

**Project Special Provisions
Structure**

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8/16/11

PROJECT SPECIAL PROVISIONS
STRUCTURE**PROJECT B-4415****BEAUFORT COUNTY****CONSTRUCTION, MAINTENANCE AND REMOVAL**
OF TEMPORARY STRUCTURE AT STATION 16+22.00 -L-**(11-5-10)**

Construct, maintain and afterwards remove a temporary structure in accordance with the applicable parts of the Standard Specifications and this Special Provision (structure only; the approaches are not a part of this pay item). Provide a temporary structure with a minimum overall length of 90 feet (meters). Center the length of the structure about Station 16+29.00 -Detour- with the alignment, grade, and skew as indicated on the Roadway plans. If the skew is not 90°, lengthening the structure to accommodate a 90° skew is permitted. Provide a temporary structure with a minimum clear roadway width of 26.0 feet (meters) and an underclearance elevation no less than elevation 21.000. Temporary structures over railroads shall maintain a minimum horizontal clearance of 25' from center of track to any temporary bent.

Design the temporary structure for HL-93 live load in accordance with the current edition of the AASHTO LRFD Bridge Design Specifications. The design of temporary structures need not satisfy the Extreme Event I Load Combination of the AASHTO LRFD Bridge Design Specifications. As a minimum, design the bridge rails for the AASHTO LRFD Test Level 2 (TL-2) crash test criteria, except when the plans state that a Test Level 3 (TL-3) bridge rail is required. The bridge rail design criteria are defined in the current edition of the AASHTO LRFD Bridge Design Specifications. In addition, design structural elements to which the bridge rail is attached, or elements which may receive loads transmitted through the rail, to distribute and/or withstand these loads.

Attach the bridge rails in a way that permits the bridge approach railing system to transition from the guardrail system and attach to the rigid railing system on the temporary bridge.

Provide a timber floor of laminated construction on the temporary structure. Place a sufficiently thick bottom layer of lumber normal to the centerline of roadway and a top layer of 2" x 8" (50 mm x 200mm) lumber on a 45° skew with the centerline of roadway. Lumber wider than 8" (200mm) is permitted if approved. For the bottom layer, use lumber that is dressed on all four sides to ensure a uniform width and thickness. For the top layer, use lumber dressed only on one side to ensure a uniform thickness. Place the lumber so that the crown of the lumber is the rough side and is "facing up" in order to receive a tack coat. Apply sand seal to the timber floor after the top layer of lumber is completed. When preservative treatment is specified, follow AWWA Standards for the applicable use.

For Sand Seal, apply a liquid asphalt material and one or more applications of fine aggregate on the surface of wooden deck detour bridges. Use materials meeting the requirements of Division 10 of the Standard Specifications shown below:

- Asphalt, Grade CRS-2 or CRS-1 Articles 1020-6, 1020-7
- Aggregate, #1S..... Article 1005-3

Clean and dry the surface of the bridges before applying treatment. Apply asphalt emulsion at a rate of 0.15 - 0.20 gal/yd² (0.7 - 0.9 liters/m²) followed by a uniform coverage of sand at a rate of 10 – 15 lbs/yd² (5.4 - 8.1 kg/m²). Roll the seal with a pneumatic-tired roller. Allow the seal to cure for a minimum of 24 hours before opening to traffic. Maintain the sand seal in an acceptable condition during the life of the detour, making additional applications as necessary.

If the timbers in the bottom layer of lumber are at least 8 inches (200mm) thick, an asphalt wearing surface of at least 3 inches (75 mm) in thickness is permitted in lieu of the sand seal and top layer of lumber. Bolt the timbers together horizontally in minimum 4 foot (1.2m) mats. Prior to the assembly of the mats, have all four sides of the individual timbers inspected in accordance with Article 1082-1 of the Standard Specifications. Place the face of timbers in contact with girder flanges so that they are even and positively bear on all girder flanges. If necessary, provide shimming to ensure positive bearing. Minor variations are permissible in the evenness of the top surface of timbers that is in contact with the asphalt. Secure the timber floor to the girder flanges at regular intervals.

Other floor systems are permitted if approved.

If timber piles are used, use piles that are new and conform to ASTM D25. Rough-peeled or clean-peeled untreated timber piles are permitted.

All wood and timber products shall be inspected in accordance with Article 1082-1 of the Standard Specifications.

Submit design calculations to the Engineer that, as a minimum, include stress calculations for the following structural components: railings, rail post, rail post connections, timber floor, main girders or floor beam system, bent cap, pile bearing, pile as a structural member and longitudinal and lateral stability of pile bents if necessary. Design calculations and detailed drawings of the structural components shall be signed and sealed by a North Carolina Registered Professional Engineer. For stream crossings, determine the pile stability assuming a scour depth equal to 250% of the pile diameter or width below the existing bed elevation. The Engineer may require a more detailed analysis of scour depth for pile bents containing more than a single row of piles.

Include material specifications for all new and used materials, including commercial grades and species of timber and lumber, in the detail drawings of the structure. In addition, show the location and a detailed sketch of the used materials indicating condition of the material, the location and geometry of existing but unused holes, attachments left over from previous use and any other irregularities in the material.

Indicate the condition of the used materials in the design calculations. Provide access to any used materials for inspection prior to assembly.

All critical bolted connections in the temporary structure require new high strength bolts. Indicate the location of the critical connections and recommended bolt size with tightening procedures in the detail drawings of the structure. The use of used high strength bolts is limited to non-critical connections and is subject to approval. For new high strength bolts, furnish the Engineer a copy of the manufacturer's test report for each component. Have the report indicate the testing date, the location where the components were manufactured, the lot number of the material represented, the rotational capacity tests lot number and the source identification marking used by the manufacturer of each component.

Before the temporary structure is loaded, the contractor shall inspect the structure and submit a written statement certifying that the erected structure complies with the approved detailed drawings. Temporary structures utilizing modular panels shall be inspected and certified by a manufacturer's representative. Any condition that does not comply with the accepted drawings, or any other condition deemed unsatisfactory by the Engineer, is cause for rejection until corrections are made.

Have all timber and lumber inspected by the Materials and Tests Unit or their authorized representative before shipping it to the project. The use of ungraded timber and lumber is not permitted. Use material conforming to grading rules of SPIB, NELMA or other nationally recognized specification.

The lump sum price bid for "Construction, Maintenance and Removal of Temporary Structure at Station 16+22.00 -L-" will be full compensation for the above work including all materials, equipment, tools, labor and incidentals necessary to complete the work.

EVAZOTE JOINT SEALS

(11-5-10)

1.0 SEALS

Use preformed seals compatible with concrete and resistant to abrasion, oxidation, oils, gasoline, salt and other materials that are spilled on or applied to the surface. Use a resilient, UV stable, preformed, impermeable, flexible, expansion joint seal. The joint seal shall consist of low-density, closed cell, cross-linked polyethylene non-extrudable, foam. The joint seal shall contain no EVA (Ethylene Vinyl Acetate). Cell generation shall be achieved by being physically blown using nitrogen. No chemical blowing agents shall be used in the cell generation process.

Use seals manufactured with grooves 1/8" (3 mm) ± wide by 1/8" (3 mm) ± deep and spaced between 1/4" (6 mm) and 1/2" (13 mm) apart along the bond surface running the length of the joint. Use seals with a depth that meets the manufacturer's recommendation, but is not less than 70% of the uncompressed width. Provide a seal designed so that, when compressed, the center portion of the top does not extend upward above the original height

of the seal by more than 1/4" (6 mm). Provide a seal that has a working range of 30% tension and 60% compression and meets the requirements given below.

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

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

2.0 BONDING ADHESIVE

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

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

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

3.0 ELASTOMERIC CONCRETE

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

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

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

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

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

4.0 SAWING THE JOINT

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

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

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

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

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

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

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

5.0 PREPARATION OF SAWED JOINT FOR SEAL INSTALLATION

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

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

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

If nozzle blasting is used to clean the joint opening, use compressed air that does not contain detrimental amounts of water or oil.

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

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

6.0 SEAL INSTALLATION

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

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

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

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

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

7.0 BASIS OF PAYMENT

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

ELASTOMERIC CONCRETE

(1-27-10)

1.0 DESCRIPTION

Elastomeric concrete is a mixture of a two-part polymer consisting of polyurethane and/or epoxy and kiln-dried aggregate. Provide an elastomeric concrete and binder system that is preapproved. Use the concrete in the blocked out areas on both sides of the bridge deck joints as indicated on the plans.

2.0 MATERIALS

Provide materials that comply with the following minimum requirements at 14 days (or at the end of the specified curing time).

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

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

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

3.0 PREQUALIFICATION

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

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

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

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

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

4.0 MATERIAL CERTIFICATION AND INSTALLATION

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

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

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

5.0 FIELD SAMPLING

Provide additional production material to allow freshly mixed elastomeric concrete to be sampled for acceptance. A minimum of six 2 inch cube molds and three 3x6 inch cylinders will be taken by the Department for each day's production. Compression, splitting tensile, and durometer hardness testing will be performed by the Department to determine acceptance. Materials failing to meet the requirements listed above are subject to removal and replacement at no cost to the Department.

6.0 BASIS OF PAYMENT

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

FALSEWORK AND FORMWORK

(4-1-11)

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. 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 (177 km/hr). In addition, Table 2.2A is included to provide the maximum wind speeds by county in North Carolina.

Table 2.2 - Wind Pressure Values

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

2. Time of Removal

The following requirements replace those of Article 3.4.8.2.

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

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

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

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

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 (25 mm). For cast-in-place concrete structures, make sure that the calculated deflection of falsework flexural members does not exceed 1/240 of their span regardless of whether or not the deflection is compensated by camber strips.

A. Maintenance and Inspection

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

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

B. Foundations

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

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

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

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

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

5.0 REMOVAL

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

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

6.0 METHOD OF MEASUREMENT

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

7.0 BASIS OF PAYMENT

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

SUBMITTAL OF WORKING DRAWINGS

(4-1-11)

1.0 GENERAL

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

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

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

2.0 ADDRESSES AND CONTACTS

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

Via US mail:

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

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

Via other delivery service:

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

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

Submittals may also be made via email.

Send submittals to:

plambert@ncdot.gov (Paul Lambert)

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

jgaither@ncdot.gov (James Gaither)

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

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

Via US mail:

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

Via other delivery service:

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

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

Via US mail:

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

Via other delivery service:

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

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

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

Primary Structures Contact:

Paul Lambert
(919) 250 – 4041
(919) 250 – 4082 facsimile
plambert@ncdot.gov

Secondary Structures Contacts:

James Gaither (919) 250 – 4042
David Stark (919) 250 – 4044

Eastern Regional Geotechnical Contact (Divisions 1-7):

K. J. Kim
(919) 662 – 4710
(919) 662 – 3095 facsimile
kkim@ncdot.gov

Western Regional Geotechnical Contact (Divisions 8-14):

John Pilipchuk
(704) 455 – 8902
(704) 455 – 8912 facsimile
jpilipchuk@ncdot.gov

3.0 SUBMITTAL COPIES

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

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

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

STRUCTURE SUBMITTALS

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

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

Structural Steel ⁴	2, then 7	0	Article 1072-10
Temporary Detour Structures	10	2	Article 400-3 & “Construction, Maintenance and Removal of Temporary Structure at Station _____”
TFE Expansion Bearings ⁴	8	0	Article 1072-10

FOOTNOTES

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

GEOTECHNICAL SUBMITTALS

Submittal	Copies Required by Geotechnical Engineering Unit	Copies Required by Structure Design Unit	Contract Reference Requiring Submittal ¹
Drilled Pier Construction Plans ²	1	0	“Drilled Piers”
Crosshole Sonic Logging (CSL) Reports ²	1	0	“Crosshole Sonic Logging” & “Drilled Piers”
Pile Driving Equipment Data Form ^{2,3}	1	0	Article 450-5 & “Piles”
Pile Driving Analyzer (PDA) Reports ²	1	0	“Pile Driving Analyzer” & “Piles”
Retaining Walls ⁴	8	2	Applicable Provisions
Contractor Designed Shoring ⁴	7	2	“Temporary Shoring”, “Anchored 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. Articles 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 Geotechnical Engineering Unit. Electronic submission is preferred.
- Download Pile Driving Equipment Data Form from the following link:
www.ncdot.org/doh/preconstruct/highway/geotech/formdet/
See second page of form for submittal instructions.
- Electronic copies of submittal are required. See referenced provision.

CRANE SAFETY**131****(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.

CONCRETE WEARING SURFACE**(7-18-06)****1.0 GENERAL**

This Special Provision governs materials, forming, and all other related work in the construction of a reinforced concrete wearing surface in accordance with applicable parts of the Standard Specifications, the details shown on the plans, and as outlined in these Special Provisions.

2.0 MATERIALS

Unless otherwise noted on the plans, use class AA concrete and a coarse aggregate gradation of 78M. The Class AA concrete shall contain fly ash or ground granulated blast furnace slag at the substitution rate specified in Article 1024-1 and in accordance with Articles 1024-5 and 1024-6 of the Standard Specifications. Place the wearing surface according to the grades, thicknesses and cross sections shown on the plans.

3.0 PREPARATION OF SURFACE

Prepare all surfaces to be overlaid using the equipment specified herein and prior to placing the epoxy coated reinforcing steel. Additionally, clean the surface within 48 hours prior to placing the overlay unless otherwise approved.

Thoroughly soak the cleaned surface for at least 12 hours prior to placing the concrete wearing surface. While soaking the surface, cover it with a layer of white opaque polyethylene film that is at least 4 mils (0.100 mm) thick. Immediately prior to placing the concrete wearing surface, remove standing water from the surface.

4.0 EQUIPMENT

Prior to beginning any work, obtain approval for all equipment to be used for deck preparation, placing, finishing, and curing the concrete wearing surface.

For surface preparation, use sandblasting or pressure washing equipment capable of removing all foreign matter. If using high pressure water blast, a minimum nozzle pressure of 3000 psi is required.

5.0 PLACING AND FINISHING

Follow the placing, finishing, and curing requirements of Article 420-14 (A) and (B). Construction Joints other than those shown on the plans are not permitted.

6.0 LIMITATIONS OF OPERATIONS

The requirements of Article 420-20 will apply to placing vehicles and construction equipment on the finished concrete wearing surface.

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

7.0 METHOD OF MEASUREMENT

The quantity of concrete wearing surface to be paid for is the actual number of square feet (square meters) of concrete wearing surface as provided on the plans.

8.0 BASIS OF PAYMENT

The quantity for which payment is made will be that quantity shown in square feet (square meters) on the plans. Where the plans have been revised, the quantity to be paid for will be the quantity shown on the revised plans.

The unit bid per square foot (square meter) will be full compensation for all work covered by this Special Provision and applicable parts of the Standard Specifications, but not limited to furnishing and placing concrete, epoxy coated reinforcing steel, joint filler and sealer, deck drains, bridge scuppers, and any other material; erecting and removing all forms, curing concrete, protecting concrete in wind, rain, low humidity, high temperatures or other unfavorable weather.

Payment will be made under:

Concrete Wearing SurfaceSquare Foot (Square Meter)

GROUT FOR STRUCTURES

(7-12-07)

1.0 DESCRIPTION

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

2.0 MATERIALS

Refer to Division 10 of the *Standard Specifications*:

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

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

3.0 REQUIREMENTS

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

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

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

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

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

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

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

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

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

4.0 SAMPLING AND PLACEMENT

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

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

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

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

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

5.0 MISCELLANEOUS

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

PRESTRESSED CONCRETE MEMBERS

(10-12-10)

The 2006 Standard Specifications shall be revised as follows:

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

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

(A) Producer Qualification

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

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

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

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

(B) Working Drawing Submittals

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

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

Position strands, ties, supports, reinforcing bars of the sizes shown on the plans and bearing plates in accordance with the detailed dimensions shown on the plans and effectively secure against displacement from their correct positions. The use of previously tensioned strands is not permitted. For prestressing strands, do not allow deflections or displacements of any kind between the end anchorages unless shown on the plans. Place the steel reinforcing in final

position after tensioning of the strands. Bend all tie wires to the inside of the member so that the ends are farther from the edge than the material tied. Support bottom strands spacings not to exceed 20 feet by supports meeting the requirements of Article 1070-4 or by other approved means. Plastic supports may be used when approved.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Members with one or more vertical cracks that extend into the bottom flange and are spaced at a distance greater than the member depth are subject to an engineering assessment to

determine their acceptability. If this engineering assessment is required, submit, at no additional cost to the Department, a proposal for repairing the member and a structural evaluation of the member prepared by a North Carolina Licensed Professional Engineer. In the structural evaluation, consider the stresses under full service loads had the member not cracked and the effects of localized loss of prestress at the crack as determined by methods acceptable to the Department.

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

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

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

After detensioning of certain girders with draped strands, cracks occasionally occur in the webs at the ends of the girders. If such cracks occur, employ a method to remedy this condition on all subsequent girders of the same type and strand pattern. If debonding of strands is used, satisfy the following criteria:

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

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

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

Store all prestressed members on solid, unyielding, storage blocks in a manner to prevent torsion or objectionable bending. In handling prestressed concrete girders 54" or less in height, including cored slabs and box beams, maintain them in an upright position at all times and pick them up within 5 feet of the points of bearing and transport and store supported only within 3 feet of points of bearing. In handling prestressed concrete girders greater than 54" in height,

maintain them in an upright position at all times and submit for approval the proposed method of lifting, transporting, and storing the girders. When requested, provide calculations to confirm girders are not overstressed by such operations.

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

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

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

Provide a 3/4" chamfer along the bottom edges on ends and sides of all box beam and cored slab sections, top outside edges of exterior sections and acute corners of sections. Round the top edges on ends of all sections with a 1/4" finishing tool. Provide square corners along top edges on all sections along shear keys. Do not chamfer vertical edges at ends of sections.

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

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

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

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

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

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

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

Width - Differential of adjacent spans in the same structure	1/2"
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Section 1078-16 (B) – Alignment and Dimensional Tolerances, revise Table 1078-4 “Tolerances for Prestressed Girders” as follows:

Position of holes for diaphragm bolts (K)	±1/4"
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Section 1078-16 (F) – Alignment and Dimensional Tolerances, revise Table 1078-8 “Tolerances for Box Beams” to be consistent with cored slab tolerances as follows:

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

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

Section 1078-17

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

Section 1078-18

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

1.0 GENERAL

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

2.0 INSTALLATION

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

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

3.0 FIELD TESTING

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

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

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

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

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

4.0 REMOVAL AND REPLACEMENT OF FAILED TEST SPECIMENS:

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

5.0 USAGE

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

6.0 BASIS OF PAYMENT

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

CURING CONCRETE

(6-12-09)

The 2006 Standard Specifications shall be revised as follows:

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

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

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

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

PILES

(3-5-10)

Revise the *Standard Specifications* as follows:

Page 4-71, Delete Section 450 **BEARING PILES** and replace it with the following:

1.0 DESCRIPTION

Furnish and install piles with sufficient lengths in accordance with the contract and accepted submittals. Provide steel and prestressed concrete piles and composite piles with both concrete and steel sections as shown on the plans. Drive and drill in piles and use pile tips and accessories as shown on the plans. Galvanize, restrike, redrive, splice, cut off and build up piles and perform predrilling, spudding and pile driving analyzer (PDA) testing as necessary or required. For this provision, “pile embedment” refers to the required pile embedment in the cap or footing and “pile penetration” refers to the minimum required pile tip elevation or penetration into natural ground, whichever is deeper.

2.0 MATERIALS

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Flowable Fill, Non-Excavatable	340
Portland Cement Concrete, Class A	1000
Reinforcing Steel	1070
Steel Pipe Pile Plates	1072
Steel and Prestressed Concrete Piles	1084

For drilled-in piles, use Class A Concrete in accordance with Article 1000-4 of the *Standard Specifications* except as modified herein. Provide concrete with a slump of 6 to 8 inches (150 to 200 mm). Use an approved high-range water reducer to achieve this slump.

For galvanized steel piles, see Section 1076 of the *Standard Specifications*. For composite piles with both prestressed concrete and steel H pile sections, use prestressed concrete piles and steel H piles in accordance with Section 1084 of the *Standard Specifications*. Use steel pile points and splicers approved by the NCDOT Materials & Tests (M&T) Unit. Obtain a list of approved pile points and splicers from:

<https://apps.dot.state.nc.us/vendor/approvedproducts/>

3.0 PILE LENGTHS

The estimated pile lengths shown on the plans are for bid purposes only. Provide piles of sufficient lengths for the required driving resistance, pile penetration and pile embedment. At the Contractor's option and no additional cost to the Department, make investigations as necessary to determine required pile lengths.

4.0 CONSTRUCTION METHODS

A. Handling and Storing Piles

Handle, transport and store piles so that piles are kept clean and undamaged. Do not use chains, cables or hooks that can damage or scar piles. Do not damage coatings on steel piles. When handling prestressed concrete piles, support piles at pick-up points as shown on the plans.

Protect steel piles as far as practicable from corrosion. Store piles above ground upon platform skids, or other supports, and keep free from dirt, grease, vegetation and other foreign material. Damaged, bent or cracked piles will be rejected.

B. Pile Installation

If applicable, completely excavate for caps and footings before installing piles. If applicable and unless noted otherwise on the plans, construct embankments to bottom of cap or footing elevations 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.

Install piles with the following tolerances.

1. Axial alignment within ¼ inch per foot (21 mm per meter) of vertical or batter shown on the plans
2. Horizontal alignment within 3" (75 mm) of plan location, longitudinally and transversely
3. Pile embedment within 3" (75 mm) more and 2" (50 mm) less of the embedment shown on the plans

No additional payment will be made for increased cap or footing dimensions due to piles installed out of position.

If necessary, build up prestressed concrete piles or splice steel piles as shown on the plans. Do not use more than 3 sections (2 splices) of steel piling per pile. Cut off piles at required elevations along a plane normal to the axis of the pile as necessary. Do not damage or spall piles when cutting off prestressed concrete piles.

C. Pile Accessories

If required, use pile accessories including pipe pile plates and steel pile points and splicers as shown on the plans. Perform any welding in accordance with the contract. Weld pipe pile plates with the specified dimensions to steel pipe piles as shown on the plans.

Attach steel pile points to steel piles in accordance with the manufacturer's instructions. The minimum weld length is twice the flange width for steel H piles.

Use steel pile tips with prestressed concrete piles as shown on the plans. Use steel pile splicers for splicing steel H pile tips and composite piles. Attach pile splicers in accordance with the manufacturer's instructions.

D. Driven Piles

When predrilling, spudding and installing the initial portions of steel piles with vibratory hammers, submit these pile installation methods with the proposed pile driving methods and equipment for review and acceptance. Spudding is defined as driving or dropping a steel H pile and then removing it. The Engineer will approve the predrilling depth and diameter, spudding depth and H pile size and depth of pile installation with a vibratory hammer. Do not use vibratory hammers to install prestressed concrete piles.

Drive piles in accordance with the accepted submittals and this provision. Unless otherwise approved, do not drive piles within 50 ft (15 m) of cast-in-place concrete until the concrete cures for at least 3 days.

Limit driving stresses in accordance with the *AASHTO LRFD Bridge Design Specifications*. If a tip elevation is noted on the plans for steel and prestressed concrete piles, drive piles to the minimum required driving resistance and tip elevation. Otherwise, drive steel and prestressed concrete piles to the minimum required driving resistance and a penetration into natural ground of at least 10 ft (3 m). For composite piles, drive piles to the minimum required driving resistance and the prestressed concrete and steel H pile sections to their respective minimum required tip elevations noted on the plans.

Also, drive piles to the minimum required tip elevation or penetration into natural ground, whichever is deeper, in a continuous operation unless stopped due to exceeding the maximum blow count or driving stresses, insufficient pile length or other approved reasons. Natural ground within an area of a new embankment is defined as the bottom of the embankment or footings, whichever is lower.

Protect coatings in an approved manner when driving coated steel piles through templates. Redrive piles raised or moved laterally due to driving adjacent piles.

1. Predrilling and Spudding

If necessary or required, perform predrilling for piles and spudding with a steel H pile as noted on the plans or in accordance with the accepted submittals. Predrill pile locations to the specified elevations noted on the plans, revised elevations approved by the Engineer or depths in accordance with the accepted submittals. When noted on the plans and at the Contractor's option, spudding may be used in lieu of predrilling. Do not perform spudding below specified predrilling elevations, revised elevations approved by the Engineer or depths in accordance with the accepted submittals.

When noted on the plans or predrilling in water or wetlands, use temporary steel casings meeting the requirements of steel casings for pile excavation in accordance with this provision with the exception of casing diameter. For steel casing diameters, use casings with a minimum inside diameter equal to the predrilling diameter. Use steel casings from a minimum of 2 ft (0.6 m) above the static water elevation or ground line, whichever is higher, to a minimum of 5 ft (1.5 m) below the ground or mud line. More than 5 ft (1.5 m) embedment may be necessary if steel casings are not stable or predrilling or spudding disturbs material outside the casings.

Perform predrilling and spudding such that large ground movements and voids below ground do not occur and piles can be driven to the required resistance and pile penetration. Do not deposit spoils above the ground or mud line in water or wetlands. Dispose of spoils in accordance with Section 802 of the *Standard Specifications* and as directed by the Engineer. When predrilling or spudding is complete, remove all steel casings before driving piles.

2. Driving Equipment

Submit the proposed pile driving methods and equipment (pile driving equipment data form) including the pile driving hammer, hammer cushion, pile helmet and cushion for all piles for review and acceptance. Do not submit more than two pile driving hammers per pile type per submittal. Provide 2 copies of this form at least 30 calendar days before driving piles. All equipment is subject to satisfactory field performance.

Drive piles with accepted driving equipment using air, steam or diesel hammers. Use pile driving hammers that will not overstress piles and provide the required driving resistance at a blows per foot ranging from 30 to 180. Use a variable energy hammer to drive prestressed concrete piles.

Operate air and steam hammers within the manufacturer's specified ranges and 10% of the manufacturer's rated speed in blows per minute or a rate approved by the Engineer. Use a 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. Provide striking parts of air and steam hammers that weigh at least one-third the weight of the pile helmet and pile, with a minimum weight of 2,750 lbs (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 determine the hammer stroke during driving. Equip closed-end (double acting) diesel hammers with a calibrated bounce chamber pressure gauge mounted near the ground and provide a current calibrated chart or graph equating bounce chamber pressure and gauge hose length to equivalent energy. Submit this chart or graph with the proposed pile driving methods and equipment for closed-end diesel hammers.

Hold pile heads in position with pile helmets that closely fit over the pile heads and extend down the sides of piles a sufficient distance. Protect pile heads of prestressed concrete piles from direct impact with accepted pile cushions. Use pile cushions made of pine plywood with a minimum thickness of 4" (100 mm). Unless otherwise approved, provide a new pile cushion for each prestressed concrete pile. Replace pile cushions during driving when a cushion is compressed more than one-half its original thickness or begins to burn.

The Engineer may inspect the hammer cushion before beginning driving and periodically throughout the project. Expose the hammer cushion for inspection as directed by the Engineer. Replace or repair any hammer cushion that is less than 25% of its original thickness.

3. Required Driving Resistance

The Engineer will determine the acceptability of the proposed pile driving methods and equipment and provide the blows per foot and equivalent set for 10 blows for the required driving resistance. The minimum required driving resistance is equal to the factored resistance noted on the plans plus any additional resistance for downdrag and scour, if applicable, divided by a resistance factor. When performing PDA testing in accordance with the *AASHTO LRFD Bridge Design Specifications*, the resistance factor is 0.75. Otherwise, the resistance factor for the wave equation analysis is 0.60.

Unless otherwise approved, stop driving piles when refusal is reached. Refusal is defined as 240 blows per foot or any equivalent set.

4. Redriving Piles

Once the required pile penetration is achieved, the Contractor may choose to or the Engineer may require the Contractor to stop driving, wait and restrike or redrive piles to achieve the required driving resistance. If the Contractor chooses to restrike or redrive piles, no payment will be made for restrikes or redrives. If the Engineer requires the Contractor to restrike or redrive piles, payment will be made in accordance with section 5.0 of this provision. When the Engineer requires restrikes or redrives, the Engineer will determine the number of restrikes or redrives and the time to wait after stopping driving and between restrikes and redrives. The time to wait will range from 4 to 24 hours.

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

E. Drilled-in Piles

If required, perform pile excavation to specified elevations shown on the plans or revised elevations approved by the Engineer. Excavate holes at pile locations with diameters that will result in at least 3" (75 mm) of clearance all around piles. Before filling holes, support and center piles in excavations and when noted on the plans, drive piles to the required driving resistance. Remove any fluid from excavations, and at the Contractor's option, fill holes with either concrete or flowable fill unless required otherwise in the contract.

1. Pile Excavation

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

If unstable, caving or sloughing soils are anticipated or encountered, stabilize holes with either slurry or temporary steel casings. When using slurry, submit slurry details including product information, manufacturer's recommendations for use, slurry equipment details and written approval from the slurry supplier that the mixing water is acceptable before beginning drilling. When using steel casings, use

either the sectional type or one continuous corrugated or non-corrugated piece. Steel casings should consist of clean watertight steel of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth and backfill. Use steel casings with an outside diameter equal to the hole size and a minimum wall thickness of ¼ inch (6 mm).

2. Filling Holes

Check the water inflow rate at the bottom of holes after all pumps have been removed. If the inflow rate is less than 6" (150 mm) per half hour, remove any fluid and free fall concrete or flowable fill into excavations. Ensure that concrete or flowable fill flows completely around piles. If the water inflow rate is greater than 6" (150 mm) per half hour, propose and obtain acceptance of a procedure for placing concrete or flowable fill before filling holes. Place concrete or flowable fill in a continuous manner and remove all steel casings.

F. Pile Driving Analyzer

If required, test piles with a pile driving analyzer (PDA) manufactured by Pile Dynamics, Inc., analyze data and provide PDA reports. Perform PDA testing in accordance with ASTM D4945. Either the Engineer will perform PDA testing and analysis or use a PDA Consultant prequalified by the NCDOT Contractual Services Unit for Pile Driving Analyzer Work (work code 3060) to perform PDA testing and analysis and provide PDA reports. When using a PDA Consultant, use a PDA Operator approved as a Field Engineer (key person) for the PDA Consultant. Also, provide PDA reports sealed by a Professional Engineer approved as a Project Engineer (key person) for the same PDA Consultant.

The Engineer will determine the number of piles and which piles to be tested with a PDA. Do not drive piles with a PDA until the proposed pile driving methods and equipment has been preliminarily accepted. Notify the Engineer of the pile driving schedule a minimum of 7 calendar days in advance.

The Engineer will complete the review and acceptance of the proposed pile driving methods and equipment and provide the blows per foot and equivalent set for 10 blows for the required driving resistance within 10 calendar days after the Engineer receives the PDA report or the Engineer finishes PDA testing. A PDA report for or PDA testing on multiple piles may be required as determined by the Engineer before the 10 day time period begins.

1. Preparation

Provide piles for PDA testing that are 5 ft (1.5 m) longer than the estimated pile lengths shown on the plans. Supply an AC electrical power source of a voltage and frequency suitable for computer equipment.

Provide a 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 by 6 ft (1.8 m by 1.8 m) and a minimum roof height of 8 ft (2.4 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 Engineer, at an approximate distance equal to 3 times the pile diameter below the pile head. If the PDA Consultant or Engineer chooses to drill the bolt holes, provide the necessary equipment, tools and assistance to do so. A hammer drill is required for concrete piles. Allow for 2 hours per pile to drill holes.

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

2. Testing

Use only the preliminarily accepted pile driving methods and equipment to drive piles with the PDA instruments attached. Drive piles in accordance with this provision and as directed by the PDA Operator or Engineer. The PDA Operator or Engineer may require the Contractor to modify the pile installation procedure during driving. Dynamic measurements will be recorded and used to evaluate the hammer performance, driving resistance and stresses, energy transfer, pile integrity and various soil parameters such as quake and damping.

If required, reattach the PDA instruments and restrike or redrive the pile in accordance with this provision. Obtain the required stroke and at least 6" (150 mm) of penetration as directed by the PDA Operator or Engineer. Dynamic measurements will be recorded during restriking and redriving. The Engineer will determine when PDA testing has been satisfactorily completed.

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.

3. Analysis

When using a PDA Consultant, analyze data with the CAsE Pile Wave Analysis Program (CAPWAP), version 2006 or later, manufactured by Pile Dynamics, Inc. 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 Engineer.

4. Report

When using a PDA Consultant, submit 2 copies of each PDA report within 7 calendar days of completing field testing. Include the following in PDA reports:

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 driving resistance and resistance factor
- Concrete compressive strength and/or steel pile yield strength
- Pile splice type and locations
- Pile batter
- Installation methods including use of predrilling, 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 data (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 data and executable CAPWAP input and output files

5.0 MEASUREMENT AND PAYMENT

_____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles* will be measured and paid for in linear feet (meters). Steel and prestressed concrete piles will be measured as the pile length before installation minus any pile cut-offs. No payment will be made for pile cut-offs or cutting off piles. No payment will be made for damaged, defective or rejected piles or any piles for falsework, bracing, templates or temporary work bridges. The contract unit prices for _____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles* will also be full compensation for driving piles.

Composite piles will be measured as the pile length of the prestressed concrete and steel H pile sections before installation minus any pile cut-offs. The concrete and steel sections will be measured and paid for at the contract unit prices for _____ *Prestressed Concrete Piles* and _____ *Steel Piles*, respectively. No payment will be made for portions of steel H pile sections embedded in prestressed concrete sections or steel pile splicers and any associated hardware or welding.

For driven piles, once the required resistance and pile penetration is achieved, the Contractor may drive the remaining portion of piles to grade in lieu of cutting off piles

provided the remaining portions do not exceed 5 ft (1.5 m) and the piles can be driven without being damaged or reaching the maximum blow count or refusal. When this occurs, the additional length of piles driven will be measured and paid for at the contract unit prices for _____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles*.

For prestressed concrete piles that are built up, the build-up will be measured and paid for at the contract unit price for _____ *Prestressed Concrete Piles*. Steel pile tips are not included in the measurement of prestressed concrete piles. No separate payment will be made for steel pile tips or splicers and any associated hardware or welding. Steel pile tips and steel pile splicers will be considered incidental to the contract unit price for _____ *Prestressed Concrete Piles*.

Steel Pile Points and *Pipe Pile Plates* will be measured and paid for in units of each. *Steel Pile Points* and *Pipe Pile Plates* will be measured as one per pile.

Predrilling for Piles will be measured and paid for in linear feet (meters). For bents with a predrilling pay item as shown on the substructure plans, predrilling will be paid for as *Predrilling for Piles* and measured per pile location as the depth from the ground or mud line to specified predrilling elevations or revised elevations approved by the Engineer. The contract unit price for *Predrilling for Piles* will also be full compensation for using temporary steel casings. For bents without a predrilling pay item as shown on the substructure plans, predrilling will be considered incidental to the contract unit prices for _____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles*.

No direct payment will be made for spudding or using temporary steel casings for spudding. Spudding and using temporary steel casings for spudding will be considered incidental to the contract unit prices for _____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles*.

Pile Redrives will be measured and paid for in units of each. *Pile Redrives* will be measured as the 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.

Pile Excavation in Soil and *Pile Excavation Not in Soil* will be measured and paid for in linear feet (meters). Pile excavation will be measured as the depth from the ground line to the specified elevations or revised elevations approved by the Engineer. Not in soil is defined as material with a rock auger penetration rate of less than 2" (50 mm) per 5 minutes of drilling at full crowd force. Once not in soil is encountered, seams, voids and weathered rock less than 3 ft (1 m) thick with a rock auger penetration rate of greater than 2" (50 mm) per 5 minutes of drilling at full crowd force will be paid for at the contract unit price for *Pile Excavation Not in Soil*. Seams, voids and weathered rock greater than 3 ft (1 m) thick will be paid for at the contract unit price for *Pile Excavation in Soil* where not in soil is no longer encountered. The contract unit prices for *Pile Excavation in Soil* and *Pile Excavation Not in Soil* will also be full compensation for stabilizing and filling holes with either concrete or flowable fill.

PDA Testing will be measured and paid for in units of each. No payment for *PDA Testing* will be made if the Engineer performs PDA testing. If the Engineer does not perform PDA testing, *PDA Testing* will be measured as one per pile. The contract unit price for *PDA Testing* will be full compensation for performing PDA testing the first time a pile is tested with a PDA, performing analysis on data collected during initial drive, restrikes and redrives and providing the PDA report. Subsequent PDA testing of the same piles will be considered incidental to the contract unit price for *Pile Redrives*.

PDA Assistance will be measured and paid for in units of each. *PDA Assistance* will be measured as one per pile. The contract unit price for *PDA Assistance* will be full compensation for the Contractor's assistance to perform the PDA testing during initial drive, restrikes and redrives.

Payment will be made under:

Pay Item	Pay Unit
_____ Prestressed Concrete Piles	Linear Foot (Meter)
_____ Steel Piles	Linear Foot (Meter)
_____ Galvanized Steel Piles	Linear Foot (Meter)
Steel Pile Points	Each
Pipe Pile Plates	Each
Predrilling for Piles	Linear Foot (Meter)
Pile Redrives	Each
Pile Excavation in Soil	Linear Foot (Meter)
Pile Excavation Not in Soil	Linear Foot (Meter)
PDA Testing	Each
PDA Assistance	Each