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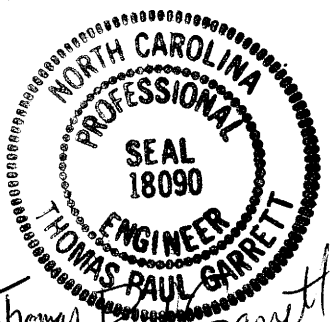

Thomas Paul Garrett
May 29, 2007
Excluding Drilled Piers, Axial Load Test, Sonic Caliper Test + Roadway Lighting Messenger Cable System

PROJECT SPECIAL PROVISIONS
STRUCTURES

PROJECT B-0682 **BRUNSWICK COUNTY**

MAINTENANCE AND PROTECTION OF TRAFFIC BENEATH PROPOSED STRUCTURE AT STATION 47+08.03 -L- **(8-13-04)**

1.0 GENERAL

Maintain traffic on Canal Drive and Shore Line Drive (NC-179) as shown in Traffic Control Plans and as directed by the Engineer.

Provide a minimum temporary vertical clearance of 16'-6" at all times during construction.

Submit plans and calculations for review and approval for protecting traffic and bracing girders, as described herein, at the above station before beginning work at this location. Have the drawings and design calculations prepared, signed, and sealed by a North Carolina Registered Professional Engineer. The approval of the Engineer will not relieve the Contractor of the responsibility for the safety of the method or equipment.

2.0 PROTECTION OF TRAFFIC

Protect traffic from any operation that affords the opportunity for construction materials, equipment, tools, etc. to be dropped into the path of traffic beneath the structure. Based on Contractor means and methods determine and clearly define all dead and live loads for this system, which, at a minimum, shall be installed between beams or girders over any travelway or shoulder area where traffic is maintained. Install the protective system before beginning any construction operations over traffic. In addition, for these same areas, keep the overhang falsework in place until after the rails have been poured.

3.0 BRACING GIRDERS

Brace girders to resist wind forces, weight of forms and other temporary loads, especially those eccentric to the vertical axis of the member during all stages of erection and construction. Before casting of intermediate diaphragms, decks, or connecting steel diaphragms do not allow the horizontal movement of girders to exceed ½ inch (13mm).

4.0 BASIS OF PAYMENT

Payment at the contract unit prices for the various pay items will be full compensation for the above work.

CONSTRUCTION, MAINTENANCE AND REMOVAL OF TEMPORARY STRUCTURE AT STATION 47+08.03 -L- **(SPECIAL)**

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 800 feet. Center the length of the structure about Station 21+00 -DET- 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 24 feet and an underclearance elevation no less than elevation 4.0.

Design the temporary structure for **HS20** 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. **Design and construct the bridge rails on the temporary structure in accordance with the current edition of the AASHTO Standard Specifications for Highway Bridges and such that guardrail can be bolted to the ends of the bridge rails.**

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 47+08.03 -L-" will be full compensation for the above work including all materials, equipment, tools, labor and incidentals necessary to complete the work.

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SECURING OF VESSELS (10-12-01)

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

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

DRILLED PIERS (SPECIAL)

1.0 GENERAL

A. Description

This special provision governs the construction of Drilled Piers, also known as "Drilled Shafts" and "Caissons". Drilled piers are a reinforced concrete section, cast-in-place against in situ material or permanent steel casing. Drilled piers are a straight shaft type and vertical. Construct drilled piers in accordance with the details and dimensions shown on the plans and this provision.

B. Prequalification and Experience Requirements

Use a Drilled Pier Contractor prequalified by the Contractual Services Unit of the Department for drilled pier work (work code 3090).

Submit documentation that the Drilled Pier Contractor has successfully completed at least 5 drilled pier projects within the last 3 years with diameters, lengths and subsurface conditions 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 the use of slurry.

Provide a list of the Drilling Superintendent, Drill Rig Operators and Project Manager that will be assigned to this project. Submit documentation for these personnel verifying employment with the Drilled Pier Contractor and a minimum of 5 years experience in drilled pier 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 drilled pier construction until replacement personnel are submitted and accepted.

C. Construction Sequence Plan

Submit two hard copies and an electronic copy (pdf or jpeg format on CD or DVD) of a drilled pier construction sequence plan for all the drilled piers 30 days before beginning drilled pier construction. Provide detailed project specific information in this plan including:

1. Experience documentation in accordance with Section 1.0, Item B
2. List and size of equipment including: cranes, kelly bars, drill rigs, vibratory hammers, augers, core barrels, cleanout buckets, airlifts and/or submersible pumps, tremies and/or concrete pumps, casing (diameters, thicknesses and lengths), desanding equipment, etc.
3. Order of drilled pier construction
4. Casing installation, drilled pier excavation and bottom cleaning methods
5. Reinforcement placement methods including how the cage will be supported and centered in the excavation
6. Concrete placement procedures including how the tremie or pump will be controlled and what type of discharge control will be used to prevent concrete contamination when the tremie or pump is initially placed in the excavation
7. Concrete mix design in accordance with Section 1000 of the Standard Specifications
8. Slurry details including intended purpose, product information, manufacturer's recommendations for use, slurry equipment information and written approval from the slurry supplier that the mixing water is acceptable
9. Procedures for handling drilling spoils and slurry overflow including environmental controls to prevent the loss of concrete, slurry and spoils
10. Methods of how the slurry level will be maintained above the highest piezometric head
11. Crosshole sonic logging (CSL) submittals in accordance with the Crosshole Sonic Logging Special Provision
12. Other information shown on the plans or requested by the Engineer

Do not begin drilled pier construction until the construction sequence plan is accepted. If alternate drilled pier construction procedures are proposed or necessary, a revised

submittal may be required. If the work deviates from the accepted submittal without prior approval, the Engineer may suspend drilled pier construction until a revised drilled pier construction sequence plan is submitted and accepted.

D. Preconstruction Meeting

Conduct a drilled pier preconstruction meeting with the Project Manager, Drilling Superintendent, the Resident or Bridge Maintenance Engineer and/or his or her representatives, the Bridge Construction Engineer and the Geotechnical Operations Engineer to discuss construction and inspection of the drilled piers. This meeting should occur after the Drilled Pier Contractor has mobilized to the site and the construction sequence plan has been reviewed and accepted.

2.0 EXCAVATION

Perform the excavations required for the drilled piers to the dimensions and elevations shown on the plans or otherwise required by the Engineer, including any miscellaneous grading or excavation to install the pier.

Excavate with a drill rig of adequate capacity. Use a rig that is capable of drilling through soil, cemented sands, weathered rock, boulders, timbers, man-made objects and any other materials encountered.

Use a drill rig capable of drilling a minimum of 25% deeper than the deepest drilled pier shown on the plans. Use drilling tools equipped with vents designed to stabilize the hydrostatic pressure above and below the tool during extraction from the excavation. Monitor the rate at which the drilling tools are inserted and extracted so as to minimize sidewall suction action in the excavation. Drilling below the tip elevations shown on the plans may be required to achieve adequate bearing.

A drilling log signed by the Drilled Pier Contractor that includes material descriptions and depths and drilling times and tools used for each material is required for each pier.

Dispose of drilling spoils in accordance with Section 802 of the Standard Specifications and as directed by the Engineer. Drilling spoils consist of all excavated material including water removed from the excavation either by pumping or drilling tools. Construct drilled piers at the locations shown on the plans and within the tolerances specified herein. If tolerances are exceeded, the Engineer may require corrective measures to meet the tolerances specified. Construct the drilled piers such that the axis at the top of the piers is no more than 3 in (75 mm) in any direction from the position shown in the plans. Build drilled piers within 2% of the plumb deviation for the total length of the piers. Verify the plumbness of the drilled pier excavations by an accurate procedure, such as an inclinometer on the kelly bar or other approved techniques. Unless a plan note requires the construction joint to be moved below the ground line, construct the finished top of pier elevation between 1 in (25 mm) above and 3 in (75 mm) below the top of pier elevation shown on the plans.

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When drilling from a barge, use a fixed template that maintains pier position and alignment during all excavation and concrete placement operations. Floating templates (attached to a barge) are not allowed.

Stabilize all drilled pier excavations with steel casing and slurry. Stabilize excavations at all times from the beginning of drilling through concrete placement.

The minimum diameter of an excavation may be 2 in (50 mm) less than the design drilled pier diameter shown on the plans. In order to remove a casing and substitute a larger diameter or longer casing through unstable or caving material, either backfill the excavation, stabilize the excavation with slurry before removing the casing to be replaced or insert the larger casing around the casing to be replaced before removal.

A. Permanent Steel Casing

Use permanent steel casings as directed by the Engineer and/or as required by a note on plans. Use permanent casings that are clean smooth non-corrugated watertight steel of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth or backfill. Provide permanent steel casings conforming to ASTM A252, Grade 2 and the following minimum wall thickness requirements.

CASING WALL THICKNESS

Casing Diameter	Minimum Wall Thickness
Less than or equal to 48 in (1220 mm)	3/8 in (9 mm)
Greater than 48 in (1220 mm) and less than or equal to 78 in (1982 mm)	1/2 in (12 mm)
Greater than 78 in (1982 mm)	5/8 in (16 mm)

Provide permanent casings with an outside diameter not less than the specified size of the drilled pier. If approved by the Engineer, a permanent casing larger in diameter than the drilled pier design diameter is permitted. However, no payment will be made for any costs associated with larger permanent casings. Extend the permanent casings from the top of pier elevation or top of permanent casing elevation, if shown on the plans, to a depth no deeper than the permanent casing tip elevation shown on the plans or the revised permanent casing tip elevation approved by the Engineer. Do not extend permanent casings below the permanent casing tip elevation shown on the plans without prior approval from the Engineer. Additional drilled pier length and reinforcement may be required if permanent casings are extended below the permanent casing tip elevation shown on the plans. No payment will be made for the resulting additional drilled pier length, reinforcement and permanent casing unless the Engineer approves the revised permanent casing tip elevation. Install permanent casings in one continuous unit. If splices are necessary for the casing, use an approved method of splicing. Splices are considered incidental and no additional compensation will be made.

Remove any portion of the permanent steel casing that extends above the top of the drilled pier after the Drilled Pier Concrete has achieved a compressive strength of 4500 psi (31.0 MPa). The cost of casing removal will be considered incidental to the cost of the permanent steel casing.

B. Slurry

The use of polymer slurry may either be required or prohibited as noted on the plans. If polymer slurry use is not noted on the plans, polymer slurry use is an option.

If polymer slurry is required or an option, use one of the following polymers listed in the table below:

PRODUCT	MANUFACTURER
SlurryPro CDP	KB Technologies Ltd. 3648 FM 1960 West, Suite 107 Houston, TX 77068 (800) 525-5237
Super Mud	PDS Company 105 West Sharp Street El Dorado, AR 71730 (800) 243-7455
Shore Pac GCV	CETCO Drilling Products Group 1500 West Shure Drive Arlington Heights, IL 60004 (800) 527-9948
Novagel Polymer	Geo-Tech Drilling Fluids 220 North Zapata Hwy, Suite 11A Laredo, TX 78043 (210) 587-4758

Use polymer slurry and associated additives in accordance with the manufacturer's guidelines and recommendations unless otherwise approved by the Engineer. The Drilled Pier Contractor should be aware that polymer slurry might not be appropriate for a given site. Polymer slurry should not be used for excavations in soft or loose soils as determined by the Engineer. When using polymer slurry, a representative of the manufacturer must be on-site to assist and guide the Contractor during the construction of the first three drilled piers unless otherwise approved by the Engineer. This representative must also be available for on-site assistance to the Contractor if problems are encountered during the construction of the remaining drilled piers as requested by the Engineer. The cost of all on-site assistance and representation will be considered incidental to the cost of the drilled piers.

If mineral slurry is required or an option, use mineral slurry composed of bentonite having a mineral grain size that remains in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system to minimize bottom sedimentation. Provide bentonite slurry to maintain the stability of the excavation and allow for proper concrete placement. The Drilled Pier Contractor should be aware that salt water with salt concentrations in excess of 500 ppm may adversely affect bentonite slurry.

If permanent steel casing is not required, use temporary steel casing at the top of the excavation. Provide temporary casing a minimum of 10 ft (3m) long with a minimum wall thickness of 3/8 in (9 mm) and an outside diameter not less than the specified size of the drilled pier. Maintain the top of the temporary casing a minimum of 1 ft (300 mm) above the ground surface surrounding the casing.

Maintain the slurry in the pier excavation at a level not less than 5 ft (1.5 m) or the drilled pier diameter (whichever is greater) above the highest piezometric head along the depth of the pier. It is anticipated that the highest piezometric head is the static water or groundwater elevation (elevation head). However, the Drilled Pier Contractor is responsible for determining the highest piezometric head. The use of steel casing to maintain the required slurry level is permitted; however, no payment will be made for casing that is used for this purpose. If the slurry level in the excavation suddenly changes or cannot be practically maintained, or the slurry construction method does not produce the desired result, stop the pier construction until an alternate construction procedure is accepted by the Engineer.

Thoroughly premix the slurry with water in tanks before introducing the slurry into the excavation. Submit written approval from the slurry supplier that the mixing water is acceptable. Allow bentonite slurry to hydrate 24 hours in tanks before use. Slurry tanks of adequate capacity are required for slurry circulation, storage and treatment. Excavated slurry pits are not allowed in lieu of slurry tanks without prior approval from the Engineer. Take all steps necessary to prevent the slurry from "setting up" in the excavation. Such methods include, but are not limited to agitation, circulation and/or adjusting the properties of the slurry. Perform desanding operations as necessary to achieve the acceptable sand contents before placing reinforcing steel.

1. Time

   Adjust the excavation operations so that the maximum time the slurry is in contact with the sidewalls of the uncased portions of the drilled pier excavation (from time of drilling to concrete placement) does not exceed 36 hours. Do not work on more than two drilled piers per drill rig below the steel casing at any time.

   Agitate bentonite slurry in the drilled pier excavations a minimum of every 4 hours. If the bentonite slurry is not agitated a minimum of every 4 hours or the 36 hour time limit is exceeded, the Engineer may require the excavation to be overreamed beneath the steel casing a minimum of 1 in (25 mm) and a maximum of

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3 in (75 mm) before performing any other operations in the excavation. Overream with a grooving tool, overreaming bucket or other approved equipment at a minimum spacing of 12 in (300 mm). All costs associated with both overreaming and the resulting additional concrete placement will be considered incidental to the cost of the drilled piers.

If concrete placement is not completed within three days of beginning drilling, enlarge the design drilled pier diameter by a minimum of 6 in (150 mm), or as required by the Engineer, the entire length of the pier at no additional cost to the Department. Enlarging the drilled pier includes replacing the steel casing with steel casing the same size to which the drilled pier is enlarged at no additional cost to the Department.

2. Sampling

Collect all slurry samples using an approved sampling tool. Test slurry samples to determine density, viscosity, pH and sand content to establish an acceptable working pattern during slurry use. Test a minimum of 4 samples during each 8 hours of slurry use for each drilled pier. Take the first sample for the first 8 hours from the slurry tank before introducing slurry into the excavation. Collect the remaining samples from the bottom of the pier excavation. When the test results are acceptable and consistent, a decrease in the testing frequency to one sample per 4 hours of slurry use is permitted.

Before placing reinforcing steel in the drilled pier excavation, extract slurry samples from the bottom of each excavation and at intervals not exceeding 10 ft (3 m) up the excavation, until two consecutive samples produce acceptable values for density, viscosity, pH and sand content.

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3. Testing

Have qualified personnel conduct slurry tests to determine density, viscosity, pH and sand content. The following tables show the acceptable range of values for the slurry properties:

BENTONITE SLURRY
Sodium Montmorillonite (Commercial Bentonite)
Acceptable Range of Values

Property (units)	**At Time of Slurry Introduction**	**In Excavation Immediately Before Concrete Placement**	**Test Method**
Density, pcf (kg/m^3)	64.3 – 69.1 (1030-1107)	64.3 – 75.0 (1030-1201)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	28 – 45	28 – 45	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 – 11	8 – 11	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 4	Less than or equal to 2	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m^3) in saltwater.

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SLURRYPRO CDP KB Technologies Ltd. Acceptable Range of Values			
Property (units)	**At Time of Slurry Introduction**	**In Excavation Immediately Before Concrete Placement**	**Test Method**
Density, pcf (kg/m^3)	Less than or equal to 67 (1073)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	50 – 120	Less than or equal to 70	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6 – 11.5	6 – 11.5	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5
Notes: 1. Perform tests when the slurry temperature is above 40°F (4.4°C). 2. Increase density by 2 pcf (32 kg/m^3) in saltwater.			

SUPER MUD PDS Company Acceptable Range of Values			
Property (units)	**At Time of Slurry Introduction**	**In Excavation Immediately Before Concrete Placement**	**Test Method**
Density, pcf (kg/m^3)	Less than or equal to 64 (1025)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	32 – 60	Less than or equal to 60	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 – 10	8 – 10	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m^3) in saltwater.

SHORE PAC GCV CETCO Drilling Products Group Acceptable Range of Values			
Property (units)	**At Time of Slurry Introduction**	**In Excavation Immediately Before Concrete Placement**	**Test Method**
Density, pcf (kg/m^3)	Less than or equal to 64 (1025)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	33 – 74	Less than or equal to 57	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8 – 11	8 – 11	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5
Notes: 1. Perform tests when the slurry temperature is above 40°F (4.4°C). 2. Increase density by 2 pcf (32 kg/m^3) in saltwater.			

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NOVAGEL POLYMER Geo-Tech Drilling Fluids Acceptable Range of Values			
Property (units)	**At Time of Slurry Introduction**	**In Excavation Immediately Before Concrete Placement**	**Test Method**
Density, pcf (kg/m^3)	Less than or equal to 67 (1073)	Less than or equal to 64 (1025)	Mud Weight (Density) API 13B-1 Section 1
Viscosity, sec./quart (sec./0.95 liters)	45 – 104	Less than or equal to 104	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	6.5 – 11.5	6.5 – 11.5	pH Paper or Glass Electrode pH Meter
Sand Content (percent)	Less than or equal to 0.5	Less than or equal to 0.5	Sand API 13B-1 Section 5

Notes:

1. Perform tests when the slurry temperature is above 40°F (4.4°C).
2. Increase density by 2 pcf (32 kg/m^3) in saltwater.

When any slurry samples are found to be unacceptable, take whatever action is necessary to bring the slurry within specification requirements. Do not place reinforcement steel until resampling and testing produce acceptable results.

Sign and submit reports of all slurry tests required above to the Engineer upon completion of each drilled pier. The Department reserves the right to perform comparison slurry tests at any time.

4. Slurry Disposal

Comply with all applicable local, state and federal regulations, as well as with the environmental permits of the project when disposing of excavated materials contaminated with slurry. Keep all excavated materials, spoils from the desanding unit and slurry out of the water and contain them at all times. The cost of the containment, removal and disposal of excavated materials contaminated with slurry, as well as the slurry itself, is incidental to the cost of the drilled piers.

3.0 CLEANING

Excavate the bottom of the drilled pier to a level plane or stepped with a maximum step height of 12 in (300 mm). Clean the bottom of the excavation of loose material using a technique accepted in the construction sequence plan. At a minimum, clean the bottom of the excavation with a cleanout bucket and an airlift or submersible pump.

4.0 INSPECTION METHODS AND REQUIREMENTS

After the drilled pier excavation is complete and immediately before placing reinforcing steel and concrete, demonstrate the proper condition of the drilled pier excavation to the Engineer. Provide weighted tape measures, steel probes, personnel and all assistance required for the Engineer to inspect the drilled pier excavations.

A. Bearing Capacity

If the required end bearing capacity is not satisfied, increase the drilled pier length as directed by the Engineer. Payment for the additional drilled pier length to achieve adequate bearing will be made per the drilled pier pay items.

A standard penetration test (SPT) may be required to verify the conditions and continuity of the bearing material before placing reinforcing steel. When noted on the plans that a SPT is required, drive a split barrel sampler a minimum of 18 in (450 mm) below the drilled pier tip elevation or to refusal in accordance with ASTM D1586, "Penetration Test and Split-Barrel Sampling of Soils". Complete the SPT using NW rods through casing or another stabilizing method as approved by the Engineer. Extend the SPT rods from the top of the drilled pier excavation to the drilled pier tip elevation. Firmly support the SPT casing at the top of the drilled pier excavation and rest it on the bottom of the excavation. Conduct the SPT a minimum of 12 in (300 mm) away from the sidewalls of the excavation and be sure not to scrape the sidewalls of the excavation while inserting or withdrawing the SPT equipment. Have the SPT device on-site before reaching the drilled pier tip elevation. Report the number of blows for each 6 in (150 mm) increment driven and a description of the recovered soil sample to the Engineer. The Engineer determines the number of blows required for bearing.

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B. Bottom Cleanliness

The pier excavation bottom is considered clean if a minimum of 50% of the bottom area has less than 1/2 in (13 mm) of sediment and no portion of the bottom area has more than 1-1/2 in (38 mm) of sediment as determined by the Engineer.

One or more of the following inspection procedures may be used to inspect the cleanliness of the pier excavation bottom before placing the reinforcing steel and concrete.

1. Steel Probe

   Lower a steel probe to the bottom of the drilled pier excavation to ensure that cleaning has been satisfactorily completed. Supply a steel probe that is 2 ft (0.6 m) long with a flat tip on the sounding end, weighs approximately 9 lbs, #10 rebar (4 kg, #32 rebar), and is suspended from the opposite end with a non-stretch cable.

2. Shaft Inspection Device (SID)

   The Department may use the SID to take sediment measurements and observe the bottom conditions of the drilled pier excavation at a minimum of five locations selected by the Engineer. The SID is a remotely operated camera capable of observing bottom conditions and measuring sediment underwater and slurry. Each SID inspection (including all 5 locations) takes approximately 1 hour after the equipment has been set up. The Engineer provides the SID and the personnel to operate the device. Notify the Engineer a minimum of 2 days before beginning the drilled pier excavation so the Engineer can arrange for the transportation of the SID to the site and the personnel to perform the inspections. SID inspections are required until the cleanliness of the drilled pier excavation bottom is acceptable in accordance with Section 4.0, Item B of this provision. Do not conduct operations that interfere with the SID inspections. Remove all cleaning and drilling equipment from the drilled pier excavation during any SID inspection. Provide a working area large enough for the SID equipment and within reach of the cabling supplied and clear sight distance of the drilled pier excavation. Assist the Engineer in the transportation and handling of the SID and all the associated equipment and in supporting the electric hoist and/or hoisting tripod for the SID. If required, provide a safe and secure location to park the trailer for the SID while it is unattended on the project site. If any of the SID equipment is damaged due to the Contractor's negligence, then replace the equipment at no additional cost to the Department. Provide replacement equipment that exactly matches the damaged equipment as directed by the Engineer. All costs involved with the initial SID inspection of each drilled pier excavation will be made per the SID pay item. No additional payment will be made for subsequent or repeated SID inspections of the same drilled pier excavation. No claims for either lost time or actual expense of any SID inspections that do not find the cleanliness of the drilled pier excavation bottom in compliance with this provision will be paid.

5.0 REINFORCING STEEL

Reinforcing steel shall conform to Section 1070 of the Standard Specifications. Completely assemble a cage of reinforcing steel, consisting of longitudinal and spiral bars and place it in the drilled pier excavation as a unit immediately after the proper condition of the excavation is demonstrated to the Engineer. When concrete placement does not follow immediately after cage placement, remove the steel from the pier excavation unless the Engineer directs otherwise. If the cage is removed, recheck pier excavation cleanliness in accordance with this provision before reinstalling the cage.

A. Construction, Placement, Support and Alignment

If it is determined in the field that the drilled pier must be longer, adequate reinforcement may be required in the extended length as directed by the Engineer. Lift the cage so racking and cage distortion does not occur. Keep the cage plumb during concrete operations and casing extraction. Check the position of the cage before and after placing the concrete. Position the splice length of the drilled pier cage so that the column or footing has the minimum concrete cover shown on the plans.

Securely cross-tie the vertical and spiral reinforcement at each intersection with double wire. Support or hold down the cage so that the vertical displacement during concrete placement and casing extraction does not exceed 6 in (150 mm).

B. Bolsters and Spacers

Set the rebar cage directly on the bottom of the drilled pier excavation with plastic bolsters under each vertical reinforcing bar. Ensure that spacers are tall enough to raise the rebar cage off the bottom of the drilled pier excavation a minimum of 3 in (75 mm). If approved by the Engineer, the rebar cage may be hung in the excavation provided the mechanisms supporting the cage are left in place until the Drilled Pier Concrete strength has achieved 3000 psi (20.7 MPa).

In order to ensure the minimum required concrete cover and achieve concentric spacing of the cage within the pier, attach plastic spacer wheels at five points around the cage perimeter. Use spacer wheels that provide a minimum of 2 in (50 mm) "blocking" from the outside face of the spiral bars to the outermost surface of the drilled pier. Tie spacer wheels that snap together with wire and allow them to rotate. Use spacer wheels that span at least two adjacent vertical bars. Start placing spacer wheels at the bottom of the cage and continue up along its length at maximum 10 ft (3 m) intervals.

6.0 CONCRETE

Drilled Pier Concrete shall conform to Section 1000 of the Standard Specifications. Begin concrete placement immediately after inserting reinforcing steel into the drilled pier excavation.

A. Concrete Mix

As an option, use Type IP blended cement with a minimum cement content of 665 lbs/yd^3 (395 kg/m^3) and a maximum cement content of 833 lbs/yd^3 (494 kg/m^3). Use No. 78M coarse aggregate in the mix.

Use an approved water-reducer, water-reducing retarder, high-range water-reducer or high-range water-reducing retarder to facilitate placement of the concrete if necessary. Do not use a stabilizing admixture as a retarder in Drilled Pier Concrete without approval of the Engineer. Use admixtures that satisfy AASHTO M194 and add them at the concrete plant when the mixing water is introduced into the concrete. Redosing of admixtures is not permitted.

B. Concrete Placement

Place concrete such that the drilled pier is a monolithic structure. Vibration is only permitted, if needed, in the top 10 ft (3 m) of the drilled pier. Remove any contaminated concrete from the top of the drilled pier at the time of concrete placement. Contain and remove all wasted concrete that spills over the casing.

Maintain a static slurry level in the excavation before placing concrete underwater. Pump concrete in accordance with Article 420-5 of the Standard Specifications. Use a steel tremie with a minimum diameter of 10 in (250 mm) and watertight joints or a pump pipe to place concrete. Use a discharge control to prevent concrete contamination when the tremie tube or pump pipe is initially placed in the excavation. Extend the tremie tube or pump pipe into the concrete a minimum of 5 ft (1.5 m) at all times except when the concrete is initially introduced into the pier excavation. If the tremie tube or pump pipe pulls out of the concrete for any reason after the initial concrete is placed, restart concrete placement with a steel capped tremie tube or pump pipe.

Place concrete within the time frames specified in Table 1000-2 of the Standard Specifications for Class AA concrete. Do not place concrete so fast as to trap air, slurry, water, fluids, soil or any other deleterious materials in the vicinity of the reinforcing steel and the annular zone between the rebar cage and the excavation walls.

Keep a record of the volume of concrete placed in each drilled pier excavation and make it available to the Engineer. Record a graphical plot of the depth versus theoretical concrete volume and actual measured concrete volume for each drilled pier and provide it to the Engineer when finished placing concrete.

7.0 SCHEDULING AND RESTRICTIONS

If caving or sloughing occurs, compensation will not be provided for additional concrete to fill the resulting voids.

For the first 16 hours after a drilled pier has achieved its initial concrete set (as determined by the Engineer), do not drill adjacent piers, do not install adjacent piles, and do not allow any equipment wheel loads or "excessive" vibrations within 20 ft (6 m) of the drilled pier.

In the event that the procedures described herein are performed unsatisfactorily, the Engineer may suspend drilled pier construction in accordance with Article 108-7 of the Standard Specifications. If the integrity of the drilled pier is in question, the Engineer reserves the right to reject the drilled piers and require remediation. Remedial measures are proposed by the Contractor and require approval of the Engineer. No compensation will be paid for losses or damage due to remedial work or any investigation of drilled piers found defective or not in accordance with this provision or the plans.

8.0 MEASUREMENT AND PAYMENT

A. Method of Measurement

1. Drilled Piers

   The quantity of "Drilled Piers" to be paid for will be the linear feet (meters) of the drilled piers computed from elevations and dimensions as shown on the plans or from revised dimensions authorized by the Engineer.

2. Permanent Steel Casing

   The quantity of "Permanent Steel Casing" to be paid for will be the linear feet (meters) of permanent steel casing as directed or required to be used. The length to be paid for will be measured along the permanent casing from the top of the casing elevation or top of the pier elevation, whichever is lower, to the permanent casing tip elevation. The Department will also pay for up to an additional 3 ft (1 m) of permanent casing cut off if the casing can not be installed to the permanent casing tip elevation shown on the plans. Permanent casing will be paid for only when permanent casing is authorized or when the Engineer directs the Contractor to leave a casing in place such that it becomes a permanent part of the pier.

3. Shaft Inspection Device (SID)

   The quantity of "SID Inspection" to be paid for will be per drilled pier as noted on the plans and/or directed by the Engineer. SID inspections are performed until the bottom cleanliness of the drilled pier excavation is acceptable by this provision; however, payment will only be made for the initial SID inspection of each drilled pier excavation.

4. Standard Penetration Test (SPT)

   The quantity of "SPT Testing" to be paid for will be the actual number of SPT tests performed as noted on the plans and/or directed by the Engineer.

B. Basis of Payment

1. Drilled Piers

   Payment will be made at the contract unit price per linear foot (meter) for "____ Dia. Drilled Piers". Such payment will include, but is not limited to, furnishing all labor, tools, equipment, materials including concrete complete and in place and all incidentals necessary to excavate the drilled piers through any material encountered and complete the work as described in this provision. No additional payment will be made for any miscellaneous grading or excavation to install the drilled pier. "Reinforcing Steel" and "Spiral Column Reinforcing Steel" will be paid for separately and will not be part of the unit bid price for "Drilled Piers".

2. Permanent Steel Casing

   Payment will be made at the contract unit price per linear foot (meter) for "Permanent Steel Casing for ____ Dia. Drilled Pier". Such payment will include, but is not limited to, furnishing all material, labor, tools, equipment and all incidentals necessary to install the casing in the pier excavation.

3. Shaft Inspection Device (SID)

   Payment for SID will be at the contract unit price per each for "SID Inspection". Such payment will include, but is not limited to, furnishing all materials, labor, tools, equipment and all incidentals necessary to complete the SID inspection as described in this provision.

4. Standard Penetration Test (SPT)

   Payment for SPT will be at the contract unit price per each for "SPT Testing". Such payment will include, but is not limited to, furnishing all materials, labor, tools, equipment and all incidentals necessary to complete the SPT at each test location.

CROSSHOLE SONIC LOGGING (11-17-06)

1.0 GENERAL

Use the non-destructive testing method crosshole sonic logging (CSL) to verify the integrity of the drilled pier and quality of concrete. The CSL test method is described in ASTM D6760, "Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing". The Engineer will determine the number of CSL tests and which drilled piers will be CSL tested. Drilled piers are referred to as piers in this special provision.

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The CSL test measures the time for an ultrasonic pulse to travel from a signal source in one tube to a receiver in another tube. In uniform, good quality concrete, the travel time between equidistant tubes should yield relatively consistent arrival times and correspond to a reasonable pulse velocity, signal amplitude and energy from the bottom to the top of the pier. Longer travel times, decrease in pulse velocity and lower amplitude/energy signals indicate the presence of irregularities such as poor quality concrete, voids, honeycombing, cracking and soil intrusions. The signal may be completely lost by the receiver and CSL recording system for severe defects such as voids.

Retain a CSL Consultant to perform CSL testing on the selected drilled piers. The CSL Consultant shall supply the Contractor with technical assistance and guidance during preparation and testing. Provide suitable access to the site and to the top of piers to be tested. Follow instructions from the CSL Consultant unless directed otherwise by the Engineer.

Place CSL tubes in all drilled piers. Perform CSL testing after concrete achieves a minimum compressive strength of 3000 psi (20.7 MPa) and within 7 to 30 days after concrete placement. After CSL test results have been reviewed and the Engineer has accepted the drilled pier, dewater the tubes and core holes, if any, and fill with an approved grout. If the Engineer elects not to CSL test a pier, obtain approval from the Engineer to dewater the tubes and fill them with an approved grout. Provide, mix and place grout in accordance with the Grout for Structures Special Provision.

2.0 PREQUALIFICATION AND EXPERIENCE REQUIREMENTS

Use a CSL Consultant prequalified by the Contractual Services Unit of the Department for Non-Destructive Foundation Testing work (work code 3070).

Submit documentation that the CSL Consultant has successfully completed at least 5 CSL testing projects within the last 3 years of a scope and complexity similar to that anticipated for this project. Documentation should include the General Contractor and Owner's name and current contact information with descriptions of each past project.

Provide the name of the Project Engineer that will be assigned to this project. Submit documentation for the Project Engineer verifying employment with the CSL Consultant, registration as professional engineer in North Carolina and a minimum of 5 years experience in CSL testing with past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc.

3.0 PREPARATION FOR CSL

Submit grout mix design or packaged grout type, CSL Consultant experience documentation, CSL tube size and Type 7 Contractor's Certification, cap details, couplings or joint details and the method for attaching the tubes. Provide this information with the drilled pier construction sequence plan.

Install 4 tubes in each drilled pier with a diameter of 5 ft (1524 mm) or less and 6 tubes in each pier with a diameter of greater than 5 ft (1524 mm). Provide 2 in (50 mm) inside diameter Schedule 40 steel pipe conforming to ASTM A53, Grade A or B, Type E, F or S. The tubes shall have a round, regular internal diameter free of defects or obstructions, including any at tube joints, in order to permit the free, unobstructed passage of source and receiver probes. The tubes shall provide a good bond with the concrete and be watertight.

Fit the tubes with a watertight threaded cap on the bottom and a removable threaded cap on the top. Securely attach the tubes to the interior of the reinforcing cage. Install the tubes in each drilled pier in a regular, symmetric pattern such that each tube is equally spaced from the others around the perimeter of the cage. Place tubes such that large vertical reinforcing bars do not block the direct line between adjacent tubes. The tubes are typically wire-tied to the reinforcing cage every 3 ft (1 m) or otherwise secured such that the tubes remain in position during placement of the cage and concrete. Install tubes as near to vertical and as parallel as possible, **as non-vertical tubes can adversely affect data analysis**. Extend the tubes from 6 in (150 mm) above the pier tip to at least 3 ft (1 m) above the top of the pier. If the pier top elevation is below ground elevation, extend tubes at least 2 ft (610 mm) above ground surface. If the drilled pier tip elevation is excavated more than 1 ft (305 mm) below the tip elevation shown on the plans, extend the tubes using proper threaded mechanical couplings to within 6 in (150 mm) of the revised pier tip elevation.

Before placing the reinforcing cage, record the tube lengths and positions along the length of the cage. After concrete placement, measure the stickup of the tubes above the top of the drilled piers and verify tube spacing.

After placing reinforcement and before placing concrete, fill the CSL tubes with clean water and cap them to keep out debris. CSL tubes that are not filled with water and capped will be rejected. When removing the caps, use care not to apply excess torque, force or stress, which could break the bond between the tubes and the concrete.

4.0 CSL EQUIPMENT

The minimum requirements of the CSL equipment are as follows:

- A microprocessor based CSL system for display of individual CSL records, analog-digital conversion and recording of CSL data, analysis of receiver responses and printing of report quality CSL logs
- Ultrasonic source and receiver probes which can travel through 2 in (50 mm) I.D. steel pipe
- An ultrasonic voltage pulser to excite the source with a synchronized triggering system to start the recording system
- A depth measurement device to electronically measure and record the source and receiver depths associated with each CSL signal
- Appropriate filter/amplification and cable systems for CSL testing

- An acquisition system that stores each log in digital format, with drilled pier identification, date, time and test details, including the source and receiver gain and displays arrival time data graphically during data acquisition
- 3D tomographic imaging software or source for completing the work

5.0 CSL Test Procedure

Perform CSL testing between each adjacent perimeter CSL tube pair and opposite tube pairs along the cross section diameter. Maintain the source and receiver probes in the same horizontal plane unless test results indicate defects or poor concrete zones, in which case, further evaluate the defect zones with angle tests (source and receiver vertically offset at greater than 1.5 ft (460 mm) in the tubes). Report any defects indicated by decreased signal velocity and lower amplitude/energy signals at the time of testing and conduct angle tests in the zones of the defects as defined by the Concrete Condition Rating Criteria (CCRC) in Section 6.0 of this provision. Make CSL measurements at depth intervals of 2.5 in (65 mm) or less from the bottom of the tubes to the top of each pier. Pull the probes simultaneously, starting from the bottom of the tubes, using a depth-measuring device to electronically measure and record the depths associated with each CSL signal. Remove any slack from the cables before pulling to provide for accurate depth measurements of the CSL records. In the event defects are detected, conduct additional logs at no additional cost to the Department.

If CSL probes will not pass through the entire length of the CSL tubes, core a 2 in (50 mm) diameter hole through the concrete the full length of the drilled pier for each inaccessible tube. If the CSL tubes debond from the concrete, core a 2 in (50 mm) diameter hole through the concrete to the depth of the debonding for each debonded tube. Locate core holes approximately 9 in (230 mm) inside the reinforcement as directed by the Engineer. Fill core holes with clean water and cover to keep out debris. No additional payment will be made for coring due to inaccessible or debonded tubes.

6.0 CSL Results And Reporting

Submit two hard copies and an electronic copy (pdf or jpeg format on CD or DVD) of a CSL report sealed by the Project Engineer within 5 calendar days after field testing is complete. The CSL report should include but not limited to the following:

A. Title Sheet

- NCDOT TIP number and WBS element number
- Project description
- County
- Bridge station number
- Pier location
- Personnel
- Report date

B. Introduction

C. Site and Subsurface Conditions (including water table elevation)

D. Pier Details

- Pier and casing diameters, lengths and elevations
- Concrete compressive strength
- Installation methods and details including use of casing, slurry, pump, tremie, dry or wet placement of concrete, etc.

E. CSL Logs

F. Results/Conclusions

G. Attachments

- Boring log(s)
- Field Drilled Pier Inspection Forms, Drilling Logs, SID Inspection Forms and Concrete Curves (from Engineer)
- CSL tube locations, elevations, lengths and identifications
- CSL hardware model
- Electronic copy of all CSL raw data

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Include CSL logs for each tube pair tested with analysis of the initial pulse arrival time, velocity, relative pulse energy/amplitude and stacked waveform plotted versus depth. List all zones defined by the CCRC in a tabular format including the percent velocity reduction and the velocity values used from the nearby zone of good quality concrete. Discuss each zone defined by the CCRC in the CSL report as appropriate. Base the results on the percent reduction in velocity value from a nearby zone of good quality concrete with good signal amplitude and energy as correlated to the following:

Concrete Condition Rating Criteria (CCRC)			
CCRC	**Rating Symbol**	**Velocity Reduction**	**Indicative Results**
Good	G	≤ 10 %	Good quality concrete
Questionable Defect	Q	>10 % & < 20 %	Minor concrete contamination or intrusion and questionable quality concrete
Poor	P/D	≥ 20 %	Defects exist, possible water/slurry contamination, soil intrusion and/or poor quality concrete
No Signal	NS	No Signal received	Soil intrusion or other severe defect absorbed the signal (assumes good bond of the tube-concrete interface)
Water	W	V = 4750 fps (1450 mps) to 5000 fps (1525 mps)	Water intrusion or water filled gravel intrusion with few or no fines present

The following are a few examples of types and causes of defects:

- Necking or arching of the concrete on withdrawal of the temporary casing.
- Necking or contamination of the concrete due to collapse of the side walls.
- Soft toe due to incomplete cleaning or collapse of the side walls.
- Horizontal lenses of silt\mud\slurry due to the tremie pipe rising above the concrete.
- Voids due to the use of low-slump concrete.
- Honeycombing due to washout of fines.
- Trapping of contaminants due to pumping concrete to fast.

The Engineer will require 5 working days to evaluate the CSL test results and determine whether or not the drilled pier is acceptable. Evaluation of CSL test results, with ratings other than good (G) per the CCRC may require further investigation and additional time for

review and analysis of the data. Do not grout the CSL tubes or perform any further work on the CSL tested drilled pier until the Engineer determines whether the drilled pier is acceptable.

Perform tomography in order to further investigate and delineate the boundaries of any defective/unconsolidated zones with 20% or more reduction in velocity value as correlated to the CCRC. Process CSL data to construct easy to understand 2D/3D (2D cross-sections between tubes and 3D volumetric images for the entire pier) *color-coded* tomographic images indicating velocity variations along the pier. Identify the location and geometry of defective/unconsolidated zones in 3D color images with detailed discussion in the CSL report. Any further tests deemed necessary by the Engineer in order to determine the acceptability of the drilled pier will be determined after reviewing the CSL report. Additional test or analysis options include 3D tomographic imaging, single-hole sonic testing, sonic echo or impact response tests and concrete coring.

The Engineer determines the depth, location, diameter (PQ or NQ size) and number of core holes when concrete coring is required. If the Engineer is concerned about concrete strength or requires the use of a borehole camera for inspection, large diameter cores (PQ size) are required. Drill a minimum of 2 core holes to intercept the suspected defect zones. Use a coring method that provides maximum core recovery and minimizes abrasion and erosion. Provide concrete cores properly marked in a wooden crate labeled with the drilled pier depth at each interval of core recovery to the NCDOT Materials and Test Unit for evaluation and testing. Submit coring records, signed by the Contractor that include NCDOT project number, name of the Drilling Contractor, date cored and percent core recovery. Allow 5 working days after submitting the core records for the Department's review.

7.0 CORRECTION OF UNACCEPTABLE DRILLED PIER

When the Engineer determines a drilled pier is unacceptable, submit remedial measures to the Department for approval. No compensation will be made for remedial work or losses or damage due to remedial work of drilled piers found defective or not in accordance with the Drilled Piers Special Provision or the plans. Modifications to the drilled pier design or any load transfer mechanisms required by the remedial action shall be designed by a Registered North Carolina Professional Engineer. Include supporting calculations and drawings sealed by a Registered North Carolina Professional Engineer for all foundation elements affected. Do not begin remedial action work until the Department has reviewed and accepted the remedial action plan. Allow 5 working days after submitting the remedial work plan for the Department's review and acceptance. Furnish all materials and work necessary to correct defective drilled piers.

8.0 MEASUREMENT AND PAYMENT

The complete and accepted CSL will be paid for at the unit bid price for "Crosshole Sonic Logging" per each. The Department will only pay for the initial CSL test on a drilled pier; no additional payment will be made for subsequent CSL tests performed on the same drilled pier. Include in this unit bid price all costs incurred for procurements, conducting

the CSL testing, reporting of results and incidentals necessary to complete the work including any other test required to determine the acceptability of the drilled pier.

Include the cost of the crosshole sonic logging tubes in the unit bid price for drilled piers. No separate payment will be made for the CSL tubes. The unit bid price for the drilled piers will include full compensation for furnishing, installing, extending tubes, dewatering and grouting of all CSL tubes and core holes, if applicable, and all materials, labor, tools, equipment and incidentals necessary to complete the work.

THERMAL SPRAYED COATINGS (METALLIZATION) (6-07-05)

1.0 DESCRIPTION

Apply a thermal sprayed coating (TSC) and sealer to metal surfaces as specified herein when called for on the plans or by other Special Provisions, or when otherwise approved by the Engineer in accordance with the SSPC-CS 23.00/AWS C2.23/NACE No. 12 Specification. Only Arc Sprayed application methods are used to apply TSC coatings, the Engineer must approve other methods of application.

2.0 QUALIFICATIONS

Only use NCDOT approved TSC Contractors meeting the following requirements:

1. Who have the capability of blast cleaning steel surfaces to SSPC SP-5 and SP-10 Finishes.

2. Who employ a Spray Operator(s) qualified in accordance with AWS C.16/C2.16M2002 and a Quality Control Inspector(s) who have documented training in the applicable test procedures of ASTM D-3276 and SSPC-CS 23.00.

   A summary of the contractor's related work experience and the documents verifying each Spray Operator's and Quality Control Inspector's qualifications are submitted to the Engineer before any work is performed.

3.0 MATERIALS

Provide wire in accordance with the metallizing equipment manufacturer's recommendations. Use the wire alloy specified on the plans which meets the requirements in Annex **C** of the SSPC-CS 23.00 Specification. Have the contractor provide a certified analysis (NCDOT Type 2 Certification) for each lot of wire material.

Apply an approved sealer to all metallized surfaces in accordance with Section 9 of SSPC-CS 23. The sealer must either meet SSPC Paint 27 or is an alternate approved by the Engineer.

4.0 SURFACE PREPARATION AND TSC APPLICATION

Grind flame cut edges to remove the carbonized surface prior to blasting. Bevel all flame cut edges in accordance with Article 442-10(D) regardless of included angle. Blast clean surfaces to be metallized with grit or mineral abrasive in accordance with Steel Structures Painting Council SSPC SP-5/10(as specified) to impart an angular surface profile of 2.5 - 4.0 mils (0.063 – 0.100 mm). Surface preparation hold times are in accordance with Section 7.32 of SSPC-CS 23. If flash rusting occurs prior to metallizing, blast clean the metal surface again. Apply the thermal sprayed coating only when the surface temperature of the steel is at least 5°F (3°C) above the dew point.

At the beginning of each work period or shift, conduct bend tests in accordance with Section 6.5 of SSPC-CS 23.00. Any disbonding or delamination of the coating that exposes the substrate requires corrective action, additional testing, and the Engineer's approval before resuming the metallizing process.

Apply TSC with the alloy to the thickness specified on the plans or as provided in the table below. All spot results (the average of 3 to 5 readings) must meet the minimum requirement. No additional tolerance (as allowed by SSPC PA-2) is permitted. (For Steel Beams: For pieces with less than 200 ft^2 (18.6m^2) measure 2 spots/surface per piece and for pieces greater than 200 ft^2 (18.6m^2) add 1 additional spots/surface for each 500 ft^2 (46.5m^2)).

Application	Thickness	Alloy	Seal Coat
Pot Bearings	8 mil	85/15 Zinc (W-Zn-Al-2)	0.5 mil
Armored Joint Angles	8 mil	85/15 Zinc (W-Zn-Al-2)	0.5 mil
Modular Joints	8 mil	99.99% Zn (W-Zn-1)	0.5 mil
Expansion Joint Seals	8 mil	99.99% Zn (W-Zn-1)	0.5 mil
Optional Disc Bearings	8 mil	85/15 Zinc (W-Zn-Al-2)	0.5 mil

When noted on the plans or as specified in the above chart, apply the sealer to all metallized surfaces in accordance with the manufacturer's recommendations and these provisions. Apply the seal coat only when the air temperature is above 40°F (4°C) and the surface temperature of the steel is at least 5°F (3°C) above the dew point. If the sealer is not applied within eight hours after the final application of TSC, the applicator verifies acceptable TSC surfaces and obtains approval from the Engineer before applying the sealer.

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5.0 INSPECTION FREQUENCY

The TSC Contractor must conduct the following tests at the specified frequency and the results documented in a format approved by the Engineer.

Test/Standard	Location	Frequency	Specification
Ambient Conditions	Site	Each Process	5°F (3°C) above the dew point
Abrasive Properties	Site	Each Day	Size, angularity, cleanliness
Surface Cleanliness SSPC Vis 1	All Surfaces	Visual All Surfaces	SSPC-SP-10 Atmospheric Service SSPC-SP - 5 Immersion Service
Surface Profile ASTM D-4417 Method C	Random Surfaces	3 per 500 ft^2	2.5 - 4.0 mils
Bend Test SSPC-CS 23.00	Site	5 per shift	Pass Visual
Thickness SSPC PA-2R SSPC-CS 23.00	Each Surface	Use the method in PA-2 Appendix 3 for Girders and Appendix 4 for frames and miscellaneous steel. See Note 1.	Zn - 8 mils minimum Al - 8 mils minimum Zn Al - 8 mils minimum Areas with more than twice the minimum thickness are inspected for compliance to the adhesion and cut testing requirements of this specification.
Adhesion ASTM 4541	Random Surfaces Splice Areas	1 set of 3 per 500 ft^2	Zn > 500 psi Al > 1000 psi Zn Al > 750 psi
Cut Test - SSPC-CS 23.00	Random Surfaces	3 sets of 3 per 500 ft^2	No peeling or delamination
Job Reference Std. SSPC-CS 23.00	Site	1 per job	Meets all the above requirements

6.0 REPAIRS

All Repairs are to be performed in accordance with the procedures below, depending on whether the repair surface is hidden or exposed. As an exception to the following, field welded splices on joint angles and field welding bearing plates to girders may be repaired in accordance with the procedures for hidden surfaces.

For hidden surfaces (including but not limited to interior girders, interior faces of exterior girders, and below-grade sections of piles):

1. Welding of metallized surfaces may be performed only if specifically permitted by the Engineer. Remove metallizing at the location of field welds by blast cleaning (SSPC SP-6 finish), or hand (SSPC SP-2 finish) or power tool cleaning (SSPC SP-3 finish) just prior to welding. Clean sufficiently to prevent contamination of the weld. All repairs to welded connections are metallized in accordance with SSPC CS 23.00.

2. Minor areas less than or equal to 0.1 ft^2 (9300mm^2) exposing the substrate are metallized in accordance with SSPC CS 23.00 or painted in accordance with ASTM A780, "Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings."

3. Large areas greater than 0.1 ft^2 (9300mm^2) exposing the substrate are metallized in accordance with SSPC CS 23.00.

4. Damaged (burnished) areas not exposing the substrate with less than the specified coating thickness are metallized in accordance with SSPC CS 23.00 or painted in accordance with ASTM A780, "Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings."

5. Damaged (burnished) areas not exposing the substrate with more than the specified coating thickness are not repaired.

6. Defective coating is repaired by either method 2 or 3 depending on the area of the defect.

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

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

2. All areas exposing the substrate are metallized in accordance with SSPC CS 23.00

3. Defective coating is repaired by either method 2 or 3 depending on the area of the defect.

7.0 TWELVE MONTH OBSERVATION PERIOD

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

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

8.0 BASIS OF PAYMENT

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

EPOXY RESIN INJECTION (SPECIAL)

1.0 GENERAL

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

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

2.0 SCOPE OF WORK

Using Epoxy Resin Injection, repair all cracks 5 mils (125 μm) wide or greater in the cast-in-place substructure units within 30 days of Engineer's notification.

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

3.0 COOPERATION

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

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

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

4.0 TESTING

The North Carolina Department of Transportation Material and Tests Unit obtains test cores from the repaired concrete. If the failure plane is located at the repaired crack, a minimum compressive strength of 3000 psi (20.7 MPa) is required of these cores.

5.0 MATERIAL PROPERTIES OF EPOXY RESIN

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

	Test Method	Specification Requirements
Viscosity @ 40 ± 3°F (4 ± 1°C), cps	Brookfield RVT Spindle No. 4 @ 20 rpm	6000 - 8000
Viscosity @ 77 ± 3°F (25 ± 1°C), cps	Brookfield RVT Spindle No. 2 @ 20 rpm	400 - 700
Epoxide Equivalent Weight	ASTM D1652	152 - 168
Ash Content, %	ASTM D482	1 max.

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

	Test Method	Specification Requirements
Viscosity @ 40 ± 3°F (4 ± 1°C), cps	Brookfield RVT Spindle No. 2 @ 20 rpm	700 - 1400
Viscosity @ 77 ± 3°F (25 ± 1°C), cps	Brookfield RVT Spindle No. 2 @ 20 rpm	105 - 240
Amine Value, mg KOH/g	ASTM D664*	490 - 560
Ash Content, %	ASTM D482	1 max.
* Method modified to use perchloric acid in acetic acid.		

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

Pot Life (60 gram mass)

@ 77 ± 3°F (25 ± 1°C) 15 minutes minimum

@ 100 ± 3°F (38 ± 1°C) 5 minutes minimum

Certify that the Adhesive, when cured for 7 days at 77 ± 3°F (25 ± 1°C) unless otherwise specified, has the following properties:

	Test Method	Specification Requirements
Ultimate Tensile Strength	ASTM D638	7000 psi (48.3 MPa) min.
Tensile Elongation at Break	ASTM D638	4% max.
Flexural Strength	ASTM D790	10,000 psi (69.0 MPa) min.
Flexural Modulus	ASTM D790	3.5 x 10^5 psi (2413.2 MPa)
Compressive Yield Strength	ASTM D695	11,000 psi (75.8 MPa) min.
Compressive Modulus	ASTM D695	2.0 - 3.5 x 10^5 psi (1379.0 - 2413.2 MPa)
Heat Deflection Temperature Cured 28 days @ 77 ± 3°F (25 ± 1°C)	ASTM D648*	125°F (52°C) min. 135°F (57°C) min.
Slant Shear Strength, 5000 psi (34.5 MPa) compressive strength concrete	AASHTO T237	
Cured 3 days @ 40°F (4°C) wet concrete		3500 psi (24.1 MPa) min.
Cured 7 days @ 40°F (4°C) wet concrete		4000 psi (27.6 MPa) min.
Cured 1 day @ 77°F (25°C) dry concrete		5000 psi (34.5 MPa) min.
* Cure test specimens so that the peak exothermic temperature of the adhesive does not exceed 77°F (25°C).		

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

6.0 Material Properties Of Surface Seal

Use a two-component paste epoxy bonding agent for the epoxy resin conforming to the following requirements:

Density, lbs/gal (kg/liter)	10.5 (1.25)
Specific Gravity	1.3
Minimum Application Temperature, °F (°C)	50 (10)
Application Temperature Range, °F (°C)	60 to 105 (16 to 41)
Shelf Life	1 year (min.)

	@ 60°F (16°C)	@ 85°F (29°C)	@ 105°F (41°C)
Potlife, hr., 1 gallon (3.8 liters)	2½	1	½
Open Time[1], minimum: hr.	4	1¾	¾
Non-sag Thickness, inches (mm) (ASTM D2730)	1 (25)	¾ (19)	½ (13)
Initial Cure[2], days (AASHTO T237)	10	6	3
Cure Time[3], days (ASTM D695)	20	10	7

Typical Mechanical Properties[4]	
Tensile Strength, psi (MPa) Elongation at Break (ASTM D638)	1,500 (10.3) 4%
Compressive Yield Strength, psi (MPa) Compressive Modulus, psi (MPa) (ASTM D695)	8,000 (55.2) 4.0×10^5 (2757.9)
Heat Deflection Temperature[5], °F (°C) (ASTM D648)	105 (41)
Slant Shear Strength, psi (MPa) Damp to Damp Concrete (AASHTO T237)	5,000 (34.5) 100% Concrete Failure

1. From start of mixing to completion of repair
2. 5,000 psi (34.5 MPa) minimum
3. Isothermal cure to eliminate effect of exotherm
4. Cure schedule 7 days @ 77°F (25°C), test temperature 77°F (25°C)
5. 128°F (53°C) after 28 day cure

7.0 EQUIPMENT FOR INJECTION

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

Use injection equipment with automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200 ± 5 psi (1380 ± 35 kPa) and equipped with a manual pressure control override.

Use equipment capable of maintaining the volume ratio for the injection adhesive as prescribed by the manufacturer. A tolerance of ± 5% by volume at any discharge pressure up to 200 psi (1380 kPa) is permitted.

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

8.0 PREPARATION

Follow these steps prior to injecting the epoxy resin:

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

9.0 EPOXY INJECTION

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

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

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

Perform epoxy adhesive injection continuously until cracks are completely filled.

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

10.0 FINISHING

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

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

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

11.0 BASIS OF PAYMENT

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

EVAZOTE JOINT SEALS (8-13-04)

1.0 SEALS

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

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

Provide seals that meet the requirements given below.

TEST	TEST METHOD	REQUIREMENT
Elongation at break	ASTM D3575	210 ± 15%
Tensile strength, psi (kPa)	ASTM D3575	110 ± 15 (755 ± 100)
Compression Recovery (% of original width)	AASHTO T42 50% compr. for 22 hr. @ 73°F (23°C) 1/2 hr. recovery	87 ± 3
Weather/Deterioration	AASHTO T42 Accelerated Weathering	No deterioration for 10 years min.
Compression/Deflection	@ 50% deflection of original width @ 50% deflection of original width	10 psi (69 kPa) min. 60 psi (414 kPa) max.
Tear Strength, psi (kPa)	ASTM D624	16 ± 3 (110 ± 20)
Density	ASTM D545	2.8 to 3.4
Water Absorption (% vol/vol)	ASTM D3575 Total immersion for 3 months	3

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

2.0 ADHESIVES

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

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

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

3.0 SAWING THE JOINTS

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

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

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

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

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

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

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

4.0 PREPARATIONS FOR SAWED JOINTS

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

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

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

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

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

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

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5.0 PREPARATIONS FOR ARMORED JOINTS

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

A. Submittals

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

B. Surface Preparation

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

1. Angle Assembly

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

2. Concrete

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

C. Elastomeric Concrete Placement

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

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

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

D. Joint Preparation

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

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

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

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

6.0 SEAL INSTALLATION

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

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

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

7.0 BASIS OF PAYMENT

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

ELASTOMERIC CONCRETE 109 (10-12-01)

1.0 DESCRIPTION

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

2.0 MATERIALS

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

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

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

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

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

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

3.0 BASIS OF PAYMENT

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

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FALSEWORK AND FORMWORK (SPECIAL)

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. **Overhang falsework hangers shall not be placed at the edge of 72-inch or 78-inch deep girders due to the thinness of the flange. Holes for hanger rods shall be set back near the girder web, well away from the flange edge, and formed with PVC sleeves of approximately ⅛" thickness.** 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 (11-17-06)

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
Man-Pan Hui (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

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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

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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.

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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/formprovdet/

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.

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CONSTRUCTION, MAINTENANCE AND REMOVAL OF TEMPORARY ACCESS AT STATION 47+08.03 -L- (SPECIAL)

1.0 GENERAL

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

The cost of the temporary supports and strong-backs shall be included in this pay item.

2.0 TEMPORARY WORK BRIDGE

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

3.0 BASIS OF PAYMENT

The lump sum price bid for "Construction, Maintenance and Removal of Temporary Access at Station 47+08.03 -L-" will be full compensation for the above work, or other methods of access, including all material, pipes, work bridge components, equipment, tools, labor, disposal, and incidentals necessary to complete the work.

BRIDGE DECK RIDEABILITY AND GROOVING AT STATION 47+08.03 -L- (7-18-06)

1.0 GENERAL

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

2.0 RIDEABILITY REQUIREMENTS

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

Submit the calibration results to the Engineer for approval prior to testing of the bridge deck.

Prior to initial profilograph testing, complete placement of the bridge deck and barrier rail within the section to be tested, with the exception of blockouts required for the installation of joints. Do not install joints until the Engineer determines that the rideability requirements herein have been met. Temporarily bridge joint locations to facilitate operation of the profilograph and corrective equipment across the joint. Remove all obstructions from the bridge deck and sweep the surface clean of debris prior to testing. Do not allow any radio transmissions or other activities that might disrupt the automated profilograph equipment during the testing.

Check the wheels of the profilograph to ensure proper tire pressure as per manufacturer's recommendations. Maintain tires free of debris and buildup during each test run. Operate the profilograph at a maximum speed of 2 miles per hour (3.2 kph). Take profiles with the recording wheel parallel to and approximately 3.5 feet (1.1 m) inside the two outer edges of each travel lane.

Plot each profilogram at a horizontal scale of 25 feet per inch (0.3 m per mm) with the vertical scale plotted at a true scale. Record station numbers on the profilogram at distances not to exceed 200 feet (61.0 m). Note joint locations on the profilogram. Determine the Profile Index for each wheel path in accordance with the procedure entitled "Determination of Profile Index" available through the Engineer.

Determine a Profile Index per lane by averaging the index for the right and left wheel paths for each test section. A test section is defined as a 600 foot (182.9 m) length of each travel lane. Submit the profilogram and Profile Index calculations for all test sections to the Engineer for review. The maximum allowable Profile Index per lane shall not exceed 6" per mile (95 mm per km) as determined with a 0.2" (5.1 mm) blanking band over any 600 foot (182.9 m) test section. Correct individual high points or depressions having deviations in excess of 0.3" in 25 feet (7.6 mm in 7.6 m) on the profilogram by planing. Additionally, the entire deck surface shall meet a 0.125" in 10 feet (3 mm in 3 m) straightedge check made atop the deck either transversely or longitudinally as deemed necessary by the Engineer.

3.0 PLANING

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

When planing, use a Boart Longyear PC 5000, a Target 3804 or approved equal. Submit grinding equipment specifications to the Engineer for approval before any planing is performed. Use a grinding machine capable of removing a minimum of 3 feet of width with each pass. Multiple passes may be required to achieve the required depth of removal. In addition, hand grinding may be required to remove vertical steps between passes.

The ground surface shall consist of between 50 and 60 grooves per foot (305 mm) of width. The grooves shall be between 0.09" (2.3 mm) and 0.15" (3.8 mm) in width and 0.0625" (1.6 mm) in depth. The area between the grooves shall be between 0.06" (1.5 mm) and 0.13" (3.3 mm) in width. The final concrete texture shall be uniform.

Construct and operate the grinding machine such that it will not cause strain or damage to the deck surface, excessive ravels, aggregate fractures, spalls, or disturbance of transverse joints. Longitudinally plane the deck parallel to the roadway centerline.

Continuously remove all slurry or other debris resulting from the grinding operations from the surfaces by vacuum pick-up or other approved methods. Prevent the slurry from flowing into floor drains or onto the ground or body of water under the bridge. Dispose of all residues off the project.

In completing all corrective work on the deck surface to satisfy the rideability criteria stated herein, limit planing such that the final reinforcement cover is not less than the plan cover minus ½" (12mm). In cases where this cannot be achieved, other corrective work may be required as directed by the Engineer.

Provide additional profilograph testing as necessary following planing and any other corrective actions, until the rideability requirements above are satisfied.

4.0 GROOVING BRIDGE FLOORS

After the concrete surface profile has been accepted by the Engineer, the joints have been installed, and the concrete blockouts poured, groove the bridge deck in accordance with Subarticle 420-14(B) of the Standard Specifications. If a substantial amount of bridge deck surface has been planed and/or the concrete cover over the slab reinforcement has been reduced to the minimum, the Engineer may delete all or a portion of the requirement of grooving in that area. In this instance, no additional compensation shall be made for underruns in grooving.

5.0 BASIS OF PAYMENT

No separate payment will be made for profilograph testing or planing of the bridge deck. The cost of the testing procedure, equipment, planing operation, and removal and disposal of slurry resulting from the planing operation is considered incidental to the contract bid price for "Reinforced Concrete Deck Slab".

CRANE SAFETY (8-15-05)

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

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

CRANE SAFETY SUBMITTAL LIST

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

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

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

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

PILE DRIVING ANALYZER (11-17-06)

1.0 GENERAL

This special provision governs driving piles with a pile driving analyzer (PDA) in accordance with the plans and as directed by the Engineer. The PDA test method is described in ASTM D4945, "Standard Test Method for High-Strain Dynamic Testing of Piles". Install piles in accordance with Section 450 of the Standard Specifications and this provision.

Submit the proposed pile driving methods and equipment (Pile Driving Equipment Data Form) in accordance with the Submittal of Working Drawings Special Provision and the Standard Specifications. The Engineer will respond with preliminary approval or rejection of the proposed pile driving methods and equipment within 10 calendar days. Preliminary approval is required before driving piles with a PDA. Notify the Engineer of the pile driving schedule a minimum of 14 calendar days in advance.

Either a PDA Consultant or the NCDOT Geotechnical Engineering Unit, as directed by the Engineer, shall perform PDA testing and analysis. If required, retain a PDA Consultant and submit experience documentation with the proposed pile driving methods and equipment.

The Engineer will determine the number of piles and which piles to be tested with the PDA based upon the subsurface conditions and the pile installation sequence and progress.

The Engineer will complete the review of the proposed pile driving methods and equipment and provide the required driving resistance within 10 calendar days after the Engineer receives the PDA report or the Geotechnical Engineering Unit completes the PDA testing. A PDA report for PDA testing on multiple piles may be required as directed by the Engineer before the 10 day time period begins.

2.0 PREQUALIFICATION AND EXPERIENCE REQUIREMENTS

Use a PDA Consultant prequalified by the Contractual Services Unit of the Department for Pile Driving Analyzer work (work code 3060).

Submit documentation that the PDA Consultant has successfully completed at least 5 PDA testing projects within the last 3 years of a scope and complexity similar to that anticipated for this project. Documentation should include the General Contractor and Owner's name and current contact information with descriptions of each past project. Also, submit documentation of experience with PDA manufactured by Pile Dynamics, Inc and the CAse Pile Wave Analysis Program (CAPWAP).

Provide a list of PDA Operators and the Project Engineer that will be assigned to this project. Submit documentation for each PDA Operator verifying employment with the PDA Consultant and a minimum of 1 year experience in collecting PDA data with past projects of scope and complexity similar to that anticipated for this project. Submit documentation for the Project Engineer verifying employment with the PDA Consultant, registration as professional engineer in North Carolina and a minimum of 5 years experience in PDA testing and analysis with past projects of scope and complexity similar to that anticipated for this project. Documentation should include resumes, references, certifications, project lists, experience descriptions and details, etc.

3.0 PREPARATION FOR PDA TESTING

Provide piles for PDA testing that are 5 ft (1.5 m) longer, or as directed by the Engineer, than the estimated pile lengths shown on the plans. Supply 110 V, 60 Hz, 30 Amp of AC electrical power to operate the PDA equipment. Direct current welders or non-constant power sources are unacceptable.

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

Place the shelter within 75 ft (23 m) of the pile such that the PDA cables reach the computer and the operator can clearly observe the pile. The Engineer may waive the shelter requirement if weather conditions allow.

Drill up to a total of 16 bolt holes in either 2 or 4 sides of the pile, as directed by the PDA Consultant or the Engineer, at an approximate distance equal to 3 times the pile diameter below the head of the pile. If the PDA Consultant or the Engineer choose to drill the bolt holes, provide the necessary equipment, tools and assistance to do so. A hammer drill is required for concrete piles and up to 2 hours may be required to drill the holes.

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

The PDA Consultant or the Engineer will furnish the PDA measuring instruments and materials for installing the instruments. Attach the PDA instruments as directed by the PDA Consultant or the Engineer after the pile is placed in the leads and the template.

4.0 PDA TESTING

Use only the preliminarily approved pile driving methods and equipment to drive piles with the PDA instruments attached. Drive the pile as directed by the PDA Operator or the Engineer in order to measure the wavespeed of the pile.

Drive the pile to the required bearing capacity and specified tip elevation, if applicable, as shown on the plans or as directed by the PDA Consultant or the Engineer. During pile driving, the PDA will be used to evaluate, including but not limited to, the following: hammer performance, bearing capacity, distribution of soil resistance, pile driving stresses, energy transfer, pile integrity and various soil parameters such as quake and damping.

The PDA Operator or the Engineer may require the Contractor to modify the pile installation procedure during driving as follows:

- Reduce the hammer energy
- Drive deeper or shallower because of variations in the subsurface conditions
- Readjust the transducers
- Realign the pile

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

5.0 REDRIVING PILES

When directed by the Engineer, reattach the PDA instruments and restrike or redrive the pile in accordance with Section 4.0 above and Subarticle 450-7(E) of the Standard Specifications. Obtain the required stroke and penetration (at least 6 in or 150 mm) or as directed by the PDA Operator or the Engineer. The PDA Operator or the Engineer will record dynamic measurements during restriking and redriving. The Engineer may require restriking and redriving more than once on the same pile. The Engineer will determine when PDA testing has been satisfactorily completed.

6.0 CAPWAP ANALYSIS AND PDA REPORT

The PDA Consultant shall perform analysis of the PDA raw data with the CAPWAP (version 2006 or later). At a minimum, analysis is required for a hammer blow near the end of initial drive and for each restrike and redrive. Additional CAPWAP analysis may be required as determined by the PDA Consultant or the Engineer.

Submit three hard copies and an electronic copy (pdf or jpeg format on CD or DVD) of a PDA report sealed by the Project Engineer within 7 calendar days after field testing is complete. The PDA report shall include but not be limited to the following:

A. Title Sheet
- NCDOT TIP number and WBS element number
- Project description
- County
- Bridge station number
- Pile location
- Personnel
- Report date

B. Introduction

C. Site and Subsurface Conditions (including water table elevation)

D. Pile Details
- Pile type and length
- Required bearing capacity and factor of safety
- Concrete compressive strength and/or steel pile yield strength
- Pile splice type and locations
- Pile batter

- Installation methods including use of jetting, preaugering, spudding, vibratory hammer, template, barge, etc.

E. Driving Details

- Hammer make, model and type
- Hammer and pile cushion type and thickness
- Pile helmet weight
- Hammer efficiency and operation data including fuel settings, bounce chamber pressure, blows per minute, equipment volume and pressure
- Ground or mud line elevation and template reference elevation at the time of driving
- Final pile tip elevation
- Driving resistance (ram stroke, blows per foot (0.3 meter) and set for last 10 hammer blows)
- Restrike and redrive information

F. PDA field work details

G. CAPWAP analysis results

- Table showing percent skin and tip, skin and toe damping, skin and toe quake and match quality

H. Summary/Conclusions

I. Attachments

- Boring log(s)
- Pile Driving Equipment Data Form (from Contractor)
- Field pile driving inspection data (from Engineer)
- Accelerometer and strain gauge locations
- Accelerometer and strain gauge serial numbers and calibration information
- PDA hardware model and CAPWAP software version information
- Electronic copy of all PDA raw data and executable CAPWAP input and output files (version 2006 format)

7.0 MEASUREMENT AND PAYMENT

The complete and accepted PDA testing will be paid for at the unit bid price for "PDA Testing" per each. Include in the unit bid price for "PDA Testing" all costs for providing the PDA, PDA instruments and materials for installing the instruments and recording the dynamic measurements the first time the pile is tested with the PDA. Costs for providing these items for the same pile after the pile is initially tested with the PDA will be considered incidental to the unit bid price for "Pile Redrives". Also include in the unit bid price for "PDA Testing" all costs for performing the CAPWAP analysis on data collected during initial drive, restrikes and redrives and preparing and submitting the PDA report. No payment for "PDA Testing" will be made if the PDA report submitted is incomplete as described in Section 6.0. No payment for "PDA Testing" will be made if the Department performs PDA testing. If the Department does not perform PDA testing, the number of "PDA Testing" per pile will be equal to one.

The complete and accepted PDA assistance will be paid for at the unit bid price for "PDA Assistance" per each. Include in the unit bid price for "PDA Assistance" all costs for PDA preparation and support including all materials, labor, tools, equipment, mobilization and incidentals necessary to complete the work described in this provision excluding the costs for the PDA testing described above. Costs for PDA preparation and support for restrikes and redrives will not be paid for separately. The number of "PDA Assistance" per pile will be equal to one for each pile tested with the PDA.

The cost of the pile and the installation including driving, restriking and redriving will be paid for separately in accordance with the Standard Specifications and will not be part of these PDA pay items.

CRACK REPAIR OF PRESTRESSED CONCRETE GIRDERS (7-18-06)

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

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

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

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GROUT FOR STRUCTURES (SPECIAL)

1.0 DESCRIPTION

This special provision addresses grout to be used in structures, including continuous flight auger (CFA) piles, micropiles, soil nail and permanent anchor tieback retaining walls and backfilling crosshole sonic logging (CSL) tubes or grout pockets, shear keys, dowel holes and recesses for cored slabs and box beams. Provide grout composed of portland cement, water, fine aggregate and, at the Contractor's option, 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 structure and this provision as directed by the Engineer.

See "Post-Tensioning Tendons" special provision for grout requirements for the post-tensioned girders.

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

If no compressive strength or shrinkage is specified on the plans or in the applicable section of the Standard Specifications or special provision for the structure, provide non-metallic, non-shrink grout with minimum compressive strengths and shrinkage in the vertical direction as follows:

Property	Requirement
Compressive Strength @ 3 days	2500 psi (17.2 Mpa)
Compressive Strength @ 28 days	4500 psi (31.0 Mpa)
Shrinkage	<0.15%

Unless using packaged grout, 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. A testing laboratory approved by the Department shall 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 has been accepted.

When submitting grout mix designs, provide laboratory test results for aggregate gradation, shrinkage, compressive strength and fluidity with each mix design. Submit compressive strength for at least two 2 in (50 mm) cube specimens at the age of 3, 7, 14 and 28 days for a total of at least eight cube specimens tested. Perform laboratory tests in accordance with the following:

Property	Test Method
Aggregate Gradation	AASHTO T27
Shrinkage	ASTM C1090
Compressive Strength	AASHTO T106
Fluidity	ASTM C939 (as modified below)

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

Unless otherwise required in the Contract or by the Engineer, a grout mix design submittal is not required when using an approved packaged grout. 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 applicable section of the Standard Specifications or special provision for the structure and the Engineer will determine the locations to sample grout and the number and type of samples collected for field and laboratory testing. The compressive strength of the grout will be considered the average compressive strength test results of two cube specimens at 28 days.

Do not place grout if the grout temperature is less than 50°F (10°C) or more than 95°F (35°C) or if the air temperature measured at the location of the grouting operation in the shade away from artificial heat is below 35°F (2°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. Control grout delivery so the interval between placing batches in the same component does not exceed 20 minutes. Solids in the grout shall remain in suspension without excessive bleed-water. 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 (31°C) or above	30 minutes	1 hr. 15 minutes
80°F (27°C) through 89°F (31°C)	45 minutes	1 hr. 30 minutes
79°F (26°C) or below	60 minutes	1 hr. 45 minutes

5.0 MISCELLANEOUS

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

HIGH STRENGTH BOLTS (11-17-06)

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

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

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

MAINTENANCE OF WATER TRAFFIC (SPECIAL)

1.0 DESCRIPTION

The Contractor will be required to maintain water traffic in a manner satisfactory to both the Engineer and the U.S. Coast Guard and in conformance with the conditions of the Bridge Permit issued by the U.S. Coast Guard. The Contractor shall provide and maintain navigational lights in conformance with the requirements of the U.S. Coast Guard on both temporary and permanent work and shall carry on all operations in connection with the construction of the project in such a manner as to avoid damage or delay to water traffic.

2.0 BASIS OF PAYMENT

No direct payment will be made for work under this section. All costs shall be considered incidental to items for which direct payment is made.

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

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

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

All construction shall progress and be maintained in a safe and timely manner. Temporary construction facilities shall be removed completely and promptly upon discontinuation of their useful purpose. Navigational lights, signals, or facilities shall be provided and maintained by the Contractor on temporary or permanent construction or vessels until such facilities are no longer needed as determined by the Engineer or permitting agency.

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

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

NAVIGATIONAL CLEARANCE VERIFICATION & WATERWAY INSPECTION (SPECIAL)

The Contractor is responsible for the following requirements:

Upon removal of the existing bridge and all temporary work bridges, inspect the waterway bottom to insure that all construction waste materials have been completely removed. Remove any bridge-related debris discovered during this survey. Provide a certification in writing by

a licensed engineer or licensed surveyor in the State of North Carolina that the waterway has not been impaired and all construction related debris has been cleared from it. The certification shall include the actual method used to conduct the inspection.

Upon completion of the proposed bridge, verify as-built clearances for the navigational channel and provide a certification by a licensed surveyor or registered professional engineer in the State of North Carolina attesting to the correctness of the clearances.

No separate payment or compensation will be made for this work. Include all costs for performing this work in the various pay items.

NAVIGATIONAL LIGHTING SYSTEM (SPECIAL)

1.0 GENERAL

The Contractor shall furnish and install the 1" conduit across the deck as shown on the plans. The Contractor shall also furnish, install, maintain, and later remove the required temporary navigational lighting. The North Carolina Department of Transportation (NCDOT) shall furnish and install the solar powered system, permanent navigational lighting, and related junction box and interconnecting wiring.

2.0 TEMPORARY LIGHTS

Prior to any work commencing in the waterway, temporary navigational lighting will be required by the Coast Guard. Additional lighting or obstruction lighting may also be required. All temporary navigational lighting should be coordinated with the District Commander of the Coast Guard.

3.0 NAVIGATIONAL LIGHTING SYSTEM INSTALLATION

Upon completion of the superstructure, deck conduit installation, solar array support platform, and rails across the navigational channel, and 30 days prior to placing traffic on the new structure, the Contractor shall coordinate and allow NCDOT forces to install the solar powered navigational lighting. The NCDOT will inspect and maintain the solar powered navigational lighting system after installation.

4.0 PAYMENT

No separate payment will be made for the Navigational Lighting System. The cost for furnishing and installing the 1" conduit shall be included in the pay item "Reinforced Concrete Deck Slab". The cost for furnishing, installing, and maintaining the temporary navigational lighting will be included in the several pay items.

SOLAR ARRAY SUPPORT PLATFORM: (SPECIAL)

1.0 GENERAL

Materials, fabrication, corrosion protection, and erection of the Solar Array Support Platform shall be in accordance with this special provision, applicable parts of the Standard Specifications and the details shown on the plans.

2.0 CORROSION PROTECTION

All structural members (including the open grid floor and excluding stainless steel nuts, bolts and washers) shall be hot dipped galvanized after fabrication in accordance with Section 1076 of the Standard Specifications. The galvanized surface shall then be cleaned as indicated below and painted in accordance with Sections 1080 and 442 of the Standard Specifications using System 3 as modified herein.

System 3 (Modified)
Acrylic Primer and Top Coats

Coat	Material	Mils Dry/Wet Film Thickness	Mils Dry/Wet Film Thickness
		Minimum	Maximum
Primer	1080-12 White	2.0 DFT	4.0 DFT
Stripe	1080-12 Brown	4.0 WFT	7.0 WFT
Topcoat	1080-12 Gray	2.0 DFT	4.0 DFT
Total		4.0 DFT	8.0 DFT

(A) *Preparation of Galvanized Surface for painting:*

Perform surface smoothing by removing or cleaning all zinc high spots, such as metal drip line, by hand or power tools in accordance with SSPC SP 2 or 3. Level zinc material flush with the surrounding plane without removing the base coating.

Abrasive sweep blasting shall be performed in accordance with Section 5.4.1 of ASTM D 6386. This section also provides a description of the abrasive blast material to be used. The material and technique used will provide a stripping action to remove corrosion products and to provide a rough surface profile while leaving base zinc layers intact.

All surfaces of the blasted beams and hardware shall be blown down with clean compressed air to provide a clean, dry surface for additional coating to be applied.

All surfaces shall be free of visible zinc oxides or zinc hydroxides.

(B) Application of Paint:

Apply all paint in the shop with an SSPC QP-3 certified Contractor.

Apply the primer coat within 8 hours after surface preparation is completed.

(C) *Repair of Damaged Coating*:

Repair damage occurring to the galvanized portion of the coating during shipment or installation in accordance with Section 1076-6 of the *Standard Specifications*. Repair damage occurring to the painted portion of the coating during shipment or installation by applying 4.0-7.0 wet mils of topcoat with a brush or roller and feather or taper this to be level with the surrounding areas.

In lieu of galvanizing and painting, the Contractor may at his option upon completion of shop fabrication blast clean and metallize the structural steel (excluding stainless steel nuts, bolts and washers) to a minimum thickness of 8 mils. See special provision for thermal sprayed coatings (metallization).

If the Contractor chooses to metallize, apply an 8 mil thick 1350 aluminum (W-Al-1350) thermal sprayed coating with a 0.5 mil thick seal coat to all structural members, including the open grid floor. Then apply 1 coat each of 1080-12 brown and 1080-12 gray paint on the web face of the b11 member which comes in contact with the concrete girder in accordance with section 442 of the standard specifications.

3.0 PAYMENT

The entire cost of furnishing and erecting the Solar Array Support Platform including but not limited to materials, corrosion protection, equipment, tools, labor, inserts and incidentals necessary to complete the work shall be included in the lump sum price bid for the "Solar Array Support Platform".

VERTICAL CLEARANCE GAGES (SPECIAL)

1.0 GENERAL

Vertical clearance gages will be required over the navigational channel. Gages will be furnished and installed by Division Bridge Maintenance forces within thirty days prior to completion of the bridge crossing the channel.

The Contractor shall be responsible for notifying, coordinating, and arranging access for Division Bridge Maintenance personnel to complete the work.

2.0 MEASUREMENT AND PAYMENT

No separate measurement will be made for the above work. Payment will be considered as incidental to the construction of the project.

STRUCTURE DRAINAGE SYSTEM FOR STRUCTURE AT STATION 47+08.03 -L- (SPECIAL)

1.0 GENERAL

The work in this section covers the furnishing of materials and installation of the drainage system and all its appurtenances called for on the plans at the locations on the plans to the lines and grades shown. The work shall also include the construction of joints or connections to other drainage structures to complete the system as shown on plans. The pipe, pipe anchors, pipe hangers, inserts and components of each shall be manufactured in accordance with the details and as indicated on the plans. All steel and hardware shall be galvanized.

Install the structure drainage system in accordance with the drawings and manufacturer's recommendations or as directed by the Engineer.

2.0 BASIS OF PAYMENT

Payment will be made at the contract lump sum price for "Structure Drainage System at Station 47+08.03 -L-". Such payment will include full compensation for all work, but not limited to providing materials and labor to install the structure drainage system as detailed in the plans.

CORROSION PROTECTION OF BRIDGE @ STATION 47+08.03 –L- (SPECIAL)

1.0 GENERAL

Corrosion protection for the bridge shall be in accordance with the plans, the applicable sections of the Standard Specifications and this special provision.

2.0 PORTLAND CEMENT CONCRETE COMPOSITION AND DESIGN

Use calcium nitrite [$Ca(NO_2)_2$] corrosion inhibitor and substitute fly ash and microsilica for a portion of the portland cement. Apply the following rates of pozzolans at the locations shown:

	$Ca(NO_2)_2$ (gal/yd^3)	Microsilica	Fly Ash
Deck Slab	3.0	-	20%[1]
End Diaphragms	3.0	-	20%[1]
Bent Diaphragms	3.0	-	20%[1]
Closure Splice Diaphragms	3.0	-	20%[1]
Parapets	3.0	-	20%[1]
All Prestressed Concrete Girders	3.0	-	-
78" Post-Tensioned Concrete Girders	3.0	-	-

	$Ca(NO_2)_2$ (gal/yd^3)	Microsilica	Fly Ash
All Interior Bent Caps	3.0	-	20%[1]
Bents 1-10, & 15-22 Columns	3.0	-	20%[1]
Bents 11-14 Columns	3.0	5%[2]	20%[2]
Bents 11-14 Footings	3.0	5%[2]	30%[2]
Bents 11-14 Drilled Piers	3.0	5%[2]	30%[2]

[1] The rate of substitution shall be 1.2 lb. of pozzolan per 1.0 lb. of cement.
[2] The rate of substitution shall be 1.0 lb. of pozzolan per 1.0 lb. of cement.

3.0 PAYMENT

No separate payment will be made for corrosion protection of the bridge. The cost of furnishing and incorporating the corrosion protection of the bridge is considered incidental to the various pay items.

MASS CONCRETE (SPECIAL)

This special provision applies to all interior bent footings on this project with a thickness of six feet or greater.

The Contractor shall provide an analysis of the anticipated thermal developments in the mass concrete elements using his proposed mix design, casting procedures, and materials. Additionally, the Contractor shall describe the measures and procedures he intends to use to limit the temperature differential to 35°F or less between the interior and exterior of the designated mass concrete elements during curing. The proposed plan to control the temperature differential shall be submitted to the Department for review and comments at the time approval is requested for the mass concrete mix design.

Maintenance of the specified thermal differential may be accomplished through a combination of the following:

A. Selection of concrete ingredients to minimize the heat generated by hydration of the cement.

B. Cooling component materials to reduce the temperature of the concrete while in its plastic state.

C. Controlling the rate of placing the concrete.

D. Insulating the surface of the concrete to prevent heat loss.

E. Providing supplemental heat at the surface of the concrete to prevent heat loss.

F. Other acceptable methods which may be developed by the Contractor.

Mass concrete shall be Class AA, vibrated, air-entrained, and shall contain an approved set-retarding, water-reducing admixture, and 30% flyash and 5% microsilica by weight of the total cementitious material. The total cementitious material shall not exceed 690 lbs. per cubic yard of concrete. The maximum water-cementitious material ratio shall be 0.366 for rounded aggregate and 0.410 for angular aggregate. The slump of the concrete shall not exceed three inches. The Contractor shall submit compressive strength results, the average of at least three cylinders made in the laboratory, of his proposed mix design. These cylinders shall show a minimum strength of 5000 psi at 28 days.

Minimum compressive strength at 28 days of field placed concrete shall be 4500 psi.

The Contractor shall meet the temperature monitoring requirements listed below for all footings on the plans which are six feet thick or greater. At the discretion of the Engineer, all temperature monitoring requirements may be waived provided the Contractor has proven to the satisfaction of the Engineer that he can limit the temperature differential to 35° F or less between the interior and exterior of the footing.

The Contractor shall provide and install a minimum of six temperature sensing devices in each mass concrete pour to monitor temperature differentials between the interior and exterior of the pour unless otherwise directed by the Engineer. These devices shall be accurate within ±2°F within the temperature range of 40°F to 180°F. One temperature sensing probe shall be placed near the center of mass of the pour, and another temperature sensing probe shall be placed at approximately two inches clear from the surface of the concrete furthest from the center of mass. The Engineer shall approve the locations of the other temperature sensing probes.

The monitoring devices shall be read and readings recorded at one-hour intervals, beginning when casting is complete and continuing until the maximum temperature is reached and two consecutive readings indicate a temperature differential decrease between the interior and exterior of the element. At the option of the Contractor, an approved strip-chart recorder furnished by the Contractor may record the temperature. If monitoring indicates the 35°F differential has been exceeded, the Contractor shall make the necessary revisions to the approved plan to reduce the differential on any remaining placements to 35°F or less. The Department must approve any revisions to the plan prior to implementation.

Flyash and microsilica used in the mass concrete mix shall meet the requirements of Articles 1024-5 and 1024-7 of the Standard Specifications. Portland Cement shall meet the requirements of AASHTO M85 for Portland Cement Type II. The temperature of mass concrete at the time of placement shall not be less than 40°F nor more than 75°F.

The placement of the mass concrete shall be continuous until the work is completed and the resulting structures shall be monolithic and homogeneous.

The entire cost of this work shall be included in the unit contract price bid for Class AA Concrete.

78" POST-TENSIONED PRESTRESSED CONCRETE GIRDERS (SPECIAL)

The Contractor shall provide girders in accordance with the plans and standard specifications.

Measurement and Payment will be for the actual number of linear feet of post-tensioned prestressed concrete girders.

Payment will be made under:

78" Post – Tensioned Prestressed Concrete Girders.....Linear Feet

POST-TENSIONING TENDONS (SPECIAL)

1.0 DESCRIPTION

Post-Tensioning Tendons consists of the furnishing, installing, stressing and grouting of prestressing tendons. In this process, prestressing steel, which may be strands, or wires, is installed through ducts in the concrete, stressed up to a predetermined load and anchored directly against the hardened concrete, initially imparting stresses through end bearing. Grout is then injected into the ducts to completely fill all remaining voids and to seal the permanently stressed tendons.

Post-Tensioning Tendons also includes furnishing and installing all the hardware and any other appurtenant items necessary for the particular prestressing system used, including but not limited to ducts, anchorage assemblies, supplementary steel reinforcing bars and grout used for pressure grouting ducts and all associated operations.

2.0 TERMINOLOGY

Post-Tensioning: The application of a compressive force to the concrete by stressing tendons after the concrete has been cast and cured. The force in the stressed tendons is transferred to the concrete by means of anchorages.

Post-Tensioning Scheme or Layout: The pattern, size and locations of post-tensioning tendons provided by the Designer on the Contract Plans.

Post-Tensioning System: A proprietary system where the necessary hardware (anchorage, wedges, strands, etc.) is supplied by a particular manufacturer or manufacturers of post-tensioning components.

Tendon: A high strength steel member made up of a number of strands or wires.

Strand: An assembly of several high strength steel wires wound together. Strands usually have six outer wires helically wound around a single straight wire of a similar diameter.

Wire: A single, small diameter, high strength steel member and, normally, the basic component of strand, although some proprietary post-tensioning systems are made up of individual or groups of single wires.

Anchorage: An assembly of various hardware components which secure a tendon at its ends after it has been stressed and imparts the tendon force into the concrete.

Anchor Plate: That part of the anchorage which bears directly on the concrete and through which the tendon force is transmitted.

Wedges: A small conically shaped steel component placed around a strand to grip and secure it by wedge action in a tapered hole through a wedge plate.

Wedge Plate: A circular steel component of the anchorage containing a number of tapered holes through which the strands pass and are secured by conical wedges.

Set (Also Anchor Set or Wedge Set): Set is the total movement of a point on the strand just behind the anchoring wedges during load transfer from the jack to the permanent anchorages. Set movement is the sum of slippage of the wedges with respect to the anchorage head and the elastic deformation of the anchor components.

Anticipated Set: Anticipated set is that set which was assumed to occur in the design calculation of the post-tensioning forces immediately after load transfer.

3.0 ALTERNATE POST-TENSIONING DESIGNS

Alternate designs using a post-tensioning scheme other than that shown on the plans may be submitted by the Contractor for the Engineer's approval provided that the proposed alternate scheme fulfills the following requirements:

(1) The prestress system is a type described in Section 4 of this Special Provision.

(2) The net compressive stress in the concrete after all losses is at least as large as that provided by the scheme shown on the Plans.

(3) The distribution of individual tendons at each cross section generally conforms to the distribution shown on the Plans.

(4) The ultimate strength of the structure with the proposed post-tensioning scheme meets the requirements of Section 9 of the AASHTO Standard Specifications for Highway Bridges, and shall be equivalent to the ultimate strength provided by the original design.

(5) Stresses in the concrete and prestressing steel at all sections and at all stages of construction meet the requirements of the Design Criteria noted on the Plans.

(6) All provisions of the Design Criteria noted on the Plans shall be satisfied.

(7) The Contractor fully redesigns and details, as required, the elements where the alternate post-tensioning scheme is proposed to be used.

(8) The Contractor submits complete shop drawings including post-tensioning scheme and system, reinforcing steel, and concrete cover; and design calculations (including short and long term prestress losses) for the Engineer's approval.

(9) Any alternate post-tensioning scheme or system approved by the Engineer will result in no additional costs to the Department.

4.0 MATERIALS

4.1 Prestressing Material:

4.1.1 Prestressing Steel:

(a) Strand: Unless otherwise noted on the plans, strand shall be uncoated, 270 ksi low relaxation 7-wire strands conforming to the requirements of ASTM A 416.

(b) Wires: Unless otherwise noted on the plans, wire shall be uncoated, low relaxation wire conforming to the requirements of ASTM A 421.

The proper use of strand and wires is predicated upon the use of suitable accessory materials. Details for the use of these materials shall be furnished by the manufacturer in connection with shop and working drawing submittals.

4.1.2 Prestress Anchorages: All prestressing steel shall be secured at the ends by anchoring devices meeting the approval of the Engineer. The anchorages shall develop at least 100% of the minimum specified ultimate tensile strength of the prestressing steel, tested in an unbonded state without exceeding the anticipated set. Certified copies of test results for the anchorage system shall be supplied to the Engineer at no additional cost. The anchorage shall be so arranged that the prestressing force in the tendon may be verified prior to the removal of the stressing equipment.

Two part wedges shall not be used. The Contractor shall furnish and use acceptable three part wedges with appropriate anchorage discs for anchoring post-tensioning strands.

The anchoring devices shall effectively distribute tendon forces to the concrete. Such devices shall conform to the following requirements:

(a) Article 9.21.7.2 of the AASHTO Standard Specifications for Highway Bridges. The concrete compressive strength at application of the post-tensioning force shall be limited to 8000 psi as the absolute maximum value, even if the concrete strength is in excess of 8000 psi at transfer (load application).

(b) Bending stresses in the plates or assemblies induced by the pull of the prestressing steel shall not exceed the yield point of the material or cause visible distortion of the anchorage plate when 100% of the ultimate strength of the tendon is applied. Certified test reports from an approved independent testing laboratory, verifying compliance with this requirement, shall be provided to the Engineer for each type and/or size of anchoring device.

Alternatively, anchorage devices which do not meet with either or both of the above requirements [(a) and (b)] may be accepted based upon previously approved usage in the State of North Carolina or on the basis of new or previous test performed in accordance with and meeting the requirements of the AASHTO Standard Specifications for Highway Bridges, Division II Section 10.3.2.3 "Special Anchorage Device Acceptance Test", all at no cost to the Department. Also, in such cases, any additional confinement reinforcement or modification to existing reinforcement required for satisfactory performance of the anchorage devices shall be incorporated in the structure at no additional cost.

4.1.3 Ducts:

4.1.3.1 General: Unless specifically noted on the Plans or otherwise approved by the Engineer, ducts for post-tensioning shall conform to the requirements of this specification. Ducts embedded in the concrete for prestressing steel shall be galvanized ferrous metal.

4.1.3.2 Size of Ducts: Ducts for multi-strand tendons shall have a minimum size which provides an inside area at least 2.5 times the net area of the prestressing steel.

4.1.3.3 Corrugated Metal Ducts: Corrugated metal ducts shall be galvanized. Rigid metal ducts may be fabricated with either welded or interlocked seams. Ducts shall bend without crimping or flattening and shall have sufficient strength to maintain their correct alignment during placing of concrete. Joints between sections of ducts shall have positive metallic connections, which do not result in angle changes at the joints.

4.1.3.4 Epoxy Coated Metal Ducts: Epoxy Coated Metal Ducts shall not be used.

4.1.3.5 Polyethylene (P.E.) Ducts and Pipes: Polyethylene (P.E.) Ducts and Pipes shall not be used.

4.1.4 Grout Vents, Injection and Ejection Pipes: Vents shall be ¾ in. minimum, inside diameter standard pipe or suitable plastic pipe. Neither metallic nor plastic components, if selected and approved, shall react with the concrete or enhance corrosion of the prestressing steel. Plastic components shall be free of water soluble chlorides.

Grout injection pipes shall be fitted with positive mechanical shut-off valves. Vents and ejection pipes shall be fitted with valves or other devices capable of withstanding the grout pumping pressures.

4.1.5 Grout:

4.1.5.1 General: The Contractor shall use a Department approved pre-packaged grout in lieu of an on site batch mix. It is the Contractor's responsibility to consult the manufacturer to determine if the pre-packaged grout selected is suitable for grouting post-tensioning ducts.

4.1.5.2 Materials: Contractor shall contact the Materials and Test Unit for a list of approved pre-packaged grouts.

Water shall comply with Section 1024 of the Standard Specifications and shall be potable, clean, and free of injurious quantities of substances known to be harmful to the prestressing steel or pre-packaged grout.

Admixtures, if approved by the Department, shall impart the properties of low water content, good flowability, minimum bleed and expansion if desired. Its formulation shall contain no chemicals in quantities that may have harmful effects on the prestressing steel or grout. Admixtures containing chlorides in excess of 0.5% by weight of admixture (assuming 1.0 lb. of admixture per sack (95 lb.) of grout), fluorides, sulfites and nitrates shall not be used.

Aluminum powder of proper fineness and quantity or other approved gas evolving material that is well dispersed through the mixture may be used to obtain expansion of the grout.

All admixtures shall be used in accordance with the instructions of the manufacturer. The date of manufacture shall be clearly stamped on each container. No admixture for which the shelf life recommended by the manufacturer has expired shall be used.

4.1.5.3 Requirements: If no compressive strength or volume change is specified on the plans or in the applicable section of the Standard Specifications or special provision for the structure, provide non-metallic, non-shrink grout with minimum compressive strengths and volume changes as follows:

Property	Requirement
Compressive Strength @ 7 days	3000 psi
Compressive Strength @ 28 days	5000 psi
Volume Change @ 24 hours	0.0% to < 0.10%
Volume Change @ 28 days	< or = to +0.20%

A testing laboratory approved by the Department shall be used to test pre-packaged grout. Provide laboratory test results for setting time, volume change, compressive strength and fluidity with the grouting of each post-tensioning duct. Submit compressive strength for at least two 2 in. cube specimens at the age of 3, 7, 14, and 28 days for a total of at least eight cube specimens tested. Perform laboratory tests in accordance with the following:

Property	Test Method
Setting Time	ASTM C953
Volume Change	ASTM C1090
Compressive Strength	ASTM C942
Fluidity	ASTM C939

Unless otherwise required in the Contract or by the Engineer, a grout mix design submittal is not required when using an approved pre-packaged grout. If a grout mix design is submitted, the Engineer will review the mix design and notify the Contractor as to its acceptability. The contractor shall not use the pre-packaged grout until written acceptance has been received. Acceptance of approved pre-packaged grout does not relieve the Contractor of the responsibility to furnish a product that meets the Contract requirements.

4.1.5.4 Sampling and Placement: The applicable section of the Standard Specifications or special provision for the structure and the Engineer will determine the locations to sample grout and the number and type of samples collected for field and laboratory testing. The compressive strength of the grout will be considered the average compressive strength test results of two cube specimens at 28 days.

Contractor is responsible for the placement of grout in accordance with the manufacturer's recommendations unless directed otherwise by the Engineer.

Grout samples for testing shall be furnished by the Contractor at no cost to the Department.

4.2 Samples for Testing:

4.2.1 General: Testing shall conform to the applicable ASTM Specifications for the prestressing material used.

All material samples for testing shall be furnished by the Contractor at no cost to the Department.

Job site or site referred to herein shall be considered the location where the prestressing steel is to be installed whether at the bridge site or a removed casting yard.

4.2.2 Prestressing Steel and Components: Samples for testing shall be furnished as described below for each manufacturer of prestressing strand, wire, and anchorage assemblies to be used on the project.

With each sample of prestressing steel strand or wires furnished for testing there shall be submitted a certification stating the manufacturer's minimum guaranteed ultimate tensile strength of the sample furnished.

The following samples of materials selected by the Engineer at the plant or job site from the prestressing steel used for post-tensioning operations shall be furnished by the Contractor to the Engineer well in advance of anticipated use:

(a) For strand: three randomly selected samples, 5 ft. long, per manufacturer, per size of stand, per shipment, with a minimum of one sample for every ten reels delivered.

(b) For wire: three randomly selected samples, 5 ft. long, per manufacturer per size of wire per heat of steel, per shipment, with a minimum of one sample for every ten coils delivered.

(c) For anchorage assemblies: two samples of each size, per manufacturer, per heat of steel.

One of each of the samples furnished to represent a lot shall be tested. The remaining sample(s), properly identified and tagged, shall be stored by the Engineer for future testing in the event of loss or failure of the component represented to meet minimum strength requirements. For acceptance of the lot represented, test results shall show that 100% of the guaranteed ultimate tensile strength has been met.

4.2.3 Lots and Identification: A lot is that parcel of components as described herein. All anchorage assemblies of each size from each mill heat of steel, all wire from each manufactured coil and all strand from each manufactured reel to be shipped shall be assigned an individual lot number and shall be tagged in such a manner that each

such lot can be accurately identified at the job site. Records shall be submitted to the Engineer identifying assigned lot numbers with the heat, coil or reel of material represented. All unidentified prestressing steel or anchorage assemblies received at the site will be rejected. Also, loss of positive identification of these items at any time will be cause for rejection.

4.3 Release of Materials: The release of any material by the Engineer shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

5.0 TESTING BY THE CONTRACTOR

5.1 Tendon Modulus of Elasticity: This test will not be required if the Contractor can demonstrate to the satisfaction of the Engineer, valid results for the tendon modulus of elasticity from previous projects. Such results must be for the same type of strand, size, material and complement of strands per tendon as required for this project and must have been performed under test conditions equal to or better than those described below.

For the purpose of accurately determining the tendon elongations while stressing, the Contractor shall bench test two samples of each size and type of tendon to determine the modulus of elasticity prior to stressing the initial tendon.

For the purpose of this test, the bench length between anchorages shall be at least 40 ft. and the tendon duct shall be at least 2 in. clear of the tendon all around. The test procedure shall consist of stressing the tendon at an anchor assembly with a load cell at the dead end. The test specimen shall be tensioned to 80% of ultimate in ten increments and then detensioned from 80% of ultimate to zero in ten decrements. For each increment and decrement, the gauge pressure, elongations and load cell force shall be recorded. Elongations of the tendon shall be noted for both ends and the central 30 ft. and shall be measured to an accuracy of 1/16 in. The elongations shall be corrected for the actual anchorage set of the dead end.

The modulus shall be calculated as follows:

$$E = \frac{PL}{Adl}$$

where;

P = force in tendon,
L = distance between pulling wedges and dead end wedges or exact length in center 30 ft. of the tendon.
A = cross sectional area of the tendon based on nominal area.
dl = strand elongation for load P.

The theoretical elongation shown on the post-tensioning shop or working drawings shall be reevaluated by the Contractor using the results of the test and corrected when the modulus of elasticity from the bench test varies from the modulus of elasticity used for shop or working drawings by more than 1%. Revisions to the theoretical elongations shall be submitted to the Engineer for approval.

When the observed elongations of the tendons in the erected structure fall outside the acceptable tolerances or to otherwise settle disputes, additional Tendon Modulus of Elasticity Tests may be required to the satisfaction of the Engineer.

If the source of prestressing steel changes during the project, additional test series or substantiation from previous projects, not to exceed two per source shall be required.

The apparatus and methods used to perform the test shall be proposed by the Contractor and be subject to the approval of the Engineer. Furthermore, this test shall be conducted by the Contractor in the presence of the Engineer.

5.2 In Place Friction Test: This test is intended to demonstrate that the friction characteristics, losses and resulting tendon forces are in agreement with the design assumptions.

For the purpose of verifying friction loss the Contractor shall test, in place, the first tendon installed of each size and type which is at least 50 ft. long. Size is defined as the size and number of strands or wires in each tendon. Type is defined as to both prestressing and duct material and to the tendon function within the structure. Function is the general category of the tendon whether it is a cantilever tendon, continuity tendon, draped external tendon or continuous profiled tendon passing through one or more spans, etc. In this respect, the function of two or more tendons may be the same even though their actual profiles and lengths differ.

The test procedure shall consist of stressing the tendon at an anchor assembly with a load cell at the dead end. The test specimen shall be tensioned to 80% of ultimate tendon strength in eight equal increments and detensioned in eight equal decrements. For each increment and decrement, the gauge pressure, elongations and load cell force shall be recorded. Account shall be taken of any wedge seating in both the live end (i.e., back of jack) and the dead end (i.e., back of load cell) and of any friction within the anchorages, wedge plates and jack as a result of slight deviations of the strands through these assemblies. For long tendons requiring multiple jack pulls with intermediate temporary anchoring, care shall be taken to keep an accurate account of the elongation at the jacking end allowing for intermediate wedge seating and slip of the jacks' wedges.

The test shall be conducted using Engineer approved lubricants required, if any, to meet the expected friction coefficient.

If, for the Contractor's expected friction coefficients, the elongations fall outside the ±5% range, the Contractor will be required to investigate the reason and make revisions to his post-tensioning operations such that the final tendon forces are in agreement with the Plans.

In reconciling theoretical and actual elongations, the value of the expected friction and wobble coefficients shall not be varied by more than ±10%. Significant shortfall in elongations is indicative of poor duct alignments and/or obstructions which the Contractor shall be required to correct or compensate for in a manner to be proposed by the Contractor and reviewed and approved by the Engineer at no additional cost to the Department.

One successful friction test for each type and size of tendon will be required for the project.

If, during the course of routine stressing operations, there are irreconcilable differences between forces and elongations, or other difficulties, the Engineer reserves the right to require additional in place friction test.

The apparatus and methods used to perform the test shall be proposed by the Contractor and be subject to the approval of the Engineer. Furthermore, this test shall be conducted by the Contractor in the presence of the Engineer.

Correction or adjustment of elongations as a consequence of the results of the friction test are the responsibility of the originator of the stressing and elongation calculations.

5.3 Test Reports Required: Two test reports of the "Tendon Modulus of Elasticity Test" shall be submitted to the Engineer at least 30 days prior to installing the tendon.

Two test reports of the "In Place Friction Test" shall be submitted to the Engineer within 2 weeks after successful installation of the test tendon.

5.4 Payment for Testing: Testing by the Contractor will not be paid for separately but shall be incidental to the price paid for the post-tensioning tendons.

5.5 Application of Test Results: The theoretical elongations shown on the post-tensioning shop or working drawings shall be reevaluated by the Contractor using the results of the tests for Tendon Modulus of Elasticity and In Place Friction as appropriate and corrected as necessary. Revisions to the theoretical elongations shall be submitted to the Engineer for approval.

6.0 PROTECTION OF PRESTRESSING STEEL

6.1 Shipping, Handling and Storage: All prestressing steel shall be protected against physical damage and corrosion at all times from manufacturer to final grouting or encasing in the concrete. Prestressing steel that has sustained physical damage at any time shall be rejected. Any reel that is found to contain broken wires shall be carefully inspected during use and lengths of strand containing broken wires shall be removed and discarded. The wire shall be bright and uniformly colored, having no foreign matter or pitting on its surface.

Prestressing steel shall be packaged in containers or shipping forms for protection of the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor which prevents rust or other results of corrosion shall be placed in the package or form, or shall be incorporated in a corrosion inhibitor carrier type packaging material, or when permitted by the Engineer, may be applied directly to the steel. The corrosion inhibitor shall have no deleterious effect on the steel or the concrete or bond strength of steel to concrete. Inhibitor carrier type packaging material shall conform to the provisions of Federal Specification MIL-P-3420. Packaging or forms damaged from any cause shall be immediately replaced or restored to the original condition.

The shipping package or form shall be clearly marked with a statement that the package contains high-strength prestressing steel, the care to be used in handling, and the type, kind and amount of corrosion inhibitor used, including the date when placed, safety orders and instructions for use. Low relaxation (stabilized) strand shall be specifically designated per requirements of ASTM A 416. All such strand not so designated shall be rejected.

6.2 During Installation in the Structure: When acceptable prestressing steel for post-tensioning is installed in the ducts after completion of concrete curing and if stressing and grouting are completed within 7 calendar days after the installation of the prestressing steel, rust which may form during these 7 days will not be cause for rejection of the steel. Post-tensioning steel installed, tensioned and grouted in this manner, all within 7 calendar days, will not require the use of a corrosion inhibitor in the duct following installation of the prestressing steel.

Post-tensioning steel installed as above but not grouted within 7 calendar days shall be protected from corrosion. The method of protection shall be determined by the Contractor and shall be approved by the Engineer. Water soluble oil shall not be allowed as a corrosion inhibitor or friction reducer.

Within 30 calendar days after installation of the post-tensioning steel, ducts shall be grouted in accordance with these specifications. Except when approved by the Engineer in writing, failure to grout tendons within the 30 calendar days specified shall result in stoppage of the affected work and no invoices shall be processed for payment of that affected work.

7.0 FABRICATION

7.1 General: All post-tensioning anchorages, ducts, vent pipes, miscellaneous hardware, reinforcing bars, and other embedments shall be accurately and securely fastened at the locations shown on the Plans or on the approved Shop or Working Drawings or as otherwise approved by the Engineer.

7.2 Ducts: Ducts shall be accurately aligned and positioned at the locations shown on the Plans or according to the approved Shop or Working Drawings or as otherwise approved by the Engineer. All internal ducts shall be securely fastened in position at regular intervals not exceeding 1'-6" to prevent movement, displacement or damage from concrete placement and consolidation operations. The method and spacing of duct supports shall be shown on appropriate Shop Drawings.

All alignments, including curves and straight portions, shall be smooth and continuous with no lips, kinks or dents.

All ducts shall be carefully checked and repaired as necessary before the placing of any concrete commences.

The tolerance on the location of the ducts for the tendons shall be as specified below.

After installation in the forms, all ends of ducts, connections to anchorages, splices, vents and the like shall at all times be sealed to prevent the entry of water and debris.

7.3 Splices and Joints: At splices and joints, and connections to anchorages, ducts shall be smoothly aligned and secured with no lips or kinks. They shall be joined in a manner which positively prevents the entrance of cement paste and water from the concrete or unwanted leakage of grout during subsequent grouting operations.

7.4 Grout Vents, Injection and Ejection Pipes: All ducts or anchorage assemblies for permanent post-tensioning shall be provided with pipes or other suitable connections at each end for the injection of grout after prestressing. As a minimum, ducts shall be vented at the high points of the tendon profile when there is more than a 6" variation in the vertical position of the duct. The Contractor may use additional injection and vent pipes when shown on the shop drawings.

All connections to ducts shall be made with metallic or plastic structural fasteners.

Vent and grouting pipes shall be mortar tight and shall provide means for injection of grout through the vents and for sealing the vents. Duct tape shall not be used to join or repair ducts or make connections.

Grout injection pipes shall be fitted with positive mechanical shut-off valves. Vents and ejection pipes shall be fitted with valves, caps or other devices capable of withstanding the grout pumping pressures.

All grout caps used must be installed to prevent entrapment of air or water voids and must provide 100% coverage of all tendons.

7.5 Tolerances: Post-tensioning duct tolerance shall be ¼ in. ± in the horizontal direction and ½ in. ± in the vertical direction.

Entrance and exit angles of tendon paths at anchorages and/or at faces of concrete shall be within ±2 degrees of desired angle measured in any direction.

Angle changes at duct joints shall not be greater than ±2 degrees in any direction.

Anchorages shall be located within ¼ in. of desired position laterally and 1 in. along the tendon except that minimum cover requirements to ends of cut off tendons and anchor components must be maintained.

Anchorage confinement reinforcement in the form of spirals, multiple U shaped bars or links, shall be positioned to start within ½ in. of the back of the main anchor plate and shall be properly centered around the duct.

In the event of conflicts between the reinforcement and post-tensioning duct, in general, the position of the post-tensioning duct shall prevail and the reinforcement shall be adjusted locally to the approval of the Engineer.

8.0 PLACING CONCRETE

8.1 Precautions: The Contractor shall exercise great care when placing and consolidating concrete so as not to displace or damage any of the post-tensioning ducts, anchorage assemblies, splices and connections, reinforcement or other embedments.

8.2 Proving of Post-Tensioning: Upon completion of concrete placement the Contractor shall prove that the post-tensioning ducts are free and clear of any obstructions or damage and will be able to accept the intended post-tensioning tendons by passing a torpedo through the ducts. The torpedo shall have the same cross-sectional shape as the duct, be ¼ in. smaller all around than the clear, nominal inside dimensions of the duct. No deductions to the torpedo section dimensions shall be made for tolerances allowed in the manufacture or fixing of the ducts. For curved ducts, the length shall be determined by the Contractor such that when both ends touch the outermost wall of the duct, the torpedo is ¼ in. clear of the innermost wall; but it need not be longer than 2 ft. If the torpedo will not travel completely through the duct, the member shall be rejected, unless a workable repair can be made to clear the duct, all to the satisfaction of the Engineer. The torpedo shall be passed through

the duct easily, by hand, without resorting to excessive effort or mechanical assistance.

8.3 Problems and Remedies: If the ducts or any part of the work is found to be deficient, it will be rejected. No remedial or repair work will be permitted without the approval of the Engineer.

9.0 INSTALLING TENDONS

Post-tensioning strands may be pushed or pulled through the ducts to make up a tendon. Pushing shall be done with care so as to avoid snagging on any lips or joints in the ducts. The Contractor shall take precautions by rounding off the end of the strand or fitting it with a smooth protective cap for this purpose.

Alternatively, strands may be assembled into the tendon which then may be pulled through the duct together using a special steel wire sock ("Chinese finger") or other device attached to the end. Also, the ends of the strands may be welded together for this purpose. If so, then the end of the bundle must be rounded for smooth passage and the entire welded end together with at least 3 ft. of tendon beyond the end of the last weld shall be cut off and wasted. Cutting shall be done with an abrasive saw or similar. Flame cutting shall not be allowed.

Installation of tendons in ducts prior to concrete placement shall not be allowed.

No permanent tendons shall be installed prior to the completion of testing as required by these specifications or Plans, except for the "In Place Friction Test" where only the tendon to be tested shall be installed prior to successful completion of the test.

10.0 POST-TENSIONING OPERATIONS

10.1 General: Post-tensioning forces shall not be applied until the concrete has attained the specified compressive strength as determined by cylinder tests.

10.2 Stressing Tendons: All post-tensioning steel shall be tensioned by means of hydraulic jacks so that the post-tensioning force shall not be less than that required by the plans or approved shop drawings, or as otherwise approved by the Engineer. Monostrand jacks shall not be utilized for stressing tendons.

10.2.1 Maximum Stress at Jacking: The maximum temporary stress (jacking stress) in the post-tensioning steel shall not exceed 80% of its specified minimum ultimate tensile strength. Tendons shall not be overstressed to achieve the expected elongation

10.2.2 Initial and Permanent Stresses: The post-tensioning steel shall be anchored at initial stresses that will result in the long term retention of permanent stresses or forces of not less than those shown on the Plans or the approved shop drawings. Unless

otherwise approved by the Engineer, the initial stress after anchor set shall not exceed 70% of the specified ultimate tensile strength of the post-tensioning steel.

Permanent stress and permanent force are the stress and force remaining in the post-tensioning steel after all losses, including long term creep and shrinkage of concrete, elastic shortening of concrete, relaxation of steel, losses in the post-tensioning steel from the sequence of stressing, friction and unintentional wobble of the ducts, anchor set, friction in the anchorages and all other losses peculiar to the post-tensioning system.

10.2.3 Stressing Sequence: Except as noted otherwise on the Plans, the approved shop drawings or as approved by the Engineer, permanent post-tensioning tendons shall be stressed from both ends. The required force shall be applied at one end and subsequently at the other end or simultaneously.

For construction in stages where some tendons are required to be stressed before others, the sequence of installation and stressing shall be in accordance with the Plans or approved shop drawings or as otherwise approved by the Engineer.

10.3 Stressing Equipment: Equipment for tensioning the tendons shall be furnished by the manufacturer of the post-tensioning system (tendons, hardware, anchorages, etc.).

10.3.1 Stressing Jacks and Gauges: Each jack used to stress tendons shall be equipped with a pressure gauge for determining the jacking pressure. The pressure gauge shall have an accurately reading dial at least 6 in. in diameter.

10.3.2 Calibration of Jacks and Gauges: Each jack and its gauge shall be calibrated as a unit with the cylinder extension in the approximate position it will be in at the final jacking force. Calibration shall be done when the jack is connected to the equipment (pumps and gauges) in the identical configuration as will be used on the job site, e.g. with the same length hydraulic lines. Initial calibration of the jacks and gauges shall be performed by an independent laboratory using a proven load cell. For each jack and gauge unit used on the project, the Contractor shall furnish certified calibration charts from the independent laboratory prior to stressing the first tendon.

Certified calibration shall be made at the start of the work and at every 6 months thereafter, or as requested by the Engineer. At the option of the Contractor, calibrations subsequent to the initial calibration with a load cell may be accomplished by the use of a master gauge. The master gauge shall be supplied by the Contractor in a protective waterproof container capable of protecting the calibration of the master gauge during shipment to a laboratory. The Contractor shall provide a quick-attach coupler next to the permanent gauge in the hydraulic lines which enables the quick and easy installation of the master gauge to verify the

permanent gauge readings. The master gauge shall be calibrated by and shall remain in the possession of the Engineer for the duration of the project.

Any repair of the jacks, such as replacing seals or changing the length of the hydraulic lines, is cause for recalibration of the jacks using a load cell.

No extra compensation shall be allowed for the initial or subsequent calibrations or for the use and required calibrations of the master gauge.

10.4 Stand-by Equipment: During post-tensioning operations, the Contractor shall provide a stand-by stressing jack with gauges located on the job site. The stand-by stressing jack and gauges shall be calibrated as described in Section 10.3 of this Special Provision. The stand-by equipment will be provided at no additional cost to the Department.

10.5 Elongations and Agreement Forces: The post-tensioning operation shall be so conducted that the forces being applied to the tendon and the elongation of the post-tensioning tendon can be measured at all times.

Elongations shall be measured to the nearest 1/16 in.

For the required tendon force, the observed elongation shall agree within 5% of the theoretical elongation or the entire operation shall be checked and the source of error determined and remedied to the satisfaction of the Engineer before proceeding further. The tendon shall not be overstressed to achieve the theoretical elongation.

In the event that agreement between the observed and theoretical elongations at the required force falls outside the acceptable tolerances, the Engineer may, at his discretion and without additional compensation to the Contractor, require additional test for "Tendon Modulus of Elasticity" and/or "In-Place Friction" in accordance with 5.1 and 5.2 of this Special Provision.

10.6 Friction: The Contract Plans were prepared based on the assumed friction and wobble coefficients and anchor set noted on the Plans. The Contractor shall submit calculations and show a typical tendon force diagram, after friction, wobble and anchor set losses, on the shop drawings based up the expected actual coefficients and values for the post-tensioning system to be used. These coefficients and values shall be given on the shop drawings.

If, in the opinion of the Engineer, the actual friction significantly varies from the expected friction, the Contractor shall revise his post-tensioning operation such that the final tendon force is in agreement with the Plans.

If friction must be reduced, the Contractor shall submit his plan of friction reduction to the Engineer for approval. Lubricants shall be flushed from the duct as soon as possible after stressing is completed by use of oil-free air. The ducts shall be

flushed again just prior to the grouting operations. Water soluble oil shall not be used as a lubricant.

10.7 Wire Failures in Post-Tensioning Tendons: Multi strand post-tensioning tendons having wires which failed by breaking or slippage during stressing may be accepted provided the following conditions are met:

(a) The completed structure shall have a final post-tensioning force of at least 98% of the design total post-tensioning force.

(b) Any single tendon shall have no more than 5 % reduction in cross-sectional area of post-tensioning steel due to wire failure.

As an exception, any of the above conditions may be waived as approved by the Engineer, when conditions permit the Contractor to propose acceptable alternative means of restoring the post-tensioning force lost due to wire failure.

10.8 Cutting of Post-Tensioning Steel: Post-tensioning steel shall be cut by an abrasive saw within ¾ in. to 1½ in. away from the anchoring device. Flame cutting of post-tensioning steel is not allowed.

10.9 Record of Stressing Operations: The Contractor shall keep a record of the following post-tensioning operations for each tendon installed:

(a) Project name, number.
(b) Contractor and/or subcontractor.
(c) Tendon location, size and type
(d) Date tendon was first installed in ducts.
(e) Coil/reel number for strands or wires and heat number and wire.
(f) Assumed and actual cross-sectional area.
(g) Assumed and actual Modulus of elasticity.
(h) Date Stressed.
(i) Jack and Gauge numbers per end of tendon.
(j) Required jacking force.
(k) Gauge pressures
(l) Elongations (anticipated and actual)
(m) Anchor sets (anticipated and actual)
(n) Stressing sequence (i.e. tendons before and after this).
(o) Stressing mode (one end/ two ends/ simultaneous).
(p) Witnesses to stressing operation (Contractor and inspector).
(q) Date grouted, days from stressing to grouting, grouting pressure applied and injection end.

Any other relevant information shall also be recorded. The Contractor shall provide the Engineer with a complete copy of all stressing and grouting operations.

11.0 GROUTING OPERATIONS

11.1 General: Within 30 calendar days after installation of the post-tensioning steel, ducts shall be grouted in accordance with these specifications. Except when approved by the Engineer in writing, failure to grout tendons within the 30 calendar days specified shall result in stoppage of the affected work and no invoices shall be processed for payment of that affected work.

After stressing and prior to grouting, tendons shall be protected against corrosion or harmful effects of debris, by temporarily plugging or sealing all openings and vents until the tendon is grouted.

When stressing has been completed and the stressed tendons have been accepted by the Engineer, the annular space between the tendons and the duct shall be grouted.

11.2 Equipment: The grout mixer shall be capable of continuous mechanical mixing and shall produce a grout free of lumps and undispersed cement. The equipment shall be able to pump and mix grout in a manner which will comply with all the provisions specified herein. Accessory equipment which will provide for accurate solid and liquid measures shall be provided to batch all materials.

Grout pumps shall be positive displacement type and shall be able to produce an outlet pressure of at least 145 psi. Pumps shall have seals adequate to prevent oil, air or other foreign substances from entering into the grout and to prevent loss of grout or water. A pressure gauge having a full scale reading of no more than 300 psi shall be placed at some point in the grout line between the pumping outlet and the duct inlet. The grouting equipment shall contain a screen having clear opening of 1/8 in. maximum size to screen the grout prior to its introduction into the grout pump. If grout with an additive is used, a screen opening of 3/16 in. is satisfactory. This screen shall be easily accessible for inspection and cleaning. The grouting equipment shall utilize a gravity feed to the pump inlet from a hopper attached to and directly over it. The hopper must be kept at least partially full at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct. Under normal conditions, the grout equipment shall be capable of continuously grouting the longest tendon on the project in not more than 20 minutes.

11.3 Stand-by Equipment: During grouting operations, the Contractor shall provide a stand-by grout mixer and pump. Where water is not supplied through the public water supply system, a water storage tank of sufficient capacity must be provided.

Stand-by water-flushing equipment shall be provided. This equipment shall be in addition to the grouting equipment described above. The stand-by water-flushing equipment shall use a different power source than the grouting equipment, have sufficient capacity to flush out any partially grouted enclosures if necessary due to

blockage or breakdown of grouting equipment, and shall be capable of developing a pressure of at least 290 psi.

Stand-by equipment shall be provided at no additional cost to the Department.

11.4 Mixing: Water shall be added to the mixer first, followed by pre-packaged grout and admixture, or as required by the admixture manufacturer. Mixing shall be of such duration as to obtain a uniform thoroughly blended grout, without excessive temperature increase or loss of properties of the admixture. The grout shall be continuously agitated until it is pumped. Water shall not be added to increase flowability that has decreased by delayed use of the grout. Proportions of the materials shall be based on manufacturer's recommendations. The water content shall be the minimum necessary for proper placement and shall not exceed the water-cement ratio of 0.45 or approximately 5 gal. of water per sack (95 lb.) of grout. The pumpability of the grout may be determined by the Engineer in accordance with ASTM C939 "Standard Test Method for Flow of Grout." When this method is used, the efflux time of the grout sample immediately after mixing should be between 11 and 30 seconds. The flow cone test may not be suitable for a grout that incorporates a thixotropic additive.

11.5 Grout Injection: All grout vents and high point vent openings shall be open when grouting starts. Injection and ejection vents shall be provided with positive shut-offs. Grout shall be allowed to flow from the first vent after the injection vent until any residual water or entrapped air has been removed, at which time the vent shall be closed. Remaining vents shall be closed in sequence in the same manner.

The pumping pressure at the injection vent shall not exceed 145 psi. Normal operations shall be performed at approximately 75 psi. If the actual grouting pressure exceeds the maximum allowed, the injection vent shall be closed and the grout shall be injected at the next vent which has been, or is ready to be, closed as long as a one way flow is maintained. Grout shall not be injected into a succeeding vent from which grout has not yet flowed. If this procedure is used, then the vent which is to be used for injection shall be fitted with a positive shut-off. When one-way flow of grout cannot be maintained as outlined above, the grout shall be immediately flushed out of the duct.

Grout shall be pumped through the duct and continuously wasted at the ejection vent unit no visible slugs of water or air are ejected. To ensure that the tendon remains filled with grout, the ejection and injection vents shall be closed in sequence, respectively, under pressure when the tendon duct is completely filled with grout. The positive shut-offs at the injection and ejection vents shall not be removed or opened until the grout has set.

11.6 Temperature Restrictions: In temperatures below 32°F, ducts shall be kept free of water to avoid damage due to freezing. The temperature of the concrete shall be 36°F or higher from the time of grouting until job cured 2 in. cubes of grout reach a

minimum compressive strength of 800 psi. Grout shall not be above 90°F during mixing or pumping. If necessary, the mixing water shall be cooled.

11.7 Finishing: Valves, caps and vent pipes shall not be removed or opened unit the grout has set. The ends of steel vents shall be removed at least 1 in. below the concrete surface after the grout has set. Ends of plastic vents shall be removed to the surface of the concrete after the grout has set. All miscellaneous material used for sealing grout caps shall be removed prior to carrying out further work to protect end anchorages or filling in concrete anchorage blockouts and the like. Miscellaneous materials include paper, tie wire, etc.

12.0 PROTECTION OF END ANCHORAGES

After tendons have been stressed, grouted, inspected and approved, exposed end anchorages, strands and other metal accessories shall be cleaned of rust, misplaced mortar, grout and other such materials and the concrete surface shall be roughened. Within 24 hours following the cleaning and roughening operation, encapsulate anchorage and permanent grout cap in pour-back of an approved, high-strength, high-bond, low-shrinkage, sand-filled epoxy grout. Anchorage recesses and drain pipes shall be filled to match the existing surface of the concrete girder. Only non-chloride bearing non-shrink grout mixes shall be used for anchorage protection.

13.0 BASIS OF PAYMENT

Unless otherwise specified on the Plans, post-tensioning tendons will be paid for at the contract unit price for "Post-Tensioning Tendons" - lump sum, of steel tendon, complete and in place. Payment shall be full compensation for furnishing, installing, stressing and grouting all post-tensioning tendons. Payment shall also include anchorage assemblies and post-tensioning system hardware which is not embedded in concrete, grout and grouting, all testing, anchorage protection systems and all labor, materials, tools, equipment and incidentals necessary for completing the work in accordance with these specifications and the Plans. This payment shall also include Engineer approved lubricants in the tendon ducts for friction control and flushing the lubricant from the tendon ducts after stressing.

GIRDER BRACING REQUIREMENTS FOR DECK SLAB PLACEMENT (SPECIAL)

1.0 Description

The work covered by this section consists of calculating the necessary bracing, providing working drawings to the Engineer, furnishing, installing and removing all materials necessary to provide bridge deck girder bracing of the fascia girders for the deck slab placement. The work shall be performed in accordance with the details shown on approved working drawings and the requirements of this Special Provision and the Special Provision entitled "Falsework and Formwork" and the Standard Specifications.

2.0 MATERIALS

Timber diagonals that are used as bracing shall conform to the requirements of Section 1082-1 or 1082-2 of the Standard Specifications.

Reinforcing steel that is used as tie bars shall conform to the requirements of Section 1070 - 2 of the Standard Specifications.

Plate steel that is used as tie plates shall be ¼" thick and conform to the requirements of Section 1072-4 of the Standard Specifications, unless otherwise approved by the Engineer.

The Engineer must approve all other materials used in bracing.

3.0 CONSTRUCTION REQUIREMENTS AND METHODS

Girders that support deck slab overhang form supports that transmit horizontal force to girders or transmit torsional forces to the girders from the slab pour will be required to be braced for slab pour. This bracing is required to reduce objectionable locked-in torsional stresses in the fascia girders.

Bracing between the bridge fascia member and the interior members will be required at sufficiently close spacing as to limit the magnitude of this stress. Computed torsional stress due to all factored dead loads and construction loads shall not exceed the girder threshold torsion. Threshold torsion of precast prestressed concrete girders and post-tensioned girders shall be computed in accordance with ACI 318, Section 11.6. Stirrups that are shown in the Contract Plans are not closed and shall not be considered as torsional reinforcement. Torque capacity of the haunched girder segments shall be calculated at multiple locations to adequately define the behavior of the member at various depths.

Bracing, if required as defined above, shall be installed between the fascia member and the first interior member. It shall consist of timber struts and steel tie bars and tie plates. The timber struts shall be placed diagonally between the bottom flange of the fascia member and the top flange of the first interior member. The reinforcing steel tie bars shall be placed between the top flanges of the same girders, at the same locations as the timber struts. Additionally, tie plates shall be welded to girder stirrups and tie bars welded to each tie plate. Field welding of tie bars and tie plates shall be done in accordance with Section 1072-20 of the Standard Specifications and details specified on the approved working drawings. The strength of all proposed welded connections shall be verified by calculations. Struts shall be spaced sufficiently close so that the computed compression stresses do not exceed AASHTO allowable values.

The Contractor is to provide a structural analysis of the effect of the overhang system on the girders and on the permanent diaphragms. The analysis and bracing details, in the form of working drawings, shall be sealed by a North Carolina Registered Professional Engineer, shall be submitted with the overhang falsework working drawings and are subject to review and approval by the Engineer.

Alternate methods of bracing, especially in the deep haunched section of the girders, which provide equivalent torsional restraint for the fascia girder, may be proposed. Details and calculations shall be submitted as working drawings and are subject to review and approval by the Engineer.

Timber struts, tie plate, and tie bars shall be installed prior to any application of loads from screed equipment, work bridges and the pouring of the bridge deck slab.

Timber struts used as bracing, or any other falsework bracing, shall be removed following curing of the deck.

4.0 BASIS OF PAYMENT

No separate payment will be made for the temporary bracing, but the entire cost for designing the system, providing working drawings, and the furnishing, installing and removal of bracing, shall be included in reinforced concrete deck slab pay items.

REMOVAL OF EXISTING STRUCTURE AT STATION 47+08.03 (SPECIAL)

Remove the existing structure in accordance with Section 402 of the Standard Specifications with the following exceptions.

Retain up to 105' of the existing bridge (retain bridge to the closest bent up to 105') on the north side as shown on the plans and as directed by the Engineer. Salvage a portion of the existing rail and securely fasten the rail to the end of the retained bridge as directed by the Engineer.

Included with the removal of existing structure are the removal of the bridge including ramps, steel barge swing span, fender system, pile clusters (dolphins) in the vicinity of the fender system, tender house, and other miscellaneous appurtenances, and the bathroom structure located on the beach side of the bridge. The bathroom structure has a septic system that will need to be pumped out, abandoned or removed per the county health department's direction.

Salvage the following items for NCDOT:

Motors, wenches, 2 gate stand operators with gate arms, boat, boat motor, wind gauge, solar powered navigation light located on top of the northwest cluster, VHF radios, phones, fire extinguishers, bridge house furniture (at the discretion of the Engineer), the traffic signal heads and the traffic signal control box.

AXIAL LOAD TEST (SPECIAL)

1.0 DESCRIPTION

The work covered by this provision consists of Osterberg Cell load testing as shown in the plans and as described in this provision. Furnish all materials and labor necessary to conduct an Osterberg Cell (O-Cell) Load Test and report results. Supply material and labor as hereinafter specified and including prior to, during and after the load test. The demonstration

drilled pier will be instrumented by LOADTEST, Inc. (the Osterberg Cell supplier) or others, as approved by the Engineer. The Osterberg Cell load test will be conducted by LOADTEST, Inc. or others, as approved by the Engineer, with the Contractor providing auxiliary equipment and services as detailed herein.

The demonstration pier shall be the first drilled pier constructed on the project. The design tip elevations of the production drilled piers in the plans may be adjusted, higher or lower, a maximum of 15 feet based upon the results of the demonstration pier axial load test. The Engineer will provide final drilled pier tip elevations two (2) weeks after receiving the final load test report from the Contractor. Drilled pier construction may begin upon receiving the final drilled pier tip elevations from the Engineer.

2.0 CRITERIA

The 48-inch diameter demonstration pier shall be tested vertically in accordance with standard Osterberg Cell load testing procedures and any procedures or requirements as noted within this special provision.

The demonstration pier shall not be load tested until a minimum time period of seven (7) days after completion of the drilled pier construction and the concrete has achieved a minimum compressive strength of 4500 psi. The demonstration pier shall be tested to failure unless the rated cell capacity (2500 tons) or the full stroke of the cell is achieved.

The Contractor shall make all necessary arrangements with the supplier to have the Osterberg Cell load test satisfactorily performed on the demonstration pier according to this provision. The supplier shall also supply to the Contractor technical instruction and guidance in pre-construction activities, and on-site technical assistance and guidance during set up and performance of the test. The Contractor shall closely follow instructions from the supplier, unless otherwise directed by the Engineer.

The demonstration pier shall be instrumented with twelve (12) waterproof vibrating wire sister bar strain gauges. The strain gauges shall be placed within the pier as specified in the structure plans. The gauges shall be well capsulated, and attached to a sister bar, which can be easily tied to the rebar cage at the approved elevations within the demonstration pier. The sister bars should be attached to the rebar cage in a manner that will prevent damage to the strain gauges during the concrete pour. Enough cable shall be provided to carry the strain data to a data collection device that shall be provided and operated by the Contractor. Strain data shall be collected throughout the load test.

Testing equipment shall be checked before and rechecked after installation. The Contractor shall be responsible for repairing damaged connections prior to testing.

3.0 MATERIALS

The Contractor shall supply all materials required to install the Osterberg Cell, conduct the load test, record the test progress and results, and remove the load test apparatus as required.

3.1 Osterberg Cell - The Contractor shall furnish one (1) 21 inch diameter Osterberg Cell as required for the load test, to be supplied by:

LOADTEST, Inc.
2631-D NW 41st Street
Gainesville, FL 32606

Phone: **(800) 368-1138**
(352) 378-3717
Fax: (352) 378-3934

The Osterberg Cell to be provided shall have a capacity of at least 1250 tons **in each direction** and shall be equipped with all necessary hydraulic lines, fittings, pressure source, pressure gauge and telltale devices.

3.2 Materials required include, but are not limited to, the following:

a) Fresh water from an approved source to mix with a water-soluble oil provided by LOADTEST, Inc., to form the hydraulic fluid used to pressurize the Osterberg Cell.

b) Materials sufficient to construct a stable reference beam system for monitoring movements of the pier during testing, supported at a minimum distance of 3 pier diameters from the center of the test pier to prevent disturbance of the reference system. A tripod shall be provided to support an automated digital survey level used to monitor movement of the reference system during testing.

Alternatively, two survey levels located in excess of three pier diameters may be used to monitor the top of pier displacement in lieu of the beam. In this case, two tripods and weather protection (Quickshade) shall be provided.

c) Materials sufficient to construct a protected work area (including provisions such as a tent or shed for protection from inclement weather for the load test equipment and personnel) of size and type required by the Engineer and LOADTEST, Inc.

d) Electric power, as required for lights, welding, instruments, etc.

e) Materials for carrier frame, steel bearing plates and/or other devices needed to adapt O-cell to rebar cage, as required.

3.3 Materials supplied which do not become a part of the finished structure become the responsibility of the Contractor at the conclusion of the load test and shall be removed from the job site, unless otherwise directed by the Engineer.

4.0 EQUIPMENT AND LABOR

The Contractor shall supply equipment and labor required to install the Osterberg Cell, conduct the load test, and remove the load test apparatus as required. Equipment and labor required includes but are not limited to:

a) Welding equipment and certified welding personnel, as required, to assemble the test equipment under the supervision of LOADTEST, Inc. personnel, attach hydraulic fittings and telltales to the Osterberg Cell, and prepare the work area.

b) Equipment and labor to construct the reinforcing steel cage and/or placement frame including any steel plates required for the test pier.

c) Equipment and operators for handling the Osterberg Cell, instrumentation and placement frame or reinforcing steel cage during the installation of the Osterberg Cell and during the conduct of the test, including but not limited to a crane or other lifting device, manual labor, and hand tools as required by LOADTEST, Inc. and the Engineer.

d) Equipment and labor sufficient to erect the protected work area and reference beam system, to be constructed to the requirements of the Engineer and LOADTEST, Inc.

e) Air compressor (minimum 185 cfm, 125 psi) for pump operation during load testing.

5.0 PROCEDURE

5.1 Construct the test pier using the approved pier installation procedure.

5.2 Perform SPT, SID, and Sonic Caliper Testing (SCT) on the completed excavation. See Drilled Piers special provision for SPT and SID testing. See Sonic Caliper Testing special provision for details regarding SCT.

5.3 The Osterberg Cell, hydraulic supply lines and other attachments shall be assembled and made ready for installation under the direction of LOADTEST, Inc. and the Engineer, in a suitable area, adjacent to the test pier, to be provided by the Contractor. The Osterberg Cell assembly shall be welded to the bottom of the cage in conjunction with the construction of the reinforcing steel cage as shown in the plans.

5.4 When the test pier excavation has been completed, inspected and accepted by the Engineer, the Contractor shall install the Osterberg Cell and the placement frame or reinforcing steel cage assembly in the excavation under the direction of LOADTEST, Inc. and the Engineer so that the Osterberg Cell is resting firmly in the concrete. The Contractor shall use the utmost care in handling the placement/test equipment assembly so as not to damage the instrumentation during installation. The Contractor shall limit the deflection of the cage to two (2) feet between pick points while lifting the cage from the horizontal position to vertical. The maximum spacing between pick points shall be 25 feet. The Contractor shall provide support bracing, strong backs, etc. to maintain the deflection within the specified tolerance.

5. 5 The drilled pier shall be concreted to the elevation as shown in the plans and in accordance to the construction sequence plan for the production drilled piers. In addition to the Department standard number of concrete compression test cylinders, at least six (6) concrete test cylinders shall be made from the concrete used in the test pier. At least one of these test cylinders shall be tested prior to the load test and at least two cylinders shall be tested on the day of the load test.

5.6 During the period required to perform the load test, no construction activities may be performed in the foundation area near the load test. If test apparatus shows any signs of negative effects due to construction activities as determined by the Engineer, such activities shall cease immediately.

6.0 COMPLETION OF LOAD TEST:

After the completion of the load test, and at the direction of the Engineer, the Contractor shall remove any equipment, material, and waste, etc., except the demonstration pier. After testing is completed, the load test location shall be cleaned, the reinforcement removed from the top of the pier, and the top of the demonstration drilled pier shall be covered with soil.

7.0 TESTING AND REPORTING

The load testing shall be performed by a qualified Geotechnical Engineer approved in advance by the Engineer. The Geotechnical Engineer must have a demonstrated knowledge of load testing procedures, and have performed at least two Osterberg Cell load tests within the past two years. The Geotechnical Engineer shall provide a planned testing procedure for review by the Engineer two weeks before testing. Any deviations from the planned procedure should be explained and justified by the Geotechnical Engineer in the final report.

The load testing shall be performed in general compliance with ASTM D-1143 (Quick Test Method). Initially the loads shall be applied in increments equaling 5% of the anticipated ultimate capacity of the test pier. The magnitude of the load increments may be increased or decreased depending on actual test pier capacity.

Direct movement indicator measurements should be made of the following: downward pier end-bearing movement (min. of two indicators required), upward top-of-pier movement (min. of two indicators required), pier compression (min. of two indicators required).

Loads shall be applied at the prescribed intervals until the ultimate capacity of the pier is reached in either end bearing or side shear, or until the maximum capacity or maximum stroke of the O-cell is reached, unless otherwise directed by the Engineer.

At each load increment, or decrement movement indicators shall be read at 1.0, 2.0 and 4.0, 8.0 minute intervals while the load is held constant.

During unloading cycles the load decrement shall be such that at least four data points are acquired for the load versus movement curve. Additional cycles of loading and unloading using similar procedures may be required by the Engineer following the completion of the initial test cycle.

Dial gages, digital gages, or LVWDT's used to measure end bearing and side shear movement should have a minimum travel of 4 inches and be capable of being read to the nearest 0.001 inch division. End bearing movement may be alternately monitored using LVWDT's capable of measuring the expansion of the Osterberg Cell (6 inches). Dial gages, digital gages or LVWDT's used to measure pier compression should have a minimum travel of 1 inch and be capable of being read to the nearest 0.001 inch division.

The reference beam selected should have a minimum length equal to six times the pier diameter and should be monitored during testing using a surveyor's level.

Unless otherwise specified by the Engineer, the Contractor will supply eight (8) copies of a report of each load test, as prepared by LOADTEST, Inc. or others approved by the Engineer. A preliminary report containing the load-movement curves and test data will be provided to the Engineer within three (3) days of the completion of load testing, to allow evaluation of the test results. A final report on the load testing shall be submitted to the Engineer within two (2) weeks after completion of all load testing on site.

8.0 RESTRICTIONS

If it is determined by the Engineer that either the drilled piers or the load tests are unsatisfactory, due to the Contractor's negligence or poor workmanship, it shall be the Contractor's responsibility to install additional drilled piers and perform additional load tests as required to fulfill this provision.

9.0 METHOD OF MEASUREMENT

The axial load tests shall be considered as any material, labor, equipment, etc. required to meet the requirements of the Osterberg Cell load testing described in this provision. This item should include everything necessary to assemble, install, conduct, report, and remove the O-Cell load testing equipment, under the direction of the Engineer and LOADTEST, Inc.

representatives. All costs associated with the normal construction of the demonstration drilled pier shall be measured and paid for separately in the contract.

10.0 BASIS OF PAYMENT

The complete and accepted "Axial Load Test" shall be paid for at the lump sum bid price for "Axial Load Test". This shall constitute full compensation for all costs incurred during the procurement, installation, conducting of the test, report preparation, and subsequent removal of test apparatus and appurtenances.

Payments shall be made under:

Axial Load Test .....Lump Sum

SONIC CALIPER TESTING (SPECIAL)

1.0 DESCRIPTION

This special provision governs the Sonic Caliper Testing (SCT) of the drilled piers. SCT provides an effective method for evaluating shaft verticality, volume and diameter insitu by profiling the excavated surfaces of drilled shafts before reinforcement or concrete placement. The Contractor shall be responsible for obtaining the services of a SCT firm experienced with SCT testing and equipment approved by the Engineer. The Contractor will be responsible for scheduling and coordinating the testing, and presentation of the data to the Engineer.

2.0 SCT TESTING AND EVALUATION OF TEST RESULTS

2.1 Preliminary Submittal – As part of the Drilled Pier Construction Sequence

Submit a technical proposal prepared by the SCT firm that addresses the testing procedures and qualifications and experience of the testing firm. Include at least 4 similar deep foundation projects for which the testing firm has been engaged. Use personnel having a minimum of one year of experience in SCT testing and interpretation. Within 30 working days, the Engineer will review the proposal and report to the Contractor whether the SCT testing firm is approved and the proposal is acceptable.

2.2 Testing

Test each shaft and determine verticality, diameter and volume. Use an approved independent testing firm meeting the requirements above to perform the SCT tests.

Provide the testing firm access to the top of the shaft enabling one person to centralize and lower the SCT device into the test shaft. Provide a surrounding work area clear and free of debris. Provide such assistance, equipment or necessary

materials to the testing firm as required facilitating the SCT process. A 110-volt power source will be required at the test shaft location for operation of the testing equipment.

Allow sufficient time for the calipering, which will occur between the completion of excavation and final clean out and the installation of the reinforcing steel cage prior to concreting. (Typically less than 30 minutes)

Perform the SCT testing process on the demonstration pier. Perform the SCT testing process in accordance with generally accepted SCT testing methods. The calipering system should be able to transmit and receive >50 data points at each elevation. At a minimum, take caliper readings every 5 feet in uncased portions, every 1 foot increments from 5 feet above and below the bottom of casing, and every 20 feet in the casing.

If a feature, which in the opinion of the Engineer could affect the integrity of the uncased shaft, is identified on the real time visual display, the Engineer may reduce the testing interval as necessary to improve the definition of the feature. Provide these additional readings at no additional cost to the department.

2.3 Test Reports

Provide real-time data regarding the shaft verticality, diameter and volume to the Engineer on site as the SCT testing is in progress. Within 1 hour after completing the SCT testing, provide a computer file of an analysis of shaft verticality, diameter and volume. Within 7 working days after completion of each test, provide 2 copies of a final report to the Engineer, including, as a minimum, the following information:

- Date of test
- Shaft No., and Reference Elevation
- A plot of shaft volume vs. depth
- Analysis of shaft verticality; and
- Description of any shaft wall encroachment

2.4 Evaluation of SCT Test Results

The Engineer will review the "real-time" data collected by the SCT testing firm during the testing process at each shaft. The Engineer will determine if the shaft verticality requirements have been met and inform the Contractor. If defects or features noted by the testing firm in the shaft excavation are deemed sufficient by the Engineer to potentially cause concrete loss or soil intrusion during concrete placement, or loss of bearing capacity, the Engineer will meet with the Contractor to discuss remediation.

3.0 Method of Measurement

The complete and accepted SCT will be paid for at the unit bid price for "Sonic Caliper Testing" per each. The Department will only pay for the initial SCT test on a drilled pier; no additional payment will be made for subsequent SCT tests performed on the same drilled pier. Include in this unit bid price all costs incurred for procurements, conducting the SCT testing, reporting of results and incidentals necessary to complete the work.

ROADWAY LIGHTING MESSENGER CABLE SYSTEM (SPECIAL)

1.0 DESCRIPTION

The work covered by this section consists of furnishing and installing a proposed new messenger cable system to support electrical conductors for roadway lighting on the bridge. Others will provide light poles and luminaires, electrical conductors, and connection to the local utility power lines. Perform all work in accordance with these Special Provisions, the Plans, the National Electrical Code, and North Carolina Department of Transportation "2006 Standard Specifications for Roads and Structures" (Standard Specifications).

Use Division 14 of the Standard Specifications except as modified or added to by these Special Provisions.

2.0 MESSENGER SUPPORTED CIRCUITRY

2.1 DESCRIPTION

The work covered by this section consists of providing and installing a messenger cable system to support electrical conductors for roadway lighting provided by others.

2.2 MATERIALS

Provide stainless steel (SS) stranded messenger cable conforming to ASTM A475, extra-high-strength grade, sized as shown in the plans. Provide SS deadends sized to accommodate the combined weight of messenger and conductors. Provide SS steel hangers, eyebolts and inserts sized as shown in the plans.

Provide SS concrete inserts with a minimum load tension capacity of 900 lb and threads to match the threaded eyebolts to be used. The inserts shall be designed so as to provide a method of fastening or securing the base of the inserts to the deck forms to avoid movement while concrete is being poured. Use SS high-strength eyebolts and any incidental nuts and washers, in accordance with Section 1072-7 of the Standard Specifications.

Provide PVC conduit in conformance with Section 1400-2(B) of the Standard Specifications.

Provide 17"(W) x 30"(L) x 24"(H), polymer concrete junction boxes with outside flanges, and a watertight gasketed recessed cover in accordance with Section 1411 of the Standard Specifications.

2.3 CONSTRUCTION METHODS

Fasten and secure the base of the concrete insert to the deck form to prevent movement during concrete placement.

Install messenger cable in lengths of no more than 300 feet. Secure ends of each section of messenger with a SS deadend. Install hangers spaced as shown in the plans.

Terminate messenger cable at each bent as shown in the plans. Install a PVC sleeve. Completely fill the void between the conduit and PVC sleeve in the backwall, as shown in the plans. Add an underground marking tape in the trench with the stubbed conduit, and extend it up to natural ground to ensure location by others.

Install junction boxes on the road shoulder near the end of the wing walls, and arrange conduits to best fit field conditions. Place the top of the junction box on the same grade as surrounding area and raise slightly to prevent surface drainage from entering the box in accordance with Section 1411-3.

2.4 MEASUREMENT AND PAYMENT

The quantity of messenger cable to be paid for will be the actual number of linear feet that have been installed and accepted. Length will be measured to the nearest foot between the two end bents. Include the cost of providing and installing the conduit and junction boxes in the overall price bid per feet for this pay item.

Messenger cable will be paid for at the contract unit price per linear foot for "Messenger Cable System". Such price and payment will be full compensation for all materials, equipment and labor necessary to complete the work in accordance with the plans and these special provisions.

Payment will be made under:

Messenger Cable System ..... Linear Feet

STEEL SHEET PILE RETAINING WALL (SPECIAL)

The Contractor shall construct the steel sheet pile retaining wall in accordance with the plans and standard specifications with the following exception.

The retaining wall will be measured and paid as the actual number of square feet of exposed face area incorporated into the completed retaining wall. The retaining wall height is measured as the difference between the top and bottom of the retaining wall. The top of the retaining wall is defined as the top of the concrete cap. The bottom of the retaining wall is defined as elevation 5.0 which is the approximate existing ground line shown on the plans.

Payment will be made under:

22.6" STEEL SHEET PILE RETAINING WALLS.....SQUARE FEET

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.