ITEM 507 BEARING PILES

507.01 Description. This work consists of furnishing and driving bearing piles.

507.02 General. Install piles of the specified type, length, and sizes shown on the plans. Furnish the piles according to the itemized order list shown on the plans. If additional length is needed to obtain bearing, furnish the additional length as determined by the Engineer. The length of the piles given in the order list is not necessarily based on available or practical lengths, but the estimated length from the bottom of each pile to the elevation of the cutoff. The Contractor may increase or decrease the pile lengths to suit the lengths available, to facilitate the method of operation, which may involve providing fresh heading as a result of hammer misalignment or a worn hammer cushion, or to provide lengths determined practical to have delivered to the project site and driven.

507.03 Materials. Furnish materials conforming to the following:

Reinforcing steel	509
Concrete, Class C	511
Chemical admixture for concrete, Type F	705.12
Steel H-piles	711.03
Steel pile points	711.01 or 711.07
Steel for reinforced concrete piles	711.03
Galvanized steel	711.02
Timber	711.26

Provide a concrete slump from 6 to 8 inches (150 to 200 mm) with the use of a superplasticizer.

507.04 Driving of Piles. Drive piles to refusal on bedrock; until obtaining the required ultimate bearing value, which may include a modification for scour, set-up, or negative skin friction; or to the minimum penetration pile tip elevation shown on the plans.

If piles begin to crush, immediately cease driving and repair or replace the pile. The counting of blows will cease until the crushed pile is either repaired or replaced.

For piles subject to scour, notify the Engineer if the required ultimate bearing value is obtained before the pile has penetrated 80 percent of its estimated depth before

appreciably overdriving the pile. The Engineer will study the conditions and determine the final penetration, the driving requirements, the use of another pile type, and the use of prebored holes.

All piles raised during the driving of adjacent piles shall be driven down again.

Use a hammer that will achieve the required ultimate bearing value for the pile and large enough to permit a dynamic load test to verify that the ultimate bearing capacity shown on the plans can be achieved.

The ram of an air-operated or diesel hammer shall weigh at least 2700 pounds (12,000 N).

The ram of a drop hammer for permanent piles shall weigh at least 3000 pounds (13,300 N). The height of fall for drop hammers shall not exceed 7 feet (2.1 m). Do not use drop hammers to drive piles that are to be driven to an ultimate bearing value in excess of 70 tons (620 kN).

When using open ended diesel hammers, provide equipment for the Engineer's use to accurately measure each stroke within 6 inches (150 mm).

Attach a gage to closed end diesel hammers, accessible to the Engineer, to monitor the pressure in the bounce chamber. Include a graph with the gage to convert pressure to energy.

Attach an impact energy monitor, or a method to accurately measure the stroke within 2 inches (50 mm) to hydraulic hammers, accessible to the Engineer, to monitor the energy of each blow.

Use securely anchored driving leads and a cap device with sliding jaws to engage the leads to guide the pile and maintain the pile alignment with the stroke of the hammer. Accurately align the travel of the hammer with the axis of the pile.

Cushion the hammer and pile to prevent the impact of driving forces from damaging the top of the pile. Shape the cap and pile top to uniformly distribute the hammer blow to the top surface of the pile.

Do not use a follower unless approved by the Engineer. If the Engineer does approve the use of a follower, account for the increased energy loss when determining the required driving criteria.

If a static load test is required, the Contractor may not drive piles except the test and anchor piles before conducting the test and the required depth of penetration has been determined.

Do not use water jets.

After being driven, cut off the piles at the elevation and angle shown on the plans. Ensure that the actual pile embedment into the concrete is within 2 inches (50mm) of the embedment shown in the plans.

507.05 Determination of Required Driving Criteria. Determine the required driving criteria to achieve the ultimate bearing value of a driven pile as if the pile was a single isolated pile using the results of dynamic pile testing as specified in Item 523. The driving criteria may consist of a minimum blow count with a minimum hammer stroke, a minimum depth of penetration, or both.

507.06 Cast-in-Place Reinforced Concrete Piles. Provide cast-in-place reinforced concrete piles conforming to one or more of the types described below. Measure the pile diameter as follows:

A. Plain cylindrical casing, the outside diameter.

B. Cylindrical casings with vertical fluting, the diameter of a circle circumscribing the outermost points or ridges.

C. Cylindrical casing with circumferential corrugations, the average of the outside diameters measured at the bottom and top of the corrugations or continuously welded helical corrugations with diameters measured at tops of the corrugations.

D. Tapered piles, the top diameter as determined in 507.06.A, 507.06.B, or 507.06.C, but the pile tip diameter shall not be less than 8 inches (200 mm).

Ensure that the pile casings are watertight after being driven. If furnished, shoes or points shall not project more than 1/4 inch (6 mm) outside the vertical surface of the casing.

For plain cylindrical casings, the minimum pile wall thickness, t, is the greater of either 0.250 inches (6.66 mm) or the thickness determined using the following formula:

$$t\,(\text{in inches}) = \frac{R}{900{,}000} \qquad \left(t\,(\text{in mm}) = \frac{R}{157606} \right)$$

Where:

R = Ultimate bearing value in pounds (newtons) corresponding with the ultimate bearing capacity as shown on the plans

For fluted piles, the minimum pile wall thickness shall be t/1.4.

For cast-in-place piles containing reinforcing steel, place reinforcing steel as stated in the second and third paragraph of 524.09 and place concrete per 524.11.

After installation, cover the tops of driven casings until the concrete is placed. Before placing concrete, remove accumulated water or other foreign matter in a driven casing. Maintain a minimum radius of 15 feet (4.5 m) between simultaneous work of placing concrete and driving pile casings. If concrete is placed within the 15-foot (4.5 m) radius, suspend driving operations until the concrete has cured for 5 days. Place concrete for cast-in-place piles using methods that prevent voids, however, do not vibrate the concrete.

507.07 Steel H-Piles. Steel H-piles shall consist of structural steel shapes of the kind and size specified.

The Engineer may allow installation of steel piles of the specified type, which the Contractor has from previous projects or stock, if the Contractor furnishes mill certifications and the pile sections are identified with the material specification number, grade, and heat number. This identification may be in the form of information painted on the steel piles or a tag physically attached to the steel.

507.08 Timber Piles. Provide timber piles of sufficient length to remove broomed or split portions caused by driving. Symmetrically trim piles right truncated cone at the

tip. If steel shoes or points are specified, carefully shape the tip of the pile so that the steel shoe or point fits snugly and symmetrically.

Handle and store timber piles to prevent warping.

If specified, provide creosoted piles conforming to 712.06.

507.09 Splices. To the fullest extent practical, avoid splicing steel casings and structural shapes. Splice pile casings and structural shapes either before or after driving a segment. If spliced after driving a segment, splice the piles at least 3 feet (1 m) above the ground and inspect the splice while the pile is driven a minimum of 150 blows.

Align segments to make the axis of all segments common.

Use full penetration butt welds to splice structural shapes according to 513.21, except delete the requirement to use temporary extension bars.

Do not splice timber piles.

507.10 Defective Piles. Piles entirely underground are defective if the pile location at the ground surface is more than the 1 foot (0.3 m) from the location shown on the plans.

Piles projecting above the ground are defective if the pile location at the ground surface is more than 3 inches (75 mm) from the location shown on the plans.

Pipe piles are defective if not water tight or if damage reduces the cross-sectional area by more than 20 percent. Provide the Engineer with a light that allows inspection of the entire length of the interior of a driven casing.

Replace, repair, or drive a substitute pile beside the defective pile. The location tolerance for underground piles does not apply to substitute piles beside defective underground piles. The off-location limits do apply to the substitute pile that project above the ground. If a defective pile is removed, fill the hole remaining in the ground with sand. Cut off a defective pile left in place under a footing 3 inches (75 mm) above the elevation of the bottom of the footing. Cut off a defective pile left in place but not under a footing at least 1 foot (0.3 m) below ground level. Fill defective pipe piles left in place with concrete.

When the outside rows of bearing piles are not located within tolerances specified above, increase the size of the footing to provide a minimum distance between the pile and footing edge of at least 75 percent of that shown on the plans.

507.11 Prebored Holes. Locate prebored holes as shown on the plans. Provide augured hole diameters:

A. For round piles, from 2 inches (50 mm) less to 4 inches (100 mm) more than the pile diameter.

B. For steel H-piles, from 6 inches (150 mm) less to 2 inches (50 mm) more than the pile's diagonal dimension but shall be such as to produce satisfactory pile driving results.

Backfill voids between the pile and the prebored hole with a granular material satisfactory to the Engineer.

507.12 Method of Measurement. The City will measure piles driven by the number of feet (meters). The City will determine the sum as the lengths of all non-defective piles measured along the axis of each pile from the bottom of each pile to the elevation of cutoff. Unless a separate pay item is specified in the Contract, the City will include Steel Points or Shoes in the measured length of driven piles. If a separate pay item is specified in the Contract, the City will measure Steel Points or Shoes by the number of each.

The City will measure piles furnished by the number of feet (meters) of plan specified order length plus any additional order length specified by the Engineer. The Engineer will include the length of undriven piles as furnished, but the Contractor will not receive additional compensation for hauling the piles off the project.

For plan specified prebored holes, the City will measure Prebored Holes by the number of feet (meters) of prebored hole lengths for non-defective piles measured from the surface of ground at the time of boring to the bottom of the hole. The City will not measure preboring to facilitate the pile driving operation.

507.13 Basis of Payment. Include the cost of preboring when the Contractor elects to prebore to facilitate the pile driving operation, the cost for preboring shall be included in the unit price bid for piles driven.

The City will consider the cost of furnishing and installing the reinforcing steel to be included in the unit price bid for piles driven.

The City will not pay for any splices due to the Contractor furnishing pile lengths shorter than plan order lengths.

The City will not pay for increased pile lengths made by the Contractor unless the Engineer determines that the additional lengths are needed to achieve bearing.

If additional penetration is necessary in order to achieve the required bearing, the City will pay for required splices at a negotiated price.

The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
507	Foot (Meter)	Steel Piles HP____×____, Furnished
507	Foot (Meter)	Steel Piles HP____×____, Driven
507	Foot (Meter)	___" (___ mm) Cast-In-Place, Reinforced Concrete Piles, Furnished
507	Foot (Meter)	___" (___ mm) Cast-In-Place, Reinforced Concrete Piles, Driven
507	Foot (Meter)	Timber Piles, Creosoted
507	Foot (Meter)	Timber Piles, Untreated
507	Foot (Meter)	Prebored Holes
507	Each	Steel Points or Shoes