Project B-4012 **Ashe County**

Project Special Provisions
Structure

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PROJECT SPECIAL PROVISIONS
STRUCTURE

PROJECT B-4012 **ASHE COUNTY**

CONSTRUCTION, MAINTENANCE AND REMOVAL OF TEMPORARY STRUCTURE AT STATION 17+30+00-L- **(10-24-06)**

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 140 feet. Center the length of the structure about Station 16+97.00-DET- 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 16 feet and an underclearance elevation no less than elevation 3116.5.

Design the temporary structure for HS25 (MS22.5) live load in accordance with the current edition of the AASHTO Standard Specifications for Highway Bridges. The design of temporary structures need not satisfy the seismic design criteria of AASHTO Division I-A "Seismic Design", Section 3. 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 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 AWPA 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/yd^2 (0.7 - 0.9 liters/m^2) followed by a uniform coverage of sand at a rate of 10 – 15 lbs/yd^2 (5.4 - 8.1 kg/m^2). 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 the Materials and Tests Unit, or their authorized representative, inspect the timber on all four sides. 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.

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. 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.

Used high strength bolts, nuts and washers are permitted only in already bolted-up connections of used diaphragm and girder systems that are proposed for reuse. The use of used bolts is limited to secondary member connections such as diaphragms and is subject to approval.

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 17+30+00-L-" will be full compensation for the above work including all materials, equipment, tools, labor and incidentals necessary to complete the work.

FALSEWORK AND FORMWORK (7-18-06)

1.0 DESCRIPTION

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

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

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

2.0 MATERIALS

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

3.0 DESIGN REQUIREMENTS

A. Working Drawings

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

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

When required, have the drawings and calculations prepared under the guidance of, and sealed by, a North Carolina Registered Professional Engineer who is knowledgeable in temporary works design.

Design falsework and formwork requiring submittals in accordance with the 1995 AASHTO *Guide Design Specifications for Bridge Temporary Works* except as noted herein.

1. Wind Loads

Table 2.2 of Article 2.2.5.1 is modified to include wind velocities up to 110 mph (177 km/hr). In addition, Table 2.2A is included to provide the maximum wind speeds by county in North Carolina.

Table 2.2 - Wind Pressure Values

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

2. Time of Removal

The following requirements replace those of Article 3.4.8.2.

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

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

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

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

Note on the working drawings any anchorages, connectors, inserts, steel sleeves or other such devices used as part of the falsework or formwork that remains in the permanent structure. If the plan notes indicate that the structure contains the necessary corrosion protection required for a Corrosive Site, epoxy coat, galvanize, metallize or otherwise protect these devices as directed by the Engineer. Any coating required by the Engineer will be considered incidental to the various pay items requiring temporary works.

B. Review and Approval

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

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

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

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

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

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

4.0 CONSTRUCTION REQUIREMENTS

All requirements of Section 420 of the Standard Specifications apply.

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

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

A. Maintenance and Inspection

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

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

B. Foundations

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

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

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

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

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

5.0 REMOVAL

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

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

6.0 METHOD OF MEASUREMENT

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

7.0 BASIS OF PAYMENT

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

SUBMITTAL OF WORKING DRAWINGS (7-12-07)

1.0 GENERAL

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

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

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

2.0 ADDRESSES AND CONTACTS

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

Via US mail:

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

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

Via other delivery service:

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

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

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

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

Via US mail:

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

Via other delivery service:

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

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

Via US mail:

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

Via other delivery service:

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

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

Primary Structures Contact:
Paul Lambert
(919) 250 – 4041
(919) 250 – 4082 facsimile
plambert@dot.state.nc.us

Secondary Structures Contacts:
James Gaither (919) 250 – 4042
David Stark (919) 250 – 4044

Eastern Regional Geotechnical Contact (Divisions 1-7):
K. J. Kim
(919) 662 – 4710
(919) 662 – 3095 facsimile
kkim@dot.state.nc.us

Western Regional Geotechnical Contact (Divisions 8-14):
John Pilipchuk
(704) 455 – 8902
(704) 455 – 8912 facsimile
jpilipchuk@dot.state.nc.us

3.0 SUBMITTAL COPIES

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

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

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

STRUCTURE SUBMITTALS

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

GEOTECHNICAL SUBMITTALS

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

FOOTNOTES

1. References are provided to help locate the part of the contract where the working drawing submittals are required. References in quotes refer to the Project Special Provision by that name. Articles refer to the Standard Specifications.
2. Electronic copies of submittals are required. See referenced Project Special Provision.
3. Download Pile Driving Equipment Data Form from following link:
   http://www.ncdot.org/doh/preconstruct/highway/geotech/formdet/
   Submit one hard copy of the completed form to the Resident Engineer. Submit a second copy of the completed form electronically, by facsimile or via US Mail or other delivery service to the Geotechnical Engineering Unit. Electronic submission is preferred. See second page of form for submittal instructions.

CRANE SAFETY (8-15-05)

Comply with the manufacturer specifications and limitations applicable to the operation of any and all cranes and derricks. Prime contractors, sub-contractors, and fully operated rental companies shall comply with the current Occupational Safety and Health Administration regulations (OSHA).

Submit all items listed below to the Engineer prior to beginning crane operations involving critical lifts. A critical lift is defined as any lift that exceeds 75 percent of the manufacturer's crane chart capacity for the radius at which the load will be lifted or requires the use of more than one crane. Changes in personnel or equipment must be reported to the Engineer and all applicable items listed below must be updated and submitted prior to continuing with crane operations.

CRANE SAFETY SUBMITTAL LIST

A. **Competent Person:** Provide the name and qualifications of the "Competent Person" responsible for crane safety and lifting operations. The named competent person will have the responsibility and authority to stop any work activity due to safety concerns.

B. **Riggers:** Provide the qualifications and experience of the persons responsible for rigging operations. Qualifications and experience should include, but not be limited to, weight calculations, center of gravity determinations, selection and inspection of sling and rigging equipment, and safe rigging practices.

C. **Crane Inspections:** Inspection records for all cranes shall be current and readily accessible for review upon request.

D. **Certifications:** **By July 1, 2006**, crane operators performing critical lifts shall be certified by NC CCO (National Commission for the Certification of Crane Operators), or satisfactorily complete the Carolinas AGC's Professional Crane Operator's Proficiency Program. Other approved nationally accredited programs will be considered upon request. All crane operators shall also have a current CDL medical card. Submit a list of anticipated critical lifts and corresponding crane operator(s). Include current certification for the type of crane operated (small hydraulic, large hydraulic, small lattice, large lattice) and medical evaluations for each operator.

GROUT FOR STRUCTURES (7-12-07)

1.0 DESCRIPTION

This special provision addresses grout for use in structures, including continuous flight auger (CFA) piles, micropiles, soil nail and anchored retaining walls and backfilling crosshole sonic logging (CSL) tubes or grout pockets, shear keys, dowel holes and recesses for cored slabs and box beams. This provision does not apply to grout placed in post-tensioning ducts for bridge beams, girders, or decks. Provide grout composed of portland

cement, water and at the Contractor's option, fine aggregate and/or pozzolan. If necessary, use set controlling admixtures. Proportion, mix and place grout in accordance with the plans, the applicable section of the *Standard Specifications* or special provision for the application and this provision.

2.0 MATERIALS

Refer to Division 10 of the *Standard Specifications*:

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 (4-02-07)

The 2006 Standard Specifications shall be revised as follows:

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

(A) Producer Qualification

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

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

- B2 Prestressed Miscellaneous Bridge Products: Includes solid piles, sheet piles and bent caps.

- B3 Prestressed Straight-Strand Bridge Members: Includes all box beams, cored slabs, straight-strand girders and bulb-tees, bridge deck panels, hollow piles, prestressed culverts and straight strand segmental components.

- B4 Prestressed Deflected-Strand Bridge Members: Includes deflected strand girders and bulb-tees, haunched girders, deflected strand segmental superstructure components and other post-tensioned elements.

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

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

1.0 GENERAL

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

2.0 INSTALLATION

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

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

3.0 FIELD TESTING

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

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

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

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

Testing should begin only after the Manufacturer's recommended cure time has been reached. For testing, apply and hold the test load for three minutes. If the jack experiences any drop in gage reading, the test must be restarted. For the

anchor to be deemed satisfactory, the test load must be held for three minutes with no movement or drop in gage reading."

4.0 REMOVAL AND REPLACEMENT OF FAILED TEST SPECIMENS:

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

5.0 USAGE

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

6.0 BASIS OF PAYMENT

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

MICROPILES (SPECIAL)

1.0 GENERAL

A. Description

Micropiles are small diameter, drilled and grouted non-displacement piles with reinforcing casings and bars. Design and construct micropiles with the required capacity in accordance with the contract. Permanent casings may be required for micropiles in or near standing water. For this provision, "pile" refers to a micropile and "pile bent" refers to an interior bent (not an end bent) with micropiles connected directly to a cap.

B. Prequalification Requirements

The Micropile Subcontractor is responsible for the design, installation, monitoring and testing of the micropiles. Use a Micropile Subcontractor prequalified by the Contractual Services Unit of the Department for micropile work (work code 3100).

When using a Load Test Supplier, use a Load Test Supplier prequalified by the Contractual Services Unit for foundation load testing work (work code 3080).

2.0 SUBMITTALS

Three submittals are required. These submittals include (1) Micropile Subcontractor personnel and experience, (2) micropile design and (3) micropile installation and testing plan. Provide 4 hard copies and an electronic copy (pdf or jpg format on CD or DVD) of each submittal. Allow 10 calendar days for the review of the Micropile Subcontractor personnel and experience submittal. After the personnel and experience submittal is accepted, submit the remaining submittals at least 30 calendar days before starting micropile construction. Do not begin micropile construction until the installation and testing plan is accepted.

A. Micropile Subcontractor Personnel and Experience Submittal

Submit documentation that the Micropile Subcontractor has successfully completed at least 5 micropile projects and 250 micropiles within the last 3 years with micropile diameters and lengths similar to those anticipated for this project. Documentation should include the General Contractor and Owner's name and current contact information with descriptions of each past project. Also, submit documentation of experience with micropile load testing and construction in subsurface conditions similar to those for this project.

Provide a list of the Superintendent, Drill Rig Operators and Project Manager that will be assigned to this project. Submit documentation for these personnel verifying employment with the Micropile Subcontractor and a minimum of 5 years experience in micropile construction with past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc. Perform work with the personnel submitted and accepted. If personnel changes are required during construction, suspend micropile construction until replacement personnel are submitted and accepted.

A Design Engineer is required to design the micropiles. Submit documentation that the Design Engineer is registered as a Professional Engineer in North Carolina and has at least 5 years experience in designing micropiles with capacities and in subsurface conditions similar to those for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc. The Design Engineer may also act as the Project Manager provided the Design Engineer meets the Project Manager requirements above.

B. Micropile Design Submittal

The micropile layout, inclination, minimum reinforcing casing, pile to cap/footing connection, top of micropile elevation and loads are shown on the plans. Verify existing site conditions and survey information before designing micropiles.

The "bond length" is defined as the micropile length below the reinforcing casing tip elevation noted on the plans. Determine the bond length and reinforcement for the required capacity. Use allowable stress design method in accordance with Chapter 5 of the *FHWA Micropile Design and Construction* (Publication No. FHWA-NHI-05-039). Design the bond length for the allowable load noted on the plans and a minimum length of 10 ft (3 m). When using tension load tests or no load testing, neglect end bearing resistance for design. Based on load testing performed, use the following factors of safety.

Condition	Factor of Safety
No Load Testing	3.0
Proof Load Testing Only (No Verification Load Testing)	2.5
Verification Load Testing	2.0

Either extend the reinforcing casing below the required tip elevation or use a center reinforcing bar for reinforcement. Extend the bar or casing full length of the pile and provide a minimum 1/2" grout cover outside the casing. Design reinforcing casing joints for the bending moment capacity noted on the plans and do not locate casing joints between the elevations shown on the plans.

Submit working drawings and design calculations including unit grout/ground bond strengths sealed by the Design Engineer in accordance with Article 105-2 of the *Standard Specifications*. Include all dimensions, quantities, elevations and cross-sections necessary to construct the micropiles. When design changes occur due to load test results, varying site conditions or other reasons, a revised micropile design submittal is required.

C. Micropile Installation and Testing Plan Submittal

Submit detailed project specific information including the following.

1. List and sizes of proposed equipment including micropile drilling rigs and tools, tremies and grouting equipment.

2. Sequence of micropile construction and step-by-step description of micropile installation including details of casing installation, drilling methods and flushing.

3. List of reinforcement and casings including grades or yield strengths and sizes.

4. Methods for placing reinforcement with procedures for supporting and positioning the reinforcement including centralizers.

5. Welding procedure and details, if any, in accordance with Article 1072-20 of the *Standard Specifications*. Special welding procedures are required for steel with yield strengths greater than 50 ksi (345 MPa).

6. Grout placement details including how the grout will be initially placed in the drill hole and acceptable ranges for grout pressures and volumes.

7. Equipment and procedures for monitoring and recording grout levels, pressures and volumes with calibration certificates within one year of submittal date.

8. Examples of construction records to be provided in accordance with Section 8.0.

9. Procedures for containment and disposal of drilling spoils, drill flush and excess waste grout in accordance with Section 802 of the *Standard Specifications*.

10. Grout mix design including laboratory test results in accordance with the Grout for Structures Special Provision and acceptable ranges for grout flow and density.

11. If load testing is required, load testing details, procedures and plan sealed by a Professional Engineer registered in North Carolina with calibration certificates within one year of submittal date.

12. Load Test Supplier and Project Engineer, when applicable. Submit documentation that the Load Test Supplier has successfully completed at least 5 pile load test projects within the last 3 years. Documentation should include the General Contractor and Owner's name and current contact information with descriptions of each past project. Also, submit documentation that the Project Engineer is registered as a Professional Engineer in North Carolina and has at least 5 years experience with past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc. When using a Load Test Supplier, the Project Engineer is required to seal the load testing details, procedures and plan.

13. Other information shown on the plans or requested by the Engineer.

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

3.0 MATERIALS

Steel casings may be new "Structural Grade", i.e., "Mill Secondary", steel pipe free from dents, cracks, cuts or any other defects.

A. Reinforcement

Store steel reinforcement on blocking a minimum of 12" (300 mm) above the ground and protect it all times from damage; and when placing in the work make sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials.

1. Reinforcing Casings

Provide Type 4 Certified Test Reports in accordance with Article 106-3 of the *Standard Specifications*. For testing yield strength, a lot is defined as each truckload delivered and 2 samples and tests are required per lot. Use steel casings with the minimum wall thickness shown on the plans and outside diameters ranging from the minimum shown on the plans to 3" (75 mm) larger. Provide casings meeting the tensile requirements of ASTM A252, Grade 3, except with a minimum elongation of 15% and a minimum yield strength of 80 ksi (550 MPa) unless noted otherwise on the plans.

2. Reinforcing Bars

Provide Type 3 Manufacturer's Certifications in accordance with Article 106-3 of the *Standard Specifications*. Use deformed steel bars meeting the requirements of AASHTO M31, Grade 60 or 75 (420 or 520) or M275.

Splice reinforcing bars in accordance with Article 1070-10 of the *Standard Specifications*. Locate reinforcing casing joints at least 2 ft (0.6 m) from any bar splice.

B. Centralizers

Fabricate bar centralizers from schedule 40 polyvinyl chloride (PVC) plastic pipe or tube, steel or other material not detrimental to steel reinforcement (no wood). Size centralizers to position reinforcement within 1" (25 mm) of the drill hole center and allow a tremie to be inserted to the bottom of the hole. Use centralizers that do not interfere with grout placement or flow around the reinforcement.

C. Grout

Use grout in accordance with the Contract.

D. Permanent and Temporary Casings

Use clean smooth non-corrugated steel casings with inside diameters a minimum of 4" (100 mm) larger than the outside diameter of the reinforcing casing.

4.0 CORROSION PROTECTION

Galvanize exposed portions of reinforcing and permanent casings that connect directly to the cap in accordance with Section 1076 of the *Standard Specifications*. Apply organic-zinc repair paint to any exposed casing joints or damaged galvanized casings in accordance with Article 1080-9 of the *Standard Specifications*. Exposed portions include that open to the atmosphere and to 2 ft (0.6 m) below the existing ground surface after bent construction is complete.

5.0 NON-PRODUCTION MICROPILES

The purpose of non-production micropiles is for lateral load testing. See Lateral Load Testing Assistance Special Provision.

Construct non-production micropiles in accordance with the accepted submittals and this provision. The layout of the non-production micropiles is shown on the plans. Adjustments in the location may be required to keep the non-production micropiles within right-of-way, away from the stream, and not to interfere with the bridge construction. The non-production micropile locations, elevations and reinforcement including reinforcing casing size, elevations, casing plunge (required penetration into rock), joint location requirements and internal reinforcement requirements, as determined by the Engineer, are shown on the plans. Install non-production micropiles using the duplex drilling method. Alternate drilling methods will not be allowed.

Non-production micropiles will be instrumented with strain gages attached to the reinforcing casings. The strain gages will be provided by the Department. The Contractor will take necessary care not to damage the strain gages, wires, or other instrumentation during micropile construction. The Contractor is responsible in terms of both actual expense and time delays for any damage to the instruments and supporting equipment due to the Contractor's fault or negligence. Replace any damaged equipment at no additional cost to the Department.

The Engineer will determine if non-production micropiles are satisfactory or not within 24 hours of receiving the non-production micropile construction records in accordance with Section 8.0 of this provision. If the Engineer determines a non-production micropile is unsatisfactory, a replacement pile is required at no additional cost to the Department. Non-production micropiles may be installed at the same time production micropiles are installed. Upon the Department's completion of the lateral load testing cut off all of the non-production micropiles 2 feet (600 mm) below final grade.

6.0 MICROPILE PRECONSTRUCTION MEETING

Before starting micropile construction, conduct a preconstruction meeting to discuss the installation, monitoring and testing of the piles. Schedule this meeting after all micropile submittals have been accepted and the Micropile Subcontractor has mobilized to the site. The Resident or Bridge Maintenance Engineer, Bridge Construction Engineer, Geotechnical Operations Engineer, General Contractor and the Micropile Subcontractor Superintendent, Drill Rig Operators, Project Manager and Design Engineer will attend this preconstruction meeting.

7.0 CONSTRUCTION METHODS

Use equipment and methods reviewed and accepted in the micropile installation and testing plan or approved by the Engineer. Inform the Engineer of any deviations from the accepted plan. Install production micropiles in the same way as satisfactory demonstration micropiles, if applicable.

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

Control drilling and grouting to prevent excessive ground movements, damaging structures and fracturing rock and soil formations. If ground heave or subsidence occurs, suspend micropile construction and take action to minimize movement. If structures are damaged, suspend micropile construction and repair structures at no additional cost to the Department with a method proposed by the Contractor and accepted by the Engineer. The Engineer may require a revised micropile installation and testing plan when corrective action is necessary.

A. Drilling and Reinforcement

Use micropile drilling rigs capable of drilling through whatever materials are encountered to the dimensions and elevations required for the micropile design. When required, install permanent casings to the elevations shown on the plans or revised elevations authorized by the Engineer.

Install reinforcing casings to a tip elevation no higher than that noted on the plans. Also, when noted on the plans, install reinforcing casings with a minimum penetration of 5 ft (1.5 m) into rock as determined by the Engineer. Construct reinforcing casing joints in accordance with the accepted submittals. Perform any welding in accordance with Article 1072-20 of the *Standard Specifications*, this provision and the accepted submittals.

Use drilling methods that result in the annulus between reinforcing casings and the ground filled with grout. For pile bents, demonstrate grout flow return around reinforcing casings.

Check for correct micropile location and plumbness or proper inclination before beginning drilling. Do not drill within 6 pile diameters, center to center, or 5 ft (1.5 m), whichever is greater, of any micropiles until the grout in all adjacent micropiles reaches initial set as determined by the Engineer. More clearance may be necessary if micropile construction affects adjacent micropiles.

Stabilize drill holes with casings from beginning of drilling through grouting if unstable material is anticipated or encountered. After drilling, flush drill holes with water or air to remove drill cuttings and other loose materials.

Use centralizers to center reinforcement in drill holes. Securely attach bar centralizers at maximum 10 ft (3 m) intervals along reinforcing bars. Attach upper and lowermost centralizers 5 ft (1.5 m) from the top and bottom of micropiles.

Place reinforcing bars before grouting or after while grout is still fluid. Do not vibrate or drive reinforcement. Reinforcing bars may be gently pushed into grout. If reinforcement can only be partially inserted, redrill or clean drill holes to permit complete insertion.

B. Grouting

Remove all oil, rust inhibitors, residual drilling fluids and similar foreign materials from holding tanks/hoppers, stirring devices, pumps, lines, tremie pipes and all other equipment in contact with grout before use. Size grouting equipment to grout each micropile in one continuous operation. Field calibrate grout pumps at the beginning of construction.

Grout micropiles the same day the bond length is drilled and do not leave drill holes open overnight. Place grout with a tremie in accordance with the Contract and accepted submittals until uncontaminated grout flows from the top of the micropile. Extend tremie pipe into grout a minimum of 5 ft (1.5 m) at all times except when grout is initially placed in drill holes. Provide grout free of segregation, intrusions, contamination, structural damage or inadequate consolidation (honeycombing). Do not extract temporary casings until the grout level reaches the ground surface.

Monitor and record grout levels, pressures and volumes during placement. To monitor grout pressure, use pumps equipped with a pressure gauge and locate a second pressure gauge at the point of injection into the drill hole. Use pressure gauges that can measure pressures of at least 150 psi (1.0 MPa) or twice the actual grout pressures, whichever is greater.

8.0 CONSTRUCTION RECORDS

Provide 2 original hard copies of micropile construction records including the following within 24 hours of completing each pile.

1. Names of Micropile Subcontractor, Superintendent, Drill Rig Operator, Project Manager and Design Engineer
2. Bridge description, county, NCDOT Contract, TIP and WBS element number
3. Bent station and number, micropile location and identifier, allowable load and required capacity
4. Micropile diameters, length and tip elevation and top of micropile and ground surface elevations
5. Reinforcement and casing types, grades or yield strengths, sizes and elevations
6. Date and time drilling begins and ends, reinforcement is placed, grout is mixed and/or arrives on-site and grout placement begins and ends
7. Grout level, pressure, volume, temperature, flow and density records
8. Ground and surface water conditions and elevations, if applicable
9. Weather conditions including air temperature at time of grout placement

10. All other pertinent details related to micropile construction

After completing all micropiles for a structure or a stage of a structure, submit electronic copies (pdf or jpg format on CD or DVD) of all corresponding construction records.

9.0 LOAD TESTING

When noted on the plans, load test micropiles in accordance with the accepted submittals, this provision and the plans. The piles to be tested are shown on the plans or as directed by the Engineer. For this provision, "verification tests" are performed on demonstration micropiles and "proof tests" are performed on micropiles incorporated into the structure, i.e., production micropiles based on test piles acceptable in accordance with Section 10.0.

Do not load test micropiles until grout achieves the required 28 day compressive strength. Do not begin construction of any production micropiles until verification tests are satisfactorily completed. For proof tests, install only the test piles and those micropiles needed to anchor the reaction frame, if applicable. Do not install the remaining micropiles for the bent until the corresponding test piles are satisfactory.

Design test piles so that applied loads do not exceed 80% of the pile's capacity including steel yielding or buckling or grout failing. It may be necessary to design test piles with additional reinforcement to allow for higher applied loads. Use a center reinforcing bar for tension load tests when the reinforcement design for production micropiles does not include one. Any costs associated with additional test pile reinforcement will be considered incidental to the load test pay items.

If reinforcement design for production micropiles does not include a center reinforcing bar, tension load tests are required. Otherwise, test micropiles in either compression or tension at the Contractor's option. Perform static compression load tests in accordance with ASTM D1143 and static tension load tests in accordance with ASTM D3689 except as modified herein.

Set up test equipment and measuring devices such that resetting or repositioning the components before completing testing is not required. Do not apply loads with known weights; a reaction frame and a hydraulic jack are required. Use reaction piles or cribbing and a frame with sufficient strength to prevent excessive deformation, misalignment or racking under peak loading. Do not use existing structures as part of the reaction frame.

Incremental strain measurements are required for all load tests. Use at least one strain gauge at the tip of the test pile, the top of the bond length and, if permanent casing is used, the tip of the casing. Use a calibrated pressure gauge and load cell with the hydraulic jack for verification tests. Provided the same pressure gauge and hydraulic jack are used for proof tests, a load cell is not required for proof tests. Repump jack as needed to maintain the intended load during hold times.

Use the quick load test method in accordance with ASTM D1143 or D3689. For proof tests, load test micropiles to the test loads noted on the plans. For verification tests, load test piles to at least the test load noted on the plans, hold the test load for 60 minutes and record measurements at 1, 2, 3, 5, 6, 10, 20, 30, 50 and 60 minutes.

At the Contractor's option, use rapid load tests (RLT) such as the Statnamic test (Applied Foundation Testing, Inc.) or dynamic load tests (DLT) such as the APPLE test (GRL Engineers, Inc.) in lieu of static load tests. Use a Load Test Supplier to perform RLT or DLT. Perform RLT or DLT in accordance with the Load Test Supplier's recommendations and the accepted micropile installation and testing plan. The DLT method is described in ASTM D4945, *Standard Test Method for High-Strain Dynamic Testing of Piles*.

For non-production micropiles, cut off piles 2 ft (0.6 m) below the ground surface when testing is complete.

Submit 3 original hard copies and an electronic copy (pdf or jpg format on CD or DVD) of a load test report within 7 days of completing each test. Submit a report sealed by the same Professional Engineer that sealed the load testing details, procedures and plan in the accepted micropile installation and testing plan. Provide a report in accordance with ASTM D1143, D3689 or the Load Test Supplier's recommendations. Also, include load versus movement curves for the top of micropile and pile tip.

Movement for top of micropiles may not exceed that noted on the plans and the test loads noted on the plans may not exceed the failure load. For static compression load tests, use Davisson's failure criteria in accordance with the *FHWA Design and Construction of Driven Pile Foundations, Vol. II* (Publication No. FHWA-NHI-05-043). For this method, the failure load is defined as the load corresponding to a movement which exceeds the elastic deformation of the micropile by 0.15 inches (4 mm) plus the micropile diameter divided by 120. For static tension load tests, use the failure criteria recommended in Section 18.8.3 of the *FHWA Design and Construction of Driven Pile Foundations, Vol. II.* For this method, the failure load is defined as the load at which the load-movement curve intersects the elastic lengthening of the micropile plus 0.15 inches (4 mm). For calculating elastic deformation, the micropile length is equal to the total pile length minus half the bond length. Obtain approval to use alternate failure criteria.

The Engineer will review the load test report and associated construction records to determine if the test results are satisfactory within 7 calendar days after the report is received.

10.0 MICROPILE ACCEPTANCE

Micropile acceptance is based on the following criteria.

1. Micropile is within 3" (75 mm) of plan location and 2% of plumb or required inclination. Top of micropile is within 1" (25 mm) below and 3" (75 mm) above the top of micropile pile elevation shown on the plans.

2. Reinforcement is properly placed and inclination and top of reinforcement is within tolerances shown above for the micropile. Center of reinforcement is within 3/4 inch (19 mm) of the center of the micropile. Tip of reinforcing casing is no higher than that noted on the plans and casing penetrates rock at least 5 ft (1.5 m) when noted on the plans.

3. Grout pressures, volumes, flow and densities are within acceptable ranges. Grout is in accordance with the Contract and does not have any evidence of segregation, intrusions, contamination, structural damage or inadequate consolidation (honeycombing). For pile bents, the Engineer verifies grout flow return around the reinforcing casing.

4. Micropile is satisfactory based on results of load testing, when applicable.

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

11.0 MEASUREMENT AND PAYMENT

Complete and accepted micropiles will be paid for at the unit bid price for "____ Dia. Micropiles" per each. The number of "____ Dia. Micropiles" per acceptable micropile will be equal to one. Include in this unit bid price all costs for submittals, design, monitoring and recording, labor, tools, equipment, casings and reinforcement complete and in place and all incidentals necessary to drill through any material and construct micropiles in accordance with this provision. Also include in this unit bid price all costs for grout up to twice the theoretical drill hole volume. Grout in excess of twice the theoretical drill hole volume will be paid for as extra work in accordance with Article 104-7 of the *Standard Specifications*. No additional payment will be made for any costs associated with unacceptable micropiles.

Complete and accepted non-production micropiles will be paid for at the unit bid price for "____ Dia Non-production Micropiles" per each. The number of "____Non-production Micropiles" per acceptable non-production micropile will be equal to one. Include in this unit bid price all costs for submittals, design, monitoring and recording, labor, tools, equipment, casings and reinforcement complete and in place and all incidentals necessary to drill through any material and construct non-production micropiles in accordance with this provision. Also include in this unit bid price all costs for grout up to twice the theoretical drill hole volume. Grout in excess of twice the theoretical drill hole volume will be paid for as extra work in accordance with Article 104-7 of the *Standard Specifications*. No additional payment will be made for any costs associated with unacceptable non-production micropiles.

Complete and accepted load tests will be paid for at the unit bid price for either "Micropile Verification Tests" or "Micropile Proof Tests" per each, depending on the type of test. Include in these unit bid prices all costs for load tests in accordance with Section 9.0 of this provision. The Department will only pay for the initial verification or proof test on an initial micropile required by the Engineer; no payment will be made for subsequent tests performed on the same micropile or replacement micropiles.

LATERAL LOAD TESTING ASSISTANCE (SPECIAL)

1.0 GENERAL

This special provision governs preparing the non-production micropiles and providing assistance to the Department for the lateral load testing of the non-production micropiles. The Lateral Load test method is described in ASTM D3966-07, *Standard Test Method for Deep Foundations Under Lateral Load.*

Provide a micropile construction schedule or notify the Engineer of the anticipated completion date and the availability of the each non-production micropile. The Department will then install lateral load testing components (frames, tie-rods, jacks, gages, etc.) a minimum of (7) seven calendar days in advance. The NCDOT Geotechnical Engineering Unit will perform the Lateral Load Testing and number of Lateral Load tests to be performed. The Lateral Load test data will not be used for the review of the proposed production micropile installation method or equipment or to provide the design of the production micropiles.

2.0 PREPARATION FOR THE LATERAL LOAD TESTING

Provide non-production micropiles in accordance with the micropile project special provisions and as shown in the plans, or as directed by the Engineer, for the Lateral Load Testing. Supply 110 V, 60 Hz and 30 amps of AC electrical power to operate computers, electronic gages, etc. Direct current welders or non-constant power sources are unacceptable.

Construct a temporary cap as shown on the plans for non-production micropiles 5, 6, 7, and 8. Upon completion of the lateral load testing, completely remove the cap. The cost of the installation and removal the temporary cap will be paid for separately. See Section 4.0 of this special provision.

Provide a suitable shelter to protect the data collection equipment and operators from conditions of sun, water, wind and temperature. The shelter should have a minimum floor size of 6 ft x 6 ft (2 m x 2 m) and a minimum roof height of 8 ft (2.5 m). If necessary, heat or cool the shelter to maintain a temperature between 50 and 85 degrees F (10 and 30 degrees C). The Engineer may waive the shelter requirement if weather conditions allow.

Provide a safe level working area around and in between the non-production micropiles to the Engineers satisfaction. Should the working area become excessively wet or rutted up, re-grading and/or placing stone may be required.

Several excavations will be required for the lateral load testing on the non-production micropiles:

- Excavate a continuous trench to rock, or as directed by the Engineer, between non-production micropiles 1 and 5, 2 and 6, 3 and 7, and 4 and 8.
- Excavate a 5 foot (1.52 m) by 5 foot (1.52 m) pit to rock, or as directed by the Engineer, on the east side of non-production micropile 9.
- Excavate a 5 foot (1.52 m) by 5 foot (1.52 m) pit to rock, or as directed by the Engineer, on the west side of non-production micropile 12.
- Excavate directly around non-production micropiles 9, 10, 11, and 12 to rock or as directed by the Engineer after completion of the lateral load testing. The Engineer will view and evaluate the grout bond around the reinforcing casing.

Upon completion of the lateral load testing, remove the temporary cap and cut off all non-production micropiles 2 feet (0.6 m) below final grade. Re-grade the area, as directed by the Engineer.

3.0 LATERAL LOAD TESTING

The NCDOT or its' designate will perform the Lateral Load Testing and will determine the number of lateral load tests to be performed.

Moving equipment around the site may require the use of the Contractors' on-site crane, grading equipment, dump trucks, etc.

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

4.0 MEASUREMENT AND PAYMENT

The complete and accepted Lateral Load Testing Assistance will be paid for at the Lump Sum bid price for "Lateral Load Testing Assistance". Include in the Lump Sum bid price for "Lateral Load Testing Assistance" all costs for preparation and support including all materials, labor, tools, equipment, mobilization and incidentals necessary to complete the work described in this provision.

The complete and accepted Temporary Cap will be paid for at the Lump Sum bid price for "Temporary Cap". Include in the Lump Sum bid price for "Temporary Cap" all costs for preparation and support including all materials, labor, tools, equipment, mobilization and incidentals necessary to complete the work described in this provision.

The cost of the installation of the non-production micropiles will be paid for separately in accordance with the Micropile Special Provision and will not be part of the "Lateral Load Testing Assistance" pay item.