

SECTION 00520 - DRIVEN PILES

(Follow all instructions and make all edits with "Track Changes" turned on. If there are no instructions [purple text] above a subsection, paragraph, sentence, or bullet, then include it in the project. Delete all purple text before preparing the final document. All other modifications to this Section will require ODOT Technical Resource and State Specifications Engineer approval.)

(Use the following lead-in paragraph when none of the following subsections are included in the project.)

Comply with Section 00520 of the Standard Specifications.

(Use the following lead-in paragraph when any of the following subsections are included in the project.)

Comply with Section 00520 of the Standard Specifications modified as follows:

(Use the following subsection .11 on projects that require steel piles. Insert bridge structure number and bent number under "Location". Insert the number of piles in each bent under "Number". Insert the estimated length of the individual piles in each bent under "Length". Insert the type and dimensions of the pile under "Type and Size". If the piles will be coated, insert the top and bottom elevations of the coating in the "Coating Top Elevation" and "Coating Bottom Elevation" columns, otherwise insert "n/a" Add rows to the table as necessary. Obtain information from the Geotechnical Designer.)

00520.11 Engineer's Estimated Length List - Add the following to the end of this subsection:

The Engineer's estimated lengths of steel piling are:

Location	Number	Length (feet)	Type and Size	Coating Top Elevation ¹	Coating Bottom Elevation ¹

¹ Protective coating system and color requirements according to 00594.10.

(Use the following subsection .13 on projects that require test piles. Insert bridge structure number and bent number under "Location". Insert the number of piles in each bent under "No.". Insert the estimated length of the individual piles in each bent under "Length". Insert the type and dimensions of the pile under "Type and Size". Obtain information from the Geotechnical Designer.)

00520.13 Test Piles - Replace this subsection, except for the subsection number and title, with the following:

Furnish test piles according to the test pile length list below. When test piles are required, the production pile lengths shown or specified below are estimated lengths only. The actual lengths furnished for production piles are determined by the Engineer after the test piles have been driven. This applies for all pile types.~~Add the following to the end of this subsection:~~

The required test piles are:

Location	No.	Length (Feet)	Type and Size
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00520.14 Unused Piles - Replace the paragraph that begins " Acceptable full-length piles ..." with the following paragraph:

Acceptable full-length piles furnished according to the estimated length list, order list, or revised pile order list, but not incorporated in the Work, is handled according to one of the following:

00520.20(a)(2) Open-End Diesel Hammers - Replace this subsection, except for the subsection number and title, with the following:

Provide open-end (single-acting) diesel hammers equipped with a device that allows the Engineer to visually determine hammer stroke at all times during pile driving operations. Provide the Engineer with the hammer manufacturer's chart equating stroke and blows per minute.

00520.20(a)(4) Gravity Hammers - Replace this subsection, except for the subsection number and title, with the following:

Provide gravity hammers that have a ram weighing between 2,000 pounds and 5,000 pounds, weigh not less than the combined weight of helmet and pile and a drop height of not more than 10 feet.

00520.20(b) Vibratory Hammers - Replace this subsection, except for the subsection number and title, with the following:

Control installation of production piles with vibratory hammers according to the power consumption, rate of penetration, specified tip elevation, or other acceptable means that assure the pile resistance equals or exceeds the required nominal pile bearing resistance. After driving piles with a vibratory hammer, verify pile resistance (see 00520.42) by driving them with an impact hammer of suitable energy. Do not use vibratory hammers to drive test piles or when preboring or jetting.

00520.20(c)(1) Helmet - Replace the paragraph that begins "Equip piles driven with ..." with the following paragraph:

Equip piles driven with impact hammers with an adequate metal helmet. Provide helmets that:

(Use the following subsection .20(c)(4) when required by the Geotechnical Designer.)

00520.20(c)(4) Followers - Replace this subsection, except for the subsection number and title, with the following:

Support piles in line and position while driving. Construct pile hammer leads to give the hammer freedom of movement while maintaining alignment of the hammer and the pile to ensure concentric impact for each blow. Use fixed leads unless the Engineer approves the use of swinging leads. Fit swinging leads, when used, with a pile gate at the bottom of the leads. To maintain alignment of batter piles, use horizontally braced swinging leads, adequately embedded in the ground, or rigidly attached to prevent movement during pile driving.~~Add the following to the end of this subsection:~~

Followers are permitted.

00520.20(d)(1) General - Replace the paragraph that begins "During pile-driving operations, no ..." with the following paragraph:

During pile-driving operations, no changes to the approved Equipment are allowed without the Engineer's written permission. Submit a request for change on a "Pile and Driving Equipment Data" form. The Engineer will give notification of approval or rejection within 7 Calendar Days of receiving the form. Time required for resubmission and review of a Contractor's Equipment change request is not a basis for a Contract Time extension request unless the Engineer does not respond in 7 Calendar Days.

00520.20(d)(2) Standard Evaluation Method - Replace the paragraph that begins "1 Requirements are based ..." with the following paragraph:

¹ Requirements are based on the FHWA Gates equation (see 00520.42(b)), except all driving criteria for double acting and differential hammers both air/steam and diesel are by the wave equation analysis.

Replace the paragraph that begins "The required number of ..." with the following paragraph:

The required number of hammer blows indicated by the FHWA Gates equation at the nominal pile bearing resistance is at a rate between 2 and 10 blows per inch.

(Use the following subsection .20(d)(3) when WEAP input values are required. Include further explanations if necessary. More than one table may be required to assess pile driving stresses through upper hard or dense soils layers or other conditions. Consult with the Geotechnical Designer regarding the appropriate input(s) to use. Typically supply the highest R_n value and the worst-case driving conditions that the contractor should use in the WEAP analysis to determine hammer requirements. Supply WEAP input data for a complete "drivability analysis" if appropriate. Obtain information from the Geotechnical Designer.)

00520.20(d)(3) Wave Equation Method - Replace the bullet that begins "The energy of the submitted ..." with the following bullet:

- The energy of the submitted hammer produces a wave equation predicted blow count between 2 and 10 blows per inch for the nominal resistances, pile lengths and other conditions specified.

Replace the bullet that begins "The pile stresses indicated by ..." with the following bullet:

- The pile stresses indicated by the wave equation at the nominal resistance are not greater than the stress at the point of impending damage to the pile as follows:

Replace the paragraph that begins "Hammers not meeting these ..." with the following paragraph:

Hammers not meeting these requirements are rejected. Replace rejected hammers with suitable hammers.

Replace the bullet that begins "Electronic and paper copies ..." with the following bullet:

- Electronic and paper copies of the wave equation input and output files. Provide output files in the standard WEAP output format.

Replace the paragraph that begins "For Agency reviewing and approving ..." with the following paragraph:

The Agency will consider the following when reviewing and approving the wave equation analysis submittals:

Replace the paragraph that begins "Failure of a previously approved ..." with the following paragraph:

Failure of a previously approved hammer to operate properly during construction is cause for rejection.

Add the following paragraph and table(s) to the end of this subsection:

The input values for the wave equation analyses are:

Bent	Pile Type	Pile Length * (Feet)	Quake (Inches) Skin	Quake (Inches) Toe	Damping (sec./ft.) Skin	Damping (sec./ft.) Toe	% skin (ITYS)	R _n (kips)

- * These pile lengths are based on the top of the pile being at the finished cutoff elevation. Add a additional pile length above the cutoff elevation, that may be required to accommodate the Contractor's pile installation method or site

conditions, ~~shall be added~~ to the lengths listed above and appropriate changes made to the skin friction distribution input listed below.

(Use one of the following two options. Delete the one that does not apply.)

[Option 1 - Use this option when either triangular or rectangular distribution is required. Delete the one (triangular or rectangular) that does not apply.]

Use (triangular)(rectangular) skin friction distribution.

[Option 2 - Use this option when providing relative skin friction values in table form. Insert Relative Skin Friction Distribution values in the table. Fill in the bent number. Add or delete rows and columns as appropriate.]

Use the relative skin friction distribution values listed below in the WEAP analysis:

(Repeat the table as needed for each bent)

Bent _____	
Depth (Feet)	Relative Distribution

Bent _____	
Depth (Feet)	Relative Distribution

(Use the following subsection .41(d) when augering or wet-rotary drilling is allowed by the Geotechnical Designer.)

00520.41(d) Preboring - Replace the paragraph that begins "Use augering, wet-rotary ..." with the following paragraph:

Use augering, wet-rotary drilling or other methods of preboring only when specified or with written approval. When allowed, prebore holes at pile locations and to the depths shown or directed. Make prebored holes smaller than the diameter or diagonal of the pile Cross Section, but sufficient to allow penetration of the pile to the specified depth. If subsurface obstructions, such as Cobbles, Boulders or Rock layers are encountered, the hole diameter may be increased to the least dimension that is adequate for pile installation. The use of a reinforced section (spud) to loosen the subsurface material at pile locations is not allowed unless otherwise approved.

Replace the paragraph that begins "Perform preboring in a manner ..." with the following paragraph:

Perform preboring in a manner that will not impair the bearing or lateral capacity of the piles already in place or the safety of existing adjacent Structures. When it is determined that preboring has disturbed the load bearing resistances of previously installed piles, restore

those piles that have been disturbed to conditions meeting the requirements of this Specification by re-driving or by other acceptable methods. The Contractor is responsible for the costs of any necessary remedial measures unless the preboring method was specifically included in the Contract Documents and properly executed by the Contractor.

Add the following sentence to the end of this subsection:

Use augering, wet-rotary drilling or other approved methods of preboring as directed.

(Use the following subsection .41(e) when jetting is allowed by the Geotechnical Designer.)

00520.41(e) Jetting - Replace the paragraph that begins "Jetting may only be used ..." with the following paragraph:

Jetting may only be used when allowed in the Contract Documents or if approved in writing. When jetting is not required in the Contract Documents, but approved at the Contractor's request, determine and submit for review the number of jets and the volume and pressure of water at the jet nozzles necessary to freely erode the material adjacent to the pile without affecting the lateral stability of the final in-place pile. The Contractor is responsible for all damage caused by unapproved or improper jetting operations, unless the jetting method was specifically included in the Contract Documents and properly executed by the Contractor. Control, treat if necessary, and dispose of all jet water in a satisfactory manner. Drive all jetted pile with an approved impact hammer.

Add the following sentence to the end of this subsection:

Jetting is permitted.

00520.41(f) Location and Alignment Tolerance - Replace the paragraph that begins "Place the tops of piles at ..." with the following paragraph:

Place the tops of piles at plan cutoff elevation and horizontally within 6 inches of plan locations and no closer than 4 inches from any edge of the cap. Any increase in cap size to meet this edge distance requirement is at no additional cost to the Agency.

00520.41(h) Test Piles - Replace the paragraph that begins "When specified, furnish and ..." with the following paragraph:

When specified, furnish and drive test piles at the locations and to the lengths directed. Furnish all test piles of the kind and size specified for the permanent foundation piles unless otherwise directed. Drive all test piles with approved pile driving Equipment. The specified length of test piles is greater than the estimated length of production piles to provide for variation in Soil conditions. Drive test piles using driving Equipment identical to what the Contractor proposes to use on the production piling. Excavate to the elevation of the bottom of the footing before driving test piles. (See Section 00510.)

Replace the paragraph that begins "Drive test piles to or below ..." with the following paragraph:

Drive test piles to or below the required minimum tip elevation and to a hammer blow count established by the Engineer. Allow test piles that do not attain the hammer blow count specified at the minimum tip elevation shown to "set up" for 24 hours, or less if directed, before being redriven. (See 00520.42(d).) If the tops of test piles reach plan grade without attaining the required pile bearing resistance, splice them and drive until the required bearing resistance is attained.

00540.42(a) General - Replace the paragraph that begins "Drive piles with approved pile ..." with the following paragraph:

Drive piles with approved pile driving Equipment to the lengths necessary to attain the required penetration and nominal pile bearing resistance. Adequate pile penetration is considered reached when the piles are driven to or below the minimum penetration depth and the specified bearing resistance is achieved. If piles do not achieve the specified resistance when driven to order length or estimated length, splice and drive them to penetrations established by the Engineer. Provide a pile blow count at a rate of between 2 and 10 blows per inch at the required nominal pile bearing resistance. Maintain the required number of hammer blows per inch at final penetration for 3 consecutive inches unless "refusal" driving is first obtained. "Refusal" driving is defined as 20 blows per 1 inch or as determined by the Engineer.

Replace the paragraph that begins "If water jets are used ..." with the following paragraph:

If water jets are used with the driving, determine the bearing value by the specified equation from the results of driving after the jetting has been completed according to 00520.42(e).

(Use the following subsection .42(d) when a minimum "set period" of longer than 24 hours is required or if piles are required to set before redriving. Check with the Geotechnical Designer.)

00520.42(d) Set Period and Redriving - Replace the paragraph that begins "If piles do not attain the ..." with the following paragraph:

If piles do not attain the required nominal bearing resistance when driven to the specified length, and if allowed or required, allow the piles to stand for a "set period" without driving. The "set period" is a minimum of 24 hours. After the set period, perform check driving on either two piles in each bent or on one pile in every 10 piles, whichever is more. The Engineer will designate the piles that check driving is to be performed. Do not use a cold hammer for redriving. Warm up the hammer before redriving begins by applying at least 20 blows to another pile. Redriving consists of driving the pile to the required bearing resistance with a maximum of 15 blows. If the specified hammer blow count is not attained on redriving, the Engineer may direct the Contractor to drive all of the remaining pile length and repeat the set period and redriving procedure. Splice those piles driven to plan grade that do not attain the hammer blow count required, and drive until the required bearing resistance is attained. If the required bearing resistance is attained for each pile that is redriven, then the remaining piles in that bent are considered satisfactory when driven to at least the same penetration and resistance as the redriven piles.

(Use the following two paragraphs when a minimum "set period" of longer than 24 hours is required. Fill in the blank. Use days or hours as appropriate and delete whichever doesn't apply.)

Replace the sentence that begins “The “set period” shall be...” with the following sentence:

The “set period” ~~shall be~~ is a minimum of _____ (Days)(hours) unless otherwise approved by the Engineer.

(Use the following two paragraphs when piles are required to set before redriving.)

Add the following sentence to the end of this subsection:

Piles are required to set before redriving.

00520.42(e) Jetted Piles - Replace this subsection, except for the subsection number and title, with the following:

The nominal pile bearing resistance of jetted piles is based on impact driving blow count after jetting has been completed. Jet pipes may be removed when the pile tip is at the required minimum pile tip elevation and before the pile is driven to the required bearing resistance. For piles that are jetted at the Contractor's request and do not attain the required nominal bearing resistance at the ordered length, splice, as required, and drive with a specified impact pile hammer until the required nominal bearing resistance is achieved according to appropriate criteria in 00520.42. If jetting is requested by the Contractor, perform all splicing and driving piles beyond the order length at no additional cost to the Agency.

00520.42(g) Vibratory Hammers - Replace this subsection, except for the subsection number and title, with the following:

The nominal bearing resistance of piles driven with vibratory hammers is based on impact driving blow count after the vibratory Equipment has been removed. When vibratory installation of the piles is approved by the Engineer and the vibrated piles do not attain the required nominal bearing resistance at the specified length, splice them as required, at no additional cost to the Agency, and drive with a specified impact pile hammer until the required nominal bearing resistance is achieved, according to 00520.42.

00520.43(b) Storage and Handling - Replace this subsection, except for the subsection number and title, with the following:

Store and handle steel piles in ways that protect them from damage. Bent or kinked piles are rejected.

(Use the following subsection .43(c) on projects with steel pipe piles that do not require reinforced tips. Delete the end treatment that does not apply and remove the parentheses. Obtain information from the Geotechnical Designer. If reinforced tips are required, do not use this subsection; instead use subsection .43(d) below.)

00520.43(c) End Treatment - Add the following sentence to the end of this subsection:

Drive steel pipe piles (open)(closed)-ended with tip treatment as shown.

(Use the following subsection .43(d) on projects with steel pipe piles that require reinforced pile tips. Delete "inside" or "outside" as appropriate and remove the parentheses. Obtain information from the Geotechnical Designer.)

00520.43(d) Reinforced Pile Tips - Add the following sentence to the end of this subsection:

For steel pipe piling, provide (inside)(outside) fit, open end cutting shoes meeting the requirements of 02520.10(e).

00520.43(g)(1) Splices - Replace this subsection, except for the subsection number and title, with the following:

Construct splice joints for pipe piles according to Joint B-U4a or B-U4a-GF (Single-Bevel Groove Weld) in D1.1. Weld back-up rings with a full penetration groove weld. Construct pipe pile splices that include a steel plate for Soil plug formation according to Joint TC-U4a or TC-U4a-GF.

Construct splice joints for H-piles according to Joint B-U3b or B-U3-GF (Double V-Groove Weld) in D1.1 for both the web and flange sections. Joint B-U4a or B-U4a-GF may be substituted on the flange weld. Provide access holes at the ends of the web according to D1.1.

00520.43(g)(2) Submittals - Replace the bullet that begins "A Welding Procedure Specification ..." with the following bullet:

- A Welding Procedure Specification (WPS) for all pile welds, according to the limitations of D1.1. Both ASTM A36 and ASTM A252 Grade 1 and 2 may be treated as prequalified base metals under Group 1. ASTM A252 Grade 3 will not be considered a prequalified base metal unless the steel has a Carbon Equivalent (CE) of 0.30 percent or less. Develop a Procedure Qualification Record (PQR) for all welding using Grade 3 steel or present proof that the chemistry of the steel meets the CE requirements.

Replace the bullet that begins "An inspection report stating ..." with the following bullet:

- An inspection report stating that the welding under the Contract was performed according to D1.1. Include a review of the WPS, a review of welder qualifications and a report on visual inspection of the welds on the Project Site in the report. Submit inspection reports signed by a Certified Welding Inspector (CWI) holding QC1 certification as defined in D1.1.

00520.43(g)(3) Additional Testing - Replace this subsection, except for the subsection number and title, with the following:

The Engineer may request additional nondestructive testing (NDT), such as radiography or ultrasonic testing of any or all welds. If the additional testing identifies defects warranting rejection, perform repair and additional inspection at no additional cost to the Agency. If the additional NDT does not identify defects warranting rejection, the Agency will pay the cost of the additional testing. Radiographic and ultrasonic defect indications are evaluated according to the statically loaded criteria of D1.1.

00520.43(h) Cutoff Lengths - Replace this subsection, except for the subsection number and title, with the following:

Cut off the tops of all permanent piles square and smooth at the elevation shown or as directed. All cut-off pile becomes the property of the Contractor. Dispose of according to 00290.20. With approval, undamaged cutoffs may be used as pile extensions or welded together to form full length piles. Do not vary steel pile cutoffs welded together from a straight line more than 1/4 inch in 20 feet measured along any edge of the pile, whether pile extensions or full length piles.

Mark all acceptable cutoffs and unused pile lengths remaining at completion of pile driving for identification by the Engineer as acceptable for use on other or future Agency projects if requested by the Contractor.

00520.46 Damaged or Defective Piles - Replace this subsection, except for the subsection number and title, with the following:

In addition to other specified requirements:

- Approval of a pile hammer does not relieve the Contractor of responsibility for piles damaged from misalignment of the leads, failure of cap block or cushion materials, failure of splices, malfunctioning of the pile hammer or other improper construction methods.
- Piles damaged during installation are considered unsatisfactory unless the nominal bearing resistance is proved by load tests performed by the Contractor. If such tests indicate inadequate resistance, take corrective measures, such as the use of damaged piles at reduced resistance, installation of additional piles, strengthening of damaged piles, or replacement of damaged piles.
- A concrete pile is considered defective if a visible crack appears around the entire periphery of the pile, or any other crack or defect is observed that is determined to affect the strength or performance of the pile.
- Do not place footing concrete until all piles within a footing are inspected by the Engineer.

00520.80(a) Furnish Pile Driving Equipment - Replace this subsection with the following subsection:

00520.80(a) Provide Pile Driving Equipment - No measurement of quantities will be made for providing Equipment for driving piles.

(Add the following lead-in paragraph and subsection .80(g) when protective coatings are required on steel piles.)

Add the following subsection:

00520.80(g) Steel Pile Protective Coatings - The estimated quantities of steel pile protective coatings are:

Coating System

**Length of Coated
Pile (feet)**

00512.90 Payment - Replace the Pay Item Furnish Pile Driving Equipment with the following Pay Item:

<u>Pay Item</u>	<u>Unit of Measurement</u>
(a) Provide Pile Driving Equipment.....	Lump Sum

Replace the bullet that begins "When Equipment for driving ..." with the following bullet:

- When Equipment for driving piles is provided and is satisfactorily driving piles 75%

Replace the paragraph that begins "The cost of all Materials ..." with the following paragraph:

The cost of all Materials and labor, including the manipulation of the pile driving Equipment in connection with driving piles will be included in the unit price each for driven piles. Providing Equipment for driving sheet piling is not included in this Work.

Replace the paragraph that begins "In items (b), (c), (d) ..." with the following paragraph:

In items (b), (c), (d) and (k) the type and size of pile is inserted in the blank.

Replace the paragraph that begins "Items (d) and (e) ..." with the following paragraph:

Items (d) and (e) include all expenses involved in driving piles that have not attained the required bearing resistance and are required to stand for a "set period".

Replace the paragraph that begins "Payment will be payment ..." with the following paragraph:

Payment will be payment in full for furnishing and placing all Materials, and for providing all Equipment, labor, and Incidentals necessary to complete the Work as specified.