

SECTION 00512 - DRILLED SHAFTS

(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.)

Comply with Section 00512 of the Standard Specifications modified as follows:

00512.14(a) Mineral Slurry - Replace the paragraph that begins "Use mineral slurry ..." with the following paragraph:

Use mineral slurry meeting the following requirements:

00512.14(b) Synthetic Slurries - Replace the paragraph that begins "Select synthetic slurries from ..." with the following paragraph:

Select synthetic slurries from the QPL. Use synthetic slurries according to the manufacturer's recommendations and the Contractor's quality control plan. The allowed Sand content of synthetic slurry is less than 1.0 percent prior to final cleaning and immediately prior to concrete placement.

00512.14(c) Water Slurry - Replace the paragraph that begins "Water may be used as ..." with the following paragraph:

Water may be used as slurry when casing is used for the entire length of the drilled shaft. Use of water slurry without full-length casing will only be allowed with the Engineer's approval. Use water slurry meeting the following requirements:

00512.15 Crosshole Sonic Log Access Tubes - Replace the bullet that begins "Steel access tubes shall ..." with the following bullet:

- Use steel access tubes at least 1 1/2 inch inside diameter Schedule 40 pipe meeting ASTM A53, Grade A or B, Type E, F, or S.

Replace the bullet that begins "Access tube acceptance ..." with the following bullet:

- Access tube acceptance is based on manufacturer's certification that the furnished Material meets the requirements of this Specification.

00512.18 Crosshole Sonic Log Cement Grout - Replace this subsection, except for the subsection number and title, with the following:

Furnish non-epoxy grout or tendon grout from the QPL or furnish a pumpable CSL cement grout consisting of neat cement and water that has a water-cement ratio between 0.38 and 0.45. Furnish portland cement for the pumpable CSL cement grout meeting the requirements of Section 02010.

00512.30 Personnel Qualifications - Replace this subsection, except for the subsection number and title, with the following:

Perform the drilled shaft construction Work using a company and personnel experienced in drilled shaft construction Work. Submit a list to the Engineer for approval identifying the on-site supervisors and drill rig operators assigned to the Project and the company's experience relevant to the Project. Submit experience relevant to the anticipated subsurface materials, groundwater conditions, shaft size, depth and any special construction techniques required. Also provide the experience qualifications of the company performing the quality assurance testing. Before the preconstruction conference, provide the following information to verify the firm's experience and the qualifications of personnel scheduled to perform the drilled shaft construction and quality assurance testing:

- Submit a project reference list of at least three separate foundation projects, successfully completed in the last 5 years, with Drilled Shafts of diameters and depths equal to or larger than those shown in the Plans and in ground conditions similar to those indicated. Include a brief description of each project and the owner's contact person's name and current phone number for each project listed.
- Submit a resume for on-site supervisors with at least 2 years' experience in supervising construction of drilled shaft foundations of similar size (diameter and depth) and scope to those shown in the Plans and in similar geotechnical conditions to those described in the geotechnical report. Submit experience that includes the direct supervisory responsibility for the on-site construction operations.
- Submit a resume for drill operators with at least 1 year of experience in the construction of drilled shaft foundations.
- Perform quality assurance testing using an independent testing organization retained by the Contractor and approved by the Agency. Provide personnel experienced in operating the specific quality assurance testing Equipment. Submit the CSL testing firm qualifications according to 00512.40(a). Provide a quality assurance testing firm that has successfully performed quality assurance testing on a minimum of five projects during the last 3 years. Provide quality assurance testing personnel that have been trained in the operation of the quality assurance Equipment and have at least 1 year of experience in operating quality assurance testing Equipment on a minimum of 10 shafts.

The Engineer will respond within 21 Calendar Days after receipt of the submittal. Do not begin Work on any drilled shafts until the qualifications have been approved. The Engineer may suspend the drilled shaft construction if the Contractor substitutes unapproved personnel during construction. Submit requests for substitution of either on-site supervisors, drill operators, or CSL testing personnel to the Engineer, who will have 7 Calendar Days to respond to each request. Additional costs resulting from the suspension of Work due to the changing of personnel is the Contractor's responsibility, and no adjustment in Contract Time resulting from the suspension of Work is allowed.

00512.40(a) Drilled Shaft Installation Plan - Replace the paragraph that begins "The Engineer will approve or reject ..." with the following paragraph:

The Engineer will approve or reject the drilled shaft installation plan within 21 Calendar Days after receipt of all submissions. Provide any additional information and submit a revised plan, if requested, for review and approval. All procedural approvals given by the Engineer are subject to trial in the field and will not relieve the Contractor of the responsibility to satisfactorily complete the Work. Submit requests for modification of adopted procedures to the Engineer. Allow 21 Calendar Days for approval of modifications. Do not begin drilled shaft construction Work until all drilled shaft submittals have been approved.

00512.41 Drilled Shaft Coordination Meeting - Replace the paragraph that begins "Hold a drilled shaft coordination ..." with the following paragraph:

Hold a drilled shaft coordination meeting at least 7 Calendar Days before beginning any shaft construction Work at the site to discuss construction procedures, schedules, staging, personnel, Equipment to be used, and other elements of the approved shaft installation plan as specified in 00512.40. If synthetic slurry is used to construct the shafts, discuss the frequency of scheduled site visits to the Project Site by the synthetic slurry manufacturer's representative. Those attending the meeting include:

Replace the bullet that begins "Representing the Contractor ..." with the following bullet:

- **Representing the Contractor** - The superintendent, on-site supervisors, and all supervisors in charge of excavating the shaft, placing the casing, mixing and installing slurry (as applicable), placing the steel reinforcing bars, and placing the concrete. If synthetic slurry is used to construct the shafts, the slurry manufacturer's representative and a Contractor's employee trained in the use of the synthetic slurry are required to also attend.

~~(Use the following subsection .43(a) when the contract requires a minimum shaft penetration into a bearing layer (as opposed to a specified tip elevation) and the bearing layer elevation at each shaft cannot be accurately determined. Obtain the information from the Geotechnical Engineer. Include subsections .45, .80(d), and .80(e).)~~

00512.43(a) Drilled Shaft Excavation, General - Replace the paragraph that begins "Excavate Drilled Shafts to the ..." with the following paragraph:

Excavate Drilled Shafts to the dimensions and elevations shown or as directed. Provide and maintain stabilized drilled shaft sidewalls and bottoms for the full depth of the excavation, using approved Materials, Equipment and methods. If caving or other unstable conditions occur during any construction procedure, stop further construction, notify the Engineer, and stabilize the shaft excavation by approved methods and submit a revised installation plan that addresses the problem and prevents further instability. Do not continue with shaft construction until any damage that occurred has been repaired according to the Specifications and until receiving the Engineer's approval of the revised shaft installation plan.

~~(Use the following subsection .43(a) when the contract requires a minimum shaft penetration into a bearing layer (as opposed to a specified tip elevation) and the~~

bearing layer elevation at each shaft cannot be accurately determined. Obtain the information from the Geotechnical Engineer. Include subsections .45, .80(d), and .80(e).)

Add the following paragraph to the end of this subsection:

Variations in the bearing layer elevation from that shown are anticipated. **Provide** Equipment on-site capable of excavating an additional _____ feet of depth below that shown.

00512.43(c) Temporary Casing - Replace the bullet that begins "The minimum diameter ..." with the following bullet:

- The minimum diameter of the shaft is as shown.

Replace the bullet that begins "Use temporary telescoping ..." with the following bullet:

- Use temporary telescoping casing material according to 00512.13.

00512.43(d) Unexpected Drilled Shaft Obstructions - Replace this subsection, except for the subsection number and title, with the following:

Remove any natural or manmade object encountered that was not revealed by the Agency's site investigation, and that would cause a significant decrease in the rate of advancement if removed using the techniques and Equipment used successfully to excavate the shaft. The Engineer is the sole judge of the significance of any reduced rate of shaft advancement and the classification of any unexpected obstructions. Removal of unexpected obstructions from the shaft excavation will be paid according to 00195.20.

00512.43(e) Lost Tools - Replace this subsection, except for the subsection number and title, with the following:

Promptly remove drilling tools lost in the excavation. Lost tools will not be considered unexpected obstructions. Remove lost tools without additional compensation. Drilling tools lost during the course of removing unexpected drilled shaft obstructions will be paid according to 00195.20.

00512.43(f) Drilling Slurry Installation - Replace the paragraph that begins "If synthetic drilling slurry is ..." with the following paragraph:

If synthetic drilling slurry is selected, provide a manufacturer's representative to provide technical assistance at the site prior to use of the slurry, and have them remain at the site during construction and completion of a minimum of one drilled shaft to adjust the slurry mix for the specific site subsurface conditions. After the manufacturer's representative is no longer at the site, provide the approved personnel trained in the use of the synthetic slurry for the remainder of the shaft slurry operations to supervise the proper slurry mix design and quality control procedures.

Replace the paragraph that begins "All in hole drilling ..." with the following paragraph:

Meet the required slurry specifications during excavation and prior to concrete placement. Clean, recirculate, de-sand or replace the slurry to maintain the required slurry properties.

00512.43(g) Drilling Slurry Inspection and Testing - Replace the paragraph that begins "Mix and thoroughly ..." with the following paragraph:

Mix and thoroughly hydrate all drilling slurries in an appropriate storage facility. Collect sample sets from the storage facility and perform tests to ensure the slurry conforms to the specified Material properties before introduction into the drilled shaft excavation. A sample set consists of samples taken at mid-depth and within 24 inches of the bottom of the storage facility.

Replace the paragraph that begins "Sample and test all slurry ..." with the following paragraph:

Sample and test all slurry in the presence of the Engineer, unless otherwise directed. Provide the sample sets of slurry within the excavation consisting of samples taken at mid-depth of the excavation and within 24 inches of the bottom of the excavation. Collect and test sample sets during the drilling operation as necessary to ensure the specified properties of the slurry are maintained. Clean, recirculate, de-sand, or replace the slurry as necessary to maintain the specified slurry properties. Final cleaning of the excavation and placement of concrete is not allowed until the test results indicate the slurry properties are as specified.

00512.43(h) Clean Out - Replace the paragraph that begins "Use appropriate means, such ..." with the following paragraph:

Use appropriate means, such as a cleanout bucket, pump or air lift, to clean the bottom of the drilled shaft excavations. No more than 2 inches of loose or disturbed material is allowed at the bottom of the excavation for end-bearing Drilled Shafts. No more than 6 inches of loose or disturbed material is allowed at the bottom of the excavation for side friction Drilled Shafts. Assume end-bearing shafts unless otherwise shown or specified. Shaft cleanliness is determined by the Engineer.

(Use the following lead-in paragraph and subsection .44 when permanent casing is required. Include the outside diameter and the wall thickness under the "Casing Size" column.)

Add the following subsection:

00512.44 Permanent Casing - **Furnish** and install permanent casing as follows:

Bridge Number	Bent Number	Casing Size	Elevation for Top of Casing (Feet)	Elevation for Bottom of Casing (Feet)

Perform welding of all permanent casing according to AWS D1.1. Test all full penetration welds using nondestructive methods by either radiograph or ultrasonic methods. Base nondestructive testing acceptance criteria on cyclic tension loading.

After concrete placement, fill all void space between the casing and the shaft excavation with a material that approximates the geotechnical properties of the in-situ materials.

(Use the following subsection .45(e) when the contract requires a minimum shaft penetration into a bearing layer (as opposed to a specified tip elevation) and the bearing layer elevation at each shaft cannot be accurately determined. Obtain the information from the Geotechnical Engineer. Include subsections .43(a), .80(d), and .80(e).)

Add the following subsection:

00512.45(e) Rock Socket - At locations requiring minimum shaft penetrations into specific bearing layers, **furnish** steel reinforcing bar cages, including CSL access tubes if specified, ___ feet longer than the lengths shown. Add the increased length to the bottom of the cage. Trim the shaft steel reinforcing bar cage to the proper length prior to placing it in the excavation. Shift or trim CSL access tubes (if present) to the revised cage length. If CSL tubes are cut, adapt the ends of the tubes to receive the watertight caps as specified.

00512.46 Crosshole Sonic Log Test Access Tubes - Replace the paragraph that begins "Furnish and install access tubes ..." with the following paragraph:

Furnish and install access tubes for CSL testing as shown. Attach CSL access tubes securely to the interior of the reinforcement cage as near to parallel as possible in each drilled shaft and in the pattern shown. Extend the access tubes from the bottom of the reinforcement cage to at least 24 inches above the top of the shaft. When joints are required to achieve full-length access tubes, furnish watertight joints. Do not damage the access tubes during reinforcement cage installation and concrete placement. Fill the tubes with potable water, according to 02020.10(b), as soon as possible, but no more than 1 hour after concrete placement and reinstall the top watertight caps. Check water level and top off as needed.

00512.47(a) Concrete Placement - Replace the paragraph that begins "Allow a maximum of 60 minutes ..." with the following paragraph:

Allow a maximum of 60 minutes between concrete placements and use no concrete older than 90 minutes from batch time. Use procedures for concrete placement ensuring that the concrete within the shaft becomes a monolithic, homogeneous unit.

00512.47(b) Casing Removal - Replace the paragraph that begins "Under free-fall placement ..." with the following paragraph:

Under free-fall placement, deposit concrete through the center of the reinforcement cage by a method that prevents segregation of Aggregates and splashing of concrete on the reinforcement cage. Place concrete so that the free-fall is vertical down the center of the shaft without hitting the sides, the steel reinforcing bars or steel cage bracing.

00512.47(e) Dry Shaft Concrete Placement - Replace the paragraph that begins "Remove all Temporary Casing during ..." with the following paragraph:

Remove all Temporary Casing during or after completion of concrete placement. Do not start Temporary Casing removal until the level of fresh concrete within the casing has reached a

depth of at least 10 feet or the level necessary to adequately counteract the external hydrostatic pressure head. As the Temporary Casing is withdrawn, maintain a minimum 5 feet head of concrete above the bottom of the casing. A slight downward movement of the casing while exerting downward pressure, or hammering or vibrating the casing is allowed to facilitate extraction. Extract the casing so that concrete is cast directly against the surrounding in-situ material. Check the elevation of the top of the reinforcing cage before and after Temporary Casing extraction for conformance with the construction tolerance criteria of 00512.42. Casing that cannot be extracted during, or immediately after, the concrete placement operation may be cause for rejection of the shaft.

00512.48 Drilled Shaft Testing and Acceptance - Replace the paragraph that begins "Acceptance of Drilled Shafts ..." with the following paragraph:

Acceptance of Drilled Shafts is based on the Engineer's review of the results of CSL, or other, integrity testing (if conducted), field inspection reports and visual observations during drilled shaft construction. The Engineer has final authority on the approval of Drilled Shafts. For shafts that are integrity tested, the Engineer will determine final acceptance of each tested shaft, based on the integrity test results and inspection reports and will provide a response to the Contractor within 5 Calendar Days after receiving the CSL test report.

00512.48(a) Crosshole Sonic Log Testing - Replace the paragraph that begins "Provide crosshole sonic log ..." with the following paragraph:

Provide crosshole sonic log testing Equipment and perform crosshole sonic log testing and analysis on the first drilled shaft completed at each Structure and subsequent shafts as specified or designated for testing by the Engineer. Provide CSL testing Equipment according to the requirements of ASTM D6760 and approved by the Engineer. Provide all necessary access and other support to the CSL testing firm necessary to do the CSL testing Work.

00512.48(b) Contractor's Crosshole Sonic Log Test Reports - Replace the paragraph that begins "Submit a stamped final CSL ..." with the following paragraph:

Submit a stamped final CSL Test Report for each shaft tested according to 00150.35 and ASTM D6760. Provide electronic file copies of the raw CSL data measurements, if requested. Include a summary of the CSL testing performed, data analysis, and interpretation of CSL data with special attention made to the identification and location of any anomalies or possible defects. Provide interpretation of the CSL test data in terms of overall shaft integrity and acceptance. Submit all reports to the Engineer within 5 Calendar Days of the performance of the tests.

00512.48(c) Additional Testing and Investigation - Replace the paragraph that begins "If requested by the Engineer ..." with the following paragraph:

If requested by the Engineer, drill a core hole in any questionable quality shaft to explore the shaft condition. The Engineer will determine the number, location and depths of the core holes. Submit the method and Equipment used to drill and remove cores from the shaft to the Engineer for review and approval prior to drilling. Use a coring method that provides complete core recovery and minimizes abrasion and erosion of the core. If a defect is confirmed, as determined by the Engineer, all investigation costs associated with identifying the defect will be at no additional cost to the Agency and no extension of the Project completion date will be granted, regardless of whether the identified defect is repaired or not.

00512.80(a) Furnish Drilling Equipment - Replace the title of this subsection with “**Provide Drilling Equipment**”

(Use the following subsection .80(d) to list the estimated amount of required concrete.)

00512.80(d) Drilled Shaft Concrete - Add the following at the end of this subsection:

The estimated quantity of drilled shaft concrete is:

Structure	Quantity (Cubic Yard)
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(Use the following paragraph when additional concrete is required to extend the minimum shaft penetrations. Include subsections .43(a), .45, and .80(e).)

The estimated quantity of drilled shaft concrete includes the concrete required to extend the shafts according to 00512.43(a).

(Use the following subsection .80(e) to list the estimated amount of required reinforcement. Remove the coated reinforcement table if coated steel is not required.)

00512.80(e) Drilled Shaft Reinforcement - Add the following at the end of the paragraph:

The estimated quantity of drilled shaft reinforcement is:

Structure Number	Uncoated Reinforcement Quantity (Pound)		
	Grade 60	Grade 80	Grade 100

Structure Number	Coated Reinforcement Quantity (Pound)		
	Grade 60	Grade 80	Grade 100

(Use the following paragraph when additional reinforcement is required to extend the minimum shaft penetrations. Include subsections .43(a), .45, and .80(d).)

The estimated quantity of drilled shaft reinforcement includes the reinforcement required to extend the shafts according to 00512.45.

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

<u>Pay Item</u>	<u>Unit of Measurement</u>
<u>(a) Provide Drilling Equipment</u>	<u>Foot</u>

Replace the paragraph that begins "Item (a) includes ..." with the following paragraph:

Item (a) includes providing and moving the drilling Equipment to the Project, setting up the Equipment at the various locations on the Project and removing the Equipment from the Project.

Replace the paragraph that begins "In item (b) ..." with the following paragraph:

In item (b), the diameter of the shaft casing is inserted in the blank.

Replace the paragraph that begins "In item (c) ..." with the following paragraph:

In item (c), the diameter of the shaft is inserted in the blank. Item (c) includes excavating the shafts and disposing of the excavated material and for providing, placing, splicing, and removing temporary shaft casing and forms.

Replace the paragraph that begins "In item (e) ..." with the following paragraph:

In item (e), the grade of reinforcement is inserted in the blank.

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.