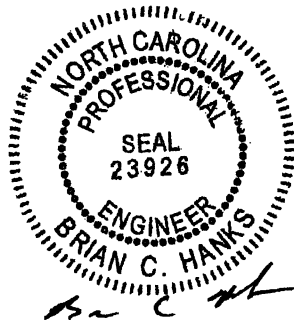


Project Special Provisions  
Structure

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*Brian C. Hanks*  
4/20/2012

*Excluding Piles and Pile Driving Analyzer  
special provisions*

**PROJECT SPECIAL PROVISIONS**  
**STRUCTURE**

**PROJECT B-5014C**

**DARE COUNTY**

**THERMAL SPRAYED COATINGS (METALLIZATION)**

**(9-30-11)**

**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. The capability of blast cleaning steel surfaces to SSPC SP-5 and SP-10 Finishes.
2. Employ Spray Operator(s) qualified in accordance with AWS C.16/C2.16M2002 and 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. 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 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> measure 2 spots/surface per piece and for pieces greater than 200 ft<sup>2</sup> add 1 additional spots/surface for each 500 ft<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 and the surface temperature of the steel is at least 5°F 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 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  $0.1 \text{ ft}^2$  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  $0.1 \text{ ft}^2$  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 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.

## SECURING OF VESSELS

(10-12-01)

Secure vessels in accordance with Section 107 of the Standard Specifications and the following provision.

When utilizing barges, tugboats or other vessels, take all necessary precautions to ensure that such vessels are securely anchored or moored when not in active operation. Take all necessary measures to ensure that the vessels are operated in a manner that avoids damage to or unnecessary contact with bridges and other highway structures and attachments. If severe weather conditions are anticipated, or should be anticipated through reasonable monitoring of weather forecasts, take additional measures to protect bridges and other highway structures and attachments from extreme conditions. The Contractor is strictly liable for damages to any bridge or other highway structure or attachment caused by a vessel owned or controlled by the Contractor. The Contractor is also liable to third parties for property damages and loss of revenue caused by vessels under the Contractor's control.

## FALSEWORK AND FORMWORK

(4-5-12)

### 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.

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

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.

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.

As an option for the Contractor, overhang falsework hangers may be uniformly spaced, at a maximum of 36 inches, provided the following conditions are met:

Member Type (PCG)	Member Depth, (inches)	Max. Overhang Width, (inches)	Max. Slab Edge Thickness, (inches)	Max. Screed Wheel Weight, (lbs.)	Bracket Min. Vertical Leg Extension, (inches)
II	36	39	14	2000	26
III	45	42	14	2000	35
IV	54	45	14	2000	44
MBT	63	51	12	2000	50
MBT	72	55	12	1700	48

Overhang width is measured from the centerline of the girder to the edge of the deck slab.

For Type II, III & IV prestressed concrete girders (PCG), 45-degree cast-in-place half hangers and rods must have a minimum safe working load of 6,000 lbs.

For MBT prestressed concrete girders, 45-degree angle holes for falsework hanger rods shall be cast through the girder top flange and located, measuring along the top of the member, 1'-2 1/2" from the edge of the top flange. Hanger hardware and rods must have a minimum safe working load of 6,000 lbs.

The overhang bracket provided for the diagonal leg shall have a minimum safe working load of 3,750 lbs. The vertical leg of the bracket shall extend to the point that the heel bears on the girder bottom flange, no closer than 4 inches from the bottom of the member. However, for 72-inch members, the heel of the bracket shall bear on the web, near the bottom flange transition.

Provide adequate overhang falsework and determine the appropriate adjustments for deck geometry, equipment, casting procedures and casting conditions.

If the optional overhang falsework spacing is used, indicate this on the falsework submittal and advise the girder producer of the proposed details. Failure to notify the Engineer of hanger type and hanger spacing on prestressed concrete girder casting drawings may delay the approval of those drawings.

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 on concrete girders with thin top flanges. 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.



When staged construction of the bridge deck is required, detail falsework and forms for screed and fluid concrete loads to be independent of any previous deck pour components when the mid-span girder deflection due to deck weight is greater than  $\frac{3}{4}$ ".

Note on the working drawings any anchorages, connectors, inserts, steel sleeves or other such devices used as part of the falsework or formwork that remains in the permanent structure. If the plan notes indicate that the structure contains the necessary corrosion protection required for a Corrosive Site, epoxy coat, galvanize or metalize these devices. Electroplating will not be allowed. Any coating required by the Engineer will be considered incidental to the various pay items requiring temporary works.

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. 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 above ground	Pressure, lb/ft <sup>2</sup> for Indicated Wind Velocity, mph				
	70	80	90	100	110
0 to 30	15	20	25	30	35
30 to 50	20	25	30	35	40
50 to 100	25	30	35	40	45
over 100	30	35	40	45	50

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

## 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.

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.

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.

## 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. 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

(2-10-12)

### 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

B-5014C

contract. Make submittals that are not specifically noted in this provision directly to the Resident Engineer. Either the Structure Design Unit or the Geotechnical Engineering Unit or both units will jointly review submittals.

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

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

## 2.0 ADDRESSES AND CONTACTS

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

Via US mail:

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

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

Via other delivery service:

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

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

Submittals may also be made via email.

Send submittals to:

[plambert@ncdot.gov](mailto:plambert@ncdot.gov) (Paul Lambert)

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

[jgaither@ncdot.gov](mailto:jgaither@ncdot.gov) (James Gaither)

[jlbolden@ncdot.gov](mailto:jlbolden@ncdot.gov) (James Bolden)



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

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

Via US mail:

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

Via other delivery service:

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

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

Via US mail:

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

Via other delivery service:

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

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

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

Primary Structures Contact: Paul Lambert (919) 707 – 6407  
(919) 250 – 4082 facsimile  
[plambert@ncdot.gov](mailto:plambert@ncdot.gov)

Secondary Structures Contacts: James Gaither (919) 707 – 6409  
James Bolden (919) 707 – 6408

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

### 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.

#### 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
Foam Joint Seals <sup>6</sup>	9	0	“Foam 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 1072-8
Miscellaneous Metalwork <sup>4,5</sup>	7	0	Article 1072-8
Optional Disc Bearings <sup>4</sup>	8	0	"Optional Disc Bearings"
Overhead and Digital Message Signs (DMS) (metalwork and foundations)	13	0	Applicable Provisions
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 ____"
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 (precast items)	10	0	Article 1077-2 & “Sound Barrier Wall”
Sound Barrier Wall Steel Fabrication Plans <sup>5</sup>	7	0	Article 1072-8 & “Sound Barrier Wall”
Structural Steel <sup>4</sup>	2, then 7	0	Article 1072-8
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 1072-8

**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 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 1072-8 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</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>
Drilled Pier Construction Plans <sup>2</sup>	1	0	Subarticle 411-3(A)
Crosshole Sonic Logging (CSL) Reports <sup>2</sup>	1	0	Subarticle 411-5(A)(2)
Pile Driving Equipment Data Forms <sup>2,3</sup>	1	0	Subarticle 450-3(D)(2)
Pile Driving Analyzer (PDA) Reports <sup>2</sup>	1	0	Subarticle 450-3(F)(3)
Retaining Walls <sup>4</sup>	8 drawings, 2 calculations	2 drawings	Applicable Provisions
Temporary Shoring <sup>4</sup>	5 drawings, 2 calculations	2 drawings	“Temporary Shoring” & “Temporary Soil Nail Walls”

**FOOTNOTES**

- 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. Subarticles refer to the *Standard Specifications*.
- Submit one hard copy of submittal to the Resident or Bridge Maintenance Engineer. Submit a second copy of submittal electronically (PDF via email) or by facsimile, US mail or other delivery service to the appropriate Geotechnical Engineering Unit regional office. Electronic submission is preferred.
- The Pile Driving Equipment Data Form is available from:  
[www.ncdot.org/doh/preconstruct/highway/geotech/formdet/](http://www.ncdot.org/doh/preconstruct/highway/geotech/formdet/)  
See second page of form for submittal instructions.
- Electronic copy of submittal is required. See referenced provision.

**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**

9-30-11

**1.0 DESCRIPTION**

This special provision addresses grout for use in pile blockouts, grout pockets, shear keys, dowel holes and recesses for structures. This provision does not apply to grout placed in post-tensioning ducts for bridge beams, girders, or decks. Mix and place grout in accordance with the manufacturer's recommendations, the applicable sections of the Standard Specifications and this provision.

## 2.0 MATERIAL REQUIREMENTS

Use a Department approved pre-packaged, non-shrink, non-metallic grout. Contact the Materials and Tests Unit for a list of approved pre-packaged grouts and consult the manufacturer to determine if the pre-packaged grout selected is suitable for the required application.

When using an approved pre-packaged grout, a grout mix design submittal is not required.

The grout shall be free of soluble chlorides and contain less than one percent soluble sulfate. Supply water in compliance with Article 1024-4 of the Standard Specifications.

Aggregate may be added to the mix only where recommended or permitted by the manufacturer and Engineer. The quantity and gradation of the aggregate shall be in accordance with the manufacturer's recommendations.

Admixtures, if approved by the Department, shall be used in accordance with the manufacturer's recommendations. The manufacture date shall be clearly stamped on each container. Admixtures with an expired shelf life shall not be used.

The Engineer reserves the right to reject material based on unsatisfactory performance.

Initial setting time shall not be less than 10 minutes when tested in accordance with ASTM C266.

Test the expansion and shrinkage of the grout in accordance with ASTM C1090. The grout shall expand no more than 0.2% and shall exhibit no shrinkage. Furnish a Type 4 material certification showing results of tests conducted to determine the properties listed in the Standard Specifications and to assure the material is non-shrink.

Unless required elsewhere in the contract the compressive strength at 3 days shall be at least 5000 psi. Compressive strength in the laboratory shall be determined in accordance with ASTM C109 except the test mix shall contain only water and the dry manufactured material. Compressive strength in the field will be determined by molding and testing 4" x 8" cylinders in accordance with AASHTO T22. Construction loading and traffic loading shall not be allowed until the 3 day compressive strength is achieved.

When tested in accordance with ASTM C666, Procedure A, the durability factor of the grout shall not be less than 80.

## 3.0 SAMPLING AND PLACEMENT

Place and maintain components in final position until grout placement is complete and accepted. Concrete surfaces to receive grout shall be free of defective concrete, laitance, oil, grease and other foreign matter. Saturate concrete surfaces with clean water and remove excess water prior to placing grout.

Do not place grout if the grout temperature is less than 50°F or more than 90°F or if the air temperature measured at the location of the grouting operation in the shade away from artificial heat is below 45°F.

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.

The Engineer will determine the locations to sample grout and the number and type of samples collected for field and laboratory testing. The compressive strength of the grout will be considered the average compressive strength test results of 3 cube or 2 cylinder specimens at 28 days.

#### **4.0 BASIS OF PAYMENT**

No separate payment will be made for "Grout for Structures". The cost of the material, equipment, labor, placement, and any incidentals necessary to complete the work shall be considered incidental to the structure item requiring grout.

### **PILES**

**(1-17-12)**

Revise the *Standard Specifications* as follows:

Replace Section 450 with the following:

## **SECTION 450**

### **PILES**

#### **450-1 DESCRIPTION**

Furnish and drive bearing piles as shown on the plans and as directed by the Engineer to the required bearing and penetration. Furnish, weld, and attach steel pile points, pipe pile plates, pile tips and splicers; provide collars, hardware, concrete, reinforcing steel, and all other materials; furnish all equipment, preauger through embankments, install piles vertically or on a batter; galvanize, cut off, splice, and build up piles; place concrete and reinforcing steel; construct pile trestles; furnish and place temporary bracing; remove any obstructions; wrap, bolt, or fasten timber fender piles; and abandon, remove, replace, and restrike or redrive piles as necessary.

## 450-2 MATERIALS

Refer to Division 10.

Item	Section
Portland Cement Concrete	1000
Reinforcing Steel	1070
Timber, Steel and Prestressed Concrete Piles	1084-1
Steel Pipe Pile Plates	1072

## 450-3 PREPARATION FOR DRIVING

If applicable, completely excavate for the cap and/or footing before installing piles. If applicable and unless noted otherwise on the plans, construct the embankment to the bottom of cap or footing elevation for a horizontal distance of 50 ft (15 m) from any pile except where fill slopes are within 50 ft (15 m) of a pile. If preaugering through an embankment is necessary before driving prestressed concrete piles, submit the preaugering and pile installation methods with the proposed pile driving methods and equipment for approval.

## 450-4 DETERMINATION OF PILE LENGTH

The estimated total pile lengths per structure shown on the plans are for bid purposes only. Determine pile lengths and furnish piling of sufficient length to obtain the required bearing and penetration and the required embedment into the cap or footing as shown on the plans. As an option and at no cost to the Department, make investigations as necessary to determine the required pile lengths.

## 450-5 DRIVING EQUIPMENT

Submit the proposed pile driving methods and equipment including the pile driving hammer, hammer cushion, pile helmet and cushion, if any. Do not submit more than two pile driving hammers per pile type per submittal. Submit this information for approval at least 20 working days before driving piles. All equipment is subject to satisfactory field performance.

Drive bearing piles with approved driving equipment using steam, air, or diesel hammers. Use pile driving hammers with an energy that will not overstress the piles during driving and provide the required driving resistance at blows per foot ranging from 36 to 96, unless otherwise approved. Use a variable energy hammer to drive prestressed concrete piles.

Operate steam, air, or diesel hammers at the length of stroke and number of blows per minute required by the Engineer. Operate air and steam hammers within 10% of the manufacturer's rated speed in blows per minute or the rate approved by the Engineer.

Provide plant and equipment for air or steam hammers with sufficient capacity to maintain, under working conditions, the volume and pressure specified by the manufacturer. Equip the plant and equipment with accurate pressure gauges that are easily accessible. Use striking parts of air and steam hammers that weigh at least 1/3 the weight of the pile helmet and pile, with a

minimum weight of 2,750 lb (1,250 kg).

Equip open-end (single acting) diesel hammers with a graduated scale (jump stick) extending above the ram cylinder, graduated rings or grooves on the ram, or an electric sound activated remote measuring instrument to allow the Engineer to visually determine hammer stroke at all times during pile driving operations.

Equip closed-end (double acting) diesel hammers with a calibrated bounce chamber pressure gauge, in good working order, mounted near ground level and easily read by the Engineer. Also, provide a current calibrated chart or graph equating bounce chamber pressure and gauge hose length to equivalent energy for the closed-end diesel hammer used. Submit this chart or graph with the proposed pile driving methods and equipment required above.

Protect and hold pile heads in position with an approved pile helmet. Make sure that the pile helmet closely fits the top of the pile and extends down the sides of the pile a sufficient distance to hold the pile in position. Protect the heads of concrete and timber piles from direct impact with an approved pile cushion. Provide collars or bands to protect timber piles against splitting or brooming where required.

#### **450-6 ACCURACY OF DRIVING**

Drive piles so that the axial alignment is within 1/4" (6 mm) per foot from the vertical or batter shown on the plans. Horizontally, keep the pile within 3" (75 mm) of the plan location longitudinally and transversely. Maintain pile embedment in the cap or footing to within 3" (75 mm) more or 2" (50 mm) less than that shown on the plans. No additional payment is made for increased cap or footing dimensions necessary due to piles driven out of position.

#### **450-7 CONSTRUCTION METHODS**

##### **(A) General**

Unless approved otherwise or directed by the Engineer, do not drive piles within 50 ft (15 m) of cast-in-place concrete until the concrete attains an age of at least 3 curing days. When approved by the Engineer, the Contractor may use vibratory hammers to install the initial portions of steel piles. The Engineer will approve the depth of pile installation with the vibratory hammer. Do not use vibratory hammers to install prestressed concrete piles.

The Engineer will inspect the capblock before beginning each pile driving project and periodically throughout the duration of the project, depending on driving conditions as determined by the Engineer. Expose the hammer cushion for inspection as directed by the Engineer. Replace or repair any hammer cushion that is less than 25% of the original thickness.

Do not exceed the allowable pile driving stresses during the entire driving time. Allowable pile driving stresses are defined in the *AASHTO Standard Specifications for Highway Bridges*. Drive piles to the required tip elevation or penetration into natural ground, whichever is lower, in a continuous operation unless stopped due to exceeding the maximum blow count or the allowable pile driving stresses, insufficient pile length,

or other reasons approved by the Engineer. Once the required embedment is achieved, the Engineer may require the Contractor to stop driving and wait before restriking to allow for soil setup.

Use a pile cushion made of pine plywood with a 4" (100 mm) minimum thickness for driving prestressed concrete piles. When using a pile cushion, provide a new cushion for each pile unless otherwise approved. Replace the pile cushion if, during the driving of any pile, the cushion is either compressed more than one-half the original thickness or begins to burn.

Redrive any pile raised or moved laterally by the driving of adjacent piles.

### **(B) Timber Piles**

Store and handle timber piles by methods that do not damage the pile. Take care to avoid breaking the surface of treated piles. Do not use cant-hooks, dogs, or pike-poles. Treat cuts or breaks in the surface of treated piles in an approved manner.

Cut off the tops of all piles at the elevation shown on the plans. Except where a cast-in-place concrete cap or footing is constructed, cut off piles to a plane that provides true bearing on every pile without the use of shims. Withdraw any pile damaged during driving operations, driven out of its proper location or below the cut-off grade and replace with a new pile, or otherwise correct as directed by the Engineer.

Thoroughly brush-coat the sawn surface of all timber piles not encased in concrete with 3 applications of approved preservative treatment and then cover with a coat of hot roofing pitch or other approved hot bituminous material. Place a sheet of galvanized iron or aluminum upon each pile head, bend it down over the sides of the pile, neatly trim and firmly secure to the pile with large headed galvanized roofing nails. Use sheets of iron that are 24 gauge and 24" (600 mm) by 24" (600 mm) in size. If using aluminum, use the same size as specified for galvanized iron sheets with a minimum thickness of 0.032" (0.81 mm).

### **(C) Prestressed Concrete Piles**

Handle, transport, and store prestressed concrete piles by methods that do not damage the pile and support the piles at the pick-up points shown on the plans or along their full length. Replace piles damaged in handling or driving unless they are repaired to an acceptable condition.

When driving or cutting off piles below the elevation shown on the plans, build up the pile section to the plan elevation as shown on the plans unless otherwise directed by the Engineer.

Cut off piles not driven to grade perpendicular to the axis of the pile by means that do not result in spalling or other damage to the pile. Use steel pile tips with prestressed concrete piles when shown on the plans. Use pile splicers for splicing steel pile tips. Contact the Materials and Tests Unit for a list of approved pile splicers. Submit pile splicer specifications with the manufacturer's attachment detail to the Engineer for approval before installation.



**(D) Steel Piles**

Handle and store steel piles by methods that do not damage the pile. Store the piles above ground upon platforms, blocks, or other supports and keep the piles free from dirt, grease, and other foreign matter, and protect insofar as is practicable from corrosion. Do not damage coatings on steel piles. Protect coatings when driving piles through templates in an approved manner.

When shown on the plans, galvanize steel piles in accordance with Section 1076. Prepare the pile surface and provide materials in accordance with the applicable portions of this section.

Use pile points for steel piles when shown on the plans or as directed by the Engineer. Contact the Materials and Tests Unit for a list of approved pile points. Weld pile points to piles in accordance with the manufacturers' details as approved by the Engineer. The minimum weld length is twice the width of the flange.

Furnish plates for pipe piles when shown on the plans or as directed by the Engineer. Weld plates to the bottom of pipe piles as shown on the plans. Use pipe pile plates with a thickness as shown on the plans and that meets the requirements of ASTM A709, Grade 50.

Cut off piles at the required elevations along a plane normal to the axis of the pile. Use approved methods for cutting off piles.

Use welded butt splices for steel piles as shown on the plans. Do not use more than 3 pieces (2 splices) of steel pile in making up one full-length pile.

**(E) Redriving Piles**

Once the required pile embedment has been achieved, the Contractor may choose to or the Engineer may require restriking or redriving piles. If the Contractor chooses to stop driving and then restrike or redrive piles, no payment will be made for restrikes or redrives. If the Engineer requires the Contractor to stop driving and then restrike or redrive piles, the payment will be made in accordance with Article 450-9. When the Engineer requires restrikes or redrives, the Engineer will determine the time to wait after stopping driving and the number of restrikes or redrives. However, the maximum number of restrikes or redrives per pile during any 48 hour period will not exceed three. The minimum time separation between redrives required by the Engineer is 4 hours.

Use the same approved pile driving methods, equipment and compressed pile cushion from the previous drive to restrike or redrive the pile unless the cushion is unacceptable due to deterioration, in which case use another acceptable cushion. Do not use a cold diesel hammer for a restrike or redrive, unless in the opinion of the Engineer, it is impractical to do otherwise. In general, warm up the hammer by applying at least 20 blows to a previously driven pile or timber mats on the ground.

**450-8 PENETRATION AND WAVE EQUATION**

When no tip elevation is shown on the plans, drive piles to the required bearing capacity and a penetration of at least 10 ft (3 m) into natural ground unless otherwise directed by the Engineer. When a tip elevation is shown on the plans, drive piles to the required bearing capacity and the

specified tip elevation. When noted on the plans, drive piles to additional capacity to account for downdrag or negative skin friction and scour.

Natural ground within an area of new embankment is defined as the bottom of the embankment or bottom of footing on piles, whichever is lower.

The Engineer will use the wave equation analysis to evaluate the suitability of the proposed pile driving methods and equipment to evaluate pile driving stresses and estimate the driving resistance in order to achieve the required bearing capacity. The required driving resistance in blows per foot or any equivalent set is based upon the bearing capacity shown on the plans with a minimum safety factor of 2 plus any additional capacity to account for downdrag or negative skin friction and scour, when applicable. The Engineer will provide the required driving resistance based upon the wave equation analysis and pile driving analyzer results, if applicable, using the approved pile driving methods and equipment.

Stop driving piles when practical refusal is reached, unless otherwise directed by the Engineer. Practical refusal is defined as 180 blows per foot (0.3 m) or any equivalent set.

#### 450-9 MEASUREMENT AND PAYMENT

*Piles (Treated Timber Piles, \_\_\_\_\_ Prestressed Concrete Piles, \_\_\_\_\_ Steel Piles or \_\_\_\_\_ Galvanized Steel Piles)* will be measured and paid as the actual number of linear feet (meters) of piles incorporated into the completed and accepted structure. This quantity is measured as the length of pile before driving minus any pile cut-offs. No payment will be made for pile cut-offs or cutting off piles. However, once the required bearing and penetration has been achieved, the Contractor may drive the remaining portion of a pile to grade in lieu of cutting off the pile provided the remaining portion does not exceed 5 ft (1.5 m) and the pile can be driven without damaging the pile or reaching the maximum blow count or practical refusal. When this occurs, the additional length of pile driven will be measured as described above.

For prestressed concrete piles that are built up, the quantity of piles to be paid for will also include the actual number of linear feet (meters) added to the original pile length by the build-up. Steel pile tips are not included in the quantity of prestressed concrete piles. No payment will be made for steel pile tips or pile splicers and any associated hardware or welding. The cost for these items will be considered incidental to the cost of the prestressed concrete pile.

*Pile points* will be measured and paid for per each for the actual number of pile points incorporated into the completed and accepted structure.

*Pipe pile plates* will be measured and paid for per each for the actual number of plates incorporated into the completed and accepted structure.

*Pile redrives* will be measured and paid for per each as the actual number of restrikes or redrives required by the Engineer. No payment will be made for restrikes or redrives when the Contractor chooses to restrike or redrive piles.

No payment will be made for any defective or rejected piles or any piles driven for falsework, bracing, or temporary work bridges.

The prices and payments will be full compensation for all items required to provide bearing piles including but not limited to those items contained in Article 450-1.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
____ Prestressed Concrete Piles	Linear Foot
____ Steel Piles	Linear Foot
____ Galvanized Steel Piles	Linear Foot
Steel Pile Points	Each
Pipe Pile Plates	Each
Pile Redrives	Each

**PILE DRIVING ANALYZER**

**(1-17-12)**

**1.0 GENERAL**

This special provision governs driving piles with a pile driving 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, and
- 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 Section 450 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 re-driving will be paid for separately in accordance with the Standard Specifications and will not be part of these PDA pay items.

### **EPOXY RESIN INJECTION**

**(SPECIAL)**

#### **1.0 GENERAL**

For repairing cracks, an approved applicator is required to perform the epoxy resin injection. Make certain the supervisor and the workmen have completed an instruction program in the methods of restoring concrete structures utilizing the epoxy injection process and have a record of satisfactory performance on similar projects.

The applicator furnishes all materials, tools, equipment, appliances, labor and supervision required when repairing cracks with the injection of an epoxy resin adhesive.

#### **2.0 SCOPE OF WORK**

Using Epoxy Resin Injection, repair all cracks 5 mils wide or greater in the cast-in-place substructure units within 30 day of Engineer's notification.

Make the underwater repairs when water surface elevation is low and the water is still. For underwater repairs, use manufacturer recommended materials.

#### **3.0 COOPERATION**

Cooperate and coordinate with the Technical Representative of the epoxy resin manufacturer for satisfactory performance of the work.

Have the Technical Representative present when the job begins and until the Engineer is assured that his service is no longer needed.

The expense of having this representative on the job is the Contractor's responsibility and no direct payment will be made for this expense.

#### **4.0 TESTING**

The North Carolina Department of Transportation Material and Tests Unit obtains test cores from the repaired concrete. If the failure plane is located at the repaired crack, a minimum compressive strength of 3000 psi is required of these cores.



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**5.0 MATERIAL PROPERTIES**

Provide a two-component structural epoxy adhesive for injection into cracks or other voids. Provide modified epoxy resin (Component "A") that conforms to the following requirements:

	Test Method	Specification Requirements
Viscosity @ 40 ± 3°F, cps	Brookfield RVT Spindle No. 4 @ 20 rpm	6000 - 8000
Viscosity @ 77 ± 3°F, cps	Brookfield RVT Spindle No. 2 @ 20 rpm	400 - 700
Epoxide Equivalent Weight	ASTM D1652	152 - 168
Ash Content, %	ASTM D482	1 max.

Provide the amine curing agent (Component "B") used with the epoxy resin that meets the following requirements:

	Test Method	Specification Requirements
Viscosity @ 40 ± 3°F, cps	Brookfield RVT Spindle No. 2 @ 20 rpm	700 - 1400
Viscosity @ 77 ± 3°F, cps	Brookfield RVT Spindle No. 2 @ 20 rpm	105 - 240
Amine Value, mg KOH/g	ASTM D664*	490 - 560
Ash Content, %	ASTM D482	1 max.
* Method modified to use perchloric acid in acetic acid.		

Certify that the Uncured Adhesive, when mixed in the mix ratio that the material supplier specifies, has the following properties:

- Pot Life (60 gram mass)
  - @ 77 ± 3°F - 15 minutes minimum
  - @ 100 ± 3°F - 5 minutes minimum

Certify that the Adhesive, when cured for 7 days at  $77 \pm 3^\circ\text{F}$  unless otherwise specified, has the following properties:

	Test Method	Specification Requirements
Ultimate Tensile Strength	ASTM D638	7000 psi (min.)
Tensile Elongation at Break	ASTM D638	4% max.
Flexural Strength	ASTM D790	10,000 psi (min.)
Flexural Modulus	ASTM D790	$3.5 \times 10^5$ psi
Compressive Yield Strength	ASTM D695	11,000 psi (min.)
Compressive Modulus	ASTM D695	$2.0 - 3.5 \times 10^5$ psi
Heat Deflection Temperature Cured 28 days @ $77 \pm 3^\circ\text{F}$	ASTM D648*	125°F min. 135°F min.
Slant Shear Strength, 5000 psi (34.5 MPa) compressive strength concrete Cured 3 days @ 40°F wet concrete Cured 7 days @ 40°F wet concrete Cured 1 day @ 77°F dry concrete	AASHTO T237	3500 psi (min.) 4000 psi (min.) 5000 psi (min.)
* Cure test specimens so that the peak exothermic temperature of the adhesive does not exceed 77°F.		

Use an epoxy bonding agent, as specified for epoxy mortar, as the surface seal (used to confine the epoxy resin during injection).

## 6.0 EQUIPMENT FOR INJECTION

Use portable positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle to meter and mix the two injection adhesive components and inject the mixed adhesive into the crack. Use electric or air powered pumps that provide in-line metering and mixing.

Use injection equipment with automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to  $200 \pm 5$  psi and equipped with a manual pressure control override.

Use equipment capable of maintaining the volume ratio for the injection adhesive as prescribed by the manufacturer. A tolerance of  $\pm 5\%$  by volume at any discharge pressure up to 200 psi is permitted.

Provide injection equipment with sensors on both the Component A and B reservoirs that automatically stop the machine when only one component is being pumped to the mixing head.

## **7.0 PREPARATION**

Follow these steps prior to injecting the epoxy resin:

- Remove all dirt, dust, grease, oil, efflorescence and other foreign matter detrimental to the bond of the epoxy injection surface seal system from the surfaces adjacent to the cracks or other areas of application. Acids and corrosives are not permitted.
- Provide entry ports along the crack at intervals not less than the thickness of the concrete at that location.
- Apply surface seal material to the face of the crack between the entry ports. For through cracks, apply surface seal to both faces.
- Allow enough time for the surface seal material to gain adequate strength before proceeding with the injection.

## **8.0 EPOXY INJECTION**

Begin epoxy adhesive injection in vertical cracks at the lower entry port and continue until the epoxy adhesive appears at the next higher entry port adjacent to the entry port being pumped.

Begin epoxy adhesive injection in horizontal cracks at one end of the crack and continue as long as the injection equipment meter indicates adhesive is being dispensed or until adhesive shows at the next entry port.

When epoxy adhesive appears at the next adjacent port, stop the current injection and transfer the epoxy injection to the next adjacent port where epoxy adhesive appeared.

Perform epoxy adhesive injection continuously until cracks are completely filled.

If port to port travel of epoxy adhesive is not indicated, immediately stop the work and notify the Engineer.

## **9.0 FINISHING**

When cracks are completely filled, allow the epoxy adhesive to cure for sufficient time to allow the removal of the surface seal without any draining or runback of epoxy material from the cracks.

Remove the surface seal material and injection adhesive runs or spills from concrete surfaces.

Finish the face of the crack flush to the adjacent concrete, removing any indentations or protrusions caused by the placement of entry ports.

**10.0 BASIS OF PAYMENT**

No separate payment will be made for epoxy resin injection. The cost of this work shall be considered incidental to the construction of the cast-in-place substructure units.

**TEMPORARY TRAFFIC CONTROL** (SPECIAL)

The Contractor shall maintain traffic on roads during construction and shall provide, install and maintain all traffic control devices as shown in the *Roadway Standard Drawings* or as directed by the Engineer.

The lump sum price bid for traffic control shall include but not be limited to providing **Signs (portable, stationary or barricade), Truck Mounted Impact Attenuators (TMIA), Changeable Message Signs (CMS), Flashing Arrow Panel (FAP), Pilot Vehicle, Flaggers, Cones, Skinny Drums and Drums** and all labor, tools, equipment and incidentals necessary to furnish, install, maintain and remove traffic control devices when no longer required.

Partial payments will be made on each payment estimate based on the following: Fifty percent of the contract lump sum price bid will be paid on the first monthly estimate and the remaining fifty percent of the contract lump sum price bid will be paid on each subsequent estimate based on the percent of the project completed.

Payment will be made under:

Temporary Traffic Control.....Lump Sum

**WORK IN, OVER OR ADJACENT TO NAVIGABLE WATERS** (SPECIAL)

All work in, over, or adjacent to navigable waters shall be in accordance with the special provisions and conditions contained in the permits obtained by the Departments from U.S. Coast Guard, U.S. Army Corps of Engineers, or other authority having jurisdiction. The work shall have no adverse effect on navigation of the waterway including traffic flow, navigational depths, and horizontal and vertical clearances without approval from the authorities granting the permits.

The Contractor shall prepare drawings necessary to obtain any permits which may be required for his operations which are not included in the Department's permit including but not limited to excavation and dumping, constructing wharves, piers, ramps, and other structures connecting to bank or shore, and drawings for constructing falsework, cofferdams, sheeting, temporary bridges, and any other construction within the waterway. Submittals shall show locations of such work with respect to the navigational opening. The Contractor shall coordinate the submittal of drawings with the Engineer.

All construction shall progress and be maintained in a safe and timely manner. Temporary construction facilities shall be removed completely and promptly upon discontinuation of their useful purpose. Navigational lights, signals, or facilities shall be provided and maintained by the

Contractor on temporary or permanent construction or vessels until such facilities are no longer needed as determined by the Engineer or permitting agency.

The Contractor shall immediately notify the appropriate authorities and take corrective measures as needed when any situation occurs that imposes a threat to the public. He shall also immediately correct any acts or occurrences that contradict or violate any requirements in the plans, special provisions, or permits when corrective measures can be performed in a safe manner. The Contractor shall notify the appropriate authorities when such corrective measures cannot be performed in a safe manner.

All costs incurred by the Contractor in complying with the above requirements shall be included in the prices bid for the various pay items and no additional payment will be made.

## **GABION MATTRESS**

**(SPECIAL)**

### **1.0 DESCRIPTION**

The work in this provision includes furnishing, assembling, filling, typing, and placing open wire rectangular compartmented gabion mattresses in accordance with these specifications and manufacturer's recommendations and in accordance with the lines, grades, and dimensions shown on the drawings or otherwise established in the field by the Engineer. Mattress units and any miscellaneous components associated with the mattress units shall be inspected for damage by the Engineer upon delivery to the site. Damaged mattress units or miscellaneous components shall be repaired or replaced by the Contractor at no additional expense to the Department.

Gabion mattress units shall consist of compartmented rectangular basket type containers fabricated from PVC coated galvanized steel triple twisted wire mesh with hexagonal openings, and filled with stone.

Mattress sections shall be supplied in various lengths which shall be multiples of three feet. The thickness shall be nine inches. The horizontal width shall be six feet. All mattress sections furnished by the manufacturer shall be subject to a tolerance of +/- 10% on the thickness and +/- 5% on the length and width. The mesh type shall be 6 x 8 with a nominal mesh opening of 2 1/2" x 3 1/4".

### **2.0 MATERIAL REQUIREMENTS**

#### **PVC COATED GALVANIZED STEEL WIRE MESH**

PVC coated gabion mattresses shall be of non-raveling construction, fabricated from a triple twisted hexagonal mesh of hot-dipped galvanized steel wire having a minimum diameter of 0.0866 inches after galvanization, and additionally coated with a minimum of 0.015 inches of PVC. The steel core wire used shall be galvanized and PVC coated prior to

fabrication into mesh. The core wire of all gabion mattresses and frame components shall equal or exceed Federal Specification QQW-461. The core wire shall possess tensile strength in the range of 60,000 to 80,000 psi and not less than a finish 5, soft, class 3, zinc coating of not less than 0.80 ounce per square foot of uncoated wire surface. Selvedges or perimeter basket frame core wire shall be of heavier gauge than that of the wire mesh with a minimum diameter after galvanization of 0.1063 inches, and an overall minimum diameter (core wire plus PVC coating) of 0.1279 inches. All wire used for lacing, tying or as internal connecting wire within basket cells shall be galvanized and PVC coated meeting the same specifications for the hexagonal mesh. The PVC coated wire of all gabion components shall be resistant to the destructive effects of immersion in acidic, salt, or polluted water, exposure to ultraviolet light and abrasion, and retain these characteristics after a period of not less than 3,000 hours under test in accordance with ASTM Test Designation G-23. The PVC coating shall have a nominal thickness of 0.0217 inches and a minimum thickness of 0.015 inches.

#### **ALTERNATE MATERIAL**

An alternate to the PVC coated galvanized steel wire mesh may be proposed. The alternate must meet the design and construction requirements of the project and will be subject to review and approval by the Department. The nominal mesh opening and tensile strength of the alternate shall be equivalent to the mesh opening and tensile strength of the PVC coated galvanized steel wire mesh.

#### **STONE**

The stone shall consist of sound, hard, dense, durable crystalline rock obtained by quarrying. The stone shall be such quality that permanence in the structures is assured under all conditions to which it will be subjected. The stone shall be free from open or incipient cracks, seams, and fissures, and from porous structure, solution cavities structural planes of weakness and from component minerals and cementing or bonding materials that might contribute to spalling or breakdown from handling and placing, and from wave action and chemical action from sea water or air. The stone shall be furnished in irregular and angular shapes, with the least dimension of any stone not less than one-third of its greatest dimension. Flat stones, slabs, boulders, and parts of boulders will be rejected. Not more than 5 percent by weight of clean spalls resulting from loading and shipment will be allowed in any one barge, carload, or truckload. The stone may be unwashed quarry material provided it meets all requirements of these specifications and is placed in conformance with all requirements of the Department's construction permits (including water quality requirements). Prior to construction the Contractor shall submit testing results and certification that all proposed construction materials meet all requirements of the Standard Specifications.

Stone shall consist of stone weighting not less than 164 pounds per cubic foot (saturated surface dry) and the absorption shall be less than 4 percent. It shall contain no organic matter, nor soft, friable particles in quantities considered objectionable to the engineer. It shall consist of quarry stone with the following size limitations:

##### **(1) Gabion Stone**

- Minimum stone size: 2 pound (3 inch nominal diameter)
- Maximum stone size: 14 pound (6 inch nominal diameter)

Fifty percent of the stone shall be of stones weighing more than 8 pounds (5 inch nominal diameter).

#### **FILTER FABRIC**

Filter fabric required within the gabion mattress shall be Type 2 as specified in Section 1056 of the Standard Specifications. Fabric shall be securely attached to the sides and ends of the mattress and seams shall be securely sewn as directed by the Engineer.

#### **PVC STAKING SLEEVES**

Staking sleeves shall be fabricated from AWWA Grade DR25 (PC100) PVC pipe as shown in plans. The sleeve shall be cut to fit within the 9 inches nominal thickness of the gabion mattress.

#### **GALVANIZED ANCHOR STAKES**

Anchor stakes located along the perimeter of the bottom layer of the gabion mattress shall be constructed from standard 4" x 4" x 3/8" grade ASTM A-36 structural steel angles 5 feet in length with two 3/4 inch diameter holes located 3/4 inch from the top of the stake. The stakes shall be galvanized after fabrication. The minimum zinc coating shall be 0.80-ounces per square foot of uncoated surface.

### **3.0 ASSEMBLY AND INSTALLATION**

The Contractor shall use reasonable care in the handling, assembly, and installation of the gabion mattresses to prevent damage to the existing structure and to the PVC coating. Any mattresses damaged shall be repaired in a manner satisfactory to the Engineer or replaced at no cost to the Department.

Gabion mattress sections shall be fabricated in such a manner that the base, sides, and ends can be assembled at the construction site into a rectangular unit of the specified size. The body of each unit shall be of single construction, the base ends, and sides formed of a single woven mesh unit. The top shall be a separate woven unit of the same mesh and wire specifications as the body.

Each unit shall be subdivided into compartments, three feet long, extending over their full width by the insertion of diaphragms made of the same mesh as the rest of the mattress. The diaphragms shall be factory secured in proper position at the base with a continuous spiral wire, in such a manner that no additional tying at this junction will be necessary.

All perimeter edges of the mesh forming the mat shall be securely selvaged so that the joints formed by tying the selvages have at least the same strength as the body of the mesh.

Lacing wire shall be supplied in sufficient quantity in order that all sides, ends, and diaphragms of the body may be securely fastened as well as the top to all sides, ends, and diaphragms of the body. The lacing wire shall meet or exceed the same specifications as the wire specified for the mesh.

The wire incorporated in the mesh constituting the body of the mat and the lacing wire shall be made of galvanized steel wire having a minimum diameter of 0.0866 inch (U.S. Gauge No. 13.13.1/2); the minimum diameter of the mesh edge wire shall not be less than 0.1063 inch (U.S. Gauge No. 11); the diameter of the selvedge rod wire shall be not less than 0.1063 inch (U.S. Gauge No. 11). The top, a separate unit shall be fabricated of the same wire quality and diameter as the body for its corresponding constituent parts.

The tensile strength of the wire shall be in the range of 60,000 to 80,000 psi. The minimum zinc coating of the wire surface shall be determined by tests conducted in accordance with Federal Specifications QQW-461, Class 3.

The Contractor shall advise the Engineer when an area is ready for installation of the Gabion mattresses and receive approval from the Engineer prior to commencing with placement.

Mattress units shall be assembled individually in accordance with the manufacturer's recommendations. The rock-filled gabion mattress shall be fabricated into sections of the largest size practical so as to minimize the number of joints between sections. Mattress sections shall be fabricated to cover, without any vacancies, holes or gaps, the entire surface shown in the plans to receive gabion mattresses. While empty, all adjoining mattress units must be connected by tie wire lacing along the perimeter of their contact surfaces in order to obtain such a monolithic structure. Lacing of adjoining units shall be accomplished by continuous stitching with alternating double loops at intervals of not more than 5 inches. The base of adjacent mattresses shall be laced at 3 foot intervals with double lacing wire. All lacing wire terminals shall be securely fastened. The use of expedient clip connections for the purpose of final lid closing will not be permitted. After the adjoining empty mattress units with common adjacent sides are laced, they shall be placed in tension and stretched to remove any kinks from the mesh and to create a uniform alignment. The stretching of empty mattress units shall be accomplished in such a manner as to prevent any possible unraveling.

Prior to filling the mattress compartment with stone, place the PVC staking sleeves within the empty mattress units as shown on the drawings. Stone filling operations shall carefully proceed with placement by hand or machine to prevent damage to the PVC wire coating, to assure the minimum amount of voids between the stones, to maintain the PVC staking sleeves in a vertical orientation and to maintain proper of alignment of the mesh throughout the filling process. Undue bulging of the mesh shall be avoided. In mechanical filling



operations, the top edges of the diaphragms and end panels shall be protected from being bent or folded by the stone during placement. Reinforcing steel may be temporarily placed across the top edges of each mesh panel and laced to them to prevent movement. Alternatively, temporary lengths of pliable metal may be bent into a V shape and placed over the vertical panels to deflect the stone. During filling, the stone shall be discharge from the bucket when it is in the lowest practical position. The maximum height from which the stone may be dropped into the basket units shall be 24 inches. The mattress units shall be overfilled to allow for rock settlement during handling of the completed unit. The last layer of stone shall be leveled with the top of the mattress to allow for the proper closing of the lid and to provide an even surface that is uniform in appearance. Where shown on the drawings, filter fabric shall be placed over the top of the completed stone fill so as to cover the entire mattress section surface. Units that become damaged due to placing operations shall be replaced by the Contractor at no additional cost to the Department.

Lids shall be stretched tight over the stone fill using crowbars or lid closing tools, until the lid meets the perimeter edges of the front and end panels. The lid shall then be tightly laced with tie wire along all edges, ends, and internal cell diaphragms by continuous stitching with alternating single and double loops at intervals of no more than 5 inches.

The top mattress layer of the two mattress layer system shall receive a double lid. Where several individual sections are joined to create a large placement unit, the double lid shall be provided through use of continuous mesh which spans several individual sections. The lids shall be tightly laced with tie wire as specified for the single lid closure as described earlier in this specification.

In placing the top mattress layer upon the lower mattress layer, the mats shall be placed so as to maximize the overlap of the top mattress over the lower mattress and to minimize the occurrence of seams in the top and bottom layers at the same location. The Contractor shall submit a placement plan to the Engineer for approval before placement begins which demonstrates how he intends to meet this requirement. The top and bottom mattress layers shall be tied together along all edges in the same manner as individual mattress sections are tied.

If cutting of the mattresses is required by the Engineer, sand filled geotextile sea bags will be used to fill irregular spaces between mattress sections and existing pier structures. Sea bags may be placed in a random fashion but the entire area within the gabion mattress area shall be covered by at least one sand bag thickness.

Anchor stakes are to be driven through the gabion mattress sections as shown on the plans. The anchor stakes shall be driven into the ground so that the top of the stake is approximately flush with the top of the basket. Each adjacent gabion shall be securely tied

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to the stake, in an approved manner, with two galvanized steel wires meeting the requirements of the lacing wire specified for the gabions. The Contractor's attention is called to the fact that the soils at the site are generally dense which will likely make the driving of stakes difficult. Therefore, special equipment will be required to drive the anchor stakes.

#### 4.0 QUALITY CONTROL

The Contractor shall have a representative of the gabion mattress manufacturer on the job site for the first week of the gabion mattress installation prior to and during the initial filling of the mats and again during the initial installation. The representative shall visit the site thereafter a minimum of 2 days of every three weeks during installation.

#### 5.0 BASIS OF PAYMENT

The quantities to be paid for under this section shall be the area, in square yards, of Gabion Mattress (9" thick) determine as specified in the drawings. Each 9" mattress (top mattress and bottom mattress) will be included in the area for pay purposes.

### **SAND FILLED GEOTEXTILE SEA BAGS**

(SPECIAL)

#### 1.0 DESCRIPTION

The work in this provision includes furnishing, assembling, filling and placing sand filled geotextile sea bags in accordance with these specifications and manufacturer's recommendations and in accordance with the lines, grades, and dimensions shown on the drawings or otherwise established in the field by the Engineer. Sea bags shall be inspected for damages by the Engineer upon deliver to the site. Damaged sea bags shall be repaired or replaced by the Contractor at no additional expense to the Department.

Sand filled geotextile sea bags consist of a 3' x 3' x 3' closed bag made from woven polypropylene sewn with high strength double stitch seams. Each unit shall have a 12-inch fill port on top center of the bag and shall be field sewn after bag is full. Reinforced lift loops approximately 18" long shall be sewn into each of the corner seams and capable of lifting a filled bag. No deviation from any physical requirements will be permitted due to the presence of the seam.

**2.0 MATERIAL REQUIREMENTS**

Sea bags shall be manufactured using a high strength woven polypropylene meeting the following minimum specifications:

Property	Test Method	English units	SI units
Grab Tensile	ASTM D 4632	200 lb	0.890 kN
Grab Elongation	ASTM D 4632	15%	15%
Mullen Burst	ASTM D 3786	400 psi	2750 kPa
Puncture	ASTM D 4833	90 lb	0.400 kN
Trapezoidal Tear	ASTM D 4533	75 lb	0.330 kN
UV Resistance	ASTM D 4355	70% @ 500 hrs	70% @ 500 hrs
AOS	ASTM D 4751	50 sieve	0.300 mm
Permittivity	ASTM D 4491	0.05 sec <sup>-1</sup>	0.05 sec <sup>-1</sup>
Flow Rate	ASTM D 4491	4 gal/min/ft <sup>2</sup>	160 L/min/m <sup>2</sup>

The Engineer shall approve the sand used to fill the bags.

**3.0 BASIS OF PAYMENT**

The quantity of geotextile sea bags to be paid for shall be the number of geotextile sea bags in place and accepted. The payment shall be full compensation for all materials, tools, equipment, labor, and any incidentals necessary to complete this work.

Payment will be made under:

3' Sand Bags.....Each

**PARTIAL REMOVAL OF EXISTING STRUCTURE**

**(SPECIAL)**

**DESCRIPTION**

Remove existing footing concrete as directed in the plans with concrete saws and hand tools. Use of hoe rams and wrecking balls will not be permitted. Dispose of debris removed from the footing in accordance with the Standard Specifications. Exercise care to ensure that existing reinforcing steel exposed by concrete removal remains undamaged. All damaged reinforcing steel shall be repaired by the contractor at the contractor's expense to the satisfaction of the Engineer.

**BASIS OF PAYMENT**

*Partial Removal of Existing Structure* will be paid for at the lump sum contract price and will be full compensation for all materials, equipment, tools, labor, and incidentals necessary to remove the existing footing concrete as indicated in the plans.

Payment will be made under:

Partial Removal of Existing Structure @ Bent 159.....Lump Sum

**CONSTRUCTION, MAINTENANCE & REMOVAL  
OF TEMPORARY ACCESS**

**(SPECIAL)**

**DESCRIPTION**

The Department has obtained permits to extend the access road to the old ferry landing just south of the Bonner Bridge to load barges to transport materials to the worksite. Permits allow placement of sandbags to temporarily extend the access road at this location. Upon completion of the project, the access road must be completely removed and the area restored to the elevation of the surrounding wetlands.

If the Contractor chooses to use a different site to access barges used to transport materials to the worksite, all costs associated with developing the site, including permitting which must be coordinated with the Department, will be at the Contractor's expense and no additional contract time will be granted.

The Contractor shall furnish all labor, materials, equipment and incidentals required to extend and/or remove the access road. Length and width of extension shall not exceed the dimensions shown in the permit drawings. Upon completion of the project, the Contractor shall remove existing asphalt pavement, existing fill material and all materials used to extend the access road and return the site to the elevation of the surrounding wetlands. All visible broken asphalt, silt fence posts, silt fence and geotextile fabric shall also be removed from the shoreline and surrounding area.

If the Contractor proposes an alternate method of extending the access road or accessing the worksite that requires changes to the permit drawings and/or modification of the environmental permits, the Contractor must coordinate these changes with the Department. No additional contract time will be granted for permit modification in this case.

**BASIS OF PAYMENT**

Payment for *Construction, Maintenance & Removal of Temporary Access* shall be full compensation for furnishing all labor, materials, equipment, and incidentals necessary for the construction, maintenance and removal of the temporary access road extension.

Payment will be made under:

Construction, Maintenance & Removal of Temporary Access.....Lump Sum