SUPPLEMENTAL SPECIFICATION

APPROVED:
Division Administrator
THADDEUS W KITOWICZ
Digitally signed by THADDEUS W KITOWICZ
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By: _____
FEDERAL HIGHWAY ADMINISTRATION

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Section 204: Structure Excavation

Delete and replace Subsection 204.4.3 Cofferdams or Cribs, Subsection 204.4.4 Backfill, Subsection 204.4.5 Temporary and Permanent Shoring Walls, Subsection 204.5 Measurement, and Subsection 204.6 Payment of the Standard Specifications in their entirety and replace with the following:

204.4.3 Cofferdams

204.4.3.1 General

1 When the project Plans require the use of cofferdams for construction of bridge substructure or other elements of work, make certain that the cofferdams comply with the following requirements:

A. Construct the cofferdam using appropriate materials. All materials used for the cofferdam shall conform to the requirements of the appropriate Sections of the Standard Specifications.
B. Materials used to construct a cofferdam remain the property of the Contractor. Remove the materials in accordance with **Subsection 204.4.3.3**.
C. Ensure the design and inspection of cofferdams complies with **Subsection 702.4.1**.
D. The Cofferdam Type (1, 2, 3, etc.) shown in the Contract is based on the theoretical plan volume of the cofferdam and is used by the Department for bidding purposes only. The unit price bid for each cofferdam is full compensation regardless of the actual volume of cofferdam constructed.

204.4.3.2 Definitions

1 To clarify the roles of the various Engineers-of-Record, the following definitions will be used:

A. Department's Engineer-of-Record (DEOR) is either the Structural or Geotechnical Engineer used by the Department to design the project.
B. Structural Engineer-of-Record (SEOR) is the Structural Engineer working for the Contractor that is responsible for the structural design of the cofferdam.
C. Geotechnical Engineer-of-Record (GEOR) is the Geotechnical Engineer working for the Contractor that is responsible for the geotechnical design of the cofferdam.

204.4.3.3 Construction of Cofferdams

1 Install cofferdams prior to excavation for foundation construction. Extend the cofferdam as determined jointly by the SEOR and/or GEOR. Ensure that the cofferdams are braced in accordance with the plans prepared by the SEOR and GEOR and constructed to permit the free pumping of water and to keep the cofferdam free of water until all foundation concrete below water has reached its initial set. Contractor to confirm that the interior dimensions of cofferdams are sufficient to give clearance for the construction of forms, inspection of the exterior of forms, and pumping and handling of leakage from outside of the forms, both when seal concrete is and is not required. Construct the forms and cofferdams to protect green concrete against damage from a sudden rising of water and to prevent damage to the foundation by erosion. Leave no bracing in cofferdams that extend into the substructure without written permission from the DEOR and concurrence from the BCE.

2 Right or enlarge cofferdams that become tilted or moved laterally to provide ample clearance. No extra compensation is made for this work.

204.4.3.4 Removal of Cofferdams

1 If the Contractor elects to leave the cofferdam in-place, contact the DEOR for evaluation of the effect on the structure by leaving the cofferdam in place. Additionally, if the Contractor elects to leave the cofferdam in-place, the Contractor is required to obtain all permit modifications at no additional cost to the Department.

2 Prior to removal of the cofferdam, Contractor to obtain concurrence from RCE and DEOR. DEOR will determine that removal of cofferdam will not affect completed structural components prior to completion of project.

3 Remove cofferdams with all falsework, sheeting, and bracing. Remove the cofferdams without disturbing or marring the finished structure.

204.4.3.5 Foundation Seal

1 When the Plans indicate that seal concrete is required, excavate the interior of the cofferdam to within 6 inches of the elevation indicated on the Plans. Remove all objectionable (soft or loose subgrade soil, organics, etc.) material from the cofferdam to the satisfaction of the RCE.

2 When foundation piles are to be driven, over excavate the cofferdam sufficiently below the anticipated finished grade to account for any “heave” that may occur during the installation of the piles. If considered necessary by the RCE, excavate to sufficient depth and backfill with bridge lift material to avoid contamination by mud. Completely remove earth material in the arched web of steel and/or concrete sheet piling so that the seal concrete is in full contact with the cofferdam sheeting in all areas. Maintain a water level inside of the cofferdam at the same level as exterior to prevent blow in or heave of the bottom of the cofferdam during the excavation of the cofferdam. After achieving the subgrade elevation beneath the seal concrete and cleaning the exposed surface, install deep foundations as indicated on the plans.

3 Where drilled shafts are required, install drilled shaft casings and seal concrete to the elevations indicated on the plans.

4 Where seal concrete is required, level the exposed subgrade of the cofferdam prior to placing seal concrete to within a 5 percent grade in any direction from one edge to the opposite edge. Remove earth material, loose rock and small boulders.

5 Obtain written concurrence of the DEOR and BCE before performing excavation by blasting. Comply with the requirements in the SCDOT Construction Manual, including notifying the SCDOT Director of Communications before performing any blasting operations. Before blasting in any stream, river or lake coordinate plans and operations with the local South Carolina Department of Natural Resources (SCDNR) District Fisheries Biologist and District Law Enforcement Captain.

6 When the seal concrete is placed underwater, maintain the same water level both inside as well as outside the cofferdam to prevent hydrostatic pressure on fresh concrete due to head differential.

7 Construct the seal concrete as prescribed in **Subsection 702.4.2.6**.

204.4.3.6 Pumping to Dewater

1 Perform dewatering of a cofferdam enclosure using a method that prevents any portion of the seal concrete materials from being carried away. Do not dewater the cofferdam during the placement of seal concrete nor until the seal concrete has achieved the required compressive strength as indicated in the plans or as directed by the RCE. After the seal concrete has achieved the required strength, dewater the cofferdam, and thoroughly clean the seal concrete of all laitance and other

objectionable (soft or loose subgrade soil, organics, etc.) materials prior to the placement of foundation concrete. Place the foundation concrete in the dry.

204.4.4 Backfill

1 Ensure that the backfill for structures conforms to the requirements of **Sub-section 205.4.2**.

204.4.5 Temporary and Permanent Shoring Systems

204.4.5.1 General

1 Temporary shoring systems may consist of the following:

A. Sheet pile (unanchored or anchored) (cut)
B. Soldier pile and lagging (unanchored or anchored) (cut)
C. Soil Nail with temporary facing (cut)
D. Gabion (fill)
E. Mechanically Stabilized Earth (MSE) Wall (welded wire or geosynthetic face) (fill)
F. Reinforced soil slope (RSS) (fill)

2 "Cut" and "fill" are indicated after each temporary shoring system in the list above, this is typical usage. The Contractor may select to use any system; however, the Contractor should also be aware of the limitations and potential concerns of using a "cut" shoring system in place of a "fill" shoring system and vice versa. "Cut" indicates top-down construction and "fill" indicates bottom-up construction. "Cut" and "fill" are used in the selection of performance criteria, (i.e., performance limits during the service life of the system). Shoring systems A, B, and C are cantilevered shoring systems, while shoring systems D, E, and F are flexible gravity shoring systems. The type of shoring system affects the selection of the appropriate resistance factors.

3 Design any shoring system that is anticipated to have a service life of less than 5 years as a temporary Earth Retaining Structure (ERS) (i.e., shoring system). Follow the requirements presented in the latest edition of the SCDOT Geotechnical Design Manual (GDM) when designing temporary shoring. Temporary shoring is used during construction to allow for the staged construction of a permanent structure (i.e., embankment, bridge abutment, etc.). Even though the shoring system is temporary, the shoring system may remain in place at the end of construction due to the impracticability of removing the shoring components (i.e., tie backs, soil reinforcement, etc.) or the potential of damage to the permanent structure that may occur during extraction of the shoring system components. Identify all components of the temporary shoring to be left in place and include all details, impacts, and design ramifications of any such components in the Working Drawings and design calculation submittals.

4 Design any temporary shoring system that is anticipated to have a service life of 5 years or more as a permanent ERS and follow the requirements presented in the latest edition of the SCDOT GDM. Temporary shoring systems with an anticipated service life of 5 years or more do not have to have a permanent face, unless required by the SEOR and/or the GEOR. Design all permanently exposed shoring systems as an ERS and follow the requirements of the latest edition of the SCDOT GDM.

204.4.5.2 Design

1 Design shoring systems in accordance with **Subsection 702.4.1**, furnish, install, maintain, and remove (if practical, consult with the RCE on the practicality of removal) temporary shoring systems at the locations shown on the plans.

2 Design the temporary shoring system to limit deformations (vertical and lateral displacements) that would affect the stability or performance of any adjacent structures (MSE walls, Bridge foundations,

Pavement Structure, Approach Slabs, Embankment (stage construction), etc.). Determine deformations for vertical settlement, sliding, bulging, bowing, bending, and buckling. Please note that this is not an all-inclusive list and that the determination of additional deformations may be required.

3 Allowable deformations are dependent on the type of structure affected by the deformation of the temporary shoring system. Regardless of the type of structure affected by the deformations, limit deformations to less than 3 inches in either the vertical or horizontal direction.

4 Provide an instrumentation plan (meeting the requirements contained in the latest version of the SCDOT GDM) for monitoring the deformations of the temporary shoring and any adjacent structure. Submit the instrumentation plan with all shop and working drawing submittals. The instrumentation plan shall indicate a maximum allowable deformation of no more than 3 inches (vertically or horizontally), for the temporary shoring system and adjacent structures.

5 Typical instrumentation used for monitoring deformations includes survey targets, settlement monuments, crack gages, inclinometers, and tilt monitors. Establish monitoring locations that permits consistent and repeatable measurements for the entire construction period.

6 Establish a monitoring schedule for the duration of construction and include the schedule in the instrumentation plan. Submit periodic monitoring reports to the RCE in accordance with the accepted instrumentation plan. Any changes in frequency of monitoring or report submittal must be sent to the DEOR for acceptance. If the initial instrumentation plan is found by the DEOR to not adequately document the movements of the temporary shoring system or the adjacent structures, revise the instrumentation plan and resubmit the revised plan to the DEOR for review and acceptance.

7 If the measured deformations exceed the maximum allowable deformations shown in the instrumentation plan, the Contractor will be required to stop work immediately, and at Contractor's expense, correct the situation prior to resumption of construction activities. The Department will determine whether the corrections proposed by the Contractor are satisfactory. Extended monitoring after construction may be required if adjacent structures have been affected by the construction. The extended monitoring of the adjacent structures shall continue until the structures have stabilized and the Department concurs with the results and conclusions of the monitoring report. All costs associated with developing the instrumentation plan, purchasing instrumentation, installing instrumentation, and monitoring of the instrumentation shall be included in the unit cost of the temporary shoring system.

204.4.5.3 Construction

1 Construct the shoring system in a manner that protects adjacent structures; roadways; railways; and existing traffic, while allowing construction access for new bridge or other structure and embankment construction. Perform backfilling operations around existing piles so that only minimal lateral loads (i.e., approximately 10 kips) are exerted on existing piles. The Contractor is responsible for any damages or retrofit to adjacent structures that result from the construction of the shoring system.

2 When timber lagging is used, use timber meeting the requirements of **Section 706** for lagging.

3 Use bracing, tiebacks, or other wall components that provide access for new bridge substructure and superstructure or other structure construction, while maintaining the existing traffic flow without interruption.

4 Backfill material for shoring systems that will be permanently incorporated into embankments shall meet or exceed the requirements for borrow excavation.

204.5 Measurement

1 The pay items involving structural excavation for bridge foundations are determined by the classification of the material excavated as set forth in **Subsection 204.2.1**. The quantities are the volumes of materials actually removed and are measured by the cubic yard (CY), complete, and accepted. The volumes are measured between the original elevation of the ground surface and the bottom of the footings. Material removed outside of an area that is bounded by vertical planes 18 inches outside of and parallel to the neat dimensions of the footings is not included in the quantity, except where specifically authorized in writing by the RCE. Where the excavation begins below the waterline, measurement is from the bottom of the watercourse to the bottom of the foundation, excluding any measurement of water.

2 In the case of a permanent structural member such as a strut, diaphragm, beam, or other structural element where it is necessary to excavate in order to place forms, such excavation is included in the volume of structure excavation. However, the limit of structural excavation measurement does not extend more than 12 inches horizontally beyond the sides of the members, nor more than 12 inches below the bottom of the members.

3 Where a foundation seal is indicated in the Contract, the quantity for the pay item Wet Excavation for Bridges is the volume of the excavation of material other than water between the bottom of the watercourse and the actual bottom of seal concrete as poured and within the vertical planes of the neat lines of the seal shown on the Plans and is measured by the cubic yard (CY) of excavated material, complete, and accepted.

4 The quantity for the pay Structure Excavation for Culverts is the volume of material removed for the construction of the culvert and is measured by the cubic yard (CY) of material, complete, and accepted. The volume is measured between the original elevation of the ground surface and the bottom of the bottom slab, bound by vertical planes located 2 feet outside of and parallel to the outside neat lines of the culvert barrel and extending to 2 feet beyond the ends of the wingwalls. This measurement excludes the material excavated for the wings that are outside the area described above. Measurement of unstable material removed as directed by the RCE as provided in **Subsection 203.4** is not limited to the area described above. Measurement does not include water or other liquid removed.

5 If material for backfill is required because of the removal of unstable material below grade is obtained from the roadway or material pits, it is included in the measurement for Unclassified Excavation. Material necessary for backfill obtained from sources other than the roadway and material pits is considered as being equal to the volume of the unstable material removed and is measured as provided in **Subsection 203.5**. No direct allowance is made for overhaul or shrinkage for material to backfill undercut areas.

6 The quantity for the pay Structure Excavation for Retaining Walls is the volume of material removed between the original elevation of the ground surface and the bottom of the footing and enclosed by vertical planes located 12 inches outside of and parallel to the neat lines of the footings and is measured by the cubic yard (CY), complete, and accepted.

7 The quantity for the pay item Cofferdam or Cofferdam – Type (1, 2, 3, 4, 5, or 6) is measured by each (EA) cofferdam designed including any required design changes, constructed, dewatered, maintained and removed in accordance with the Plans, complete, and accepted. The type is based on a theoretical range of the volume contained in the cofferdam. No adjustment is made for differences between theoretical and actual volume of the cofferdam constructed.

8 The quantity for the pay item Permanent Shoring System or Temporary Shoring System is the length of the shoring system and is measured by the linear foot (LF) along the actual horizontal length of the shoring system, complete, and accepted. Borrow excavation is anticipated to be used

to backfill the shoring system, the quantities of borrow excavation have been included in the quantity of borrow excavation for the project.

204.6 Payment

1 Payment for the accepted quantity of each pay item, measured or determined as provided in **Subsection 204.5**, is determined using the contract unit bid price for the applicable pay item. The payment is full compensation for all direct and indirect costs and expenses necessary for the successful completion of excavation to the depth indicated on the Plans, in the Specifications, or directed by the RCE**.**

2 If it is necessary and approved by the RCE to carry a foundation more than 5 feet, but not more than 10 feet below the Plan elevation for any individual footing, payment for the excavation work performed below the elevation of the waterline within these limits is determined using an adjusted unit price equal to 150% of the contract unit bid price for the applicable classification of excavation.

3 If it is necessary and approved by the RCE to carry a foundation more than 10 feet below Plan elevation for any individual footing, payment for the excavation work performed below the elevation of the waterline is made at a adjusted unit price equal to 200% of the contract unit bid price for the applicable excavation. The payment includes the cost of removing cofferdams, cribs, sheeting, backfill, and disposing of surplus material. Excavation is paid under one classification only once and no allowance is made for necessary re-excavation.

4 Payment for Structure Excavation for Culverts is full compensation for excavating of material necessary for the construction of box culverts as specified or directed and includes removing and disposing of unstable material and backfill material obtained from sources outside the limits of the roadway, and all other materials, labor, equipment, tools, supplies, transportation, and incidentals necessary to complete the work in accordance with the Plans, the Specifications, and other terms of the Contract.

5 Payment for Cofferdam or Cofferdam – Type (1, 2, 3, 4, 5, or 6) is full compensation for the design (includes necessary calculations, drawings, and any required revisions), construction, dewatering, maintenance and removal of the cofferdam as specified or directed. Payment includes installation of the cofferdam; placement of seal concrete if required or used; dewatering; underwater inspection; and all other materials, labor, equipment, tools, supplies, transportation, and incidentals necessary to complete the work in accordance with the Plans, the Specifications, and other terms of the Contract. Cofferdams are paid at 75 percent of the contract unit bid price after the cofferdam is dewatered and the remaining 25 percent upon removal of the cofferdam. If the cofferdam is not be removed, then the remaining 25 percent will be paid upon substantial completion and acceptance of the substructure.

6 Payment for the accepted quantity for Permanent Shoring System or Temporary Shoring System is full compensation for design (includes necessary calculations and drawings), construction, maintenance and removal of the Temporary Shoring System as specified or directed. Payment includes providing and installation of all materials necessary to construct either Temporary Shoring Systems or Permanent Shoring Systems and all other materials (excluding MSE Wall and RSS backfill materials which have been included in the borrow excavation quantities), labor equipment, tools, supplies, transportation, and other items or incidental work necessary to complete the work in accordance with the Plans, the Specifications, and other terms of the Contract. Borrow excavation required to construction shoring systems will be paid at the unit rate of borrow excavation for the project. The cost of any excess backfill material to be removed from the project following removal of the shoring systems is incidental to the cost of temporary and permanent shoring systems.

7 Pay items under this section include the following:

Item No.	Pay Item	Unit
2041000	Structure Excavation for Culverts	CY
2041005	Structure Excavation for Retaining Wall	CY
2042000	Dry Excavation for Bridges	CY
2043000	Wet Excavation for Bridges	CY
2043500	Wet & Dry Excavation for Bridges	CY
2044000	Rock Excavation for Bridges	CY
2045000	Cofferdam	EA
2045010	Cofferdam - Type 1 (0 – 10,000 CF)	EA
2045020	Cofferdam - Type 2 (10,001 – 20,000 CF)	EA
2045030	Cofferdam - Type 3 (20,001 – 30,000 CF)	EA
2045040	Cofferdam - Type 4 (30,001 – 40,000 CF)	EA
2045050	Cofferdam - Type 5 (40,001 – 50,000 CF)	EA
2045060	Cofferdam - Type 6 (>50,000 CF)	EA
2047000	Temporary Shoring System	LF
2047210	Permanent Shoring System	LF