

SECTION 510 CAST IN PLACE CONCRETE PILING

510.1 Description

- (1) This section describes furnishing, driving, pre boring if required, splicing if necessary, cutting off and painting if necessary, metal piling shells; furnishing, placing, curing and protecting the concrete cores within the shells; and placing the bar steel reinforcement in the top of the cast in place concrete trestle piling or cast in place concrete foundation piling.
- (2) This section also describes pile redriving in non-granular soils.

510.2 Materials

510.2.1 General

- (1) Furnish materials conforming to the following:
 - Concrete section 501
 - Steel reinforcement..... section 505
- (2) Construct the concrete cores using grade A, A-FA, A-S, A-T, A-IS, or A-IP conforming to 501.2.

510.2.2 Steel Pile Shells

510.2.2.1 General

- (1) Ensure that the steel pile have the outside diameter at the butt the plans show. Ensure they are cylindrical or tapered; are the spiral welded, straight-seam welded, or the seamless tube type and have a minimum nominal shell thickness of 0.219 inches (5.56 mm); or are fluted steel shells having a minimum shell thickness of at least 0.179 inches (4.55 mm), unless the plans show otherwise, or the special provisions specify otherwise.
- (2) All pile shells shall have sufficient strength and rigidity to withstand driving to the required penetration and bearing. Unless the plans show or the contract specifies otherwise, equip all pile shells with engineer-approved conical driving points or attached plate ends.
- (3) Plates shall have a minimum thickness of 3/4 inch (19 mm) unless the plans show otherwise, and the plate diameter shall not exceed the outside diameter of the piles by more than 3/4 inch (19 mm).
- (4) Use only one type of pile throughout a structure unless the engineer allows otherwise.
- (5) Paint the portion of the steel pile shells exposed in the completed work according to 511.3.5.

510.2.2.2 Material Requirements

510.2.2.2.1 Cylindrical Type

- (1) Make the pile shells from steel conforming to ASTM A 252, grade 2, or an engineer-approved alternate.

510.2.2.2.2 Tapered, Fluted Type

- (1) The material in the pile shell shall conform to SAE Steel Specifications and have the following chemical ranges and limits:

CONSTITUENT	PERCENT
Carbon.....	0.08-0.13
Manganese.....	0.30-0.60
Sulfur	0.05 maximum
Phosphorus	0.04 maximum
- (2) The minimum tensile yield strength of the steel in the fabricated pile shall equal 50 000 pounds per square inch (344.8 MPa).

510.2.2.3 Sampling and Testing

- (1) Unless the contract requires otherwise, the contractor shall submit to the engineer at the time of pile shells delivery a manufacturer's certified report of test or analysis showing the pile shells conform to the above requirements. The delivered shells shall bear markings identifying them with the applicable test report or, in the absence of this identification; certify that the delivered shells are from the same lot the test report represents.

510.3 Construction

510.3.1 Ordering Pile Shells

- (1) The estimated lengths of piling the plans show are approximate only and were determined for design and estimating purposes from a few soil soundings taken at the site. The contractor shall furnish cast in place piles of sufficient lengths to obtain the required penetration and specified bearing for each pile.

510.3.2 Shell Lengths and Splices

- (1) Unless the contract requires otherwise, and except for piling made, with the engineer's permission, from cutoffs, furnish all steel shells for cast in place concrete piling up to 50 feet (15 m) in length with not more than 3 shop or field welded splices. Furnish pile shells over 50 feet (15 m) in length with not more than 4 shop or field welded splices.
- (2) Weld all splices in piles as specified for welding in 506.3.19.1 and as the plans show. Perform all welding using skilled welders conforming to 506.3.19.1.

510.3.3 Equipment for Driving

- (1) Use equipment to drive metal shells for trestle piling or foundation piling conforming to the equipment requirements in 508.3.3.

510.3.4 Driving

510.3.4.1 General

- (1) Except as specified otherwise, use the following to drive the piling: a gravity hammer, if allowed; single-acting hammer (air or steam); double-acting hammer (air or steam); differential-acting hammer (air or steam); diesel hammer; or with a combination of water jet and hammer.
- (2) Drive the pile shells with a variation of not more than 1/4 inch per foot (6 mm per 300 mm) from the vertical or from the batter the plans show. Except, drive the piles for trestle bents so placing the cap in its proper location does not induce excessive stress in the piles and the piles in each row appear aligned. Ensure the foundation piles are within 6 inches (150 mm) of the position the plans show after driving.
- (3) Do not drive any metal pile shells for a substructure unit until completing the excavation for that unit.
- (4) Coordinate the pile driving and concrete placement operations so that no damage or displacement to concrete occurs in any substructure unit because of pile driving operations in any other unit.
- (5) Drive down all foundation or trestle piles raised by the driving of adjacent piles if the engineer directs.
- (6) Perform pile driving continuously to the required bearing, unless the engineer approves discontinuous driving. The engineer may review discontinuous driving at the end of the initial driving. Perform subsequent driving as the engineer directs. For the purposes of this subsection, define discontinuous driving as an interruption to the driving of a pile lasting 3 hours or more.
- (7) Drive piles in a cluster circumferentially, starting at the inside of the cluster and proceeding toward the outside.
- (8) Protect the top of the metal pile shell being driven from damage by using a suitable driving head.
- (9) After driving, keep the shells watertight until placing concrete in the shell.
- (10) Remove and replace all shells that suffer breaks, bends, or kinks that result from handling or driving, or are damaged due to internal defects and that in the engineer's judgment are unsuitable for use, at no expense to the department. Instead of removing and replacing, at the engineer's option the contractor may drive a second pile adjacent to the damaged pile, if this can be done without detriment to the structure.
- (11) Make available a suitable light for inspecting the entire interior of the driven shell before placing concrete in the shell.
- (12) If possible drive all pile shells required for a given substructure unit before placing concrete in any of the shells in the unit. Do not drive pile shells within a 15-foot (5 m) radius of any concrete filled pile shell, until the concrete cures for at least 7 days, or 3 days if using high early strength concrete. Except that if using grade A-FA, A-S, A-T, A-IS, or A-IP concrete in the work, and field operations are not controlled by cylinder tests, then increase the time to 14 days. If controlling field operations by cylinder tests, proceed driving the pile shells as described, with the engineer's approval, if cylinder tests show a compressive strength of not less than 2500 pounds per square inch (17.3 MPa), determined as specified under falsework removal in 502.3.4.2.

- (13) Do not drive any pile shell after filling the shell with concrete.

510.3.4.2 Bearing Value

- (1) Drive the shells for cast in place concrete piling to a bearing value not less than that the plans show.
- (2) Unless specified otherwise in the contract, determine the bearing value of each individual pile shell as specified in section 508 for timber piling.
- (3) Under the Pile Redriving bid item, drive one piling in each substructure unit to plan length unless the required bearing is obtained by piling bearing formula at a shorter length. If the bearing is not obtained in the plan length, allow the piling to set up for 48 hours; then re-tap. Determine the bearing capacity using the first 10 blows of the hammer. If bearing is still not obtained, splice additional length to the piling, drive the piling an additional 10 feet (3 m) or to the depth the engineer directs, and repeat the 48-hour set up and retapping process. Add more length and repeat this entire process until the required bearing is obtained. After obtaining the required bearing, drive other piling in the substructure to the same tip elevation.

510.3.4.3 Penetration

- (1) Drive the shells for cast in place concrete piling to the minimum penetration specified in section 508 for timber piling. The engineer may require preboring to achieve minimum penetration

510.3.4.4 Cutting Off Shells

- (1) After driving the metal shell and before placing the concrete core inside, cut the shell off at the elevation the plans show using a saw or cutting torch.
- (2) The contractor may splice and extend with suitable cutoffs delivered, or driven lengths of steel pile shells, if necessary.
- (3) The engineer may allow the contractor to produce pile lengths by splicing together suitable cutoffs, except do not use cutoffs less than 5 feet (1.5 m) in length to fabricate piling.
- (4) All pile shell cutoffs are the contractor's property. Dispose of any cutoffs not used in the work.

510.3.4.5 Prebored Holes

- (1) If the plans or contract special provisions require prebored holes, make them the length or depth the plans show. Unless directed otherwise, make the diameter of the hole approximately the same as the diameter of the pile. Backfill bored holes through roadway embankments that exceed the diameter of the piling with sand after driving the piling.

510.3.5 Concrete Cores

- (1) Except as specified in this subsection, conform to section 501 for concrete core placement, protection and curing.
- (2) Remove any accumulated water or other foreign material from inside the shell before placing the concrete inside.
- (3) After the engineer inspects and approves the pile shells, deposit the concrete in each shell in one continuous operation, in a manner, and at a rate, that causes no air pockets. There is no requirement to use a tremie or downspout within the shell. Fill the shell completely with concrete and compact with a mechanical vibrator, or by other methods that satisfy the engineer, for as great a depth below the top as is possible.
- (4) Place steel reinforcement in the concrete core as the plans show and ensure it is in place when the level of concrete placement reaches the lower limits of the reinforcement.
- (5) Do not place concrete in shells that are within a 15 feet (5 m) radius of driving other shells. If necessary to place concrete within the above limits, cease driving operations and resume after the concrete cures for at least 7 days, or 3 days if using high early strength concrete. Except, if using grade A-FA, A-S, A-T, A-IS, or A-IP concrete and field operations are not controlled by cylinder tests, increase the time to 14 days. If field operations are controlled by cylinder tests, proceed with driving pile shells, with the engineer's approval, if cylinder tests show a compressive test of not less than 2500 pounds per square inch (17.3 MPa), determined as specified under falsework removal in 502.3.4.2.

510.3.6 Painting

- (1) Paint portions of the completed trestle or other exposed piling as specified for steel piling in 511.3.5.

510.4 Measurement

- (1) The department will measure holes the plans show or the special provisions specify as prebored by the linear foot acceptably completed, measured as the depth of the hole.
- (2) The department will measure the Piling CIP Concrete Delivered and Driven bid items by the linear foot acceptably completed. The measured quantity equals the sum of the lengths of piling delivered, driven, and left in place below cutoff.
- (3) The department will measure Pile Redriving as each individual substructure acceptably completed, measured as one 48-hour setoff and re-driving of one piling per substructure.

510.5 Payment

510.5.1 General

- (1) The department will pay for measured quantities at the contract unit price under the following bid items:

<u>ITEM NUMBER</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
510.2005	Preboring CIP Concrete Piling	LF
510.3000 - 3099	Piling CIP Concrete Delivered and Driven (inch)	LF
510.5000	Pile Redriving	EACH

- (2) If the engineer requires preboring, but the contract does not contain the Preboring CIP Concrete Piling bid item, the department will pay for preboring as extra work.

510.5.2 Preboring Cast In Place Concrete Piling

- (1) Payment for Preboring CIP Concrete Piling is full compensation for boring; for providing and placing necessary backfill material; and for disposing of all material excavated by boring.

510.5.3 Cast In Place Concrete Piling Delivered and Driven

- (1) Payment for the Piling CIP Concrete Delivered and Driven bid items is full compensation for fabricating, furnishing, and delivering acceptable pile shells; for preparing, driving, splicing, and cutting off metal shells; for disposing of cutoffs not used; for painting if required; and for providing, placing, curing and protecting the concrete cores.
- (2) The department will pay an amount equivalent to the contract price for 6 feet of Piling CIP Concrete Delivered and Driven for field splices. The department will pay for one splice per pile under the Splices CIP Piling administrative item. The department will only pay for splices meeting the following conditions:
 1. The contractor can not get the plan bearing capacity in the length the plans show.
 2. The contractor actually splices the pile.
 3. The spliced pile is acceptably driven to the plan bearing capacity.
- (3) The department will pay separately for steel reinforcement incorporated in the concrete core under the applicable section 505 bid item as specified in 505.5.
- (4) The department will not pay separately or additionally for providing a pile shell fabricated from cutoffs, as allowed under 510.3.4.4, or for providing and attaching the conical point or end plate to that fabricated shell.

510.5.4 Pile Redriving

- (1) Payment for Pile Redriving is full compensation for time delays, extra movement of equipment, and re-tapping one piling per substructure.