of auger flight. Magnitude of pressure and performance of augering and grouting procedures, such as rate of augering, rate of grout injection, and control of grout return around auger flight, are dependent on soil conditions, and equipment capability will be at Contractor's option, subject to COR's approval.
- M. Locate piles as shown on drawings, unless otherwise directed by COR. Do not place piles closer than 1050 mm (3.5 feet) center to center until grout in adjacent piles has set for 24 hours. In locations where no concrete slabs or other means of distributing pile placing equipment load, keep equipment minimum 3000 mm (10 feet) away from pile location, or case upper 3000 mm (10 feet) of pile.
- N. Where pile top is near surface or above bottom of excavation, place metal sleeves of proper diameter around pile top.
- O. Cut off pile tops square with pile axis, at elevations indicated on drawings. Remove fresh grout from pile top or by cutting hardened grout down to final cutoff point at any time after initial set. Where pile cut-off is near surface or above bottom of excavation, place sleeves or

casing of proper diameter and minimum 457 mm (18 inches) long around pile tops. (Special conditions may require longer metal sleeves).

- P. Redrill pile to original depth at no additional cost if any of the following occur:
1. Design pile reinforcement cannot be placed manually on top of any pile following grouting completion.
 2. Trap door at bottom discharge outlet fails to open completely, creating side discharge condition.
 3. Loss of grout head occurs for any reason during pile installation.
 4. More than twenty-minute delay during grouting of any individual pile.
 5. Drop in grout level after pile completion, which exceeds average for remainder of pile installations by more than 600 mm (2 feet).
- Q. Install additional piles at no additional cost for damaged, misaligned and/or mislocated piles, including concrete and reinforcing for required modifications to pile caps/grade beams due to damaged piles and/or misaligned or mislocated piles.
- R. If the grout level in any completed pile drops, replace pile.
- S. Do not load any pile until grout has attained full design strength.

3.4 OBSTRUCTIONS

- A. Provide necessary means and methods of auger advancement through naturally occurring materials such as cobbles, boulders and rock ledges, as outlined in Geotechnical Report.
- B. Complete pile to required depth when unforeseen material is encountered, which reduces rate of penetration to less than 300 mm (1 foot) per minute above desired tip elevation or causes pile to drift and cannot be augered.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections and Tests:
 1. Installation of each pile.
 2. Pile location and plumbness.
 3. Total quantity of grout placed.
 4. Load Test.
 5. Pile Installation records for all ACP's.
- B. Independent Testing and Inspection Agency: Document, monitor, and observe load test, probe pile, test pile, and production pile work. Submit field reports and test results required by Article 3.2 for pile

load tests, pile installations, and grout testing and inspection. Submit installation report for each pile no later than three days after installation is complete.

1. Pile Acceptance: Immediately notify Consultant and COR if any pile is not in compliance with specifications. Cost of removing and replacing piles which are not in compliance will be at no additional cost to the Government.
- C. Surveyor: Prepare field survey of completed piles and submit drawing to COR showing pile plumbness and actual locations.
- D. Pile Record: Submit complete and accurate record of all auger-placed piles to the COR, including pile location, diameter, length, top and bottom elevation, and quantity of grout used in each pile. Note any unusual conditions encountered during pile installation.
- E. Completion Certificate: Provide written statement, stamped by a Professional Engineer registered in the State where project is located, verifying piles were installed as shown on drawings, and that any piles not installed as shown on drawings were installed such that they will not negatively impact proposed structure.
- F. Grout Mix: Test grout mix by making minimum six, 50 mm (2 inches) cubes for each day during which piles are placed. For each set of six cubes, test two cubes at seven days, two cubes at 28 days, and two cubes held in reserve. Cure and test cubes according to ASTM C109/C109M. Cube specimens may be restrained from expansion as described in ASTM C942.

3.6 CORRECTIONS OF DEFICIENCIES

- A. Notify COR in writing, of failure of any pile to meet any requirement of this section. Include information required for evaluation of remedial measures and information required for redesign.
- B. Based on survey provided, if a pile fails to comply with location or tolerance requirements, or design load requirements, COR will calculate load capacity requirements of pile and each pile in associated pile group, based on actual locations and inclinations. If calculation indicates loading exceeds design load, perform remedial work required by COR; provide additional piles at approved locations and modify concrete or reinforcement steel.
- C. If a pile fails to comply with requirements of this section and COR determines modification to concrete or reinforcement steel, A/E will perform required reanalysis, redesign and detailing, for reimbursement as change to contract.

D. Replace piles that does not meet requirements.

3.7 CLEANING

A. Remove and dispose all debris off-site.

B. Clean project site at frequent intervals with no material obstructing easy access of equipment and personnel.

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