

SECTION 31 62 00
DRIVEN PILES

PART 1 GENERAL

1.1 DESCRIPTION

This section specifies materials and installation required for the construction of impact driven foundation piles.

1.2 RELATED WORK

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete, including materials, reinforcing steel, and mixes: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Steel: Section 05 12 00, STRUCTURAL STEEL FRAMING.
- E. Subsurface investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.3 CONTRACT BASIS

- A. Contract price for piles will be based upon length of piles shown and number of pile load tests indicated in the Contract Documents. Length of piles will be measured from tip to point of cutoff.
 - 1. Adjustment of contract price shall 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 in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable.
 - 2. No payment will be made for withdrawn, broken or rejected piles, piles out of tolerance, or for portion of pile remaining above cutoff point.
 - 3. Contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable, when artificial materials that are not shown are encountered.

1.4 TOLERANCES

Install piling with a maximum variation of 75 mm (3 inches) of center of any pile from location shown. Piles shall not be out of plumb more than 2 percent. Top of any pile at elevation of cutoff shall be within 50 mm (2 inches) of the planar location indicated. Additionally, a variation in

batter, as measured on the driven pile, of not more than 6 mm per m (1/4 inch per foot) of longitudinal axis will be permitted. Manipulation of piles to force them into position will not be permitted. Piles shall be checked for heave, and those found to have heaved shall be redriven to the required tip elevation. Piles damaged or driven outside the above tolerances shall be replaced, or additional piles driven at locations specified by the Contracting Officer at no expense to the Government.

1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** A firm experienced in installing piles similar in material, design, and extent indicated for this Project, whose work has resulted in a history of successful in-service performance. This firm must have sufficient production capacity to produce the required piles without causing delay in the work. The Specialty Contractor shall demonstrate a consistent record of at least ten (10) successfully completed projects of equal or greater magnitude with similar subsurface conditions and piling requirements performed over the preceding five (5) years. Submit satisfactory proof of compliance to the Architect at time of bid.
 - 1. Installer's responsibility includes providing a qualified professional engineer to prepare pile-driving records. Engineer must have a minimum of three years of experience in the design and construction of type of the specific type of piles used in project.
- B. **Testing Agency Qualifications:** An independent testing agency qualified according to ASTM C1077 and ASTM E329 for testing indicated, as documented according to ASTM E548 shall be engaged by the Contractor and approved by the Resident Engineer.
- C. **Welding Standards:** Qualify welding procedures and personnel according to AWS D1.1.
- D. **Pre-installation Conference:** Contractor shall conduct conference at Project site prior to pile installation.
- E. **Approval by Geotechnical Engineer:** The COR's ITL shall approve all pile installation criteria with regard to the requirements of the specifications and drawings, Geotechnical Report, job conditions, and any and all other criteria relevant to installation in the judgment of the ITL. Judgment of the ITL shall be final. Report results of all evaluations and tests, if any, to the Architect and Structural Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piles to Project site in such quantities and at such times to ensure continuity of installation. Handle and store piles at Project site to prevent physical damage:
 - 1. Protect pile coatings and touch up damage to coatings before driving piles.

1.7 PROJECT CONDITIONS

- A. Protect structures, underground utilities, and other construction from damage caused by pile driving. Contractor shall be completely liable and responsible for all damages to existing structures, utilities, or other construction that may occur due to performance of pile installation work. Such liability shall include, but not be limited to, repair or replacement of such damaged property, cost or performance of cleaning, and any associated costs due to such damage. Repair, replacement, cleaning and any other measures necessary to return property to its original condition shall be subject to the satisfaction of its owner and his requirements at no cost to the owner. Contractor shall also be liable for all architectural and engineering costs necessary to make required repairs.
- B. Site Information: Contractor is responsible for evaluating and implementing the information provided in the geotechnical report prepared for the Project.

1.8 DESIGN MODIFICATIONS

- A. Where piles are installed exceeding specified tolerances for plumb or location, the foundation design will be analyzed by the Resident Engineer and if necessary redesigned by the Resident Engineer. The costs for analysis, redesign, and remediation shall be responsibility of Contractor.
- B. Additional piles and pile cap modifications necessitated by redesign shall be furnished and installed, at no additional cost to the Government.

1.9 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data: For each type of pile product, accessory, and paint indicated.
- C. Shop Drawings: Show fabrication and installation details for piles, including driving points, splices, field-cut holes, and pile caps.
 - 1. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

2. Include arrangement of static pile reaction frame, test and anchor piles, equipment, and instrumentation. Submit structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Include design mixes, qualification data, material test reports, material certifications, pile driving equipment information.
- D. Reports: Wave equation analysis report, driving of each pile, pile location plumbness, welding, and static pile test reports.
- E. Hammer: Include type, make, maximum rated energy, and rated energy per blow of hammer; weight of striking part of hammer; weight of drive cap; details, type, and structural properties of hammer cushion; and details of follower and jetting equipment.
- F. Mini-pile Schedule: Including mini-pile number, mini-pile design loads and type and size of mini-piles.
- H. Welding certificates.
- I. Pile Load Testing:
 1. A schedule and sequencing plan for pile testing and installation.
 2. Pile Load Test Work Plan:
 - a. At least two weeks before commencing pile load testing work, the Contractor shall submit a pile load test work plan describing the equipment, apparatus, procedures, and schedule for testing ACP's in accordance with ASTM D1143, ASTM D3689 and ASTM D3966 and as specified herein, to verify the design pile capacity. The work plan shall also include the proposed instrumentation of the test pile indicating depth, location, and details of the pile.
 - b. As part of the Pile Load Test Work Plan, submit shop drawings and other information describing the loading and test monitoring arrangement for pile load tests, including the following:
 - 1) Structural design of the test load support/reaction frame.
 - 2) Details of equipment and apparatus to be used for the monitoring load and pile movements.
 - 3) Data on testing and measuring equipment 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.
- J. Record drawings at Project closeout according to Division 01 Section "Closeout Procedures" including the following: As-built drawings showing

the locations of the Mini-piles and the piles length, steel manufacturer's mill test reports for the steel pile components incorporated in the installation, detailed drilling records including depth to rock quality, grouting records indicating the cement type, and quantity injection mini-pile test results and graphs.

1.10 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
- A27/A27M-10.....Standard Specification for Steel Castings, Carbon, for General Application
 - A36/A36M-08.....Standard Specification for Carbon Structural Steel
 - A82/A82M-07.....Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - A148/A148M-08.....Standard Specification for Steel Castings, High Strength, for Structural Purposes
 - A252-10.....Standard Specification for Welded And Seamless Steel Pipe Piles
 - A416/A416M-10.....Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
 - A496/A496M-07.....Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
 - A572/A572M-07.....Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 - A588/A588M-10.....Standard Specification for High-Strength Low-Alloy Structural Steel with 345 Mpa (50 ksi) Minimum Yield Point to 100 mm (4 in) Thick
 - A615/A615M-09b.....Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
 - A706/A706M-09b.....Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
 - A767/A767M-09.....Standard Specification for Zinc Coated (Galvanized) Steel Bars for Concrete Reinforcement
 - C33-C33M-11a.....Standard Specification for Concrete Aggregates

- C1077-11c.....Standard Practice for Agencies Testing Concrete
and Concrete Aggregates for Use in Construction
and Criteria for Testing Agency Evaluation
- D1143/D1143M-07e1.....Standard Test Methods for Deep Foundations Under
Static Axial Compressive Load
- D3689-07.....Standard Test Method for Individual Piles Under
Static Axial Tensile Load
- D3966-07.....Standard Test Method for Piles Under Lateral Loads
- D4945-08.....Standard Test Method for High Strain Dynamic
Testing of Piles
- E94-04(2010).....Standard Guide for Radiographic Examination
- E164-08.....Standard Practice for Ultrasonic Contact
Examination of Weldments
- E165-09.....Standard Test Method for Liquid Penetrant
Examination
- E329-11c.....Standard Specification for Agencies Engaged in
Construction Inspection, Testing, or Special
Inspection
- E548-94e1.....Standard Guide for General Criteria Used for
Evaluating Laboratory Competence
- E709-08.....Standard Guide for Magnetic Particle Examination
- C. American Welding Society (AWS):
- D1.1/D1.1M-2010.....Structural Welding Code - Steel
- F..American Concrete Institute (ACI):
- 315-99.....Details and Detailing of Concrete Reinforcement
- G..Society for Protective Coatings (SSPC):
- Paint 16-82(2004).....Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint

PART 2 - PRODUCTS

2.1 PILES

- A. General: Piles shall have a 75 ton capacity. Piles shall be steel pipe piles. Submit details of type proposed for installation, showing cross-sections, end closures, and details of connections for approval by Resident Engineer before delivery of any material to project site.
- D. Steel Pipe Piles:
1. Pipe Steel: ASTM A252, seamless or welded. Grade 3.
 2. Micropiles must be installed open-ended. Ends shall be closed with forged or cast steel conical point continuously welded to pipe. Minimum

- wall thickness of open-ended pipe shall be 6 mm (0.25 inch) for diameter less than 350 mm (14 inches) and 10 mm (0.375 inch) for diameters greater than 350 mm (14 inches). Minimum wall thickness of concrete filled pipe piles installed with closed ends shall be 2.5 mm (0.10 inch). Minimum outside diameter shall be 250 mm (10 inches) for open-ended pipe piles and 200 mm (8 inches) for pipe piles installed with closed ends.
- a. Allowable design unit stresses: 0.33 f'c average cross-sectional area of pile. For pipe sections 6 mm (0.25 inch) or more in thickness, 35 percent of minimum specified yield strength is permitted on full steel area. Minimum specified yield strength shall not be assumed greater than 250 MPa (36,000 psi) for computation purposes.
 - b. Drilling: Piles shall be driven to required penetration without distortion, damage or not exceeding a drilling stress of 0.9 minimum specified yield strength. Tip reinforcement and steel caps shall be provided as required. Establish and maintain axial alignment of leads and pile before and during drilling.
 - 1) Piles may be placed in single length or may be spliced with continuous butt weld. In sections below upper splice, splices shall be spaced at not less than 6000 mm (20 feet). Shell, splices and end closures shall be watertight. Driving surfaces of shell shall be square cut.
 - 2) Do not drill pile within 3000 mm (10 feet) in granular soil and 6000 mm (20 feet) in cohesive soil of any pile in which concrete has been placed until 24 hours after concrete placement.
 3. Grout: Flowable grout (4000psi) consisting of a mixture of Portland Cement Type 1 or III ASTM C150, sand, potable water (ASTM C94), fluidifier (ASTM C494) and admixtures to produce a suitable grout for pumping under pressure. Mix shall be capable of maintaining the solids in suspension without appreciable water gain. Grout must be able to penetrate and fill pipe and annular space outside pipe
 4. Reinforcement Bars: ASTM A615/A615M, Grade 60; deformed.
 5. Filling Casings: Pile interior shall be cleaned and approved by Resident Engineer before placing concrete. Place concrete using funnel or hopper. Place no concrete through water, except with written

approval of the Resident Engineer. Proportions of concrete so placed and method of placing shall be approved by the Resident Engineer.

PART 3 - EXECUTION

3.1 GENERAL

- A. It shall be Contractor's responsibility to furnish a specified type of pile and casing of gauges necessary to install a satisfactory pile foundation. Conversion from one type of pile to another, or from lighter to heavier casing gauges shall be at no additional cost to the Government.
- B. Survey: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and levels and stake pile locations.
 - 1. After all piles are drilled and installed, Registered Professional Land Surveyor or Registered Civil Engineer shall make field survey of completed piling work. Submit drawing to Resident Engineer showing actual pile locations with respect to planned pile locations and indicating plumbness of piles.
- C. Reports: Submit a report in quadruplicate to Resident Engineer, for each pile, detailing pile location tied to project grid, date pile installed, dimensions of pile including drilled hole size, pipe size and pipe wall thickness, elevation of pile tip, length of pile, grout volume and volume factor, range of grouting pressure, grout temperature, reinforcing steel size and any other pertinent information.
- D. Welding (Shop and Field): Qualification of welding procedures, welders, and operators shall comply with requirements of AWS D1.1. Contractor shall keep records of test results of welding procedures and submit copies of each qualified welding operator to Resident Engineer for approval before starting welding.

3.2 DRILLING EQUIPMENT

- A. Unless otherwise directed, core drilling, rotary drilling, percussion drilling, auger drilling, driven casing or other acceptable means can be used. The mini-pile can be installed in the drill hole after drilling or it can be advanced by the drill.

3.3 STATIC PILE TESTS

- A. General: Static pile tests will be used to verify design pile lengths and to confirm design load capacity of piles.
 - 1. Furnish test piles 1500 mm (60 inches) longer than production piles.
 - 2. Actual length of piles will be based on results of static pile tests.

- B. Pile Tests: Arrange and perform the following pile tests:
 - 1. Axial Compressive Static Load Test: ASTM D1143.
 - 2. Axial Tension Static Load Test: ASTM D3689.
 - 3. Lateral Load Test: ASTM D3966.
- C. Equip each test pile with two telltale rods, according to ASTM D1143, for measuring deformation during load test.
- D. Drill test piles at locations indicated to a tip elevation below final cutoff elevation equal to pile length specified as basis of bid, or to refusal, whichever occurs first.
 - 1. Allow a minimum of seven days to elapse after driving test piles before starting pile testing.
- E. Provide pile reaction frame, anchor piles, equipment, and instrumentation with sufficient reaction capacity to perform tests. Notify Resident Engineer at least 48 hours in advance of performing tests. On completion of testing, remove testing structure, anchor piles, equipment, and instrumentation:
 - 1. Number of Test Piles: Two single piles, or as directed by Resident Engineer.
- F. Drilling Test Piles: Contractor shall use test piles of same size as proposed for use in work and shall drive with appropriate driving equipment operated at rated driving energy to be used in driving production piles.
- G. Test Pile Driving Records: Prepare driving records for each test pile, compiled and attested to by a qualified professional engineer. Include same data as required for driving records of permanent piles.
- H. Test piles that comply with requirements, including location tolerances, may be used at production pile locations.
- I. Contractor guarantees that should the test pile fail to give acceptable results, he will modify his design and install and test another pile at his expense. He also guarantees that he will repair or replace at his own expenses all structural damage caused by inability of his piles to support the working loads satisfactorily for a period of two years.

3.4 ALLOWABLE LOAD ON PILES

- A. The test load shall be applied in compliance with ASTM D 1143-81, Paragraph 5.6 Quick Pile Test. In essence the load shall be applied in intervals in increments of 20 percent of the anticipated working load to maximum of a least 200 percent of the working load. The maximum load

shall be maintained for 1 hour or until the settlement is less than or equal to 0.001 foot per hour. Load increments shall be maintained as applied as described in ASTM D 1143.81, Paragraph 5.4. Load increments shall be maintained as applied as described in ASTM D1143-81, Paragraph 5.4. Readings of settlements and rebounds shall be referred to a constant elevation benchmark and shall be recorded to 1/1000 of a foot for each increment or decrement of load.

- B. Following the 1-hour hold on the maximum load, the test piles shall be rebound as described in ASTM D 1143.81, Paragraph 6.2. Six settlement and rebounded readings shall be made in addition to the initial and final readings (total of 8) during each load or rebound cycle.
- C. The rebound curve shall be established by unloading in decrements of 75, 50, 25 and 10 percent of the total applied load.

3.5 INSTALLATION

- A. Drilled holes shall be a minimum of 2.5" larger in diameter than the specified pipe outside diameter, creating an annular grout space outside the pipe. Annular space outside of the pipe shall be 1.25" minimum thickness.
- B. Plumb leads and casing before drilling.
- C. Provide casing at drilled holes as necessary for drilling and to prevent water intrusion and/or caving of sidewalls of hole.
- D. Fit casing with cutting teeth as required to penetrate anticipated subsurface elements.
- E. Drill into partially weathered rock and hard rock strata to the specified tip elevation. Should a pile meet refusal at a tip elevation significantly above the tip elevation shown on the drawings, Architect/Structural Engineer may require an additional pile to be installed which may require revisions to the pile cap size and reinforcing steel. Do not proceed with pile cap construction until notified in writing by the Architect.
- F. Install pipe in center of completed hole. Pipe shall have grout holes along the full length to permit grout flow to annular space outside of the pipe.
- G. Install reinforcing steel in pile(s) as required by drawings. Center reinforcing steel and maintain required spacing by use of approved centralizers.

- H. Report any unusual occurrences observed during pile drilling and installation to the Geotechnical Engineer and Architect/Structural Engineer.
- I. Casing, if required, shall be slowly withdrawn in vertical direction (no rotation permitted) as pressure is applied to grout. Rate of extraction will be determined by field conditions.
- J. Check grout level periodically to insure grout level does not fall below bottom of casing. Grout pressure shall be lowered or eliminated as required near surface to prevent damage to existing structures.
- K. Installation, including drilling, of adjacent piles within 7'-6", or as otherwise approved by the Architect/Structural Engineer, of freshly grouted pile shall not be permitted while fresh grout is plastic and not hardened sufficiently to prevent damage by installation of additional piles. Minimum period to elapse between placement of adjacent piles as described above is 24 hours, but shall not operate to relieve the Contractor or Specialty Contractor from responsibility for maintaining integrity of completed piles.
- L. Grout Mixing: Use only approved continuous mixing, pumping and agitating equipment in preparation and handling of grout mix. Remove all oil or other rust inhibitors from mixing drums, stirring mechanism and other portions of equipment in contact with grout before mixers are used.
 - 1) Use screen no larger than $\frac{1}{4}$ " between mixer and pump or between mixer and agitator.
 - 2) Materials shall be accurately measured by volume or weight as they are fed into mixer. Order of placing materials into mixer shall be as follows: Water, Admixture, Other solids in order of increasing particle size
 - 3) Quantity of water used shall be such as to produce grout having a consistency in accordance with ASTM C91.
 - 4) Time of mixing shall not be less than one minute. If agitated continuously, grout may be held in mixer or agitator for a period not exceeding three (3) hours at temperatures below 70 degrees F. and for a period not exceeding two and one-half ($2\frac{1}{2}$) hours at temperatures below 90 degrees F. Maximum grout temperature not to exceed 90 degrees F.
- M. Pumping: Grout pump, pressure gage and other equipment for pumping of grout shall be as required by Specialty Contractor to insure sufficient

grout pressure and assist in determining volume of grout pumped into each pile.

- N. Volume of grout injected per pile shall be 1.40 times (minimum) calculated volume based on nominal pile diameter and actual depth drilled. Piles not meeting this requirement may be rejected, and if rejected, shall be re-drilled and re-grouted immediately. Re-drilling of an individual pile may be required or waived by the Geotechnical Engineer during installation of the production piles based on subsurface conditions at a specific location.
- O. If the installation process of a pile is interrupted or a loss of grouting pressure occurs, the pile shall be rejected, and re-drilled to the original depth and re-grouted, unless otherwise approved by the Geotechnical Engineer.
- P. Pile Tops: Temporary metal sleeves of the proper diameter shall be placed around the top of the pile to prevent contamination by foreign material. Length as required to seal off possible contaminants.
- Q. When the pile cutoff elevation is below existing ground surface, metal casing of proper diameter shall be placed around pile tops and extend above the existing ground surface. Casing shall prohibit loose material from falling onto the pile top.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified independent testing agency, approved by the Resident Engineer, to perform field quality-control testing.
- D. Weld Testing: In addition to visual inspection, welds shall be tested and inspected according to AWS D1.1 and the inspection procedures listed below, at testing agency's option. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
 - 1. Liquid Penetrant Inspection: ASTM E165.
 - 2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Radiographic Inspection: ASTM E94, minimum quality level "2-2T."
 - 4. Ultrasonic Inspection: ASTM E164.

Expand/Repair Intensive Care Unit, Step Down Unit and Pulmonary VA #534-325
Ralph H. Johnson VA Medical Center
Charleston, SC HDG #13026

3.7 DISPOSAL

Remove withdrawn piles and cutoff sections of piles from site and legally
dispose of them off Owner's property.

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