

## SECTION 152

### CONCRETE PILES

#### 152.1 GENERAL

Four types of concrete piles are covered by these specifications; namely, precast piles, cast-in-place piles, prestressed piles, and centrifugal cast piles. The type to be used or furnished shall be as indicated on the drawings or specified in the Supplementary Specifications. The manufacture of prestressed piles shall be performed in accordance with Section 502. Driving of pile shall conform to Section 502.

#### 152.2 REFERENCES

##### 152.2.1 ASTM

A 252

C 31

##### 152.2.2 This publication

SECTION 101

SECTION 102

SECTION 502

SECTION 512

#### 152.3 PRECAST PILES

152.3.1 Precast concrete piles shall be constructed of concrete of such quality that the finished piles can be handled and driven to required bearing without cracking or other damage which would impair their strength or durability. Concrete shall have a strength at 28 days of not less than 4,000 pounds per square inch in compression and shall be mixed and proportioned in accordance with the requirements of Section 101 with a minimum cement content of 6.5 sacks per cubic yard. Reinforcing steel placed therein shall conform to the requirements of Section 102.

152.3.2 Concrete for precast concrete piles shall be poured in smooth, mortar-tight forms so supported as to prevent appreciable deformation or settlement during pouring or curing. The piles after being poured shall be cured by water curing, steam curing, application of curing compound, or such other method of curing as may be approved by the ENGINEER. Curing shall be continued until specimens of the concrete from which the piles were poured, cured in the same manner as the piles, attain a compressive strength of at least 4,000 pounds per square inch. Piles shall not be driven until completion of the curing.

152.3.3 Upon completion, the piles shall present true, smooth, even surfaces, free from honeycombs or voids and shall be sufficiently straight that a line stretched from butt to tip along any face will not deviate therefrom nor be deflected more than 1 inch in 50 feet at any point. Repaired defects in any pile may be accepted by the ENGINEER if repaired to his satisfaction.

152.3.4 If dowel extensions are required, the piles may be cast the full length of the reinforcing rods provided that the tops are cut off after driving to expose the ends of the rods as specified or indicated by the drawings.

152.3.5 Precast piles must at all times be so handled as to avoid and prevent cracking, breaking, or chipping the edges thereof. Slings shall be provided at or near the quarter points for raising and transporting long piles.

#### 152.4 CAST-IN-PLACE CONCRETE PILES

##### 152.4.1 METAL CASED CAST-IN-PLACE CONCRETE PILES:

152.4.1.1 Concrete shall have a minimum strength at 28 days of 3,000 pounds per square inch in compression and shall be Mixed and proportioned in accordance with the requirements of Section 101. Reinforcing steel placed therein shall conform to the requirements of Section 102.

152.4.1.2 Piles shall be cast in steel shells that have been previously driven to the penetration and bearing value specified or indicated on the drawings.

152.4.1.3 The sheet shall be cylindrical, fluted, step-tapered, or uniformly tapered from butt to tip.

152.4.1.4 The shells shall be of such material and construction as to properly and satisfactorily serve the intended purpose. Those that are driven without a mandrel shall be constructed of material conforming to the requirements prescribed in ASTM A 252, Grade 2, being of sufficient thickness, strength, and rigidity to withstand distortion as a consequence of driving, soil pressure, or the driving of adjacent piles.

152.4.1.5 After being driven but prior to placing of the reinforcing steel and concrete, the shells shall be examined for collapse or reduced diameter at any point, the CONTRACTOR being required to provide and have available at all times a suitable light for the inspection of the shell throughout the entire length thereof. Shells that are improperly driven or are broken or show partial collapse will not be accepted and shall be replaced by and at the expense of the CONTRACTOR. Driven shells shall be clean and free of water before reinforcing steel and concrete is placed therein. The replacement of the shell shall be made by withdrawing the entire shell and driving another in its place. Driving one shell within a shell already driven will not be permitted. If the withdrawal of the defective shell is impossible or impracticable as decided by the ENGINEER, the CONTRACTOR shall fill the defective shell with concrete and shall replace the defective pile with another pile driven alongside. Any enlargement of the footing required to accommodate such piling shall be at the expense of the CONTRACTOR. Partial collapse of pile shells shall be interpreted to mean any collapse which reduces any diameter of the shell at any point in its length to less than 80 percent of the original diameter at such point, and such partial collapse shall be cause for rejection.

#### 152.4.2 CAST IN DRILLED HOLE PILES:

152.4.2.1 All holes for concrete piles cast in drilled holes shall be drilled dry to the tip elevations shown on the plans or to the elevations determined by the ENGINEER. All holes shall be examined for straightness and any hole which on visual inspection from the top shows less than 1/2 of the diameter of the hole at the bottom of the hole shall be rejected. Suitable casings shall be furnished and placed when required to prevent caving of the hole before concrete is placed therein.

152.4.2.2 All loose material existing at the bottom of the hole after drilling operations have been completed shall be removed before placing concrete in the hole.

152.4.2.3 The use of water for drilling operations or for any other purpose where it may enter the hole will not be permitted. Surface water shall not be permitted to enter the hole and all water which may have infiltrated into the hole shall be removed before placing concrete therein.

152.4.2.4 Casing, if used in drilling operations, shall be removed from the hole as concrete is placed therein. The bottom of the casing shall be maintained not more than 5 feet nor less than 1 foot

below the top of the concrete during withdrawal and placing operations, unless otherwise permitted by the ENGINEER. Separation of the concrete during withdrawal operations shall be avoided by hammering or otherwise vibrating the casing.

152.4.2.5 Care shall be exercised to insure that the concrete in the hole is dense and homogeneous. Vibration of the concrete during placing will not be required, however, rodding may be required. After the hole has been filled with concrete, the concrete at the top 10 feet of the hole or for the length of the reinforcing, whichever is the greater, shall be vibrated.

152.4.2.6 The reinforcing cage shall be placed and secured symmetrically about the axis of the pile and shall be securely blocked to clear the sides of the hole.

#### 152.5 PRESTRESSED CONCRETE PILES

##### 152.5.1 MATERIAL:

152.5.1.1 Piles shall be homogeneous, high strength concrete from head to tip, stressed with high tensile cold drawn strands. Piles of cross section differing from the section shown on the drawings for bearing piles may be accepted by the ENGINEER provided the surface area, sectional area, bending resistance, and prestress are equivalent to that indicated.

152.5.1.2 Bearing piles showing defects when forms are stripped in the upper 10 feet of the pile which reduce the cover over the steel to less than required will be rejected. Defects in the remainder of the pile may be repaired and the pile accepted if repaired in a manner satisfactory to the ENGINEER.

152.5.1.3 Upon completion, the piles shall present true, smooth, even surfaces, free from honeycombs or voids and shall be sufficiently straight that a line stretched from butt to tip along any face will not deviate therefrom nor be deflected more than 1 inch in 50 feet at any point. Defects in any pile may be repaired and the pile accepted by the ENGINEER if repaired to his satisfaction.

##### 152.5.2 HANDLING

152.5.2.1 Piles may be removed from the prestressing bed for transportation or storage after the concrete has reached a compressive strength of 3,500 pounds per square inch, but they shall not be driven until they have attained a minimum compressive strength of 5,000 pounds per square inch as determined by tests on concrete cylinders cast and

cured under the same conditions as the piles. The compressive strength test specimens shall be made in accordance with ASTM C 31 at no additional cost to the OWNER.

152.5.2.2 Lifting shall be only at predetermined points of pickup and in such a manner as to avoid cracking, spalling, excessive bending, or other injurious results.

## 152.6 CENTRIFUGAL CAST CONCRETE PILES

152.6.1 Materials shall conform to the requirements of Section 101 unless otherwise specified in the Supplementary Specifications. Concrete casings shall be manufactured by the centrifugal process. They shall be formed and compacted by centrifugal force in a machine of suitable type so designed that the casing molds may be revolved without harmful vibration at sufficient speeds to insure even distribution and dense packing of the concrete true design.

152.6.2 Filling of the mold and spinning shall be a continuous operation, and the spinning shall take place before any of the concrete in the mold has taken an initial set.

152.6.3 When filled, the mold shall be placed on the spinning machine in a horizontal position and rotated at a gradually increasing speed until maximum rotation is attained. Excess water and laitance forced to the center of the mass shall be drained or expelled in a suitable manner.

152.6.4 The concrete casing shall not be removed from the mold until the concrete has attained sufficient strength to prevent deformation. The casing shall be cast full length in one piece and the finished casing shall have a wall thickness not less than the thickness shown on the plans.

152.6.5 The casing shall be reinforced in accordance with the details shown on the plans. Prior to spinning the casing, each longitudinal bar shall be prestressed to a value of 10,000 pounds per bar and such prestresses shall be maintained in each bar until after the concrete has set.

152.6.6 The proportion of Portland cement in the concrete mixture for the casings shall not be less than 6 sacks per cubic yard of concrete. The concrete aggregate shall be so graded and proportioned and thoroughly mixed in a batch mixer with such proportions of cement and water as will produce a homogeneous concrete mixture of such quality that the resulting casing shall be of sufficient

strength to resist the stresses resulting from handling and driving without cracking or other damage which would impair its strength or durability.

152.6.7 Following removal from the molds, the finished casings shall be cured for such period of time as may be necessary to produce a strength satisfactory for handling and driving. Curing may be any of the following methods:

152.6.7.1 Continuous spraying with water for at least 72 hours.

152.6.7.2 Covering with heavy burlap or other suitable material which is kept saturated with water for at least 72 hours.

152.6.7.3 Steam Curing--The manufacturer shall provide adequate facilities for curing the piles including a suitable enclosure. Humidity in the enclosure shall be provided to keep the surfaces of the piles moist at all times and the temperature shall be maintained continuously between 120 degrees F and 170 degrees F. Piles shall be cured for not less than 30 hours and for a longer time when so directed by the ENGINEER.

## 152.7 MEASUREMENT AND PAYMENT

Measurement shall be by the linear foot in place to the specified cut-off point. Payment shall be made at the unit price per linear foot.