ORIGINATION FORM

THE INFORMATION BELOW IS TO BE PROVIDED BY THE ORIGINATOR
(The person who receives or originates the issue and needs to forward the issue for action.)

XXX Modify Specification _____455_____.
Section/File number

☐ New Section _____.
Section number

Subject: Section 455 Structures Foundations
Multiple Articles

Origination date:

Originator: Larry Jones
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ST986LJ

Problem statement: Resolves multiple issues reported by District Geotechnical Engineers, State Construction Office & State Specifications Office

Information source: District Geotechnical Engineers, Steve Plotkin, Juan Castellanos, CEI Consultants' comments, Industry comments

Background data:

Desired implementation date: Beginning with the July 2012 Workbook

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Florida Department of Transportation

RICK SCOTT
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

ANANTH PRASAD, P.E.
SECRETARY

M E M O R A N D U M

DATE: November 22, 2011

TO: Specification Review Distribution List

FROM: Rudy Powell, Jr., P.E., State Specifications Engineer

SUBJECT: Proposed Specification: **4550503 Structures Foundations**.

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change.

This change was proposed by Larry Jones to resolve multiple issues reported by District Geotechnical Engineers and correct several references.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at SP965RP or rudy.powell@dot.state.fl.us. Comments received after **December 20, 2011,** may not be considered. Your input is encouraged.

RP/cah
Attachment

STRUCTURES FOUNDATIONS.
(REV ~~10-18~~*11-10*-11)

SUBARTICLE 455-5.3.2 (of the Supplemental Specification) is deleted and the following substituted:

455-5.3.2 Pile Cushion: Provide a pile cushion that is adequate to protect the pile from being overstressed in compression and tension during driving. Use a pile cushion sized so that it will fully fill the lateral dimensions of the pile helmet minus one inch *but does not cover any void or hole extending through the top of the pile*. Determine the thickness based upon the hammer-pile-soil system. For driving concrete piles, use a pile cushion made from pine plywood or oak lumber. Alternative materials may be used with the approval of the Engineer. Obtain the Engineer's approval for all pile cushions. Do not use materials previously soaked, saturated or treated with oil. Maintain pile cushions in good condition and change when charred, splintered, excessively compressed, or otherwise deteriorated to the point it will not protect the pile against overstressing in tension and/or compression. Protect cushions from the weather, and keep them dry. Do not soak the cushions in any liquid. Replace the pile cushion if, during the driving of any pile, the cushion is either compressed more than one-half the original thickness or begins to burn. Provide a new cushion for each pile unless approved otherwise by the Engineer after satisfactory field trial.

Reuse pile cushions in good condition to perform all set-checks and redrives. Use the same cushion to perform the set-check or redrive as was used during the initial driving, unless this cushion is unacceptable due to deterioration, in which case use a similar cushion.

SUBARTICLE 455-5.10.3 (of the Supplemental Specification) is deleted and the following substituted:

455-5.10.3 Practical Refusal: Practical refusal is defined as 20 blows per inch with the hammer operating at the highest setting or setting determined by the Engineer and less than 1/4 inch rebound per blow. Stop driving as soon as the Engineer determines that the pile has reached practical refusal. The Engineer will generally make this determination within 2 inches of driving. ~~However, the Engineer will in no case approve the continuation of driving at practical refusal for more than 12 inches.~~ When the required pile penetration cannot be achieved by driving without exceeding practical refusal, use other penetration aids such as jetting or Preformed Pile Holes.

SUBARTICLE 455-8.3 (of the Supplemental Specification) is deleted and the following substituted:

455-8.3 Pile Splices: Order and use the full authorized pile length where practicable. Do not splice to obtain authorized lengths less than 40 feet except when shown in the plans. ~~When approved by the Engineer, perform splicing to obtain authorized lengths between 40 and 60 feet. The Engineer will permit splicing to obtain authorized lengths in excess of 60 feet.~~ *When it is not*

practicable to provide authorized pile lengths longer than 40 feet in a single length, use no more than one field splice per additional 40 feet of authorized pile length. Shop splices may be used to join single lengths of pile which are at least 20 feet in length. One shorter segment of pile may be added by field splicing or shop splicing to achieve the authorized pile length when needed. Locate all splices in the authorized pile length in portions of the pile expected to be at least 15 feet below the final ground surface after driving.

Where the pile length authorized is not sufficient to obtain the required bearing value or penetration, order an additional length of pile and splice it to the original length.

Make all splices in accordance with details shown in the plans and in compliance with the general requirements of AWS D1.1 or American Petroleum Institute Specification 5L (API 5L).

SUBARTICLE 455-11.2.2 (of the Supplemental Specifications) is deleted and the following substituted:

455-11.2.2 Furnished Length: The furnished length of precast concrete piles will be considered as the overall length from head to tip. Final pay length will be based on the casting length as authorized in accordance with 455-5.14.3 subject to provisions of 455-11.2.3 through 455-11.2.~~10~~*8*, 455-11.8, 455-11.9 and 455-11.13.

SUBARTICLE 455-11.6 (of the Supplemental Specification) is deleted and the following substituted:

455-11.6 Steel Sheet Piling: The quantity to be paid for will be the plan quantity area, in square feet, measured from top of pile elevation to the bottom of pile elevation and beginning and end wall limits as shown in the plans with no allowance for variable depth surface profiles. *Approved alternate support structures would be paid for as plan quantity computed for sheet pile.* Sheet piling used in cofferdams and to incorporate the Contractor's specific means and methods, and not ordered by the Engineer, will be paid for as required in Section 125.

SUBARTICLE 455-11.13 (of the Supplemental Specification) is deleted and the following substituted:

455-11.13 Preformed Pile Holes: The quantity ~~to be paid for~~*added to the payment for piling* will be 30% of ~~one foot of piling for each foot~~*the length* of completed Preformed Pile Holes from existing ground or the bottom of any required excavation, whichever is lower, to the bottom of preformed hole acceptably provided, complete for the installation of the bearing piles, regardless of the type of pile *(test pile or production pile)* installed therein. Only those holes authorized to be paid for, as provided in 455-5.9.3, will be included in the measurement for payment. The Engineer will authorize payment for Preformed Pile Holes only when the pile has been placed in proper position and has achieved the required penetration.

SUBARTICLE 455-12.8 (of the Supplemental Specification) is deleted and the following substituted:

455-12.8 Preformed Pile Holes: *There is no separate pay item for Preformed Pile Holes. Payment will be made as the unit price for Piling of the applicable pile type.* P~~rice and p~~ayment will be full compensation for all labor, equipment, casings and materials required to perform this work. ~~*Payment will be made under the pay item for Piling (455-34, 455-35 or 455-36) as described in 455-11.143.*~~

SUBARTICLE 455-15.7 and 455-15.8 (of the Supplemental Specification) is deleted and the following substituted:

455-15.7 Casings: Ensure that casings are metal, ~~or concrete when indicated in the plans,~~ of ample strength to withstand handling and driving stresses and the pressure of concrete and of the surrounding earth materials, and that they are smooth and water tight. Ensure that the inside diameter of casing is not less than the specified size of shaft except as provided below. The Department will not allow extra compensation for concrete required to fill an oversize casing or oversize excavation.

The Engineer will allow the Contractor to supply casing with an outside diameter equal to the specified shaft diameter (O.D. casing) provided he supplies additional shaft length at the shaft tip. Determine the additional length of shaft required by the following relationship:

$$Additional\ Length = \frac{(D_1 - D_2)\,L}{D_2}$$

where:

D_1= casing inside diameter specified = shaft diameter specified
D_2= casing inside diameter provided (D_2 = D_1 minus twice the wall thickness).
L= authorized shaft length below ground for temporary casing methods or below casing for permanent casing methods.

Bear all costs relating to this additional length including but not limited to the cost of extra excavation, extra concrete, and extra reinforcing steel.

Remove all casings from shaft excavations except those used for the Permanent Casing Method. Ensure that the portion of casings installed under the Permanent Casing Method of construction below the shaft cut-off elevation remains in position as a permanent part of the Drilled Shaft. The Contractor may leave casings if in the opinion of the Engineer the casings will not adversely affect the shaft capacity in place. When casings that are to be removed become bound in the shaft excavation and cannot be practically removed, drill the shaft excavation deeper as directed by the Engineer to compensate for loss of capacity due to the presence of the casing. The Department will not compensate for the casing remaining. The Department will pay for the additional length of shaft under Item No. 455-88 and the additional excavation under Item No. 455-125.

If temporary casing is advanced deeper than the Minimum Top of Rock Socket Elevation shown in the plans or actual top of rock elevation if deeper, withdraw the casing from

the rock socket and overream the shaft. If the temporary casing cannot be withdrawn from the rock socket before final cleaning, extend the length of rock socket below the authorized tip elevation one-half of the distance between the Minimum Top of Rock Socket Elevation or actual elevation if deeper, and the temporary casing tip elevation.

When the shaft extends above ground or through a body of water, the Contractor may form the portion exposed above ground or through a body of water, with removable casing except when the Permanent Casing Method is specified (see 455-23.10). When approved, the Contractor may form drilled shafts extending through a body of water with permanent or removable casings. However, for permanent casings, remove the portion of metal casings between an elevation 2 feet below the lowest water elevation or 2 feet below ground whichever is higher and the top of shaft elevation after the concrete is cured. Dismantle casings removed to expose the concrete as required above in a manner which will not damage the drilled shaft concrete. Dismantle removable casings in accordance with the provisions of 455-17.5.

Generally when removal of the temporary casing is required, do not start the removal until completing all concrete placement in the shaft. The Engineer will permit movement of the casing by rotating, exerting downward pressure, and tapping it to facilitate extraction, or extraction with a vibratory hammer. Extract casing at a slow, uniform rate with the pull in line with the axis of the shaft. Withdraw temporary casings while the concrete remains fluid.

When conditions warrant, the Contractor may pull the casing in partial stages. Maintain a sufficient head of concrete above the bottom of the casing to overcome the hydrostatic pressure of water outside the casing. At all times maintain the elevation of the concrete in the casing high enough to displace the drilling slurry between the outside of the casing and the edge of the hole while removing the casing.

The Contractor may use special casing systems in open water areas, when approved, which are designed to permit removal after the concrete has hardened. Design special casings so that no damage occurs to the drilled shaft concrete during their removal.

455-15.8 Slurry and Fluid in Excavation at Time of Concrete Placement:

455-15.8.1 Mineral Slurry: When mineral slurry is used in an excavation, use only processed attapulgite or bentonite clays *with up to 2% (by dry weight) of added polymer*. Use mineral slurry having a mineral grain size such that it will remain in suspension and having sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. Use a percentage and specific gravity of the material to make the suspension sufficient to maintain the stability of the excavation and to allow proper placement of concrete. Ensure that the material used to make the slurry is not detrimental to concrete or surrounding ground strata. During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole. In the event of a sudden significant loss of slurry such that the slurry level cannot practically be maintained by adding slurry to the hole, backfill the excavation and delay the construction of that foundation until an alternate construction procedure has been approved.

Thoroughly premix the ~~mineral~~ slurry with clean fresh water prior to introduction into the shaft excavation. Ensure that the percentage of mineral admixture used to make the suspension is such as to maintain the stability of the shaft excavation. The Engineer will require adequate water and/or slurry tanks when necessary to perform the work in accordance with these Specifications. The Engineer will not allow excavated pits on projects requiring slurry tanks without the written permission of the Engineer. Take the steps necessary to prevent the slurry from “setting up” in the shaft, including but not limited to agitation,

circulation, and/or adjusting the composition and properties of the slurry. Provide suitable offsite disposal areas and dispose of all waste slurry in a manner meeting all requirements pertaining to pollution.

Provide a CTQP qualified drilled shaft inspector to perform control tests using suitable apparatus on the mineral slurry mixture to determine the following parameters:

(a) Freshly mixed mineral slurry: Measure the density of the freshly mixed mineral slurry regularly as a check on the quality of the suspension being formed using a measuring device calibrated to read within plus or minus0.5 lb per cubic foot.

(b) Mineral slurry supplied to the drilled shaft excavation: Perform the following tests on the mineral slurry supplied to the shaft excavation and ensure that the results are within the ranges stated in the table below:

Item to be measured	Range of Results at 68ºF	Test Method
Density	64 to 73 lb/ft^3 (in fresh water environment) 66 to 75 lb/ft^3 (in salt water environment)	Mud density balance: FM 8-RP13B-1
Viscosity	30 to 450 seconds	Marsh Cone Method: FM 8-RP13B-2
pH	8 to 11	Electric pH meter or pH indicator paper strips: FM 8-RP13B-4
Sand Content	4% or less	FM 8-RP13B-3

The Contractor may adjust the limits in the above table when field conditions warrant as successfully demonstrated in a Test Hole or with other methods approved by the Engineer. The Engineer must approve all changes in writing before the Contractor can continue to use them.

Perform tests to determine density, viscosity, and pH value to establish a consistent working pattern, taking into account the mixing process and blending of freshly mixed mineral slurry and previously used mineral slurry. Perform a minimum of four sets of tests to determine density, viscosity, and pH value during the first 8 hours mineral slurry is in use.

When the results show consistent behavior, discontinue the tests for pH value, and only carry out tests to determine density and viscosity during each four hours mineral slurry is in use. If the consistent working pattern changes, reintroduce the additional tests for pH value for the time required to establish consistency of the test values within the required parameters.

(c) The Department may perform comparison tests as determined necessary during the mineral slurry operations.

During construction, maintain the level of mineral slurry in the shaft excavation within the excavation and at a level not less than 4 feet above the highest expected piezometric water pressure along the depth of a shaft.

At any time the wet construction method of stabilizing excavations fails, in the opinion of the Engineer, to produce the desired final result, discontinue this method of construction, and propose modifications in procedure or alternate means of construction for approval.

455-15.8.2 Polymer Slurry For Shafts For Miscellaneous Structures:

Materials manufactured expressly for use as polymer slurry for drilled shafts may be used as slurry for drilled shaft excavations installed to support mast arms, cantilever signs, overhead truss signs, high mast light poles or other miscellaneous structures. 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. The Engineer will not allow polymer slurries during construction of drilled shafts for bridge foundations. 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 published recommendations. Submit the MSDS for the product, the manufacturer's published mixing procedures, and the manufacturer's published range of values for pH and viscosity of the mixed slurry. Certify that the polymer slurry and components meet the following requirements:

a. The polymer slurries to be used on the project and their waste products are classified as non-hazardous as defined by Resource Conservation and Recovery Act (RCRA) Subpart C rules, Table 1 of 40 CFR 261.24 Toxicity Characteristic.

b. Pull out tests demonstrate the bond between the bar reinforcement and the concrete is not materially affected by exposure to the slurry under typical construction conditions, over the typical range of slurry viscosities to be used.

~~c. The slurry does not have a detrimental effect on the strength or quality of the concrete as a result of continuous contact with the concrete, and when 10% of the concrete mix water is replaced by slurry, over the typical range of slurry viscosities to be used.~~

c~~d~~. Load tests demonstrate the bond between the concrete and the soil is not materially affected by exposure to the *polymer* slurry under typical construction conditions, over the typical range of *polymer* slurry viscosities to be used for the project *versus affect of exposure to mineral slurry*.

d~~e~~. The method of disposal meets the approval of all federal, state and local regulatory authorities.

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

Mixed Polymer Slurry Properties		
Item to be measured	Range of Results at 68ºF	Test Method
Density	62 to 64 lb/ft^3 (fresh water) 64 to 66 lb/ft^3 (salt water)	Mud density balance: FM 8-RP13B-1
Viscosity	Range Published By The Manufacturer for Materials Excavated	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

Polymer slurry may be mixed in the cased portion of the shaft in accordance with the manufacturer's published procedures.

During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole. At any time the wet construction method of stabilizing excavations fails, in the opinion of the Engineer, to produce the desired final result, discontinue this method of construction, and propose modifications in procedure or alternate means of construction for approval.

455-15.8.3 Fluid In Excavation At Time Of Concrete Placement: When any fluid is present in any drilled shaft excavation, including shafts to support miscellaneous structures, the applicable test methods and reporting requirements described in 455-15.8.1 apply to tests of fluid in the shaft prior to placing the concrete.

Take samples of the fluid in the shaft from *within 1 inch of* the base of the shaft and at intervals not exceeding 10 feet up the shaft, using an approved 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 455-15.8.1, except as follows:

The Engineer will not require tests for pH or viscosity when slurry has not been introduced into the shaft excavation.

When using polymer slurry to support the excavation for drilled shafts installed to support mast arms, cantilever signs, overhead truss signs, high mast light poles or other miscellaneous structures, take whatever action is necessary prior to placing the concrete to bring the properties of the fluid within the ranges in 455-15.8.2.

Provide a CTQP qualified drilled shaft inspector to perform testing. The Department may also perform comparison tests. Provide equipment for such comparison tests when requested by the Engineer.

SUBARTICLE 455-15.9.3 (of the Supplemental Specification) is deleted and the following substituted:

455-15.9.3 Wet Excavations: Construct the tremie or pump line used to deposit concrete beneath the surface of water so that it is water-tight and will readily discharge concrete. Construct the discharge end of the tremie or pump line to prevent water intrusion and permit the free flow of concrete during placement operations. Ensure that the tremie or pump line has sufficient length and weight to rest on the shaft bottom before starting concrete placement.

During placement operations, ensure that the discharge end of the tremie or pump line is within 6 inches of the bottom of the shaft excavation until at least 10 feet of concrete has been placed and is continuously ~~Ensure that the discharge end of the tremie or pump line is~~ embedded at least 10 feet into the concrete ~~at all times during placement operations~~ after 10~~-~~ feet of concrete has been placed *until the* ~~*shaft*~~*casing is overpoured sufficiently to eliminate all contaminated concrete*. Ensure that the free fall of concrete into the hopper is less than 5 feet at all times. Support the tremie so that it can be raised to increase the discharge of concrete and lowered to reduce the discharge of concrete. ~~The Engineer will not allow~~*Do not* rapid*ly* rais*e*~~ing~~ or lower~~ing of~~ the tremie to increase the discharge of the concrete. Maintain a continuous flow of concrete and a positive pressure differential of the concrete in the tremie or pump line at all times to prevent water or slurry intrusion into the shaft concrete.

SUBARTICLE 455-17 (of the Supplemental Specification) is deleted and the following substituted:

455-17.1 General: Place concrete in accordance with the applicable portions of Sections 346 and 400, 455-15.2, 455-15.3, 455-15.4, 455-15.5, 455-15.8, 455-15.9, and the requirements herein.

Place concrete as soon as possible after completing all excavation, cleaning the shaft excavation, inspecting and finding it satisfactory, and immediately after placing reinforcing steel. Continuously place concrete in the shaft to the top ~~elevation~~ of the ~~shaft~~*casing*. Continue placing concrete after the ~~shaft~~*casing* is full until good quality concrete is evident at the top of the ~~shaft~~*casing*. Place concrete through a tremie or concrete pump using approved methods. After the shaft is overpoured sufficiently to eliminate all contaminated concrete, additional concrete may be added to the shaft without the use of a tremie or pump in accordance with Section 400.

If the pressure head is lost during concrete placement for any reason, the Engineer may direct the Contractor to perform integrity testing at no expense to the Department.

Immediately after concreting, check the water levels in the CSL access tubes and refill as necessary. If tubes become unserviceable, core new holes in the drilled shaft as directed by the Engineer.

ARTICLE 455-20 (of the Supplemental Specification) is deleted and the following substituted:

455-20 Construction Tolerances.

Meet the following construction tolerances for drilled shafts:

(a) Ensure that the top of the drilled shaft is no more than 3 inches laterally in the X or Y coordinate from the position indicated in the plans.

(b) Ensure that the vertical alignment of the shaft excavation does not vary from the alignment shown in the plans by more than 1/4 in/ft of depth.

(c) After placing all the concrete, ensure that the top of the reinforcing steel cage is no more than 6 inches above and no more than 3 inches below plan position.

(d) Ensure that the reinforcing cage is concentric with the shaft within a tolerance of 1 1/2 inches. Ensure that concrete cover is a minimum of ~~6~~*4-1/2* inches unless shown otherwise in the plans.

(e) All casing diameters shown in the plans refer to I.D. (inside diameter) dimensions. However, the Contractor may use casing with an outside diameter equal to the specified shaft diameter if the extra length described in 455-15.7 is provided. In this case, ensure that the I.D. of the casing is not less than the specified shaft diameter less 1 inch. When approved, the Contractor may elect to provide a casing larger in diameter than shown in the plans to facilitate meeting this requirement. When casing is not used, ensure that the minimum diameter of the drilled shaft is 1 inch less than the specified shaft diameter. When conditions are such that a series of telescoping casings are used, provide the casing sized to maintain the minimum shaft diameters listed above.

~~(f) Excavate the bearing area of bells to the plan bearing area as a minimum. Ensure that the diameter of the bells does not exceed three times the specified shaft diameter.~~

~~The Contractor may vary all other plan dimensions shown for the bells, when approved, to accommodate his equipment.~~

(*f*~~g~~) Ensure that the top elevation of the drilled shaft concrete has a tolerance of +1 and -3 inches from the top of shaft elevation shown in the plans.

(*g*~~h~~) The dimensions of casings are subject to American Petroleum Institute tolerances applicable to regular steel pipe.

(*h*~~i~~) Use excavation equipment and methods designed so that the completed shaft excavation will have a flat bottom. Ensure that the cutting edges of excavation equipment are normal to the vertical axis of the equipment within a tolerance of ±3/8 in/ft of diameter.

ARTICLE 455-23 (of the Supplemental Specification) is deleted and the following substituted:

455-23 Method of Measurement.

455-23.1 Drilled Shafts: The quantity to be paid for will be the length, in feet, of the reinforced concrete drilled shaft of the diameter shown in the plans, completed and accepted. The length will be determined as the difference between the top of shaft elevation as shown in the plans and the final bottom of shaft elevation as authorized and accepted. When the Contractor elects to provide outside diameter (O.D.) sized casing rather than inside diameter (I.D.) sized casing as allowed in 455-15.7, the pay quantity measured as described above will be multiplied by a factor (F) determined as follows:

$$F = \frac{2D_2 - D_1}{D_2}$$

where:

F= factor to adjust pay quantities to compensate for smaller shafts.

D_1= casing inside diameter specified = shaft diameter specified.

D_2= casing inside diameter provided ($D_2 = D_1$ minus twice the wall thickness).

455-23.2 Drilled Shafts (Unreinforced): The quantity to be paid for will be the length, in feet, of unreinforced concrete drilled shaft of the diameters shown in the plans, completed and accepted. The length will be determined as the difference between the top of shaft elevation as shown in the plans and the final bottom of shaft elevation as authorized and accepted. When the Contractor elects to use O.D. casing, the quantity as determined above will be multiplied by the factor “F” determined as described in 455-23.1.

455-23.3 Unclassified Shaft Excavation: The quantity to be paid for will be the length, in feet, of unclassified shaft excavation of the diameter shown in the plans, completed and accepted, measured along the centerline of the shaft from the ground surface elevation after any required excavation per 455-1.2 to the plan bottom of shaft elevation authorized and accepted plus up to 15 feet or 3 shaft diameters, whichever is deeper, of additional excavation as authorized by the Engineer. When drilled shafts are constructed through fills placed by the Contractor, the original ground surface before the fill was placed will be used to determine the quantity of unclassified shaft excavation. When the Contractor elects to use O.D. casing, the

quantity as determined above will be multiplied by the factor "F" determined as described in 455-23.1.

455-23.4 Unclassified Extra Depth Excavation: When excavation is required by the Engineer to extend more than 15 feet or 3 shaft diameters, whichever is deeper, below the bottom of the shaft elevation shown in the plans, the work will be considered as Unforeseeable Work.

~~**455-23.5 Drilled Shaft Sidewall Overreaming:** The quantity to be paid for will be the length, in feet, of drilled shaft sidewall overreaming authorized, completed and accepted, measured between the elevation limits authorized by the Engineer. When the Contractor elects to use O.D. casing, the quantity as determined above will be multiplied by the factor "F" determined as described in 455-23.1.~~

~~**455-23.6 Bell Footings:** The quantity to be paid for will be the number of bells of the diameter and shape shown in the plans, completed and accepted.~~

455-23.*5*~~7~~ Test Holes: The cost of all test holes will be included in the cost of Drilled Shafts.

~~**455-23.*6*8 Test Bells:** The quantity to be paid for will be the number of test bells, completed and accepted.~~

455-23.*6*~~7~~9 Core (Shaft Excavation): The quantity to be paid for will be the length, in feet, measured from the bottom of shaft elevation to the bottom of the core-hole, for each authorized core drilled below the shaft excavation, completed and accepted. When the Engineer authorizes pilot holes extending through part or all of the shaft, prior to excavation, to some depth below the shaft bottom, the quantity paid as Core (Shaft Excavation) will be the length in feet, measured from the top elevation to the bottom elevation authorized by the Engineer, completed and accepted. When SPT tests are substituted for coring or pilot holes as provided in 455-15.6, the quantity will be determined as described above in this Section.

455-23.*7*~~8~~10 Casings: The quantity to be paid for will be the length, in feet, of each size casing as directed and authorized to be used. The length will be measured along the casing from the top of the shaft elevation or the top of casing whichever is lower to the bottom of the casing at each shaft location where casing is authorized and used, except as described below when the top of casing elevation is shown in the plans. Casing will be paid for only when the Permanent Casing Method is specified, when the plans show a casing that becomes a permanent part of the shaft, or when the Engineer directs the Contractor to leave a casing in place which then becomes a permanent part of the shaft. No payment will be made for casings which become bound or fouled during shaft construction and cannot be practically removed. The Contractor shall include the cost of all temporary removable casings for methods of construction other than that of the Permanent Casing Method in the bid price for Unclassified Shaft Excavation item.

When the Permanent Casing Method and the top of casing elevation are specified, the casing will be continuous from top to bottom. Authorization for temporary casing will not be given unless the Contractor demonstrates that he can maintain alignment of the temporary upper casing with the lower casing to be left in place during excavation and concreting operations. When artesian conditions are or may be encountered, the Contractor shall also demonstrate that he can maintain a positive water-tight seal between the two casings during excavation and concreting operations.

When the top of casing elevation is shown in the Contract Documents, payment will be from the elevation shown in the plans or from the actual top of casing elevation, whichever is lower, to the bottom of the casing. When the Contractor elects to use an approved

special temporary casing system in open water locations, the length to be paid for will be measured as a single casing as provided above.

455-23.*8*~~9~~11 Protection of Existing Structures: The quantity to be paid for will be at the lump sum price.

455-23.*9*~~10~~2 Load Tests: The quantity to be paid for will be the number and type of load tests conducted.

455-23.1*0*~~1~~3 Instrumentation and Data Collection: The quantity to be paid for will be at the lump sum price.

455-23.1*1*~~2~~4 Cross-Hole Sonic Logging: The quantity of the cross-hole sonic logging test set-ups to be paid for will be the number of drilled shafts accepted based on cross-hole sonic logging tests.

ARTICLE 455-44 (of the Supplemental Specification) is deleted and the following substituted:

455-44 Pile Installation.

Meet the following requirements:

1. Locate the piles as shown on the drawings.

2. Should soft, compressible muck, organics, clay or other unsuitable materials (non A-1, A-3, A-2-4 or limestone materials) be encountered, remove the unsuitable material to a maximum depth of 5 feet and a maximum diameter about the pile centerline, not to exceed 1/2 of the distance to the adjacent pile. Backfill with clean granular backfill materials (A-1, A-3, A-2-4), placed and compacted in maximum 12 inch lifts to at least 95% of maximum dry density as determined by AASHTO T 180. Complete this work to the Engineer's satisfaction prior to auger cast pile construction. Should more than 5 feet or excessive quantities of unsuitable material be encountered, immediately advise the Engineer and proceed with the work as directed by the Engineer.

3. Provide continuous auger flighting from the auger head to the top of auger with no gaps or other breaks, uniform in diameter throughout its length, and of the diameter specified for the piles less a maximum of 3%. Provide augers with a distance between flights of approximately half the diameter of the auger.

4. Use augers with the grout injection hole located at the bottom of the auger head below the bar containing the cutting teeth, and with pile auger leads containing a bottom guide.

5. Construct piles of the length and diameter shown on the drawings.

6. Clearly mark the auger leads to facilitate monitoring of the incremental drilling and grout placement. Provide individual foot marks with 5 foot increments highlighted and clearly visible. Provide a clear reference mark on the moving auger assembly to facilitate accurately monitoring the vertical movement of the auger.

7. Place piles by rotating a continuous flight hollow shaft auger into the ground at a continuous rate that prevents removal of excess soil. Stop advancement after reaching the predetermined depth.

8. Should auger penetration to the required depth prove difficult due to hard materials/refusal, the pile location may be predrilled, upon approval of the Engineer, through the obstruction using appropriate drilling equipment, to a diameter no larger than 1/2 the prescribed finish diameter of the auger cast pile. Commence auger cast pile construction immediately upon predrilling to minimize ground loss and soil relaxation. Should non-drillable material be

encountered preventing placement to the depth required, immediately advise the Engineer and proceed with the work as directed by the Engineer. Refusal is defined as the depth where the penetration of the standard auger equipment is less than 12 inches/minute.

9. Plug the hole in the bottom of the auger while being advanced into the ground. Remove the plug by the grout or with the reinforcing bar.

10. Pump the grout with sufficient pressure as the auger is withdrawn to fill the auger hole, preventing hole collapse and to cause the lateral penetration of the grout into soft or porous zones of the surrounding soil. *Prior to commencing withdrawal of the auger, establish a head of at least 5 feet of grout by pumping a volume of grout equivalent to 5 feet of pile volume. Maintain this* ~~Carry a~~ head of at least 5 feet of grout above the injection point around the perimeter of the auger to displace and remove any loose material from the hole. Maintain positive rotation of the auger at least until placement of the grout.

11. Once the grout head has been established, greatly reduce the speed of rotation of the auger and commence extraction at a rate consistent with the pump discharge. Maintain extraction at a steady rate to prevent a locked-in auger, necking of the pile, or a substantially reduced pile section. Ensure grout starts flowing out from the hole when the cutting head is at least 5 feet below the ground surface. Place a minimum volume of grout in the hole of at least 115% of the column of the auger hole from a depth of 5 feet to the tip. Place a minimum volume of grout in the hole of at least 105% of the column of the auger hole from the ground surface to a depth of 5 feet. Do not include any grout needed to create surplus grout head in the volume of grout placed into the hole. If the grout does not flow out from the hole when the cutting head is at least 5 feet below the ground surface, redrill the pile under the direction of the Engineer. If grouting is interrupted for any reason, reinsert the auger by drilling at least 5 feet below the tip of the auger when the interruption occurred, and then regrout.

Use this method of placement at all times. Do not depend on the stability of the hole without the earth filled auger. Place the required steel reinforcement while the grout is still fluid, but no later than 1/2 hour after pulling of the auger.

12. Assume responsibility for the grout volume placed. If less than 115% of the theoretical volume of grout is placed in any 5 foot increment (105% in the top 5 foot increment), reinstall the pile by advancing the auger 10 feet or to the bottom of the pile if that is less, followed by controlled removal and grout injection.

13. Furnish and install the reinforcing steel and anchoring bolts as shown in the Contract drawings.

14. Use reinforcement that is without kinks or nonspecified bends, free of mud, oil or other coatings that could adversely affect the bond. Make splices in reinforcement as shown on the Contract drawings, unless otherwise approved by the Engineer.

15. Leave any temporary supports of/for items placed into a grouted pile (reinforcement template, anchor bolt template, precast column supports, etc.) in place for a minimum of 12 hours after completion of the pile. Do not place wall panels or other significant loads, before the grout has set a minimum of seven days or reached the 28 day strength.