SECTION 02455

DRIVEN PILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials, equipment and procedures for driving steel piles.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete

B. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

B. ASTM A 252: Welded and Seamless Steel Pipe Piles

C. ANSI/AASHTO/AWS D 1.1

1.4 SUBMITTALS

A. Complete and submit the "Pile and Driving Equipment Data" form located at the end of this Section.
   1. The Department uses this information to perform a pile driving wave equation analysis.
   2. Within 14 calendar days after submitting the form, the Engineer provides either:
      a. Approval to continue
      b. Notification of inadequate equipment

3. Mobilize pile driver to the site only after the Engineer indicates that acceptable results of the wave equation analysis have been obtained.
4. Remove pile hammer and other related equipment found to be inadequate for the project pile driving conditions and re-mobilize another hammer at no cost to the Department.
5. Provide accurate test information regarding the yield stress values for each batch (heat) of piles to be used on the project.

1.5 ACCEPTANCE

A. Driven piles may be accepted at a reduced price when the concrete strength is below that specified.
   1. Price adjustment pay factor following Section 03055.
   2. Sixty-five dollars per cubic yard will be used in the price reduction determination.
   3. The computed lump sum pay reduction will be subtracted from the payment for this item.

PART 2 PRODUCTS

2.1 PIPE PILE SHELLS

A. Use new pipe pile shells having wall thickness as shown on plans.

B. Meet requirements for ASTM A 252 steel, for either Grade 2 (normal strength) or Grade 3 (high strength) steel, or for other minimum yield stress values shown on the plans.

2.2 "H" PILES

A. As specified on the plans.

2.3 PORTLAND CEMENT CONCRETE

A. Class A Concrete following Section 03055.

2.4 REINFORCING STEEL

A. Meet AASHTO M 31, Grade 60.

B. Refer to Section 03211.

2.5 PILE DRIVER

A. Equip pile driver following manufacturer's recommendations.

B. Leads:
   1. Used with all types of hammers.
   2. Free moving.
   3. Hold in the required position with guys, stiff braces, or both. Hold the pile parallel to the leads.
   4. Accommodate the maximum length of the pile segment, and extend to the lowest point that the hammer must reach. Obtain approval from the Engineer before using followers.

C. Driving Head: Fits the top of pile and provides full bearing.

D. Hammer:
   1. With fully-operable adjustable settings.
   2. Rated energy as much or greater than the value indicated on the foundation plans.
   3. Install a new hammer cushion before beginning pile driving.
      a. Inspect the hammer cushion with the Engineer present after completing 100 hours of pile driving.
      b. Replace the cushion when it loses 25 percent or more of its original thickness.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete all foundation excavation before driving piles. Dewater excavation a minimum of 3 feet below bottom of footing at all times during pile driving.

B. Compare designated position of piles with the locations of existing piles from previous construction, existing utilities, old foundations, and other potential conflicts. Notify the Engineer of any conflicts. The Engineer designates new pile locations as required to resolve conflicts with locations of existing piles or other conflicts.

3.2 DYNAMIC ANALYSIS

A. Notify the Engineer at least two working days before pile driving is to commence on the project, and at least two working days before piles are to be driven on all subsequent abutment, bent, or pier foundations.

B. The Department performs dynamic testing using a Pile Driving Analyzer (PDA), during the driving of the initial pile at each abutment and bent location. Additional piles may be monitored by the Department if driving conditions warrant.

C. Cooperate fully with the Department in the conducting of PDA including, but not limited to, the following:

1. Provide adequate space and conditions for the PDA rig and equipment.
2. Climb the driver leads as necessary to attach, check and remove PDA gauges; or provide a platform at least 4 feet square with a 4 feet high safety rail, equipped to be raised to the top of the pile located in the leads, to allow Department personnel to safely attach and remove the gauges.
3. Begin installation of instrumentation after placing the pile in the leads. Allow approximately one hour per pile for installation of dynamic measuring equipment. Allow one additional hour for installation of measuring equipment after splicing, if splicing is performed.
4. Reduce the energy of the hammer and/or make other adjustments as necessary, if the stress exceeds the specified limit.
5. Drive piles to the required resistance as determined by the Department to obtain the specified ultimate loads, unless otherwise indicated by the Department.
6. Where required by the Department, re-strike the PDA-tested pile after a sufficient time period (at least 24 hours or more after the initial driving of the pile). Do not perform re-strikes using a cold hammer. If a re-strike is to be performed after the hammer has not been used for over two hours, operate the hammer first on another pile for at least 200 blows before performing the PDA re-strike.

D. The Department must approve the PDA results before pile driving proceeds for the remaining piles. The Department may revise the pile driving criteria during the dynamic test pile driving period, including re-establishing required pile tip elevations.

E. Allow for the Department or PDA firm to conduct one analysis per foundation (abutment or bent), of the Case Pile Wave Analysis Program (CAPWAP) from the PDA testing. Suspend pile driving on the foundation until the CAPWAP results are presented and the Engineer gives notice that results indicate sufficient capacity has been obtained.

3.3 INSTALLATION

A. Pre-drill/pre-auger if the designated pile tip elevation cannot be reached by the approved pile driver. Do not drill holes greater in diameter than the diameter or other maximum dimension of the pile.

B. Pile Splicing:
   1. Butt weld the entire pile cross section using full penetration welds as per ANSI/AASHTO/AWS D.1.1.
   2. Use no more than one spliced section less than 6 ft, and splice no other section less than 30 ft for any pile.
   3. Inspect the driven pile section before splicing any pile section to determine if it has been distorted from its original shape, or otherwise damaged from pile driving operations. Remove the damaged portion where distortion/damage has occurred, before splicing the next segment.

C. Keep driven piles within 6 inches of the designated position and keep exposed portion of the pile within 1/4 inch/feet from vertical (or from direction otherwise shown for battered piles). Before proceeding with backfilling or other associated foundation work, verify that the criteria have been met at the ground surface at the end of pile driving. If either requirement is not met, contact the Engineer to determine the appropriate resolution. The Contractor bears all costs for any measures required to resolve the non-conformance.

D. Drive additional piles at locations designated by the Engineer when replacing damaged piles and/or piles driven out of position and/or alignment as specified above.

E. Drive down piles that were raised because of driving adjacent piles.

F. Engineer evaluates the possible damage to piles from water collecting in open pipe piles. Drive additional piles as determined by the Engineer to resolve concerns with any such pile damage.

G. Remove all loose, displaced, and foreign materials from around the completed piles leaving clean, solid surfaces to receive the concrete.

H. Cutting and capping piles:
   1. Remove all damaged material from the top of the pile.
   2. Keep the sides of piles at least 9 inches away from the nearest edge of footing.
   3. Cut off piles with clean, straight-line cuts to the designated elevation at a right angle to the pile axis. Level all irregularities before placing concrete pile cap.

I. Receive approval from Engineer prior to concrete placement.

J. Embed the tops of piles in the concrete pile cap as shown on the plans.

3.4 CONCRETE FILLING OF PIPE PILES

A. Fill pipe piles with specified concrete shown on drawings, after compliance with all tolerances and required criteria have been established.

B. Prior to filling pipe shell, fill any annular space between the pipe shell and the surrounding soil with grout or clean sand washed down to reestablish lateral support.

C. Avoid segregation of the concrete ingredients.

D. Slump at the time of placement: between 4 and 6 inches.

E. Arrange chutes, pipes, etc. used as aids in placing concrete so concrete does not separate (i.e. flows freely without having to be pushed or shoveled).

F. Place concrete in pipe shell either by free fall or through a tremie or concrete pump.

G. Concrete placed by free-fall falls directly to the base without contacting either the rebar cage or the pipe wall. Use drop chutes or tremie as necessary to achieve this.

H. Do not chute concrete directly into hole.

I. If a hopper or concrete bucket is used, do not discharge concrete directly from the mixer into the hopper or bucket; discharge concrete into a funnel-type downpipe centered over the hopper or bucket.

J. Use high frequency internal vibrators to densify concrete to at least 3 feet below the bottom of the rebar cage, or to at least 12 feet below the pile cutoff level, whichever is deeper.

K. Do not allow vibrators to penetrate concrete that has taken initial set.

L. If concrete placement is to occur after daylight hours, light the work site so all operations are plainly visible.

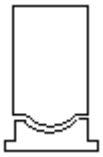
END OF SECTION

A “Pile and Driving Equipment Data” form follows

Sheet # _____

Pile and Driving Equipment Data

Project No: _____
Project Name: _____ County: _____
Drawing No: _____
General Contractor:_____
Pile Driving Contractor/Subcontractor: _____
Phone: _____ FAX: _____
(Piles driven by, foreman): _____
Date Submitted: _____

		**Hammer**	Manufacturer: _____ Model: _____ Type: _____ Serial No: _____ Manufacturer's Maximum Rated Energy: _____(ft-lb) Stroke at Maximum Rated Energy: _____(ft) Range in Operating Energy: ____ to ____(ft-lb) Range in Operating Stroke: ____ to ____(ft) Modifications: _____ _____
		Ram	Ram Weight: _____ (lb) Ram Length: _____(ft) (for diesel hammers)
		Anvil	Ram Cross Sectional Area: _____(in^2) (With diesel hammers) Anvil Weight: _____(lb)
		**Hammer Cushion**	Material #1 / Material #2 Name: _____ _____ Area: _____ _____ (in^2) No. of Plates: _____ _____ Thickness: _____ _____ (in) Mod. of Elasticity - E: _____ _____ (psi) Coeff. of Restitution - e:_____ _____