Project Special Provisions
Structures and Culverts

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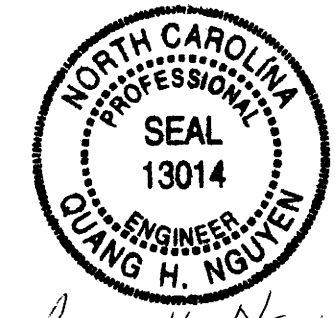

Quang H. Nguy 5-7-08

PROJECT SPECIAL PROVISIONS
STRUCTURES AND CULVERTS

PROJECT R-2518A & R-2518B **MADISON / YANCEY COUNTIES**

DRILLED PIERS **(11-17-06)**

1.0 GENERAL

A. Description

This special provision governs the construction of Drilled Piers, also known as "Drilled Shafts" and "Caissons". Drilled piers are a reinforced concrete section, cast-in-place against in situ material or permanent steel casing. Drilled piers are a straight shaft type and vertical. Construct drilled piers in accordance with the details and dimensions shown on the plans and this provision.

B. Prequalification and Experience Requirements

Use a Drilled Pier Contractor prequalified by the Contractual Services Unit of the Department for drilled pier work (work code 3090).

Submit documentation that the Drilled Pier Contractor has successfully completed at least 5 drilled pier projects within the last 3 years with diameters, lengths and subsurface conditions similar to those anticipated for this project. Documentation should include the General Contractor and Owner's name and current contact information with descriptions of each past project. Also, submit documentation of experience with dry and wet placement of concrete and the use of temporary casing or slurry.

Provide a list of the Drilling Superintendent, Drill Rig Operators and Project Manager that will be assigned to this project. Submit documentation for these personnel verifying employment with the Drilled Pier Contractor and a minimum of 5 years experience in drilled pier construction with past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc. Perform work with the personnel submitted and accepted. If personnel changes are required during construction, suspend drilled pier construction until replacement personnel are submitted and accepted.

C. Construction Sequence Plan

Submit two hard copies and an electronic copy (pdf or jpeg format on CD or DVD) of a drilled pier construction sequence plan for all the drilled piers 30 days before beginning drilled pier construction. Provide detailed project specific information in this plan including:

1. Experience documentation in accordance with Section 1.0, Item B
2. List and size of equipment including: cranes, kelly bars, drill rigs, vibratory hammers, augers, core barrels, cleanout buckets, airlifts and/or submersible pumps, tremies and/or concrete pumps, casing (diameters, thicknesses and lengths), desanding equipment (for slurry construction), etc.
3. Order of drilled pier construction
4. Casing installation and temporary casing removal methods including the order of telescoped casing removal
5. Drilled pier excavation and bottom cleaning methods
6. Reinforcement placement methods including how the cage will be supported and centered in the excavation
7. Concrete placement procedures including how the tremie or pump will be controlled and what type of discharge control will be used to prevent concrete contamination when the tremie or pump is initially placed in the excavation
8. Concrete mix design in accordance with Section 1000 of the Standard Specifications
9. Slurry details (if applicable) including intended purpose, product information, manufacturer's recommendations for use, slurry equipment information and written approval from the slurry supplier that the mixing water is acceptable
10. Procedures for handling drilling spoils and slurry overflow including environmental controls to prevent the loss of concrete, slurry and spoils
11. Methods of how the slurry level will be maintained above the highest piezometric head (if applicable)
12. Crosshole sonic logging (CSL) submittals (if applicable) in accordance with the Crosshole Sonic Logging Special Provision
13. Other information shown on the plans or requested by the Engineer

Do not begin drilled pier construction until the construction sequence plan is accepted. If alternate drilled pier construction procedures are proposed or necessary, a revised submittal may be required. If the work deviates from the accepted submittal without prior approval, the Engineer may suspend drilled pier construction until a revised drilled pier construction sequence plan is submitted and accepted.

D. Preconstruction Meeting

Conduct a drilled pier preconstruction meeting with the Project Manager, Drilling Superintendent, the Resident or Bridge Maintenance Engineer and/or his or her representatives, the Bridge Construction Engineer and the Geotechnical Operations Engineer to discuss construction and inspection of the drilled piers. This meeting should occur after the Drilled Pier Contractor has mobilized to the site and the construction sequence plan has been reviewed and accepted.

E. Definition of Rock

For the purposes of this provision, "Rock" is defined as a continuous intact natural material in which the penetration rate with a rock auger is less than 2 in (50 mm) per 5 minutes of drilling at full crowd force. This definition excludes discontinuous loose natural materials such as boulders and man-made materials such as concrete, steel, timber, etc. This definition of rock is not for pay purposes; see Section 8.0 for method of measurement of "Drilled Piers Not in Soil".

F. Rock Socket

When required by a note on plans, provide a minimum penetration into rock as directed by the Engineer.

2.0 EXCAVATION

Perform the excavations required for the drilled piers to the dimensions and elevations shown on the plans or otherwise required by the Engineer, including any miscellaneous grading or excavation to install the pier.

Excavate with a drill rig of adequate capacity. Use a rig that is capable of drilling through soil and non-soil including rock, boulders, timbers, man-made objects and any other materials encountered. Blasting is not permitted to advance the excavation. Blasting for core removal is only permitted when approved by the Engineer.

Use a drill rig capable of drilling a minimum of 25% deeper than the deepest drilled pier shown on the plans. Use drilling tools equipped with vents designed to stabilize the hydrostatic pressure above and below the tool during extraction from the excavation. For drilled piers constructed with slurry, monitor the rate at which the drilling tools are inserted and extracted so as to minimize sidewall suction action in the excavation. Drilling below the tip elevations shown on the plans may be required to achieve adequate bearing.

A drilling log signed by the Drilled Pier Contractor that includes material descriptions and depths and drilling times and tools used for each material is required for each pier.

Dispose of drilling spoils in accordance with Section 802 of the Standard Specifications and as directed by the Engineer. Drilling spoils consist of all excavated material including water removed from the excavation either by pumping or drilling tools. Construct drilled piers at the locations shown on the plans and within the tolerances specified herein. If tolerances are exceeded, the Engineer may require corrective measures to meet the tolerances specified. Construct the drilled piers such that the axis at the top of the piers is no more than 3 in (75 mm) in any direction from the position shown in the plans. Build drilled piers within 2% of the plumb deviation for the total length of the piers. Verify the plumbness of the drilled pier excavations by an accurate procedure, such as an inclinometer on the kelly bar or other approved techniques. Unless a plan note requires the construction joint to be moved below the ground line, construct the finished top of pier elevation between 1 in (25 mm) above and 3 in (75 mm) below the top of pier elevation shown on the plans. When drilling from a barge, use a fixed template that maintains pier position and alignment during all excavation and concrete placement operations. Floating templates (attached to a barge) are not allowed.

Stabilize all drilled pier excavations with steel casing and/or slurry except, as approved by the Engineer, the portions of the excavations in rock as defined by Section 1.0, Item E. Stabilize excavations at all times from the beginning of drilling through concrete placement. When using multiple casings in a telescoped arrangement, overlap subsequent casings a minimum of 2 ft (600 mm). Provide casing or slurry in rock if unstable material is anticipated or encountered during drilling. When slurry is used, a partially excavated pier is subject to the time requirements in Section 2.0, Item C, Number 1. When slurry is not used, do not leave a drilled pier excavation open overnight unless it is cased to rock.

If a note on plans does not prohibit dewatering and the tip of the drilled pier excavation is in rock as defined by Section 1.0, Item E, dewater the excavation to the satisfaction of the Engineer. The minimum diameter of a drilled pier excavation in rock or an excavation constructed with slurry may be 2 in (50 mm) less than the design drilled pier diameter shown on the plans.

In order to remove a casing and substitute a larger diameter or longer casing through unstable or caving material, either backfill the excavation, stabilize the excavation with slurry before removing the casing to be replaced or insert the larger casing around the casing to be replaced before removal.

A. Permanent Steel Casing

Use permanent steel casings as directed by the Engineer and/or as required by a note on plans. Use permanent casings that are clean smooth non-corrugated watertight steel of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth or backfill. Provide permanent steel casings conforming to ASTM A252, Grade 2 and the following minimum wall thickness requirements.

CASING WALL THICKNESS

Casing Diameter	Minimum Wall Thickness
Less than or equal to 48 in (1220 mm)	3/8 in (9 mm)
Greater than 48 in (1220 mm) and less than or equal to 78 in (1982 mm)	1/2 in (12 mm)
Greater than 78 in (1982 mm)	5/8 in (16 mm)

Provide permanent casings with an outside diameter not less than the specified size of the drilled pier. If approved by the Engineer, a permanent casing larger in diameter than the drilled pier design diameter is permitted. However, no payment will be made for any costs associated with larger permanent casings. Extend the permanent casings from the top of pier elevation or top of permanent casing elevation, if shown on the plans, to a depth no deeper than the permanent casing tip elevation shown on the plans or the revised permanent casing tip elevation approved by the Engineer. Do not extend permanent casings below the permanent casing tip elevation shown on the plans without prior approval from the Engineer. Additional drilled pier length and reinforcement may be required if permanent casings are extended below the permanent casing tip elevation shown on the plans. No payment will be made for the resulting additional drilled pier length, reinforcement and permanent casing unless the Engineer approves the revised permanent casing tip elevation. Install permanent casings in one continuous unit. If splices are necessary for the casing, use an approved method of splicing. Splices are considered incidental and no additional compensation will be made.

Remove any portion of the permanent steel casing that extends above the top of the drilled pier after the Drilled Pier Concrete has achieved a compressive strength of 4500 psi (31.0 MPa). The cost of casing removal will be considered incidental to the cost of the permanent steel casing.

B. Temporary Steel Casing

Provide temporary steel casing to stabilize drilled pier excavations, protect personnel and prevent caving or sloughing that is clean smooth non-corrugated watertight steel of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth or backfill. Use temporary steel casings with a minimum wall thickness of 3/8 in (9 mm) and an outside diameter not less than the specified size of the drilled pier.

Temporary steel casings that become bound or fouled during construction and cannot be practically removed may constitute a defect in the drilled pier. Improve defective piers to the satisfaction of the Engineer by removing the concrete and extending the pier deeper, providing a replacement drilled pier or other acceptable means. Complete all corrective measures including any additional design work to the satisfaction of the Engineer without additional compensation or an extension of the completion date of the project.

C. Slurry

When slurry use is not noted on the plans, slurry construction is an option. If slurry use is required or an option, polymer slurry use may either be required or prohibited as noted on the plans. If slurry use is required or an option and polymer slurry use is not noted on the plans, polymer slurry use is an option.

If polymer slurry is required or an option, use one of the following polymers listed in the table below:

PRODUCT	MANUFACTURER
SlurryPro CDP	KB Technologies Ltd. 3648 FM 1960 West, Suite 107 Houston, TX 77068 (800) 525-5237
Super Mud	PDS Company 105 West Sharp Street El Dorado, AR 71730 (800) 243-7455
Shore Pac GCV	CETCO Drilling Products Group 1500 West Shure Drive Arlington Heights, IL 60004 (800) 527-9948
Novagel Polymer	Geo-Tech Drilling Fluids 220 North Zapata Hwy, Suite 11A Laredo, TX 78043 (210) 587-4758

Use polymer slurry and associated additives in accordance with the manufacturer's guidelines and recommendations unless otherwise approved by the Engineer. The Drilled Pier Contractor should be aware that polymer slurry might not be appropriate for a given site. Polymer slurry should not be used for excavations in soft or loose soils as determined by the Engineer. When using polymer slurry, a representative of the manufacturer must be on-site to assist and guide the Contractor during the construction of the first three drilled piers unless otherwise approved by the Engineer. This representative must also be available for on-site assistance to the Contractor if problems are encountered during the construction of the remaining drilled piers as requested by

the Engineer. The cost of all on-site assistance and representation will be considered incidental to the cost of the drilled piers.

If mineral slurry is required or an option, use mineral slurry composed of bentonite having a mineral grain size that remains in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system to minimize bottom sedimentation. Provide bentonite slurry to maintain the stability of the excavation and allow for proper concrete placement. The Drilled Pier Contractor should be aware that salt water with salt concentrations in excess of 500 ppm may adversely affect bentonite slurry.

When slurry is used and permanent steel casing is not required, use temporary casing a minimum of 10 ft (3 m) long at the top of the excavation. Maintain the top of the temporary casing a minimum of 1 ft (300 mm) above the ground surface surrounding the casing.

Maintain the slurry in the pier excavation at a level not less than 5 ft (1.5 m) or the drilled pier diameter (whichever is greater) above the highest piezometric head along the depth of the pier. It is anticipated that the highest piezometric head is the static water or groundwater elevation (elevation head). However, the Drilled Pier Contractor is responsible for determining the highest piezometric head. The use of steel casing to maintain the required slurry level is permitted; however, no payment will be made for casing that is used for this purpose. If the slurry level in the excavation suddenly changes or cannot be practically maintained, or the slurry construction method does not produce the desired result, stop the pier construction until an alternate construction procedure is accepted by the Engineer.

Thoroughly premix the slurry with water in tanks before introducing the slurry into the excavation. Submit written approval from the slurry supplier that the mixing water is acceptable. Allow bentonite slurry to hydrate 24 hours in tanks before use. Slurry tanks of adequate capacity are required for slurry circulation, storage and treatment. Excavated slurry pits are not allowed in lieu of slurry tanks without prior approval from the Engineer. Take all steps necessary to prevent the slurry from "setting up" in the excavation. Such methods include, but are not limited to agitation, circulation and/or adjusting the properties of the slurry. Perform desanding operations as necessary to achieve the acceptable sand contents before placing reinforcing steel.

1. Time

   Adjust the excavation operations so that the maximum time the slurry is in contact with the sidewalls of the uncased portions of the drilled pier excavation (from time of drilling to concrete placement) does not exceed 36 hours. Do not work on more than two drilled piers per drill rig below the steel casing at any time.

Agitate bentonite slurry in the drilled pier excavations a minimum of every 4 hours. If the bentonite slurry is not agitated a minimum of every 4 hours or the 36 hour time limit is exceeded, the Engineer may require the excavation to be overreamed beneath the steel casing a minimum of 1 in (25 mm) and a maximum of 3 in (75 mm) before performing any other operations in the excavation. Overream with a grooving tool, overreaming bucket or other approved equipment at a minimum spacing of 12 in (300 mm). All costs associated with both overreaming and the resulting additional concrete placement will be considered incidental to the cost of the drilled piers.

If concrete placement is not completed within three days of beginning drilling, enlarge the design drilled pier diameter by a minimum of 6 in (150 mm), or as required by the Engineer, the entire length of the pier at no additional cost to the Department. Enlarging the drilled pier includes replacing the steel casing with steel casing the same size to which the drilled pier is enlarged at no additional cost to the Department.

2. Sampling

Collect all slurry samples using an approved sampling tool. Test slurry samples to determine density, viscosity, pH and sand content to establish an acceptable working pattern during slurry use. Test a minimum of 4 samples during each 8 hours of slurry use for each drilled pier. Take the first sample for the first 8 hours from the slurry tank before introducing slurry into the excavation. Collect the remaining samples from the bottom of the pier excavation. When the test results are acceptable and consistent, a decrease in the testing frequency to one sample per 4 hours of slurry use is permitted.

Before placing reinforcing steel in the drilled pier excavation, extract slurry samples from the bottom of each excavation and at intervals not exceeding 10 ft (3 m) up the excavation, until two consecutive samples produce acceptable values for density, viscosity, pH and sand content.

3. Testing

Have qualified personnel conduct slurry tests to determine density, viscosity, pH and sand content. The following tables show the acceptable range of values for the slurry properties:

BENTONITE SLURRY
Sodium Montmorillonite (Commercial Bentonite)
Acceptable Range of Values

Property (units)	**At Time of Slurry Introduction**	**In Excavation Immediately Before Concrete Placement**	**Test Method**
Density, pcf (kg/m^3)	64.3 – 69.1 (1030-1107)	64.3 – 75.0 (1030-1201)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	28 – 45	28 – 45	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 – 11	8 – 11	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 4	Less than or equal to 2	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m^3) in saltwater.

SLURRYPRO CDP KB Technologies Ltd. Acceptable Range of Values			
Property (units)	**At Time of Slurry Introduction**	**In Excavation Immediately Before Concrete Placement**	**Test Method**
Density, pcf (kg/m^3)	Less than or equal to 67 (1073)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	50 – 120	Less than or equal to 70	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6 – 11.5	6 – 11.5	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m^3) in saltwater.

SUPER MUD PDS Company Acceptable Range of Values			
Property (units)	**At Time of Slurry Introduction**	**In Excavation Immediately Before Concrete Placement**	**Test Method**
Density, pcf (kg/m^3)	Less than or equal to 64 (1025)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	32 – 60	Less than or equal to 60	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 – 10	8 – 10	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m^3) in saltwater.

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SHORE PAC GCV CETCO Drilling Products Group Acceptable Range of Values			
Property (units)	**At Time of Slurry Introduction**	**In Excavation Immediately Before Concrete Placement**	**Test Method**
Density, pcf (kg/m^3)	Less than or equal to 64 (1025)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	33 – 74	Less than or equal to 57	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 – 11	8 – 11	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m^3) in saltwater.

NOVAGEL POLYMER
Geo-Tech Drilling Fluids
Acceptable Range of Values

Property (units)	At Time of Slurry Introduction	In Excavation Immediately Before Concrete Placement	Test Method
Density, pcf (kg/m^3)	Less than or equal to 67 (1073)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	45 – 104	Less than or equal to 104	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6.5 – 11.5	6.5 – 11.5	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m^3) in saltwater.

When any slurry samples are found to be unacceptable, take whatever action is necessary to bring the slurry within specification requirements. Do not place reinforcement steel until resampling and testing produce acceptable results.

Sign and submit reports of all slurry tests required above to the Engineer upon completion of each drilled pier. The Department reserves the right to perform comparison slurry tests at any time.

4. Slurry Disposal

Comply with all applicable local, state and federal regulations, as well as with the environmental permits of the project when disposing of excavated materials contaminated with slurry. Keep all excavated materials, spoils from the desanding unit and slurry out of the water and contain them at all times. The cost of the containment, removal and disposal of excavated materials contaminated with slurry, as well as the slurry itself, is incidental to the cost of the drilled piers.

3.0 CLEANING

Excavate the bottom of the drilled pier to a level plane or stepped with a maximum step height of 12 in (300 mm). Clean the bottom of the excavation of loose material using a technique accepted in the construction sequence plan. When the drilled pier excavation is not hand cleaned, clean the bottom of the excavation with a cleanout bucket and an airlift or submersible pump.

4.0 INSPECTION METHODS AND REQUIREMENTS

After the drilled pier excavation is complete and immediately before placing reinforcing steel and concrete, demonstrate the proper condition of the drilled pier excavation to the Engineer. Provide bosun chairs, gas meters, safety equipment, lights, mirrors, weighted tape measures, steel probes, personnel and all assistance required for the Engineer to inspect the drilled pier excavations.

A. Bearing Capacity

If the required end bearing capacity is not satisfied, increase the drilled pier length as directed by the Engineer. Payment for the additional drilled pier length to achieve adequate bearing will be made per the drilled pier pay items.

One or more of the following tests may be used to verify the conditions and continuity of the bearing material before placing reinforcing steel.

1. Visual Inspection

   The end bearing of the drilled pier excavation may be inspected either by entering the excavation or visually from the top of the excavation.

2. Test Hole

   If the tip of the drilled pier excavation is in rock as defined by Section 1.0, Item E, drill a 1-1/2 in (38 mm) diameter test hole in each drilled pier to a depth at least 6 ft (1.8 m) below the tip elevation.

3. Standard Penetration Test (SPT)

   When noted on the plans that a SPT is required, drive a split barrel sampler a minimum of 18 in (450 mm) below the drilled pier tip elevation or to refusal in accordance with ASTM D1586, "Penetration Test and Split-Barrel Sampling of Soils". Complete the SPT using NW rods through casing or another stabilizing method as approved by the Engineer. Extend the SPT rods from the top of the drilled pier excavation to the drilled pier tip elevation. Firmly support the SPT casing at the top of the drilled pier excavation and rest it on the bottom of the excavation. Conduct the SPT a minimum of 12 in (300 mm) away from the sidewalls of the excavation and be sure not to scrape the sidewalls of the excavation while inserting or withdrawing the SPT equipment. Have the SPT device on-site

before reaching the drilled pier tip elevation. Report the number of blows for each 6 in (150 mm) increment driven and a description of the recovered soil sample to the Engineer. The Engineer determines the number of blows required for bearing.

B. Bottom Cleanliness

The pier excavation bottom is considered clean if a minimum of 50% of the bottom area has less than 1/2 in (13 mm) of sediment and no portion of the bottom area has more than 1-1/2 in (38 mm) of sediment as determined by the Engineer.

One or more of the following inspection procedures may be used to inspect the cleanliness of the pier excavation bottom before placing the reinforcing steel and concrete.

1. Visual Inspection

   The cleanliness of the drilled pier excavation bottom may be observed either by entering the excavation or from the top of the excavation.

2. Steel Probe

   If the excavation is not dewatered or if the Engineer requires it, lower a steel probe to the bottom of the drilled pier excavation to ensure that cleaning has been satisfactorily completed. Supply a steel probe that is 2 ft (0.6 m) long with a flat tip on the sounding end, weighs approximately 9 lbs, #10 rebar (4 kg, #32 rebar), and is suspended from the opposite end with a non-stretch cable.

3. Shaft Inspection Device (SID)

   The Department may use the SID to take sediment measurements and observe the bottom conditions of the drilled pier excavation at a minimum of five locations selected by the Engineer. The SID is a remotely operated camera capable of observing bottom conditions and measuring sediment underwater and slurry. Each SID inspection (including all 5 locations) takes approximately 1 hour after the equipment has been set up. The Engineer provides the SID and the personnel to operate the device. Notify the Engineer a minimum of 2 days before beginning the drilled pier excavation so the Engineer can arrange for the transportation of the SID to the site and the personnel to perform the inspections. SID inspections are required until the cleanliness of the drilled pier excavation bottom is acceptable in accordance with Section 4.0, Item B of this provision. Do not conduct operations that interfere with the SID inspections. Remove all cleaning and drilling equipment from the drilled pier excavation during any SID inspection. Provide a working area large enough for the SID equipment and within reach of the cabling supplied and clear sight distance of the drilled pier excavation. Assist the Engineer in the transportation and handling of the SID and all the associated equipment and in supporting the electric hoist and/or hoisting tripod for the SID. If required, provide a safe and secure location to park the trailer for the SID while it is unattended on the project site. If any of the SID equipment is damaged due to the Contractor's

negligence, then replace the equipment at no additional cost to the Department. Provide replacement equipment that exactly matches the damaged equipment as directed by the Engineer. All costs involved with the initial SID inspection of each drilled pier excavation will be made per the SID pay item. No additional payment will be made for subsequent or repeated SID inspections of the same drilled pier excavation. No claims for either lost time or actual expense of any SID inspections that do not find the cleanliness of the drilled pier excavation bottom in compliance with this provision will be paid.

5.0 REINFORCING STEEL

Reinforcing steel shall conform to Section 1070 of the Standard Specifications. Completely assemble a cage of reinforcing steel, consisting of longitudinal and spiral bars and place it in the drilled pier excavation as a unit immediately after the proper condition of the excavation is demonstrated to the Engineer. When concrete placement does not follow immediately after cage placement, remove the steel from the pier excavation unless the Engineer directs otherwise. If the cage is removed, recheck pier excavation cleanliness in accordance with this provision before reinstalling the cage.

If the drilled pier excavation is cased down to rock, immediate placement of the reinforcing steel and the concrete is not required. If electing to delay placement of the reinforcing steel and concrete due to the presence of rock, recheck the excavation for proper cleanliness immediately before placing reinforcing steel.

A. Construction, Placement, Support and Alignment

If it is determined in the field that the drilled pier must be longer, adequate reinforcement may be required in the extended length as directed by the Engineer. Lift the cage so racking and cage distortion does not occur. Keep the cage plumb during concrete operations and casing extraction. Check the position of the cage before and after placing the concrete. Position the splice length of the drilled pier cage so that the column or footing has the minimum concrete cover shown on the plans.

Securely cross-tie the vertical and spiral reinforcement at each intersection with double wire. Support or hold down the cage so that the vertical displacement during concrete placement and casing extraction does not exceed 6 in (150 mm).

B. Bolsters and Spacers

Set the rebar cage directly on the bottom of the drilled pier excavation with plastic bolsters under each vertical reinforcing bar. Ensure that spacers are tall enough to raise the rebar cage off the bottom of the drilled pier excavation a minimum of 3 in (75 mm). If approved by the Engineer, the rebar cage may be hung in the excavation provided the mechanisms supporting the cage are left in place until the Drilled Pier Concrete strength has achieved 3000 psi (20.7 MPa).

In order to ensure the minimum required concrete cover and achieve concentric spacing of the cage within the pier, attach plastic spacer wheels at five points around the cage perimeter. Use spacer wheels that provide a minimum of 4 in (100 mm) "blocking" from the outside face of the spiral bars to the outermost surface of the drilled pier except in rock as defined by Section 1.0, Item E and when using slurry construction. Use spacer wheels for slurry construction or in rock that provide a minimum of 2 in (50 mm) "blocking". Tie spacer wheels that snap together with wire and allow them to rotate. Use spacer wheels that span at least two adjacent vertical bars. Start placing spacer wheels at the bottom of the cage and continue up along its length at maximum 10 ft (3 m) intervals.

6.0 CONCRETE

Drilled Pier Concrete shall conform to Section 1000 of the Standard Specifications. Begin concrete placement immediately after inserting reinforcing steel into the drilled pier excavation.

A. Concrete Mix

As an option, use Type IP blended cement with a minimum cement content of 665 lbs/yd^3 (395 kg/m^3) and a maximum cement content of 833 lbs/yd^3 (494 kg/m^3). Use No. 78M coarse aggregate in the mix.

Use an approved water-reducer, water-reducing retarder, high-range water-reducer or high-range water-reducing retarder to facilitate placement of the concrete if necessary. Do not use a stabilizing admixture as a retarder in Drilled Pier Concrete without approval of the Engineer. Use admixtures that satisfy AASHTO M194 and add them at the concrete plant when the mixing water is introduced into the concrete. Redosing of admixtures is not permitted.

B. Concrete Placement

Place concrete such that the drilled pier is a monolithic structure. Vibration is only permitted, if needed, in the top 10 ft (3 m) of the drilled pier. Remove any contaminated concrete from the top of the drilled pier at the time of concrete placement. Contain and remove all wasted concrete that spills over the casing.

Do not twist, move or otherwise disturb temporary casings until the concrete depth in the casing is in excess of 10 ft (3 m) above the bottom of the casing being disturbed. If the head is greater than 30 ft (9 m), the Engineer may require a concrete depth greater than 10 ft (3 m). The head is defined as the difference between the highest piezometric head along the depth of the pier and the static water elevation inside the excavation. If the Engineer requires a concrete depth greater than 10 ft (3 m), the Drilled Pier Contractor may choose to either place concrete with this required concrete depth or place concrete with the wet method and a minimum concrete depth of 10 ft (3 m).

Maintain the required concrete depth above the bottom of the innermost casing during casing removal, except when the concrete level is at or above the top of drilled pier elevation. Sustain a sufficient concrete depth above the bottom of casing to overcome outside soil and water pressure. As the casing is withdrawn, exercise care in maintaining an adequate concrete depth within the casing so that fluid trapped behind the casing is displaced upward and discharged at the ground surface without contaminating or displacing the Drilled Pier Concrete. Exerting downward pressure, hammering and/or vibrating the temporary casing is permitted to facilitate removal.

Use the water inflow rate to determine the concrete placement procedure after any pumps have been removed from the excavation. If the inflow rate is less than 6 in (150 mm) per half hour, the concrete placement is considered dry. If the water inflow rate is greater than 6 in (150 mm) per half hour, the concrete placement is considered wet.

Keep a record of the volume of concrete placed in each drilled pier excavation and make it available to the Engineer. For drilled piers constructed with slurry or as directed by the Engineer, record a graphical plot of the depth versus theoretical concrete volume and actual measured concrete volume for each drilled pier and provide it to the Engineer when finished placing concrete.

1. Dry Placement

   Before concrete placement, make certain the drilled pier excavation is dry so the flow of concrete around the reinforcing steel can be verified by visual inspection. If the concrete free fall does not exceed 60 ft (18.3 m), placing the concrete by a central drop method where the concrete is chuted directly down the center of the excavation is permitted.

   For drilled piers exceeding 60 ft (18.3 m) in length, use a tremie or a pump to place concrete unless otherwise approved by the Engineer. Support the tremie or pump pipe so that the concrete free fall is less than 60 ft (18.3 m) at all times.

2. Wet Placement

   Maintain a static water or slurry level in the excavation before placing concrete underwater. When temporary casing is used as the method to stabilize the excavation, place concrete with a sectional tremie or pump (no continuous tremie).

   Once the concrete in the excavation reaches the same elevation as the static water level, placing concrete with the dry method is permitted. Before changing to the dry method of concrete placement, remove the water above the concrete and clean the concrete surface of all scum and sediment to expose clean, uncontaminated concrete.

3. Pump and Tremie

   Pump concrete in accordance with Article 420-5 of the Standard Specifications. Use a steel tremie with watertight joints and a minimum diameter of 10 in (250 mm). Use a discharge control to prevent concrete contamination when the tremie tube or pump pipe is initially placed in the excavation. Extend the tremie tube or pump pipe into the concrete a minimum of 5 ft (1.5 m) at all times except when the concrete is initially introduced into the pier excavation. If the tremie tube or pump pipe pulls out of the concrete for any reason after the initial concrete is placed, restart concrete placement with a steel capped tremie tube or pump pipe.

4. Placement Time

   Place concrete within the time frames specified in Table 1000-2 of the Standard Specifications for Class AA concrete. Do not place concrete so fast as to trap air, slurry, water, fluids, soil or any other deleterious materials in the vicinity of the reinforcing steel and the annular zone between the rebar cage and the excavation walls.

7.0 SCHEDULING AND RESTRICTIONS

If caving or sloughing occurs, compensation will not be provided for additional concrete to fill the resulting voids.

For the first 16 hours after a drilled pier has achieved its initial concrete set (as determined by the Engineer), do not drill adjacent piers, do not install adjacent piles, and do not allow any equipment wheel loads or "excessive" vibrations within 20 ft (6 m) of the drilled pier.

In the event that the procedures described herein are performed unsatisfactorily, the Engineer may suspend drilled pier construction in accordance with Article 108-7 of the Standard Specifications. If the integrity of the drilled pier is in question, the Engineer reserves the right to reject the drilled piers and require remediation. Remedial measures are proposed by the Contractor and require approval of the Engineer. No compensation will be paid for losses or damage due to remedial work or any investigation of drilled piers found defective or not in accordance with this provision or the plans.

8.0 MEASUREMENT AND PAYMENT

A. Method of Measurement

1. Drilled Piers in Soil

   The quantity of "Drilled Piers in Soil" to be paid for will be the linear feet (meters) of the drilled piers exclusive of the linear feet (meters) of "Drilled Piers Not in Soil" computed from elevations and dimensions as shown on the plans or from revised dimensions authorized by the Engineer. Drilled piers through air or water will be paid for as "Drilled Piers in Soil".

2. Drilled Piers Not in Soil

The quantity of "Drilled Piers Not in Soil" to be paid for will be the linear feet (meters) of drilled piers excavated in non-soil as determined by the Engineer. Non-soil is defined as material that can not be cut with a rock auger and requires excavation by coring, air tools, hand removal or other acceptable methods. Top of non-soil elevation is that elevation where the rock auger penetration rate is less than 2 in (50 mm) per 5 minutes of drilling at full crowd force and coring, air tools, etc. are used to advance the excavation. For pay purposes, after non-soil is encountered, earth seams, rock fragments and voids in the excavation less than 3 ft (0.9 m) in total length will be considered "Drilled Piers Not in Soil". If the non-soil is discontinuous, payment will revert to "Drilled Piers in Soil" at the elevation where non-soil is no longer encountered.

3. Permanent Steel Casing

The quantity of "Permanent Steel Casing" to be paid for will be the linear feet (meters) of permanent steel casing as directed or required to be used. The length to be paid for will be measured along the permanent casing from the top of the casing elevation or top of the pier elevation, whichever is lower, to the permanent casing tip elevation. The Department will also pay for up to an additional 3 ft (1 m) of permanent casing cut off if the casing can not be installed to the permanent casing tip elevation shown on the plans. Permanent casing will be paid for only when permanent casing is authorized or when the Engineer directs the Contractor to leave a casing in place such that it becomes a permanent part of the pier. No payment will be made for temporary steel casings that become bound or fouled during pier construction and cannot be practically removed.

4. Shaft Inspection Device (SID)

The quantity of "SID Inspection" to be paid for will be per drilled pier as noted on the plans and/or directed by the Engineer. SID inspections are performed until the bottom cleanliness of the drilled pier excavation is acceptable by this provision; however, payment will only be made for the initial SID inspection of each drilled pier excavation.

5. Standard Penetration Test (SPT)

The quantity of "SPT Testing" to be paid for will be the actual number of SPT tests performed as noted on the plans and/or directed by the Engineer.

B. Basis of Payment

1. Drilled Piers in Soil

Payment will be made at the contract unit price per linear foot (meter) for "____ Dia. Drilled Piers in Soil". Such payment will include, but is not limited to, furnishing all labor, tools, equipment, materials including concrete complete and in

place and all incidentals necessary to excavate the drilled piers and complete the work as described in this provision. No additional payment will be made for slurry use. No additional payment will be made for any miscellaneous grading or excavation to install the drilled pier. "Reinforcing Steel" and "Spiral Column Reinforcing Steel" will be paid for separately and will not be part of the unit bid price for "Drilled Piers in Soil".

2. Drilled Piers Not in Soil

   Payment will be made at the contract unit price per linear foot (meter) for "____ Dia. Drilled Piers Not in Soil". Such payment will include, but is not limited to, furnishing all labor, tools, equipment, materials including concrete complete and in place and all incidentals necessary to excavate the drilled piers and complete the work as described in this provision. No additional payment will be made for slurry use. No additional payment will be made for any miscellaneous grading or excavation to install the drilled pier. "Reinforcing Steel" and "Spiral Column Reinforcing Steel" will be paid for separately and will not be part of the unit bid price for "Drilled Piers Not in Soil".

3. Permanent Steel Casing

   Payment will be made at the contract unit price per linear foot (meter) for "Permanent Steel Casing for ____ Dia. Drilled Pier". Such payment will include, but is not limited to, furnishing all material, labor, tools, equipment and all incidentals necessary to install the casing in the pier excavation.

4. Shaft Inspection Device (SID)

   Payment for SID will be at the contract unit price per each for "SID Inspection". Such payment will include, but is not limited to, furnishing all materials, labor, tools, equipment and all incidentals necessary to complete the SID inspection as described in this provision.

5. Standard Penetration Test (SPT)

   Payment for SPT will be at the contract unit price per each for "SPT Testing". Such payment will include, but is not limited to, furnishing all materials, labor, tools, equipment and all incidentals necessary to complete the SPT at each test location.

CROSSHOLE SONIC LOGGING (11-17-06)

1.0 GENERAL

Use the non-destructive testing method crosshole sonic logging (CSL) to verify the integrity of the drilled pier and quality of concrete. The CSL test method is described in ASTM D6760, "Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing". The Engineer will determine the number of CSL tests and which drilled piers will be CSL tested. Drilled piers are referred to as piers in this special provision.

The CSL test measures the time for an ultrasonic pulse to travel from a signal source in one tube to a receiver in another tube. In uniform, good quality concrete, the travel time between equidistant tubes should yield relatively consistent arrival times and correspond to a reasonable pulse velocity, signal amplitude and energy from the bottom to the top of the pier. Longer travel times, decrease in pulse velocity and lower amplitude/energy signals indicate the presence of irregularities such as poor quality concrete, voids, honeycombing, cracking and soil intrusions. The signal may be completely lost by the receiver and CSL recording system for severe defects such as voids.

Retain a CSL Consultant to perform CSL testing on the selected drilled piers. The CSL Consultant shall supply the Contractor with technical assistance and guidance during preparation and testing. Provide suitable access to the site and to the top of piers to be tested. Follow instructions from the CSL Consultant unless directed otherwise by the Engineer.

Place CSL tubes in all drilled piers. Perform CSL testing after concrete achieves a minimum compressive strength of 3000 psi (20.7 MPa) and within 7 to 30 days after concrete placement. After CSL test results have been reviewed and the Engineer has accepted the drilled pier, dewater the tubes and core holes, if any, and fill with an approved grout. If the Engineer elects not to CSL test a pier, obtain approval from the Engineer to dewater the tubes and fill them with an approved grout. Provide, mix and place grout in accordance with the Grout for Structures Special Provision.

2.0 PREQUALIFICATION AND EXPERIENCE REQUIREMENTS

Use a CSL Consultant prequalified by the Contractual Services Unit of the Department for Non-Destructive Foundation Testing work (work code 3070).

Submit documentation that the CSL Consultant has successfully completed at least 5 CSL testing projects within the last 3 years of a scope and complexity similar to that anticipated for this project. Documentation should include the General Contractor and Owner's name and current contact information with descriptions of each past project.

Provide the name of the Project Engineer that will be assigned to this project. Submit documentation for the Project Engineer verifying employment with the CSL Consultant, registration as professional engineer in North Carolina and a minimum of 5 years experience in CSL testing with past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc.

3.0 PREPARATION FOR CSL

Submit grout mix design or packaged grout type, CSL Consultant experience documentation, CSL tube size and Type 7 Contractor's Certification, cap details, couplings or joint details and the method for attaching the tubes. Provide this information with the drilled pier construction sequence plan.

Install 4 tubes in each drilled pier with a diameter of 5 ft (1524 mm) or less and 6 tubes in each pier with a diameter of greater than 5 ft (1524 mm). Provide 2 in (50 mm) inside diameter Schedule 40 steel pipe conforming to ASTM A53, Grade A or B, Type E, F or S. The tubes shall have a round, regular internal diameter free of defects or obstructions, including any at tube joints, in order to permit the free, unobstructed passage of source and receiver probes. The tubes shall provide a good bond with the concrete and be watertight.

Fit the tubes with a watertight threaded cap on the bottom and a removable threaded cap on the top. Securely attach the tubes to the interior of the reinforcing cage. Install the tubes in each drilled pier in a regular, symmetric pattern such that each tube is equally spaced from the others around the perimeter of the cage. Place tubes such that large vertical reinforcing bars do not block the direct line between adjacent tubes. The tubes are typically wire-tied to the reinforcing cage every 3 ft (1 m) or otherwise secured such that the tubes remain in position during placement of the cage and concrete. Install tubes as near to vertical and as parallel as possible, **as non-vertical tubes can adversely affect data analysis**. Extend the tubes from 6 in (150 mm) above the pier tip to at least 3 ft (1 m) above the top of the pier. If the pier top elevation is below ground elevation, extend tubes at least 2 ft (610 mm) above ground surface. If the drilled pier tip elevation is excavated more than 1 ft (305 mm) below the tip elevation shown on the plans, extend the tubes using proper threaded mechanical couplings to within 6 in (150 mm) of the revised pier tip elevation.

Before placing the reinforcing cage, record the tube lengths and positions along the length of the cage. After concrete placement, measure the stickup of the tubes above the top of the drilled piers and verify tube spacing.

After placing reinforcement and before placing concrete, fill the CSL tubes with clean water and cap them to keep out debris. CSL tubes that are not filled with water and capped will be rejected. When removing the caps, use care not to apply excess torque, force or stress, which could break the bond between the tubes and the concrete.

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4.0 CSL EQUIPMENT

The minimum requirements of the CSL equipment are as follows:

- A microprocessor based CSL system for display of individual CSL records, analog-digital conversion and recording of CSL data, analysis of receiver responses and printing of report quality CSL logs
- Ultrasonic source and receiver probes which can travel through 2 in (50 mm) I.D. steel pipe
- An ultrasonic voltage pulser to excite the source with a synchronized triggering system to start the recording system
- A depth measurement device to electronically measure and record the source and receiver depths associated with each CSL signal
- Appropriate filter/amplification and cable systems for CSL testing
- An acquisition system that stores each log in digital format, with drilled pier identification, date, time and test details, including the source and receiver gain and displays arrival time data graphically during data acquisition
- 3D tomographic imaging software or source for completing the work

5.0 CSL TEST PROCEDURE

Perform CSL testing between each adjacent perimeter CSL tube pair and opposite tube pairs along the cross section diameter. Maintain the source and receiver probes in the same horizontal plane unless test results indicate defects or poor concrete zones, in which case, further evaluate the defect zones with angle tests (source and receiver vertically offset at greater than 1.5 ft (460 mm) in the tubes). Report any defects indicated by decreased signal velocity and lower amplitude/energy signals at the time of testing and conduct angle tests in the zones of the defects as defined by the Concrete Condition Rating Criteria (CCRC) in Section 6.0 of this provision. Make CSL measurements at depth intervals of 2.5 in (65 mm) or less from the bottom of the tubes to the top of each pier. Pull the probes simultaneously, starting from the bottom of the tubes, using a depth-measuring device to electronically measure and record the depths associated with each CSL signal. Remove any slack from the cables before pulling to provide for accurate depth measurements of the CSL records. In the event defects are detected, conduct additional logs at no additional cost to the Department.

If CSL probes will not pass through the entire length of the CSL tubes, core a 2 in (50 mm) diameter hole through the concrete the full length of the drilled pier for each inaccessible tube. If the CSL tubes debond from the concrete, core a 2 in (50 mm) diameter hole through the concrete to the depth of the debonding for each debonded tube. Locate core holes approximately 9 in (230 mm) inside the reinforcement as directed by the Engineer. Fill core holes with clean water and cover to keep out debris. No additional payment will be made for coring due to inaccessible or debonded tubes.

6.0 CSL Results And Reporting

Submit two hard copies and an electronic copy (pdf or jpeg format on CD or DVD) of a CSL report sealed by the Project Engineer within 5 calendar days after field testing is complete. The CSL report should include but not limited to the following:

A. Title Sheet
- NCDOT TIP number and WBS element number
- Project description
- County
- Bridge station number
- Pier location
- Personnel
- Report date

B. Introduction

C. Site and Subsurface Conditions (including water table elevation)

D. Pier Details
- Pier and casing diameters, lengths and elevations
- Concrete compressive strength
- Installation methods and details including use of casing, slurry, pump, tremie, dry or wet placement of concrete, etc.

E. CSL Logs

F. Results/Conclusions

G. Attachments
- Boring log(s)
- Field Drilled Pier Inspection Forms, Drilling Logs, SID Inspection Forms and Concrete Curves (from Engineer)
- CSL tube locations, elevations, lengths and identifications
- CSL hardware model
- Electronic copy of all CSL raw data

Include CSL logs for each tube pair tested with analysis of the initial pulse arrival time, velocity, relative pulse energy/amplitude and stacked waveform plotted versus depth. List all zones defined by the CCRC in a tabular format including the percent velocity reduction and the velocity values used from the nearby zone of good quality concrete. Discuss each zone defined by the CCRC in the CSL report as appropriate. Base the results on the percent reduction in velocity value from a nearby zone of good quality concrete with good signal amplitude and energy as correlated to the following:

Concrete Condition Rating Criteria (CCRC)			
CCRC	**Rating Symbol**	**Velocity Reduction**	**Indicative Results**
Good	G	≤ 10 %	Good quality concrete
Questionable Defect	Q	>10 % & < 20 %	Minor concrete contamination or intrusion and questionable quality concrete
Poor	P/D	≥ 20 %	Defects exist, possible water/slurry contamination, soil intrusion and/or poor quality concrete
No Signal	NS	No Signal received	Soil intrusion or other severe defect absorbed the signal (assumes good bond of the tube-concrete interface)
Water	W	V = 4750 fps (1450 mps) to 5000 fps (1525 mps)	Water intrusion or water filled gravel intrusion with few or no fines present

The following are a few examples of types and causes of defects:

- Necking or arching of the concrete on withdrawal of the temporary casing.
- Necking or contamination of the concrete due to collapse of the side walls.
- Soft toe due to incomplete cleaning or collapse of the side walls.
- Horizontal lenses of silt\mud\slurry due to the tremie pipe rising above the concrete.
- Voids due to the use of low-slump concrete.
- Honeycombing due to washout of fines.
- Trapping of contaminants due to pumping concrete to fast.

The Engineer will require 5 working days to evaluate the CSL test results and determine whether or not the drilled pier is acceptable. Evaluation of CSL test results, with ratings other than good (G) per the CCRC may require further investigation and additional time for review and analysis of the data. Do not grout the CSL tubes or perform any further work on the CSL tested drilled pier until the Engineer determines whether the drilled pier is acceptable.

Perform tomography in order to further investigate and delineate the boundaries of any defective/unconsolidated zones with 20% or more reduction in velocity value as correlated to the CCRC. Process CSL data to construct easy to understand 2D/3D (2D cross-sections between tubes and 3D volumetric images for the entire pier) *color-coded* tomographic images indicating velocity variations along the pier. Identify the location and geometry of defective/unconsolidated zones in 3D color images with detailed discussion in the CSL report. Any further tests deemed necessary by the Engineer in order to determine the acceptability of the drilled pier will be determined after reviewing the CSL report. Additional test or analysis options include 3D tomographic imaging, single-hole sonic testing, sonic echo or impact response tests and concrete coring.

The Engineer determines the depth, location, diameter (PQ or NQ size) and number of core holes when concrete coring is required. If the Engineer is concerned about concrete strength or requires the use of a borehole camera for inspection, large diameter cores (PQ size) are required. Drill a minimum of 2 core holes to intercept the suspected defect zones. Use a coring method that provides maximum core recovery and minimizes abrasion and erosion. Provide concrete cores properly marked in a wooden crate labeled with the drilled pier depth at each interval of core recovery to the NCDOT Materials and Test Unit for evaluation and testing. Submit coring records, signed by the Contractor that include NCDOT project number, name of the Drilling Contractor, date cored and percent core recovery. Allow 5 working days after submitting the core records for the Department's review.

7.0 CORRECTION OF UNACCEPTABLE DRILLED PIER

When the Engineer determines a drilled pier is unacceptable, submit remedial measures to the Department for approval. No compensation will be made for remedial work or losses or damage due to remedial work of drilled piers found defective or not in accordance with the Drilled Piers Special Provision or the plans. Modifications to the drilled pier design or any load transfer mechanisms required by the remedial action shall be designed by a Registered North Carolina Professional Engineer. Include supporting calculations and drawings sealed by a Registered North Carolina Professional Engineer for all foundation elements affected. Do not begin remedial action work until the Department has reviewed and accepted the remedial action plan. Allow 5 working days after submitting the remedial work plan for the Department's review and acceptance. Furnish all materials and work necessary to correct defective drilled piers.

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8.0 MEASUREMENT AND PAYMENT

The complete and accepted CSL will be paid for at the unit bid price for "Crosshole Sonic Logging" per each. The Department will only pay for the initial CSL test on a drilled pier; no additional payment will be made for subsequent CSL tests performed on the same drilled pier. Include in this unit bid price all costs incurred for procurements, conducting the CSL testing, reporting of results and incidentals necessary to complete the work including any other test required to determine the acceptability of the drilled pier.

Include the cost of the crosshole sonic logging tubes in the unit bid price for drilled piers. No separate payment will be made for the CSL tubes. The unit bid price for the drilled piers will include full compensation for furnishing, installing, extending tubes, dewatering and grouting of all CSL tubes and core holes, if applicable, and all materials, labor, tools, equipment and incidentals necessary to complete the work.

THERMAL SPRAYED COATINGS (METALLIZATION) (6-07-05)

1.0 DESCRIPTION

Apply a thermal sprayed coating (TSC) and sealer to metal surfaces as specified herein when called for on the plans or by other Special Provisions, or when otherwise approved by the Engineer in accordance with the SSPC-CS 23.00/AWS C2.23/NACE No. 12 Specification. Only Arc Sprayed application methods are used to apply TSC coatings, the Engineer must approve other methods of application.

2.0 QUALIFICATIONS

Only use NCDOT approved TSC Contractors meeting the following requirements:

1. Who have the capability of blast cleaning steel surfaces to SSPC SP-5 and SP-10 Finishes.

2. Who employ a Spray Operator(s) qualified in accordance with AWS C.16/C2.16M2002 and a Quality Control Inspector(s) who have documented training in the applicable test procedures of ASTM D-3276 and SSPC-CS 23.00.

A summary of the contractor's related work experience and the documents verifying each Spray Operator's and Quality Control Inspector's qualifications are submitted to the Engineer before any work is performed.

3.0 MATERIALS

Provide wire in accordance with the metallizing equipment manufacturer's recommendations. Use the wire alloy specified on the plans which meets the requirements in Annex C of the SSPC-CS 23.00 Specification. Have the contractor provide a certified analysis (NCDOT Type 2 Certification) for each lot of wire material.

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Apply an approved sealer to all metallized surfaces in accordance with Section 9 of SSPC-CS 23. The sealer must either meet SSPC Paint 27 or is an alternate approved by the Engineer.

4.0 SURFACE PREPARATION AND TSC APPLICATION

Grind flame cut edges to remove the carbonized surface prior to blasting. Bevel all flame cut edges in accordance with Article 442-10(D) regardless of included angle. Blast clean surfaces to be metallized with grit or mineral abrasive in accordance with Steel Structures Painting Council SSPC SP-5/10(as specified) to impart an angular surface profile of 2.5 - 4.0 mils (0.063 – 0.100 mm). Surface preparation hold times are in accordance with Section 7.32 of SSPC-CS 23. If flash rusting occurs prior to metallizing, blast clean the metal surface again. Apply the thermal sprayed coating only when the surface temperature of the steel is at least 5°F (3°C) above the dew point.

At the beginning of each work period or shift, conduct bend tests in accordance with Section 6.5 of SSPC-CS 23.00. Any disbonding or delamination of the coating that exposes the substrate requires corrective action, additional testing, and the Engineer's approval before resuming the metallizing process.

Apply TSC with the alloy to the thickness specified on the plans or as provided in the table below. All spot results (the average of 3 to 5 readings) must meet the minimum requirement. No additional tolerance (as allowed by SSPC PA-2) is permitted. (For Steel Beams: For pieces with less than 200 ft^2 (18.6m^2) measure 2 spots/surface per piece and for pieces greater than 200 ft^2 (18.6m^2) add 1 additional spots/surface for each 500 ft^2 (46.5m^2)).

Application	Thickness	Alloy	Seal Coat
Pot Bearings	8 mil	85/15 Zinc (W-Zn-Al-2)	0.5 mil
Armored Joint Angles	8 mil	85/15 Zinc (W-Zn-Al-2)	0.5 mil
Modular Joints	8 mil	99.99% Zn (W-Zn-1)	0.5 mil
Expansion Joint Seals	8 mil	99.99% Zn (W-Zn-1)	0.5 mil
Optional Disc Bearings	8 mil	85/15 Zinc (W-Zn-Al-2)	0.5 mil

When noted on the plans or as specified in the above chart, apply the sealer to all metallized surfaces in accordance with the manufacturer's recommendations and these provisions. Apply the seal coat only when the air temperature is above 40°F (4°C) and the surface temperature of the steel is at least 5°F (3°C) above the dew point. If the sealer is not applied within eight hours after the final application of TSC, the applicator verifies acceptable TSC surfaces and obtains approval from the Engineer before applying the sealer.

5.0 INSPECTION FREQUENCY

The TSC Contractor must conduct the following tests at the specified frequency and the results documented in a format approved by the Engineer.

Test/Standard	Location	Frequency	Specification
Ambient Conditions	Site	Each Process	5°F (3°C) above the dew point
Abrasive Properties	Site	Each Day	Size, angularity, cleanliness
Surface Cleanliness SSPC Vis 1	All Surfaces	Visual All Surfaces	SSPC-SP-10 Atmospheric Service SSPC-SP - 5 Immersion Service
Surface Profile ASTM D-4417 Method C	Random Surfaces	3 per 500 ft^2	2.5 - 4.0 mils
Bend Test SSPC-CS 23.00	Site	5 per shift	Pass Visual
Thickness SSPC PA-2R SSPC-CS 23.00	Each Surface	Use the method in PA-2 Appendix 3 for Girders and Appendix 4 for frames and miscellaneous steel. See Note 1.	Zn - 8 mils minimum Al - 8 mils minimum Zn Al - 8 mils minimum Areas with more than twice the minimum thickness are inspected for compliance to the adhesion and cut testing requirements of this specification.
Adhesion ASTM 4541	Random Surfaces Splice Areas	1 set of 3 per 500 ft^2	Zn > 500 psi Al > 1000 psi Zn Al > 750 psi
Cut Test - SSPC-CS 23.00	Random Surfaces	3 sets of 3 per 500 ft^2	No peeling or delamination
Job Reference Std. SSPC-CS 23.00	Site	1 per job	Meets all the above requirements

6.0 REPAIRS

All Repairs are to be performed in accordance with the procedures below, depending on whether the repair surface is hidden or exposed. As an exception to the following, field welded splices on joint angles and field welding bearing plates to girders may be repaired in accordance with the procedures for hidden surfaces.

For hidden surfaces (including but not limited to interior girders, interior faces of exterior girders, and below-grade sections of piles):

1. Welding of metallized surfaces may be performed only if specifically permitted by the Engineer. Remove metallizing at the location of field welds by blast cleaning (SSPC SP-6 finish), or hand (SSPC SP-2 finish) or power tool cleaning (SSPC SP-3 finish) just prior to welding. Clean sufficiently to prevent contamination of the weld. All repairs to welded connections are metallized in accordance with SSPC CS 23.00.

2. Minor areas less than or equal to 0.1 ft^2 (9300mm^2) exposing the substrate are metallized in accordance with SSPC CS 23.00 or painted in accordance with ASTM A780, "Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings."

3. Large areas greater than 0.1 ft^2 (9300mm^2) exposing the substrate are metallized in accordance with SSPC CS 23.00.

4. Damaged (burnished) areas not exposing the substrate with less than the specified coating thickness are metallized in accordance with SSPC CS 23.00 or painted in accordance with ASTM A780, "Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings."

5. Damaged (burnished) areas not exposing the substrate with more than the specified coating thickness are not repaired.

6. Defective coating is repaired by either method 2 or 3 depending on the area of the defect.

For Exposed Surfaces (including but not limited to exterior faces of exterior girders and above-grade sections of piles):

1. Welding of metallized surfaces may be performed only if specifically permitted by the Engineer. Remove metallization at the location of field welds by blast cleaning (SSPC SP-6 finish), or hand (SSPC SP-2 finish) or power tool cleaning (SSPC SP-3 finish) just prior to welding. Clean sufficiently to prevent contamination of the weld. All repairs to welded connections are metallized in accordance with SSPC CS 23.00.

2. All areas exposing the substrate are metallized in accordance with SSPC CS 23.00

3. Defective coating is repaired by either method 2 or 3 depending on the area of the defect.

7.0 TWELVE MONTH OBSERVATION PERIOD

The contractor maintains responsibility for the coating system for a twelve (12) month observation period beginning upon the satisfactory completion of all the work required in the plans or as directed by the engineer. The contractor must guarantee the coating system under the payment and performance bond (refer to article 109-10). To successfully complete the observation period, the coating system must meet the following requirements after twelve (12) months service:

- No visible rust, contamination or application defect is observed in any coated area.
- Painted surfaces have a uniform color and gloss.
- Surfaces have an adhesion of no less than 500 psi (3.45 MPa) when tested in accordance with ASTM D-4541.

8.0 BASIS OF PAYMENT

The contract price bid for the bridge component to which the coating is applied will be full compensation for the thermal sprayed coating.

REPAIR OF BRIDGE DECKS AND APPROACH PAVEMENT WITH LATEX MODIFIED CONCRETE (10-12-01)

1.0 DESCRIPTION

This work consists of repairing existing bridge decks and approach pavement by removing existing asphalt overlay and loose, deteriorated or contaminated concrete and resurfacing with latex modified concrete overlayment course together with other work necessary to restore structural integrity to the deck in accordance with this provision, applicable parts of the Standard Specifications, and the dimensions, lines and grades shown on the plans or established by the Engineer.

2.0 EQUIPMENT

Use the following Surface Preparation Equipment:

- Sawing equipment capable of sawing concrete to the specified depth.
- Scarifying equipment that is a power-operated, mechanical scarifier or grinder capable of removing at least 1/4 inch (6 mm) for each pass.
- Sandblasting equipment capable of removing rust scale from reinforcing steel, or removing small chips of concrete partially loosened by the scarifying or chipping operation, and of removing rehydrated dust left from scarification.
- Power driven hand tools for removal of unsound concrete are required that meet the following requirements:

  Pneumatic hammers weighing a nominal 35 lb (16 kg) or less.

  Pneumatic hammer chisel-type bits that do not exceed the diameter of the shaft in width.
- Hand tools such as hammers and chisels for removal of final particles of unsound concrete.
- Vibratory screed for overlays, except as noted herein.

3.0 CONSTRUCTION METHODS

Remove all existing asphalt overlays and all loose, disintegrated, unsound or contaminated concrete from the bridge deck and approach pavement in accordance with the following surface preparation classifications:

A. Class IA Surface Preparation: Scarify and remove portland cement concrete from the concrete approach pavement to the depth shown on the plans to permit the construction of a 1¼ inch (32 mm) minimum depth overlay on the approach pavement to the limits shown on the plans. Transversely saw the existing concrete pavement to create a square construction joint for the overlay. Remove concrete in front of the sawed joint with power driven hand tools. Dispose of removed concrete and thoroughly clean the exposed scarified pavement surface.

B. Class IB Surface Preparation: Scarify, or use other acceptable means, to remove all asphalt overlay from the existing bridge deck and, if applicable, the concrete approach pavement. Limits for this removal are the same as for Class I and, when applicable, Class IA Surface Preparation. Perform this work as a separate operation prior to the Class I or IA Surface Preparation and make sure the concrete surface is not removed.

C. Class I Surface Preparation: Scarify and remove the entire concrete surface of the deck to a uniform depth of 1/2 inch (13 mm), remove and dispose concrete, and thoroughly clean the scarified surface. Perform Class I Surface Preparation before Class II or Class III. In areas where reinforcing steel is located in the 1/2 inch (13 mm) depth to be scarified, use another method with the Engineer's approval.

D. Class II Surface Preparation (Partial Depth): Remove by chipping with hand tools all loose, unsound and contaminated deck concrete and in areas where reinforcing steel is exposed, by scarifying to an average depth of approximately one-half the deck thickness, but no less than 3/4 inch (19 mm) below the top mat of steel. Dispose of the removed concrete,, clean, repair or replace rusted or loose reinforcing steel, and thoroughly clean the newly exposed surface.

When chipping, be careful not to cut, stretch, or damage any exposed reinforcing steel.

In overhangs, removing concrete areas of less than 0.60 ft^2/ft (0.2 m^2/m) length of bridge without overhang support is permitted unless the Engineer directs otherwise. For concrete areas greater than 0.60 ft^2/ft (0.2 m^2/m) length of bridge, approval of the overhang support is required.

Refill areas where concrete was removed with Class AA concrete up to the bottom of the proposed concrete overlay in accordance with Section 420 of the Standard Specifications. Any of the methods for curing Class AA concrete as stated in the Standard Specifications are permitted except the membrane curing compound method.

Provide a raked finish to the surface of the Class AA concrete. Place the overlay course only after the Class AA concrete has attained 2500 psi (17.2 MPa) as measured by an approved, non-destructive test method.

Refilling the areas from which concrete has been removed with latex modified concrete during the Class I repair is permitted if any of the following conditions are met:

- The reinforcing steel cover is 1½ inches (38 mm) or less.

- The area being repaired is less than 1 yd^2 (1 m^2).
- The Engineer directs the fill.

E. Class III Surface Preparation (Full Depth): Remove full depth all loose, unsound and contaminated deck concrete. Thoroughly clean the routed out area and dispose of concrete removed. Clean, repair, or replace reinforcing bars and fill the areas from which unsound concrete has been removed with Class AA concrete up to the bottom of the proposed concrete overlay.

Clean or replace reinforcing bars and place Class AA concrete in accordance with the methods described under Class II Surface Preparation.

Provide a raked finish to the surface of the Class AA concrete. Place the overlay course only after the Class AA concrete has attained 2500 psi (17.2 MPa) as measured by an approved non-destructive test method.

For areas of less than 3 ft^2 (0.3 m^2), suspending forms from existing reinforcing steel using wire ties is permitted. For larger areas, support forms by blocking from the beam flanges.

Submit for approval detailed plans for Class III Surface Preparation. Detail how waste and debris is kept from falling below. When Class III repairs adjacent to the rail are necessary, support the rail in a manner approved by the Engineer. The entire cost of the above work will be included in the unit price bid for Class III Surface Preparation.

F. General

After scarification, the Engineer locates and marks structural cracks. Remove all concrete within 2 inches (50 mm) each side of the crack by chipping to a minimum depth of 3/4 inch (19 mm). When reinforcing steel is exposed, chip to a minimum depth of 3/4 inch (19 mm) below the top mat of steel. Remove, chip, and dispose of the concrete, clean, repair, or replace reinforcing bars, and place Class AA concrete in accordance with the methods described under Class II or III Surface Preparation.

When concrete is removed under Class II or III Surface Preparation, provide 90° corners and vertical sides.

The Engineer determines the areas where concrete is to be removed under Class II or Class III Surface Preparation and inspects for delaminations by sounding with a chain drag.

Thoroughly clean exposed reinforcing steel by sandblasting. Remove bar sections that have lost 25% or more of their original section dimension and weld new, same-size bars in their place. Maintain 1½ inches (38 mm) cover of Class AA concrete over the reinforcing steel.

Provide a minimum overlay thickness of 1¼ inches (32 mm) and a final surface that is approximately 3/4 inch (19 mm) higher than the original surface. Prior to placing the overlay, attach a 1¼ inch (32 mm) filler block to the bottom of the screed and pass it over the area to be repaired to check the thickness. Remove all concrete that the block does not clear.

Keep areas where unsound concrete has been removed free of slurry produced from wet sawing or scarifying by planning the work so that this slurry drains away from the completed area of preparation. Remove all slurry from prepared areas before placing any overlay. Sandblast the edge of previously placed lanes of overlayment. If necessary, use detergent followed by sand and air blasting to remove rust, oil, or other foreign materials detrimental to achieving bond.

4.0 METHOD OF MEASUREMENT

Class IA, Class IB, Class I, Class II and Class III Surface Preparation will be measured in square yards (square meters) for the appropriate areas so prepared as directed by the Engineer. Measurement for the appropriate class of surface preparation will be made prior to the placement of the overlayment concrete. Class II or Class III Surface Preparation will be measured for payment in addition to Class I Surface Preparation.

5.0 BASIS OF PAYMENT

Surface preparation of bridge decks and approach pavement will be paid for at the respective contract unit price per square yard (square meter) for the specified class of surface preparation, which price will be full compensation for deck preparation, removal and disposal of unsound and contaminated concrete, cleaning, repairing or replacing of reinforcing steel, placement of all Class AA concrete, and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Class I Surface Preparation	Square Yard (Square Meter)
Class IA Surface Preparation	Square Yard (Square Meter)
Class IB Surface Preparation	Square Yard (Square Meter)
Class II Surface Preparation	Square Yard (Square Meter)
Class III Surface Preparation	Square Yard (Square Meter)

LATEX MODIFIED CONCRETE (7-18-06)

1.0 DESCRIPTION

This work consists of furnishing and placing an overlay of latex modified concrete over conventional existing concrete or repair concrete on bridge decks and approach pavement. Perform this work in accordance with this Special Provision and the applicable parts of the Standard Specifications. For material, equipment, and proportioning and mixing of modified compositions, see Section 1000-8 of the Standard Specification.

2.0 PREPARATION OF SURFACE

Completely clean all surfaces within the 48 hours prior to placing the overlay unless otherwise approved.

Thoroughly soak the clean surface for at least 2 hours immediately prior to placing the latex modified concrete. After soaking the surface for at least 2 hours, cover it with a layer of white opaque polyethylene film that is at least 4 mils (0.100 mm) thick. Immediately prior to placing the latex modified concrete, remove standing water from the surface.

3.0 PLACING AND FINISHING

Prior to placing modified material, install a bulkhead of easily compressible material at expansion joints to the required grade and profile. Placing material across expansion joints and sawing it later is not permitted.

Place and fasten screed rails in position to ensure finishing the new surface to the required profile. Do not treat screed rails with parting compound to facilitate their removal.

Separate screed rails and/or construction dams from the newly placed material by passing a pointing trowel along their inside face. Carefully make this trowel cut for the entire depth and length of rails or dams after the modified composition has sufficiently stiffened and cannot flow back.

Brush a latex cement mixture onto the wetted, prepared surface. Carefully give all vertical and horizontal surfaces a thorough, even coating and do not let the brushed material dry before it is covered with the additional material required for the final grade.

Construction joints other than those shown on the plans are not permitted.

When a tight, uniform surface is achieved and before the concrete becomes non-plastic, further finish the surface of the floor by burlap dragging or another acceptable method that produces an acceptable uniform surface texture.

Do not allow more than 15 feet (4.5 m) of exposed latex concrete behind the screed. In the event of a delay of 10 minutes or more, temporarily cover all exposed latex concrete with wet burlap and white opaque polyethylene.

As soon as the surface supports burlap without deformations, cover the surface with a single layer of clean, wet burlap.

Do not place the latex modified concrete before the burlap is saturated and approved by the Engineer. Drain excess water from the wet burlap before placement.

Within 1 hour of covering with wet burlap, place a layer of 4 mil (0.100 mm) white opaque polyethylene film on the wet burlap and cure the surface for 48 hours. Then remove the curing material for an additional 96 hours air cure.

As soon as practical, after the concrete has hardened sufficiently, test the finished surface with an approved rolling straightedge that is designed, constructed, and adjusted so that it will accurately indicate or mark all floor areas which deviate from a plane surface by more than 1/8 inch in 10 feet (3 mm in 3 m). Remove all high areas in the hardened surface in excess of 1/8 inch in 10 feet (3 mm in 3 m) with an approved grinding or cutting machine. Where variations are such that the corrections extend below the limits of the top layer of grout, seal the corrected surface with an approved sealing agent if required by the Engineer. If approved by the Engineer, correct low areas in an acceptable manner.

Unless otherwise indicated on the plans, groove the bridge floor in accordance with Article 420-14(B) of the Standard Specifications.

4.0 LIMITATIONS OF OPERATIONS

The mixer is not permitted on the bridge deck unless otherwise approved.

No traffic is permitted on the finished latex modified concrete surface until the total specified curing time is completed and until the concrete reaches the minimum specified compressive strength.

Do not place latex modified concrete if the temperature of the concrete surface on which the overlay is to be placed is below 40°F (4°C) or above 85°F (29°C). Measure the surface temperature by placing a thermometer under the insulation against the surface.

Prior to placing latex modified concrete, the Engineer determines the air temperature and wind speed. Do not place latex modified concrete if the ambient air temperature is below 45°F (7°C) or above 85°F (29°C), or if the wind velocity is in excess of 10 mph (16 km/h). If working at night, provide approved lighting. Provide aggregates for use in the latex modified concrete that are free from ice, frost and frozen particles when introduced into the mixer.

Do not place latex modified concrete when the temperature of the latex modified concrete is below 45°F (7°C) or above 85°F (29°C).

Do not place latex modified concrete if the National Weather Service predicts the air temperature at the site to be below 35°F (2°C) during the next 72 hours. If this predicted air temperature is above 35°F (2°C) but below 50°F (10°C), then use insulation to protect the latex modified concrete for a period of at least 48 hours.

Use insulation that meets the requirements of Subarticle 420-7(C) and, if required, place it on the latex modified concrete as soon as initial set permits.

When using insulation to protect latex modified concrete during the wet curing period, do not remove the insulation until the ambient air temperature is at least 40°F (4°C) and rising. Leave the latex modified concrete uncovered for the 96 hour air curing period.

Assume all risks connected with the placement of latex modified concrete under cold weather conditions referred to above.

Stop all placement operations during periods of precipitation. Take adequate precautions to protect freshly placed latex modified concrete from sudden or unexpected precipitation. Keep an adequate quantity of protective coverings at the worksite to protect the freshly placed pavement from precipitation.

5.0 METHOD OF MEASUREMENT

The quantity of "Latex Modified Concrete Overlay" paid for will be the number of cubic yards (cubic meters) of latex modified concrete satisfactorily placed in the completed deck.

The quantity of "Placing and Finishing of Latex Modified Concrete Overlay" will be measured for payment by the number of square yards (square meters) of surface satisfactorily covered.

The quantity of "Grooving Bridge Floors" will be measured for payment by the actual number of square feet (square meters) shown on the plans for "Grooving Bridge Floors". Where the plans are revised, the quantity to be paid for is the quantity shown on the revised plans.

6.0 BASIS OF PAYMENT

The pay item "Latex Modified Concrete Overlay" will be paid for at the contract unit price bid per cubic yard (cubic meter) which price will be full compensation for furnishing all latex modified concrete.

The pay item "Placing and Finishing of Latex Modified Concrete Overlay" will be paid for at the contract unit price bid per square yard (square meter), which price will be full compensation for furnishing all labor, materials, tools, equipment and incidentals required to complete the work in accordance with this Special Provision and applicable parts of the Standard Specifications.

The pay item "Grooving Bridge Floors" will be paid for at the contract unit price per square foot (square meter).

EVAZOTE JOINT SEALS (8-13-04)

1.0 SEALS

Use preformed seals compatible with concrete and resistant to abrasion, oxidation, oils, gasoline, salt and other materials that are spilled on or applied to the surface. Use a low-density closed cell, cross-linked ethylene vinyl acetate polyethylene copolymer nitrogen blown material for the seal.

Use seals manufactured with grooves 1/8" (3 mm) ± wide by 1/8" (3 mm) ± deep and spaced between 1/4 (6 mm) and 1/2 inch (13 mm) apart along the bond surface running the length of the joint. Use seals sized so that the depth of the seal meets the manufacturer's recommendation, but is not less than 70% of the uncompressed width. Provide a seal

designed so that, when compressed, the center portion of the top does not extend upward above the original height of the seal by more than 1/4 inch (6 mm). Splice the seal using the heat welding method by placing the joint material ends against a teflon heating iron of 350°F (177°C) for 7 - 10 seconds, then pressing the ends together tightly. Do not test the welding until the material has completely cooled. Use material that resists weathering and ultraviolet rays. Provide a seal that has a working range of 30% tension and 60% compression and is watertight along its entire length including the ends.

Provide seals that meet the requirements given below.

TEST	TEST METHOD	REQUIREMENT
Elongation at break	ASTM D3575	210 ± 15%
Tensile strength, psi (kPa)	ASTM D3575	110 ± 15 (755 ± 100)
Compression Recovery (% of original width)	AASHTO T42 50% compr. for 22 hr. @ 73°F (23°C) 1/2 hr. recovery	87 ± 3
Weather/Deterioration	AASHTO T42 Accelerated Weathering	No deterioration for 10 years min.
Compression/Deflection	@ 50% deflection of original width @ 50% deflection of original width	10 psi (69 kPa) min. 60 psi (414 kPa) max.
Tear Strength, psi (kPa)	ASTM D624	16 ± 3 (110 ± 20)
Density	ASTM D545	2.8 to 3.4
Water Absorption (% vol/vol)	ASTM D3575 Total immersion for 3 months	3

Have the top of the evazote seal clearly shop marked. Inspect the evazote seals upon receipt to ensure that the marks are clearly visible upon installation.

2.0 ADHESIVES

Use a two component, 100% solid, modified epoxy adhesive with the seal that meets the requirements of ASTM C881, Type 1, Grade 3, Class B & C and has the following physical properties:

Tensile strength ..... 3500 psi (24.1 MPa) min.
Compressive strength ..... 7000 psi (48.3 MPa) min.
Shore D Hardness ..... 75 psi (0.5 MPa) min.
Water Absorption ..... 0.25% by weight

Use an adhesive that is workable to 40°F (4°C). When installing in temperatures below 40°F (4°C) or for application on moist, difficult to dry concrete surfaces, use an adhesive specified by the manufacturer of the joint material.

3.0 SAWING THE JOINTS

When the plans call for sawing the joints, the joints shall be initially formed to a width as shown on the plans including the blockout for the elastomeric concrete. Complete placement of the elastomeric concrete after the reinforced concrete deck slab has cured for seven full days and reached a minimum strength of 3000 psi (20.7 Mpa).

Cure the elastomeric concrete for a minimum of 2 days prior to sawing the elastomeric concrete to the final width and depth as specified in the plans.

When sawing the joint to receive the evazote seal, always use a rigid guide to control the saw in the desired direction. To control the saw and to produce a straight line as indicated on the plans, anchor and positively connect a template or a track to the bridge deck. Do not saw the joint by visual means such as a chalk line. Fill the holes used for holding the template or track to the deck with an approved, flowable non-shrink, non-metallic grout.

Saw cut to the desired width and depth in one or two passes of the saw by placing and spacing two metal blades on the saw shaft to the desired width for compression seals.

The desired depth is the depth of the seal plus 1/4 inch (6 mm) above the top of the seal plus approximately 1 inch (25 mm) below the bottom of the seal. An irregular bottom of sawed joint is permitted as indicated on the plans. Grind exposed corners on saw cut edges to a 1/4" (6 mm) chamfer.

Remove any staining or deposited material resulting from sawing with a wet blade to the satisfaction of the Engineer.

Use extreme care to saw the joint straight to the desired width and to prevent any chipping or damage to sawed edges of the joint.

4.0 PREPARATIONS FOR SAWED JOINTS

When the plans call for sawing the joint, the Engineer thoroughly inspects the sawed joint opening for spalls, popouts, cracks, etc. Make all necessary repairs prior to blast cleaning and installing the seal.

Immediately before sealing, clean the joints by sandblasting with clean dry sand. Sandblast to provide a firm, clean joint surface free of curing compound, loose material and any foreign matter. Sandblast without causing pitting or uneven surfaces. The aggregate in the elastomeric concrete may be exposed after sandblasting.

After blasting, either brush the surface with clean brushes made of hair, bristle or fiber, blow the surface with compressed air, or vacuum the surface until all traces of blast products and abrasives are removed from the surface, pockets, and corners.

If nozzle blasting, use compressed air that does not contain detrimental amounts of water or oil.

Examine the blast cleaned surface and remove any traces of oil, grease or smudge deposited in the cleaning operations.

Bond the seal to the blast cleaned surface on the same day the surface is blast cleaned.

5.0 PREPARATIONS FOR ARMORED JOINTS

When the plans call for armored joints, form the joint and blockout openings in accordance with the plans. If preferred, wrap the temporary form with polyethylene sheets to allow for easier removal. Do not use form release agents.

A. Submittals

Submitting detailed working drawings is not required; however, submitting catalog cuts of the proposed material is required. In addition, direct the joint supplier to provide an angle segment placing plan.

B. Surface Preparation

Prepare the surface within the 48 hours prior to placing the elastomeric concrete. Do not place the elastomeric concrete until the surface preparation is completed and approved.

1. Angle Assembly

Clean and free metallized steel of all foreign contaminants and blast the non-metallized steel surfaces to SSPC SP-10. Blast-cleaning anchor studs is not required.

2. Concrete

Prior to placing the elastomeric concrete, thoroughly clean and dry all concrete surfaces. Sandblast the concrete surface in the blockout and clear the surface of all loose debris.

C. Elastomeric Concrete Placement

Make sure that a manufacturer's representative is present when placing elastomeric concrete. Do not place elastomeric concrete if the ambient air temperature is below 45°F (7°C).

Prepare and apply a primer, as per manufacturer's recommendations, to all vertical concrete faces, all steel components to be in contact with elastomeric concrete, and to areas specified by the manufacturer. Align the angles with the joint opening.

Prepare, batch, and place the elastomeric concrete in accordance with the manufacturer's instructions. Place the elastomeric concrete in the areas specified on the plans while the primer is still tacky and within 2 hours after applying the primer. Pay careful attention to properly consolidate the concrete around the steel and anchors. Trowel the elastomeric concrete to a smooth finish.

D. Joint Preparation

Prior to installing the seal, the Engineer thoroughly inspects the armored joint opening for proper alignment and full consolidation of elastomeric concrete under the angle assemblies. Make all necessary repairs prior to cleaning the joint opening and installing the seal.

Clean the armored joint opening with a pressure washer rated at 3000 psi (20.7 MPa) minimum at least 24 hours after placing the elastomeric concrete. Dry the cleaned surface prior to installing the seal.

Examine the cleaned surface and remove traces of oil, grease or smudge deposited during the cleaning operations.

Bond the seal to the cleaned surface on the same day the surface is cleaned.

6.0 SEAL INSTALLATION

Install the joint seal according to the manufacturer's procedures and recommendations and as recommended below. Do not install the joint seal if the ambient air temperature is below 45°F (7°C). Have a manufacturer's representative present during the installation of the first seal of the project.

Begin installation at the low end of the joint after applying the mixed epoxy to the sides of both the joint material and both sides of the joint, making certain to completely fill the grooves with epoxy. With gloved hands, compress the material and with the help of a blunt probe, push it down into the joint until it is recessed approximately 1/4 inch (6 mm) below the surface. Do not push the seal at an angle that would stretch the material. Once work on a joint begins, do not stop until it is completed. Clean the excess epoxy off the surface of the joint material *quickly* and *thoroughly*. Do not use solvents to remove excess epoxy. Remove excess epoxy in accordance with the joint manufacturer's recommendations.

Install the seal so that it is watertight. Testing of the joint seal is not required, but it is observed until final inspection.

7.0 BASIS OF PAYMENT

Payment for all evazote joint seals will be at the lump sum contract price bid for "Evazote Joint Seals" which prices and payment will be full compensation for furnishing all material, including elastomeric concrete when required, labor, tools and equipment necessary for installing these units in place and accepted.

OPTIONAL PRECAST REINFORCED CONCRETE BOX CULVERT AT STATION 82+70.000-L-, 10+26.580-Y11- (2-14-04)

1.0 GENERAL

This Special Provision covers precast reinforced concrete box culverts intended for the construction of culverts and for the conveyance of storm water.

If the option is indicated on the plans, the submittal of a design for a precast reinforced box culvert in lieu of a cast-in-place culvert is permitted. Provide the size and number of barrels as indicated on the plans. Precast wing walls will not be allowed. For culverts with less than 2 feet (0.6 m) of cover, design the precast culvert sections in accordance with AASHTO M273. Detail the culvert with cast in place wings. Provide a precast box culvert that meets the requirements of Section 1077 and any other applicable parts of the Standard Specifications.

The design of the precast members is the responsibility of the Contractor and is subject to review, comments and approval. Submit two sets of detailed plans for review. Include all details in the plans, including the size and spacing of the required reinforcement necessary to build the precast box culvert. Include checked design calculations for the precast members complying with the latest AASHTO Standard Specifications and requirements detailed herein. Have a North Carolina Registered Professional Engineer check and seal the plans and design calculations. After the plans are reviewed and, if necessary, the corrections made, submit one set of reproducible tracings on 22" x 34" sheets to become the revised contract plans.

A pre-installation meeting is required prior to installation. Representatives from the Contractor, the precast box manufacturer, and the Department should attend this meeting. The precast box manufacturer representative shall be on site during installation.

2.0 PRECAST REINFORCED CONCRETE BOX SECTIONS

A. Types

Precast reinforced concrete box sections manufactured in accordance with this Special Provision are designated by span, rise, and design earth cover.

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B. Design

1. Design – The box section dimensions and reinforcement details are subject to the provisions of Section F.

2. Placement of Reinforcement – Provide a 1 inch (25 mm) concrete cover over the circumferential reinforcement subject to the provisions of Section F. Extend the inside circumferential reinforcement into the male portion of the joint and the outside circumferential reinforcement into the female portion of the joint. Detail the clear distance of the end circumferential wires so it is not less than 1/2 inch (13 mm) nor more than 2 inches (51 mm) from the ends of the box section. Assemble reinforcement per the requirements of AASHTO M259, Section 7.3. The exposure of the ends of the wires used to position the reinforcement is not a cause for rejection.

3. Laps and Spacing – Use lap splices for the circumferential reinforcement. Detail the circumferential wires so that the center to center spacing is not less than 2 inches (50 mm) nor more than 4 inches (100 mm). Do not detail the longitudinal wires with a center to center spacing of more than 8 inches (200 mm).

4. The design earth cover is reported on the plans as the elevation difference between the point of maximum fill and the top of the top slab.

C. Joints

1. Produce the precast reinforced concrete box section with male and female ends. Design and form these ends of the box section so, when the sections are laid together, they make a continuous line of box sections with a smooth interior free of appreciable irregularities in the flowline, all compatible with the permissible variations given in Section F. The internal joint formed at the male and female ends of the precast units shall be sealed with either bitumen/butyl sealant or closed-cell neoprene material. The internal joint material shall be installed in accordance with the manufacturer's recommendations. The material shall be shown on the shop drawings when they are submitted for review.

2. Seal the external joint with an outside sealer wrap that is at least 12 inches (300 mm) wide and covers the joint on both the sides and the top of the box section. Use ConWrap CS-212 from Concrete Sealants, Inc., EZ-Wrap from Press-Seal Gasket Corporation, Seal Wrap from Mar-Mac Manufacturing Co., Inc., Cadilloc External Pipe Joint from Cadilloc, or an approved equal for the outside sealer wrap. If the outside sealer wrap is not applied in a continuous strip along the entire joint, a

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12 inch (300 mm) minimum lap of the outside sealer wrap is permitted. Before placing the outside sealer wrap, clean and prime the area receiving the outside sealer wrap in accordance with the sealer wrap manufacturer recommendations. The joint wrap manufacturer installation recommendations shall be included with shop drawings submitted for review. The external joint wrap shall be installed in three pieces, as indicated on Figure 1 below:

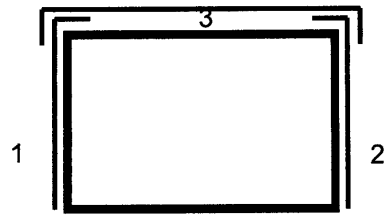

Figure 1

Cover the external joint sealer with a 3 foot (900 mm) strip of filter fabric conforming to Type 4 requirements in Section 1056 of the Standard Specifications.

Place multiple lines of a precast reinforced concrete box culvert such that the longitudinal joint between the sections has a minimum width of 3 inches (75 mm). Fill the joint between multiple lines of precast box sections with Class A concrete. Use Class A concrete that meets the requirements listed in the Standard Specifications except that Field Compressive Strength Specimens are not required.

D. Manufacture

Precast box culverts may be manufactured by either the wet cast method or dry cast method.

1. Mixture – In addition to the requirements of Section 1077 of the Standard Specifications, do not proportion the mix with less than 564 lb/yd^3 (335 kg/m^3) of portland cement.

2. Strength – Make sure that all concrete develops a minimum 28-day compressive strength of 5000 psi (34.5 MPa). Movement of the precast sections should be minimized during the initial curing period. Any damage caused by moving or handling during the initial curing phase will be grounds for rejection of that precast section.

3. Air Entrainment – Air entrain the concrete in accordance with Section 1077 - 5(A) of the Standard Specifications. For dry cast manufacturing, air entrainment is not required.

4. Testing – Test the concrete in accordance with the requirements of Section 1077 - 5(B).

5. Handling – Handling devices or holes are permitted in each box section for the purpose of handling and laying. Submit details of handling devices or holes for approval and do not cast any concrete until approval is granted. Remove all handling devices flush with concrete surfaces as directed. Fill holes in a neat and workmanlike manner with an approved non-metallic non-shrink grout, concrete, or hole plug.

E. Physical Requirements

Acceptability of precast culvert sections is based on concrete cylinders made and tested in accordance with AASHTO T22 and AASHTO T23.

F. Permissible Variations

1. Flatness – All external surfaces shall be flat, true, and plumb. Irregularities, depressions, or high spots on all external surfaces shall not exceed 1/2 inch (12 mm) in 8 feet (2.5 meters).

2. Internal Dimensions – Produce sections so that the internal and haunch dimensions do not vary by more than 1/4 inch (6 mm) from the plan dimensions.

3. Adjacent Sections - Internal, external, and haunch dimensions for connecting sections shall not vary by more than 1/2 inch (12 mm).

4. Length of Tongue and Groove – The minimum length of the tongue shall be 4 inches (100 mm). The minimum length of the groove shall be 4 inches (100 mm). The dimensions of the tongue and groove shall not vary by more than 1/4 inch (6 mm) from the plan dimensions.

5. Slab and Wall Thickness – Produce sections so that the slab and wall thickness are not less than that shown on the plans by more than 5% or 3/16 inch (5 mm), whichever is greater. A thickness more than that required on the plans is not a cause for rejection.

6. Length of Opposite Surfaces – Produce sections so that variations in laying lengths of two opposite surfaces of the box section meet the requirements of AASHTO M259, Section 11.3.

7. Length of Section – Produce sections so that the underrun in length of a section is not more than 1/2 inch (13 mm) in any box section.

8. Position of Reinforcement – Produce sections so that the maximum variation in the position of the reinforcement is ±3/8" (±10 mm) for slab and wall thicknesses of 5 inches (125 mm) or less and ±1/2" (±13 mm) for slab and wall thicknesses greater than 5 inches (125 mm). Produce sections so that the concrete cover is never less than 5/8 inch (16 mm) as measured to the internal surface or the external surface. The preceding minimum cover limitations do not apply at the mating surfaces of the joint.

9. Area of Reinforcement – Use the design steel shown on the plans for the steel reinforcement. Steel areas greater than those required are not cause for rejection. The permissible variation in diameter of any wire in finished fabric is prescribed for the wire before fabrication by either AASHTO M32 or M225.

G. Marking

1. Each section shall be match-marked in order of intended installation as indicated on the approved shop drawings. Ensure that pieces fit together neatly and in a workmanlike manner. In order to ensure a good, neat field fit, assemble adjacent sections at the producer's facility and match-mark the pieces. This will require that a minimum of three adjacent sections of the culvert be fitted at the production yard at a time and then match-marked. Once three sections have been match-marked, the first section may be removed for shipment and a fourth section set for marking. Continue in a progressive manner until all sections have been properly match-marked.

2. Clearly mark each section of the box culvert in accordance with AASHTO M259, Section 15.

H. Construction

1. Foundation – Foundation for precast box culvert shall meet the requirements of Section 414 of the Standard Specifications. In addition, Type VI foundation material shall be encapsulated in filter fabric conforming to Type 4 requirements in Section 1056 of the Standard Specifications. The filter fabric shall be placed perpendicular to the culvert barrel. Provide sufficient overhang beyond the excavation to allow a minimum lap of 3 feet (900 mm) when the foundation material is placed and fabric wrapped on top. Perpendicular sections of fabric shall be continuous. A minimum lap of 2 feet (600 mm) shall be provided between sections of fabric.

2. Installation – Sections shall be placed at the beginning of the outlet end of the culvert with the groove end being laid upgrade. Tongue sections shall be laid into the groove sections. Positive means shall be provided to pull each section firmly into the previously placed section so that the joints are tightly homed. Use a "come-along", box pullers or other approved methods to create a positive means of joining box sections. Construction equipment shall not have direct contact with the box section. The load of the box shall be suspended by lifting device during joining procedure.

3. Backfill – Complete backfill in accordance with Section 414 of the Standard Specifications.

3.0 BASIS OF PAYMENT

Any additional cost of redesigning will be paid for by the Contractor if Precast Reinforced Concrete Culvert is used in lieu of the cast-in-place culvert shown on the plans. Except for Foundation Conditioning Material and Culvert Excavation, payment for the Precast Box Culvert will be a lump sum amount equal to the payment that would be allowed for construction of a Cast-in-Place Box Culvert. Plan quantities and unit bid prices will be used to compute the lump sum amount. Such price and payment will be full compensation for all work covered by this Special Provision, the plans and applicable parts of the Standard Specifications and will include, but not be limited to, furnishing all labor, materials (including all filter fabric), equipment and other incidentals necessary to complete this work. Such price and payment will also be full compensation for concrete, reinforcing steel, labor, equipment and all other related materials necessary for the completion of the barrel section, and the construction of the headwalls, leveling pad, end curtain walls, wings and wing footings.

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ELASTOMERIC CONCRETE (10-12-01)

1.0 DESCRIPTION

Elastomeric concrete is a mixture of a two-part polymer consisting of polyurethane and/or epoxy, and kiln-dried aggregate. Have the manufacturer supply it as a unit. Use the concrete in the blocked out areas on both sides of the bridge deck joints as indicated on the plans.

2.0 MATERIALS

Provide materials that comply with the following minimum requirements at 14 days.

CONCRETE PROPERTIES	TEST METHOD	MINIMUM REQUIREMENT
Bond Strength to Concrete, psi (MPa)	*(a) STM D638 (D638M)*	450 (3.1)
Brittleness by Impact, ft-lb (kg-m)	Ball Drop	7 (0.97)
Compressive Strength, psi (MPa)	ASTM D695 (D695M)	2800 (19.3)

BINDER PROPERTIES (without aggregate)	TEST METHOD	MINIMUM REQUIREMENT
Tensile Strength, psi (MPa)	ASTM D638 (D638M)	800 (5.5)
Ultimate Elongation	ASTM D638 (D638M)	150%
Tear Resistance, lb/in (kN/m)	ASTM D624	90 (15.7)

In addition to the requirements above, use elastomeric concrete that also resists water, chemical, UV, and ozone exposure and withstands extreme temperature (freeze-thaw) changes.

Furnish a manufacturer's certification verifying that the materials satisfy the above requirements. Provide samples of elastomeric concrete to the Engineer, if requested, to independently verify conformance with the above requirements.

Require a manufacturer's representative to be present on site during the installation of the elastomeric concrete.

3.0 BASIS OF PAYMENT

No separate payment will be made for elastomeric concrete. The lump sum contract price bid for "Evazote Joint Seals" will be full compensation for furnishing and placing the Elastomeric Concrete.

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FALSEWORK AND FORMWORK (7-18-06)

1.0 DESCRIPTION

Use this Special Provision as a guide to develop temporary works submittals required by the Standard Specifications or other provisions; no additional submittals are required herein. Such temporary works include, but are not limited to, falsework and formwork.

Falsework is any temporary construction used to support the permanent structure until it becomes self-supporting. Formwork is the temporary structure or mold used to retain plastic or fluid concrete in its designated shape until it hardens. Access scaffolding is a temporary structure that functions as a work platform that supports construction personnel, materials, and tools, but is not intended to support the structure. Scaffolding systems that are used to temporarily support permanent structures (as opposed to functioning as work platforms) are considered to be falsework under the definitions given. Shoring is a component of falsework such as horizontal, vertical, or inclined support members. Where the term "temporary works" is used, it includes all of the temporary facilities used in bridge construction that do not become part of the permanent structure.

Design and construct safe and adequate temporary works that will support all loads imposed and provide the necessary rigidity to achieve the lines and grades shown on the plans in the final structure.

2.0 MATERIALS

Select materials suitable for temporary works; however, select materials that also ensure the safety and quality required by the design assumptions. The Engineer has authority to reject material on the basis of its condition, inappropriate use, safety, or nonconformance with the plans. Clearly identify allowable loads or stresses for all materials or manufactured devices on the plans. Revise the plan and notify the Engineer if any change to materials or material strengths is required.

3.0 DESIGN REQUIREMENTS

A. Working Drawings

Provide working drawings for items as specified in the contract, or as required by the Engineer, with design calculations and supporting data in sufficient detail to permit a structural and safety review of the proposed design of the temporary work.

When concrete placement is involved, include data such as the drawings of proposed sequence, rate of placement, direction of placement, and location of all construction joints. Submit the number of copies as called for by the contract.

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When required, have the drawings and calculations prepared under the guidance of, and sealed by, a North Carolina Registered Professional Engineer who is knowledgeable in temporary works design.

Design falsework and formwork requiring submittals in accordance with the 1995 AASHTO *Guide Design Specifications for Bridge Temporary Works* except as noted herein.

1. Wind Loads

   Table 2.2 of Article 2.2.5.1 is modified to include wind velocities up to 110 mph (177 km/hr). In addition, Table 2.2A is included to provide the maximum wind speeds by county in North Carolina.

Table 2.2 - Wind Pressure Values

Height Zone feet (m) above ground	Pressure, lb/ft^2 (kPa) for Indicated Wind Velocity, mph (km/hr)				
	70 (112.7)	80 (128.7)	90 (144.8)	100 (160.9)	110 (177.0)
0 to 30 (0 to 9.1)	15 (0.72)	20 (0.96)	25 (1.20)	30 (1.44)	35 (1.68)
30 to 50 (9.1 to 15.2)	20 (0.96)	25 (1.20)	30 (1.44)	35 (1.68)	40 (1.92)
50 to 100 (15.2 to 30.5)	25 (1.20)	30 (1.44)	35 (1.68)	40 (1.92)	45 (2.15)
over 100 (30.5)	30 (1.44)	35 (1.68)	40 (1.92)	45 (2.15)	50 (2.39)

2. Time of Removal

   The following requirements replace those of Article 3.4.8.2.

   Do not remove forms until the concrete has attained strengths required in Article 420-16 of the Standard Specifications and these Special Provisions.

   Do not remove forms until the concrete has sufficient strength to prevent damage to the surface.

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Table 2.2A - Steady State Maximum Wind Speeds by Counties in North Carolina

COUNTY	25 YR (mph) (km/hr)	COUNTY	25 YR (mph) (km/hr)	COUNTY	25 YR (mph) (km/hr)
Alamance	70 (112.7)	Franklin	70 (112.7)	Pamlico	100 (160.9)
Alexander	70 (112.7)	Gaston	70 (112.7)	Pasquotank	100 (160.9)
Alleghany	70 (112.7)	Gates	90 (144.8)	Pender	100 (160.9)
Anson	70 (112.7)	Graham	80 (128.7)	Perquimans	100 (160.9)
Ashe	70 (112.7)	Granville	70 (112.7)	Person	70 (112.7)
Avery	70 (112.7)	Greene	80 (128.7)	Pitt	90 (144.8)
Beaufort	100 (160.9)	Guilford	70 (112.7)	Polk	80 (128.7)
Bertie	90 (144.8)	Halifax	80 (128.7)	Randolph	70 (112.7)
Bladen	90 (144.8)	Harnett	70 (112.7)	Richmond	70 (112.7)
Brunswick	100 (160.9)	Haywood	80 (128.7)	Robeson	80 (128.7)
Buncombe	80 (128.7)	Henderson	80 (128.7)	Rockingham	70 (112.7)
Burke	70 (112.7)	Hertford	90 (144.8)	Rowan	70 (112.7)
Cabarrus	70 (112.7)	Hoke	70 (112.7)	Rutherford	70 (112.7)
Caldwell	70 (112.7)	Hyde	110 (177.0)	Sampson	90 (144.8)
Camden	100 (160.9)	Iredell	70 (112.7)	Scotland	70 (112.7)
Carteret	110 (177.0)	Jackson	80 (128.7)	Stanley	70 (112.7)
Caswell	70 (112.7)	Johnston	80 (128.7)	Stokes	70 (112.7)
Catawba	70 (112.7)	Jones	100 (160.9)	Surry	70 (112.7)
Cherokee	80 (128.7)	Lee	70 (112.7)	Swain	80 (128.7)
Chatham	70 (112.7)	Lenoir	90 (144.8)	Transylvania	80 (128.7)
Chowan	90 (144.8)	Lincoln	70 (112.7)	Tyrell	100 (160.9)
Clay	80 (128.7)	Macon	80 (128.7)	Union	70 (112.7)
Cleveland	70 (112.7)	Madison	80 (128.7)	Vance	70 (112.7)
Columbus	90 (144.8)	Martin	90 (144.8)	Wake	70 (112.7)
Craven	100 (160.9)	McDowell	70 (112.7)	Warren	70 (112.7)
Cumberland	80 (128.7)	Mecklenburg	70 (112.7)	Washington	100 (160.9)
Currituck	100 (160.9)	Mitchell	70 (112.7)	Watauga	70 (112.7)
Dare	110 (177.0)	Montgomery	70(112.7)	Wayne	80 (128.7)
Davidson	70 (112.7)	Moore	70 (112.7)	Wilkes	70 (112.7)
Davie	70 (112.7)	Nash	80 (128.7)	Wilson	80 (128.7)
Duplin	90 (144.8)	New Hanover	100 (160.9)	Yadkin	70 (112.7)
Durham	70 (112.7)	Northampton	80 (128.7)	Yancey	70 (112.7)
Edgecombe	80 (128.7)	Onslow	100 (160.9)		
Forsyth	70 (112.7)	Orange	70 (112.7)		

Note on the working drawings any anchorages, connectors, inserts, steel sleeves or other such devices used as part of the falsework or formwork that remains in the permanent structure. If the plan notes indicate that the structure contains the necessary corrosion protection required for a Corrosive Site, epoxy coat, galvanize, metallize or otherwise protect these devices as directed by the Engineer. Any coating required by the Engineer will be considered incidental to the various pay items requiring temporary works.

B. Review and Approval

The Engineer is responsible for the review and approval of temporary works' drawings.

Submit the working drawings sufficiently in advance of proposed use to allow for their review, revision (if needed), and approval without delay to the work.

Do not start construction of any temporary work for which working drawings are required until the drawings have been approved. Such approval does not relieve the Contractor of the responsibility for the accuracy and adequacy of the working drawings.

The time period for review of the working drawings does not begin until complete drawings and design calculations, when required, are received by the Engineer.

On the drawings, show all information necessary to allow the design of any component to be checked independently as determined by the Engineer.

If requested by the Engineer, submit with the working drawings manufacturer's catalog data listing the weight of all construction equipment that will be supported on the temporary work. Show anticipated total settlements and/or deflections of falsework and forms on the working drawings. Include falsework footing settlements, joint take-up, and deflection of beams or girders. Falsework hangers that support concentrated loads and are installed at the edge of thin top flange concrete girders (such as bulb tee girders) shall be spaced so as not to exceed 75% of the manufacturer's stated safe working load. Use of dual leg hangers (such as Meadow Burke HF-42 and HF-43) are not allowed. Design the falsework and forms supporting deck slabs and overhangs on girder bridges so that there will be no differential settlement between the girders and the deck forms during placement of deck concrete.

4.0 CONSTRUCTION REQUIREMENTS

All requirements of Section 420 of the Standard Specifications apply.

Construct temporary works in conformance with the approved working drawings. Ensure that the quality of materials and workmanship employed is consistent with that assumed in the design of the temporary works. Do not weld falsework members to any portion of the permanent structure unless approved. Show any welding to the permanent structure on the approved construction drawings.

Provide tell-tales attached to the forms and extending to the ground, or other means, for accurate measurement of falsework settlement. Make sure that the anticipated compressive settlement and/or deflection of falsework does not exceed 1 inch (25 mm). For cast-in-place concrete structures, make sure that the calculated deflection of falsework flexural members does not exceed 1/240 of their span regardless of whether or not the deflection is compensated by camber strips.

A. Maintenance and Inspection

Inspect and maintain the temporary work in an acceptable condition throughout the period of its use. Certify that the manufactured devices have been maintained in a condition to allow them to safely carry their rated loads. Clearly mark each piece so that its capacity can be readily determined at the job site.

Perform an in-depth inspection of an applicable portion(s) of the temporary works, in the presence of the Engineer, not more than 24 hours prior to the beginning of each concrete placement. Inspect other temporary works at least once a month to ensure that they are functioning properly. Have a North Carolina Registered Professional Engineer inspect the cofferdams, shoring, sheathing, support of excavation structures, and support systems for load tests prior to loading.

B. Foundations

Determine the safe bearing capacity of the foundation material on which the supports for temporary works rest. If required by the Engineer, conduct load tests to verify proposed bearing capacity values that are marginal or in other high-risk situations.

The use of the foundation support values shown on the contract plans of the permanent structure is permitted if the foundations are on the same level and on the same soil as those of the permanent structure.

Allow for adequate site drainage or soil protection to prevent soil saturation and washout of the soil supporting the temporary works supports.

If piles are used, the estimation of capacities and later confirmation during construction using standard procedures based on the driving characteristics of the pile is permitted. If preferred, use load tests to confirm the estimated capacities; or, if required by the Engineer conduct load tests to verify bearing capacity values that are marginal or in other high risk situations.

The Engineer reviews and approves the proposed pile and soil bearing capacities.

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5.0 REMOVAL

Unless otherwise permitted, remove and keep all temporary works upon completion of the work. Do not disturb or otherwise damage the finished work.

Remove temporary works in conformance with the contract documents. Remove them in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight.

6.0 METHOD OF MEASUREMENT

Unless otherwise specified, temporary works will not be directly measured.

7.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items requiring temporary works will be full compensation for the above falsework and formwork.

SUBMITTAL OF WORKING DRAWINGS (7-12-07)

1.0 GENERAL

Submit working drawings in accordance with Article 105-2 of the Standard Specifications and the requirements of this special provision. For the purposes of this provision, "submittals" refers to only those listed in this provision. The list of submittals contained herein does not represent a list of required submittals for this project. Submittals are only necessary for those items as required by the Standard Specifications, other Special Provisions or contract plans. Make submittals that are not specifically noted in this Special Provision directly to the Resident Engineer. Either the Structure Design Unit or the Geotechnical Engineering Unit or both units will jointly review submittals.

If a submittal contains variations from plan details or specifications or significantly affects project cost, field construction or operations, discuss the submittal with and submit all copies to the Resident Engineer. State the reason for the proposed variation in the submittal. To minimize review time, make sure all submittals are complete when initially submitted. Provide a contact name and information with each submittal. Direct any questions regarding submittal requirements to the Resident Engineer, Structure Design Unit contacts or the Geotechnical Engineering Unit contacts noted below.

In order to facilitate in-plant inspection by NCDOT and approval of working drawings, provide the name, address and telephone number of the facility where fabrication will actually be done if different than shown on the title block of the submitted working drawings. This includes, but is not limited to, precast concrete items, prestressed concrete items and fabricated steel or aluminum items.

2.0 ADDRESSES AND CONTACTS

For submittals to the Structure Design Unit, use the following addresses:

Via US mail:

Mr. G. R. Perfetti, P. E.
State Bridge Design Engineer
North Carolina Department
of Transportation
Structure Design Unit
1581 Mail Service Center
Raleigh, NC 27699-1581

Attention: Mr. P. D. Lambert, P. E.

Via other delivery service:

Mr. G. R. Perfetti, P. E.
State Bridge Design Engineer
North Carolina Department
of Transportation
Structure Design Unit
1000 Birch Ridge Drive
Raleigh, NC 27610

Attention: Mr. P. D. Lambert, P. E.

For submittals to the Geotechnical Engineering Unit, use the following addresses:

For projects in Divisions 1-7, use the following Eastern Regional Office address:

Via US mail:

Mr. K. J. Kim, Ph. D., P. E.
Eastern Regional Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
1570 Mail Service Center
Raleigh, NC 27699-1570

Via other delivery service:

Mr. K. J. Kim, Ph. D., P. E.
Eastern Regional Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Eastern Regional Office
3301 Jones Sausage Road, Suite 100
Garner, NC 27529

For projects in Divisions 8-14, use the following Western Regional Office address:

Via US mail:

Mr. John Pilipchuk, L. G., P. E.
Western Regional Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Western Regional Office
5253 Z Max Boulevard
Harrisburg, NC 28075

Via other delivery service:

Mr. John Pilipchuk, L. G., P. E.
Western Region Geotechnical
Manager
North Carolina Department
of Transportation
Geotechnical Engineering Unit
Western Regional Office
5253 Z Max Boulevard
Harrisburg, NC 28075

Direct any questions concerning submittal review status, review comments or drawing markups to the following contacts:

Primary Structures Contact:
Paul Lambert
(919) 250 – 4041
(919) 250 – 4082 facsimile
plambert@dot.state.nc.us

Secondary Structures Contacts:
James Gaither (919) 250 – 4042
David Stark (919) 250 – 4044

Eastern Regional Geotechnical Contact (Divisions 1-7):
K. J. Kim
(919) 662 – 4710
(919) 662 – 3095 facsimile
kkim@dot.state.nc.us

Western Regional Geotechnical Contact (Divisions 8-14):
John Pilipchuk
(704) 455 – 8902
(704) 455 – 8912 facsimile
jpilipchuk@dot.state.nc.us

3.0 SUBMITTAL COPIES

Furnish one complete copy of each submittal, including all attachments, to the Resident Engineer. At the same time, submit the number of hard copies shown below of the same complete submittal directly to the Structure Design Unit and/or the Geotechnical Engineering Unit.

The first table below covers "Structure Submittals". The Resident Engineer will receive review comments and drawing markups for these submittals from the Structure Design Unit. The second table in this section covers "Geotechnical Submittals". The Resident Engineer will receive review comments and drawing markups for these submittals from the Geotechnical Engineering Unit.

Unless otherwise required, submit one set of supporting calculations to either the Structure Design Unit or the Geotechnical Engineering Unit unless both units require submittal copies in which case submit a set of supporting calculations to each unit. Provide additional copies of any submittal as directed by the Engineer.

STRUCTURE SUBMITTALS

Submittal	Copies Required by Structure Design Unit	Copies Required by Geotechnical Engineering Unit	Contract Reference Requiring Submittal [1]
Arch Culvert Falsework	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Box Culvert Falsework [7]	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Cofferdams	6	2	Article 410-4
Evazote Joint Seals [6]	9	0	"Evazote Joint Seals"
Expansion Joint Seals (hold down plate type with base angle)	9	0	"Expansion Joint Seals"
Expansion Joint Seals (modular)	2, then 9	0	"Modular Expansion Joint Seals"
Expansion Joint Seals (strip seals)	9	0	"Strip Seals"
Falsework & Forms [2] (substructure)	8	0	Article 420-3 & "Falsework and Formwork"
Falsework & Forms (superstructure)	8	0	Article 420-3 & "Falsework and Formwork"
Girder Erection over Railroad	5	0	Railroad Special Provisions
Maintenance and Protection of Traffic Beneath Proposed Structure	8	0	"Maintenance and Protection of Traffic Beneath Proposed Structure at Station ___"
Metal Bridge Railing	8	0	Plan Note
Metal Stay-in-Place Forms	8	0	Article 420-3
Metalwork for Elastomeric Bearings [4,5]	7	0	Article 1072-10

Miscellaneous Metalwork [4,5]	7	0	Article 1072-10
Optional Disc Bearings [4]	8	0	"Optional Disc Bearings"
Overhead Signs	13	0	Article 903-3(C) & Applicable Project Special Provisions
Pile Splicer	7	2	Subarticle 450-7(C)
Placement of Equipment on Structures (cranes, etc.)	7	0	Article 420-20
Pot Bearings [4]	8	0	"Pot Bearings"
Precast Concrete Box Culverts	2, then 1 reproducible	0	"Optional Precast Reinforced Concrete Box Culvert at Station ___"
Precast Retaining Wall Panels	10	1	Article 1077-2
Prestressed Concrete Cored Slab (detensioning sequences) [3]	6	0	Article 1078-11
Prestressed Concrete Deck Panels	6 and 1 reproducible	0	Article 420-3
Prestressed Concrete Girder (strand elongation and detensioning sequences)	6	0	Articles 1078-8 and 1078-11
Removal of Existing Structure over Railroad	5	0	Railroad Special Provisions
Revised Bridge Deck Plans (adaptation to prestressed deck panels)	2, then 1 reproducible	0	Article 420-3
Revised Bridge Deck Plans (adaptation to modular expansion joint seals)	2, then 1 reproducible	0	"Modular Expansion Joint Seals"
Sound Barrier Wall Casting Plans	10	0	Article 1077-2 & "Sound Barrier Wall"
Sound Barrier Wall Steel Fabrication Plans [5]	7	0	Article 1072-10 & "Sound Barrier Wall"
Structural Steel [4]	2, then 7	0	Article 1072-10

Temporary Detour Structures	10	2	Article 400-3 & "Construction, Maintenance and Removal of Temporary Structure at Station ____"
Temporary Shoring [8]	7	2	"Temporary Shoring"
TFE Expansion Bearings [4]	8	0	Article 1072-10

FOOTNOTES

1. References are provided to help locate the part of the contract where the submittals are required. References in quotes refer to the Project Special Provision by that name. Articles or subarticles refer to the Standard Specifications.
2. Submittals for these items are necessary only when required by a note on plans.
3. Submittals for these items may not be required. A list of pre-approved sequences is available from the producer or the Materials and Tests Unit.
4. The fabricator may submit these items directly to the Structure Design Unit.
5. The two sets of preliminary submittals required by Article 1072-10 of the Standard Specifications are not required for these items.
6. Submittals for Fabrication Drawings are not required. Submittals for Catalogue Cuts of Proposed Material are required. See Section 5.A of the referenced Project Special Provision.
7. Submittals are necessary only when the top slab thickness is 18 inches or greater.
8. Electronic copies of submittals are required. See referenced Project Special Provision.

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GEOTECHNICAL SUBMITTALS

Submittal	Copies Required by Geotechnical Engineering Unit	Copies Required by Structure Design Unit	Contract Reference Requiring Submittal [1]
Crosshole Sonic Logging (CSL) Reports [2]	1	0	"Crosshole Sonic Logging"
Drilled Pier Construction Sequence Plans [2]	1	0	"Drilled Piers"
Mechanically Stabilized Earth (MSE) Retaining Walls	8	2	"MSE Retaining Walls"
Pile Driving Analyzer (PDA) Reports [2]	2	0	"Pile Driving Analyzer"
Pile Driving Equipment Data [3]	1	0	Article 450-5
Proprietary Retaining Walls	8	2	Applicable Project Special Provision
Anchored Retaining Walls	8	2	Applicable Project Special Provision
Soil Nail Retaining Walls	8	2	Applicable Project Special Provision
Temporary Mechanically Stabilized (MSE) Earth Wall [2]	9	0	"Temporary Shoring"

FOOTNOTES

1. References are provided to help locate the part of the contract where the working drawing submittals are required. References in quotes refer to the Project Special Provision by that name. Articles refer to the Standard Specifications.

2. Electronic copies of submittals are required. See referenced Project Special Provision.

3. Download Pile Driving Equipment Data Form from following link:
http://www.ncdot.org/doh/preconstruct/highway/geotech/formdet/
Submit one hard copy of the completed form to the Resident Engineer. Submit a second copy of the completed form electronically, by facsimile or via US Mail or other delivery service to the Geotechnical Engineering Unit. Electronic submission is preferred. See second page of form for submittal instructions.

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CONSTRUCTION, MAINTENANCE AND REMOVAL OF TEMPORARY ACCESS AT STATION 191+92.500-L-, 223+53.200-L- (11-17-06)

1.0 GENERAL

Construct, maintain, and remove the temporary access required to provide the working area necessary for construction of the new bridge, construction of the temporary detour structure, or for the removal of an existing bridge, as applicable. Temporary access may include other methods than those outlined in this Special Provision; however, all types of temporary access are required to meet the requirements of all permits, the Standard Specifications, and this Special Provision.

2.0 TEMPORARY ROCK CAUSEWAY [WORKPAD]

Construction of a temporary rock causeway [workpad] within the limits shown on the plans is permitted. Build the causeway [workpad] with Class II riprap topped by a layer of Class A riprap or as otherwise designated on the plans or approved by the Engineer. If desired, recycle the Class II riprap used in the causeway [workpad] for placement in the final riprap slope protection as directed by the Engineer. No payment will be made for recycled riprap as this material is considered incidental to the causeway [workpad] placement and removal. If this option is exercised, no adjustment in contract bid price will be allowed due to an underrun in the quantity of "Plain Rip Rap Class II (2'-0" (600 mm) Thick)".

Completely remove all causeway [workpad] material including pipes and return the entire causeway [workpad] footprint to the original contours and elevations within 90 days of the completion of the deck slab or as otherwise required by permits.

For sites affected by moratoriums or restrictions on in-stream work: Do not construct or remove causeway [workpad] during the moratorium period shown on the permit. If the completion of the deck slab falls within the prohibitive dates for causeway [workpad] construction or removal, begin causeway [workpad] removal immediately following the prohibitive dates.

3.0 TEMPORARY WORK BRIDGE

At the contractor's option, construction of a temporary work bridge in lieu of the causeway(s) [workpad] is acceptable, provided the temporary work bridge satisfies all permits. Submit details of the temporary work bridge to the Engineer prior to constructing the work bridge to ensure conformance with the plans and all permits. Completely remove the temporary bridge prior to final acceptance or as otherwise required by the permits.

4.0 BASIS OF PAYMENT

The lump sum price bid for "Construction, Maintenance and Removal of Temporary Access at Station 191+92.500-L-, 223+53.200-L-" will be full compensation for the above work, or other methods of access, including all material, pipes, work bridge components, equipment, tools, labor, disposal, and incidentals necessary to complete the work.

CRANE SAFETY (8-15-05)

Comply with the manufacturer specifications and limitations applicable to the operation of any and all cranes and derricks. Prime contractors, sub-contractors, and fully operated rental companies shall comply with the current Occupational Safety and Health Administration regulations (OSHA).

Submit all items listed below to the Engineer prior to beginning crane operations involving critical lifts. A critical lift is defined as any lift that exceeds 75 percent of the manufacturer's crane chart capacity for the radius at which the load will be lifted or requires the use of more than one crane. Changes in personnel or equipment must be reported to the Engineer and all applicable items listed below must be updated and submitted prior to continuing with crane operations.

CRANE SAFETY SUBMITTAL LIST

A. **Competent Person:** Provide the name and qualifications of the "Competent Person" responsible for crane safety and lifting operations. The named competent person will have the responsibility and authority to stop any work activity due to safety concerns.

B. **Riggers:** Provide the qualifications and experience of the persons responsible for rigging operations. Qualifications and experience should include, but not be limited to, weight calculations, center of gravity determinations, selection and inspection of sling and rigging equipment, and safe rigging practices.

C. **Crane Inspections:** Inspection records for all cranes shall be current and readily accessible for review upon request.

D. **Certifications:** **By July 1, 2006**, crane operators performing critical lifts shall be certified by NC CCO (National Commission for the Certification of Crane Operators), or satisfactorily complete the Carolinas AGC's Professional Crane Operator's Proficiency Program. Other approved nationally accredited programs will be considered upon request. All crane operators shall also have a current CDL medical card. Submit a list of anticipated critical lifts and corresponding crane operator(s). Include current certification for the type of crane operated (small hydraulic, large hydraulic, small lattice, large lattice) and medical evaluations for each operator.

CRACK REPAIR OF PRESTRESSED CONCRETE GIRDERS (7-18-06)

The following shall be added to 1078-15 Final Finish of the Standard Specifications:

> All cracks that are 0.010 inches (0.25mm) or greater shall be repaired by means of epoxy injection in accordance with the Standard Specifications and as approved by the Engineer. Any crack less than 0.010 inches (0.25mm) need not be repaired, except that cracks greater than 0.007 inches (0.18mm) and less than 0.010 inches (0.18mm) on any member containing Calcium Nitrite corrosion inhibitor shall be coated with epoxy paint.

All material and operations concerning the epoxy injection repair process shall be in accordance with the Standard Specifications and approved by the Engineer.

GROUT FOR STRUCTURES (7-12-07)

1.0 DESCRIPTION

This special provision addresses grout for use in structures, including continuous flight auger (CFA) piles, micropiles, soil nail and anchored retaining walls and backfilling crosshole sonic logging (CSL) tubes or grout pockets, shear keys, dowel holes and recesses for cored slabs and box beams. This provision does not apply to grout placed in post-tensioning ducts for bridge beams, girders, or decks. Provide grout composed of portland cement, water and at the Contractor's option, fine aggregate and/or pozzolan. If necessary, use set controlling admixtures. Proportion, mix and place grout in accordance with the plans, the applicable section of the *Standard Specifications* or special provision for the application and this provision.

2.0 MATERIALS

Refer to Division 10 of the *Standard Specifications*:

Item	Article
Portland Cement	1024-1
Water	1024-4
Fine Aggregate	1014-1
Fly Ash	1024-5
Ground Granulated Blast Furnace Slag	1024-6
Admixtures	1024-3

At the Contractor's option, use an approved packaged grout in lieu of the materials above with the exception of the water. Contact the Materials and Tests (M&T) Unit for a list of approved packaged grouts. Consult the manufacturer to determine if the packaged grout selected is suitable for the application and meets the compressive strength and shrinkage requirements.

3.0 REQUIREMENTS

Unless required elsewhere in the Contract, provide non-metallic grout with minimum compressive strengths as follows:

Property	Requirement
Compressive Strength @ 3 days	2500 psi (17.2 MPa)
Compressive Strength @ 28 days	4500 psi (31.0 MPa)

For applications other than micropiles, soil nails and ground anchors, use non-shrink grout with shrinkage of less than 0.15%.

When using approved packaged grout, a grout mix design submittal is not required. Submit grout mix designs in terms of saturated surface dry weights on M&T Form 312U in accordance with the applicable section of the *Standard Specifications* or special provision for the structure. Use an approved testing laboratory to determine the grout mix proportions. Adjust proportions to compensate for surface moisture contained in the aggregates at the time of mixing. Changes in the saturated surface dry mix proportions will not be permitted unless a revised grout mix design submittal is accepted.

For each grout mix design, provide laboratory test results for compressive strength, density, flow and if applicable, aggregate gradation and shrinkage. Submit compressive strength for at least 3 cube and 2 cylinder specimens at the age of 3, 7, 14 and 28 days for a total of at least 20 specimens tested. Perform laboratory tests in accordance with the following:

Property	Test Method
Compressive Strength	AASHTO T106 and T22
Density	AASHTO T133
Flow for Sand Cement Grout	ASTM C939 (as modified below)
Flow for Neat Cement Grout (no fine aggregate)	Marsh Funnel and Cup API RP 13B-1, Section 2.2
Aggregate Gradation for Sand Cement Grout	AASHTO T27
Shrinkage for Non-shrink Grout	ASTM C1090

When testing grout for flow in accordance with ASTM C939, modify the flow cone outlet diameter from ½ to ¾ inch (13 to 19 mm).

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When grout mix designs are submitted, the Engineer will review the mix designs and notify the Contractor as to their acceptability. Do not use grout mix designs until written acceptance has been received. Acceptance of grout mix designs or use of approved packaged grouts does not relieve the Contractor of responsibility to furnish a product that meets the Contract requirements.

Upon written request from the Contractor, a grout mix design accepted and used satisfactorily on a Department project may be accepted for use on other projects.

4.0 SAMPLING AND PLACEMENT

The Engineer will determine the locations to sample grout and the number and type of samples collected for field and laboratory testing. Use API RP 13B-1 for field testing grout flow and density of neat cement grout. The compressive strength of the grout will be considered the average compressive strength test results of 3 cube or 2 cylinder specimens at 28 days.

Do not place grout if the grout temperature is less than 50°F (10°C) or more than 90°F (32°C) or if the air temperature measured at the location of the grouting operation in the shade away from artificial heat is below 40°F (4°C).

Provide grout at a rate that permits proper handling, placing and finishing in accordance with the manufacturer's recommendations unless directed otherwise by the Engineer. Use grout free of any lumps and undispersed cement. Agitate grout continuously before placement.

Control grout delivery so the interval between placing batches in the same component does not exceed 20 minutes. Place grout before the time between adding the mixing water and placing the grout exceeds that in the table below.

ELAPSED TIME FOR PLACING GROUT

(with continuous agitation)

Air or Grout Temperature Whichever is Higher	**Maximum Elapsed Time**	
	No Set Retarding Admixture Used	**Set Retarding Admixture Used**
90°F (32°C) or above	30 min.	1 hr. 15 min.
80°F (27°C) through 89°F (31°C)	45 min.	1 hr. 30 min.
79°F (26°C) or below	60 min.	1 hr. 45 min.

5.0 MISCELLANEOUS

Comply with Articles 1000-9 through 1000-12 of the *Standard Specifications* to the extent applicable for grout in lieu of concrete.

HIGH STRENGTH BOLTS (11-17-06)

In Section 440-8(A) of the Standard Specifications, revise the third paragraph and insert a new paragraph four, respectively, as follows:

"Make sure that plain bolts and washers have a thin coat of lubricant at the time of installation."

"Use nuts that are pre-waxed by the producer/supplier prior to shipping to the project."

PRESTRESSED CONCRETE MEMBERS (4-02-07)

The 2006 Standard Specifications shall be revised as follows:

In Section 1078-1 "General" of the Standard Specifications, add the following after the second paragraph:

(A) Producer Qualification

Producers of precast, prestressed concrete members are required to establish proof of their competency and responsibility in accordance with the Precast/Prestressed Concrete Institute's (PCI) Plant Certification Program in order to perform work for the project. Certification of the manufacturing plant under the PCI program and submission of proof of certification to the State Materials Engineer is required prior to beginning fabrication. Maintain certification at all times while work is being performed for the Department. Submit proof of certification following each PCI audit to the State Materials Engineer for continued qualification. These same requirements apply to producers subcontracting work from the producer directly employed by the Contractor.

Employ producers PCI certified in Product Group B, Bridge Products, and in one of the appropriate categories as listed below:

- B2 Prestressed Miscellaneous Bridge Products: Includes solid piles, sheet piles and bent caps.
- B3 Prestressed Straight-Strand Bridge Members: Includes all box beams, cored slabs, straight-strand girders and bulb-tees, bridge deck panels, hollow piles, prestressed culverts and straight strand segmental components.
- B4 Prestressed Deflected-Strand Bridge Members: Includes deflected strand girders and bulb-tees, haunched girders, deflected strand segmental superstructure components and other post-tensioned elements.

Categories for other elements will be as required by the project special provision or plans.

ADHESIVELY ANCHORED ANCHOR BOLTS OR DOWELS (6-11-07)

1.0 GENERAL

Installation and Testing of Adhesively anchored anchor bolts and dowels shall be in accordance with Section 420-13, 420-21 and 1081-1 of the Standard Specifications except as modified in this provision.

2.0 INSTALLATION

Installation of the adhesive anchors shall be in accordance with manufacturer's recommendations and shall occur when the concrete is above 40 degrees Fahrenheit and has reached its 28 day strength.

The anchors shall be installed before the adhesive's initial set ('gel time').

3.0 FIELD TESTING

Replace the third paragraph of Section 420-13 (C) with the following:

> "In the presence of the Engineer, field test the anchor bolt or dowel in accordance with the test level shown on the plans and the following:.
>
> Level One Field testing: Test a minimum of 1 anchor but not less than 10% of all anchors to 50% of the yield load shown on the plans. If less than 60 anchors are to be installed, install and test the required number of anchors prior to installing the remaining anchors. If more than 60 anchors are to be installed, test the first 6 anchors prior to installing the remaining anchors, then test 10% of the number in excess of 60 anchors.
>
> Level Two Field testing: Test a minimum of 2 anchors but not less than 10% of the all anchors to 80% of the yield load shown on the plans. If less than 60 anchors are to be installed, install and test the required number of anchors prior to installing the remaining anchors. If more than 60 anchors are to be installed, test the first 6 anchors prior to installing the remaining anchors, then test 10% of the number in excess of 60 anchors.
>
> Testing should begin only after the Manufacturer's recommended cure time has been reached. For testing, apply and hold the test load for three minutes. If the jack experiences any drop in gage reading, the test must be restarted. For the anchor to be deemed satisfactory, the test load must be held for three minutes with no movement or drop in gage reading."

4.0 REMOVAL AND REPLACEMENT OF FAILED TEST SPECIMENS:

Remove all anchors and dowels that fail the field test without damage to the surrounding concrete. Redrill holes to remove adhesive bonding material residue and clean the hole in accordance with specifications. For reinstalling replacement anchors or dowels, follow the

same procedures as new installations. Do not reuse failed anchors or dowels unless approved by the Engineer.

5.0 USAGE

The use of adhesive anchors for overhead installments is not permitted without written permission from the Engineer.

6.0 BASIS OF PAYMENT

No separate measurement or payment will be made for furnishing, installing, and testing anchor bolts/dowels. Payment at the contract unit prices for the various pay items will be full compensation for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

SPECIAL STEEL 2 BAR METAL RAIL (SPECIAL)

1.0 GENERAL

Provide Special Steel 2 Bar Metal Rail in accordance with the Standard Specifications, the details shown in the contract plans and this Special Provision.

2.0 MEASUREMENT

Quantity paid for is the actual number of linear meter of metal rail, complete in place and accepted, measured along the bottom channel of the completed metal rail.

3.0 BASIS OF PAYMENT

The quantity for which payment is made is shown in linear meter on the plans for "Special Steel 2 Bar Metal Rail". The unit bid per linear meter is full compensation for all materials, painting, tools, labor, equipment and incidentals necessary to complete this item.

METRIC STRUCTURAL STEEL (10-12-01)

The structural steel for this project is specified in SI (Metric) units with plate thickness designated in millimeters in accordance with AASHTO M160M.

The substitution of structural steel in US Customary nominal thickness is permitted for primary and secondary members defined as follows:

- Primary members - members such as webs and flanges of plate girders, transverse and bearing stiffeners, girder field splice plates, and connector plates for curved girders.

- Secondary members - members such as connector plates for straight girders, bearing plates and miscellaneous hardware.

Such substitution is limited to the values shown in the following table.

Material Specified Metric (mm)	Primary Members US Customary (in)	Secondary Members US Customary (in)
8	3/8	*
9	3/8	*
10	7/16	3/8
11	7/16	*
12	1/2	*
14	9/16	*
16	11/16	5/8
18	3/4	11/16
20	13/16	3/4
22	7/8	*
25	1	*
28	1-1/8	*
30	1-3/16	*
32	1-5/16	1-1/4
35	1-7/16	1-3/8
38	1-1/2	*
40	1-5/8	*
45	1-13/16	*
50	2	*
55	2-1/4	*
60	2-3/8	*
70	2-13/16	2-3/4
* These values are the same as those for Primary members.		

There will be no additional payment for any extra weight incurred as a result of any substitution.

CONSTRUCTION, MAINTENANCE AND REMOVAL OF TEMPORARY ACCESS AT STATION 11+30.000 -Y2- **(SPECIAL)**

1.0 GENERAL

Construct, maintain, and remove the temporary access required to provide the working area necessary for construction of the new bridge, construction of the temporary detour structure, or for the removal of an existing bridge, as applicable. Temporary access may include other methods than those outlined in this Special Provision; however, all types of temporary access are required to meet the requirements of all permits, the Standard Specifications, and this Special Provision.

2.0 TEMPORARY ROCK CAUSEWAY [WORKPAD]

Construction of a temporary rock causeway [workpad] within the limits shown on the plans is permitted. Build the causeway [workpad] with Class I riprap topped by a layer of #57 stone or as otherwise approved by the Engineer.

Completely remove all causeway [workpad] material including pipes and return the entire causeway [workpad] footprint to the original contours and elevations within 90 days of the completion of the deck slab or as otherwise required by permits.

For sites affected by moratoriums or restrictions on in-stream work: Do not construct or remove causeway [workpad] during the moratorium period shown on the permit. If the completion of the deck slab falls within the prohibitive dates for causeway [workpad] construction or removal, begin causeway [workpad] removal immediately following the prohibitive dates.

At the contractor's option, construction of a temporary work bridge in lieu of the causeway(s) [workpad] is acceptable, provided the temporary work bridge satisfies all permits. Submit details of the temporary work bridge to the Engineer prior to constructing the work bridge to ensure conformance with the plans and all permits. Completely remove the temporary bridge prior to final acceptance or as otherwise required by the permits.

3.0 TEMPORARY WORK BRIDGE

Construction of a temporary work bridge is permitted as shown on the plans. The temporary work bridge shall have a minimum span length of 20 meters. Submit details of the temporary work bridge to the Engineer prior to constructing the work bridge to ensure conformance with the plans and all permits. Completely remove the temporary bridge prior to final acceptance or as otherwise required by the permits.

4.0 BASIS OF PAYMENT

The lump sum price bid for "Construction, Maintenance and Removal of Temporary Access at Station 11+30.000 –Y2-" will be full compensation for the above work, or other methods of access, including all material, pipes, work bridge components, equipment, tools, labor, disposal, and incidentals necessary to complete the work.

VERTICAL CONCRETE BARRIER RAIL (SPECIAL)

Use Vertical Concrete Barrier Rail in accordance with the concrete barrier rail provisions of Section 460 of the Standard Specifications. Replace references to "concrete barrier rail" with "vertical concrete barrier rail".

Payment will be made under:

Vertical Concrete Barrier Rail.....Linear Meter

MECHANICALLY STABILIZED EARTH RETAINING WALLS (4-15-08)

1.0 GENERAL

A. Description

A mechanically stabilized earth (MSE) retaining wall is defined as a soil-retaining system with steel or geogrid tensile reinforcements in the reinforced zone and vertical or nearly vertical facing elements. The facing elements may be precast concrete panels or segmental retaining wall (SRW) units unless noted otherwise on the plans or the *NCDOT Policy for Mechanically Stabilized Earth Retaining Walls* prohibits the use of SRW units. Design and construct MSE retaining walls based on actual elevations and dimensions in accordance with this provision, the accepted submittals and the plans. For this provision, "MSE wall" refers to a mechanically stabilized earth retaining wall and "MSE Wall Vendor" refers to the vendor supplying the chosen MSE wall system. Also, "blocks" and "SRW blocks" refer to SRW units.

B. MSE Wall System

Use an MSE wall system approved by the Department in accordance with any restrictions for the chosen system, the plans and the *NCDOT Policy for Mechanically Stabilized Earth Retaining Walls*. Value engineering proposals for other MSE wall systems will not be considered. Obtain the NCDOT MSE wall policy and the list of approved MSE wall systems from:
http://www.ncdot.org/doh/preconstruct/highway/geotech/msewalls/

MSE wall systems with conditional approval are restricted to a design height of 20 ft (6.1 m) and an exposed face area of 5,000 ft^2 (465 m^2) per MSE wall. The design height is defined as the difference between where the finished grade elevation intersects the top and bottom of the MSE wall.

The conditional status of an MSE wall system will be reevaluated after satisfactorily completing a representative MSE wall that meets the following requirements.

- Design height exceeds 15 ft (4.6 m) for a horizontal distance of at least 150 ft (46 m) along the wall face
- Designed and constructed in accordance with this provision
- Movement monitored during construction to 3 months after wall is subject to surcharge loads or movement stops, whichever is longer, in accordance with the NCDOT MSE wall policy
- MSE wall system evaluation report submitted in accordance with the NCDOT MSE wall policy

When designing an MSE wall with a conditionally approved system, notify the Engineer if the MSE wall will meet the above requirements.

C. Temporary Shoring for Wall Construction

This provision is not applicable to "Temporary Shoring". If required, temporary shoring is addressed elsewhere in the Contract. "Temporary Shoring for Wall Construction" may be shown on the Retaining Wall Plans or proposed for MSE wall construction. When this occurs, submit temporary shoring for wall construction working drawings and design calculations with the MSE wall design submittal described below and design and construct the shoring in accordance with the requirements for temporary shoring.

2.0 SUBMITTALS

Two submittals are required which include the MSE wall design and installation submittals. Provide 11 hard copies of working drawings and 3 hard copies of design calculations for the MSE wall design submittal and 4 hard copies of the MSE wall installation submittal. Also, submit an electronic copy (pdf or jpeg format on CD or DVD) of each submittal. Provide the MSE wall installation submittal at least 30 calendar days before conducting the MSE wall preconstruction meeting. Do not begin MSE wall construction until both submittals are accepted.

A. MSE Wall Design Submittal

The Retaining Wall Plans show plan views, typical sections, details, notes and elevation or profile views (wall envelope) for each MSE wall. When noted on plans and before beginning MSE wall design, survey all existing ground elevations shown on the plans and submit a revised wall envelope for review and acceptance. Use the accepted revised wall envelope for design.

Design MSE walls in accordance with any restrictions for the chosen MSE wall system, the plans and the *AASHTO Standard Specifications for Highway Bridges* unless otherwise required. Either the simplified or Meyerhof coherent gravity approach is acceptable for determining maximum reinforcement loads. Design steel components including reinforcement and connection hardware for non-aggressive backfill with corrosion losses in accordance with *AASHTO Standard Specifications for Highway Bridges*. Also, design MSE walls with a minimum reinforcement length of 6 ft (1.8 m) unless shown otherwise on the plans and the reinforcement coefficients and geogrid reduction factors submitted to the Department for the approval of the chosen MSE wall system.

Cast-in-place concrete coping is required when noted on the plans and for all MSE walls with SRW blocks. Regardless of wall backfill type, fill between and behind blocks for a horizontal distance of 18" (450 mm) and, unless otherwise approved, any block core spaces with stone meeting the requirements of standard size nos. 57, 67 or 78M in accordance with Sections 1005 and 1014 of the *Standard Specifications*. When using standard size nos. 2S or 2MS for wall backfill, place separation fabric between the stone behind the blocks and the wall backfill.

An unreinforced cast-in-place concrete leveling pad that is continuous at steps is required for all MSE walls. If existing or future obstructions such as foundations, guardrail posts, pavements, pipes, inlets or utilities will interfere with reinforcement, maintain a minimum clearance of 3" (75 mm) between the obstruction and reinforcement unless otherwise approved. Place reinforcement at or within 3" (75 mm) above the corresponding connection elevation. Separation fabric is required between the wall backfill and the overlying fill or aggregate with the exception of when concrete pavement is placed immediately over the backfill.

Submit working drawings and design calculations for review and acceptance in accordance with Article 105-2 of the *Standard Specifications*. Include items in the MSE wall design submittal listed in Section 7.2 of the *AASHTO LRFD Bridge Construction Specifications*. Submit working drawings showing plan views, wall profiles with maximum applied bearing pressures, typical sections with reinforcement connection details, wall backfill type and separation fabric locations and details for a leveling pad, precast elements, SRW blocks, coping, bin walls, slip joints, etc. If necessary, include details on working drawings for end bent caps connected to reinforcement and obstructions interfering with reinforcement or extending through walls. Submit design calculations for each wall section with different surcharge loads, wall geometry or material parameters. A minimum of one analysis is required for each wall section with different reinforcement lengths. When using a software program other than MSEW by ADAMA Engineering, Inc. for design, provide a hand calculation verifying the analysis of the section with the longest reinforcement length. Have MSE walls designed, detailed and sealed by a Professional Engineer registered in North Carolina.

B. MSE Wall Installation Submittal

The MSE wall installation submittal includes a construction sequence and manual and the MSE Wall Installer personnel and experience.

Submit a detailed project specific construction sequence and a field construction manual describing with illustrations the step-by-step wall construction process for the chosen MSE wall system.

Use an MSE Wall Installer prequalified by the Construction Unit of the Department for MSE retaining walls work (work code 3015). Submit documentation of experience with the chosen MSE wall system that includes 5 MSE wall projects in the last 3 years with wall heights similar to those for this project and an exposed face area for all 5 walls of at least 10,000 ft^2 (930 m^2). Documentation should include the General Contractor and Owner's name and current contact information with descriptions of each past project.

Submit documentation for the Superintendent assigned to this project verifying employment with the MSE Wall Installer and a minimum of 5 years experience with the chosen MSE wall system including past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references,

certifications, project lists, experience descriptions and details, etc. Perform work with the Superintendent submitted and accepted. If a different Superintendent is required during construction, suspend MSE wall construction until the replacement Superintendent is submitted and accepted.

If the MSE Wall Installer or Superintendent does not have 5 years experience with the chosen MSE wall system, experience with another approved MSE wall system with the same type of facing element (precast concrete panels or SRW blocks) as that for the chosen MSE wall system may be used for the requirements above.

3.0 MATERIALS

A. Certifications, Storage and Handling

Provide certifications in accordance with Section 106-3 of the *Standard Specifications*. Provide Type 3 Manufacturer's Certifications for all MSE wall materials. For each geogrid product, provide Type 2 Typical Certified Mill Test Reports for tensile strength. For SRW blocks, provide Type 4 Certified Test Reports for all block properties with the exception of durability. When a note on plans requires freeze-thaw durable blocks, provide Type 5 Typical Certified Test Reports for durability.

Load, transport, unload and store MSE wall materials such that they are kept clean and free of damage. Damaged panels or blocks with excessive discoloration, chips or cracks as determined by the Engineer will be rejected. Do not damage reinforcement connection hardware or mechanisms in handling and storing panels or blocks. Label each pallet of blocks with the information listed in Article 1077-13 of the *Standard Specifications*. Do not transport SRW blocks away from the casting yard until the concrete strength reaches 4000 psi (27.6 MPa) and a period of at least 5 days elapses after casting unless otherwise approved.

Identify, store and handle all geogrids in accordance with ASTM D4873. Geogrids with defects, flaws, deterioration or damage will be rejected. Do not leave geogrids uncovered for more than 7 days.

B. Facing Elements

Provide facing elements produced by a manufacturer approved or licensed by the MSE Wall Vendor.

1. Precast Concrete Panels

Provide precast concrete panels meeting the requirements of Sections 1000 and 1077 of the *Standard Specifications* and reinforcing steel meeting the requirements of Section 1070 of the *Standard Specifications*. Accurately locate and secure reinforcement connection hardware and maintain a minimum 2" (50 mm) clearance to the reinforcing steel. Produce panels within ¼ inch (6 mm) of the panel dimensions shown in the accepted submittals.

A minimum compressive strength of 4000 psi (27.6 MPa) at 28 days is required. For testing panels for compressive strength, 4 cylinders are required per 2000 ft^2 (186 m^2) of panel face area or a single day's production, whichever is less.

Unless required otherwise on the plans, provide a final finish in accordance with Article 1077-11 of the *Standard Specifications*.

2. Segmental Retaining Wall (SRW) Blocks

Use blocks meeting the requirements of ASTM C1372 with the exception of absorption, compressive strength and durability requirements. Test blocks in accordance with ASTM C140 with the exception of the number of units in a lot. For testing blocks, a lot is defined as 5000 units or a single day's production, whichever is less, and 6 blocks are required per lot. Provide blocks with a maximum absorption of 5%.

A minimum compressive strength of 4000 psi (27.6 MPa) at 28 days is required for blocks with the exception of freeze-thaw durable blocks. When a note on plans requires freeze-thaw durable blocks, a minimum compressive strength of 5500 psi (37.9 MPa) at 28 days is required.

Test freeze-thaw durable blocks in accordance with ASTM C1262. Test specimens in water. Freeze-thaw durable blocks are acceptable if the weight loss of each of 4 of the 5 specimens after 150 cycles does not exceed 1% of its initial weight.

Unless required otherwise on the plans, provide blocks with a split face finish and a concrete gray color with no tints, dyes or pigments.

C. Reinforcement

Provide reinforcement supplied by the MSE Wall Vendor or a manufacturer approved or licensed by the vendor.

1. Steel (Inextensible) Reinforcement

Use welded wire reinforcement mesh and mats meeting the requirements of AASHTO M55 or M221 and steel strips or straps meeting the requirements of ASTM A572 or A1011 with a grade as specified in the accepted submittals. Galvanize steel reinforcement in accordance with Section 1076 of the *Standard Specifications*.

2. Geogrid (Extensible) Reinforcement

Use geogrids approved by the Department for the chosen MSE wall system. Obtain the list of approved geogrids for each MSE wall system from the website shown elsewhere in this provision.

Test geogrids in accordance with ASTM D6637. Provide tensile strength values as minimum average roll values (MARV) in accordance with ASTM D4759. For testing geogrids, a lot is defined as a single day's production.

D. Wall Backfill

Use wall backfill in the reinforced zone for MSE walls. Provide wall backfill meeting the requirements of standard size nos. 2S, 2MS, 57, 67 or 78M in accordance with Sections 1005 and 1014 of the *Standard Specifications* with the following exception. Do not use 2S or 2MS when prohibited by a note on plans or when SRW blocks are not allowed.

When using steel reinforcement, provide wall backfill meeting the electrochemical requirements of Section 7.3.6.3 of the *AASHTO LRFD Bridge Construction Specifications* tested in accordance with the following methods:

Property	AASHTO Test Method
pH	T289
Resistivity	T288
Chlorides	T291
Sulfates	T290

Use wall backfill free of deleterious materials with a maximum organic content of 1% tested in accordance with AASHTO T267.

E. Leveling Pads, Coping and Moment Slabs

Provide leveling pads, coping and moment slabs meeting the requirements of Section 1000 of the *Standard Specifications* and reinforcing steel meeting the requirements of Section 1070 of the *Standard Specifications*. Provide precast coping meeting the requirements of Section 1077 of the *Standard Specifications*.

Use Class A Concrete for leveling pads, coping and moment slabs in accordance with Article 1000-4 of the *Standard Specifications*. For testing precast coping for compressive strength, 4 cylinders are required per 40 yd^3 (31 m^3) of concrete or a single day's production, whichever is less.

F. Separation Fabric

Use separation fabric meeting the requirements of Type 2 Engineering Fabric in accordance with Section 1056 of the *Standard Specifications*.

G. Joint Materials

Use joint materials in accordance with Section 1028 of the *Standard Specifications*.

H. Miscellaneous Components

Miscellaneous components may include attachment devices, connectors (e.g., pins, bars, plates, etc.), bearing pads, dowels, fasteners (e.g., bolts, nuts, etc.), filter fabric or any other wall components not included above. Galvanize steel components in accordance with Section 1076 of the *Standard Specifications*. Provide miscellaneous components approved by the Department for the chosen MSE wall system. Obtain the list of approved miscellaneous components for each MSE wall system from the website shown elsewhere in this provision.

4.0 CORROSION MONITORING

Corrosion monitoring is required for MSE walls with steel reinforcement. The Engineer will determine the number of monitoring locations and where to install the instrumentation. Contact the Materials & Tests Unit Chemical Testing Engineer before beginning wall construction. The Department will provide the corrosion monitoring instrumentation kit and assistance with installation, if necessary.

5.0 MSE WALL PRECONSTRUCTION MEETING

Before starting MSE wall construction, conduct a preconstruction meeting to discuss the construction and inspection of the MSE walls. Schedule this meeting after all MSE wall submittals have been accepted. The Resident or Bridge Maintenance Engineer, Bridge Construction Engineer, Geotechnical Operations Engineer, General Contractor and the MSE Wall Installer Superintendent will attend this preconstruction meeting.

6.0 MSE WALL VENDOR SITE ASSISTANCE

Provide a representative employed by the MSE Wall Vendor to assist and guide the MSE Wall Installer on-site for at least 8 hours when the first panels or blocks are set and the first reinforcement layer is placed unless otherwise approved. If problems are encountered during construction, the Engineer may require the vendor representative to return to the site for a time period determined by the Engineer at no additional cost to the Department.

7.0 CONSTRUCTION METHODS

Control drainage during construction in the vicinity of MSE walls. Collect and direct run off away from MSE walls and wall backfill. Contain and maintain wall backfill and protect material from erosion.

Perform all necessary clearing and grubbing in accordance with Section 200 of the Standard Specifications. Excavate as necessary for MSE walls in reasonably close conformity to the accepted submittals.

Unless prohibited by a note on plans, install foundations located within the reinforced zone before placing wall backfill or the first reinforcement layer. Notify the Engineer when foundation excavation is complete. Do not place leveling pad concrete, wall backfill or first reinforcement layer until obtaining approval of the excavation depth and foundation material.

Construct cast-in-place concrete leveling pads at elevations and with dimensions shown in the accepted submittals and in accordance with Section 420 of the Standard Specifications. Cure leveling pads a minimum of 24 hours before placing panels or blocks.

Erect and support panels or blocks with no negative batter (wall face leaning forward) such that the final position is as shown in the accepted submittals. Stagger vertical joints of blocks to create a running bond when possible unless shown otherwise in the accepted submittals. Place blocks with a maximum joint width of ½ inch (13 mm) and set panels with a joint width of ½ to 1 inch (13 to 25 mm). Construct MSE walls with a vertical and horizontal tolerance of ¾ inch (19 mm) when measured with a 10 ft (3 m) straight edge and a final overall vertical plumbness (batter) of less than ½ inch per 10 ft (13 mm per 3 m) of wall height.

Place reinforcement at the locations and elevations shown in the accepted submittals. Do not splice reinforcement. Replace any damaged reinforcement to the satisfaction of the Engineer. Contact the Engineer when unanticipated existing or future obstructions such as foundations, guardrail posts, pavements, pipes, inlets or utilities will interfere with reinforcement. To avoid obstructions, deflect, skew and modify reinforcement as shown in the accepted submittals. Place reinforcement in slight tension free of kinks, folds, wrinkles or creases.

Place wall backfill in the reinforced zone in 8 to 10 inch (200 to 250 mm) thick lifts. Compact standard size nos. 2S and 2MS wall backfill in accordance with Subarticle 235-4(C) of the Standard Specifications. Use only hand operated compaction equipment within 3 ft (1 m) of the wall face. At a distance greater than 3 ft (1 m), compact wall backfill with at least 4 passes of an 8 – 10 ton (7.3 - 9.1 metric ton) vibratory roller. Smooth wheeled or rubber tired rollers are also acceptable for compacting wall backfill. Do not use sheepsfoot, grid rollers or other types of compaction equipment with feet. Compact wall backfill in a direction parallel to the wall face. Do not damage reinforcement when placing and compacting wall backfill. End dumping directly on the reinforcement is not permitted. Do not operate heavy equipment on the reinforcement until it is covered with at least 10" (250 mm) of wall backfill.

Random backfill is defined as backfill for wall construction that is outside the reinforced zone. Use approved material for random backfill that is free from large or frozen lumps, wood or other undesirable material. Compact random backfill in accordance with Subarticle 235-4(C) of the Standard Specifications.

Place and construct coping as shown in the accepted submittals. Construct cast-in-place concrete coping and moment slabs in accordance with Section 420 of the Standard Specifications. Provide a Class 2 Surface Finish for cast-in-place coping in accordance

with Article 420-17 of the Standard Specifications. Construct concrete barrier rail coping in accordance with the plans and Subarticle 460-3(C) of the Standard Specifications.

Construct cast-in-place coping joints at a maximum spacing of 10 ft (3 m) to coincide with the vertical joints between the panels or blocks. Half-inch (13 mm) thick expansion joints in accordance with Article 420-10 of the Standard Specifications are required every third joint. Half-inch (13 mm) deep grooved contraction joints in accordance with Subarticle 825-10(B) are required for the remaining joints. Stop coping reinforcement 2" (50 mm) from either side of expansion joints.

Seal joints above and behind MSE walls between coping and pavements with joint sealer. When fabric is required to separate the wall backfill from the overlying fill or aggregate, overlap fabric a minimum of 18" (450 mm) with seams oriented parallel to the wall face.

8.0 MEASUREMENT AND PAYMENT

MSE Retaining Walls will be measured and paid for at the contract unit price per square foot (square meter) of exposed face area incorporated into the completed and accepted wall. The wall height will be measured as the difference between the top and bottom of wall elevation. The top of wall elevation is defined as the top of coping or concrete barrier rail coping. The bottom of wall elevation is defined as where the finished grade intersects the front face of the MSE wall. No payment will be made for portions of MSE walls below bottom of wall elevations.

Include in the unit bid price for MSE Retaining Walls all costs for design, submittals, furnishing labor, tools, equipment and materials, performing any excavation, providing site assistance, leveling pads, facing elements, reinforcement, backfill, fabric, coping and miscellaneous components and any incidentals necessary to design and construct MSE walls in accordance with this provision. If necessary, also include in this unit bid price all costs for concrete barrier rail coping, moment slabs and "Temporary Shoring for Wall Construction" as shown elsewhere in this provision.

Pay Item	**Pay Unit**
MSE Retaining Walls	Square Foot (Square Meter)

PILE/PANEL RETAINING WALL **(SPECIAL)**

The Contractor shall construct a pile and precast concrete panel retaining wall at the locations indicated in the plans and in accordance with the details in plans, the following special provision and as directed by the Engineer.

A pile/panel retaining wall preconstruction conference shall be scheduled with the Contractor including the drilling superintendent, the Resident Engineer including the inspector, the Area

Bridge Construction Engineer and the Regional Geotechnical Operations Engineer to discuss construction and inspection of the pile/panel retaining wall. This conference shall be completed a minimum of 5 days prior to beginning any work.

Steel Piles

HP steel piles shall conform to the applicable parts of the Standard Specifications and these provisions. All steel piles shall meet the requirements of Section 1084 in the 2006 NCDOT Standard Specifications for Roads and Structures. The size and locations of piles shall be as shown in the plans.

See special provisions contained herein for painting of steel piles.

The piles shall be installed to grade using the lengths and cut off elevations shown in the plans by pre-augering or drilling a 0.762 meter minimum diameter hole for the HP steel piles. The hole shall be backfilled with concrete up to the bottom of the cushioning material.

Where the alignment of the wall is curved, the piles shall be laid out on chords and aligned such that their flanges are tangent to the curve at the web.

Piles shall be installed to within 51 mm of their plan location and the center to center distance between piles shall not differ from the plans by more than 76 mm after installation.

The plumbness of the piles shall not vary from the vertical by more than 10 mm per meter. In general, installed piles will be acceptable if the precast concrete panels, when installed, have an acceptable appearance without significant gaps between the face of the panels and the pile flanges. The precast concrete panels shall have a minimum 51 mm bearing on the pile flanges.

Splicing of piles is subject to the Engineer's approval and shall be in accordance with the plans. Splices will not be permitted in the portion of the pile that is permanently exposed. Welding shall conform to the requirements of Article 1072-20 of the Standard Specifications.

Precast Concrete Panels

Concrete materials for precast panels shall conform to the applicable parts of the Standard Specifications and these special provisions.

Concrete for the precast panels shall have a minimum 28-day compressive strength of 31 MPa. The panels shall not be removed from the forms until the concrete has attained sufficient strength to prevent damage. Cracked, spalled or discolored panels shall be rejected.

The exposed face of the concrete panels shall have a dark gray, exposed aggregate finish. The side of the panels shall be plumb and have a minimum bearing distance of 51 mm. 13 mm thick expansion joint material shall be placed between the panels and pile flanges for the width of the bearing surface. The panels shall be seated firmly on the cushioning material and shall be held securely against the pile flange until the backfill is placed sufficiently to hold the panels in place.

C.I.P. Coping

The work covered by this provision consists of the construction of portland cement concrete coping in accordance with the details in the plans and the following provisions.

(1) Concrete shall be Class A conforming to the applicable requirements of Sections 420 and 1000 of the Specifications.

(2) Reinforcing steel in the coping shall conform to the applicable requirements of Sections 425 and 1070 of the Specifications.

Expansion joints are allowed on 10 meter centers, construction joints may be used where the coping changes slopes and at 30 meter centers, and contraction joints are allowed on 3 meter centers.

Shaft Excavation and Concrete

Shaft excavation shall conform to the applicable provisions of Section 410 of the Standard Specifications. The shaft concrete shall be a drilled pier mix meeting the requirements of Section 1000 of the Standard Specifications.

The shaft, as shown in the plans, shall be excavated by drilling, augering or coring to a depth sufficient to set the full length of steel pile to grade, and shall be constructed in accordance with Section 825 of the Standard Specifications. If rock is encountered during drilling or pre-augering as determined by the Engineer, the pile tip elevation may be raised if a rock socket at least 3 meters in length is maintained. Shaft concrete shall be cast against undisturbed ground unless otherwise permitted by the Engineer. If over-excavation occurs vertically, the Contractor shall backfill with No. 57 stone before selling the pile. All loose and soft material shall be removed and the excavation dewatered immediately before and during the concrete casting operation. The top of the concrete shafts shall be generally level.

If necessary, special measures shall be taken to insure the stability of the shaft such as installing temporary casings prior to drilling, installing the pile and placing concrete immediately after a shaft is excavated before caving occurs, installing well points or other measures. If caving occurs, the shaft excavation operation shall be halted until special measures are implemented.

Concrete panels shall not be installed before the shaft concrete has cured for a minimum of 3 days.

Excavation and Backfill

Where necessary for safety, the excavation shall be sloped or shored in accordance with local and state safety standards. It is suggested to use timber lagging in conjunction with the permanent retaining wall piles as excavation shoring. However, the Contractor may elect to use alternate methods of providing a safe excavation provided the methods are submitted to the Engineer for review and acceptance.

The Contractor shall take care to minimize the excavation necessary to place the cushioning material and panels. The excavation for cushioning material and panels shall be backfilled immediately after panels are placed with No. 57 stone. Excavation to install panels and timber lagging shall be limited 150 mm behind the panels. Any overexcavation shall be backfilled with No. 57 stone.

No. 57 stone shall conform to the applicable requirements of Section 1005 of the Standard Specifications and these provisions.

Compaction of the No. 57 stone backfill shall be to the satisfaction of the Engineer. The stone shall be rodded and spread in order to fill all voids and insure maximum density. Larger areas shall be compacted with hand operated equipment. Flushing the stone with water will not be allowed. Heavy compaction equipment will not be allowed behind the wall.

The No. 57 stone cushioning material shall be compacted with at least two (2) passes of lightweight compaction equipment.

Painting of Piles

Steel piles shall be painted in accordance with Section 442 of the Standard Specifications and these provisions.

Painting is required only from the top of the pile down to 450 mm below grade. The color of the finish coat shall match the color of the precast concrete panels.

In addition to surface preparation requirements of Section 442, all free edges to be painted shall be planed in accordance with Section 1072-14.

Measurement and Payment

The quantity of pile/panel retaining walls to be paid for will be the actual number of square meters of precast concrete panels which have been incorporated into the completed and accepted retaining wall. Measurement shall be made horizontally and vertically from outside edge to outside edge.

The quantity of pile/panel retaining wall, measured as provided above, will be paid for at the contract unit price per square meter for "Pile/Panel Retaining Wall".

Such price and payment shall be full compensation for all work covered by this provision including but not limited to shaft excavation, stabilization and dewatering of the shafts, furnishing, installing and painting the piles, furnishing and placing shaft concrete, furnishing and placing precast concrete panels, furnishing and placing No. 57 stone, construction of C.I.P. coping, and all other incidental work and materials necessary to construct the pile/panel retaining walls.

RIP RAP, CLASS B FOR CULVERT AT STATION 82+70.00 -L- **(SPECIAL)**

Class B riprap used for the culvert at Station 82+70.00 -L- shall be in accordance with Section 876 of the Standard Specifications.