Section 705. FOUNDATION PILING

705.01. Description. This work consists of providing and driving timber piles, cast-in-place concrete piles, and steel piles. The following definitions apply to this work:

Absolute Refusal. The nominal pile driving resistance value of 150 percent of the nominal pile driving resistance shown on the plans.

CIP. In this section, the abbreviation for cast-in-place.

Design Pile Length. The pile length shown on the plans.

Design Pile Tip Elevation. The pile tip elevation if the design pile length is shown on the plans.

Dynamic Formula. Empirical formula to estimate Nominal Pile Driving Resistance during pile driving. The FHWA Gates formula is specified.

Dynamic Testing. High strain dynamic testing during pile driving to estimate Nominal Pile Driving Resistance using instrumentation and signal-matching computer software.

Estimated Pile Length. The length shown on the plans used as a guide for estimating the work and ordering test piles if the nominal pile driving resistance is shown on the plans.

Estimated Pile Tip Elevation. The elevation shown on the plans, estimated for piles to develop the nominal pile driving resistance.

Manufacturer. The company that manufactures the pile driving equipment including hammers and appurtenances.

Minimum Pile Length. The length between pile cutoff elevation and minimum pile penetration elevation shown on the plans.

Minimum Pile Penetration Elevation. The elevation shown on the plans that the bottom of piles must be driven to, or below.

Nominal Pile Driving Resistance. Nominal pile driving resistance measured during pile driving with the dynamic formula or dynamic testing methods in kips, as shown on the plans.

Ordered Pile Length. The length determined from test pile results. For timber piles, the Engineer will determine the ordered length. For cast-in-place concrete piles and steel piles, the Contractor will determine the ordered length.
Practical Refusal. A nominal pile driving resistance value of 110 percent of the nominal pile driving resistance shown on the plans.

Prebore Elevation. The elevation designated for stopping preboring, as shown on the plans.

Production Piles. Piles other than test piles.

Spuds. Short, strong, driven members, removed to make holes for inserting piles.

Test Pile. A pile driven at a location shown on the plans to determine pile driving characteristics. The Engineer will certify Nominal Pile Resistance of a test pile using a static load test, dynamic formula, or dynamic testing methods.

705.02. Materials. Provide materials in accordance with the following:

- Concrete, Grade S1 ................................................................. 701
- Granular Material, Class II ...................................................... 902
- Steel Reinforcement ............................................................... 905
- Foundation Piles ................................................................. 906
- Water ........................................................................................ 911
- Treated Timber Piles ............................................................ 912
- Pile Points (including Shoes and End Plates) ......................... 906

Provide new or used steel piles, consisting of the rolled structural steel shapes meeting yield strengths shown on the plans or the Engineer’s authorization. Provide used steel piles in good condition, as approved by the Engineer. Provide new steel shells for watertight Cast-In-Place (CIP) Concrete Piles.

Provide steel reinforcement meeting the yield strength shown on the plans.

Provide full length treated timber piles.

Provide Concrete, Grade S1 for CIP Concrete Piles.

705.03. Construction.

A. Piling.

1. Storage and Handling of Piles. Store piles off the ground with cribbing to prevent bending or distorting the piles.

   Store and handle piles to prevent dirt, water, or other deleterious material from entering steel shells for CIP concrete piles.

   Handle timber piles in accordance with subsection 709.03.
2. **Equipment.** Size pile driving equipment to drive production and test piles without damage, in accordance with this subsection. Do not use driving equipment that damages the piling.

Obtain advance approval from the Engineer for pile driving equipment, including the pile driving hammer, hammer cushion, helmet, pile cushion, and other appurtenances. Submit a description of pile driving equipment to the Engineer at least 21 calendar days before beginning pile driving. The Engineer will evaluate the proposed driving system using the dynamic formula, the wave equation analysis, or both.

The Engineer will use the required number of hammer blows per inch, and the pile driving stresses over the entire driving process to evaluate pile driving equipment.

Select pile driving equipment that installs piles at a rate from two blows per inch to 10 blows per inch, at the required nominal pile driving resistance, for every method of pile resistance certification.

For preliminary hammer selection purposes, the Contractor may estimate the minimum and maximum hammer energy as follows:

\[
E_d \geq 0.082(R_{ndr} + 100)^2 \quad \text{Formula 705-1}
\]

\[
E_d \leq 0.193(R_{ndr} + 100)^2 \quad \text{Formula 705-2}
\]

Where:

\[R_{ndr} = \text{Nominal pile driving resistance measured during pile driving in kips.}\]

\[E_d = \text{Energy developed by the hammer per blow in foot-pounds.}\]

For pile stresses determined by wave equation analysis, do not exceed the maximum pile driving stresses specified in Table 705-1 for the entire driving operation.

<table>
<thead>
<tr>
<th>Table 705-1 Maximum Pile Driving Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pile Material</strong></td>
</tr>
<tr>
<td>Steel</td>
</tr>
<tr>
<td>Timber</td>
</tr>
</tbody>
</table>

The Engineer will predict pile stresses for vertical piles using wave equation analysis, based on hammer efficiencies specified in Table 705-2.
<table>
<thead>
<tr>
<th>Hammer Type</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop</td>
<td>25 – 40</td>
</tr>
<tr>
<td>Single Acting Air</td>
<td>67</td>
</tr>
<tr>
<td>Double Acting Air</td>
<td>50</td>
</tr>
<tr>
<td>Diesel</td>
<td>80</td>
</tr>
<tr>
<td>Hydraulic or Diesel with Built-in</td>
<td>95</td>
</tr>
<tr>
<td>Energy Measurement</td>
<td></td>
</tr>
</tbody>
</table>

The Engineer will notify the Contractor of acceptance or rejection of the driving system within 14 calendar days of receiving the Pile and Driving Equipment Data Form. If the Engineer rejects the driving system, modify or replace the proposed methods or equipment, at no additional cost to the Department.

Use the approved system during pile driving operations. Submit revised pile driving equipment data to the Engineer for review and acceptance before changing driving system. The Engineer will notify the Contractor of acceptance or rejection of the driving system changes within five working days of the Engineer's receipt of the requested change. The Department will not grant a time extension for time required for submission, review, and approval of a revised driving system.

The Engineer’s approval of pile driving equipment does not relieve the Contractor of responsibility to drive piles without damage to the required nominal pile driving resistance and the minimum pile penetration elevation shown on the plans.

Use air, diesel, or hydraulic hammers to drive piles.

a. Drop Impact Hammers. The Contractor may use drop impact hammers to drive timber piles, if allowed by the contract.

Do not use drop hammers for piles where the required nominal pile driving resistance exceeds 200 kip. If the contract allows drop hammers, ensure the ram weighs at least 2.0 kip and the height of drop is no greater than 12 feet. Do not use a ram weight less than the combined weight of the helmet and the pile. Equip drop hammers with hammer guides and a helmet to ensure concentric impact.

b. Air Impact Hammers. Operate air hammers within the manufacturer’s specified ranges. Provide the Engineer with the hammer specifications to determine the energy developed by the hammer with each blow. Use striking parts that weigh at least 2.75 kip and at least ⅓ the combined weight of pile and helmet.
Provide the power plant and equipment for air hammers with a capacity capable of maintaining, under working conditions, the air volume and pressure at the hammer, as specified by the manufacturer. Equip the power plant and equipment with accurate pressure gauges, easily accessible to the Engineer.

Connect the compressor to the hammer with a hose of at least the minimum size recommended by the manufacturer.

The Engineer will evaluate hammer performance at the end of driving by measuring blows per minute and comparing with the manufacturer’s recommendations. Measure the blow rate using an automatic measuring device.

c. **Diesel Impact Hammers.** For open-end, single acting hammers, provide the Engineer with a chart from the hammer manufacturer equating stroke and blows per minute. The Engineer will determine the average hammer stroke at the end of drive from the blow rate in blows per minute or by using an automatic measuring device to determine average hammer stroke. Equip open-end diesel hammers with rings, or other device on the ram to allow the Engineer to visually determine hammer stroke during pile driving operations.

Equip closed-end, double acting hammers with a bounce chamber pressure gauge, mounted near ground level and easily accessible to the Engineer. Provide a correlation chart of bounce chamber pressure and potential energy. The Engineer will determine the average hammer stroke at the end of drive from bounce chamber pressure.

d. **Hydraulic Impact Hammers.** Operate hydraulic hammers within the manufacturer’s specified ranges. Provide a power plant for hydraulic hammers with a capacity capable of maintaining the hydraulic volume and pressure specified by the manufacturer. Equip the power plant with pressure gauges, easily accessible to the Engineer.

Equip hydraulic hammers with an energy readout device. Provide wave equation analysis to the Engineer indicating the nominal pile driving resistance of the pile. The Engineer will use the wave equation analysis to determine the capability of the hammer. Do not use Formula 705-1 through Formula 705-5 for calculating the nominal pile driving resistance.

e. **Non-Impact Hammers.** Do not use non-impact hammers, including vibratory hammers, or driving aids, followers, and
prebored holes unless approved by the Engineer in writing or stated in the contract.

3. **Additional Equipment or Methods.** If using a hammer specified in subsection 705.03.A.2 does not obtain the minimum pile penetration elevation, provide a hammer of greater energy or, if approved by the Engineer, use supplemental methods, such as preboring. The Engineer will conduct additional wave equation analyses for the new hammers to assess predriving pile stresses in accordance with subsection 705.03.A.2.

B. **Driving Appurtenances.**

1. **Hammer Cushion.** Equip impact pile driving equipment with a hammer cushion to prevent damage to the hammer or pile, except drop hammers and hammers designed for use without hammer cushions.

   Provide hammer cushions fabricated from durable manufactured materials that will retain uniform properties during driving. Do not use wood, wire rope, or asbestos hammer cushions. Place a striker plate on the hammer cushion to ensure uniform compression of the cushion material.

   Remove the hammer cushion from the helmet and inspect in the presence of the Engineer before beginning pile driving at each structure or after each 100 hours of pile driving, whichever is less. Replace the hammer cushion if the thickness is reduced more than 25 percent of the original thickness before continuing driving.

2. **Helmet.** Fit piles with a helmet to distribute the hammer blow uniformly and concentrically to the pile top. Ensure the helmet surface, contacting the pile, is planed and smooth and aligned parallel with the hammer base and the pile top. Guide the helmet with leads; do not allow it to swing freely. Fit the helmet to the pile top to maintain the hammer and pile in concentric alignment.

   For timber piles, do not allow the least inside horizontal dimension of the helmet or hammer base to exceed the pile top diameter by more than 2 inches. Trim the pile top to fit the helmet if the timber pile diameter exceeds the least helmet or hammer base horizontal dimension. Do not trim the pile top below the cutoff elevation.

3. **Pile Cushion.** If CIP concrete piles require redriving after concrete placement and curing inside steel shells, protect pile tops with a pile cushion. Proportion the pile cushion to distribute the blow of the hammer throughout the cross-section of the pile.
4. **Leads.** Use pile driving leads that align the pile and hammer in positions throughout the driving operation. Use leads constructed to allow free movement of the hammer and maintain hammer and pile alignment to ensure concentric impact. Use leads designed to allow alignment of battered piles, if required. Do not allow the driven pile section to extend above leads.

Provide fixed or swinging type leads. Fit swinging leads with a pile gate at the bottom of the leads. Use leads embedded in the ground or constrain the pile in a structural frame to maintain alignment. Provide leads with a length that eliminates the need for a follower.

5. **Followers.** Use followers only if the Engineer approves in writing, or required by the contract. If the Engineer does not perform a wave equation analysis, use a follower with impedance from 50 percent to 200 percent of the pile impedance.

Maintain the follower and pile in alignment during driving. Drive the first pile in each bent, and every tenth pile full length without a follower to ensure pile penetration develops the required nominal pile driving resistance. Use a follower constructed of material and dimensions to allow pile driving to the penetration depth determined by driving the full-length piles. Verify the final position and alignment of the first two piles in each substructure unit, installed with followers, meet location tolerances specified in subsection 705.03.C.2.e, before installing additional piles.

6. **Spud.** The Engineer will not allow spuds in lieu of preboring.

C. **Driving Methods.**

1. **Preparation for Driving.** Before driving, cut pile tops square with the axis of the pile. Use collars, bands, or other devices to protect timber piles against splitting and brooming.

   a. **Excavation and Fill.** Do not drive, or redrive piles until completion of excavation, fill, or both, unless otherwise required. If piles require driving or redriving through fills, compact the embankment to the bottom of the concrete substructure unit before driving piles. Remove material forced up between the piles to the required elevation before placing concrete foundation.

   b. **Pile Preboring to Facilitate Driving.** Prebore holes to the prebore elevation shown on the plans. Provide a finished hole with a diameter equal to or no more than 6 inches greater than the diameter of the pile.
Maintain a stable, open hole until pile installation to the bottom of the bore. Do not begin final drive for bearing until the pile reaches the prebore elevation shown on the plans. Control caving or unstable soil layers using temporary casing or non-toxic and non-hazardous drilling slurry. Handle and dispose of drilling slurry on the project, or at an off-site location where structures will be unaffected, in accordance with 1994 PA 451, Part 91 Soil Erosion and Sedimentation Control. Obtain the Engineer’s approval for on-site disposal.

Remove or clear boulders, cobbles, or other obstructions. Provide rock chisels, extractors, core barrels, or other equipment to clear obstructions.

To the extent possible, complete preboring in a foundation unit and advance piles to the prebore elevation, before beginning the final drive. If preboring within 20 feet of a completed pile, recheck the pile capacity by restriking the pile. The Engineer will select the piles for restrike. Restrike with the same driving equipment from the initial installation. If a reduction in capacity occurs, redrive piles to the nominal pile driving resistance.

Backfill voids after the final drive with granular material Class II or a Department-approved equal.

Prebore pile holes within a vertical tolerance of ¼ inch per foot, or within the batter line shown on the plans. Upon completion, ensure the center of the hole at cutoff elevation is within 6 inches of the position shown on the plans.

Unless otherwise shown on the plans, if driving piles through compacted fill deeper than 5 feet, drive piles in holes prebored to natural ground.

2. Driving. During driving, maintain pile tops square with the axis of the pile.

a. Obstructions. If an impenetrable obstruction is encountered during pile driving, remove and reuse the pile, or cut the pile off and drive a new pile.

If removing a pile, reuse as approved by the Engineer, adjust the pile laterally, and redrive in accordance with subsection 705.03.C.2.e.

If cutting off a pile, cut the pile at the lowest possible elevation and drive another pile, adjusted laterally. Drive the new pile in accordance with subsection 705.03.C.3.e.
If removing and adjusting, or cutting off and adjusting a pile, does not bypass the obstruction, remove the obstruction. Provide rock chisels, extractors, core barrels, or other equipment to clear obstructions.

b. **Penetration.** For design pile lengths, install piles to the design pile tip elevation shown on the plans, unless driving operations attain absolute refusal.

If the plans show the estimated pile length, install piles to a penetration that meets the following:

i. The nominal pile driving resistance equals at least the required nominal pile driving resistance shown on the plans; and

ii. The bottom of the pile is at or below the minimum pile penetration elevation shown on the plans.

Do not drive piles past absolute refusal unless Dynamic Testing is required. If Dynamic Testing is required, ensure pile stresses do not exceed the stresses specified in Table 705-1, as determined by the Engineer.

c. **Test Piles.** If test piles are required by the contract, use the pile lengths shown on the plans for estimating purposes. Provide actual pile lengths to achieve the required nominal pile driving resistance and minimum pile length. If test piles are not required, provide the piles in accordance with the design pile length shown on the plans.

Complete the excavation or embankment to within 2 feet of the proposed grade at test pile locations. Install test piles at locations shown on the plans with approved impact hammer equipment. Drive test piles to the minimum pile length or absolute refusal, whichever is greater.

The Engineer may stop test pile driving at tip penetrations greater than 10 feet below the estimated pile tip elevation to check for soil setup.

If test piles fail to achieve the required nominal pile driving resistance after driving 10 feet below the estimated pile tip elevation, but the resistance reaches at least 85 percent of the required nominal pile driving resistance, leave piles in place for at least 48 hours to allow soil setup, unless otherwise directed by the Engineer.
After the waiting period, restrike the test pile to check the nominal pile driving resistance. The Engineer will determine the nominal pile driving resistance after soil setup based on the number of restrike blows necessary to drive the pile an additional 3 inches. Use a hammer for restriking piles, warmed up by applying at least 20 blows to another pile at least 25 feet away from the restrike pile, or as approved by the Engineer. The Engineer will accept restrike piles if they exhibit a nominal pile driving resistance greater than the resistance required.

After restriking, continue test pile driving, providing piling, splices, and restrikes until the nominal pile driving resistance measured during driving reaches practical refusal, or until the Engineer stops driving. The Engineer will prepare a record of test pile driving, including the number of hammer blows per foot for the driven length, the as-driven length of the test pile, cutoff elevation, penetration in ground, and other pertinent information.

Cut off test piles, driven in production pile locations and incorporated in the structure as permanent piles. Cut off or pull test piles, not driven in production pile locations, as directed by the Engineer.

Determine the ordered pile lengths of steel H-piles and CIP concrete piles from the test pile results. Provide CIP pile shell and steel pile lengths to obtain the required nominal pile driving resistance and penetration.

The Engineer will evaluate test pile results and determine the ordered pile lengths for timber piles.

The Engineer will not require test piles if the plans show a design pile length.

d. Splicing. Do not splice timber piles. Provide steel piles in full length sections or splice them as shown on the plans, or approved by the Engineer.

The Contractor may provide piling and field splices, as required to obtain the required nominal pile driving resistance and penetration.

Weld in accordance with AWS D1.1 and subsection 707.03.D.8.b, subsection 707.03.D.8.c, and subsection 707.03.D.8.d, with the temperature exceptions specified in this subsection. The Contractor may use E7015, E7016, or E7018.
electrodes provided they are stored and used in accordance with AWS requirements.

Do not perform field welding if the ambient temperature is below 0 °F. If the pile metal temperature falls below 32 °F, preheat the pile metal in the area of the weld to at least 70 °F, and maintain the temperature during welding. Employ welders certified by agencies approved by the Department.

Remove slag from all weld passes including finished welds. For fillet welds, verify weld size by using a fillet weld gage witnessed by the Engineer. Non-destructive testing of the pile splices by the Contractor is not required unless visual inspection by the Engineer indicates unacceptable welds.

e. **Accuracy.** Drive piles for foundation work within ¼ inch per foot from the vertical or batter line shown on the plans. After driving, ensure the position of each pile at the cutoff elevation is within 6 inches of the position shown on the plans. Ensure a distance of at least 9 inches between the edges of piles and the outline of the superimposed concrete.

Drive pile bents to allow the adjustment of piles to the positions and elevations shown on the plans without damaging or overstressing piles. Do not pull laterally on piles to correct misalignment, or splice an aligned section on a misaligned section.

Drive timber piles to allow adjustment to the position shown on the plans at the elevation of cap or wale, without damaging or overstressing piles. Draw and hold piles requiring capping, in position before cutoff. If the pile cutoff diameter is greater than the width of the cap, trim the pile to eliminate horizontal projections outside the cap.

Do not drive timber piles to the exact grade shown on the plans; cut them off below the tapered head to provide an unfractured, bearing with a full cross section of the pile.

Increase pile cap dimensions or reinforcing to accommodate out-of-position piles at no additional cost to the Department.

f. **Redriving of Heaved Piles.** At the start of pile driving operations, the Engineer will make level readings to measure pile heave after driving until the Engineer determines checking is no longer required. If piles heave up during driving adjacent piles, redrive heaved up piles to the required bearing capacity or
penetration. Adjust upheaval or settlement of material between the piles to the correct elevation before placing concrete for the foundation.

If the Engineer detects pile heave for CIP concrete pile shells filled with concrete, redrive the piles to the original position after concrete obtains the required strength using a pile cushion system, approved by the Engineer.

D. Determination of Nominal Pile Resistance.

1. Static Load Test. Perform load tests as required. Refer to the contract for load testing details.

2. Dynamic Formula. Do not use the dynamic formula to install production piles with a required nominal pile driving resistance greater than 600 kip, or if the contract requires dynamic testing with signal matching.

   The Engineer will determine the nominal pile driving resistance for test piles using the same method specified for production piles.

   \[ R_{n,b} = 1.75 \sqrt{E_d \log_{10}(10N_b)} - 100 \]  

   Where:

   \( N_b \) = Number of hammer blows per inch of pile penetration;
   \( E_d \) = Energy developed by the hammer per blow in foot-pounds; and
   \( R_{n,b} \) = Nominal pile driving resistance measured during pile driving in kips.

   The Engineer will determine the value of “\( E_d \)”. For piles driven on a batter, multiply the value of “\( E_d \)” by the hammer energy reduction coefficient “\( U \)” as follows:

   \[ U = \sin(\alpha) \times 0.975 \]  

   \[ \alpha = \tan^{-1}(m) \]

   Where:

   \( U \) = Hammer energy reduction coefficient, less than unity;
   \( \alpha \) = Angle of batter from horizontal (less than 90 degrees for battered piles); and
   \( m \) = Vertical component of batter.
For drop, single acting air hammers, and open type diesel hammers, the Engineer will measure the ram velocity using the kinetic energy. If measuring ram velocity is not possible, the Engineer may approximate the velocity using the potential energy calculated by multiplying the weight of hammer striking parts by the observed fall or stroke height.

For double acting air hammers and closed type diesel hammers, the Engineer will calculate the energy using ram weight and bounce chamber pressure. Submit hammer literature and correlation charts to the Engineer to determine the hammer energy of each blow. The Engineer will reduce the calculated value of “E_d” for battered piles by the hammer energy reduction coefficient “U” before calculating the nominal pile driving resistance.

Formula 705-3, Formula 705-4, and Formula 705-5, for piles driven with a drop hammer are applicable under the following conditions:

a. Hammers have an unrestricted free fall;
b. Pile tops are not broomed, crushed, or splintered;
c. The hammer exhibits no appreciable bounce after striking the pile; and

d. Penetration is at a uniform or uniformly decreasing rate.

If required, or if using a hydraulic hammer, the Engineer will determine the nominal pile driving resistance using the results of a wave equation analysis. The Engineer will consider the hammer driving system, site-specific subsurface data, and project pile geometry, to develop driving criteria that will not overstress the pile and indicate the nominal pile driving resistance.

3. Dynamic Testing and Analysis. Perform dynamic testing with signal matching as required by the contract.

E. Defective Piles. Protect piles from splitting, splintering and brooming of the wood, or excessive deformation of the steel. Do not manipulate piles to force them into position using excessive force, as determined by the Engineer.

At no additional cost to the Department, use one of the following methods to correct piles damaged by internal defects, driven improperly, driven below the cutoff elevation determined by the Engineer or as required, or piles driven outside the required location:

1. Withdraw the pile and replace with a new, longer pile;
2. Drive a second pile adjacent to the defective or low pile; or
3. Splice or build up the pile or extend a portion of the footing to properly embed the pile.

F. **Placing Concrete in Cast-in-Place Concrete Piles.** Before placing concrete, inspect piles to confirm the full pile length and dry bottom condition. Provide a mirror or light for inspection.

Do not place concrete in piles until after driving, redriving, cleaning, and obtaining the Engineer’s acceptance of pile shells within a radius of 20 feet. Place the concrete in the pile shells to the cutoff elevation as soon as practical after driving.

Place concrete in accordance with subsection 706.03.H, except concrete may free-fall more than 5 feet. During placement, vibrate the concrete in the upper 1/5 of the pile shell, to a depth no greater than 25 feet, without causing segregation.

G. **Protective Coating for Steel Piles and CIP Concrete Piles.** If required, galvanize steel H-piles and steel shells exposed to air or water in the finished structure, in accordance with ASTM A 123.

Do not use corrosive embankment material within 30 feet of piles. Repair damage to galvanization in accordance with subsection 716.03.E at no additional cost to the Department.

H. **Cleaning Steel Piles and Steel Pile Shells.** If embedding steel piles or pile shells at least 1 foot or more in structural concrete, exclusive of tremie concrete, clean dirt and loose scale from the portion requiring embedding.

I. **Pile Cutoff.** Cut off piles normal to the longitudinal axis of the pile and within 1 inch of the elevation required and anchor to the structure as required by the contract.

Take possession of piling cutoff lengths. Dispose of cutoff lengths in accordance with local, state, and federal regulations.

Cut off timber piles to completely remove material damaged by driving.

**705.04. Measurement and Payment.**

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pile, Treated Timber, Furn.........</td>
<td>Foot</td>
</tr>
<tr>
<td>Pile, Treated Timber, Driven.......</td>
<td>Foot</td>
</tr>
<tr>
<td>Pile, CIP Conc, Furn and Driven, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Pile, Steel, Furn and Driven, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Pile, Galv, (Structure No.)........</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Test Pile, Treated Timber..........</td>
<td>Each</td>
</tr>
<tr>
<td>Test Pile, CIP Conc, __ inch ......</td>
<td>Each</td>
</tr>
</tbody>
</table>
A. Piles.

1. **Driven Piles.** The unit prices for **Pile, CIP Conc, Furn and Driven, __ inch**, and **Pile, Steel, Furn and Driven, __ inch**, include the cost of restrike due to preboring.

   For piles removed, adjusted, and reused, due to obstructions, the Engineer will measure the total length of the pile driven, including the length of pile embedded in the ground and removed. For piles that require cutting off due to obstructions, the Engineer will measure the total length of the new pile driven, including the length of obstructed pile cut off and left in the ground.

   Payment for initial restrike is included in pay item Test Pile. The Department will pay for subsequent restrikes, if necessary, as extra work. The Department will pay for pile restrike for production piles as extra work unless the Contractor chooses to stop driving, wait and restrike or redrive piles to achieve the required nominal pile driving resistance. If the Contractor chooses to restrike or redrive piles, no payment will be made for the restrikes or redrive.

   The Department will pay for redriving heaved piles as extra work.

   The Engineer will measure **Pile, Treated Timber, Driven** by the piling length left in place below cutoff. The unit price for **Pile, Treated Timber, Driven** includes the cost of cutting off piles. Cutoff material will remain the property of the Contractor.

   The Engineer will measure **Pile, CIP Conc, Furn and Driven**, and **Pile, Steel, Furn and Driven**, by the length of piling left in place below cutoff.

   The unit prices for **Pile, CIP Conc, Furn and Driven**, and **Pile, Steel, Furn and Driven** include the cost of providing ungalvanized pile shells or steel piles, and the cost of driving the galvanized pile length.

   The unit prices for **Pile, CIP Conc, Furn and Driven**, and **Pile, Steel, Furn and Driven** do not include the cost of the length of the pile point extending beyond the pile.
The unit prices for furnished and driven pile pay items include the cost of splices.

2. **Pile, Treated Timber, Furnished.** The Department will pay for Pile, Treated Timber, Furn, at the ordered pile length.

3. **Galvanized Piles.** The unit price for Pile, Galv, includes the cost associated with galvanizing the required length of pile as shown on the plans.

4. **Pile Driving Equipment.** The Engineer will measure Pile Driving Equipment, Furn as a unit for each structure. The unit price for Pile Driving Equipment, Furn, includes the cost of providing and removing equipment for driving piles.

The unit price for the length of pile driven includes the cost of operating equipment for driving piles.

5. **Prebore Foundation Piling.** The Engineer will measure Prebore, Fdn Piling, from the bottom of the foundation to the prebore elevation shown on the plans. The unit price for Prebore, Fdn Piling includes the cost of the following:
   a. Boring pile holes;
   b. Disposing of excavated material;
   c. Backfilling voids;
   d. Installing and removing temporary casings;
   e. Providing and disposing of drilling slurry;
   f. Restriking completed piles within a radius of 20 feet; and
   g. Equipment operating costs.

If Prebore, Fdn Piling, is shown on the plans, the unit price for Pile Driving Equipment, Furn includes the cost of providing equipment for prebore. If the plans do not show preboring, but the Engineer authorizes preboring in writing, the Department will pay for providing equipment as extra work.

6. **Pile Points.** If the contract includes the pay item Pile Points, the Department will pay separately for Pile Points, of the type required. If the plans do not include Pile Points, but the Engineer requires pile points, the Department will pay for pile points as extra work.

7. **Test Piles.** The Department will pay for test piles in addition to the contract unit prices for furnished and driven pile pay items.

The unit prices for Test Pile, of the type required, include the cost of initial restrike. The Department will pay for subsequent restrikes as extra work.
B. **Obstruction Removal.** The Engineer will measure and the Department will pay for the removal of obstructions, which require the use of special equipment or tools specified in subsection 705.03.C.2.a, at the unit price for **Obstruction Removal**, in accordance with subsection 718.04.D.