

**Project Special Provisions  
Structures and Culverts**

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*Quang H. Nguyen* 5-7-08

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

**PROJECT R-2518A**

**MADISON/YANCEY COUNTIES**

**OPTIONAL PRECAST REINFORCED CONCRETE**  
**BOX CULVERT AT STATION 82+70.000-L-, 10+26.580-Y11-**

**(2-14-04)**

**1.0 GENERAL**

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

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

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

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

## 2.0 PRECAST REINFORCED CONCRETE BOX SECTIONS

### A. Types

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

### B. Design

1. Design – The box section dimensions and reinforcement details are subject to the provisions of Section F.
2. Placement of Reinforcement – Provide a 1 inch (25 mm) concrete cover over the circumferential reinforcement subject to the provisions of Section F. Extend the inside circumferential reinforcement into the male portion of the joint and the outside circumferential reinforcement into the female portion of the joint. Detail the clear distance of the end circumferential wires so it is not less than 1/2 inch (13 mm) nor more than 2 inches (51 mm) from the ends of the box section. Assemble reinforcement per the requirements of AASHTO M259, Section 7.3. The exposure of the ends of the wires used to position the reinforcement is not a cause for rejection.
3. Laps and Spacing – Use lap splices for the circumferential reinforcement. Detail the circumferential wires so that the center to center spacing is not less than 2 inches (50 mm) nor more than 4 inches (100 mm). Do not detail the longitudinal wires with a center to center spacing of more than 8 inches (200 mm).
4. The design earth cover is reported on the plans as the elevation difference between the point of maximum fill and the top of the top slab.

### C. Joints

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

2. Seal the external joint with an outside sealer wrap that is at least 12 inches (300 mm) wide and covers the joint on both the sides and the top of the box section. Use ConWrap CS-212 from Concrete Sealants, Inc., EZ-Wrap from Press-Seal Gasket Corporation, Seal Wrap from Mar-Mac Manufacturing Co., Inc., Cadilloc External Pipe Joint from Cadilloc, or an approved equal for the outside sealer wrap. If the outside sealer wrap is not applied in a continuous strip along the entire joint, a 12 inch (300 mm) minimum lap of the outside sealer wrap is permitted. Before placing the outside sealer wrap, clean and prime the area receiving the outside sealer wrap in accordance with the sealer wrap manufacturer recommendations. The joint wrap manufacturer installation recommendations shall be included with shop drawings submitted for review. The external joint wrap shall be installed in three pieces, as indicated on Figure 1 below:

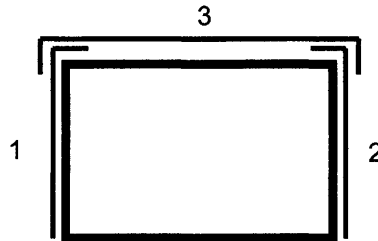


Figure 1

Cover the external joint sealer with a 3 foot (900 mm) strip of filter fabric conforming to Type 4 requirements in Section 1056 of the Standard Specifications. Place multiple lines of a precast reinforced concrete box culvert such that the longitudinal joint between the sections has a minimum width of 3 inches (75 mm). Fill the joint between multiple lines of precast box sections with Class A concrete. Use Class A concrete that meets the requirements listed in the Standard Specifications except that Field Compressive Strength Specimens are not required.

#### D. Manufacture

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

1. Mixture – In addition to the requirements of Section 1077 of the Standard Specifications, do not proportion the mix with less than 564 lb/yd<sup>3</sup> (335 kg/m<sup>3</sup>) of portland cement.
2. Strength – Make sure that all concrete develops a minimum 28-day compressive strength of 5000 psi (34.5 MPa). Movement of the precast sections should be minimized during the initial curing period. Any damage caused by moving or handling during the initial curing phase will be grounds for rejection of that precast section.
3. Air Entrainment – Air entrain the concrete in accordance with Section 1077 - 5(A) of the Standard Specifications. For dry cast manufacturing, air entrainment is not required.
4. Testing – Test the concrete in accordance with the requirements of Section 1077 - 5(B).
5. Handling – Handling devices or holes are permitted in each box section for the purpose of handling and laying. Submit details of handling devices or holes for approval and do not cast any concrete until approval is granted. Remove all handling devices flush with concrete surfaces as directed. Fill holes in a neat and workmanlike manner with an approved non-metallic non-shrink grout, concrete, or hole plug.

#### E. Physical Requirements

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

#### F. Permissible Variations

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

2. Internal Dimensions – Produce sections so that the internal and haunch dimensions do not vary by more than 1/4 inch (6 mm) from the plan dimensions.
3. Adjacent Sections - Internal, external, and haunch dimensions for connecting sections shall not vary by more than 1/2 inch (12 mm).
4. Length of Tongue and Groove – The minimum length of the tongue shall be 4 inches (100 mm). The minimum length of the groove shall be 4 inches (100 mm). The dimensions of the tongue and groove shall not vary by more than 1/4 inch (6 mm) from the plan dimensions.
5. Slab and Wall Thickness – Produce sections so that the slab and wall thickness are not less than that shown on the plans by more than 5% or 3/16 inch (5 mm), whichever is greater. A thickness more than that required on the plans is not a cause for rejection.
6. Length of Opposite Surfaces – Produce sections so that variations in laying lengths of two opposite surfaces of the box section meet the requirements of AASHTO M259, Section 11.3.
7. Length of Section – Produce sections so that the underrun in length of a section is not more than 1/2 inch (13 mm) in any box section.
8. Position of Reinforcement – Produce sections so that the maximum variation in the position of the reinforcement is  $\pm 3/8$ " ( $\pm 10$  mm) for slab and wall thicknesses of 5 inches (125 mm) or less and  $\pm 1/2$ " ( $\pm 13$  mm) for slab and wall thicknesses greater than 5 inches (125 mm). Produce sections so that the concrete cover is never less than 5/8 inch (16 mm) as measured to the internal surface or the external surface. The preceding minimum cover limitations do not apply at the mating surfaces of the joint.
9. Area of Reinforcement – Use the design steel shown on the plans for the steel reinforcement. Steel areas greater than those required are not cause for rejection. The permissible variation in diameter of any wire in finished fabric is prescribed for the wire before fabrication by either AASHTO M32 or M225.

#### G. Marking

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

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

#### H. Construction

1. Foundation – Foundation for precast box culvert shall meet the requirements of Section 414 of the Standard Specifications. In addition, Type VI foundation material shall be encapsulated in filter fabric conforming to Type 4 requirements in Section 1056 of the Standard Specifications. The filter fabric shall be placed perpendicular to the culvert barrel. Provide sufficient overhang beyond the excavation to allow a minimum lap of 3 feet (900 mm) when the foundation material is placed and fabric wrapped on top. Perpendicular sections of fabric shall be continuous. A minimum lap of 2 feet (600 mm) shall be provided between sections of fabric.
2. Installation – Sections shall be placed at the beginning of the outlet end of the culvert with the groove end being laid upgrade. Tongue sections shall be laid into the groove sections. Positive means shall be provided to pull each section firmly into the previously placed section so that the joints are tightly homed. Use a "come-along", box pullers or other approved methods to create a positive means of joining box sections. Construction equipment shall not have direct contact with the box section. The load of the box shall be suspended by lifting device during joining procedure.
3. Backfill – Complete backfill in accordance with Section 414 of the Standard Specifications.

### 3.0 BASIS OF PAYMENT

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

**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**

(7-12-07)

#### **1.0 GENERAL**

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

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

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

**2.0 ADDRESSES AND CONTACTS**

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

Via US mail:

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

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

Via other delivery service:

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

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

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

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

Via US mail:

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

Via other delivery service:

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

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

Via US mail:

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

Via other delivery service:

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

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

Primary Structures Contact:	Paul Lambert (919) 250 – 4041 (919) 250 – 4082 facsimile plambert@dot.state.nc.us
Secondary Structures Contacts:	James Gaither      (919) 250 – 4042 David Stark        (919) 250 – 4044
Eastern Regional Geotechnical Contact (Divisions 1-7):	K. J. Kim (919) 662 – 4710 (919) 662 – 3095 facsimile kkim@dot.state.nc.us
Western Regional Geotechnical Contact (Divisions 8-14):	John Pilipchuk (704) 455 – 8902 (704) 455 – 8912 facsimile jpilipchuk@dot.state.nc.us

### 3.0 SUBMITTAL COPIES

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

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

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

**STRUCTURE SUBMITTALS**

Submittal	Copies Required by Structure Design Unit	Copies Required by Geotechnical Engineering Unit	Contract Reference Requiring Submittal <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 Special Provisions
Maintenance and Protection of Traffic Beneath Proposed Structure	8	0	“Maintenance and Protection of Traffic Beneath Proposed Structure at Station ____”
Metal Bridge Railing	8	0	Plan Note
Metal Stay-in-Place Forms	8	0	Article 420-3
Metalwork for Elastomeric Bearings <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 Project Special Provisions
Pile Splicer	7	2	Subarticle 450-7(C)
Placement of Equipment on Structures (cranes, etc.)	7	0	Article 420-20
Pot Bearings <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 Special Provisions
Revised Bridge Deck Plans (adaptation to prestressed deck panels)	2, then 1 reproducible	0	Article 420-3
Revised Bridge Deck Plans (adaptation to modular expansion joint seals)	2, then 1 reproducible	0	“Modular Expansion Joint Seals”
Sound Barrier Wall Casting Plans	10	0	Article 1077-2 & “Sound Barrier Wall”
Sound Barrier Wall Steel Fabrication Plans <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 ____”
Temporary Shoring <sup>8</sup>	7	2	“Temporary Shoring”
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 Project Special Provision by that name. Articles or subarticles refer to the Standard Specifications.
2. Submittals for these items are necessary only when required by a note on plans.
3. Submittals for these items may not be required. A list of pre-approved sequences is available from the producer or the Materials and Tests Unit.
4. The fabricator may submit these items directly to the Structure Design Unit.
5. The two sets of preliminary submittals required by Article 1072-10 of the Standard Specifications are not required for these items.
6. Submittals for Fabrication Drawings are not required. Submittals for Catalogue Cuts of Proposed Material are required. See Section 5.A of the referenced Project Special Provision.
7. Submittals are necessary only when the top slab thickness is 18 inches or greater.
8. Electronic copies of submittals are required. See referenced Project Special Provision.

**GEOTECHNICAL SUBMITTALS**

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

**FOOTNOTES**

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

**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.

**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*:

<b>Item</b>	<b>Article</b>
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:

<b>Property</b>	<b>Requirement</b>
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 (with continuous agitation)</b>		
<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.

**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.

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

**1.0 GENERAL**

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

**2.0 TEMPORARY ROCK CAUSEWAY [WORKPAD]**

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

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

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



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

**3.0 TEMPORARY WORK BRIDGE**

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

**4.0 BASIS OF PAYMENT**

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

**VERTICAL CONCRETE BARRIER RAIL (SPECIAL)**

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

Payment will be made under:

Vertical Concrete Barrier Rail.....Linear Meter

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

**1.0 GENERAL**

**A. Description**

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

## B. MSE Wall System

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

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

MSE wall systems with conditional approval are restricted to a design height of 20 ft (6.1 m) and an exposed face area of 5,000 ft<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*. When using standard size nos. 2S or 2MS for wall backfill, place separation fabric between the stone behind the blocks and the wall backfill.

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

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

wall section with different reinforcement lengths. When using a software program other than MSEW by ADAMA Engineering, Inc. for design, provide a hand calculation verifying the analysis of the section with the longest reinforcement length. Have MSE walls designed, detailed and sealed by a Professional Engineer registered in North Carolina.

#### B. MSE Wall Installation Submittal

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

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

Use an MSE Wall Installer prequalified by the Construction Unit of the Department for MSE retaining walls work (work code 3015). Submit documentation of experience with the chosen MSE wall system that includes 5 MSE wall projects in the last 3 years with wall heights similar to those for this project and an exposed face area for all 5 walls of at least 10,000 ft<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. 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 Materials & Tests Unit Chemical Testing Engineer before beginning wall construction. The Department will provide the corrosion monitoring instrumentation kit and assistance with installation, if necessary.

#### 5.0 MSE WALL PRECONSTRUCTION MEETING

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

#### 6.0 MSE WALL VENDOR SITE ASSISTANCE

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

#### 7.0 CONSTRUCTION METHODS

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

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

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

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

Erect and support panels or blocks with no negative batter (wall face leaning forward) such that the final position is as shown in the accepted submittals. Stagger vertical joints of blocks to create a running bond when possible unless shown otherwise in the accepted submittals. Place blocks with a maximum joint width of ½ inch (13 mm) and set panels



with a joint width of ½ to 1 inch (13 to 25 mm). Construct MSE walls with a vertical and horizontal tolerance of ¾ inch (19 mm) when measured with a 10 ft (3 m) straight edge and a final overall vertical plumbness (batter) of less than ½ inch per 10 ft (13 mm per 3 m) of wall height.

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

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

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

Place and construct coping as shown in the accepted submittals. Construct cast-in-place concrete coping and moment slabs in accordance with Section 420 of the Standard Specifications. Provide a Class 2 Surface Finish for cast-in-place coping in accordance with Article 420-17 of the Standard Specifications. Construct concrete barrier rail coping in accordance with the plans and Subarticle 460-3(C) of the Standard Specifications.

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

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

**8.0 MEASUREMENT AND PAYMENT**

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

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

<b>Pay Item</b>	<b>Pay Unit</b>
MSE Retaining Walls	Square Foot (Square Meter)

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

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

A pile/panel retaining wall preconstruction conference shall be scheduled with the Contractor including the drilling superintendent, the Resident Engineer including the inspector, the Area Bridge Construction Engineer and the Regional Geotechnical Operations Engineer to discuss construction and inspection of the pile/panel retaining wall. This conference shall be completed a minimum of 5 days prior to beginning any work.

**Steel Piles**

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

See special provisions contained herein for painting of steel piles.

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

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

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

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

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

#### Precast Concrete Panels

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

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

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

#### C.I.P. Coping

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

- (1) Concrete shall be Class A conforming to the applicable requirements of Sections 420 and 1000 of the Specifications.
- (2) Reinforcing steel in the coping shall conform to the applicable requirements of Sections 425 and 1070 of the Specifications.

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

### Shaft Excavation and Concrete

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

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

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

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

### Excavation and Backfill

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

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

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

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

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

#### Painting of Piles

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

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

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

#### Measurement and Payment

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

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

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

#### **RIP RAP, CLASS B FOR CULVERT AT STATION 82+70.00-L-**

**(SPECIAL)**

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