

SECTION 31 63 16 – AUGER CAST GROUT PILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division- 01 Specification sections, apply to work of this section.
- B. Information concerning a sub-surface soil investigation by an independent testing laboratory is available and will be furnished by the owner upon request. The data included therein may be used by the Contractor for his general information only. The Architect/Engineer will not be responsible for the accuracy or applicability of the data therein.

1.2 SCOPE OF WORK

- A. The Pile Contractor shall furnish all materials, labor, services, equipment and shall install and cut off all piles at the locations and depths shown on the drawings or as otherwise directed by the Owner's Geotechnical Engineer. The piles shall be installed to have minimum working capacity as indicated in the General Notes on the drawings. The piles shall be free of defects, mud inclusions, voids, or other anomalies which can adversely influence pile performance.
- B. The Pile Contractor shall furnish and place all reinforcing steel, dowels, and anchor bolts as shown on the drawings.
- C. The Pile Contractor shall furnish all materials and labor as required to perform the load tests as specified herein and on the drawings.
- D. The General Contractor shall provide all necessary excavation, sheeting and bracing or other adequate maintenance of excavation banks, suitable runways and ramps as necessary for pile driving, control of ground and surface water as necessary to keep the work area sufficiently dry, suitable access roads for movement of equipment and materials to and from pile locations, field layout required for pile work including setting and maintaining a location stake for each pile and giving cut-off grades on all piles, and removal of all overhead and underground obstructions as required.

1.3 INSTALLATION

- A. Auger cast piles shall be placed by rotating a continuous flight hollow shaft auger into the ground to a predetermined pile depth or as otherwise directed by the Owner's Geotechnical Engineer. High-strength cement-base non-shrink grout shall be pumped with sufficient pressure through the auger shaft as the auger is withdrawn to fill the augered hole preventing hole collapse and any infiltration of soil into the hole and to cause the lateral penetration of the grout into soft or porous zones of the adjacent soil. A head of grout at least five feet above the

point of injection shall be maintained at all times during the pumping process so that the grout has a displacing action removing any loose material and maintaining the shape of the hole. This method of displacement shall be used at all times and shall not be dependent on whether the hole is sufficiently stable to retain its shape without support from the earth filled auger. Where reinforcement is shown on the drawings to be placed in the pile, it shall be placed while the grout is in a fluid state.

1.4 QUALIFICATIONS

- A. Piles shall be installed only by a specialty Pile Contractor with suitable equipment, competent personnel, and a reputation of satisfactorily performing the work. He shall have a minimum of five years auger cast pile experience and a minimum of five successful pile installations on projects comparable in scope to this project. Evidence of compliance with this section shall be submitted to the Architect/Engineer prior to entering into a contract for the work.

1.5 QUALITY ASSURANCE

- A. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.
- B. The Pile Contractor shall comply with all provisions of the local building code and all other codes and standards specified on the drawings.

1.6 JOB CONDITIONS

- A. Site Information:
 - 1. Data on indicated subsurface conditions are not intended as representations or warranties of continuity of such conditions. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn from there by the Contractor. The data are made available for convenience of the Contractor.
 - 2. Additional test borings and other exploratory operations may be made by the Contractor at no additional cost to the Owner. Notify and obtain approval from Owner prior to drilling borings.
- B. Protection of Existing Structures: Protect structures, underground utilities and other construction from damage caused by pile augering operations.
- C. Survey of Existing Structures: When structures are adjacent to pile augering operations record and report to Architect/Engineer surveyed elevation bench marks on structures where directed by Architect/Engineer before commencing work. Record and report elevation of each bench mark at least twice a day while pile augering is in progress. Should bench mark readings indicate displacement, halt drilling operations until corrective action has been provided and is acceptable to Architect/Engineer and Owner.

1.7 SUBMITTALS:

- A. **Drilling Records:** The Pile Contractor and the Owner's Geotechnical Engineer shall each submit copies of the drilling record of each pile to the Architect/Engineer not later than 48 hours after drilling. The reports shall indicate the name of job, name of pile contractor, and drilling superintendent. For each pile installed, the report shall include the following information: pile location, pile number, pile diameter, actual tip elevation; actual surface elevation (top of grout), pile length, theoretical volume of grout, actual volume of grout placed, reinforcing steel size and depth actually placed, drilling start and finish time, grouting start and finish time, amount of drop in grout level in 24 hours, and a report of any unusual occurrences affecting pile performance. Notify the Architect/Engineer immediately by telephone when the grout level for any pile drops within 24 hours after installation. Reports prepared by the Owner's Geotechnical Engineer shall be compiled and signed by a registered professional engineer in the state of Texas. Reports prepared by the Pile Contractor shall be compiled and signed by the drilling superintendent.
- B. **Load Test Reports:** The Owner's Geotechnical Engineer shall submit copies of test reports for each load test within 48 hours after completion of tests. The report shall include pile load test capacity, compressive test reports of the pile grout, tabular and graphical presentation of gross and net settlement of the pile top, pile data as prescribed in the previous section, and recommendations for production pile installation.
- C. **Alternates:** The Pile Contractor shall submit his bid based on the specifications as written without exceptions. He may submit bids for alternates to the specifications or modifications to the design, load test program, or installation specifications for consideration by the Architect/Engineer and the Owner.
- D. **Shop Drawings:** Submit shop drawings for review prior to construction. Shop drawings shall include, for each pile, grout design strength, sizes and lengths of piles, type and arrangement of reinforcing steel, dowels, and anchor bolts and total number and location of piles.
- E. **Calculations:** Calculations sealed by a registered professional engineer in the state of Texas shall be submitted to verify any pile design and reinforcing steel different from that shown on the drawings. Installation shall not commence until such calculations have been reviewed and approved.
- F. **Load Test Frame:** Submit shop drawings of the load test frame sealed by a registered professional engineer in the state of Texas.
- G. **Post Construction Survey:** After completion of pile driving, the Contractor shall provide the Architect/Engineer with an as-built survey showing the actual locations of the piles at cut-off elevations. This survey shall show the plumbness of vertical piles, the slope of batter piles, and all abandoned piles and their replacements. No construction of superstructures shall commence until this survey has been reviewed and accepted by the Architect/Engineer. In order to facilitate the progress of the Work, the Contractor shall submit partial pile surveys for approval as the Work proceeds.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Grout: The cement-base non-shrink grout used to fill the augered hole shall consist of a mixture of Portland Cement, fine aggregate (sand), mineral filler (where used), fluidifier, and water. The grout shall be proportioned and mixed so as to be capable of maintaining solids in suspension without appreciable water gain and will penetrate and fill any voids in the foundation soils. The twenty-eight day compressive strength, as determined by grout cube tests, shall be 5000 psi minimum unless shown otherwise on the drawings. The grout mix design shall be prepared by the Pile Contractor and shall be reviewed and approved by the Owner's Testing Laboratory at least 15 days prior to use on the job.
- B. Portland Cement: Portland cement shall conform to ASTM C150.
- C. Fine Aggregate: Fine aggregate (sand) shall consist of hard, dense, durable, uncoated rock particles free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances and shall meet the requirements of ASTM C33. The sand shall be well graded from fine to coarse, with a fineness modulus between 1.4 and 3.4.
- D. Mineral Filler: Mineral filler, when used, shall conform to ASTM C618 and shall be finely powdered silicious material which possesses the property of combining with the lime liberated during the process of hydration of Portland cement.
- E. Fluidifier: Fluidifier shall be a compound possessing characteristics which will increase the fluidity of the grout, reduce bleeding, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the grout. Acceptable products include "Interaid" as manufactured by the Grout Supply Company in Brecksville, Ohio, or other products approved by the Owner's Testing Laboratory.
- F. Water: Clean, fresh, and potable.
- G. Reinforcing Steel: ASTM A615, Grade 60.

2.2 AUGERING EQUIPMENT

- A. The injection port through which the grout is discharged during the pile pumping procedures shall be located at the bottom of the auger below the cutting steel.
- B. The auger flighting shall be continuous from the auger head to the top of the auger with no gaps or other breaks. The pitch of the auger flighting shall not exceed 9 inches.
- C. Rotation of the piling leads shall be prevented by the use of a stabilizing arm.
- D. A middle guide shall be used when the auger length exceeds 40 feet.

2.3 GROUT MIXING AND PUMPING EQUIPMENT

- A. Only approved mixing and pumping equipment, free of oil or rust inhibitors, shall be used in the preparation and handling of the grout. All materials shall be such as to produce a homogeneous grout of the desired consistency.
- B. Only ready-mix grout shall be used with an agitator of sufficient size between the ready-mix truck and the grout pump to insure a homogeneous mix and continuity in the pumping operations.
- C. The grout pump shall be a positive displacement piston type pump with the capability of developing displacing pressures up to 400 psi at the pump. The pump shall have a pressure gauge in good working condition which indicates grout pumping pressure. The pump shall be equipped with a device to determine the volume of grout pumped into each pile. The minimum volume of grout placed in the pile hole shall at least equal the volume of the augered hole.
- D. Additional standby grout equipment shall be maintained at the job site to prevent abandonment of piles if breakdowns occur.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Pile Contractor shall examine the conditions under which piles are to be installed and shall notify the General Contractor in writing of conditions detrimental to proper and timely completion of the work. The Pile Contractor shall not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to him.

3.2 PRE-AUGERING WORK:

- A. Site Conditions: Do not auger piles until earthwork in area which piles are to occupy has been completed, as follows:
 - 1. Excavations: Earth excavation will be stopped at an elevation of 6" to 12" above bottom of footing before piles are drilled. Final excavation of required elevation of footing bottoms will be done as part of earthwork for buildings, after piles have been augered and tested.
 - 2. Fills: Fills will be constructed and compacted to elevation of grade indicated on the drawings.
- B. Pile Length Markings: Mark each auger length with a horizontal line at 1'-0" intervals, and the number of feet from tip at 5'-0" intervals.

3.3 AUGER CAST PILE EXCAVATION

- A. Requirements:

1. Excavate holes for auger cast piles to required bearing strata or elevation as shown on the drawings, unless directed otherwise by the Owner's Geotechnical Engineer. Final auger cast pile elevations different from those shown on the drawings will be paid for in accordance with contract conditions relative to changes in the work.
2. Adjacent auger cast piles shall not be installed until the grout in any existing piles has attained its initial set to insure that there will be no interconnection between piles.
3. Maintain top of auger cast pile at the proper elevation shown on the drawings and do not allow grout overflow beyond pile configuration without cleaning pile top of excess grout. Top of pile shall be square and shall not be contaminated with soil.
4. Metal sleeves of the proper diameter and at least 18 inches in length shall be placed around the pile top to prevent contamination by foreign material.
5. The minimum volume of grout pumped into each pile shall at least equal the theoretical volume of the augered hole.

B. Drilling Tolerances:

1. Location: Locate center of gravity of each single pile or pile groups within 3" from specified location. Locate piles under walls within 1" from specified locations.
2. Plumbness: Piles shall not be out of plumb by more than 1.5% of length.
3. Grout Cut-Off Elevation: Plus 0" to minus 3".
4. Batter Angle: Maintain 1" in 10'-0" from required angle.

C. Piles with Drop in Grout Level: Piles that show a drop in grout level more than 1" in 24 hours shall be abandoned unless tested and approved otherwise by the Owner's Geotechnical Engineer. Pile capacity may be downgraded as determined by the Owner's Geotechnical Engineer.

D. Damaged or Misplaced Piles: Damaged piles, piles with a drop in grout level, or piles placed outside specified tolerances will not be accepted. Such piles shall be reported to the Architect/Engineer by the Contractor and the Owner's Testing Laboratory prior to augering new piles so that they may be evaluated and a possible redesign implemented. Cost of re-engineering shall be borne by the Pile Contractor.

1. Abandon piles rejected after drilling and backfill hole if required with approved cohesionless soil, placed and compacted throughout the length. Replace with new piles as directed by the Architect/Engineer and the Owner's Geotechnical Engineer.

2. Drill additional pile or piles where centerline tolerance is exceeded and redesign indicates the load on any pile exceeds 110% of design load, unless directed otherwise by the Architect/Engineer.
- E. Obstructions: If rocks, boulders, timbers, bricks, or other unforeseen obstructions are encountered during the drilling operation that causes auger refusal (penetration rate of the earth augering equipment less than one foot per minute), then such piles shall be completed to the refusal depth and paid for on the unit basis specified in the contract. Additional piles, if required, as determined by the Owner's Geotechnical Engineer, shall be added and paid for in accordance with the contract basis for changes in the work.
 - F. Overexcavation: No payment will be made for extra length of auger cast piles when they are installed to a greater depth than required or as authorized by the Owner's Geotechnical Engineer. Overexcavated piles will be measured and paid for in accordance with the original design or authorized depth.
 - G. Excavated Material:
 1. Remove excavated material and dispose of it off site.

3.4 GROUT PLACEMENT

- A. All grout shall be ready-mix grout from a batch plant in accordance with the requirements of ASTM C94.
- B. Stop grout placement at cut-off elevation shown, screed level, and apply a scoured, rough finish. Where cut-off elevation is above ground level, form top section above grade and extend pile, with proper reinforcing steel splices, as specified.
- C. The operation of augering and grouting shall be uninterrupted. If interruptions occur and continuity of pile in its full cross-section cannot be assured then the pile shall be abandoned at the discretion of the Owner's Geotechnical Engineer.
- D. Hot Weather Placement: Grout shall not exceed a temperature of 90°F during mixing or pumping. The mixing water shall be cooled as required to maintain this temperature limit.
- E. Cold Weather Placement: Outside air temperature shall be 40°F and rising for the grouting operation unless special precautions, as approved by the Owner's Testing Laboratory, are maintained to keep the grout at 55°F or higher.

3.5 REINFORCING STEEL PLACEMENT

- A. Before placing, clean reinforcing steel and dowels of loose rust, scale, dirt, grease, and other material which could reduce or destroy bond.
- B. For piles with a single reinforcing bar specified, place bar during grouting operation. Maintain bar at center of pile for specified depth.

- C. For piles with reinforcing cages specified, fabricate and erect cages as one continuous unit. Securely tie cage together with adequate ties (above that shown on the drawings if required) and with interior cross ties as required to maintain proper shape. Provide cage with guiding devices between cage and pile circumference along the pile length to insure minimum 3" cover to cage. Detail such devices on the shop drawings. Work cages into final position without bar misplacement after grout is placed and still in a fluid state.
- D. Use templates to set anchor bolts and dowels. Protect exposed ends of dowels and anchor bolts from mechanical injury and exposure to weather.

3.6 PILE LOAD TEST

- A. Perform load tests to verify design pile lengths and loads. Provide complete testing materials and equipment as required. Notify the Architect/Engineer in ample time before performing tests and perform tests only in the presence of the Owner's Geotechnical Engineer.
- B. Test piles, furnished and installed by the Pile Contractor to determine pile criteria, may be located, cut off, and become part of foundation system provided they conform to contract requirements and are approved by the Owner's Geotechnical Engineer.
- C. Test Piles Required:

Provide one single test pile as directed by the Owner's Geotechnical Engineer.
- D. Drilling Test Piles:
 - 1. Use test piles of same size and design as required for the project, and install with the same equipment as will be used in drilling permanent piles.
 - 2. Install test piles at locations and to the depths as specified by the Owner's Geotechnical Engineer.
- E. Pile Design Load: Design load per pile is shown on drawings.
- F. Test Loads:
 - 1. Load single test piles to twice required design load for each type pile.
 - 2. Load groups of 3 test piles to 1-1/2 times load capacity of pile group.
- G. Pile Load Testing: Pile test shall be at a location as determined by the Geotechnical Engineer and approved by the Architect/Engineer. Test shall be performed under the supervision of the Owner's Geotechnical Engineer. Costs of load tests shall be borne by the Pile Contractor. Design of the load test frame shall be the responsibility of the Drilling Contractor. Shop drawings of the load test frame shall be submitted for Architect/Engineer review and shall be prepared under the supervision of and sealed by a registered professional engineer in the state of Texas. Load and test piles which have been in place sufficient time to

allow concrete to attain its 28 day design compressive strength. Determine the load-settlement relationship of test piles under a vertical axial load, complying with ASTM D 1143.

1. Apply loads in increments not exceeding 25% of allowable pile load.
2. Apply test loads either by use of hydraulic jacks or by static loading. Use certified, calibrated jacks to develop the required test loads, maintain them, and release them in continuous operations. Drive anchor piles not closer than 5 ft. from any test pile or as directed by the Owner's Geotechnical Engineer.
3. Apply test loads so that allowable design load is reached in not less than 8 hours from start of load application. Maintain this load until no measurable settlement is observed in a period of 16 hours or longer, as may be required by local codes having jurisdiction. Do not apply subsequent loads until pile settlement becomes negligible.
4. After satisfactory allowable design load testing, apply additional loads so that total test load is reached in not less than 8 hours. Maintain total load until no measurable settlement is observed in a period of 16 hours, or longer as may be required by local codes having jurisdiction.
5. Measure and record settlement immediately before and after each increment of test load is applied, and immediately before and 24 hours after total load is removed.
6. The test pile will be considered as acceptable for stipulated bearing capacity if total net settlement, after deducting rebound, does not exceed 0.01" per ton of test load.

H. Test Reports:

1. Prepare reports for each test pile and include: Date of installation, test pile location, size and length of pile, grout compressive strength, tip elevation, surface elevation, theoretical and actual volume of grout, reinforcing steel size and depth placed, drilling start and finish time, grouting start and finish time, amount of drop in grout level in 24 hours, and any unusual circumstances affecting pile performance.
2. Include with the report a record of drilling equipment used.
3. Also include tabular and graphical representation of gross and net settlement of the pile top, relationship of actual load capacity to that predicted, and any recommendations for production pile installation.

3.7 APPROVAL BY GEOTECHNICAL ENGINEER

- A. Approval by the Owner's Geotechnical Engineer is required on all pile installation criteria and his decision and judgment on pile length, rejection of piles, additional piles required, and all other pile installation and capacity questions shall be final.

3.8 CONTRACT BASIS

- A. Basis for Bids: Bids will be based on the number, size, and length of piles shown on the drawings from tip to top of grout.
- B. Basis for Payment:
 - 1. The Contractor and the Owner's Geotechnical Engineer shall calculate the actual total length of piles installed on the job. The contract price per lineal foot shall include all labor, materials, tools, equipment, and incidentals, and for performing work for furnishing, drilling, cutting off, and capping all piles.
 - 2. Measurements of pile lengths shall be based on effective length of acceptable piles in place with fractional lengths measured to the nearest foot. Payment for lineal footage in excess of that indicated in the bid and credit for lineal footage less than that indicated in the bid, shall be made at unit prices stated in the contract. Note that payment will be based on lengths of all the piles on the job added together for application of the unit prices and not lengths on a per pile basis.
 - 3. Test piles that become part of completed foundation work will be considered as an integral part of the work.
 - 4. No payment will be made for piles rejected for any reason including but not limited to piles placed out of specified tolerances, imperfect piles, piles that had a drop in grout level, piles with grout strength less than specified, misplaced or omitted reinforcing steel, and insufficient drilled length from that specified.

END OF SECTION 31 63 16