Project U-2519DA **Cumberland Co.**

Project Special Provisions
Structures and Culverts

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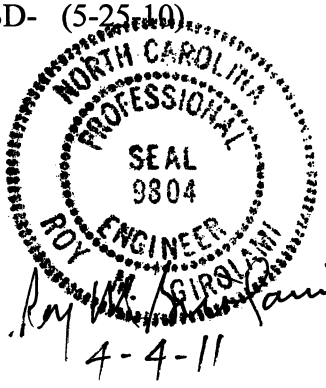

NORTH CAROLINA PROFESSIONAL SEAL 11915 ENGINEER JOHN C. ERVE

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4-4-11

PROJECT SPECIAL PROVISIONS
STRUCTURES AND CULVERTS

PROJECT U-2519DA **CUMBERLAND COUNTY**

MAINTENANCE AND PROTECTION OF TRAFFIC BENEATH PROPOSED STRUCTURE AT STATION 28+66.746-COL2- **(8-13-04)**

1.0 GENERAL

Maintain traffic on All American Freeway as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 5.4m at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch (13mm).

4.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

MAINTENANCE AND PROTECTION OF TRAFFIC BENEATH PROPOSED STRUCTURE AT STATION 19+34.958-Y- (LT & RT) (8-13-04)

1.0 GENERAL

Maintain traffic on –TT3- as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 5.0m at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch (13mm).

4.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

MAINTENANCE AND PROTECTION OF TRAFFIC BENEATH PROPOSED STRUCTURE AT STATION 12+10.929-LP1B- & 14+60.500-RP1A- (8-13-04)

1.0 GENERAL

Maintain traffic on –TT1- & -TT3- as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 5.0m at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch (13mm).

4.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

MAINTENANCE AND PROTECTION OF TRAFFIC BENEATH PROPOSED STRUCTURE AT STATION 28+72.626-RP1BD- (8-13-04)

1.0 GENERAL

Maintain traffic on All American Freeway as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 5.46m at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch (13mm).

4.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

MAINTENANCE AND PROTECTION OF TRAFFIC BENEATH PROPOSED STRUCTURE AT STATION 41+33.963 –RP1BD- (8-13-04)

1.0 GENERAL

Maintain traffic on Bragg Boulevard as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 5.0m at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch (13mm).

4.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

POT BEARINGS (6-07-05)

1.0 GENERAL

This item consists of furnishing, fabrication and installation of pot bearings in accordance with AASHTO Standard Specifications, the Standard Specifications, the recommendations of the manufacturer and the details shown on the plans and as specified herein.

Fixed pot bearings consist of a sole plate, a disc of elastomer in a steel cylinder with a snug fitting steel piston, masonry plate, anchor bolts, nuts and washers. Expansion pot bearings consist of a sole plate, a top steel plate with a polished stainless steel sheet facing bearing on a fixed pot bearing with a layer of virgin polytetraflouroethylene (PTFE) material on its top, masonry plate, anchor bolt assembly which includes anchor bolts, nuts, washers, pipe sleeves, a closure plate, grout and various sizes of standard pipe and any other necessary material as detailed on the plans.

2.0 MATERIALS

Use pot bearings produced by the same manufacturer.

Use AASHTO M270 Grade 50W (345W) for all steel in the pot bearings. Clean, coat, and seal the plates in the pot bearing assemblies except for the areas with special facings and the internal surfaces of pot, in accordance with the Special Provision for "Thermal Sprayed Coatings (Metallization)". Metallization of the internal surfaces of the pot is permitted provided these surfaces are then polished to a surface smoother than 63 micro inches (0.0016 mm) root mean square. Coat surfaces to a thickness of 8 mils (0.200 mm) minimum on all external parts. Repair surfaces that are abraded or damaged after the application of metallizing in accordance with the Special Provision for "Thermal Sprayed Coatings (Metallization)".

Galvanize all fill plates specified on the plans. Provide anchor bolts and nuts in accordance with the Standard Specifications.

When the maximum plan dimension of the sheet is 12" (300 mm) or less, provide a stainless steel sheet in expansion pot bearings that is at least 16 gage or 1/16" (1.6 mm). When the maximum plan dimension is greater than 12" (300 mm), provide a stainless steel sheet that is at least 11 gage or 1/8" (3 mm). Ensure that all stainless steel sheets are in conformance with ASTM A240/A167 Type 304 and polished to a minimum #8 mirror surface finish.

Blast clean the surface of the plate that will be attached to the stainless sheet to a near white condition in accordance with the Standard Specifications. Position and clamp the back of the stainless sheet that is to be in contact with the steel plate on the steel plate. Apply the stainless steel to the blast cleaned surface of the steel plate as soon as possible after blasting and before any visible oxidation of the blast cleaned surface occurs. Weld the stainless sheet continuously around its perimeter using a tungsten inert gas, wire-fed welder.

For the PTFE sheet, used as a mating surface for the stainless sheet, provide an unfilled virgin PTFE Sheet (Recessed) or a glass-fiber filled PTFE sheet, resulting from skiving billets formed under hydraulic pressure and heat. Provide resin that conforms to the requirements of ASTM D4894 or D4895.

To bond the PTFE and the piston, use heat cured high temperature epoxy capable of withstanding temperature of -320°F to 500°F (-195°C to 260°C).

Provide a neoprene or natural rubber elastomer with a durometer hardness of 50 that allows for a minimum rotation of 0.02 radians. Place a 1/64" (0.4 mm) thick unfilled PTFE disc on either side of the elastomer inside the bearing. Use a brass sealing ring with the neoprene or natural rubber elastomer.

3.0 DESIGN

Have the manufacturer design the pot bearings for the loads and movements shown on the contract plans. However, use the anchor bolt size, length, spacing and masonry plate

thickness as shown on the contract plans and provide an overall height of the bearing assembly that is at least the height shown on the contract plans, but no more than 1/2 inch (13 mm) greater than this height. Either combine, cast as a single piece, or weld together the sole plate and top plate/piston and the cylinder with the masonry plate.

When designing the bearings, use the following allowable bearing stresses:

- On confined elastomer: 3500 psi (24.1 MPa)
- On PTFE Sliding Surface, filled or unfilled PTFE (recessed): 3500 psi (24.1 MPa)

Submit eight sets of shop drawings and one set of design calculations for review, comments and acceptance. Have a North Carolina Registered Professional Engineer check and seal the shop drawings and design calculations.

After the Engineer reviews the drawings and, if necessary, corrections are made, submit one 22" x 34" reproducible set of the working drawings.

4.0 SAMPLING AND TESTING

A. Sampling

The manufacturer is responsible for randomly selecting and testing sample bearings from completed lots of bearings. The manufacturer is also responsible for certifying that the completed bearings and their components have been tested and are in compliance with the requirements of this Special Provision. Have the manufacturer furnish the results of the tests to the Materials and Tests Engineer.

B. Testing

1. Proof Load Test

   Load a test bearing to 150% of the bearing's rated design capacity and simultaneously subject it to a rotational range of 0.02 radians (1.146°) for a period of 1 hour.

   Have the bearing visually examined both during the test and upon disassembly after the test. Any resultant visual defects, such as extruded or deformed elastomer or PTFE, damaged seals or rings, or cracked steel is cause for rejection.

   Keep the steel bearing plate and steel piston in continuous and uniform contact for the duration of the test. Any observed lift-off is cause for rejection.

2. Sliding Coefficient of Friction

   For all guided and non-guided expansion type bearings, measure the sliding coefficient of friction at the bearing's design capacity in accordance with the test method described below, and on the fifth and fiftieth cycles, at a sliding speed of 1 in/min (25 mm/min).

Calculate the sliding coefficient of friction as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's vertical design capacity.

The test results are evaluated as follows:

- A maximum measured sliding coefficients of friction of 3%.
- A visual examination both during and after the test. Any resultant visual defects, such as bond failure, physical destruction, cold flow of PTFE to the point of debonding, or damaged components is cause for rejection of the lot.

Using undamaged test bearings in the work is permitted.

3. Test Method

For the test method and equipment, meet the following requirements:

a. Arrange the test to determine the coefficient of friction on the first movement of the manufactured bearing.

b. Clean the bearing surface prior to testing.

c. Conduct the test at maximum working stress for the PTFE surface with the test load applied continuously for 12 hours prior to measuring friction.

d. Determine the first movement static and dynamic coefficient of friction of the test bearing at a sliding speed of less than 1 in/min (25 mm/min), not to exceed:

0.04	unfilled PTFE
0.08	filled PTFE

e. Subject the bearing specimen to 100 movements of at least 1 inch (25 mm) of relative movement and, if the test facility permits, the full design movement at a speed of less than 1 ft/min (300 mm/min). Following this test determine the static and kinetic coefficient of friction again. The specimen is considered a failure if it exceeds the values measured in (d) above or if it shows any signs of bond failure or other defects.

Bearings represented by test specimens passing the above requirements are approved for use in the structure subject to on-site inspection for visible defects.

5.0 INSTALLATION

Prior to shipment, seal the joint between the steel piston and the steel cylinder with a bead of caulk. Store pot bearings delivered to the bridge site under cover on a platform above the ground surface. Protect the bearings from injury at all times and, before placing the bearings, dry and clean all dirt, oil, grease or other foreign substances from the bearing. Do not disassemble the bearings during installation, except at the manufacturer's direction.

Place the bearings in accordance with the recommendations of the manufacturer, Contract Drawings, and as directed by the Engineer. If there is any discrepancy between the recommendations of the manufacturer, Special Provisions, and Contract Drawings, the Engineer is the sole judge in reconciling any such discrepancy.

Provide preformed bearing pads under the masonry plates in accordance with Article 1079-1 of the Standard Specifications.

Do not install any bearing before the Engineer approves it.

6.0 BASIS OF PAYMENT

Payment will be at the lump sum contract price bid for "Pot Bearings" which price will be full compensation for furnishing all labor, materials, tools, equipment and incidentals required to complete the work in accordance with the Standard Specifications, this Special Provision, the manufacturer's requirements and as directed by the Engineer.

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.

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

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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).

MODULAR EXPANSION JOINT SEALS (6-07-05)

1.0 GENERAL

Furnish and install modular expansion joint seals within the limits indicated on the plans.

Obtain modular expansion joint seals from Fabricators that are AISC certified in Category I.

Use a modular expansion joint seal that is a waterproof system such as WABOMODULAR as manufactured by Watson Bowman and Acme Corporation of Amherst New York, BROWN/MAURER as manufactured by the D. S. Brown Company of North Baltimore, Ohio or an approved equal. Do not use aluminum components in the modular expansion joint. Use a modular expansion joint seal consisting of three or more transverse rails holding two or more elastomeric seals in place and a support mechanism that ensures the rails maintain parallel and equidistant spacing. Do not use bolts to connect the rails to the support mechanism.

Provide an elastomeric component for each modular expansion joint seal that is one continuous unit for the entire length of the joint. Do not field splice the elastomeric component. Only vulcanized shop splicing of the elastomeric component is permitted. Provide an elastomeric component that is clearly shop marked to indicate the top side and joint location of the elastomeric component. On skewed bridges, or under unsymmetrical conditions, clearly mark the left side of the elastomeric component also. Left is defined as being on the left when facing in the direction of increasing station. Inspect the seals upon receipt to ensure that the marks are clearly visible upon installation.

Provide modular expansion joint seals capable of handling a total movement measured parallel to the centerline of the roadway as shown on plans. Limit clear distance between centerbeams, and edgebeams and centerbeams, to 3 ½" (90 mm). Limit centerbeam spans to approximately 48" (1220 mm).

2.0 DRAWING AND SPECIFICATION SUBMITTAL

Submit Shop Drawings for Fabrication and Installation Procedure and Revised Contract Plan Sheets, showing revised details of the Structure contract plans.

A. Shop Fabrication and Installation Procedure Drawings

The deck slab is detailed in the contract plans with a required full depth transverse construction joint separating the main slab pour from the blockout area for the modular joint assembly. Position the modular joint assembly in the blockout area only after the main slab pours adjacent to the blockout area have been made and the girder rotation, deflection, and longitudinal movement due to slab pours have occurred.

Detail the method of positioning and securing the modular assembly in the blockout prior to the closure pour on the working drawings.

Submit two complete sets of working drawings for review. Submit these drawings well in advance of the scheduled installation time for the modular expansion joint seals. Include material requirements and installation procedures and specifications in the drawings.

After the drawings have been reviewed and, if necessary, corrections have been made, submit nine additional sets of the working drawings.

B. Revised Contract Plan Sheets

Concurrent with the submission of the working drawings, submit two sets of revised Structure plans for review. In the revised plans, include necessary changes in dimensions, reinforcing steel, and concrete blockouts to accommodate modular expansion joint seals. Have a North Carolina Registered Professional Engineer prepare and seal the revised plans. No adjustment will be made in the contract price for any bid item due to revisions necessary to accommodate the modular expansion joint seals. This cost is included in the lump sum price bid for furnishing and installing the modular expansion joint seal.

After the revised plans have been reviewed and, if necessary, corrections have been made, submit one 22" x 34" reproducible set of revised structure contract plans.

3.0 FABRICATION AND INSTALLATION

Protect the components of the modular expansion joint seal in the following manner. Upon completion of any shop fabrication, commercially blast clean (SP-6) all steel components, excluding stainless steel parts. Metallize to a minimum thickness of 8 mils (0.200 mm) on these surfaces. Metallize in accordance with the Special Provision for "Thermal Sprayed Coatings (Metallization)". Repair abraded or damaged coated surfaces anytime after applying the coating as specified for repair of galvanizing in the Standard Specifications. As an alternative to Metallizing, galvanizing in accordance with the Standard Specifications is permitted.

Install the modular expansion joint seals according to the procedures and recommendations of the manufacturer, except as amended in the next paragraph.

Limit modular expansion joint seal splices to crown points, abrupt changes in deck slab cross slope, lane lines, or as necessary for proper installation and alignment. All splice locations and details must be shown on the submitted working drawings and are subject to the Engineer's approval. For shop splices, full penetration welds are required for centerbeam splices. For shop splices, partial penetration welds are not allowed for centerbeam splices, except at barrier rail upturns or sidewalk upturns. For field splices, partial penetration welds are not allowed for centerbeam splices. Show and submit for approval all splice locations on the working drawings. For location of lane markings at the modular expansion joint seals, see the Structure plans.

When indicated on the plans, provide special snowplow protection, such as a snowplow blade guide or steel ribs, to prevent the blade from entering the joint recess.

If the Engineer deems any aspects of the modular expansion joint seals unacceptable, make necessary corrections.

Watertight Integrity Test

- Upon completion of each modular expansion joint seal, perform a water test on the top surface to detect any leakage. Cover the roadway section of the joint from curb to curb, or barrier rail to barrier rail, with water, either ponded or flowing, not less than 1 inch (25 mm) above the roadway surface at all points. Block sidewalk sections and secure an unnozzled water hose delivering approximately 1 gallon (3.8 liters) of water per minute to the inside face of the bridge railing, trained in a downward position about 6 inches (150 mm) above the sidewalk, such that there is continuous flow of water across the sidewalk and down the curb face of the joint.
- Maintain the ponding or flowing of water on the roadway and continuous flow across sidewalks and curbs for a period of 5 hours. At the conclusion of the test, the underside of the joint is closely examined for leakage. The modular expansion joint seal is considered watertight if no obvious wetness is visible on the Engineer's finger after touching a number of underdeck areas. Damp concrete that does not impart wetness to the finger is not considered a sign of leakage.
- If the joint system leaks, locate the place(s) of leakage and take any repair measures necessary to stop the leakage at no additional cost to the Department. Use repair measures recommended by the manufacturer and approved by the Engineer prior to beginning corrective work.
- If measures to eliminate leakage are taken, perform a subsequent water integrity test subject to the same conditions as the original test. Subsequent tests carry the same responsibility as the original test and are performed at no additional cost to the Department.

4.0 BASIS OF PAYMENT

Basis of payment for all modular expansion joint seals will be at the lump sum contract price for "Modular Expansion Joint Seals" which price and payment will be full compensation for furnishing all material, including steel accessory plates for sidewalks, medians and rails, labor, tools, and incidentals necessary for installing the modular expansion joint seals in place and including all materials, labor, tools and incidentals for performing the original watertight integrity test.

EXPANSION JOINT SEALS (10-12-01)

1.0 GENERAL

The work covered by this Special Provision consists of furnishing and installing the expansion joint seals as shown on the contract drawings. All materials, labor, equipment and incidentals necessary for the proper installation of the expansion joint seals are included.

2.0 MATERIAL

Provide expansion joint seals capable of accommodating a total movement measured parallel to the centerline of the roadway as shown on plans.

Provide an elastomeric component for each expansion joint seal that is a continuous unit for the entire length of the joint. Do not field splice the elastomeric component. Only vulcanized shop splicing of the elastomeric component is permitted. The minimum length of an elastomeric component before shop splicing is 20 feet (6.1 m). However, one piece shorter than 20 feet (6.1 m) is permitted. Provide an elastomeric component that is clearly shop marked to indicate the top side and joint location of the elastomeric component. On skewed bridges, or under unsymmetrical conditions, clearly mark the left side of the elastomeric component also. Left is defined as being on the left when facing in the direction of increasing station. Inspect the seals upon receipt to ensure that the marks are clearly visible upon installation.

Make sure the convolution of the gland does not project above the top of the hold-down plates when the joint opening is in the most compressed condition. Use either elastic polychloroprene (neoprene) or ethyl propylene diene monomer (EPDM) for the elastomer that meets the following minimum properties:

	ASTM TEST METHOD	REQUIREMENTS
Hardness, Durometer - Shore A	D2240	60 ± 5, Neoprene (upward corrugated shape - fabric reinforced) 75 ± 5, EPDM and Neoprene (upward non-corrugated shape) 80 ± 5, EPDM (upward corrugated shape-fabric reinforced)
Tensile Strength	D412	2000 psi (13.8 MPa), min.
Elongation at Break	D412	250% min.
Width of Gland in Relaxed Condition	N/A	10" ± 0.25" (254 mm ± 6 mm)

	ASTM TEST METHOD	REQUIREMENTS
Thickness of Upturned portion of gland	N/A	0.25" (6 mm) non-corrugated shape, -0.032" to +0.032" (-0.8 mm to +0.8 mm)
Thickness of Upturned portion of gland	N/A	0.1875" (5 mm) corrugated shape, -0.032" to +0.032" (-0.8 mm to +0.8 mm)
Thickness of Flat portion of gland	N/A	0.1563" (4 mm), -0.032" to +0.032" (-0.8 mm to +0.8 mm)

For fabric reinforced glands, submit one unreinforced sample per lot number, up to 500 feet (152.4 m) of Expansion Joint Seal, to the Engineer for testing.

Only field splice hold-down plates at crown points, at abrupt changes in the deck slab cross slope, and on lane lines. Splicing within travel lanes is not permitted and splicing on edge lines is not required. Field splice hold-down plates between the edge line and gutter upturn and where necessary for proper installation and alignment is permitted. Show all splice locations on the working drawings for approval. For the location of lane markings at the expansion joint seal, see the Structure plans. At the splice locations, locate the hold-down bolts 3 inches (76 mm) from the end of the hold-down plate. At splice locations where changes in deck slab cross slope occur, cut the ends of hold-down plates parallel to the bridge centerline for skews less than 80° and greater than 100°.

Do not use welded shop splices in hold-down plates.

3.0 SHOP DRAWINGS

Submit nine sets of working drawings to the Engineer for review, comments and acceptance. Show complete details drawn to scale and include:

- The proposed template details including the makeup of the template
- The proposed method of holding the base angle assembly in place while concrete is cast around it
- The proposed procedure to correct for the effects of beam movement and rotation when setting width of joint opening
- The proposed chronology of installation including the sequence and direction of the concrete casting

- The details of cross connectors between base angles, such as steel bars with slots bolted to angles, to maintain evenness between the adjacent base angles while accommodating movement that occurs when concrete is cast. Indicate when bolts are loosened to allow movement.
- The proposed method for removing the hold-down plate
- A section detail through the joint showing horizontal offset dimensions of the base angles from the centerline joint. This detail is required when the vertical face of the joint opening is not perpendicular to the roadway surface (e.g. when the roadway grade is significant).

Have someone other than the one who prepares the drawing check all detailed drawings and include the signatures of both the drafter and checker on each sheet of the drawings. The Engineer returns unchecked drawings to the Contractor. Provide all completed drawings well in advance of the scheduled installation time for the expansion joint seal.

4.0 INSTALLATION

Provide supports for the base angle assembly at a maximum spacing of 9 feet (2.75 m). Place supports near field splices of base angles to ensure that field splices are straight and even. Provide base angles with ½" (13 mm) diameter weep holes at 12 inch (305 mm) centers to allow bleeding of trapped air and/or water. Do not obstruct the weep holes with falsework. Make the bottom of the trough parallel to grade and the sides parallel to the sides of the expansion joint seal.

For damaged areas, depressions, spalls, cracks, or irregularities of curbs or decks adjacent to the expansion joint, submit a proposed method of repair and repair material specifications for approval.

If the Engineer deems any aspects of the expansion joint seals unacceptable, make necessary corrections.

5.0 INSPECTION

When concrete is cast, use a non-aluminum, 10 foot (3 m), true to line straight edge to check and grade the top of the slab on each side of the joint to ensure smooth transition between spans.

Watertight Integrity Test

- Upon completion of an expansion joint seal, perform a water test on the top surface to detect any leakage. Cover the roadway section of the joint from curb to curb, or barrier rail to barrier rail, with water, either ponded or flowing, not less than 1 inch (25 mm) above the roadway surface at all points. Block sidewalk sections and secure an unnozzled water hose delivering approximately 1 gallon (3.8 liters) of water per minute to the inside face of the bridge railing, trained in a downward position about 6 inches (150 mm) above the sidewalks, such that there is continuous flow of water across the sidewalk and down the curb face of the joint.

- Maintain the ponding or flowing of water on the roadway and continuous flow across sidewalks and curbs for a period of 5 hours. At the conclusion of the test, the underside of the joint is closely examined for leakage. The expansion joint seal is considered watertight if no obvious wetness is visible on the Engineer's finger after touching a number of underdeck areas. Damp concrete that does not impart wetness to the finger is not a sign of leakage.
- If the joint system leaks, locate the place(s) of leakage and take any repair measures necessary to stop the leakage at no additional cost to the Department. Use repair measures recommended by the manufacturer and approved by the Engineer prior to beginning corrective work.
- If measures to eliminate leakage are taken, perform a subsequent water integrity test subject to the same conditions as the original test. Subsequent tests carry the same responsibility as the original test and are performed at no extra cost to the Department.

6.0 BASIS OF PAYMENT

Basis of payment for all expansion joint seals will be at the lump sum contract price for "Expansion Joint Seals" which price and payment will be full compensation for furnishing all material, including any steel accessory plates for sidewalks, medians and rails, labor, tools, and incidentals necessary for installing the expansion joint seal in place and including all materials, labor, tools and incidentals for performing the original watertight integrity test.

EVAZOTE JOINT SEALS (11-5-10)

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 resilient, UV stable, preformed, impermeable, flexible, expansion joint seal. The joint seal shall consist of low-density, closed cell, cross-linked polyethylene non-extrudable, foam. The joint seal shall contain no EVA (Ethylene Vinyl Acetate). Cell generation shall be achieved by being physically blown using nitrogen. No chemical blowing agents shall be used in the cell generation process.

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" (13 mm) apart along the bond surface running the length of the joint. Use seals with a depth that 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" (6 mm). Provide a seal that has a working range of 30% tension and 60% compression and meets the requirements given below.

TEST	TEST METHOD	REQUIREMENT
Tensile strength	ASTM D3575-08, Suffix T	110 – 130 psi (758 – 896 kpa)
Compression Set	ASTM D1056 Suffix B, 2 hr recovery	10% - 16%
Water Absorption	ASTM D3575	< 0.03 lb/ft^2 (< 0.001 kpa)
Elongation at Break	ASTM D3575	180% - 210%
Tear Strength	ASTM D624 (D3575-08, Suffix G)	14 – 20 pli
Density	ASTM D3575-08, Suffix W, Method A	1.8 – 2.2 lb/ft^3 (28.8 – 35.2 kg/m^3)
Toxicity	ISO-10993.5	Pass (not cytotoxic)

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

2.0 BONDING ADHESIVE

Use a two component, 100% solid, modified epoxy adhesive supplied by the joint seal manufacturer that meets the requirements given below.

TEST	TEST METHOD	REQUIREMENT
Tensile strength	ASTM D638	3000 psi (20.7 MPa) min.
Compressive strength	ASTM D695	7000 psi (48.3 MPa) min.
Hardness	Shore D Scale	75-85 psi (0.51-0.58 MPa)
Water Absorption	ASTM D570	0.25% by weight max.
Elongation to Break	ASTM D638	5% max.
Bond Strength	ASTM C882	2000 psi (13.8 MPa) min.

Use an adhesive that is workable to 40°F (4°C). When installing in ambient air or surface 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 seal.

3.0 ELASTOMERIC CONCRETE

The elastomeric concrete shall not be placed until the reinforced concrete deck slab has cured for seven full days and reached a minimum strength of 3000 psi (20.7 Mpa).

Prepare the concrete surface within 48 hours prior to placing the elastomeric concrete. Before placing the elastomeric concrete, all concrete surfaces shall be thoroughly cleaned and dry. Sandblast the concrete surface in the blockout and clear the surface of all loose debris. Do not place the elastomeric concrete until the surface preparation is completed and approved.

A manufacturer's representative shall be present when placing elastomeric concrete. Do not place elastomeric concrete if the ambient air or surface temperature is below 45°F (7°C).

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

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. Trowel the elastomeric concrete to a smooth finish.

4.0 SAWING THE JOINT

The joint opening shall be initially formed to the width shown on the plans including the blockout for the elastomeric concrete.

The elastomeric concrete shall cure 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 the joint opening.

The desired depth is the depth of the seal plus 1/4" (6 mm) above the top of the seal plus approximately 1" (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.

Saw cut a straight joint, centered over the formed opening and to the desired width specified in the plans. Prevent any chipping or damage to the sawed edges of the joint.

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

5.0 PREPARATION OF SAWED JOINT FOR SEAL INSTALLATION

After sawing the joint, the Engineer will thoroughly inspect the sawed joint opening for spalls, popouts, cracks, etc. All necessary repairs will be made by the Contractor prior to blast cleaning and installing the seal.

Clean the joints by sandblasting with clean dry sand immediately before placing the bonding agent. Sandblast the joint opening to provide a firm, clean joint surface free of curing compound, loose material and any foreign matter. Sandblast the joint opening 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 is used to clean the joint opening, 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.

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 or surface temperature is below 45°F (7°C). Have a manufacturer's certified trained factory representative present during the installation of the first seal of the project.

Before installing the joint seal, check the uninstalled seal length to insure the seal is the same length as the deck opening. When the joint seal requires splicing, use the heat welding method by placing the joint material ends against a teflon heating iron of 425-475°F (218-246°C) for 7 - 10 seconds, then pressing the ends together tightly. Do not test the welding until the material has completely cooled.

Begin installation by protecting the top edges of the concrete deck adjacent to the vertical walls of the joint as a means to minimize clean up. After opening both cans of the bonding agent, stir each can using separate stirring rods for each component to prevent premature curing of the bonding agent. Pour the two components, at the specified mixing ratio, into a clean mixing bucket. Mix the components with a low speed drill (400 rpm max.) until a uniform gray color is achieved without visible marbling. Apply bonding agent to both sides of the elastomeric concrete as well as both sides of the joint seal, making certain to

completely fill the grooves with epoxy. With gloved hands, compress the joint seal and with the help of a blunt probe, push the seal into the joint opening until the seal is recessed approximately 1/4" (6 mm) below the surface. When pushing down on the joint seal, apply pressure only in a downward direction. Do not push the joint seal into the joint opening at an angle that would stretch the material. Seals that are stretched during installation shall be removed and rejected. Once work on placing a seal begins, do not stop until it is completed. Clean the excess epoxy from the top of the joint seal immediately with a trowel. Do not use solvents or any cleaners to remove the excess epoxy from the top of the seal. Remove the protective cover at the joint edges and check for any excess epoxy on the surface. Remove excess epoxy with a trowel, the use of solvents or any cleaners will not be allowed.

The installed system shall be watertight and will be monitored until final inspection and approval.

7.0 BASIS OF PAYMENT

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

ELASTOMERIC CONCRETE (1-27-10)

1.0 DESCRIPTION

Elastomeric concrete is a mixture of a two-part polymer consisting of polyurethane and/or epoxy and kiln-dried aggregate. Provide an elastomeric concrete and binder system that is preapproved. 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 (or at the end of the specified curing time).

ELASTOMERIC CONCRETE PROPERTIES	TEST METHOD	MINIMUM REQUIREMENT
Compressive Strength, psi (MPa)	*(a) STM D695*	2000 (13.8)
5% Deflection Resilience	ASTM D695	95
Splitting Tensile Strength	ASTM D3967	625 (4.31)
Bond Strength to Concrete, psi (MPa)	ASTM D882 (D882M)	450 (3.10)
Durometer Hardness	ASTM D2240	50

BINDER PROPERTIES (without aggregate)	TEST METHOD	MINIMUM REQUIREMENT
Tensile Strength, psi (MPa)	ASTM D638	1000 (6.89)
Ultimate Elongation	ASTM D638	150%
Tear Resistance, lb/in (kN/m)	ASTM D624	200 (34.9)

In addition to the requirements above, the elastomeric concrete must be resistant to water, chemical, UV and ozone exposure and withstand temperature extremes. Elastomeric concrete systems requiring preheated aggregates are not allowed.

3.0 PREQUALIFICATION

Manufacturers of elastomeric concrete materials shall submit samples (including aggregate, primer and binder materials) and a Type 4 certification in accordance with article 106-3 (F) of the Standard Specifications for prequalification to:

North Carolina Department of Transportation
Materials and Tests Unit
1801 Blue Ridge Road
Raleigh, NC 27607

Prequalification will be determined for the system. Individual components will not be evaluated, nor will individual components of previously evaluated systems be deemed prequalified for use.

The submitted binder (a minimum volume of 1 gallon (3.8 liters)) and corresponding aggregate samples will be evaluated for compliance with the Materials requirements specified above. Systems satisfying all of the Materials requirements will be prequalified for a one year period. Before the end of this period new product samples shall be resubmitted for prequalification evaluation.

If, at any time, any formulation or component modifications are made to a prequalified system that system will no longer be approved for use.

4.0 MATERIAL CERTIFICATION AND INSTALLATION

Provide a Type 5 certification in accordance with article 106-3 (F) of the Standard Specifications, verifying that the materials satisfy the above requirements and proof of NCDOT prequalification.

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.

Provide a manufacturer's representative at the bridge site during the installation of the elastomeric concrete to ensure that all steps being performed comply with all manufacturer installation requirements including, but not limited to weather conditions (ambient temperature, relative humidity, precipitation, wind, etc), concrete deck surface preparation, binder and aggregate mixing, primer application, elastomeric concrete placement, curing conditions and minimum curing time before joint exposure to traffic.

5.0 FIELD SAMPLING

Provide additional production material to allow freshly mixed elastomeric concrete to be sampled for acceptance. A minimum of six 2 inch (51 mm) cube molds and three 3x6 inch (76 mm x 152 mm) cylinders will be taken by the Department for each day's production. Compression, splitting tensile, and durometer hardness testing will be performed by the

Department to determine acceptance. Materials failing to meet the requirements listed above are subject to removal and replacement at no cost to the Department.

6.0 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.

FALSEWORK AND FORMWORK (8-4-09)

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.

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.

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 or metalize these devices. Electroplating will not be allowed. 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.

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 (1-27-10)

1.0 GENERAL

Submit working drawings in accordance with Article 105-2 of the *Standard Specifications* and this provision. For 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 the project. Submittals are only necessary for those items as required by the contract. Make submittals that are not specifically noted in this 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.

Submittals may also be made via email.

Send submittals to:

plambert@ncdot.gov (Paul Lambert)

Send an additional e-copy of the submittal to the following address:

jgaither@ncdot.gov (James Gaither)

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

The status of the review of structure-related submittals sent to the Structure Design Unit can be viewed from the Unit's web site, via the "Contractor Submittal" link.

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@ncdot.gov

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@ncdot.gov

Western Regional Geotechnical Contact (Divisions 8-14):
John Pilipchuk
(704) 455 – 8902
(704) 455 – 8912 facsimile
jpilipchuk@ncdot.gov

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 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 Provisions

Pile Splicers	7	2	Subarticle 450-7(C) & "Piles"
Pile Points	7	2	Subarticle 450-7(D) & "Piles"
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 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 ____"
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 provision by that name. Articles and 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 & 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 provision.
7. Submittals are necessary only when the top slab thickness is 18" or greater.

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GEOTECHNICAL SUBMITTALS

Submittal [1]	Copies Required by Geotechnical Engineering Unit	Copies Required by Structure Design Unit	Contract Reference Requiring Submittal [2]
Crosshole Sonic Logging (CSL) Reports	1	0	"Crosshole Sonic Logging"
Drilled Pier Construction Sequence Plans	1	0	"Drilled Piers"
Pile Driving Analyzer (PDA) Reports	2	0	"Pile Driving Analyzer"
Pile Driving Equipment Data [3]	1	0	Article 450-5 & "Piles"
Retaining Walls	8	2	Applicable Provisions
Contractor Designed Shoring	7	2	"Temporary Shoring", "Anchored Temporary Shoring" & "Temporary Soil Nail Walls"

FOOTNOTES

1. With the exception of "Pile Driving Equipment Data", electronic copies of geotechnical submittals are required. See referenced provision.

2. References are provided to help locate the part of the contract where the submittals are required. References in quotes refer to the provision by that name. Articles refer to the *Standard Specifications*.

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.

CONSTRUCTION, MAINTENANCE AND REMOVAL OF TEMPORARY ACCESS AT STATION 14+60.500-RP1A, 28+66.746-COL2-, 28+72.626-RP1BD (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 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 feet (6.1 m). 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 BASIS OF PAYMENT

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

OPTIONAL DISC BEARINGS (6-07-05)

1.0 GENERAL

This item consists of furnishing, fabrication and installation of disc bearings in accordance with AASHTO Standard Specifications, the Standard Specifications, the recommendations of the manufacturer and as specified herein. In addition, all plan notes pertaining to furnishing and installing pot bearing assemblies shall also apply to disc bearing assemblies, except as noted herein.

Disc Bearings consist of a polyether urethane structural element (disc) confined by upper and lower steel bearing plates. Equip disc bearings with a shear restriction mechanism to prevent movement of the disc. Supply disc bearings as fixed bearings and guided expansion bearings as designated by the Contract Documents.

Fixed disc bearings allow rotation but no longitudinal or transverse movement in the bearing plane. Fixed bearings consist of a sole plate, an elastomer disc, upper bearing plate, lower bearing plate, masonry plate, anchor bolts, nuts and washers.

Guided expansion disc bearings allow rotation and only longitudinal movement in the bearing plane. Guided expansion disc bearings consist of a sole plate, a top steel plate with a polished stainless steel sheet facing bearing on a fixed disc bearing with a layer of virgin polytetraflouroethylene (PTFE) material on its top, masonry plate, anchor bolt assembly which includes anchor bolts, nuts, washers, pipe sleeves, a closure plate, grout and various sizes of standard pipe and any other necessary material as detailed on the plans. To allow longitudinal movement, bond a polytetraflouroethylene (PTFE) sheet to the upper steel bearing plate. Support a sliding steel top bearing plate with the upper steel bearing plate. Face the mating surface of the sliding steel top bearing plate with polished stainless steel. Use either a guide bar or keyway system to restrict transverse movement. Face the sliding surfaces of the guide bar or keyway systems with either PTFE sheets or stainless steel.

2.0 MATERIALS

Use disc bearings produced by the same manufacturer.

Use AASHTO M270 Grade 50W (345W) for all steel in the disc bearings. Clean, coat, and seal the plates in the disc bearing assemblies except for the areas with special facings and the areas that come in contact with the elastomer disc, in accordance with the Special Provision for "Thermal Sprayed Coatings (Metallization)". Coat surfaces to a thickness of 8 mils (0.200 mm) minimum on all external parts. Repair surfaces that are abraded or damaged after the application of metallizing in accordance with the Special Provision for "Thermal Sprayed Coatings (Metallization)".

Provide anchor bolts and nuts in accordance with the Standard Specifications.

When the maximum plan dimension of the sheet is 12" (300 mm) or less, provide a stainless steel sheet in expansion disc bearings that is at least 16 gage or 1/16" (1.6 mm). When the maximum plan dimension is greater than 12" (300 mm), provide a stainless steel sheet that is at least 11 gage or 1/8" (3 mm). Ensure that all stainless steel sheets are in conformance with ASTM A167/A240 Type 304 and polished to a minimum #8 mirror surface finish.

Blast clean the surface of the plate that will be attached to the stainless sheet to a near white condition in accordance with the Standard Specifications. Position and clamp the back of the stainless sheet that is to be in contact with the steel plate on the steel plate. Apply the stainless steel to the blast cleaned surface of the steel plate as soon as possible after blasting and before any visible oxidation of the blast cleaned surface occurs. Weld the stainless sheet continuously around its perimeter using a tungsten inert gas, wire-fed welder.

For the PTFE sheet, used as a mating surface for the stainless sheet, provide an unfilled virgin PTFE Sheet (Recessed) or a glass-fiber filled PTFE sheet, resulting from skiving billets formed under hydraulic pressure and heat. Provide resin that conforms to the requirements of ASTM D4894 or D4895.

To bond the PTFE and the bearing plate, use heat cured high temperature epoxy capable of withstanding temperature of –320°F to 500°F (-195 °C to 260 °C).

Mold the polyether urethane structural element from a polyether urethane compound. Conform the physical properties of the polyether urethane to the following requirements:

Physical Property	ASTM Test Method	Requirements Min.	Max.
Hardness, Type D Durometer	D2240	60	64
Tensile Stress psi (Mpa) At 100% elongation At 200% elongation	D412	 2000 (13.8) 3700 (25.5)	 - - - -
Tensile Strength psi (Mpa)	D412	5000 (34.5)	- - - -
Ultimate Elongation %	D412	220	- - - -
Compression Set % 22 hrs. at 158°F (70°C)	D395	- - - -	40

3.0 DESIGN

Design the disc bearings for the loads and movements shown on the contract plans. However, use the anchor bolt size, length, spacing and masonry plate thickness as shown on the contract plans and provide an overall height of the bearing assembly that is at least the height shown on the contract plans, but no more than 1/2 inch (13 mm) greater than this height. Either combine and cast the sole plate and top plate/upper bearing plate and the lower bearing plate and masonry plate as a single unit or weld together prior to the installation of the disc.

When designing the bearings, use the following allowable bearing stresses:

- On polyether urethane structural element: 5000 psi (34.5 MPa)
- On PTFE Sliding Surface, filled or unfilled PTFE (recessed): 3500 psi (24.1 MPa)

Submit eight sets of shop drawings and one set of design calculations for review, comments and acceptance. Have a North Carolina Registered Professional Engineer check and seal the shop drawings and design calculations.

After the Engineer reviews the drawings and, if necessary, corrections are made, submit one 22" x 34" reproducible set of the working drawings.

4.0 SAMPLING AND TESTING

A. Sampling

The manufacturer is responsible for randomly selecting and testing sample bearings from completed lots of bearings. The manufacturer is also responsible for certifying that the completed bearings and their components have been tested and are in compliance with the requirements of this Special Provision. Have the manufacturer furnish the results of the tests to the Materials and Tests Engineer.

B. Testing

1. Proof Load Test

Load a test bearing to 150% of the bearing's rated design capacity and simultaneously subject it to a rotational range of 0.02 radians (1.146°) for a period of 1 hour.

Have the bearing visually examined both during the test and upon disassembly after the test. Any resultant visual defects, such as extruded or deformed elastomer or PTFE, damaged seals or rings, or cracked steel is cause for rejection.

Keep continuous and uniform contact between the polyether urethane element and the bearing plates and between the sliding steel top plate and the upper bearing plate for the duration of the test. Any observed lift-off is cause for rejection.

2. Sliding Coefficient of Friction

For all guided and non-guided expansion type bearings, measure the sliding coefficient of friction at the bearing's design capacity in accordance with the test method described below, and on the fifth and fiftieth cycles, at a sliding speed of 1 in/min (25 mm/min).

Calculate the sliding coefficient of friction as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's vertical design capacity.

The test results are evaluated as follows:

- A maximum measured sliding coefficient of friction of 3%.
- A visual examination both during and after the test. Any resultant visual defects, such as bond failure, physical destruction, cold flow of PTFE to the point of debonding, or damaged components is cause for rejection of the lot.

Using undamaged test bearings in the work is permitted.

3. Test Method

The test method and equipment shall meet the following requirements:

f. Arrange the test to determine the coefficient of friction on the first movement of the manufactured bearing.

g. Clean the bearing surface prior to testing.

h. Conduct the test at maximum working stress for the PTFE surface with the test load applied continuously for 12 hours prior to measuring friction.

i. Determine the first movement static and dynamic coefficient of friction of the test bearing at a sliding speed of less than 1 in/min (25 mm/min), not to exceed:

0.04 unfilled PTFE

0.08 filled PTFE

j. Subject the bearing specimen to 100 movements of at least 1 inch (25 mm) of relative movement and, if the test facility permits, the full design movement at a speed of less than 1 ft/min (300 mm/min). Following this test determine the static and kinetic coefficient of friction again. The specimen is considered a failure if it exceeds the values measured in (d) above or if it shows any signs of bond failure or other defects.

Bearings represented by test specimens passing the above requirements are approved for use in the structure subject to on-site inspection for visible defects.

5.0 INSTALLATION

Store disc bearings delivered to the bridge site under cover on a platform above the ground surface. Protect the bearings from injury at all times and, before placing the bearings, dry and clean all dirt, oil, grease or other foreign substances from the bearing. Do not disassemble the bearings during installation, except at the manufacturer's direction. Place the bearings in accordance with the recommendations of the manufacturer, Contract Drawings, and as directed by the Engineer. If there is any discrepancy between the recommendations of the manufacturer, Special Provisions, and Contract Drawings, the Engineer is the sole judge in reconciling any such discrepancy.

Provide preformed bearing pads under the masonry plates in accordance with Article 1079-1 of the Standard Specifications.

Do not install any bearing before the Engineer approves it.

6.0 BASIS OF PAYMENT

Payment for all optional disc bearings will be at the lump sum contract price bid for "Pot Bearings" which includes full compensation for furnishing all disc bearings, labor, materials, tools, equipment, testing and incidentals required to complete the work in accordance with the Standard Specifications, this Special Provision, the manufacturer's requirements and as directed by the Engineer.

BRIDGE DECK RIDEABILITY AND GROOVING AT STA. 68+72.626 -RP1BD- (5-25-10)

1.0 GENERAL

This Special Provision shall govern the testing, diamond grinding, transverse grooving and all other related work associated with obtaining satisfactory rideability and surface texture of the bridge deck surface. Provide a surface finish in accordance with Article 420-14(B) of the Standard Specifications.

2.0 TESTING REQUIREMENTS

Perform acceptance testing of the longitudinal profile of the finished bridge deck in each wheel path of each lane in the presence of the Engineer. It is the Contractor's responsibility to submit a proposed plan of action and schedule for profilograph testing. Use a certified independent provider, approved by the Engineer, to perform the profilograph test.

Prior to profilograph testing, placement of the bridge deck and barrier rail within the section to be tested shall be complete, with the exception of blockouts required for the installation of joints. Do not install joints until the Engineer determines that the rideability requirements herein have been met. Joint locations should be temporarily bridged sufficiently to facilitate operation of the profilograph and corrective equipment across the joint. Remove all obstructions from the bridge deck and sweep the surface clean of debris prior to testing. If automated profilograph equipment is used, there shall be no radio transmissions or other activities that might disrupt the automated profilograph equipment during the testing.

Ensure that the profilograph is in good operating condition per the manufacturer's recommendations. Maintain tires free of debris and buildup during each test run. Operate the profilograph at a maximum speed of 2 miles per hour (3.2 kph). If a propulsion vehicle is used, it shall be approved, and the gross vehicle weight shall not exceed 1,000 pounds.

At the beginning and end of each day's testing, and at other times determined to be necessary by the Engineer, operate the profilograph over a calibration strip so the Engineer can verify correct operation of the profilograph. The calibration strip shall be a 100 foot section of pavement that is reasonably level and smooth. Submit each day's calibration graphs with that day's test section graphs to the Engineer. Calibrate the profilograph in accordance with the current NCDOT procedure entitled "Determination of Profile Index". Copies of this procedure may be obtained from the NCDOT Construction Unit.

Plot each profilogram on a continuous graph at a horizontal scale of 25 feet per inch (0.3 m per mm) with the vertical scale plotted at a true scale. Station numbers shall be recorded on the profilogram at distances not to exceed 200 feet (61.0 m). Note joint locations on the profilogram.

Take profiles with the recording wheel in each wheel path of each lane. The wheel paths of a lane are considered parallel to and approximately 3.5 feet (1.1 m) inside both edges of the travel lane. Take profiles over the entire length of the travel lanes on the bridge deck including approach slabs. Upon completion of testing, submit the profilograms for each wheelpath to the Engineer for analysis. The Engineer will retain the profilograms.

The Engineer will determine the Profile Index for each wheel path in accordance with the procedure entitled "Determination of Profile Index".

A test section is defined as a 600 foot (182.9 m) length of each travel lane. The maximum allowable Profile Index per lane shall not exceed 25" per mile (395 mm per km) as determined with a 0.0" (0.0 mm) blanking band over any 600 foot (182.9 m) test section. The Contractor will correct individual deviations in excess of 0.3" over any 25 foot (7.6 mm in 7.6 m) length on the line tested by diamond grinding. Additionally, the entire deck surface shall meet a 0.125" in 10 feet (3 mm in 3 m) straightedge check made atop the deck either transversely or longitudinally as deemed necessary by the Engineer.

3.0 DIAMOND GRINDING

If the deck does not meet the testing requirements, diamond grinding is required to make corrections. Diamond grind the full width of all lanes and shoulders in the direction of travel.

When diamond grinding, use either a Boart Longyear PC 5000, a Target 3804 or an approved equal. Submit grinding equipment specifications to the Engineer for approval before any grinding is performed. Use a grinding machine capable of removing a minimum of 3 feet of width with each pass. Multiple passes may be needed to achieve the required depth of removal. In addition, hand grinding may be required to remove vertical steps between passes.

The ground surface shall consist of between 50 and 60 grooves per foot (305 mm) of width. The grooves shall be between 0.09" (2.3 mm) and 0.15" (3.8 mm) in width and 0.0625" (1.6 mm) in depth. The area between the grooves shall be between 0.06" (1.5 mm) and 0.13" (3.3 mm) in width. The final concrete texture shall be uniform.

Construct and operate the grinding machine such that it will not cause strain or damage to the deck surface, excessive ravels, aggregate fractures, spalls, or disturbance of transverse joints. Longitudinally grind the deck parallel to the roadway centerline.

Continuously remove all slurry or other debris resulting from the grinding operations by vacuum pick-up or other approved methods. Prevent the slurry from flowing into floor drains, onto the ground or into the body of water under the bridge. Dispose of all residues off the project.

In completing all corrective work on the deck surface to satisfy the rideability criteria stated herein, limit grinding such that the final reinforcement cover is not less than the plan cover minus ½" (12mm). In cases where this cannot be achieved, other corrective work may be required as directed by the Engineer.

Provide additional profilograph testing as necessary following grinding until the rideability requirements above are satisfied.

4.0 GROOVING BRIDGE FLOORS

After the concrete surface profile has been accepted by the Engineer, the concrete blockouts poured, and the joints installed, groove the bridge deck in accordance with Subarticle 420-14(B) of the Standard Specifications. If a substantial amount of bridge deck surface has been diamond ground and/or the concrete cover over the slab reinforcement has been reduced to the minimum, the Engineer may delete all or a portion of the requirement of grooving in that area. In this instance, no additional compensation shall be made for underruns in grooving.

5.0 BASIS OF PAYMENT

No separate payment will be made for profilograph testing or diamond grinding of the bridge deck. The cost of the testing procedure, equipment, grinding operation, and removal and disposal of slurry resulting from the grinding operation is considered incidental to the contract bid price for "Reinforced Concrete Deck Slab".

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.

PILE DRIVING ANALYZER (11-17-06)

1.0 GENERAL

This special provision governs driving piles with a pile dynamic analyzer (PDA) in accordance with the plans and as directed by the Engineer. The PDA test method is described in ASTM D4945, "Standard Test Method for High-Strain Dynamic Testing of Piles". Install piles in accordance with Section 450 of the Standard Specifications and this provision.

Submit the proposed pile driving methods and equipment (Pile Driving Equipment Data Form) in accordance with the Submittal of Working Drawings Special Provision and the Standard Specifications. The Engineer will respond with preliminary approval or rejection of the proposed pile driving methods and equipment within 10 calendar days. Preliminary approval is required before driving piles with a PDA. Notify the Engineer of the pile driving schedule a minimum of 14 calendar days in advance.

Either a PDA Consultant or the NCDOT Geotechnical Engineering Unit, as directed by the Engineer, shall perform PDA testing and analysis. If required, retain a PDA Consultant and submit experience documentation with the proposed pile driving methods and equipment.

The Engineer will determine the number of piles and which piles to be tested with the PDA based upon the subsurface conditions and the pile installation sequence and progress.

The Engineer will complete the review of the proposed pile driving methods and equipment and provide the required driving resistance within 10 calendar days after the Engineer receives the PDA report or the Geotechnical Engineering Unit completes the PDA testing.

A PDA report for PDA testing on multiple piles may be required as directed by the Engineer before the 10 day time period begins.

2.0 PREQUALIFICATION AND EXPERIENCE REQUIREMENTS

Use a PDA Consultant prequalified by the Contractual Services Unit of the Department for Pile Driving Analyzer work (work code 3060).

Submit documentation that the PDA Consultant has successfully completed at least 5 PDA 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. Also, submit documentation of experience with PDA manufactured by Pile Dynamics, Inc and the CAse Pile Wave Analysis Program (CAPWAP).

Provide a list of PDA Operators and the Project Engineer that will be assigned to this project. Submit documentation for each PDA Operator verifying employment with the PDA Consultant and a minimum of 1 year experience in collecting PDA data with past projects of scope and complexity similar to that anticipated for this project. Submit documentation for the Project Engineer verifying employment with the PDA Consultant, registration as professional engineer in North Carolina and a minimum of 5 years experience in PDA testing and analysis 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 PDA TESTING

Provide piles for PDA testing that are 5 ft (1.5 m) longer, or as directed by the Engineer, than the estimated pile lengths shown on the plans. Supply 110 V, 60 Hz, 30 Amp of AC electrical power to operate the PDA equipment. Direct current welders or non-constant power sources are unacceptable.

Provide a suitable shelter to protect the PDA equipment and operator from conditions of sun, water, wind and temperature. The shelter should have a minimum floor size of 6 ft x 6 ft (2 m x 2 m) and a minimum roof height of 8 ft (2.5 m). If necessary, heat or cool the shelter to maintain a temperature between 50 and 85 degrees F (10 and 30 degrees C). Place the shelter within 75 ft (23 m) of the pile such that the PDA cables reach the computer and the operator can clearly observe the pile. The Engineer may waive the shelter requirement if weather conditions allow.

Drill up to a total of 16 bolt holes in either 2 or 4 sides of the pile, as directed by the PDA Consultant or the Engineer, at an approximate distance equal to 3 times the pile diameter below the head of the pile. If the PDA Consultant or the Engineer choose to drill the bolt holes, provide the necessary equipment, tools and assistance to do so. A hammer drill is required for concrete piles and up to 2 hours may be required to drill the holes.

Lift, align and rotate the pile to be tested with the PDA as directed by the PDA Consultant or the Engineer. Place the pile in the leads and template so that the PDA instruments and their accompanying wires will not be damaged.

The PDA Consultant or the Engineer will furnish the PDA measuring instruments and materials for installing the instruments. Attach the PDA instruments as directed by the PDA Consultant or the Engineer after the pile is placed in the leads and the template.

4.0 PDA TESTING

Use only the preliminarily approved pile driving methods and equipment to drive piles with the PDA instruments attached. Drive the pile as directed by the PDA Operator or the Engineer in order to measure the wavespeed of the pile.

Drive the pile to the required bearing capacity and specified tip elevation, if applicable, as shown on the plans or as directed by the PDA Consultant or the Engineer. During pile driving, the PDA will be used to evaluate, including but not limited to, the following: hammer performance, bearing capacity, distribution of soil resistance, pile driving stresses, energy transfer, pile integrity and various soil parameters such as quake and damping.

The PDA Operator or the Engineer may require the Contractor to modify the pile installation procedure during driving as follows:

- Reduce the hammer energy
- Drive deeper or shallower because of variations in the subsurface conditions
- Readjust the transducers
- Realign the pile

The Contractor is responsible in terms of both actual expense and time delays for any damage to the PDA instruments and supporting equipment due to the Contractor's fault or negligence. Replace any damaged equipment at no additional cost to the Department.

5.0 REDRIVING PILES

When directed by the Engineer, reattach the PDA instruments and restrike or redrive the pile in accordance with Section 4.0 above and Subarticle 450-7(E) of the Standard Specifications. Obtain the required stroke and penetration (at least 6 in or 150 mm) or as directed by the PDA Operator or the Engineer. The PDA Operator or the Engineer will record dynamic measurements during restriking and redriving. The Engineer may require restriking and redriving more than once on the same pile. The Engineer will determine when PDA testing has been satisfactorily completed.

6.0 CAPWAP Analysis and PDA Report

The PDA Consultant shall perform analysis of the PDA raw data with the CAPWAP (version 2006 or later). At a minimum, analysis is required for a hammer blow near the end of initial drive and for each restrike and redrive. Additional CAPWAP analysis may be required as determined by the PDA Consultant or the Engineer.

Submit three hard copies and an electronic copy (pdf or jpeg format on CD or DVD) of a PDA report sealed by the Project Engineer within 7 calendar days after field testing is complete. The PDA report shall include but not be limited to the following:

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

B. Introduction

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

D. Pile Details
- Pile type and length
- Required bearing capacity and factor of safety
- Concrete compressive strength and/or steel pile yield strength
- Pile splice type and locations
- Pile batter
- Installation methods including use of jetting, preaugering, spudding, vibratory hammer, template, barge, etc.

E. Driving Details
- Hammer make, model and type
- Hammer and pile cushion type and thickness
- Pile helmet weight
- Hammer efficiency and operation data including fuel settings, bounce chamber pressure, blows per minute, equipment volume and pressure

- Ground or mud line elevation and template reference elevation at the time of driving
- Final pile tip elevation
- Driving resistance (ram stroke, blows per foot (0.3 meter) and set for last 10 hammer blows)
- Restrike and redrive information

F. PDA field work details

G. CAPWAP analysis results

- Table showing percent skin and tip, skin and toe damping, skin and toe quake and match quality

H. Summary/Conclusions

I. Attachments

- Boring log(s)
- Pile Driving Equipment Data Form (from Contractor)
- Field pile driving inspection data (from Engineer)
- Accelerometer and strain gauge locations
- Accelerometer and strain gauge serial numbers and calibration information
- PDA hardware model and CAPWAP software version information
- Electronic copy of all PDA raw data and executable CAPWAP input and output files (version 2006 format)

7.0 MEASUREMENT AND PAYMENT

The complete and accepted PDA testing will be paid for at the unit bid price for "PDA Testing" per each. Include in the unit bid price for "PDA Testing" all costs for providing the PDA, PDA instruments and materials for installing the instruments and recording the dynamic measurements the first time the pile is tested with the PDA. Costs for providing these items for the same pile after the pile is initially tested with the PDA will be considered incidental to the unit bid price for "Pile Redrives". Also include in the unit bid price for "PDA Testing" all costs for performing the CAPWAP analysis on data collected during initial drive, restrikes and redrives and preparing and submitting the PDA report. No payment for "PDA Testing" will be made if the PDA report submitted is incomplete as described in Section 6.0. No payment for "PDA Testing" will be made if the Department performs PDA testing. If the Department does not perform PDA testing, the number of "PDA Testing" per pile will be equal to one.

The complete and accepted PDA assistance will be paid for at the unit bid price for "PDA Assistance" per each. Include in the unit bid price for "PDA Assistance" all costs for PDA preparation and support including all materials, labor, tools, equipment, mobilization and incidentals necessary to complete the work described in this provision excluding the costs for the PDA testing described above. Costs for PDA preparation and support for restrikes and redrives will not be paid for separately. The number of "PDA Assistance" per pile will be equal to one for each pile tested with the PDA.

The cost of the pile and the installation including driving, restriking and redriving will be paid for separately in accordance with the Standard Specifications and will not be part of these PDA pay items.

SHIPPING STEEL STRUCTURAL MEMBERS **(7-18-06)**

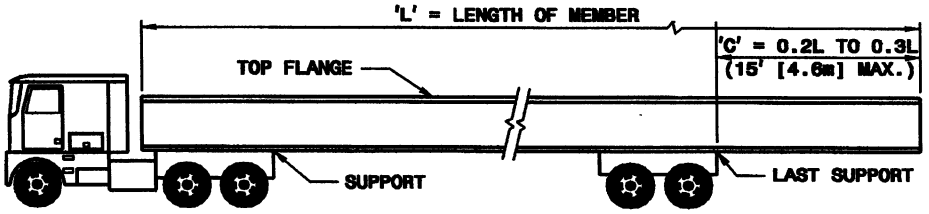
Section 1072-23 Marking and Shipping

Add the following paragraphs after the third paragraph of the Section.

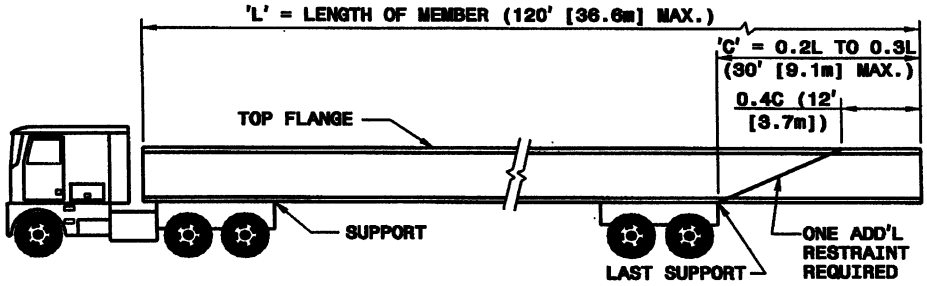
Load and ship steel beams and girders in accordance with the Figure below for all types of transportation.

Below is the sketches provided to Materials and Tests Unit on May 8, 1991. When the contractor wishes to place members on trucks not in accordance with these limits, to ship by rail, to attach shipping restraints to the members, to ship horizontally curved steel members, or to invert members, he shall submit a shipping plan prior to shipping. See also Article 1072-11.

LIMITS FOR PLACEMENT OF BEAMS AND GIRDERS DURING SHIPMENT



WHEN 'C' = 15' (4.6m) OR LESS



WHEN 'C' = OVER 15' (4.6m) THRU 30' (9.1m)

L	MIN. 'C'	MAX 'C'
75 (22.9m)	15 (4.6m)	22½ (6.9m)
80 (24.4m)	16 (4.9m)	24 (7.3m)
85 (25.9m)	17 (5.2m) 0.3L	25½ (7.8m)
90 (27.4m)	18 (5.5m)	27 (8.2m)
95 (29.0m) 0.2L	19 (5.8m)	28½ (8.7m)
100 (30.5m)	20 (6.1m)	30 (9.1m)
105 (32.0m)	21 (6.4m)	30 (9.1m)
110 (33.5m)	22 (6.7m)	30 (9.1m)
115 (35.1m)	23 (7.0m)	30 (9.1m)
120 (36.6m)	24 (7.3m)	30 (9.1m)

NOTES: ALL DIMENSIONS ARE IN FEET (METERS).
TRUCK LOADING SHOWN FOR SIMPLICITY
DIMENSIONS APPLY TO ALL TYPES OF SHIPMENTS.

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).

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)		
	Maximum Elapsed Time	
Air or Grout Temperature Whichever is Higher	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 (5-25-10)

The 2006 Standard Specifications shall be revised as follows:

In Section **440-8(A) - General**, 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.

In Section **440-8(D) – Inspection** replace the first sub-paragraph under the third paragraph with the following:

> At least once each working day, place 3 calibration sample bolts of the same grade, size, representative length, and conditions as those under inspection in a tension indicating calibration device. Furnish a tension indicating calibration device certified by an approved independent testing lab within 12 calendar months prior to testing the bolts under inspection. The calibration device should be in good working order and provide accuracy within plus or minus 10 percent for the range of loads between 25,000 (11,340 kg) and 40,000 pounds (18,144 kg). Place a washer under the part turned in tightening for each bolt if washers are so used in the structure. If no washer is used make sure that the material abutting the part turned is the same as that used in the structure.

PRESTRESSED CONCRETE MEMBERS (10-12-10)

The 2006 Standard Specifications shall be revised as follows:

Section 1078-1 - General, add the following after the second paragraph:

The intent of this section is to require the producer to provide prestressed concrete members that meet the Specifications and exhibit characteristics that are not objectionable to the Department.

(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 elements not listed above will be as required by the project special provision or plans.

(B) Working Drawing Submittals

Prior to casting girders, submit complete working drawings to the Engineer for approval. The drawings shall detail the exact location and description of all casting holes, attachments and inserts cast in the member for both temporary and permanent applications. The casting holes, attachments and inserts are in association with, but not limited to: fall protection, overhang falsework, metal stay-in-place forms, solar platforms, temporary girder bracing, transit, erection, lifting and handling. If the plan notes indicate that the structure contains the necessary corrosion protection required for a Corrosive Site, epoxy coat, galvanize or metalize all metallic components except stainless steel and malleable iron components. Electroplating will not be allowed.

Section 1078-7 – Placing Strands, Ties, and Reinforcing Steel, replace the first paragraph with the following:

Position strands, ties, supports, reinforcing bars of the sizes shown on the plans and bearing plates in accordance with the detailed dimensions shown on the plans and effectively secure against displacement from their correct positions. The use of previously tensioned strands is not permitted. For prestressing strands, do not allow deflections or displacements of any kind between the end anchorages unless shown on the plans. Place the steel reinforcing in final position after tensioning of the strands. Bend all tie wires to the inside of the member so that the ends are farther from the edge than the material tied. Support bottom strands spacings not to exceed 20 feet (6.1 m) by supports meeting the requirements of Article 1070-4 or by other approved means. Plastic supports may be used when approved.

Section 1078-7 – Placing Strands, Ties, and Reinforcing Steel, replace the third paragraph with the following:

Strand splices are only permitted at the end of a reel and when using a single strand jack. Ensure that the strand lengths to be spliced together have the same lay of wire to avoid unraveling and position the splice so that it does not fall within a member. Do not torch cut the ends of the spliced strand lengths. Cut by shears, abrasive grinders, or other means approved by the Engineer. No more than one strand splice per bed is allowed on an individual strand and the use of previously tensioned strands for splicing is not permitted.

Section 1078-8 – Tensioning Procedure, add the following to the beginning of the Section:

A producer quality control representative shall be present during strand tensioning.

Section 1078-9 – Placing Concrete, replace the entire Section with the following:

Place concrete in accordance with Article 1077-8 and the additional requirements of this article.

Upon completion of stressing strand, place concrete within a reasonable time to prevent contamination of the strands and reinforcing steel.

Place concrete for girders 54" (1372 mm) or less in height, and concrete for all cored slabs and box beams, in 2 or more equal horizontal layers. Place concrete for girders over 54" (1372 mm) in height in 3 horizontal layers. When placing concrete in 3 layers locate the top of the first layer approximately at the top of the bottom flange and locate the top of the second layer approximately at the top of the web. To prevent separation of surfaces between layers, do not allow the time between successive placements onto previously placed concrete to exceed 20 minutes, unless the previously placed concrete has not yet stiffened, as evidenced by the continuous effective use of vibration. Should shrinkage or settlement cracks occur, the Engineer reserves the right to require additional layers and/or vibration.

The requirement of the above paragraph may be waived with the permission of the Engineer if self consolidating concrete is used.

Internal or a combination of internal and external vibration is required as is necessary to produce uniformly dense concrete without honeycomb.

Place concrete in cold weather in accordance with the requirements of Article 420-9.

Place concrete in daylight unless an adequate lighting system meeting the approval of the Engineer is provided.

Do not exceed a temperature of 95°F (35°C) in the freshly mixed concrete when placed in the forms.

Place the concrete in the bed in one continuous operation, finishing each member before proceeding to the next one. If the pour stops before the concrete in all the members in the bed is placed, start curing immediately. Do not place concrete in any remaining members in that bed setup once curing at elevated temperatures has begun.

When cored slabs and box beams are cast, employ an internal hold-down system to prevent the voids from moving. At least six weeks prior to casting cored slabs or box beams, submit to the Engineer for review and comment, detailed drawings of the proposed void material and hold-down system. In addition to structural details, indicate the location and spacing of the holds-downs. Submit the proposed method of concrete placement and of consolidating the concrete under the void.

Section 1078-11 – Transfer of Load, replace the first paragraph with the following:

A producer quality control representative or equivalent qualified personnel shall be present during removal of forms and during transfer of load.

Transfer load from the anchorages to the members when the concrete reaches the required compressive strength shown on the plans. Loosen and remove all formwork in one continuous operation as quickly as possible as soon as release strength is obtained. As soon as the forms are removed, and after the NCDOT Inspector has had a reasonable opportunity to inspect the member, transfer the load from the anchorages to the members as quickly as possible in one continuous operation using the approved detensioning sequence.

Section 1078-12 – Vertical Cracks in Prestressed Concrete Girders Prior to Detensioning, replace the entire Section with the following:

This Section addresses prestressed concrete members that have vertical casting cracks prior to strand detensioning. Certain types of these cracks have been determined by the Department to render the girders unacceptable.

Unacceptable cracked members are those with two or more vertical cracks spaced at a distance less than the member depth which extend into the bottom flange. Such members are not considered serviceable and will be rejected. Members with two or more vertical cracks spaced at a distance less than the member depth but do not extend into the bottom flange are subject to an engineering assessment. Such members may not be considered serviceable and may be rejected.

Members with one or more vertical cracks that extend into the bottom flange and are spaced at a distance greater than the member depth are subject to an engineering assessment to determine their acceptability. If this engineering assessment is required, submit, at no additional cost to the Department, a proposal for repairing the member and a structural evaluation of the member prepared by a North Carolina Licensed Professional Engineer. In the structural evaluation, consider the stresses under full service loads had the member not cracked and the effects of localized loss of prestress at the crack as determined by methods acceptable to the Department.

All members, except those defined as unacceptable, which exhibit vertical cracks prior to detensioning, shall receive a 7 day water cure as directed by the Engineer. The water cure shall begin within 4 hours after detensioning the prestressing strands and shall be a minimum of 3'-0" (914 mm) beyond the region exhibiting vertical cracks.

The Department has the final determination regarding acceptability of any members in question.

Section 1078-13 – Prestressed Concrete Girder Web Splitting, replace the entire Section with the following:

After detensioning of certain girders with draped strands, cracks occasionally occur in the webs at the ends of the girders. If such cracks occur, employ a method to remedy this condition

on all subsequent girders of the same type and strand pattern. If debonding of strands is used, satisfy the following criteria:

(A) Do not debond the two straight strands in the top of the girder. Debond one half of the straight strands, as nearly as possible, in the bottom flange. As nearly as possible, debond one quarter of the straight strands in the bottom of girder 4 feet (1.22 m) from each end of the girder and debond one quarter of the straight strands 2 feet (610 mm) from each end of the girder.
(B) Use a debonding pattern that is symmetrical about the vertical axis of the girder.
(C) Debond strands so that the center of gravity of the strands in the bottom of the girder remain within 1" (25 mm) of their original location at the end of the girder.
(D) Debond strands by encasing the strand in a conduit meeting the approval of the Engineer. Conduit may be rigid one-piece or rigid two-piece split sheathing. Do not use flexible conduit or sheathing.

No separate payment is made for debonding strands as payment is included in the contract unit price bid for prestressed concrete girders.

Section 1078-14 – Handling, Transporting and Storing, replace the second paragraph with the following:

Store all prestressed members on solid, unyielding, storage blocks in a manner to prevent torsion or objectionable bending. In handling prestressed concrete girders 54" (1372 mm) or less in height, including cored slabs and box beams, maintain them in an upright position at all times and pick them up within 5 feet (1.52 m) of the points of bearing and transport and store supported only within 3 feet (914 mm) of points of bearing. In handling prestressed concrete girders greater than 54" (1372 mm) in height, maintain them in an upright position at all times and submit for approval the proposed method of lifting, transporting, and storing the girders. When requested, provide calculations to confirm girders are not overstressed by such operations.

Section 1078-15 – Final Finish, replace the entire Section with the following:

Finish prestressed concrete members that are intended for composite action with subsequently placed concrete or asphalt with a roughened surface for bonding. Make sure that no laitance remains on the surfaces to be bonded.

Rough float the tops of girders. Broom finish the top surface of the cored slab and box beam sections receiving an asphalt overlay. Rake the top surface of cored slab and box beam sections receiving a concrete overlay to a depth of 3/8" (10 mm). No surface finish is required for sides and bottom of the slab and beam sections except the exposed side of the exterior unit as noted below. Provide a resulting surface finish essentially the same color and surface finish as the surrounding concrete.

Provide a 3/4" (19 mm) chamfer along the bottom edges on ends and sides of all box beam and cored slab sections, top outside edges of exterior sections and acute corners of sections. Round the top edges on ends of all sections with a 1/4"(6 mm) finishing tool. Provide

square corners along top edges on all sections along shear keys. Do not chamfer vertical edges at ends of sections.

Fill all voids in the diagonal face of the bottom flange of prestressed concrete girders and the outside face of exterior cored slabs and box beams with a sand-cement or other approved grout. Fill all voids in piles greater than 1/2" (13 mm) in diameter or depth as above. Provide a resulting surface finish essentially the same color and surface finish as the surrounding concrete. Repair voids greater than 1/4" (6 mm) in diameter or depth in other faces of these and other members except piles in a like manner. Where an excessive number of smaller voids exist in any member, the Engineer requires a similar repair.

Repair honeycomb, excessively large fins, and other projections as directed. Submit, at no additional cost to the Department, a proposal for repairing members with honeycomb, cracks, or spalls. Do not repair members containing honeycomb, cracks, or spalls until a repair procedure is approved and the member is inspected by the Engineer. Any appreciable impairment of structural adequacy that cannot be repaired to the satisfaction of the Engineer is cause for rejection.

Clean and fill holes caused by strand hold downs upon removal from the casting bed. Use patches of materials approved by the Engineer that develop strength at least equal to the minimum 28 day strength requirement for the concrete prior to approval of the member. Ensure that members are clean and surfaces have a uniform appearance.

Give the top surface of prestressed concrete panels a raked finish or other approved finish to provide an adequate bond with the cast-in-place concrete. As soon as the condition of the concrete permits, rake the top surface of the concrete making depressions of approximately 1/4" (6 mm). Take care when raking not to catch and pull the coarse aggregate.

Clean reinforcing bars exposed on the tops of girders and exterior cored slabs or box beams of mortar build up and excessive rust.

Apply epoxy protective coating to the ends of prestressed members as noted on the plans.

Section 1078-16 (A) – Alignment and Dimensional Tolerances, revise Table 1078-3 "Tolerances for Prestressed Cored Slabs" as follows:

Width - Differential of adjacent spans in the same structure	1/2" (13 mm)

Section 1078-16 (B) – Alignment and Dimensional Tolerances, revise Table 1078-4 "Tolerances for Prestressed Girders" as follows:

Position of holes for diaphragm bolts (K)	±1/4" (6 mm)

Section 1078-16 (F) – Alignment and Dimensional Tolerances, revise Table 1078-8 "Tolerances for Box Beams" to be consistent with cored slab tolerances as follows:

Width - Any one span	Plan width + 1/8" (3 mm) per joint
Width – Differential of adjacent spans in the same structure	1/2" (13 mm)

Section 1078-16 – Identification of Members, revise Section number to the following:

Section 1078-17

Section 1078-17 – Quality Control, revise Section number to the following:

Section 1078-18

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.

PLACING LOAD ON STRUCTURE MEMBERS (8-4-09)

The 2006 Standard Specifications shall be revised as follows:

Replace the fifth paragraph of Section **420-20 – Placing Load on Structure Members** with the following:

Do not place vehicles or construction equipment on a bridge deck until the deck concrete develops the minimum specified 28 day compressive strength and attains an age of at least 14 curing days. The screed may be rolled across a previously cast bridge deck if the entire pour has not achieved initial set. If any portion of the deck concrete has achieved initial set, the screed can not be rolled across the bridge deck until the concrete develops a compressive strength of at least 1,500 psi (10.4 MPa). Construction equipment is allowed on bridge approach slabs after the slab concrete develops a compressive strength of at least 3,000 psi (20.7 MPa) and attains an age of at least 7 curing days. A curing day is defined in Subarticle 420-15(A).

PILES (8-4-09)

Refer to Section 450 of the *Standard Specifications*.

DIRECT TENSION INDICATORS (6-12-09)

The 2006 Standard Specifications shall be revised as follows:

Replace Section **440-8(C)(6) – Direct Tension Indicators** with the following:

Supply direct tension indicators in accordance with the requirements of ASTM F959 and Article 1072-7.

Furnish the Engineer with at least one metal feeler gage for each container of direct tension indicators shipped before beginning installation.

Make sure that the lot number on the containers of direct tension indicators is for the same lot number tested as indicated on the test documents.

Furnish to the Engineer three samples of load indicating washers from each lot number, each size and type for tests and two each of the metal feeler gages required for performing the tests.

Install the direct tension indicator under the bolt head. If it is necessary to install the direct tension indicator under the nut, or if the bolt head shall be turned, install additional hardened washers between the nut or bolt head and the direct tension indicator.

Provide a tension indicating device on the project for determining the tension imposed on a fastener when the protrusions on direct tension indicator are properly compressed.

Test 3 samples from each lot of direct tension indicators in the presence of the Engineer. Achieve a minimum bolt tension of 5% greater than that required by Table 440-1 of Article 440-8.

Do not substitute direct tension indicators for hardened steel washers required with short slotted or oversized holes. If desired, use direct tension indicators in conjunction with hardened steel washers.

Install direct tension indicators initially to a snug tight condition as specified in Subarticle 440-8(C)(3). After initial tightening, fully tighten beginning at the most rigid part of the joint and continuing toward its free edges.

For tightening fasteners containing direct tension indicators, use a clean and lubricated wrench. Maintain air supply and hoses in good condition and provide air pressure of at least 100 psi (0.689 MPa) at the wrench.

When tightening the fasteners, ensure that the part of the fastener being restrained from turning does not rotate during the tightening process. Ensure that no portion of the direct tension indicator protrusions is accidentally partially flattened before installing in the structural steel joints.

Do not reuse direct tension indicators. If it is necessary to loosen a bolt previously tensioned, discard and replace the direct tension indicator.

CURING CONCRETE (6-12-09)

The 2006 Standard Specifications shall be revised as follows:

Replace the first paragraph of Section **420-15(A) – Curing Concrete – General** with the following:

Unless otherwise specified in the contract, use any of the following methods except for membrane curing compounds on bridge deck and approach slab, or on concrete which is to receive epoxy protective coating in accordance with 420-18. Advise the Engineer in advance of the proposed method. Have all material, equipment, and labor necessary to promptly apply the curing on the site before placing any concrete. Cure all patches in accordance with this article. Improperly cured concrete is considered defective.

Replace the third paragraph of Section **420-15(C) – Curing Concrete – Membrane Curing Compound Method** with the following:

Seal the surface with a single uniform coating of the specified type of curing compound applied at the rate of coverage recommended by the manufacturer or as directed, but not less than 1 gallon (3.8 liters) per 150 square feet (14 square meters) of surface area.

POST-TENSIONING TENDONS: (SPECIAL)

1.0 DESCRIPTION

1.1 General: Post-Tensioning Tendons consists of the furnishing, installing, stressing and grouting of prestressing tendons. In this process, prestressing steel, which may be strands, or wires, is installed through ducts in the girder webs and concrete, stressed up to a predetermined load and anchored directly against the girder webs and hardened concrete, initially imparting stresses through end bearing. Grout is then injected into the ducts to completely fill all remaining voids and to seal the permanently stressed tendons.

Post-Tensioning Tendons also includes furnishing and installing all the hardware and any other appurtenant items necessary for the particular prestressing system used, including but not limited to ducts, anchorage assemblies, supplementary steel,

reinforcing bars, grout, and labor used for pressure grouting ducts and all associated operations.

1.2 Qualified Personnel: The installation, stressing and grouting of post-tensioning tendons shall be supervised, performed and inspected by personnel with qualifications and experience as described in Appendix B of the "Post-Tensioning Tendon Installation and Grouting Manual" published by the Federal Highway Administration. Documentation of the qualifications and experience shall be submitted to the Engineer for approval.

1.3 Working Drawings:

1.3.1 The Contractor shall submit signed and sealed Working Drawings and Calculations showing complete details and designs for the post-tensioning system to the Engineer for approval. Submittal of the Working drawings and Calculations shall meet the requirements outlined in the Special Provision "Submittal of Working Drawings." Designs and details shall be sealed by a Professional Engineer registered in the State of North Carolina.

1.3.2 The Working Drawings shall detail the ducts installation and support of the ducts, location of grout vents and other related details. The Working Drawings shall include integrated drawings of post-tensioning system including anchorages and mild reinforcing required by the design shown on the bent drawings due to the congestion around the anchorage of the post-tensioning system. Show complete details of the anchorage system, anchorage protection, and any appurtenances for accommodating stressing equipment. Show anchorage zone reinforcement as designed by the post-tensioning supplier. The Contractor shall be responsible for resolving conflicts between the different elements in the anchorage zone. Any shifting of the design reinforcing steel shall be approved by the Engineer.

1.3.3 The Working Drawings and Calculations shall show complete details of tendon stressing. These details shall include sequence of stressing, jacking forces, calculated tendon elongations, guage pressures, jack calibrations, friction and wobble coefficients, and anchor set loss. All of these shall be based on the actual post-tensioning system and hardware proposed for installation in the bent caps.

1.3.4 The Working Drawings shall include complete details of grout materials equipment, and procedures for approval by the Engineer.

1.3.5 The Working Drawings shall include details and calculations for the temporary falsework. The details shall include temporary support or bearings for the girders, support locations and how those supports will keep the girders in proper horizontal and vertical alignment, and allow for expansion and contraction of girders. The design of the temporary falsework shall follow the AASHTO Guide Design Specifications for Bridge Temporary Works, 1995.

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2.0 TERMINOLOGY

Post-Tensioning: The application of a compressive force to the concrete by stressing tendons after the concrete has been cast and cured. The force in the stressed tendons is transferred to the concrete by means of anchorages.

Post-Tensioning Scheme or Layout: The pattern, size and locations of post-tensioning tendons provided by the Designer on the Contract Plans.

Post-Tensioning System: A proprietary system where the necessary hardware (anchorage, wedges, strands, etc.) is supplied by a particular manufacturer or manufacturers of post-tensioning components.

Tendon: A high strength steel member made up of a number of strands or wires.

Strand: An assembly of several high strength steel wires wound together. Strands usually have six outer wires helically wound around a single straight wire of a similar diameter.

Wire: A single, small diameter, high strength steel member and, normally, the basic component of strand, although some proprietary post-tensioning systems are made up of individual or groups of single wires.

Bar: Post-tensioning bars are high strength steel bars, normally available from 15 to 36 mm dia. and usually threaded with very coarse thread.

Anchorage: An assembly of various hardware components which secure a tendon at its ends after it has been stressed and imparts the tendon force into the concrete.

Anchor Plate: That part of the anchorage which bears directly on the concrete and through which the tendon force is transmitted.

Wedges: A small conically shaped steel component placed around a strand to grip and secure it by wedge action in a tapered hole through a wedge plate.

Wedge Plate: A circular steel component of the anchorage containing a number of tapered holes through which the strands pass and are secured by conical wedges.

Set (Also Anchor Set or Wedge Set): Set is the total movement of a point on the strand just behind the anchoring wedges during load transfer from the jack to the permanent anchorages. Set movement is the sum of slippage of the wedges with respect to the anchorage head and the elastic deformation of the anchor components.

Anticipated Set: Anticipated set is that set which was assumed to occur in the design calculation of the post-tensioning forces immediately after load transfer.

3.0 ALTERNATE POST-TENSIONING DESIGNS

Alternate designs using a post-tensioning scheme other than that shown on the plans may be submitted by the Contractor for the Engineer's approval provided that the proposed alternate scheme fulfills the following requirements:

(1) The prestress system is a type described in Section 4 of this Special Provision.

(2) The net compressive stress in the concrete after all losses is at least as large as that provided by the scheme shown on the Plans.

(3) The distribution of individual tendons at each cross section generally conforms to the distribution shown on the Plans.

(4) The ultimate strength of the structure with the proposed post-tensioning scheme meets the requirements of Section 9 of the AASHTO Standard Specifications for Highway Bridges, and shall be equivalent to the ultimate strength provided by the original design.

(5) Stresses in the concrete and prestressing steel at all sections and at all stages of construction meet the requirements of the Design Criteria noted on the Plans.

(6) All provisions of the Design Criteria noted on the Plans shall be satisfied.

(7) The Contractor fully redesigns and details, as required, the elements where the alternate post-tensioning scheme is proposed to be used.

(8) The Special Provisions of 41.4 MPa Concrete shall be satisfied.

(9) The Contractor submits complete shop drawings including post-tensioning scheme and system, reinforcing steel, and concrete cover; and design calculations (including short and long term prestress losses) for the Engineer's approval.

(10) Any alternate post-tensioning scheme or system approved by the Engineer will result in no additional costs to the Department.

4.0 MATERIALS

4.1 Prestressing Material:

4.1.1 Prestressing Steel:

(a) Strand: Unless otherwise noted on the plans, strand shall be uncoated, 1860 MPa (270 ksi) low relaxation 7-wire strands conforming to the requirements of ASTM A 416.

(b) Wires: Unless otherwise noted on the plans, wire shall be uncoated, low relaxation wire conforming to the requirements of ASTM A 421.

(c) Prestressing Bar (hereinafter called the "Bar"): Unless otherwise noted on the plans, bar shall be uncoated, Grade 1035 MPa (150 ksi), high strength, coarse thread bar conforming to the requirements of AASHTO M275, Type II (ASTM 722).

The proper use of strand, bar or wires is predicated upon the use of suitable accessory materials. Details for the use of these materials shall be furnished by the manufacturer in connection with shop and working drawing submittals.

4.1.2 Bar and Tendon Couplers: Bar and tendon couplers shall not be used. Contractor shall furnish and use bars or tendons of appropriate length for each installation.

4.1.3 Prestress Anchorages: All prestressing steel shall be secured at the ends by anchoring devices meeting the approval of the Engineer. The anchorages shall develop at least 100% of the minimum specified ultimate tensile strength of the prestressing steel, tested in an unbonded state without exceeding the anticipated set. Certified copies of test results for the anchorage system shall be supplied to the Engineer at no additional cost. The anchorage shall be so arranged that the prestressing force in the tendon may be verified prior to the removal of the stressing equipment.

Two part wedges shall not be used. The Contractor shall furnish and use acceptable three part wedges with appropriate anchorage discs for anchoring post-tensioning strands.

The anchoring devices shall effectively distribute tendon forces to the concrete. Such devices shall conform to the following requirements:

(a) Article 9.21.7.2 of the AASHTO Standard Specifications for Highway Bridges. The concrete compressive strength at application of the post-tensioning force shall be limited to 31.0 MPa (4500 psi) as the absolute maximum value, even if the concrete strength is in excess of 31.0 MPa at transfer (load application).

(b) Bending stresses in the plates or assemblies induced by the pull of the prestressing steel shall not exceed the yield point of the material or cause visible distortion of the anchorage plate when 100% of the ultimate strength of the tendon is applied. Certified test reports from an approved independent testing laboratory, verifying compliance with this requirement, shall be provided to the Engineer for each type and/or size of anchoring device.

Alternatively, anchorage devices which do not meet with either or both of the above requirements [(a) and (b)] may be accepted based upon previously approved usage in the State of North Carolina or on the basis of new or previous test performed in accordance with and meeting the requirements of the AASHTO Standard Specifications for Highway Bridges, Division II Section 10.3.2.3 "Special Anchorage Device Acceptance Test", all at no cost to the Department. Also, in such cases, any additional confinement reinforcement or modification to existing reinforcement required for satisfactory performance of the anchorage devices shall be incorporated in the structure at no additional cost.

4.1.4 Ducts:

4.1.4.1 General: Unless specifically noted on the Plans or otherwise approved by the Engineer, ducts for post-tensioning shall conform to the requirements of this specification. Ducts embedded in the concrete for prestressing steel shall be galvanized ferrous metal.

Joints in ducts shall not be used. Ducts shall be one continuous piece between connections to anchor plates. Ducts, pipes and all connections shall be capable of withstanding the pressure required for flushing the ducts in the event of an aborted grouting operation.

4.1.4.2 Size of Ducts: Ducts for multi-strand tendons shall have a minimum size which provides an inside area at least 2.5 times the net area of the prestressing steel.

4.1.4.3 Corrugated Metal Ducts: Corrugated metal ducts shall be galvanized. Rigid metal ducts may be fabricated with either welded or interlocked seams. Ducts shall bend without crimping or flattening and shall have sufficient strength to maintain their correct alignment during placing of concrete. Joints between sections of ducts shall have positive metallic connections, which do not result in angle changes at the joints.

4.1.4.4 Epoxy Coated Metal Ducts: Epoxy Coated Metal Ducts shall not be used.

4.1.4.5 Polyethylene (P.E.) Ducts and Pipes: Polyethylene (P.E.) Ducts and Pipes shall not be used.

4.1.5 Grout Vents, Injection and Ejection Pipes: Vents shall be 19 mm (¾ in.) minimum, inside diameter standard pipe or suitable plastic pipe. Neither metallic nor plastic components, if selected and approved, shall react with the concrete or enhance corrosion of the prestressing steel. Plastic components shall be free of water soluble chlorides.

Grout injection pipes shall be fitted with positive mechanical shut-off valves. Vents and ejection pipes shall be fitted with valves or other devices capable of withstanding the grout pumping pressures.

4.1.6 Grout:

4.1.6.1 General: The Contractor shall use a Department approved pre-packaged grout in lieu of an on site batch mix. It is the Contractor's responsibility to consult the manufacturer to determine if the pre-packaged grout selected is suitable for grouting post-tensioning ducts.

4.1.6.2 Materials: Contractor shall contact the Materials and Test Unit for a list of approved pre-packaged grouts.

Water shall comply with Section 1024 of the Standard Specifications and shall be potable, clean, and free of injurious quantities of substances known to be harmful to the prestressing steel or pre-packaged grout.

Admixtures, if approved by the Department, shall impart the properties of low water content, good flowability, minimum bleed and expansion if desired. Its formulation shall contain no chemicals in quantities that may have harmful effects on the prestressing steel or grout. Admixtures containing chlorides in excess of 0.5% by weight of admixture (assuming 0.45 kg (1.0 lb.) of admixture per sack (43.1 kg {95 lb.}) of grout), fluorides, sulfites and nitrates shall not be used.

Aluminum powder of proper fineness and quantity or other approved gas evolving material that is well dispersed through the mixture may be used to obtain expansion of the grout.

All admixtures shall be used in accordance with the instructions of the manufacturer. The date of manufacture shall be clearly stamped on each container. No admixture for which the shelf life recommended by the manufacturer has expired shall be used.

4.1.6.3 Requirements: If no compressive strength or volume change is specified on the plans or in the applicable section of the Standard Specifications or special provision for the structure, provide non-metallic, non-shrink grout with minimum compressive strengths and volume changes as follows:

Property	Requirement
Compressive Strength @ 7 days	20.7 MPa (3000 psi)
Compressive Strength @ 28 days	34.4 MPa (5000 psi)
Volume Change @ 24 hours	0.0% to < 0.10%
Volume Change @ 28 days	< or = to +0.20%

A testing laboratory approved by the Department shall be used to test pre-packaged grout. Provide laboratory test results for setting time, volume change, compressive strength and fluidity with the grouting of each post-tensioning duct. Submit compressive strength for at least two 50 mm (2 in.) cube specimens at the age of

3, 7, 14, and 28 days for a total of at least eight cube specimens tested. Perform laboratory tests in accordance with the following:

Property	Test Method
Setting Time	ASTM C953
Volume Change	ASTM C1090
Compressive Strength	ASTM C942
Fluidity	ASTM C939

Unless otherwise required in the Contract or by the Engineer, a grout mix design submittal is not required when using an approved pre-packaged grout. If a grout mix design is submitted, the Engineer will review the mix design and notify the Contractor as to its acceptability. The contractor shall not use the pre-packaged grout until written acceptance has been received. Acceptance of approved pre-packaged grout does not relieve the Contractor of the responsibility to furnish a product that meets the Contract requirements.

4.1.6.4 Sampling and Placement: The applicable section of the Standard Specifications or special provision for the structure and the Engineer will determine the locations to sample grout and the number and type of samples collected for field and laboratory testing. The compressive strength of the grout will be considered the average compressive strength test results of two cube specimens at 28 days.

Contractor is responsible for the placement of grout in accordance with the manufacturer's recommendations unless directed otherwise by the Engineer.

Grout samples for testing shall be furnished by the Contractor at no cost to the Department.

4.2. Samples for Testing:

4.2.1 General: Testing shall conform to the applicable ASTM Specifications for the prestressing material used.

All material samples for testing shall be furnished by the Contractor at no cost to the Department.

Job site or site referred to herein shall be considered the location where the prestressing steel is to be installed whether at the bridge site or a removed casting yard.

4.2.2 Prestressing Steel and Components: Samples for testing shall be furnished as described below for each manufacturer of prestressing strand, wire, and anchorage assemblies to be used on the project.

With each sample of prestressing steel strand or wires furnished for testing there shall be submitted a certification stating the manufacturer's minimum guaranteed ultimate tensile strength of the sample furnished.

The following samples of materials selected by the Engineer at the plant or job site from the prestressing steel used for post-tensioning operations shall be furnished by the Contractor to the Engineer well in advance of anticipated use:

(a) For strand: two randomly selected samples, 1.5 meters long, per manufacturer, per size of stand, per shipment, with a minimum of one sample for every ten reels delivered.

(b) For bars: two randomly selected samples, 1.5 meters long, per manufacturer, per size of bar, per heat of steel, with a minimum of one sample per shipment.

(c) For wire: two randomly selected samples, 1.5 meters long, per manufacturer per size of wire per heat of steel, per shipment, with a minimum of one sample for every ten coils delivered.

(d) For anchorage assemblies: two samples of each size, per manufacturer, per heat of steel.

One of each of the samples furnished to represent a lot shall be tested. The remaining sample(s), properly identified and tagged, shall be stored by the Engineer for future testing in the event of loss or failure of the component represented to meet minimum strength requirements. For acceptance of the lot represented, test results shall show that 100% of the guaranteed ultimate tensile strength has been met.

4.2.3 Lots and Identification: A lot is that parcel of components as described herein. All anchorage assemblies of each size from each mill heat of steel, all wire from each manufactured coil and all strand from each manufactured reel to be shipped shall be assigned an individual lot number and shall be tagged in such a manner that each such lot can be accurately identified at the job site. Records shall be submitted to the Engineer identifying assigned lot numbers with the heat, coil or reel of material represented. All unidentified prestressing steel or anchorage assemblies received at the site will be rejected. Also, loss of positive identification of these items at any time will be cause for rejection.

4.3 Release of Materials: The release of any material by the Engineer shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

5.0 TESTING BY THE CONTRACTOR

5.1 Tendon Modulus of Elasticity: This test will not be required if the Contractor can demonstrate to the satisfaction of the Engineer, valid results for the tendon modulus of elasticity from previous projects. Such results must be for the same type of strand, size, material and complement of strands per tendon as required for this project and must have been performed under test conditions equal to or better than those described below.

For the purpose of accurately determining the tendon elongations while stressing, the Contractor shall bench test two samples of each size and type of tendon to determine the modulus of elasticity prior to stressing the initial tendon.

For the purpose of this test, the bench length between anchorages shall be at least 10 m (33 ft.) and the tendon duct shall be at least 50 mm (2 in.) clear of the tendon all around. The test procedure shall consist of stressing the tendon at an anchor assembly with a load cell at the dead end. The test specimen shall be tensioned to 81% of ultimate in ten increments and then detensioned from 81% of ultimate to zero in ten decrements. For each increment and decrement, the gauge pressure, elongations and load cell force shall be recorded. Elongations of the tendon shall be noted for both ends and the central 8 m (26 ft.) and shall be measured to an accuracy of 2 mm (1/16 in.). The elongations shall be corrected for the actual anchorage set of the dead end.

The modulus shall be calculated as follows:

$$E = \frac{PL}{Adl}$$

where;
P = force in tendon,
L = distance between pulling wedges and dead end wedges or exact length in center 8 m (26 ft.) of the tendon.
A = cross sectional area of the tendon based on nominal area.
dl = strand elongation for load P.

The theoretical elongation shown on the post-tensioning shop or working drawings shall be reevaluated by the Contractor using the results of the test and corrected when the modulus of elasticity from the bench test varies from the modulus of elasticity used for shop or working drawings by more than 1%. Revisions to the theoretical elongations shall be submitted to the Engineer for approval.

When the observed elongations of the tendons in the erected structure fall outside the acceptable tolerances or to otherwise settle disputes, additional Tendon Modulus of Elasticity Tests may be required to the satisfaction of the Engineer.

If the source of prestressing steel changes during the project, additional test series or substantiation from previous projects, not to exceed two per source shall be required.

The apparatus and methods used to perform the test shall be proposed by the Contractor and be subject to the approval of the Engineer. Furthermore, this test shall be conducted by the Contractor in the presence of the Engineer.

5.2 In Place Friction Test: This test is intended to demonstrate that the friction characteristics, losses and resulting tendon forces are in agreement with the design assumptions.

For the purpose of verifying friction loss the Contractor shall test, in place, the first tendon installed of each size and type which is at least 10 m (33 ft.) long. Size is defined as the size and number of strands or wires in each tendon. Type is defined as to both prestressing and duct material and to the tendon function within the structure. Function is the general category of the tendon whether it is a cantilever tendon, continuity tendon, draped external tendon or continuous profiled tendon passing through one or more spans, etc. In this respect, the function of two or more tendons may be the same even though their actual profiles and lengths differ.

The test procedure shall consist of stressing the tendon at an anchor assembly with a load cell at the dead end. The test specimen shall be tensioned to 81% of ultimate tendon strength in eight equal increments and detensioned in eight equal decrements. For each increment and decrement, the gauge pressure, elongations and load cell force shall be recorded. Account shall be taken of any wedge seating in both the live end (i.e., back of jack) and the dead end (i.e., back of load cell) and of any friction within the anchorages, wedge plates and jack as a result of slight deviations of the strands through these assemblies. For long tendons requiring multiple jack pulls with intermediate temporary anchoring, care shall be taken to keep an accurate account of the elongation at the jacking end allowing for intermediate wedge seating and slip of the jacks' wedges.

The test shall be conducted using Engineer approved lubricants required, if any, to meet the expected friction coefficient.

If, for the Contractor's expected friction coefficients, the elongations fall outside the ±5% range, the Contractor will be required to investigate the reason and make revisions to his post-tensioning operations such that the final tendon forces are in agreement with the Plans.

In reconciling theoretical and actual elongations, the value of the expected friction and wobble coefficients shall not be varied by more than ±10%. Significant shortfall in elongations is indicative of poor duct alignments and/or obstructions which the Contractor shall be required to correct or compensate for in a manner to

be proposed by the Contractor and reviewed and approved by the Engineer at no additional cost to the Department.

One successful friction test for each type and size of tendon will be required for the project.

If, during the course of routine stressing operations, there are irreconcilable differences between forces and elongations, or other difficulties, the Engineer reserves the right to require additional in place friction test.

The apparatus and methods used to perform the test shall be proposed by the Contractor and be subject to the approval of the Engineer. Furthermore, this test shall be conducted by the Contractor in the presence of the Engineer.

Correction or adjustment of elongations as a consequence of the results of the friction test are the responsibility of the originator of the stressing and elongation calculations.

5.3 Test Reports Required: Two test reports of the "Tendon Modulus of Elasticity Test" shall be submitted to the Engineer at least 30 days prior to installing the tendon.

Two test reports of the "In Place Friction Test" shall be submitted to the Engineer within 2 weeks after successful installation of the test tendon.

5.4 Payment for Testing: Testing by the Contractor will not be paid for separately but shall be incidental to the price paid for the post-tensioning tendons.

5.5 Application of Test Results: The theoretical elongations shown on the post-tensioning shop or working drawings shall be reevaluated by the Contractor using the results of the tests for Tendon Modulus of Elasticity and In Place Friction as appropriate and corrected as necessary. Revisions to the theoretical elongations shall be submitted to the Engineer for approval.

6.0 PROTECTION OF PRESTRESSING STEEL

6.1 Shipping, Handling and Storage: All prestressing steel shall be protected against physical damage and corrosion at all times from manufacturer to final grouting or encasing in the concrete. Prestressing steel that has sustained physical damage at any time shall be rejected. Any reel that is found to contain broken wires shall be carefully inspected during use and lengths of strand containing broken wires shall be removed and discarded. The wire shall be bright and uniformly colored, having no foreign matter or pitting on its surface.

Prestressing steel shall be packaged in containers or shipping forms for protection of the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor which prevents rust or other results of corrosion shall be

placed in the package or form, or shall be incorporated in a corrosion inhibitor carrier type packaging material, or when permitted by the Engineer, may be applied directly to the steel. The corrosion inhibitor shall have no deleterious effect on the steel or the concrete or bond strength of steel to concrete. Inhibitor carrier type packaging material shall conform to the provisions of Federal Specification MIL-P-3420. Packaging or forms damaged from any cause shall be immediately replaced or restored to the original condition.

The shipping package or form shall be clearly marked with a statement that the package contains high-strength prestressing steel, the care to be used in handling, and the type, kind and amount of corrosion inhibitor used, including the date when placed, safety orders and instructions for use. Low relaxation (stabilized) strand shall be specifically designated per requirements of ASTM A 416. All such strand not so designated shall be rejected.

6.2 During Installation in the Structure: When acceptable prestressing steel for post-tensioning is installed in the ducts after completion of concrete curing and if stressing and grouting are completed within 15 calendar days after the installation of the prestressing steel, rust which may form during these 15 days will not be cause for rejection of the steel. Post-tensioning steel installed, tensioned and grouted in this manner, all within 15 calendar days, will not require the use of a corrosion inhibitor in the duct following installation of the prestressing steel.

Post-tensioning steel installed as above but not grouted within 15 calendar days shall be protected from corrosion. The method of protection shall be determined by the Contractor and shall be approved by the Engineer. Water soluble oil shall not be allowed as a corrosion inhibitor or friction reducer.

Within 30 calendar days after installation of the post-tensioning steel, ducts shall be grouted in accordance with these specifications. Except when approved by the Engineer in writing, failure to grout tendons within the 30 calendar days specified shall result in stoppage of the affected work and no invoices shall be processed for payment of that affected work.

7.0 FABRICATION

7.1 General: All post-tensioning anchorages, ducts, vent pipes, miscellaneous hardware, reinforcing bars, and other embedments shall be accurately and securely fastened at the locations shown on the Plans or on the approved Shop or Working Drawings or as otherwise approved by the Engineer.

7.2 Ducts: Ducts shall be accurately aligned and positioned at the locations shown on the Plans or according to the approved Shop or Working Drawings or as otherwise approved by the Engineer. All internal ducts shall be securely fastened in position at regular intervals not exceeding 0.450 m (1'-6") to prevent movement, displacement or damage from concrete placement and consolidation operations.

The method and spacing of duct supports shall be shown on appropriate Shop Drawings.

All alignments, including curves and straight portions, shall be smooth and continuous with no lips, kinks or dents.

All ducts shall be carefully checked and repaired as necessary before the placing of any concrete commences.

The tolerance on the location of the ducts for the tendons shall be as specified below.

After installation in the forms, all ends of ducts, connections to anchorages, splices, vents and the like shall at all times be sealed to prevent the entry of water and debris.

7.3 Joints: At connections to anchorages, ducts shall be smoothly aligned and secured with no lips or kinks. They shall be joined in a manner which positively prevents the entrance of cement paste and water from the concrete or unwanted leakage of grout during subsequent grouting operations.

7.4 Grout Vents, Injection and Ejection Pipes: All ducts or anchorage assemblies for permanent post-tensioning shall be provided with pipes or other suitable connections at each end for the injection of grout after prestressing. As a minimum, ducts shall be vented at the high points of the tendon profile when there is more than a 150 mm (6") variation in the vertical position of the duct. The Contractor may use additional injection and vent pipes when shown on the shop drawings.

All connections to ducts shall be made with metallic or plastic structural fasteners. Vent and grouting pipes shall be mortar tight and shall provide means for injection of grout through the vents and for sealing the vents. Duct tape shall not be used to join or repair ducts or make connections.

Grout injection pipes shall be fitted with positive mechanical shut-off valves. Vents and ejection pipes shall be fitted with valves, caps or other devices capable of withstanding the grout pumping pressures.

All grout caps used must be installed to prevent entrapment of air or water voids and must provide 100% coverage of all tendons.

7.5 Tolerances: Post-tensioning duct tolerance shall be 6 mm ± (¼ in. ±) in the horizontal direction and 13 mm ± (½ in. ±) in the vertical direction.

Entrance and exit angles of tendon paths at anchorages and/or at faces of concrete shall be within ±2 degrees of desired angle measured in any direction.

Angle changes at duct joints shall not be greater than ±2 degrees in any direction.

Anchorages shall be located within 6 mm (¼ in.) of desired position laterally and 25 mm (1 in.) along the tendon except that minimum cover requirements to ends of cut off tendons and anchor components must be maintained.

Anchorage confinement reinforcement in the form of spirals, multiple U shaped bars or links, shall be positioned to start within 13 mm (½ in.) of the inside face of the girder web and shall be properly centered around the duct.

In the event of conflicts between the reinforcement and post-tensioning duct, in general, the position of the post-tensioning duct shall prevail and the reinforcement shall be adjusted locally to the approval of the Engineer.

8.0 PLACING CONCRETE

8.1 Precautions: The Contractor shall exercise great care when placing and consolidating concrete so as not to displace or damage any of the post-tensioning ducts, anchorage assemblies, splices and connections, reinforcement or other embedments.

8.2 Proving of Post-Tensioning: Upon completion of concrete placement the Contractor shall prove that the post-tensioning ducts are free and clear of any obstructions or damage and will be able to accept the intended post-tensioning tendons by passing a torpedo through the ducts. The torpedo shall have the same cross-sectional shape as the duct, be 6 mm (¼ in.) smaller all around than the clear, nominal inside dimensions of the duct. No deductions to the torpedo section dimensions shall be made for tolerances allowed in the manufacture or fixing of the ducts. For curved ducts, the length shall be determined by the Contractor such that when both ends touch the outermost wall of the duct, the torpedo is 6 mm (¼ in.) clear of the innermost wall; but it need not be longer than 0.610 m (2 ft.). If the torpedo will not travel completely through the duct, the integral cap shall be rejected, unless a workable repair can be made to clear the duct, all to the satisfaction of the Engineer. The torpedo shall be passed through the duct easily, by hand, without resorting to excessive effort or mechanical assistance.

8.3 Problems and Remedies: If the ducts or any part of the integral cap work is found to be deficient, it will be rejected. No remedial or repair work will be permitted without the approval of the Engineer.

9.0 INSTALLING TENDONS

Post-tensioning strands may be pushed or pulled through the ducts to make up a tendon. Pushing shall be done with care so as to avoid snagging on any lips or joints in the ducts. The Contractor shall take precautions by rounding off the end of the strand or fitting it with a smooth protective cap for this purpose.

Alternatively, strands may be assembled into the tendon which then may be pulled through the duct together using a special steel wire sock ("Chinese finger") or other device attached to the end. Also, the ends of the strands may be welded together for this purpose. If so, then the end of the bundle must be rounded for smooth passage and the entire welded end together with at least 0.900 m (3 ft.) of tendon beyond the end of the last weld shall be cut off and wasted. Cutting shall be done with an abrasive saw or similar. Flame cutting shall not be allowed.

Installation of tendons in ducts prior to concrete placement shall not be allowed.

No permanent tendons shall be installed prior to the completion of testing as required by these specifications or Plans, except for the "In Place Friction Test" where only the tendon to be tested shall be installed prior to successful completion of the test.

10.0 POST-TENSIONING OPERATIONS

10.1 General: Post-tensioning forces shall not be applied until the concrete has attained the specified compressive strength as determined by cylinder tests.

10.2 Stressing Tendons: All post-tensioning steel shall be tensioned by means of hydraulic jacks so that the post-tensioning force shall not be less than that required by the plans or approved shop drawings, or as otherwise approved by the Engineer. Monostrand jacks shall not be utilized for stressing tendons.

10.2.1 Maximum Stress at Jacking: The maximum temporary stress (jacking stress) in the post-tensioning steel shall not exceed 81% of its specified minimum ultimate tensile strength. Tendons shall not be overstressed to achieve the expected elongation

10.2.2 Initial and Permanent Stresses: The post-tensioning steel shall be anchored at initial stresses that will result in the long term retention of permanent stresses or forces of not less than those shown on the Plans or the approved shop drawings. Unless otherwise approved by the Engineer, the initial stress after anchor set shall not exceed 70% of the specified ultimate tensile strength of the post-tensioning steel.

Permanent stress and permanent force are the stress and force remaining in the post-tensioning steel after all losses, including long term creep and shrinkage of concrete, elastic shortening of concrete, relaxation of steel, losses in the post-tensioning steel from the sequence of stressing, friction and unintentional wobble of the ducts, anchor set, friction in the anchorages and all other losses peculiar to the post-tensioning system.

10.2.3 Stressing Sequence: Stressing of all tendons shall take place from the Girder 1 end of the tendon. Any exception must be approved by the Engineer. The sequence of installation and stressing shall be in accordance with the Plans or approved shop drawings or as otherwise approved by the Engineer.

10.3 Stressing Equipment: Equipment for tensioning the tendons shall be furnished by the manufacturer of the post-tensioning system (tendons, hardware, anchorages, etc.).

10.3.1 Stressing Jacks and Gauges: Each jack used to stress tendons shall be equipped with a pressure gauge for determining the jacking pressure. The pressure gauge shall have an accurately reading dial at least 150 mm (6 in.) in diameter.

10.3.2 Calibration of Jacks and Gauges: Each jack and its gauge shall be calibrated as a unit with the cylinder extension in the approximate position it will be in at the final jacking force. Calibration shall be done when the jack is connected to the equipment (pumps and gauges) in the identical configuration as will be used on the job site, e.g. with the same length hydraulic lines. Initial calibration of the jacks and gauges shall be performed by an independent laboratory using a proven load cell. For each jack and gauge unit used on the project, the Contractor shall furnish certified calibration charts from the independent laboratory prior to stressing the first tendon.

Certified calibration shall be made at the start of the work and at every 6 months thereafter, or as requested by the Engineer. At the option of the Contractor, calibrations subsequent to the initial calibration with a load cell may be accomplished by the use of a master gauge. The master gauge shall be supplied by the Contractor in a protective waterproof container capable of protecting the calibration of the master gauge during shipment to a laboratory. The Contractor shall provide a quick-attach coupler next to the permanent gauge in the hydraulic lines which enables the quick and easy installation of the master gauge to verify the permanent gauge readings. The master gauge shall be calibrated by and shall remain in the possession of the Engineer for the duration of the project.

Any repair of the jacks, such as replacing seals or changing the length of the hydraulic lines, is cause for recalibration of the jacks using a load cell.

No extra compensation shall be allowed for the initial or subsequent calibrations or for the use and required calibrations of the master gauge.

10.4 Stand-by Equipment: During post-tensioning operations, the Contractor shall provide a stand-by stressing jack with gauges located on the job site. The stand-by stressing jack and gauges shall be calibrated as described in Section 10.3 of this Special Provision. The stand-by equipment will be provided at no additional cost to the Department.

10.5 Elongations and Agreement Forces: The post-tensioning operation shall be so conducted that the forces being applied to the tendon and the elongation of the post-tensioning tendon can be measured at all times.

Elongations shall be measured to the nearest 2 mm (1/16 in.).

For the required tendon force, the observed elongation shall agree within 5% of the theoretical elongation or the entire operation shall be checked and the source of error determined and remedied to the satisfaction of the Engineer before proceeding further. The tendon shall not be overstressed to achieve the theoretical elongation.

In the event that agreement between the observed and theoretical elongations at the required force falls outside the acceptable tolerances, the Engineer may, at his discretion and without additional compensation to the Contractor, require additional test for "Tendon Modulus of Elasticity" and/or "In-Place Friction" in accordance with 5.1 and 5.2 of this Special Provision.

10.6 Friction: The Contract Plans were prepared based on the assumed friction and wobble coefficients and anchor set noted on the Plans. The Contractor shall submit calculations and show a typical tendon force diagram, after friction, wobble and anchor set losses, on the shop drawings based upon the expected actual coefficients and values for the post-tensioning system to be used. These coefficients and values shall be given on the shop drawings.

If, in the opinion of the Engineer, the actual friction significantly varies from the expected friction, the Contractor shall revise his post-tensioning operation such that the final tendon force is in agreement with the Plans.

If friction must be reduced, the Contractor shall submit his plan of friction reduction to the Engineer for approval. Lubricants shall be flushed from the duct as soon as possible after stressing is completed by use of oil-free air. The ducts shall be flushed again just prior to the grouting operations. Water soluble oil shall not be used as a lubricant.

10.7 Wire Failures in Post-Tensioning Tendons: Multi strand post-tensioning tendons having wires which failed by breaking or slippage during stressing may be accepted provided the following conditions are met:

(a) The completed structure shall have a final post-tensioning force of at least 98% of the design total post-tensioning force.

(b) Any single tendon shall have no more than 5 % reduction in cross-sectional area of post-tensioning steel due to wire failure.

As an exception, any of the above conditions may be waived as approved by the Engineer, when conditions permit the Contractor to propose acceptable alternative means of restoring the post-tensioning force lost due to wire failure.

10.8 Cutting of Post-Tensioning Steel: Post-tensioning steel shall be cut by an abrasive saw within 19 mm (¾ in.) to 38 mm (1½ in.) away from the anchoring device. Flame cutting of post-tensioning steel is not allowed.

10.9 Record of Stressing Operations: The Contractor shall keep a record of the following post-tensioning operations for each tendon installed:

(a) Project name, number.
(b) Contractor and/or subcontractor.
(c) Tendon location, size and type
(d) Date tendon was first installed in ducts.
(e) Coil/reel number for strands or wires and heat number and wire.
(f) Assumed and actual cross-sectional area.
(g) Assumed and actual Modulus of elasticity.
(h) Date Stressed.
(i) Jack and Gauge numbers per end of tendon.
(j) Required jacking force.
(k) Gauge pressures
(l) Elongations (anticipated and actual)
(m) Anchor sets (anticipated and actual)
(n) Stressing sequence (i.e. tendons before and after this).
(o) Stressing mode (one end/ two ends/ simultaneous).
(p) Witnesses to stressing operation (Contractor and inspector).
(q) Date grouted, days from stressing to grouting, grouting pressure applied and injection end.

Any other relevant information shall also be recorded. The Contractor shall provide the Engineer with a complete copy of all stressing and grouting operations.

11.0 GROUTING OPERATIONS

11.1 General: Within 30 calendar days after installation of the post-tensioning steel, ducts shall be grouted in accordance with these specifications. Except when approved by the Engineer in writing, failure to grout tendons within the 30 calendar days specified shall result in stoppage of the affected work and no invoices shall be processed for payment of that affected work.

After stressing and prior to grouting, tendons shall be protected against corrosion or harmful effects of debris, by temporarily plugging or sealing all openings and vents until the tendon is grouted.

When stressing has been completed and the stressed tendons have been accepted by the Engineer, the annular space between the tendons and the duct shall be grouted.

11.2 Equipment: The grout mixer shall be capable of continuous mechanical mixing and shall produce a grout free of lumps and undispersed cement. The equipment shall be able to pump mix grout in a manner which will comply with all the provisions

specified herein. Accessory equipment which will provide for accurate solid and liquid measures shall be provided to batch all materials.

Grout pumps shall be positive displacement type and shall be able to produce an outlet pressure of at least 21 KPa (145 psi.). Pumps shall have seals adequate to prevent oil, air or other foreign substances from entering into the grout and to prevent loss of grout or water. A pressure gauge having a full scale reading of no more than 44 KPa (300 psi) shall be placed at some point in the grout line between the pumping outlet and the duct inlet. The grouting equipment shall contain a screen having clear opening of 3 mm (1/8 in.) maximum size to screen the grout prior to its introduction into the grout pump. If grout with an additive is used, a screen opening of 5 mm (3/16 in.) is satisfactory. This screen shall be easily accessible for inspection and cleaning. The grouting equipment shall utilize a gravity feed to the pump inlet from a hopper attached to and directly over it. The hopper must be kept at least partially full at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct. Under normal conditions, the grout equipment shall be capable of continuously grouting the longest tendon on the project in not more than 20 minutes.

11.3 Stand-by Equipment: During grouting operations, the Contractor shall provide a stand-by grout mixer and pump. Where water is not supplied through the public water supply system, a water storage tank of sufficient capacity must be provided.

Stand-by water-flushing equipment shall be provided. This equipment shall be in addition to the grouting equipment described above. The stand-by water-flushing equipment shall use a different power source than the grouting equipment, have sufficient capacity to flush out any partially grouted enclosures if necessary due to blockage or breakdown of grouting equipment, and shall be capable of developing a pressure of at least 42 KPa (290 psi.).

Stand-by equipment shall be provided at no additional cost to the Department.

11.4 Mixing: Water shall be added to the mixer first, followed by pre-packaged grout and admixture, or as required by the admixture manufacturer. Mixing shall be of such duration as to obtain a uniform thoroughly blended grout, without excessive temperature increase or loss of properties of the admixture. The grout shall be continuously agitated until it is pumped. Water shall not be added to increase flowability that has decreased by delayed use of the grout. Proportions of the materials shall be based on manufacturer's recommendations. The water content shall be the minimum necessary for proper placement and shall not exceed the water-cement ratio of 0.45 or approximately 19 liters (5 gal.) of water per sack (43 kg {95 lb.}) of grout. The pumpability of the grout may be determined by the Engineer in accordance with ASTM C939 "Standard Test Method for Flow of Grout." When this method is used, the efflux time of the grout sample immediately after mixing should be between 11 and 30 seconds. The flow cone test may not be suitable for a grout that incorporates a thixotropic additive.

11.5 Grout Injection: All grout vents and high point vent openings shall be open when grouting starts. Injection and ejection vents shall be provided with positive shut-offs. Grout shall be allowed to flow from the first vent after the injection vent until any residual water or entrapped air has been removed, at which time the vent shall be closed. Remaining vents shall be closed in sequence in the same manner.

The pumping pressure at the injection vent shall not exceed 21 KPa (145 psi.). Normal operations shall be performed at approximately 11 KPa (75 psi.). If the actual grouting pressure exceeds the maximum allowed, the injection vent shall be closed and the grout shall be injected at the next vent which has been, or is ready to be, closed as long as a one way flow is maintained. Grout shall not be injected into a succeeding vent from which grout has not yet flowed. If this procedure is used, then the vent which is to be used for injection shall be fitted with a positive shut-off. When one-way flow of grout cannot be maintained as outlined above, the grout shall be immediately flushed out of the duct.

Grout shall be pumped through the duct and continuously wasted at the ejection vent unit no visible slugs of water or air are ejected. To ensure that the tendon remains filled with grout, the ejection and injection vents shall be closed in sequence, respectively, under pressure when the tendon duct is completely filled with grout. The positive shut-offs at the injection and ejection vents shall not be removed or opened until the grout has set.

11.6 Temperature Restrictions: In temperatures below 0°C (32°F), ducts shall be kept free of water to avoid damage due to freezing. The temperature of the concrete shall be 2°C (36°F) or higher from the time of grouting until job cured 50 mm (2 in.) cubes of grout reach a minimum compressive strength of 116 KPa (800 psi.). Grout shall not be above 32° (90°F) during mixing or pumping. If necessary, the mixing water shall be cooled.

11.7 Finishing: Valves, caps and vent pipes shall not be removed or opened until the grout has set. The ends of steel vents shall be removed at least 25 mm (1 in.) below the concrete surface after the grout has set. Ends of plastic vents shall be removed to the surface of the concrete after the grout has set. All miscellaneous material used for sealing grout caps shall be removed prior to carrying out further work to protect end anchorages or filling in concrete anchorage blockouts and the like. Miscellaneous materials include paper, tie wire, etc.

12.0 PROTECTION OF END ANCHORAGES (POST-TENSIONING ENCASEMENT)

After tendons have been stressed, inspected, grouted, and approved, exposed end anchorages, strands and other metal accessories, and girder web and flange surfaces within the limits of the post-tensioning encasement shall be cleaned of rust, misplaced mortar, grout and other such materials. All cleaned surfaces shall be dried as part of the cleaning operation. Immediately following the cleaning operation, a heavy unbroken coating of an epoxy bonding compound shall be applied to all such metal surfaces. The

cleaning of the girder surfaces and application of epoxy bonding compound to the girder surfaces shall be done in neat lines matching the final dimensions of the encasement. Epoxy bonding compound shall conform to AASHTO M 235, Type III. Within 24 hours following the cleaning and application of epoxy bonding compound, and within the recommended tack-time of the epoxy bonding compound application, encapsulate anchorage with post-tensioning encasement pour-back using an approved, high-strength, high-bond, low-shrinkage, sand-filled epoxy grout. Only non-chloride bearing non-shrink grout mixes shall be used for anchorage protection.

13.0 BASIS OF PAYMENT

13.1 Unless otherwise specified on the Plans, post-tensioning tendons will be paid for at the contract unit price for "Post-Tensioning Tendons" - lump sum, of steel tendon, complete and in place. Payment shall be full compensation for furnishing, installing, stressing and grouting all post-tensioning tendons. Payment shall also include anchorage assemblies and any other post-tensioning system hardware required to complete the work, grout and grouting, all testing, and all labor, materials, tools, equipment and incidentals necessary for completing the work in accordance with these specifications and the Plans. This payment shall also include Engineer approved lubricants in the tendon ducts for friction control and flushing the lubricant from the tendon ducts after stressing.

Post Tensioning Tendons	Lump Sum

13.2 Payment for "Post-Tensioning Encasement" shall be full compensation for all labor, materials, tools and equipment necessary for the work listed in the section "Protection of End Anchorages (Post-Tensioning Encasement). Payment will be made under:

Post-Tensioning Encasement	C.M.

PRESTRESS -41.4 MPa CONCRETE **(SPECIAL)**

Prestress -41.4 MPa (Prestress -6000) concrete shall be in accordance with the Sections 1000 and 1078 of the Standard Specifications.

Payment will be made under:

Prestress -41.4 MPa Concrete	C.M.

PILE RESTRIKES FOR LRFD **(SPECIAL)**

After testing piles with the pile driving analyzer (PDA) during initial drive and any pile restrikes or redrives in accordance with the Contract, restrike the same piles with the PDA attached for the purpose of load resistance factor design (LRFD) calibration. Wait 96 hours to a maximum of 7 days to restrike piles. In some subsurface conditions, the Engineer may require greater than 96 hours before restriking piles.

Test piles with the PDA in accordance with Section 5.0 of the Pile Driving Analyzer Special Provision. The NCDOT Geotechnical Engineering Unit will perform the PDA testing for pile restrikes for LRFD. Notify the Engineer of the pile driving schedule in accordance with the Contract.

No payment will be made for any PDA pay items for pile restrikes for LRFD. The cost of restriking piles will be paid for at the unit bid price for "Pile Redrives" in accordance with Section 450 of the *Standard Specifications*.

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.

REMOVAL OF EXISTING STRUCTURE AT STA. 19+34.958 –Y1- (LEFT AND RIGHT LANE) **(SPECIAL)**

Remove the existing structure as indicated on the plans and in accordance with the Standard Specifications with the exception of one bar metal rail, which shall be removed as noted below.

The existing one bar metal rail of the existing structure shall be removed and salvaged for the Division of Highways as directed by the Engineer and stored neatly on the right of way at a location selected by the engineer.

The one bar metal rail shall be removed carefully without any damage.

The Contractor shall contact the Kennie Covington at the Fayetteville Bridge Maintenance Yard at 910-308-9023 at least 48 hours prior to the delivery of the salvaged material. The Contractor will deliver the salvaged material to the Bridge Maintenance Yard.

No separate payment will be made for this work and the entire cost of this work shall be included in the lump sum price bid for "Removal of Existing Structure at Station 19+34.958 –Y1- (Left and Right Lane)".

MECHANICALLY STABILIZED EARTH RETAINING WALLS (SPECIAL)

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 required 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 the contract and accepted submittals. Use an MSE Wall Installer prequalified by the NCDOT Contractual Services Unit for MSE retaining walls work (work code 3015). 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" refer to SRW units and "panels" refer to precast concrete panels.

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 6.1 m and an exposed face area of 465 m^2 per MSE wall. The design height is defined as the difference between where the finished grade intersects the back and front of an MSE wall.

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

- Design height exceeds 4.6 m for a horizontal distance of at least 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.

2.0 MSE WALL DESIGN SUBMITTAL

Submit 11 hard copies of working drawings and 3 hard copies of design calculations and an electronic copy (PDF on CD or DVD) of each for the MSE wall design submittal. Provide the submittal at least 30 calendar days before conducting the MSE wall preconstruction meeting. Do not begin MSE wall construction until the design submittal is accepted.

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 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 the AASHTO specifications. Also, design MSE walls with a minimum reinforcement length of 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.

If existing or future obstructions such as foundations, guardrail posts, pavements, pipes, inlets or utilities will interfere with reinforcement, maintain a minimum clearance of 75 mm between the obstruction and reinforcement unless otherwise approved. Place reinforcement within 75 mm above the corresponding connection elevation.

Use 150 mm thick cast-in-place unreinforced concrete leveling pads beneath panels and blocks that are continuous at steps and extend a minimum of 150 mm in front of and behind bottom row of panels and blocks. Unless required otherwise on the plans, embed top of leveling pads in accordance with the following.

EMBEDMENT DEPTH

Front Slope (H:V)	Minimum Facing Embedment Depth* (whichever is greater)	
6:1 or Flatter (except abutment walls)	H/20	0.3 m
6:1 or Flatter (abutment walls)	H/10	0.6 m
Steeper than 6:1 to 3:1	H/10	0.6 m
Steeper than 3:1 to 2:1	H/7	0.6 m
* H is from the top of leveling pad to the grade elevation		

When a drain is required with a note on plans, extend a continuous drain along the base of the reinforced zone behind the select material. Provide drains meeting the requirements of an aggregate shoulder drain in accordance with Roadway Standard Drawing No. 816.02.

Use select material in the reinforced zone for MSE walls and extend the reinforced zone 150 mm beyond the end of reinforcement. Regardless of select material type, fill between and behind SRW units for a horizontal distance of 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*. Separation fabric is required between select material and overlying fill or aggregate with the exception of when concrete pavement is placed directly on the select material. Separation fabric may also be required between stone and backfill or natural ground as determined by the Engineer.

Unless shown otherwise on the plans, use reinforced concrete coping at top of walls with dimensions shown on the plans. Extend coping a minimum of 150 mm above where finished grade intersects the back of MSE walls unless required otherwise on the plans. Cast-in-place concrete coping is required when noted on plans and for MSE walls with SRW units. At the Contractor's option, connect cast-in-place concrete coping to panels and blocks with dowels or extend coping down the back of MSE walls. Also, connect cast-in-place leveling concrete for precast concrete coping to panels with dowels. When barriers are required above MSE walls, use concrete barrier rails with moment slabs in accordance with the plans and design reinforcement for impact loads in accordance with the *AASHTO Standard Specifications for Highway Bridges* unless otherwise required.

Submit working drawings and design calculations for review and acceptance in accordance with Article 105-2 of the *Standard Specifications*. Submit working drawings showing plan views, wall profiles with maximum applied bearing pressures, typical sections with reinforcement connection details, select material type and separation fabric locations and details of leveling pads, facing elements, coping, bin walls, slip joints, etc. If necessary, include details on working drawings for concrete barrier rails with moment slabs, reinforcement connected to end bent caps and obstructions interfering with reinforcement or extending through walls. Submit design calculations for each wall section with different

surcharge loads, 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.

3.0 MATERIALS

A. Certifications, Storage and Handling

Provide certifications in accordance with Article 106-3 of the *Standard Specifications*. Provide Type 3 Manufacturer's Certifications for all MSE wall materials with the exception of geogrids, SRW units and precast elements. For each geogrid product, provide Type 2 Typical Certified Mill Test Reports for tensile strength. For SRW units, 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 units away from the casting yard until the concrete strength reaches 27.6 MPa and a period of at least 5 days elapses after casting unless otherwise approved.

Identify, store and handle geogrids and fabrics in accordance with ASTM D4873. Geogrids and fabrics with defects, flaws, deterioration or damage will be rejected. Do not leave geogrids and fabrics 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 50 mm clearance to the reinforcing steel. Produce panels within 6 mm of the panel dimensions shown in the accepted submittals.

A minimum compressive strength of 27.6 MPa at 28 days is required. For testing panels for compressive strength, 4 cylinders are required per 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) Units

Unless required otherwise on the plans, provide SRW units with a vertical split face and a concrete gray color with no tints, dyes or pigments. Before beginning block production, obtain approval of sample blocks of the type, face and color proposed for the project.

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 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 SRW units, a minimum compressive strength of 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.

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 minimum average roll values (MARV) as defined by ASTM D4439 for tensile strength of geogrids. For testing geogrids, a lot is defined as a single day's production.

D. Select Material

Provide select material 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 nos. 2S or 2MS when prohibited by a note on plans or when SRW units are not allowed.

When using steel reinforcement with nos. 2S or 2MS, provide select material 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 select material free of deleterious materials with a maximum organic content of 1% tested in accordance with AASHTO T267.

E. 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 and 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.

F. Coping, Leveling Concrete and Pads

Provide concrete coping and leveling pads 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* and leveling concrete for precast coping meeting the requirements of Section 1000 of the *Standard Specifications*.

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

G. Wall Drainage Systems

Wall drainage systems consist of drains and outlet components. Use shoulder drain materials meeting the requirements of Section 816 of the *Standard Specifications*.

H. Separation Fabrics

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

I. Concrete Barrier Rails with Moment Slabs

Provide concrete barrier rails with 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*.

Use Class A Concrete for moment slabs and Class AA Concrete for concrete barrier rails in accordance with Article 1000-4 of the *Standard Specifications*.

J. Joint Materials

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

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 NCDOT Materials & Tests (M&T) Unit before beginning wall construction. M&T will provide the corrosion monitoring instrumentation kits 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, Contractor and 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. Direct run off away from MSE walls, select material and backfill. Contain and maintain select material and backfill and protect material from erosion.

Perform necessary clearing and grubbing in accordance with Section 200 of the *Standard Specifications*. Excavate as necessary for MSE walls in accordance with the accepted submittals. If applicable and at the Contractor's option, "temporary shoring for wall construction" may be used in lieu of temporary slopes to construct MSE walls. For this provision, temporary shoring for wall construction is defined as temporary shoring not shown on the plans or required by the Engineer including shoring for OSHA reasons or the Contractor's convenience.

Unless prohibited by a note on plans, install foundations located in the reinforced zone before placing select material or the first reinforcement layer. Notify the Engineer when foundation excavation is complete. Do not place leveling pad concrete, select material or reinforcement 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 block joints to create a running bond when possible unless shown otherwise in the accepted submittals. Place blocks with a maximum joint width of 10 mm and set panels with a joint width of 13 to 25 mm. Construct MSE walls with a vertical and horizontal tolerance of 19 mm when measured with a 3 m straight edge and a final overall vertical plumbness (batter) of less than 13 mm per 3 m of wall height.

Place reinforcement at the locations and elevations shown in the accepted submittals. Do not splice reinforcement. 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 select material in the reinforced zone in 200 to 250 mm thick lifts. Compact standard size nos. 2S and 2MS select material in accordance with Subarticle 235-4(C) of the *Standard Specifications*. Use only hand operated compaction equipment within 1 m of the wall face. At a distance greater than 1 m, compact select material with at least 4 passes of a 7.3 - 9.1 metric ton vibratory roller. Smooth wheeled or rubber tired rollers are also acceptable for compacting select material. Do not use sheepsfoot, grid rollers or other types of compaction equipment with feet. Compact select material in a direction parallel to the wall face. Do not damage reinforcement when placing and compacting select material. End dumping directly on the reinforcement is not permitted. Do not operate heavy equipment on the reinforcement until it is covered with at least 250 mm of select material. Replace any damaged reinforcement to the satisfaction of the Engineer. Backfill for wall construction outside the reinforced zone in accordance with Article 410-8 of the *Standard Specifications*.

If a drain is required, install wall drainage systems as shown in the accepted submittals and in accordance with Section 816 of the *Standard Specifications*. Provide drains with positive drainage towards outlets.

Place and construct coping and leveling concrete as shown in the accepted submittals. Construct cast-in-place concrete coping, leveling concrete and moment slabs in accordance with Section 420 of the *Standard Specifications*. Do not remove forms until concrete achieves a minimum compressive strength of 16.5 MPa. Provide a Class 2 Surface Finish for cast-in-place concrete coping in accordance with Article 420-17 of the *Standard Specifications*. Construct concrete barrier rails with moment slabs in accordance with the plans and concrete barrier rails in accordance with Subarticle 460-3(C) of the *Standard Specifications*.

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

When separation fabric is required, overlap fabric a minimum of 450 mm with seams oriented parallel to the wall face. Seal joints above and behind MSE walls between coping and ditches with joint sealer as shown on the plans.

8.0 MEASUREMENT AND PAYMENT

MSE Retaining Walls will be measured and paid for in square meters. MSE walls will be measured as the exposed face area with the wall height equal to the difference between the top and bottom of wall elevation. The top of wall elevation is defined as the top of coping unless shown otherwise on the plans. 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.

The contract unit price bid for *MSE Retaining Walls* will be full compensation for design, submittals, furnishing labor, tools, equipment and MSE wall materials, excavating, backfilling, hauling and removing excavated materials and providing site assistance, leveling pads, facing elements, reinforcement, select material, wall drainage systems, fabrics, coping, miscellaneous components and any incidentals necessary to design and construct MSE walls in accordance with this provision. If necessary, the contract unit price bid for *MSE Retaining Walls* will also be full compensation for reinforcement connected to and select material behind end bent caps in the reinforced zone in accordance with the contract.

No separate payment will be made for temporary shoring for wall construction. Temporary shoring for wall construction will be considered incidental to the contract unit price bid for *MSE Retaining Walls. Concrete Barrier Rail* will be measured and paid for in accordance with Article 460-4 of the *Standard Specifications*. The contract unit price bid for *Concrete Barrier Rail* will be full compensation for providing concrete barrier rails with moment slabs in accordance with the contract and no separate payment for moments slabs will be made. Payment will be made under:

Pay Item	**Pay Unit**
MSE Retaining Walls	Square Meter

ONE BAR METAL RAIL REATTACHMENT **(SPECIAL)**

1.0 GENERAL

Install salvaged one bar metal rail in accordance with the details shown in the contract plans, Standard Specifications, and this Special Provision.

2.0 BASIS OF PAYMENT

The quantity for which payment is made is shown in linear meters on the plans for "One Bar Rail ReAttachment". The unit bid per linear meters is full compensation for all materials, tools, labor, equipment and incidentals necessary to complete this item.

MASS CONCRETE: **(SPECIAL)**

Structure 7 at Station 14+60.500 -RP1A-: the footings, columns, and caps of all interior bents are mass concrete elements.

Structure 8 at Station 28+72.626 –RP1BD-: the footings, columns and caps of all interior bents are mass concrete elements. The Post-Tensioning Encasements of Bents 5, 6 & 7 are not mass concrete elements.

The Contractor shall provide an analysis of the anticipated thermal developments in the mass concrete elements using his proposed mix design, casting procedures, and materials. Additionally, the Contractor shall describe the measures and procedures he intends to use to limit the temperature differential to 20°C (35°F) or less between the interior and exterior of the designated mass concrete elements during curing. The proposed plan to control the temperature differential shall be submitted to the Department for review and comments at the time approval is requested for the mass concrete mix design.

Maintenance of the specified thermal differential may be accomplished through a combination of the following:

A. Selection of concrete ingredients to minimize the heat generated by hydration of the cement.

B. Cooling component materials to reduce the temperature of the concrete while in its plastic state.

C. Controlling the rate of placing the concrete.

D. Insulating the surface of the concrete to prevent heat loss.

E. Providing supplemental heat at the surface of the concrete to prevent heat loss.

F. Other acceptable methods which may be developed by the Contractor.

Mass concrete shall be the Class A or Prestress -41.4 MPa (6000 psi) Concrete as shown on the plans, vibrated, air-entrained, and shall contain an approved set-retarding, water-reducing admixture, and 30% flyash by weight of the total cementitious material. The total cementitious material shall not exceed 410 kg per cubic meter (690 lbs. per cubic yard) of concrete. The maximum water-cementitious material ratio shall be 0.366 for rounded aggregate and 0.410 for angular aggregate. The slump of the concrete shall not exceed 150mm (6 inches). The Contractor shall submit compressive strength results, the average of at least three cylinders made in the laboratory, of his proposed mix design. These cylinders shall show a minimum strength of 24.2 MPA (3500 psi) for Class A concrete and 44.9 MPa (6500 psi) for Prestress -41.4MPa Concrete at 28 days.

Minimum compressive strength at 28 days of field placed Class A concrete shall be 20.7 MPa (3000 psi), and the minimum compressive strength at 28 days of field placed Prestress -41.4 MPa Concrete shall be 41.4 MPa (6000 psi).

The Contractor shall meet the temperature monitoring requirements listed below for all elements designated as mass concrete elements. At the discretion of the Engineer, all temperature monitoring requirements may be waived provided the Contractor has proven to the satisfaction of the Engineer that he can limit the temperature differential to 20°C (35°F) or less between the interior and exterior of a given element.

The Contractor shall provide and install a minimum of six temperature sensing devices in each mass concrete pour to monitor temperature differentials between the interior and exterior of the pour unless otherwise directed by the Engineer. These devices shall be accurate within ±1.1°C (±2°F) within the temperature range of 4°C (40°F) to 82°C (180°F). One temperature sensing probe shall be placed near the center of mass of the pour, and another temperature sensing probe shall be placed at approximately 50 mm (2 inches) clear from the surface of the concrete furthest from the center of mass. The locations of the other temperature sensing probes shall be approved by the Engineer.

The monitoring devices shall be read and readings recorded at one hour intervals, beginning when casing is complete and continuing until the maximum temperature is reached and two consecutive readings indicate a temperature differential decrease between the interior and exterior of the element. At the option of the Contractor, the temperature may be recorded by an approved strip-chart recorder furnished by the Contractor. If monitoring indicated the 20°C (35°F) differential has been exceeded, the Contractor shall make the necessary revisions to the approved plan to reduce the differential on any remaining placements to 20°C (35°F) or less. Revisions to the approved plan must be approved by the Department prior to implementation.

Flyash used in the mass concrete mix shall meet the requirements of Article 1024-5 and 1024-7 of the Standard Specifications. Portland Cement shall meet the requirements of AASHTO M85 for Portland Cement Type II.

The temperature of mass concrete at the time of placement shall not be less than 4°C (40°F) nor more than 24°C (75°F).

The placement of the mass concrete shall be continuous until the work is completed and the resulting structures shall be monolithic and homogeneous.

The entire cost of this work shall be included in the unit contract price bid for Class A or Prestress -41.4MPa concrete.