Origination Form

Specifications

Submittal Information			
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Date:	2026-06-09T12:01:21Z	**Associated Specs:**	455 Design Build

Summary:

Updates to pile driving and drilled shaft construction items intended mostly to ensure consistency between the conventional and design-build versions of the Specification.

Justification:

To ensure consistency between the conventional and design-build versions of the Specification, to address time requirements for review of construction documents, update the limits on stress levels for cylinder piles, and ensure adequate use of polymer slurry during drilled shaft excavation.

Do the changes affect other types of specifications?

Neither

List Specifications Affected:

Other Affected Documents/Offices	Contacted	Yes/No
Other Standard Plans		No
Florida Design Manual		No
Structures Manual		No
Basis of Estimates Manual		No
Approved Product List		No
Construction Office		No
Maintenance Office		No

Materials Manual		No
Traffic Engineering Manual		No

Are changes in line with promoting and making progress on improving safety, enhancing mobility, inspiring innovation, and fostering talent; explain how?

Section 455 in the Construction Specification focuses on enabling foundation construction in a manner that is efficient, safe and reliable. The recent updates include clarification on time requirements for submittals, ensuring consistency between the conventional and design-build versions of the document, reporting of results, and monitoring of stresses during pile installation, in particular as it refers to cylinder piles.

What financial impact does the change have; project costs, pay item structure, or consultant fees?

The updates made to the Specification should not have any significant financial impact on project cost, pay item structure or consultant fees.

What impact does the change have on production or construction schedules?

The updates made to the Specification should not have any significant impact on construction schedule.

How does this change improve efficiency or quality?

The updates are intended to clarify the Department’s requirements and should result in improved efficiency during construction operations.

Which FDOT offices does the change impact?

Construction

What is the impact to districts with this change?

The updates should assist the Districts in implementing pile driving and drilled shaft construction requirements in an efficient manner.

Does the change shift risk and to who?

No, the risk model remains unchanged.

Provide summary and resolution of any outstanding comments from the districts or industry.

Comments and Responses are available on the Track the Status of Revisions hyperlink located on the Specifications landing page: https://www.fdot.gov/specifications/default.shtm

What is the communication plan?

Through the established specification revision process (e.g., Internal and Industry Review)

What is the schedule for implementation?

The Standard Specifications eBook and Workbook are effective July 1st every year.

STRUCTURES FOUNDATIONS
(REV 6-9-26)

SUBARTICLE 455-2.2.1 is deleted and the following substituted:

455-2.2.1 Modified Quick Test:

1. Loading Procedure: Apply vertical loads concentric with the longitudinal axis of the tested pile/shaft to accurately determine and control the load acting on the pile/shaft at any time. ~~Place the~~Add each load ~~on the pile/shaft continuously~~increment in a continuous fashion immediately after recording movement and strain readings for the previous load interval.~~,~~ Apply the load in increments equal to approximately 5% of the maximum test load specified until approaching the failure load, as indicated by the measuring apparatus and/or instruments. Then, apply increments of approximately 2.5% until the pile/shaft "plunges" or attains the limiting load. The Engineer may elect to stop the loading increments when they determine the Contractor has met the failure criteria or when a settlement equal to 10% of the pile/shaft width or diameter is reached. Apply each load increment immediately after taking and verifying the complete set of readings from all gauges and instruments. Apply each increment of load within the minimum length of time practical, and immediately take the readings. Complete the addition of a load increment and the completion of the readings within 5 to 15 minutes. The Engineer may elect to hold the maximum applied load up to one hour.

Remove the load in decrements of about 10% of the maximum test load. Remove each decrement of load within the minimum length of time practical, and immediately take the readings. Complete the removal of a load decrement and the taking of the readings within 5 to 15 minutes. The Engineer may also require up to two reloading cycles with five loading increments and three unloading decrements. Record the final recovery of the pile/shaft until movement is essentially complete for a period up to one hour after the last unload interval.

2. Failure Criteria and Nominal Resistance: Use the criteria described herein to establish the failure load. The failure load is defined as the load that causes a pile/shaft top deflection equal to the calculated elastic compression plus 0.15 inches plus 1/120 of the pile/shaft minimum width or the diameter in inches for piles/shafts 24 inches or less in width, and equal to the calculated elastic compression plus 1/30 of the pile/shaft minimum width or diameter for piles/shafts greater than 24 inches in width. Consider the nominal resistance of any pile/shaft so tested as either the maximum applied load or the failure load, whichever is smaller.

SUBARTICLE 455-2.8 is deleted and the following substituted:

455-2.8 Required Reports: Include in the report of the load test the following information:

1. A tabulation of the time of, and the amount of, the load and settlement readings, and the load and recovery readings taken during the loading and unloading of the pile/shaft.

2. A graphic representation of the test results, during loading and unloading of pile/shaft top movement as measured by the average of the dial gauge readings, from wireline readings and from level readings.

3. A graphic representation of the test results, when using telltales, showing pile/shaft compression and pile/shaft tip movement.

4. The estimated failure and safe loads according to the criteria described herein.

5. The derived side friction component for each pile/shaft segment, and end bearing component. Include all pertinent test data, analysis and charts used to determine these values.

~~5~~6. Remarks concerning any unusual occurrences during the loading of the pile/shaft.

~~6~~7. The names of those making the required observations of the results of the load test, the weather conditions prevailing during the load test, and the effect of weather conditions on the load test.

~~7~~8. All supporting data including jack and load cell calibrations and certificates and other equipment requiring calibration.

~~8~~9. Furnish initial strain readings and all of the data taken during the load test together with instrument calibration certifications. Include analysis of the results of axial load and lateral load tests in which soil resistance along and against the pile/shaft is reported as a function of deflection, strain data, soil borings and associated laboratory testing.

10. For drilled shafts include drilled shaft installation logs, all cross-hole sonic logging results, gamma-gamma density logging results, the results of other integrity tests, caliper measurements data and the pilot holes reports of core borings. Attach this report to the final authorized tip elevations letter in accordance with 455-15.6.

11. For piles, include pile driving records and dynamic testing data and analysis.

Submit the necessary reports prepared by the Specialty Engineer responsible for collection and interpretation of the data, except when the Contract Documents show that the Department will provide a Geotechnical Engineer.

SUBARTICLE 455-5.9 is deleted and the following substituted:

455-5.9 Penetration Requirements: Measure the penetration of piles from the elevation of the natural ground, the existing surface, the deepest scour elevation shown in the Pile Data Table, or the bottom of excavation, whichever is lowest. The Engineer will accept the bearing of a pile only if the Contractor achieves the required bearing when the tip of the pile is at or below the specified minimum tip elevation and below the bottom of the preformed or predrilled pile hole.

Do not drive piles beyond practical refusal. When piles cannot be driven to the required penetration without reaching practical refusal~~To meet the requirements in this Subarticle,~~ provide penetration aids, such as jetting or preformed pile holes, with or without casing, to satisfy the Contract Documents. ~~when piles cannot be driven to the required penetration without reaching practical refusal.~~

If the Contractor encounters unforeseeable, isolated obstructions that the Contractor cannot practically penetrate by driving, jetting, or preformed pile holes, and the Contractor must remove the pile to obtain the required pile penetration, the Department will pay the costs for such removal as Unforeseeable Work.

SUBARTICLE 455-5.11.1 is deleted and the following substituted:

455-5.11.1 General: Drive piles to provide the bearing required for carrying the loads shown in the Plans. For all types of bearing piles, consider the driving resistance as determined by the methods described herein sufficient for carrying the specified loads as the minimum bearing which is accepted for any type of piles. Determine pile bearing using the method described herein or as shown in the Plans.

For foundations requiring 100% dynamic testing of production piles, ensure each pile has achieved minimum ~~penetration~~ pile tip requirements in 455-5.9 and the required bearing for minimum 6 inches of consecutive driving, or when the minimum ~~penetration~~ pile tip is achieved, driving has reached practical refusal in firm material and the bearing capacity is obtained in all the refusal blows.

For foundations not requiring 100% dynamic testing of production piles, ensure each pile has achieved the minimum ~~penetration~~ pile tip requirements in 455-5.9, the blow count is generally the same or increasing and the minimum required bearing capacity obtained for 24 inches of consecutive driving with less than 1/4 inch rebound per blow, or achieved the minimum ~~penetration~~ pile tip requirements in 455-5.9 and driving has reached practical refusal in accordance with 455-5.11.3.

With concurrence of the Engineer, the Dynamic Testing Engineer (DTE) may modify the scour resistance shown in the Plans if the dynamic load test is used to determine the actual soil resistance through the scour zone.

SUBARTICLE 455-5.12.2 is deleted and the following substituted:

455-5.12.2 Wave Equation:

1. Use Wave Equation Analysis for Piles (WEAP) programs to evaluate the suitability of the proposed driving system (including the hammer, follower, capblock and pile cushions) as well as to estimate the driving resistance, in blows per 12 inches or blows per inch, to achieve the pile bearing requirements and to evaluate pile driving stresses.

Use Wave Equation Analyses to show the hammer meets the requirements described in 455-5.3 and maximum allowed pile stresses are not exceeded.

2. Required Equipment for Driving: Hammer approval is based on satisfactory field performance including dynamic load test results. In the event piles require different hammer sizes, the Contractor may elect to drive with more than one size hammer or with a variable energy hammer, provided the hammer is properly sized and cushioned, will not damage the pile, and will develop the required resistance.

3. Maximum Allowed Pile Stresses:

a. General: The maximum allowed driving stresses for concrete, steel, and timber piles are given below. In the event dynamic load tests show that the hammer will overstress the pile, modify the driving system or method of operation as required to prevent overstressing the pile. In such cases provide additional cushioning, reduce the stroke, or make other appropriate agreed upon changes.

b. Prestressed Concrete Piles: Use the following equations to determine the maximum allowed pile stresses:

$$s_{apc} = 0.7\, f'_c - 0.75\, f_{cpe} \qquad \text{(1a)}$$

$s_{apc} = 0.6(0.7\, f'_c - 0.75\, f_{cpe})$ _____(1b) for voided piles

$s_{apt} = 6.5(f'_c)^{0.5} + 1.05\, f_{cpe}$ _____(2a) for piles less than 50 feet long

$s_{apt} = 3.25(f'_c)^{0.5} + 1.05\, f_{cpe}$ _____(2b) for piles 50 feet long and greater

$s_{apt} = 1.05\, f_{cpe}$ _____(2c) for post-tensioned cylinder piles

$s_{apt} = 500$ _____(2ed) within 20 feet of a mechanical splice

where:

s_{apc}= maximum allowed pile compressive stress, psi

s_{apt}= maximum allowed pile tensile stress, psi

f'_c= specified minimum compressive strength of concrete, psi

f_{cpe}= effective prestress (after all losses) at the time of driving, psi, taken as 0.8 times the initial prestress force divided by the minimum net concrete cross-sectional area of the pile (f_{cpe}= 0 for dowel spliced piles).

Equation 1b is applicable for cylinder piles, and piles that have a void that extends all the way to the pile head (e.g., high-moment square prestressed concrete piles).

c. Steel Piles: Ensure the maximum pile compression and tensile stresses measured during driving are no greater than 0.9 times the yield strength (0.9 f_y) of the steel.

d. Timber Piles: Ensure the maximum pile compression and tensile stresses measured during driving are no greater than 3.6 ksi for Southern Pine and Pacific Coast Douglas Fir and 0.9 of the ultimate parallel to the grain strength for piles of other wood.

SUBARTICLE 455-5.13.1 is deleted and the following substituted:

455-5.13.1 General: All test piles will have dynamic load tests. Drive piles of the same cross-section and type as the permanent piles shown in the Plans, in order to determine any or all of the following:

1. installation criteria for the piles.
2. nature of the soil.
3. lengths of permanent piles required for the work.
4. driving resistance characteristics of the various soil strata.
5. amount of work necessary to obtain minimum required pile penetration.
6. ability of the driving system to do the work.
7. need for point protection.
8. the bearing stratum is of sufficient thickness to prevent punching shear failure.

Because test piles are exploratory in nature, drive them harder (within the limits of practical refusal), deeper, and to a greater bearing resistance than required for the permanent piling. Except for test piles which are to be statically or Statnamically load tested, drive test piles their full length or to practical refusal. Splice test piles which have been driven

their full length without achieving the required bearing, and proceed with further driving unless otherwise directed by the Engineer.

As a minimum, unless otherwise directed by the Engineer, do not cease driving of test piles until obtaining the required bearing capacity continuously, where the blow count is increasing, for 10 feet unless reaching practical refusal first. Drive test piles which are to be statically or Statnamically load tested as anticipated for the production piles.

When test piles attain practical refusal prior to attaining minimum penetration, perform all work necessary to attain minimum penetration and the required bearing. Where practical, use water jets to break the pile loose for further driving. Where jetting is impractical, extract the pile and install a preformed pile hole through which driving will continue. The Department will consider the work of extracting the pile to be Unforeseeable Work.

When driving test piles other than low displacement steel test piles, have preforming equipment available at the site and water jets as specified in 455-5.8 when jetting is allowed, ready for use, before the test pile driving begins.

The Engineer may elect to interrupt pile driving up to four times on each test pile, two times for up to two hours and two additional times during the next working day of initial driving to determine time effects during the driving of test piles.

SUBARTICLE 455-5.14 is deleted and the following substituted:

455-5.14 Dynamic Load Tests: Take dynamic measurements during the driving of piles designated in the Plans. Provide all personnel, materials and equipment for dynamic testing. For concrete piles, install instruments prior to driving and monitor all blows delivered to the pile. For steel production piles, the Engineer may accept instrumented set checks or redrives. Perform dynamic load tests to evaluate the following:

1. Suitability of the Contractor's driving equipment, including hammer, capblock, pile cushion, and any proposed follower.
2. Pile capacity.
3. Pile stresses.
4. Energy transfer to pile.
5. Distribution of soil resistance.
6. Soil variables including quake and damping.
7. Hammer-pile-soil system for Wave Equation analyses.
8. Pile installation problems.
9. Pile integrity
10. Other.

Either supply and install embedded gauges in the piles in accordance with Standard Plans, Index 455-003 or attach instruments (strain transducers to measure force and accelerometers to measure acceleration) with bolts to the pile for dynamic testing.

Make each follower and pile to be dynamically tested with externally attached instruments available to drill holes for attaching instrumentation and for wave speed measurements. Support the pile with timber blocks placed at appropriate intervals. Ensure that the pile is in a horizontal position and does not contact adjacent piles. Provide a sufficient clear distance at the sides of the pile for drilling the holes. Furnish the equipment, materials, and labor necessary for drilling holes and taking the wave speed measurements. If the Engineer directs

dynamic load testing, instrumented set-checks, instrumented redrives or verification testing, provide safe access to the top of the piles for drilling the attachment holes. After placing the leads provide safe access to the piles to attach the instruments and for removal of the instruments after completing the pile driving.

The DTE will monitor ~~the stresses in the piles~~pile installation with ~~the~~ dynamic testing equipment during driving to ensure ~~the Contractor does not~~ the maximum allowed stresses are not exceeded ~~the maximum allowed stresses~~. If necessary, add additional cushioning, replace the cushions, or reduce the hammer stroke to maintain stresses below the maximum allowable. If dynamic test equipment measurements indicate non-axial driving, immediately realign the driving system. If the cushion is compressed to the point that a change in alignment of the hammer will not correct the problem, add cushioning or change the cushion as directed by the DTE.

Drive the pile to the required penetration and resistance or as directed by the Engineer.

When directed by the Engineer, perform instrumented set-checks or redrives. Do not use a cold diesel hammer for a set-check or redrive unless in the opinion of the Engineer it is impractical to do otherwise. Warm up the hammer by driving another pile or applying at least 20 blows to a previously driven pile or to timber mats placed on the ground.

455-5.14.1 Remote Monitoring of Dynamic Load Tests: A Dynamic Testing Technician (DTT), under the supervision of the DTO and DTE, may set up equipment on site for remote monitoring of dynamically load tested pile foundations. Remote monitoring is defined as the DTO or DTE using a remote connection to direct the dynamic load testing of piles while not on site or in direct line of sight of the pile driving operation. The DTO or DTE shall only monitor one pile at a time. The remote connection shall provide continuous and uninterrupted audio communication and live viewing of data collection. If the remote connection is lost between the DTT and the DTO or DTE during dynamic load testing, the DTT shall stop the pile driving operation until a stable connection can be established.

If the Engineer determines that remote monitoring is not equivalent to on-site monitoring, then a DTO or DTE shall be on site for dynamic load testing.

SUBARTICLE 455-5.15.2.1 is deleted and the following substituted:

455-5.15.2.1 Structures with Test Piles: When test pile lengths are shown in the Plans, the production pile bid quantity is based on information available during design and estimated pile lengths. Production pile lengths shall be recommended by the DTE for the Engineer's approval based on all information available before the driving of the permanent piles, including, but not limited to, information gained from the driving of test piles, dynamic load testing, static load testing, supplemental soil testing, etc. When authorized by the Department, soil freeze information obtained during set checks and pile redrives may be used to determine authorized pile lengths for sites with extreme soil conditions.

After completion of the test pile program, production pile lengths shall be recommended in a letter signed and sealed by the DTE. At least three working days, excluding weekends and Department observed holidays, prior to beginning of production pile driving, ~~–~~ s~~S~~ubmit the letter and load test reports to the Engineer including the following electronic files (Windows 10 compatible): dynamic testing data, pile driving logs, signal matching data and results, and Wave Equation data and results.

SUBARTICLE 455-5.16.5 is deleted and the following substituted:

455-5.16.5 Deviation from Above Tolerances: The Contractor's Specialty Engineer shall perform an evaluation of the as built foundation to determine whether a foundation redesign or an increase in the loading requirements of the piles is needed. If the evaluation indicates the foundation or the pile load requirements must be modified, propose a redesign to incorporate out of tolerance piles into pile caps or footings, at no expense to the Department. Provide signed and sealed redesign drawings and computations to the Engineer for review at least 5 working days prior to submitting the foundation certification package. Do not begin any proposed construction until the redesign has been reviewed and accepted by the Engineer, except as noted in 455-5.20. Include the accepted signed and sealed evaluation as part of the certification package submitted in accordance with 455-5.19.

~~When the Contractor has failed to meet the above tolerances for position of axial alignment, the Contractor may propose a redesign to incorporate out of tolerance piles into pile caps or footings, at no expense to the Department. Ensure the Contractor's Engineer of Record performs any redesign and signs and seals the redesign drawings and computations. Do not begin any proposed construction until the redesign has been reviewed for acceptability and approved by the Engineer. Utilize Standard Plans for treatment of piles driven more than 4 inches below cutoff elevation.~~

SUBARTICLE 455-10.1 is deleted and the following substituted:

455-10.1 General: Submit the completed Pile Driving Installation Plan Form (Form No. 700-020-01) with the following information at the preconstruction conference or no later than 30 days before driving the first pile.

1. Name and experience record of pile driving superintendent or foreman in responsible charge of pile driving operations. Ensure the pile driving superintendent or foreman in responsible charge of the pile driving operations has the experience requirements of 105-8.13 installing driven piles of the size and depth shown in the Plans.

2. The names of the CTQP qualified inspectors assigned to inspect the pile installation. If the Dynamic Testing Engineer is also a CTQP qualified pile driving inspector and is able to perform both operations, then an additional pile driving inspector is not required when driving piles using embedded sensors.

3. Names of the Dynamic Testing Engineer, Dynamic Testing Operator and Dynamic Testing Technician. Include documentation meeting the qualification requirements of Section 105.

~~2~~4. The quality control processes to ensure the required capacity is achieved in all piles. Include in the PIP the steps and analyses that would be performed when driving conditions change (such as unanticipated tip elevations, hammer modifications, presence of temporary piles and structures, preforming, changes, etc.).

~~3~~5. The name and contact information for the single representative of the Contractor, independent of field operations personnel, to resolve to the Engineer's satisfaction conflicts in the driving procedures or interpretations of the driving criteria. This person shall be

available within two hours notice, and shall have the authority to refer issues to higher levels (corporate, if needed).

46. A letter from the DTE certifying concurrence with the PIP.

Notify the Engineer of any test pile driving and production pile driving at least five working days prior to beginning the installation operations of any pile.

SUBARTICLE 455-15.1.2 is deleted and the following substituted:

455-15.1.2 Drilled Shaft Installation Plan (DSIP): At the preconstruction conference submit a DSIP for review by the Engineer. Final approval will be subject to satisfactory performance. Include in this plan the following details:

1. Name and experience record of drilled shaft superintendent or foreman in responsible charge of drilled shaft operations. Ensure the drilled shaft superintendent or foreman in responsible charge of the drilled shaft operations has a minimum of one year of experience of installing drilled shafts of the size and depth shown in the Plans and a minimum of three years' experience in the construction of drilled shafts using the following methods:

a. Wet Method (mineral and polymer slurry),

b. Casings up to the length shown in the Plans,

c. Shaft drilling operations on water under conditions as shown in the Plans.

2. List and size of proposed equipment, including cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, core sampling equipment, tremies or concrete pumps, casings, and equipment to install and remove casing.

3. Details of sequence of construction operations and sequence of shaft construction in bents or shaft groups.

4. Details of shaft excavation methods, including casing installation procedures.

5. Details of slurry, including proposed methods to mix, circulate, desand, test methods, and proposed CTQP certified technician that will perform and document the fluid tests.

6. Details of proposed methods to clean the shaft excavation.

7. Details of shaft reinforcement, including methods to ensure centering/required cover, cage integrity during placement, placement procedures, cage support, and tie downs.

8. Details of concrete placement, slump loss time, including elapsed concrete placement times and proposed operational procedures for concrete tremie or pump, including initial placement, raising during placement, and overfilling of the shaft concrete. Include provisions to ensure proper final shaft cutoff elevation.

9. Details of casing removal when removal is required, including minimum concrete head in casing during removal.

10. Required submittals, including shop drawing and concrete design mixes.

11. Details of any required load tests, including equipment and procedures, and recent calibrations for any jacks or load cells.

12. Proposed Cross-Hole Sonic Logging (CSL) and Thermal Integrity Testing for Drilled (TITDS) Specialty Engineer to supervise field testing and report the test results.

13. Methods and equipment proposed to prevent displacement of casing and/or shafts during placement and compaction of fill.

14. Provide the make and model of the shaft inspection device, if applicable.

15. Details of environmental control procedures used to prevent loss of slurry or concrete into waterways or other protected areas.

16. Proposed schedule for test shaft installation, load tests and production shaft installation.

17. For drilled shafts constructed using polymer slurry, identify the polymer slurry, the pH and proposed viscosity ranges and a description of the mixing method to be used. Submit the contact information for the manufacturer's representative available for immediate contact during shaft construction and the representative's schedule of availability.

18. When settlement and vibration monitoring of adjacent structures are required as per 108-2, submit a proposed monitoring plan identifying the proposed equipment, the structures and the specific points that will be monitored.

19. Procedure for grouting non-destructive testing access tubes.

20. Other information shown in the Plans or requested by the Engineer.

The Engineer will evaluate the DSIP for conformance with the Contract Documents. Within 20 days after receipt of the plan, the Engineer will notify the Contractor of any additional information required and/or changes that may be necessary to meet the above requirements and satisfy the Contract Documents. The Engineer will reject any part of the plan that does not meet specifications, plans or has the potential to affect the integrity of adjacent structures or negatively affect the environmental conditions. Submit changes agreed upon for reevaluation. The Engineer will notify the Contractor within seven days after receipt of proposed changes of their acceptance or rejection. All equipment and procedures are subject to trial and satisfactory performance in the field.

Acceptance by the Engineer does not relieve the Contractor of the responsibility to perform the work in accordance with the Contract Documents. The installation plan is for the Contractor to explain the approach to the work and allow the Engineer an opportunity to comment on the equipment and procedures chosen before field operations begin. The Engineers acceptance is not a guarantee that the chosen methods and equipment are capable of obtaining the required results, this responsibility lies with the Contractor.

SUBARTICLE 455-15.8.3 is deleted and the following substituted:

455-15.8.3 Polymer Slurry: A representative of the manufacturer must be on-site or available for immediate contact to assist and guide the construction of the first three drilled shafts at no additional cost to the Department. This representative must also be available for on-site assistance or immediate contact if problems are encountered during the construction of the remaining drilled shafts as determined by the Engineer. Use polymer slurry only if the soils below the casing are not classified as organic, and the pH of the fluid in the hole can be maintained in accordance with the manufacturer's recommendations.

Perform the following tests on the polymer slurry supplied to and in the shaft excavation and ensure that the results are maintained within the ranges stated in the table below:

Table 455-4 Mixed Polymer Slurry Properties		
Item to be measured	Range of Results at 68ºF fluid temperature	Test Method
Density	62 to 65 lb/ft^3 (in freshwater environment) 64 to 67 lb/ft^3 (in saltwater environment)	Mud density balance: FM ~~8-RP13B-1~~3-D4380
Viscosity ~~for bridges and main structure foundations~~	50 seconds to upper limit defined by the APL	Marsh Cone Method: FM 8-RP13B-2
~~Viscosity for miscellaneous structure foundations~~	~~50 seconds to upper limit recommended by the manufacturer based on soil type~~	~~Marsh Cone Method: FM 8-RP13B-2~~
pH	Range published by the manufacturer for materials excavated	Electric pH meter or pH indicator paper strips: FM 8-RP13B-4
Sand Content	0.5% or less	FM 8-RP13B-3

If desired, sodium bicarbonate or soda ash may be added to the fluid in the hole to raise the pH. Premix polymer slurry in accordance with the manufacturer's published procedures. Do not mix the slurry in the excavation as a means to prepare slurry. When approved by the Engineer, adjustments to slurry properties can be made in the excavation.

During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole and which should not be lower than 4 feet above the highest expected piezometric water elevation along the depth of the shaft.

Ensure the method of disposal meets the requirements of local authorities.

SUBARTICLE 455-15.8.4 is deleted and the following substituted:

455-15.8.4 Fluid in Excavation at Time of Concrete Placement: When any fluid is present in any drilled shaft excavation, including shafts to support sign, signal, lighting and ITS structures, the applicable test methods and reporting requirements described in 455-15.8.1, 455-15.8.2 and 455-15.8.3 apply to tests of fluid in the shaft prior to placing the concrete.

When mineral slurries are used, ensure the properties at the time of concrete placement are within the acceptable ranges indicated in 455-15.8.2. When polymer slurries are used ensure the properties of the polymer slurry are within the ~~following acceptable~~ ranges ~~at the time of concrete placement~~outlined in Table 455-4:

Table 455-5 Polymer Slurry Properties at Time of Concrete Placement		
Item to be measured	Range of Results at 68°F fluid temperature	Test Method
Density	62 to 65 lb/ft^3 (in freshwater environment) 64 to 67 lb/ft^3 (in saltwater environment)	Mud density balance: FM 8-RP13B-1
Viscosity	50 seconds to upper limit defined by the API	Marsh Cone Method: FM 8-RP13B-2
pH	Range published by the manufacturer for materials excavated	Electric pH meter or pH indicator paper strips: FM 8-RP13B-4

Test samples of the fluid in the shaft from within 1 inch of the base of the shaft and from the middle of the shaft height for shafts up to 60 feet in depth. Test samples of the fluid in the shaft from within 1 inch of the base of the shaft and at intervals not exceeding 30 feet up the shaft for shafts deeper than 60 feet. Use a sampling tool designed to sample over a depth range of 12 inches or less. Take whatever action is necessary prior to placing the concrete to bring the fluid within the specification and reporting requirements, outlined in the tables in 455-15.8.2 and 455-15.8.3, except as follows:

The Engineer will not require tests for pH or viscosity, nor require the fluid to meet the minimum density specified in 455-15.8.2 and 455-15.8.3 when neither polymer nor mineral slurry has been introduced into the shaft excavation.

SUBARTICLE 455-15.11.3 is deleted and the following substituted:

455-15.11.3 Shaft Inspection Device (SID): When shown in the Plans, furnish all power and equipment necessary for the Engineer to inspect the bottom conditions of a drilled shaft excavation and to measure the thickness of bottom sediment or any other debris using a SID. Utilize a SID on bridge foundations that have nonredundant drilled shafts and for redundant drilled shafts when shown in the Contract Documents. Provide a means to position and lower the SID into the shaft excavation to enable the bell housing to rest vertically on the bottom of the excavation. Include all cost related to the inspection device in the cost of drilled shaft items.

Furnish a SID meeting the following requirements:

1. A remotely operated, high resolution, color video camera sealed inside a watertight bell housing.
2. Provides a clear view of the bottom inspection on a video monitor at the surface in real time.
3. Provides a permanent record of the entire inspection with voice annotation on a quality DVD with a resolution of not less than 720 x 480.
4. Provides a minimum field of vision of 110 square inches, with at least two graduated measuring devices to record the depth of sediment on the bottom of the shaft excavation to a minimum accuracy of 1/2 inch and a length greater than 1-1/2 inches.

5. Provides sufficient lighting to illuminate the entire field of vision at the bottom of the shaft in order for the operator and inspector to clearly see the depth measurement scale on the video monitor and to produce a clear recording of the inspection.

6. Provides a regulated compressed air or gas system to precisely adjust the drilling fluid level within the bell housing and a pressurized water system to assist in determination of bottom sedimentation depth.

Obtain the Engineer's approval of the device in advance of the first inspection contingent on satisfactory field performance. Notify the Engineer for approval before a different device is used for any subsequent inspection.

SUBARTICLE 455-17.2 is deleted and the following substituted:

455-17.2 ~~Placement~~ Elapsed Time for Placement Requirements: The elapsed time for placing drilled shaft concrete includes the concrete mixing and ~~transit~~ delivery time, the concrete placement time, the time required to remove any temporary casing that causes or could cause the concrete to flow into the space previously occupied by the casing, and the time to insert any required column steel, bolts, weldments, etc. The elapsed time begins at the time the first truck load placed in the shaft is batched and shall not exceed the slump loss time. ~~Maintain a minimum slump of 5 inches throughout the elapsed time. Use materials to produce and maintain the required slump through the elapsed time that meets the class of concrete specified.~~ Provide the slump loss ~~tests~~ time ~~that demonstrate~~ to the Engineer ~~that the concrete will maintain a 5 inch or greater slump for the anticipated elapsed time before beginning drilled shaft construction~~.

ARTICLE 455-38 is deleted and the following substituted:

455-38 Description.

Furnish and install auger cast piles (ACP), or augered cast-in-place (ACIP) piles, used for structural support, other than bridge foundations.

ACP piles are defined as a foundation made by rotating a hollow-stem continuous-flight auger into the ground to the required pile depth with sufficient crowd (downward thrust) to prevent mining of the soil. A fluid cement grout is injected through the auger shaft under continuous positive pressure as the auger is being withdrawn. A reinforcing steel cage, as specified, is inserted into the column of fluid grout following the completion of grout placement.