


**Project Special Provisions  
Structures and Culverts  
Table of Contents**

	Page #
1 Maintenance & Protection of Traffic Beneath Proposed Structure at Station 63+66.830 -L- (8-13-04)	1
2 Maintenance & Protection of Traffic Beneath Proposed Structure at Station 41+41.155 -COL2- (8-13-04)	2
3 Pot Bearings (6-7-05)	2
4 Thermal Sprayed Coatings (Metallization) (6-7-05)	6
5 Modular Expansion Joint Seals (6-7-05)	10
6 Evazote Joint Seals (8-13-04)	13
7 Elastomeric Concrete (10-12-01)	17
8 Mechanically Stabilized Earth Retaining Walls (4-15-08)	18
9 Falsework and Formwork (7-18-06)	27
10 Submittal of Working Drawings (9-16-08)	32
11 Construction, Maintenance & Removal of Temporary Access at Station 58+15.000 -L-(LT. LN.)	39
12 Optional Disc Bearings (6-7-05)	39
13 Bridge Deck Rideability and Grooving at Station 63+66.830 -L- (7-18-06)	44
14 Crane Safety (8-15-05)	46
15 Pile Driving Analyzer (11-17-06)	47
16 Crack Repair of Prestressed Concrete Girders (7-18-06)	52
17 Shipping Steel Structural Members (7-18-06)	52
18 Grout for Structures (7-12-07)	54
19 High Strength Bolts (11-17-06)	56
20 Prestressed Concrete Members (04-02-07)	56
21 Adhesively Anchored Anchor Bolts or Dowels (6-11-07)	57
22 Continuous Flight Auger Piles for Sound Barrier and Visual Barrier Walls (SPECIAL)	58
23 Pile Restrikes for LRFD (SPECIAL)	63
24 Visual Barrier Wall (SPECIAL)	64
25 Visual Barrier Wall on Structure (SPECIAL)	66
26 Metric Structural Steel (SPECIAL)	67
27 Structural Steel for Bridge at Station 63+66.830 -L- (SPECIAL)	68
28 Charpy V-Notch Tests (SPECIAL)	73

  
 Except for  
 22, 23, 25 thru 28

**PROJECT SPECIAL PROVISIONS**  
**STRUCTURES AND CULVERTS**

PROJECTS U-2519E &amp; X-0002B

CUMBERLAND COUNTY

**MAINTENANCE AND PROTECTION OF TRAFFIC BENEATH**  
**PROPOSED STRUCTURE AT STATIONS 63+66.830 -L-**

(8-13-04)

**1.0 GENERAL**

Maintain traffic on NC 210 (-Y1-) as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 5.0 meters 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 STATIONS 41+41.155 -COL2-**

(8-13-04)

**1.0 GENERAL**

Maintain traffic on Bragg Boulevard (-Y2-) as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 5.0 meters 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 polytetrafluoroethylene (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<sup>2</sup> (18.6m<sup>2</sup>) measure 2 spots/surface per piece and for pieces greater than 200 ft<sup>2</sup> (18.6m<sup>2</sup>) add 1 additional spots/surface for each 500 ft<sup>2</sup> (46.5m<sup>2</sup>)).

<b>Application</b>	<b>Thickness</b>	<b>Alloy</b>	<b>Seal Coat</b>
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 <sup>2</sup>	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 <sup>2</sup>	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 <sup>2</sup>	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  $0.1 \text{ ft}^2$  ( $9300\text{mm}^2$ ) 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  $0.1 \text{ ft}^2$  ( $9300\text{mm}^2$ ) exposing the substrate are metallized in accordance with SSPC CS 23.00.
4. Damaged (burnished) areas not exposing the substrate with less than the specified coating thickness are metallized in accordance with SSPC CS 23.00 or painted in accordance with ASTM A780, "Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings."
5. Damaged (burnished) areas not exposing the substrate with more than the specified coating thickness are not repaired.
6. Defective coating is repaired by either method 2 or 3 depending on the area of the defect.

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

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

## 7.0 TWELVE MONTH OBSERVATION PERIOD

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

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

## 8.0 BASIS OF PAYMENT

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

## 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.

**EVAZOTE JOINT SEALS**

**(8-13-04)**

**1.0 SEALS**

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

Use seals manufactured with grooves 1/8" (3 mm) ± wide by 1/8" (3 mm) ± deep and spaced between 1/4 (6 mm) and 1/2 inch (13 mm) apart along the bond surface running the length of the joint. Use seals sized so that the depth of the seal meets the manufacturer's recommendation, but is not less than 70% of the uncompressed width. Provide a seal designed so that, when compressed, the center portion of the top does not extend upward above the original height of the seal by more than 1/4 inch (6 mm). Splice the seal using the heat welding method by placing the joint material ends against a teflon heating iron of 350°F (177°C) for 7 - 10 seconds, then pressing the ends together tightly. Do not test the welding until the material has completely cooled. Use material that resists weathering and ultraviolet rays. Provide a seal that has a working range of 30% tension and 60% compression and is watertight along its entire length including the ends.

Provide seals that meet the requirements given below.

TEST	TEST METHOD	REQUIREMENT
Elongation at break	ASTM D3575	210 ± 15%
Tensile strength, psi (kPa)	ASTM D3575	110 ± 15 (755 ± 100)
Compression Recovery (% of original width)	AASHTO T42 50% compr. for 22 hr. @ 73°F (23°C) 1/2 hr. recovery	87 ± 3
Weather/Deterioration	AASHTO T42 Accelerated Weathering	No deterioration for 10 years min.

TEST	TEST METHOD	REQUIREMENT
Compression/Deflection	@ 50% deflection of original width	10 psi (69 kPa) min.
	@ 50% deflection of original width	60 psi (414 kPa) max.
Tear Strength, psi (kPa)	ASTM D624	16 ± 3 (110 ± 20)
Density	ASTM D545	2.8 to 3.4
Water Absorption (% vol/vol)	ASTM D3575 Total immersion for 3 months	3

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

**2.0 ADHESIVES**

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

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

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

**3.0 SAWING THE JOINTS**

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

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

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

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

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

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

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

#### **4.0 PREPARATIONS FOR SAWED JOINTS**

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

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

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

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

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

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

#### **5.0 PREPARATIONS FOR ARMORED JOINTS**

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

##### **A. Submittals**

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



**B. Surface Preparation**

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

**1. Angle Assembly**

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

**2. Concrete**

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

**C. Elastomeric Concrete Placement**

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

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

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

**D. Joint Preparation**

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

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

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

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

**6.0 SEAL INSTALLATION**

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

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

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

**7.0 BASIS OF PAYMENT**

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

**ELASTOMERIC CONCRETE**

(10-12-01)

**1.0 DESCRIPTION**

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

**2.0 MATERIALS**

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

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

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

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

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

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

**3.0 BASIS OF PAYMENT**

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

**MECHANICALLY STABILIZED EARTH RETAINING WALLS**

**(4-15-08)**

**1.0 GENERAL**

**A. Description**

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

## B. MSE Wall System

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

<http://www.ncdot.org/doh/preconstruct/highway/geotech/msewalls/>

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

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

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

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

## C. Temporary Shoring for Wall Construction

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

## 2.0 SUBMITTALS

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

### A. MSE Wall Design Submittal

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

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

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

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

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

verifying the analysis of the section with the longest reinforcement length. Have MSE walls designed, detailed and sealed by a Professional Engineer registered in North Carolina.

#### B. MSE Wall Installation Submittal

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

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

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

Submit documentation for the Superintendent assigned to this project verifying employment with the MSE Wall Installer and a minimum of 5 years experience with the chosen MSE wall system including past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc. Perform work with the Superintendent submitted and accepted. If a different Superintendent is required during construction, suspend MSE wall construction until the replacement Superintendent is submitted and accepted.

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

### 3.0 MATERIALS

#### A. Certifications, Storage and Handling

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

Load, transport, unload and store MSE wall materials such that they are kept clean and free of damage. Damaged panels or blocks with excessive discoloration, chips or cracks as determined by the Engineer will be rejected. Do not damage reinforcement

connection hardware or mechanisms in handling and storing panels or blocks. Label each pallet of blocks with the information listed in Article 1077-13 of the *Standard Specifications*. Do not transport SRW blocks away from the casting yard until the concrete strength reaches 4000 psi (27.6 MPa) and a period of at least 5 days elapses after casting unless otherwise approved.

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

## B. Facing Elements

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

### 1. Precast Concrete Panels

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

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

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

### 2. Segmental Retaining Wall (SRW) Blocks

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

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

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

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

**C. Reinforcement**

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

**1. Steel (Inextensible) Reinforcement**

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

**2. Geogrid (Extensible) Reinforcement**

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

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

**D. Wall Backfill**

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

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

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

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



#### E. Concrete Leveling Pads, Coping and Moment Slabs

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

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

#### F. Separation Fabric

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

#### G. Joint Materials

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

#### H. Miscellaneous Components

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

### 4.0 CORROSION MONITORING

Corrosion monitoring is required for MSE walls with steel reinforcement. The Engineer will determine the number of monitoring locations and where to install the instrumentation. Contact the 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. Collect and direct run off away from MSE walls and wall backfill. Contain and maintain wall backfill and protect material from erosion.

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

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

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

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

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

Place wall backfill in the reinforced zone in 8 to 10 inch (200 to 250 mm) thick lifts. Compact standard size nos. 2S and 2MS wall backfill in accordance with Subarticle 235-4(C) of the *Standard Specifications*. Use only hand operated compaction equipment within

3 ft (1 m) of the wall face. At a distance greater than 3 ft (1 m), compact wall backfill with at least 4 passes of an 8 – 10 ton (7.3 - 9.1 metric ton) vibratory roller. Smooth wheeled or rubber tired rollers are also acceptable for compacting wall backfill. Do not use sheepsfoot, grid rollers or other types of compaction equipment with feet. Compact wall backfill in a direction parallel to the wall face. Do not damage reinforcement when placing and compacting wall backfill. End dumping directly on the reinforcement is not permitted. Do not operate heavy equipment on the reinforcement until it is covered with at least 10" (250 mm) of wall backfill. Backfill for wall construction outside the reinforced zone in accordance with Article 410-8 of the *Standard Specifications*.

Place and construct coping as shown in the accepted submittals. Construct cast-in-place concrete coping and moment slabs in accordance with Section 420 of the *Standard Specifications*. Do not remove forms until concrete achieves a minimum compressive strength of 2400 psi (16.5 MPa). Provide a Class 2 Surface Finish for cast-in-place coping in accordance with Article 420-17 of the *Standard Specifications*. Construct concrete barrier rail coping with moment slabs in accordance with the plans and barrier rail coping in accordance with Subarticle 460-3(C) of the *Standard Specifications*.

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

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

## 8.0 MEASUREMENT AND PAYMENT

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

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

**Pay Item**  
MSE Retaining Walls

**Pay Unit**  
Square Foot (Square Meter)

**FALSEWORK AND FORMWORK**

(7-18-06)

**1.0 DESCRIPTION**

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

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

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

**2.0 MATERIALS**

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

**3.0 DESIGN REQUIREMENTS**

**A. Working Drawings**

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

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

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 <sup>2</sup> (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, metallize or otherwise protect these devices as directed by the Engineer. Any coating required by the Engineer will be considered incidental to the various pay items requiring temporary works.

#### B. Review and Approval

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

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

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

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

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

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

#### 4.0 CONSTRUCTION REQUIREMENTS

All requirements of Section 420 of the Standard Specifications apply.

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

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

#### A. Maintenance and Inspection

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

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

#### B. Foundations

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

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

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

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

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

### 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**

(9-16-08)

#### **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.

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

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

Via US mail:

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

Via other delivery service:

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

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

Via US mail:

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

Via other delivery service:

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

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

- Primary Structures Contact: Paul Lambert  
(919) 250 – 4041  
(919) 250 – 4082 facsimile  
[plambert@ncdot.gov](mailto: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](mailto:kkim@ncdot.gov)
- Western Regional Geotechnical Contact (Divisions 8-14):  
John Pilipchuk  
(704) 455 – 8902  
(704) 455 – 8912 facsimile  
[jpilipchuk@ncdot.gov](mailto: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 <sup>1</sup>
Arch Culvert Falsework	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Box Culvert Falsework <sup>7</sup>	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Cofferdams	6	2	Article 410-4
Evazote Joint Seals <sup>6</sup>	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 <sup>2</sup> (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 <sup>4,5</sup>	7	0	Article 1072-10

Miscellaneous Metalwork <sup>4,5</sup>	7	0	Article 1072-10
Optional Disc Bearings <sup>4</sup>	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 <sup>4</sup>	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) <sup>3</sup>	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 <sup>5</sup>	7	0	Article 1072-10 & “Sound Barrier Wall”
Structural Steel <sup>4</sup>	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 <sup>4</sup>	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.

**GEOTECHNICAL SUBMITTALS**

<b>Submittal <sup>1</sup></b>	<b>Copies Required by Geotechnical Engineering Unit</b>	<b>Copies Required by Structure Design Unit</b>	<b>Contract Reference Requiring Submittal <sup>2</sup></b>
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 <sup>3</sup>	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 58+15.000 -L- (LT. LN.)**

(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. 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 polytetrafluoroethylene (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 polytetrafluoroethylene (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:

- 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

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 STATION 63+66.830 -L-

(7/18/06)

### 1.0 GENERAL

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

### 2.0 RIDEABILITY REQUIREMENTS

Test all traffic lanes on the bridge deck surface with a Rainhart Profilograph (Model 1, No. 860) in accordance with the criteria herein. It is the Contractor's responsibility to submit a proposed plan of action and to schedule and perform the profilograph testing. Use an independent provider, approved by the Engineer, to perform the profilograph test. Use equipment calibrated for both height and distance in accordance with ASTM E1274. Submit the calibration results to the Engineer for approval prior to testing of the bridge deck.

Prior to initial profilograph testing, complete placement of the bridge deck and barrier rail within the section to be tested, 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. Temporarily bridge joint locations 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. Do not allow any radio transmissions or other activities that might disrupt the automated profilograph equipment during the testing.

Check the wheels of the profilograph to ensure proper tire pressure as per 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). Take profiles with the recording wheel parallel to and approximately 3.5 feet (1.1 m) inside the two outer edges of each travel lane.

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

Determine the Profile Index for each wheel path in accordance with the procedure entitled "Determination of Profile Index" available through the Engineer.

Determine a Profile Index per lane by averaging the index for the right and left wheel paths for each test section. A test section is defined as a 600 foot (182.9 m) length of each travel lane. Submit the profilogram and Profile Index calculations for all test sections to the Engineer for review. The maximum allowable Profile Index per lane shall not exceed 6" per mile (95 mm per km) as determined with a 0.2" (5.1 mm) blanking band over any 600 foot (182.9 m) test section. Correct individual high points or depressions having deviations in excess of 0.3" in 25 feet (7.6 mm in 7.6 m) on the profilogram by planing. 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 PLANING

If a test section does not meet the rideability requirements above, plane the full width of all lanes and shoulders in that direction of travel beginning 150 feet (45.7 m) before and ending 150 feet (45.7 m) beyond the limits of the unacceptable test section. Additional planing beyond these limits may be required as deemed necessary by the Engineer.

When planing, use a Boart Longyear PC 5000, a Target 3804 or approved equal. Submit grinding equipment specifications to the Engineer for approval before any planing is performed. Use a grinding machine capable of removing a minimum of 3 feet of width with each pass. Multiple passes may be required 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 plane the deck parallel to the roadway centerline.

Continuously remove all slurry or other debris resulting from the grinding operations from the surfaces by vacuum pick-up or other approved methods. Prevent the slurry from flowing into floor drains or onto the ground or 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 planing 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 planing and any other corrective actions, until the rideability requirements above are satisfied.

#### 4.0 GROOVING BRIDGE FLOORS

After the concrete surface profile has been accepted by the Engineer, the joints have been installed, and the concrete blockouts poured, 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 planed 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 planing of the bridge deck. The cost of the testing procedure, equipment, planing operation, and removal and disposal of slurry resulting from the planing 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.

**CRACK REPAIR OF PRESTRESSED CONCRETE GIRDERS**

(7-18-06)

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

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

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

**SHIPPING STEEL STRUCTURAL MEMBERS**

(7-18-06)

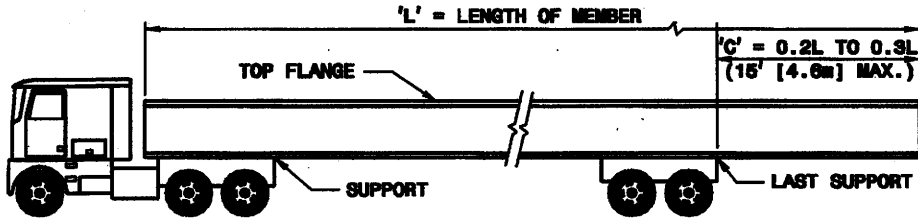
**Section 1072-23 Marking and Shipping**

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

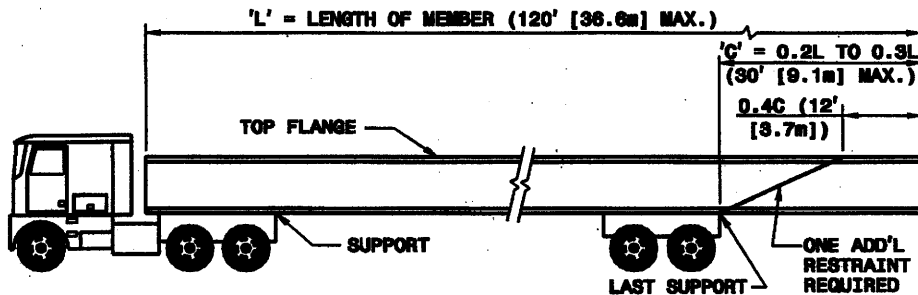
Load and ship steel beams and girders in accordance with the Figure below for all types of transportation.

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)	25½ (7.8m)
90 (27.4m)	18 (5.5m)	27 (8.2m)
95 (29.0m)	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  $\frac{1}{2}$  to  $\frac{3}{4}$  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.

<b>ELAPSED TIME FOR PLACING GROUT</b> (with continuous agitation)		
<b>Air or Grout Temperature Whichever is Higher</b>	<b>Maximum Elapsed Time</b>	
	<b>No Set Retarding Admixture Used</b>	<b>Set Retarding Admixture Used</b>
90°F (32°C) or above	30 min.	1 hr. 15 min.
80°F (27°C) through 89°F (31°C)	45 min.	1 hr. 30 min.
79°F (26°C) or below	60 min.	1 hr. 45 min.

**5.0 MISCELLANEOUS**

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

**HIGH STRENGTH BOLTS**

(11-17-06)

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

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

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

**PRESTRESSED CONCRETE MEMBERS**

(4-02-07)

The 2006 Standard Specifications shall be revised as follows:

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

(A) Producer Qualification

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

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

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

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

## **ADHESIVELY ANCHORED ANCHOR BOLTS OR DOWELS**

(6-11-07)

### **1.0 GENERAL**

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

### **2.0 INSTALLATION**

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

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

### **3.0 FIELD TESTING**

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

"In the presence of the Engineer, field test the anchor bolt or dowel in accordance with the test level shown on the plans and the following:

Level One Field testing: Test a minimum of 1 anchor but not less than 10% of all anchors to 50% of the yield load shown on the plans. If less than 60 anchors are to be installed, install and test the required number of anchors prior to installing the remaining anchors. If more than 60 anchors are to be installed, test the first 6 anchors prior to installing the remaining anchors, then test 10% of the number in excess of 60 anchors.

**Level Two Field testing:** Test a minimum of 2 anchors but not less than 10% of the all anchors to 80% of the yield load shown on the plans. If less than 60 anchors are to be installed, install and test the required number of anchors prior to installing the remaining anchors. If more than 60 anchors are to be installed, test the first 6 anchors prior to installing the remaining anchors, then test 10% of the number in excess of 60 anchors.

Testing should begin only after the Manufacturer's recommended cure time has been reached. For testing, apply and hold the test load for three minutes. If the jack experiences any drop in gage reading, the test must be restarted. For the anchor to be deemed satisfactory, the test load must be held for three minutes with no movement or drop in gage reading."

#### **4.0 REMOVAL AND REPLACEMENT OF FAILED TEST SPECIMENS:**

Remove all anchors and dowels that fail the field test without damage to the surrounding concrete. Redrill holes to remove adhesive bonding material residue and clean the hole in accordance with specifications. For reinstalling replacement anchors or dowels, follow the same procedures as new installations. Do not reuse failed anchors or dowels unless approved by the Engineer.

#### **5.0 USAGE**

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

#### **6.0 BASIS OF PAYMENT**

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

### **CONTINUOUS FLIGHT AUGER PILES FOR SOUND BARRIER AND VISUAL BARRIER WALLS**

**(SPECIAL)**

#### **1.0 GENERAL**

This special provision governs the construction of continuous flight auger (CFA) piles. CFA piles are constructed by drilling a borehole with a continuous flight hollow stem auger and filling the borehole by pumping grout through the auger as it is withdrawn. After completing grout placement, reinforcement is inserted into the column of fluid grout. At the Contractor's option, construct CFA piles for sound barrier and visual barrier walls in lieu of pile excavation. Install CFA piles with the required depth in accordance with the Contract. Use a CFA Pile Subcontractor prequalified by the Contractual Services Unit of the Department for CFA pile work (work code 3110). For this provision, "pile" refers to a CFA pile and "reinforcement" refers to steel piles.

## 2.0 CFA PILE INSTALLATION PLAN SUBMITTAL

Provide 4 hard copies and an electronic copy (pdf or jpg format on CD or DVD) of the CFA pile installation plan submittal. Submit the installation plan at least 20 working days before starting CFA pile construction. Do not begin pile construction until the CFA pile installation plan is accepted.

Submit detailed project specific information including the following.

1. List and sizes of proposed equipment including CFA drilling rigs, augers and other drilling tools and grouting equipment.
2. Step-by-step description of CFA pile installation and sequence of pile construction.
3. Methods for placing reinforcement with procedures for supporting and positioning the reinforcement.
4. Minimum grout volume factor. The grout volume factor is equal to the grout volume placed divided by the theoretical grout volume for each depth increment. A grout volume factor of at least 1.15 is required.
5. Equipment and procedures for monitoring and recording grout volume.
6. Examples of construction records to be provided in accordance with Section 6.0.
7. Procedures for containment and disposal of drilling spoils in accordance with Section 802 of the *Standard Specifications*.
8. Grout mix design including laboratory test results in accordance with the Grout for Structures Special Provision.
9. Other information shown on the plans or requested by the Engineer.

If alternate installation procedures are proposed or necessary, a revised CFA pile installation plan submittal may be required. If the work deviates from the accepted submittal without prior approval, the Engineer may suspend CFA pile construction until a revised plan is submitted and accepted.

## 3.0 MATERIALS

Use steel piles meeting the requirements of Section 1084 of the *Standard Specifications*.

Use grout in accordance with the Contract.

## 4.0 CFA PILE PRECONSTRUCTION MEETING

Before starting CFA pile construction, conduct a preconstruction meeting to discuss the installation and monitoring of the CFA piles. Schedule this meeting after all CFA pile submittals have been accepted and the CFA Pile Subcontractor has mobilized to the site.

The Resident or Bridge Maintenance Engineer, Bridge Construction Engineer, Geotechnical Operations Engineer, General Contractor and the CFA Pile Subcontractor Superintendent, Drill Rig Operators and Project Manager will attend this preconstruction meeting.

## 5.0 CONSTRUCTION METHODS

Use equipment and methods reviewed and accepted in the CFA pile installation plan or approved by the Engineer. Inform the Engineer of any deviations from the accepted plan.

Dispose of drilling spoils and excess waste grout in accordance with Section 802 of the *Standard Specifications* and as directed by the Engineer. Drilling spoils consist of all excavated material including water removed from boreholes.

### A. Drilling

Use CFA piling rigs capable of drilling through whatever materials are encountered to the dimensions and depths shown on the plans or otherwise required by the Engineer.

Use single helix hollow stem augers with uniform diameters and continuous flights from the top of the auger to the bottom tip of the cutting face. Provide augers with flights and teeth that cut the bottom of the borehole flat. Augers with outside diameters at least 97% of the pile design diameter are required. Augers capable of installing piles to a depth 20% greater than plan depth are also required.

Unless piles are installed with a hydraulic fixed mast installation platform and the stem to which the auger is fixed has an outside diameter 10" (250 mm) or greater, at least one guide connected to the leads of the CFA piling rig is required. Prevent the leads from rotating during drilling and grouting.

Seal the grout injection port to prevent entry during drilling. Keep the hollow stem of augers clean when drilling. Clearly mark augers or leads every foot (0.3 m) along their length with markings visible to the unaided eye from the ground. Check for correct pile location and alignment before beginning drilling. Do not begin drilling until enough grout to complete the pile is on the project site.

Advance the auger into the ground at a continuous rate. Do not raise the auger until beginning grout placement. Control the auger rotation speed to prevent excess spoil from being transported to the ground surface and surrounding soil being drawn laterally into the borehole.

If muck, organics, soft soil or other unsuitable materials are encountered within 5 ft (1.5 m) of the ground surface, contact the Engineer as these materials can cause problems with top of pile construction. If auger refusal is encountered before reaching plan depth, stop the auger rotation and inform the Engineer. Unless it is determined otherwise, refusal is defined as less than 1 ft (0.3 m) of auger penetration per minute.

## B. Grouting

Remove all oil, rust inhibitors, residual drilling slurries and similar foreign materials from holding tanks/hoppers, stirring devices, pumps and lines and all other equipment in contact with grout before use.

Place a screen between the ready mix truck and the grout pump to remove large particles or cement balls using a mesh that has openings no larger than 3/4 inch (19 mm).

Use a positive displacement piston type pump with a known volume per stroke that can develop peak pressures at the pump of at least 350 psi (2.4 MPa). Size the pump to maintain a smooth continuous delivery of grout while limiting pressure variations (particularly pressure drops) due to pump strokes. At the beginning of construction, provide the grout volume delivered by each pump stroke and verify this value is within 3% of the actual volume. Recalibrate the grout volume per pump stroke during construction as necessary or directed by the Engineer.

Place grout in accordance with the Contract and accepted submittals. Pump grout without difficulty to fill any soft or porous zones and with sufficient pressure to ensure a continuous monolithic pile with at least the plan cross section from the maximum borehole depth to the top of the grout column. Provide grout free of segregation, intrusions, contamination, structural damage or inadequate consolidation (honeycombing).

Begin placing grout within 5 minutes after the auger has reached plan depth. At the beginning of grout placement, lift the auger 6 to 12 inches (150 to 300 mm) and remove the sealing device by applying grout pressure or with a steel bar. Do not lift the auger beyond this range in order to minimize soil movement. After grout flow is initiated, reinsert the auger to the original depth.

Pump grout continuously while extracting the auger at a smooth steady rate. Maintain a positive grout pressure at the auger injection point at all times. If rotation occurs while removing the auger, rotate the auger in the same direction as during drilling. If grout placement is suspended for any reason, inform the Engineer and redrill the CFA pile.

Monitor the depth of the auger injection point while counting pump strokes during grouting. Record the grout volume and factor versus depth of the auger injection point in increments of 5 ft (1.5 m) or less.

## C. Top of Pile Finishing and Protection

After placing grout, remove all excess grout and spoil from and place a temporary form within the top of the grout column. Use a form 3 to 5 ft (1 to 1.5 m) long with a diameter equal to or larger than the pile diameter. Place the form with equal lengths above and below the ground surface. Recheck the top of the grout and remove any foreign material. After the grout has reached initial set as determined by the Engineer, remove the form without disturbing the ground surface around the pile.

After placing the reinforcement, square the top of the CFA pile with the pile axis while grout is still fluid or by cutting off hardened grout. Construct the top of CFA pile to the elevation shown on the plans.

#### D. Reinforcement

Provide reinforcement for CFA piles consisting of steel piles as shown on the plans and accepted submittals. Place reinforcement as a unit while the grout is still fluid. Lower or gently push reinforcement into the grout. Do not vibrate or drive the reinforcement. Support the reinforcement at the ground surface until the grout strength reaches 2,500 psi (17.2 MPa). Contact the Engineer if reinforcement can not be properly inserted to the required depth.

### 6.0 CONSTRUCTION RECORDS

Provide 2 original hard copies of CFA pile construction records including the following after completing each pile.

1. Names of CFA Pile Subcontractor, Superintendent, Drill Rig Operator and Project Manager
2. Project description, county, NCDOT Contract, TIP and WBS element number
3. Wall station and number and pile location and identifier
4. The grout volume and factor versus depth of the auger injection point in increments of 5 ft (1.5 m) or less
5. CFA pile diameter, length and tip elevation, top of pile and ground surface elevations
6. Auger diameter and theoretical volume of the borehole
7. Grout temperature and flow for each ready mix truck
8. Size, length, top elevation and grade of reinforcement
9. Date and time drilling begins and ends, grout is mixed and arrives on-site, pumping grout begins and ends and reinforcement is placed
10. Weather conditions including air temperature at time of grout placement
11. All other pertinent details related to CFA pile construction

After completing all CFA piles for a sound barrier wall or visual barrier wall, submit electronic copies (pdf or jpg format on CD or DVD) of all corresponding construction records.

### 7.0 CFA PILE ACCEPTANCE

CFA pile acceptance is based on the following criteria.

1. Grout volume factor is greater than the minimum required for any 5 ft (1.5 m) depth increment.

2. Grout is in accordance with the Contract and does not have any evidence of segregation, intrusions, contamination, structural damage or inadequate consolidation (honeycombing).
3. CFA pile and reinforcement location, alignment and elevations are within tolerances for sound barrier walls or visual barrier walls for pile excavation and steel piles are in accordance with the Contract and accepted submittals.

If the Engineer determines a CFA pile is unacceptable or unsatisfactory, additional testing, remedial measures or replacement piles are required at no additional cost to the Department. Obtain approval for remediation proposals before performing work. No compensation will be made for losses or damages for remedial work or investigation of unacceptable or unsatisfactory piles.

### **8.0 MEASUREMENT AND PAYMENT**

Include the cost of the CFA piles in the unit bid price for "Sound Barrier Wall" or "Visual Barrier Wall". No separate payment will be made for the CFA piles. Include in this unit bid price all costs for submittals, monitoring and recording, labor, tools, equipment, reinforcement and grout complete and in place and all incidentals necessary to drill and construct CFA piles in accordance with this provision. No additional payment will be made for drilling through non-soil materials or any costs associated with unacceptable CFA piles.

### **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*.



**VISUAL BARRIER WALL****(SPECIAL)****1.0 DESCRIPTION**

This work consists of furnishing precast panels, structural steel, concrete, and all other materials; handling, transporting, fabricating, galvanizing, and storing materials; furnishing erection drawings, backfilling, pile excavation, and erecting and installing the visual barrier wall members and all other materials as required by the plans, Standard Specifications and this Special Provision.

The plans allow for a choice of a 10 ft (3.1 m) or 15 ft (4.6 m) pile spacing. Pile spacings greater than 15 ft (4.6 m) will not be permitted for any reasons. Once selected, use the pile spacing throughout the entire length of the wall unless the Engineer approves otherwise.

**2.0 MATERIALS AND FABRICATION**

Provide materials and fabricate members in accordance with the requirements of Division 10 of the Standard Specifications for Roads and Structures.

Provide precast panels that are 4 inches  $\pm$  1/4 inch (102  $\pm$  6 mm) thick with an exposed aggregate finish on one face. Install this face in the wall facing the roadway. The depth of the exposure is required to range from 0 to 1/4 inch (0 mm to 6 mm). Furnish three 12" x 12" (300 mm x 300 mm) samples for approval which establish the acceptable variations in color, texture, and uniformity. After the color, texture, and uniformity of the furnished samples are approved, produce a full scale panel unit meeting design requirements. This mock-up and the furnished samples establish the base or standard quality for acceptance of the panels. When producing the final installed panels, use fine and coarse aggregate, retarder, and cement from the same source as those used in the approved sample panels.

**3.0 CONSTRUCTION METHODS**

Complete the final survey of existing ground profile after clearing the wall area but prior to submitting any working drawings. Submit the final groundline survey with the working drawings.

If the Department is responsible for the survey, the Engineer field verifies the existing ground profile along the visual barrier wall. Contact the Engineer to obtain the survey information. Otherwise, complete the existing ground survey to determine the number and heights of the precast panels.

Provide consistent pile spacing throughout the length of the wall. Use odd pile spacings, if necessary, only at the ends of the wall and at turning points as approved by the Engineer.

Excavate holes with the diameters shown on the plans. Perform pile excavation to the depths shown on the plans and install piles as shown on the plans or in the accepted submittals with a tolerance of 1/2 inch per foot (42 mm per meter) from vertical. Backfill excavations with concrete after placing piles.

#### A. Pile Excavation

Use equipment of adequate capacity and capable of drilling through soil and non-soil including rock, boulders, debris, man-made objects and any other materials encountered. Blasting is not permitted to advance the excavation. Blasting for core removal is only permitted when approved by the Engineer. Dispose of drilling spoils in accordance with Section 802 of the Standard Specifications and as directed by the Engineer. Drilling spoils consist of all excavated material including water removed from the excavation either by pumping or drilling tools.

If unstable, caving or sloughing soils are anticipated or encountered, stabilize excavations with either slurry or steel casing. When using slurry, submit slurry details including product information, manufacturer's recommendations for use, slurry equipment information and written approval from the slurry supplier that the mixing water is acceptable before beginning drilling. When using steel casing, use either the sectional type or one continuous corrugated or non-corrugated piece. Steel casings should consist of clean watertight steel of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth or backfill. Use steel casings with an outside diameter equal to the hole size and a minimum wall thickness of 1/4 inch (6 mm).

#### B. Concrete Placement

Before placing concrete, center and support the pile in the excavation and check the water inflow rate in the excavation after any pumps have been removed. If the inflow rate is less than 6" (150 mm) per half hour, remove any water and free fall the concrete into the excavation. Ensure that concrete flows completely around the pile. If the water inflow rate is greater than 6" (150 mm) per half hour, propose a concrete placement procedure to the Engineer. The Engineer shall approve the concrete placement procedure before placing concrete.

Fill the excavation with Class A concrete in accordance with Section 1000 of the Standard Specifications except as modified herein. Provide concrete with a slump of 6" to 8" (150 to 200 mm). Use an approved high-range water reducer to achieve this slump. Place concrete in a continuous manner and remove all casings.

### 4.0 WORKING DRAWINGS

Submit casting drawings for the precast face panels for approval in accordance with Article 1077-2 of the Standard Specifications prior to casting. Show the inserts, method of handling, and support details used for transportation on casting drawings. Submit metalwork fabrication drawings for approval prior to fabrication of steel wall components. Submit an erection plan and concrete face panel placing plan, including location of various

heights of panels, for review and acceptance prior to fabrication of metalwork. Submit five sets of detail drawings.

**5.0 METHOD OF MEASUREMENT**

The quantity of visual barrier wall to be paid for will be the actual square feet (square meters) of precast panels used in the completed and accepted wall. Measurement will be made of the total area of precast panels used in the wall.

**6.0 BASIS OF PAYMENT**

The quantity of visual barrier wall, measured as provided above, will be paid for at the contract unit price bid per square foot (square meter) for "Visual Barrier Wall".

The unit price bid per square foot (square meter) will be full compensation for all work covered by this Special Provision including, but not limited to, furnishing precast panels, structural steel, concrete, and all other materials; handling, transporting, fabricating, galvanizing, and storing materials; furnishing erection drawings, backfilling, pile excavation including any casing or slurry, and erecting and installing the visual barrier wall members.

Payment will be made under:

Visual Barrier Wall .....Square Foot (Square Meter)

**VISUAL BARRIER WALL ON STRUCTURE**

**(SPECIAL)**

**Description**

This work consists of furnishing planks, structural steel and all other materials; handling, transporting, fabricating, galvanizing and storing materials; and erecting and installing the visual barrier wall members and all other materials as required by the plans, Standard Specifications and this Special Provision.

**Materials and Fabrication**

The structural planks for the visual barrier wall are to have the following properties:

Flexural Strength	57,000 psi (393.3 MPa)	ASTM D-790
Tensile Strength	60,000 psi (414.0 MPa)	ASTM D-638
Compressive Strength	65,000 psi (448.5 MPa)	ASTM D-695
Tensile Modulus	3,500,000 psi (24,150 MPa)	ASTM D-638
Specific Gravity	1.8 (typ)	ASTM D-792

The structural planks are to be color matched to the visual barrier walls adjacent to the structure. The Contractor will submit three color samples to the Engineer for approval before the planks are delivered to the jobsite.

The structural planks shall exhibit good workmanship and shall be free of burrs, cracks or other objectionable marks which would adversely affect the barrier's performance or serviceability. All cracked, discolored, burned and damaged structural panels will be rejected either at the fabrication shop or the construction site even after installation, but prior to acceptance of the project.

The structural steel is to meet the requirements of the Standard Specifications. The posts, backing angles, bolts, nuts and washers are to be galvanized.

Method of Measurement

The quantity of Visual Barrier Wall on Structure to be paid for will be the completed and accepted wall, according to the limits shown on the plans.

Basis of Payment

The quantity of Visual Barrier Wall on Structure, measured as provided above, will be paid for at the contract unit price for "Visual Barrier Wall on Structure."

Payment will be made under:

Visual Barrier Wall on Structure.....Square Meter

**METRIC STRUCTURAL STEEL**

**(SPECIAL)**

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.

**STRUCTURAL STEEL FOR BRIDGE AT STATION 63+66.830-L- (SPECIAL)**

Structural Steel in flanges designated in the plans shall be AASHTO M270 Grade HPS 485W and shall be in accordance with the plans and this special provision. All other structural steel shall be AASHTO M270 Grade 345W and shall be in accordance with the plans and Standard Specifications.

**1.0 GENERAL**

High performance steel shall be produced and fabricated in accordance with ANSI/AASHTO/AWS Bridge Welding Code D1.5-02, applicable portions of the Standard Specifications, and these Special Provisions.

## 2.0 MATERIAL PROPERTIES

Structural steel designated on the plans as Grade HPS 485W shall conform to the requirements of ASTM A709-04a.

## 3.0 WELDING

### A. General

All welding procedures for HPS 485W Steel shall be qualified in accordance with AWS D1.5 unless otherwise modified within this Special Provision.

Butt welds of flanges and webs and fillet welds of web to flanges of plate girders shall be made using the Submerged Arc Welding process. Only Submerged Arc Welding (SAW) or Shielded Metal Arc Welding (SMAW) may be used for all other connections involving HPS 485W steel.

The maximum level of diffusible hydrogen in deposited weld metal shall be 4 mL/100g. The level of diffusible hydrogen may be raised to 8mL/100g for SMAW only, provided that the higher preheat temperatures of Table 1 are attained.

### B. Filler Metal Requirements

1. Filler metals for use in connecting Grade HPS 485W plates using the SAW process shall be as follows:
  - a. LA85 electrode with Mil800HPNi flux, by Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199; (216) 481-8100
  - b. ENi4 electrode, by ESAB, 801 Wilson Avenue, Hanover, PA 17331-1058; (800) 933-7070, combined with Mil800H flux by Lincoln Electric Company
  - c. In lieu of the above consumable combinations, the contractor may request approval of alternate consumables from the Engineer. Alternate manufacturer specific filler metals, both electrode and flux, shall meet the AWS Electrode/Flux Classification F9A4 EXXX-X, with supplementary moisture resistance designators H4 or H2, as per AWS A5.23, with 1% Nickel minimum in the weld deposit.

When using alternate consumables, the fabricator is required to perform the full range of weld tests as required by AWS D1.5 Section 12.6.

When using alternate consumables, diffusible hydrogen ( $H_d$ ) tests shall be performed on the weld metal. Minimum preheat and interpass temperatures to be used with alternate consumables shall be in accordance with AWS D1.5, Table 4.4. The deposited weld metal shall have a diffusible hydrogen level equivalent to 4 mL/100g or less.  $H_d$  test

specimens are to be prepared at the fabrication plant. Specimens are to be tested in accordance with AWS A4.3. Test results in excess of 4 mL/100g are unacceptable, and a retest is required, with or without revised welding procedures. AWS D1.5 Section 5.7.6 is applicable, but WPS or H<sub>d</sub> results are not transferable from fabricator to fabricator. Fabricators with multiple plants under a common umbrella of welding equipment, welding training, and supervision are required to perform the H<sub>d</sub> testing only once per combination of consumables for each location. Plants audited as a single facility by the American Institute of Steel Construction (AISC) as a part of their Quality Certification Program, or other owner approved equal Quality Assurance Program, are considered one location. Multiple plants not falling under the AISC, or other 'single facility' audit definition, are considered separate facilities and additional WPS and H<sub>d</sub> tests are required.

SAW consumables shall meet the hydrogen control level of H4 as per AWS D1.5, Section VIII6.2.2.1(1).

2. Filler metals for all welds connecting a Grade HPS 485W plate to a Grade 345W plate shall conform to the requirements for Grade 345W base metal as listed in AWS D1.5, Table 4.1 (H8 maximum). At the fabricator's option, the consumable combinations of Section 3.0(B)(1)(a) or 3.0(B)(1)(b) may be used provided the hydrogen control level of H4 is met as per AWS D1.5, Section VIII6.2.2.1(1). Electrodes for use in connecting Grade HPS 485W plates to Grade 345W plates using the SMAW process shall have the designator 'R' for moisture resistant coating. The designator 'HZ' shall be either H4 or H8, depending upon the level of preheat used.
3. SAW consumables and SMAW electrodes shall produce weld deposits that meet the requirements of AWS D1.5 Table 4.3.
4. Filler Metal Qualification Test Requirements for welding of HPS 485W plates together are as listed in AWS D1.5, Table 4.1, for Grade 485W base metal. Qualification, Pretest and Verification Test Requirements for welding HPS 485W plates as determined using WPS Test Plates shall provide properties equal to or greater than the base metal requirements as specified in ASTM A709-04a.

C. Preheat and Interpass Temperature

The maximum interpass temperature for welding HPS 485W steel is 232°C.

The minimum preheat and interpass temperatures for welding of HPS 485W steel plates using the electrodes of Section 3.0(B)(1)(a) or 3.0(B)(1)(b) shall be in accordance with Table 1.

**Table 1**

**Minimum Preheat and Interpass Temperature, °C, for HPS 485W**

Welding Process	H <sub>d</sub> maximum	Thickness, t, (mm) of Thickest Part at Point of Welding			
		t ≤ 19	19 < t ≤ 38	38 < t ≤ 64	t > 64
SAW/SMAW*	4 mL/100g	10	22	22	52
SMAW	8 mL/100g	10	52	80	108

If satisfactory results are not achieved with the above minimum preheat and interpass temperatures during development of the Welding Procedure Specifications (WPS), and an increased preheat temperature is used to provide a satisfactory Procedure Qualification Record (PQR), the higher preheat temperature shall be used during bridge fabrication as the required minimum.

The minimum preheat or interpass temperature required for a joint composed of different base metals and/or thicknesses, shall be based on the highest of the minimum preheat from AWS D1.5, Table 4.4 or the table above.

\* Diffusible hydrogen or filler metal tested by manufacturer shall not exceed a H4 classification. Heat input shall be limited as indicated below.

For all other consumable combinations:

The preheat and interpass temperature requirements shall be in accordance with AWS D1.5, Table 4.4. When welding two pieces of Grade HPS 485W steel, the temperature requirements of Table 4.4, Group IV shall be used. When welding Grade HPS 485W steel to Grade 345W steel, the temperature requirements of Table 4.4, Group I/II shall be used.



D. Heat Input

The minimum amount of heat input shall be 1.57 kilojoules per millimeter (kJ/mm) and the maximum shall be 3.54 kJ/mm determined using AWS D1.5, Section 5.12.

E. Backing

Steel backing material for Welding Procedure Specification test plates may be composed of Grade 345W (Sulfur = 0.025 maximum) or HPS 485W material.

4.0 AISC CERTIFICATION

Only fabricators meeting the requirements of the AISC Quality Certification Program for "Major Steel Bridges " may be used to fabricate HPS 485W steel.

5.0 BASIS OF PAYMENT

Structural steel will be paid for at the contract lump sum price for "Approximately \_\_\_\_\_ Kilograms Structural Steel". No separate payment will be made for HPS 485W Steel. The approximate quantity shown in the contract pay item is an estimate based on the computed weight of the structural steel necessary to complete the work. No measurement for payment will be made for this pay item, and no adjustment in the contract lump sum price will be made for any variation from the approximate quantity shown except for revisions in the plans which affect the quantity of structural steel necessary to complete the work.

When revisions in the plans have been made which affect the quantities of structural steel, adjustments in compensation will be made by supplemental agreement.

Payment at the contract lump sum price for "Approximately \_\_\_\_\_ Kilograms Structural Steel" will be full compensation for shop painting.

The above prices and payments will be full compensation for all work covered by this section including but not limited to furnishing, fabricating, delivering, placing, erecting, cleaning, and shop painting; furnishing, erecting, and removing falsework; setting bearings and anchorages; welding; and assembling all structural joints.

Payment will be made under:

Approximately \_\_\_\_\_ Kilograms Structural Steel.....Lump Sum

**CHARPY V-NOTCH TESTS**

**(SPECIAL)**

Replace the first sentence of Section 1072-9(D) of the Standard Specifications with the following:

**For Bridges with High Performance Steel**

Furnish all structural steel for main beam and girder members (for girder members see plans) meeting the longitudinal Charpy V-Notch Tests specified in the supplementary requirements in ASTM A709-04a for zone 1. Unless otherwise noted on the plans, the material shall be marked and tested as non-fracture critical. Sampling and testing procedures shall be in accordance with AASHTO T243M (ASTM A673M). The (P) frequency of heat testing shall be used. For grade or grades of structural steel required, see Structure plans.

**For Bridges with Curved Girders**

Furnish all structural steel for main beam and girder members (for girder members see plans) and for diaphragms and crossframes connecting horizontally curved members meeting the longitudinal Charpy V-Notch Tests specified in the supplementary requirements in AASHTO M270 for zone 1.

Obtain and submit certified mill test reports to the Materials and Tests Unit to show the results of each test required by this specification.

Material failing to meet the qualification requirements outlined above is unacceptable for use on this project.