Project Special Provisions
Structure

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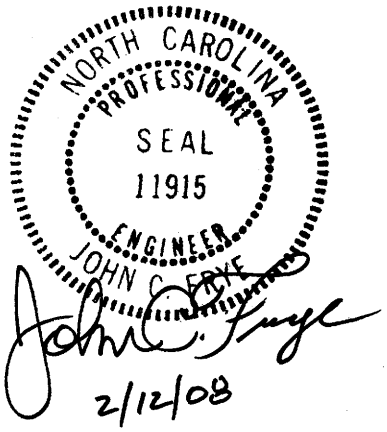

PROJECT SPECIAL PROVISIONS
STRUCTURE

PROJECT B-3625 **CARTERET COUNTY**

FALSEWORK AND FORMWORK (7-18-06)

1.0 DESCRIPTION

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

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

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

2.0 MATERIALS

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

3.0 DESIGN REQUIREMENTS

A. Working Drawings

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

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

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

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

1. Wind Loads

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

Table 2.2 - Wind Pressure Values

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

2. Time of Removal

   The following requirements replace those of Article 3.4.8.2.

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

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

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

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

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

B. Review and Approval

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

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

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

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

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

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

4.0 CONSTRUCTION REQUIREMENTS

All requirements of Section 420 of the Standard Specifications apply.

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

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

A. Maintenance and Inspection

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

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

B. Foundations

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

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

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

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

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

5.0 REMOVAL

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

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

6.0 METHOD OF MEASUREMENT

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

7.0 BASIS OF PAYMENT

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

SUBMITTAL OF WORKING DRAWINGS (7-12-07)

1.0 GENERAL

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

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

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

2.0 ADDRESSES AND CONTACTS

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

Via US mail:

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

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

Via other delivery service:

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

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

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

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

Via US mail:

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

Via other delivery service:

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

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

Via US mail:

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

Via other delivery service:

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

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

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

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

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

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

3.0 SUBMITTAL COPIES

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

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

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

STRUCTURE SUBMITTALS

Submittal	Copies Required by Structure Design Unit	Copies Required by Geotechnical Engineering Unit	Contract Reference Requiring Submittal [1]
Arch Culvert Falsework	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Box Culvert Falsework [7]	5	0	Plan Note, SN Sheet & "Falsework and Formwork"
Cofferdams	6	2	Article 410-4
Evazote Joint Seals [6]	9	0	"Evazote Joint Seals"
Expansion Joint Seals (hold down plate type with base angle)	9	0	"Expansion Joint Seals"
Expansion Joint Seals (modular)	2, then 9	0	"Modular Expansion Joint Seals"
Expansion Joint Seals (strip seals)	9	0	"Strip Seals"
Falsework & Forms [2] (substructure)	8	0	Article 420-3 & "Falsework and Formwork"
Falsework & Forms (superstructure)	8	0	Article 420-3 & "Falsework and Formwork"
Girder Erection over Railroad	5	0	Railroad Special Provisions
Maintenance and Protection of Traffic Beneath Proposed Structure	8	0	"Maintenance and Protection of Traffic Beneath Proposed Structure at Station ___"
Metal Bridge Railing	8	0	Plan Note
Metal Stay-in-Place Forms	8	0	Article 420-3
Metalwork for Elastomeric Bearings [4,5]	7	0	Article 1072-10

Miscellaneous Metalwork [4,5]	7	0	Article 1072-10
Optional Disc Bearings [4]	8	0	"Optional Disc Bearings"
Overhead Signs	13	0	Article 903-3(C) & Applicable Project Special Provisions
Pile Splicer	7	2	Subarticle 450-7(C)
Placement of Equipment on Structures (cranes, etc.)	7	0	Article 420-20
Pot Bearings [4]	8	0	"Pot Bearings"
Precast Concrete Box Culverts	2, then 1 reproducible	0	"Optional Precast Reinforced Concrete Box Culvert at Station ___"
Precast Retaining Wall Panels	10	1	Article 1077-2
Prestressed Concrete Cored Slab (detensioning sequences) [3]	6	0	Article 1078-11
Prestressed Concrete Deck Panels	6 and 1 reproducible	0	Article 420-3
Prestressed Concrete Girder (strand elongation and detensioning sequences)	6	0	Articles 1078-8 and 1078-11
Removal of Existing Structure over Railroad	5	0	Railroad Special Provisions
Revised Bridge Deck Plans (adaptation to prestressed deck panels)	2, then 1 reproducible	0	Article 420-3
Revised Bridge Deck Plans (adaptation to modular expansion joint seals)	2, then 1 reproducible	0	"Modular Expansion Joint Seals"
Sound Barrier Wall Casting Plans	10	0	Article 1077-2 & "Sound Barrier Wall"
Sound Barrier Wall Steel Fabrication Plans [5]	7	0	Article 1072-10 & "Sound Barrier Wall"
Structural Steel [4]	2, then 7	0	Article 1072-10

Temporary Detour Structures	10	2	Article 400-3 & "Construction, Maintenance and Removal of Temporary Structure at Station ____"
Temporary Shoring [8]	7	2	"Temporary Shoring"
TFE Expansion Bearings [4]	8	0	Article 1072-10

FOOTNOTES

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

GEOTECHNICAL SUBMITTALS

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

FOOTNOTES

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

2. Electronic copies of submittals are required. See referenced Project Special Provision.

3. Download Pile Driving Equipment Data Form from following link:
   http://www.ncdot.org/doh/preconstruct/highway/geotech/formdet/
   Submit one hard copy of the completed form to the Resident Engineer. Submit a second copy of the completed form electronically, by facsimile or via US Mail or other delivery service to the Geotechnical Engineering Unit. Electronic submission is preferred. See second page of form for submittal instructions.

CRANE SAFETY (8-15-05)

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

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

CRANE SAFETY SUBMITTAL LIST

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

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

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

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

PILE DRIVING ANALYZER (11-17-06)

1.0 GENERAL

This special provision governs driving piles with a pile dynamic 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.

GROUT FOR STRUCTURES (7-12-07)

1.0 DESCRIPTION

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

2.0 MATERIALS

Refer to Division 10 of the *Standard Specifications*:

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

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

3.0 REQUIREMENTS

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

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

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

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

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

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

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

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

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

4.0 SAMPLING AND PLACEMENT

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

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

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

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

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

5.0 MISCELLANEOUS

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

PRESTRESSED CONCRETE MEMBERS **(4-02-07)**

The 2006 Standard Specifications shall be revised as follows:

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

(A) Producer Qualification

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

PCI audit to the State Materials Engineer for continued qualification. These same requirements apply to producers subcontracting work from the producer directly employed by the Contractor.

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

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

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

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

1.0 GENERAL

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

2.0 INSTALLATION

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

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

3.0 FIELD TESTING

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

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

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

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

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

4.0 REMOVAL AND REPLACEMENT OF FAILED TEST SPECIMENS:

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

5.0 USAGE

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

6.0 BASIS OF PAYMENT

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

REMOVAL OF EXISTING BRIDGE AT STA. 17+44.00 –L- (SPECIAL)

The existing structure is to be removed in accordance with the Standard Specifications.

The steel channel beams, guardrail and posts will become the property of the State of North Carolina. These items shall be loaded onto NCDOT equipment by the contractor. The contractor shall give Reed Smith, telephone number 252-514-4724, a minimum of seven (7) days notice before the steel items are ready for pick up.

Payment will be made under:

Removal of Existing Structure at Station 17+44.00 –L- . . . . . Lump Sum

PRECAST CONCRETE BARRIER RAIL **(SPECIAL)**

Use the precast concrete barrier rail in accordance with the plans, sections 460 and 1077 of the Standard Specifications and this special provision.

Replace references to "concrete barrier rail" with "precast concrete barrier rail."

Submit 8 copies of casting drawings as required in accordance with the "Submittal of Working Drawings" Special Provision. Casting drawings should include all details and notes required for casting and installing precast concrete barrier rail including the installation, tensioning of the anchor bolts, and grouting of anchor bolt pockets. Inspection of the elements is required in accordance with the Standard Specifications.

Payment shall include all work, tools and materials required beginning with precasting the concrete barriers through the completed installation of the barriers on the bridge. The payment includes but is not be limited to casting, storing, transporting, erecting, and anchoring the precast concrete barrier rail units. The payment shall include the grout bed, steel anchor plates, and adhesive anchors.

Payment will be made under:

Precast Concrete Barrier Rail.....Linear Feet

PRECAST POST-TENSIONED CONCRETE APPROACH SLAB **(SPECIAL)**

1.0 GENERAL

Precast Post-Tensioned Concrete Approach Slab Panels shall meet the requirements of Section 1078, Section 422 and Section 430 of the Standard Specifications and the details and notes on the plans. Panels shall be produced at a plant that has been PCI certified to produce products in Category B4.

Panels shall have a 28 day strength of 5000 psi.

Chamfers are not required on any edges of the approach slab panels. Chamfers shall not be placed along edges of shear keys.

Float or broom finish top surface of panels.

Submit 10 copies of working drawings in accordance with the "Submittal of Working Drawings" Special Provision. Working drawings shall be complete drawings necessary for the casting of the approach slab panels, and shall include all details, catalogue cuts, material properties and notes necessary for the fabrication of the panels. The working drawings shall contain details, catalogue cuts, material properties and notes necessary for the installation and post-tensioning of the approach slab panels. Calculations necessary for the design of anchorage zones, post-tensioned strand elongations, and final post-tensioned strand and concrete stresses (including short term and long term prestress losses) shall be submitted.

In order to ensure a good neat field fit, assemble panels in the yard and have them match marked. Ensure that pieces fit together neatly and in a workmanlike manner.

Location of the pick-up points and details for lifting loops or other lifting devices shall be included in the shop or working drawings or as otherwise approved by the Engineer.

2.0 PRESTRESS ANCHORAGES

A. All post-tensioning steel shall be secured at the ends by anchoring devices meeting the approval of the Engineer. The anchorages shall develop at least 100 percent of the minimum specified ultimate tensile strength of the post-tensioning 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 post-tensioning force in the tendon may be verified prior to the removal of the stressing equipment.

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

C. The anchoring devices shall meet the requirements of the AASHTO LRFD Construction Specifications. The Contractor shall determine the confinement reinforcement (in the form of spirals, multiple U shaped bars or links) in accordance with the design shown on the plans and the selected anchorage devices, detailed drawings and calculations shall be submitted to the Engineer for approval. The confinement reinforcing will not be paid for separately, but shall be incidental to the price paid for the precast concrete approach slab panels.

3.0 DUCTS

A. 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 post-tensioning steel shall be high density virgin polyethylene or polypropylene with a minimum thickness of .079 in. The duct shall meet the requirements of ASTM D3350 (Polyethylene) or D4101 (Polypropylene).

Ducts, pipes and all connections shall be capable of withstanding the pressure required for flushing the ducts in the event of an aborted grouting operation.

B. Size of Ducts

Ducts for tendons shall have a minimum size in accordance with manufacturer's recommendations for the number and size of post-tensioning strands.

4.0 GROUT VENTS, INJECTION AND EJECTION PIPES

Vents shall be 3/4" minimum 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.

5.0 FABRICATION

A. 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 Working Drawings or as otherwise approved by the Engineer.

B. 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 3'-0" 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 shall be smooth and continuous with no lips, kinks or dents.

The tolerance on the location of the ducts for the tendons shall be as specified in 5.0 (E) of this provision.

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.

All ducts shall be carefully checked, proofed and repaired as necessary before the placing of any concrete commences. Proving of the ducts shall be done in a manner that assures no cement paste or water enters the duct during subsequent concrete or grout operations. Duct tape shall not be used to join or repair ducts or make connections.

C. 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,

D. 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 tensioning. 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. Neither metallic nor plastic connection components, if selected and approved, shall react with the concrete or enhance corrosion of the prestressing steel. Plastic connectors shall be free of water-soluble chlorides.

Vents shall be mortar tight and shall provide means for injection of grout through the vents and for sealing the vents.

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 percent coverage of all tendons.

E. Tolerances

Complete approach slab panels shall meet the tolerances specified in Table 1078-7 of the Standard Specifications, except as follows:

Post-tensioning ducts shall be positioned within the tolerances given as follows:

Vertical position = $\pm$ ¼ inch

Horizontal position = $\pm$ ¼ inch

In all other cases or in cases of doubt, tendons shall not be out of position by more than $\pm$ ¼" in any direction.

Anchorages shall be located within $\pm$ ¼" of desired position laterally and $\pm$ 1" 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" of the back of the main anchor plate, providing the anchorage is to be encased or sealed later in the construction, and shall be properly centered around the duct. In the event of conflicts between the approach slab reinforcing steel and post-tensioning duct and confinement reinforcing steel, in general, the position of the post-tensioning duct and confinement steel shall prevail and the approach slab reinforcement shall be adjusted locally to the approval of the Engineer.

6.0 PLACING CONCRETE

A. Precautions

The Fabricator 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.

B. Proving of Post-Tensioning Ducts

Upon completion of concrete placement the Fabricator 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 length of the assembled ducts. Pass the torpedo through the duct easily, by hand, without resorting to excessive effort or mechanical assistance. The torpedo shall be the same cross-sectional shape as the duct, be ¼" smaller all around than the clear, nominal inside dimensions of the duct. 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.

C. 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.

7.0 BASIS OF PAYMENT

Price and payment below will be full compensation for all items required to construct bridge approach slabs including but not limited to those items contained in Article 422-1 of the Standard Specifications. The payment shall include but not be limited to casting, storing, transporting, erecting, vertically adjusting and grouting Precast Concrete Approach Slab Panels. Post-Tensioning and Grouting associated with Post-Tensioning of approach slabs is not included in this payment.

The following list of items and all work and materials to include those items in the precast approach slab panels are included in the cost of the Precast Concrete Approach Slabs:

A. Elements of post-tensioning anchorage assemblies cast within panels
B. Post-Tensioning ducts including joints and splices between panels and duct grout vents and shut-off valves
C. Any additional post-tensioning hardware cast in panels
D. All testing of post-tensioning anchorage assemblies, ducts, or other post-tensioning hardware
E. Leveling bolts and associated hardware including leveling plates not cast in approach slab panels (this includes leveling plates cast in backwalls of end bents)
F. Grout vents and shut-off valves for grouting beneath approach slabs

G. Grout, grouting equipment, all testing of equipment, and stand-by equipment for grouting beneath the approach slabs and other incidental grout joints or pockets necessary to complete the grouting of the approach slabs

Payment will be made under:

Precast Concrete Approach Slab	Lump Sum

GROUTING FOR APPROACH SLAB **(SPECIAL)**

1.0 GENERAL

Grout in the following applications shall be non-shrink and in accordance with the PSP "Grout for structures": grout between approach slab panels and base course, longitudinal approach slab panel joints, leveling bolt blockouts, lifting device blockouts, grout vents, and joints between backwall and cored slab units at end bents. This grout is for these blockouts and panel joints only and is not to be placed in the ducts with the tendons.

For grout used in post-tensioning ducts, see special provision for "Post-Tensioning and Grouting."

2.0 GROUTING UNDER APPROACH SLAB

Grout the void beneath the approach slab panels and the base course to assure a uniform bed for the completed approach slab. Take appropriate measures to assure the grout is continuous and uniform, filling the void. The construction sequence for placing, grouting and post-tensioning of approach slabs is shown on the plans.

The minimum number of grout vents allowed are shown on the contract plans. The contractor shall determine if more grout vents or a different spacing of grout vents is necessary to ensure complete coverage and flow of the grout throughout the void.

As necessary, erect side or end barriers to hold grout beneath approach slabs. Barriers shall be of sufficient strength to resist the maximum grout pressure without displacement of the barriers. Barriers shall be sufficiently vented so that the grout coverage under the approach slabs can be determined.

3.0 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 mixed 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 120 psi. Pumps shall have seals adequate to prevent oil, air or other foreign substances entering into the grout and to prevent loss of grout or water. A pressure gauge having a full scale reading of no more than 200 psi shall be placed at some point in the grout line between the pumping outlet and the duct inlet.

Provide a stand-by grout mixer and pump during grouting operations. If water is not supplied by a public water system, a water storage tank of sufficient capacity must be provided and filled before grouting begins.

Provide stand-by water flushing equipment. This equipment is in addition to the grouting equipment described above. The stand-by water flushing equipment shall use a different power source than the grouting equipment and have sufficient capacity to flush out any partially grouted enclosures if necessary due to blockage or breakdown of grouting equipment. If water is not supplied by a public water system, a water storage tank of sufficient capacity for flushing grouted enclosures must be provided and filled before grouting begins. This water supply may be the same as provided for the stand-by grout mixing and pumping if it is deemed of sufficient capacity for both operations by the Engineer.

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

4.0 MIXING

Mixing of the grout shall be performed in accordance with the grout manufacturer instructions.

5.0 GROUT INJECTION

All grout vents, vent openings and joints shall be open when grouting starts. Injection and ejection vents shall be provided with positive shut-offs. Grout shall be injected through a vent until grout is determined to have covered the surrounding area by grout venting around the sides of the slab, through joints between the slabs, and through the adjacent vent(s). Once sufficient coverage is established, that vent shall be shut off and the grouting operation will move to the next vent. Remaining vents shall be closed in sequence in the same manner.

The grout paste is allowed to eject through the joints between the slabs and the void between the approach slab and the end bent backwall. Grout ejected from void between the approach slab and end bent backwall maybe used to fill the joint between the cored slab units and the backwall and approach slab. Any grout ejected into these joints shall be properly tamped or vibrated. These joints shall be completely filled with grout before the grouting beneath approach slab operation is considered complete.

The positive shut-offs at the injection vents shall not be removed or opened until the grout has set. The ends of steel vents shall be removed at least 1" below the concrete surface after the grout has set. Immediately patch any damage to the surface of the approach slabs due to the removal of the vents using the same grout.

units and the backwall and approach slab. Any grout ejected into these joints shall be properly tamped or vibrated. These joints shall be completely filled with grout before the grouting beneath approach slab operation is considered complete.

The positive shut-offs at the injection vents shall not be removed or opened until the grout has set. The ends of steel vents shall be removed at least 1" below the concrete surface after the grout has set. Immediately patch any damage to the surface of the approach slabs due to the removal of the vents using the same grout.

6.0 TEMPERATURE RESTRICTIONS

Do not grout beneath the approach slab if the ambient air temperature is below 35° F or if the sub-base is frozen. At time of placement, the grout shall have a minimum temperature of 50° F. Grout shall not be above 90°F during mixing or pumping. If necessary, the mixing water shall be cooled.

7.0 CURING

Cure grout for a minimum of three days and until the grout reaches a compressive strength of 3000 psi.

8.0 PAYMENT

No separate payment will be made for Grouting for Approach Slabs. The entire cost of providing manpower, equipment, tools, grout, water and any other materials or incidentals and placing of grout is included in the lump sum price bid for Precast Concrete Approach Slab.

POST-TENSIONING AND GROUTING (SPECIAL)

1.0 DESCRIPTION

Grouting and Post-tensioning concrete members consists of the furnishing, installing, stressing and grouting of post-tensioning tendons. In this process, post-tensioning steel, is installed through preformed voids or 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.

This also includes furnishing and installing all the hardware and any other appurtenant items necessary for the particular post-tensioning 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.

The submission of working drawings and calculations is required in accordance with the "Submittal of Working Drawings" and "Precast Post-Tensioned Concrete Approach Slab" Special Provisions.

B. Post-Tensioning Scheme or Layout

The pattern, size and locations of post-tensioning tendons provided by the Designer on the plans.

C. Post-Tensioning System

A proprietary system where the necessary hardware (anchorages, wedges, strands, bars, couplers, etc.) is supplied by a particular manufacturer or manufacturers of post-tensioning components.

D. 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.

E. 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.

F. 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.

G. Anchor Plate

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

H. 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.

I. 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.

J. 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.

K. 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

A. 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 post-tensioning system meets the requirements of Part 2 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 shall be equivalent to the ultimate strength provided by the original design.

5. Stresses in the concrete and post-tensioning 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, which results in a change in quantity from that shown on the plans, shall be paid based on the quantity actually used and accepted or the plan quantity, whichever is less, and at the unit bid price.

9. Any alternate post-tensioning scheme or system approved by the Engineer, which results in a change in quantity from that shown on the plans, shall be paid based on the quantity actually used and accepted or the plan quantity, whichever is less, and at the unit bid price.

4.0 POST TENSIONING AND GROUTING PERSONNEL

The installation, stressing and grouting of post-tensioning tendons shall be supervised, and performed by personnel with qualifications and experience as described in Appendix B of the "Post-Tensioning Tendon Installation and Grouting Manual" published by the Federal Highway Administration. Documentation of the qualifications and experience shall by submitted to the Engineer for approval.

5.0 POST-TENSIONING MATERIALS

A. Post-tensioning Steel

Strand: Unless otherwise noted on the plans, strand shall be uncoated, Grade 270 Ksi, low relaxation 7-wire strand conforming to the requirements of AASHTO M203.

The proper use of strand 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 the working drawing submittals.

B. Testing

Testing shall conform to the applicable ASTM Specifications for the post-tensioning material used.

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

6.0 PORTLAND CEMENT GROUT FOR STRANDS IN POST-TENSIONED STRUCTURES

A. General

Use a pre-packaged grout approved by the Department in-lieu of an on-site batch mix. Contact the Materials and Tests Unit for a list of approved pre-packaged grouts. Consult with the manufacturer to determine if the pre-packaged grout selected is suitable for grouting highly stressed steel in post-tensioning ducts

Mix and install grout in accordance with all of the manufacturer recommendations and instructions. The maximum water/cementitious material ratio shall be 0.40. Any admixtures used in the grout shall be in accordance with Section 1024 of the Standard Specifications and shall be included in the pre-bagged grout. The addition of pozzolans to pre-bagged grout at the site will not be allowed.

Portland cement shall be Type I or II.

This is the only type of grout allowed in the ducts with the tendons.

B. Required Physical Properties of Grout

The efflux time of the grout shall satisfy the following requirements:

Non-thixotropic grouts: ASTM C939 - Immediately after initial mixing efflux time shall be between 11 and 30 seconds. After grout has rested for 30 minutes without agitation, the efflux time shall be no more than 30 seconds. Remix grout for 30 seconds prior to the final flow measurement.

Thixotropic grouts: ASTM C939 Modified as follows - Completely fill the standard flow cone with grout and measure the time taken to fill a 1-Liter container placed under the cone orifice. Immediately after initial mixing efflux time shall be between 5 and 30 seconds. After grout has rested for 30 minutes without agitation, the efflux time shall be no more than 30 seconds. Remix grout for 30 seconds prior to the final flow measurement.

The compressive strength of restrained cubes of grout shall exceed the following minimum requirements as determined by ASTM C942.

3000 psi at 7 days

5000 psi at 28 days

Setting time shall be greater than 3 hours and less than 12 hours as determined by ASTM C953.

The volume change of the grout shall be between 0.00 and +0.20 percent at 28 days as determined by ASTM C1090.

The maximum permissible bleed after 3 hours shall be 0.0 percent as determined by the Wick Induced Bleed Test (Modified ASTM C940).

The acid soluble chloride ion content shall be less than or equal to 0.08 percent by weight of portland cement as determined by ASTM C1152.

C. Laboratory Tests

Prior to commencement of grouting operations and with sufficient time for the necessary tests to be completed, the Contractor shall propose a grout mix or mixes and shall provide all the material and arrange for tests of all the above properties to be carried out at an approved materials testing laboratory at no cost to the Department.

The Contractor shall provide certified copies of test results to the Department for approval and shall not initiate grouting until the Department approves the proposed grout mix in writing.

The mix proportions and material constituents of the approved grout(s) shall then be retained throughout all grouting operations.

The ambient temperature during the testing shall be between 90 and 96 degrees F in order to simulate the highest ambient temperatures expected during field grouting operations.

D. On Site Testing

During on-site grouting operations, the ASTM C939 flow cone test shall be performed a minimum of one test per 2 hours of grouting operations or per 1.5 cubic meters of grout. If the efflux time is outside the range specified above the Contractor shall take appropriate corrective action at no cost to the Department. Corrective action may require disposal of old materials and use of new materials but shall not involve changing the grout mix or the supplier of the grout without repeating the above laboratory tests to verify physical properties.

E. Storage and Shelf Life

Pre-bagged grout shall be stored on a raised platform with adequate weatherproof covering. Material with a total time from manufacture to use in excess of six months should be retested or recertified by the supplier before use or else be rejected and replaced.

7.0 GROUT FOR POST-TENSIONING ANCHORAGE PROTECTION

Grout for anchorage protection shall be in accordance with the Special Provision "Grout for Structures." Only non-chloride bearing, non-shrink grout mixes shall be used for anchorage protection. After grout patches have been finished and cured, two heavy brush coats of bituminous protective coating material conforming with AASHTO M115 shall be applied in a manner and thickness recommended by the manufacturer.

8.0 EPOXY FOR DUCT COUPLING and ANCHORAGE BLOCKOUTS

Epoxy shall be AASHTO 235M (ASTM 881) Type VI.

9.0 PROTECTION OF POST-TENSIONING STEEL

A. Shipping, Handling and Storage

All post-tensioning steel shall be protected against physical damage and corrosion at all times from manufacturer to final grouting or encasing in the concrete. Post-tensioning 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.

Post-tensioning 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 AASHTO M203. All such strand not so designated shall be rejected.

B. During Installation in the Structure

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

Post-tensioning steel installed as above but not grouted within seven 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 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.

10.0 APPLYING EPOXY IN BLOCKOUTS

Prior to grouting the duct coupling blockouts, apply epoxy to the surfaces that are to receive the grout. For applying epoxy to the End Anchorages, see section 3.6.

11.0 INSTALLING STRANDS

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.

12.0 POST-TENSIONING OPERATIONS

A. General

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

B. 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.

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

3. Stressing Sequence: Post-tensioning tendons shall be stressed as indicated on the plans, the approved shop drawings or as approved by the Engineer.

C. Stressing Equipment

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

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 diameter.

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, certified calibration charts shall be furnished by the Contractor from the independent laboratory prior to stressing the first tendon.

   Certified calibration shall be made at the start of the work and at every six 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, shall be 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.

D. Elongations and Agreement with 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 seven (7) percent 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.

E. Wire Failures in Post-Tensioning Strands

Post-tensioning strands having wires which failed by breaking or slippage during stressing shall be considered acceptable when the following conditions are met:

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

2. Any single strand shall have no more than a five percent reduction in cross-sectional area of post-tensioning steel due to wire failure.

At the option of the Contractor, alternative methods of restoring the post-tensioning force lost due to wire failure may be proposed, subject to approval of the Engineer.

F. Cutting of Post-Tensioning Steel

Post-tensioning steel shall be cut by an abrasive saw within 3/4" to 1½" away from the anchoring device. Flame cutting of post-tensioning steel will be not permitted.

G. Record of Stressing Operations

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

1. Project name, number.

2. Contractor and/or subcontractor.

3. Tendon location, size, type and designation.

4. Date tendon was first installed in ducts.

5. Coil/reel number for strands or wires and heat number for bars and wire.
6. Assumed and actual cross-sectional area.
7. Assumed and actual Modulus of elasticity.
8. Date Stressed.
9. Jack and Gauge numbers per end of tendon.
10. Required jacking force.
11. Gauge pressures.
12. Elongations (anticipated and actual).
13. Anchor sets (anticipated and actual).
14. Stressing sequence (i.e. tendons before and after this).
15. Stressing mode (one end/ two ends/ simultaneous).
16. Witnesses to stressing operation (Contractor and inspector).
17. 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.

13.0 GROUTING OPERATIONS

A. General

For protection of post-tensioning strands, 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. Complete duct grouting operations according to these specifications within 30 calendar days after installation of the post-tensioning steel. Except when approved by the Engineer in writing, failure to grout tendons within 30 calendar days shall result in stoppage of the affected work and no invoices shall be processed for payment of that affected work.

B. 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 mixed 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 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.

Provide a stand-by grout mixer and pump during grouting operations. If water is not supplied by a public water system, a water storage tank of sufficient capacity must be provided and filled before grouting begins.

Provide stand-by water flushing equipment. This equipment is in addition to the grouting equipment described above. The stand-by water flushing equipment shall use a different power source than the grouting equipment and have sufficient capacity to flush out any partially grouted enclosures if necessary due to blockage or breakdown of grouting equipment. If water is not supplied by a public water system, a water storage tank of sufficient capacity for flushing grouted enclosures must be provided and filled before grouting begins. This water supply may be the same as provided for the stand-by grout mixing and pumping if it is deemed of sufficient capacity for both operations by the Engineer.

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

C. Mixing

Mixing of the grout shall be performed in accordance with the grout manufacturer instructions.

D. Grout Injection

All grout vents and 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 flushing 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 for circular ducts, however; normal operations shall be performed at approximately 75 psi. To ensure that the tendon remains filled with grout, the ejection vent shall be closed and the pumping pressure is allowed to build up to a minimum of 75 psi before the injection vent is closed. 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 with water.

Grout shall be pumped through the duct and continuously wasted at the ejection vent until 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.

E. 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 4°F or higher from the time of grouting until job-cured 2-inch 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.

F. Finishing

Valves, caps and vent pipes shall not be removed or opened until the grout has set. The ends of steel vents shall be removed at least 1" 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, duct tape, etc.

14.0 PROTECTION OF END ANCHORAGES

Within 24 hours after grouting is completed, exposed end anchorages, strands and other metal accessories shall be cleaned of rust, misplaced mortar, grout and other such materials. Immediately following the cleaning operation, a heavy unbroken coating of an epoxy bonding compound shall be applied to all such dry metal surfaces. Epoxy bonding compound shall conform to Section 2.5 of this provision.

Tight fitting forms shall be installed and held in place securely against the previously placed concrete. After application of the epoxy bonding agent, the void between the form and the anchorage shall be filled with a non-shrink grout mix to protect the anchorage. This non-shrink grout may be Embeco, Chem-Comp, Five Star or approved equal. The non-shrink grout shall be placed within the "tack time" period of the epoxy bonding agent/compound. All work described in this and the preceding paragraph shall be accomplished within the designated 24 hour time period.

15.0 MEASUREMENT AND PAYMENT

Post-Tensioning and Grouting will be measured and paid for at the contract lump sum price. No separate measurement will be made for this pay item, and no adjustment in the contract lump sum price will be made for this pay item, except whereas revisions in the plans affect the quantity. The approximate quantity of post-tensioning tendons shown on the plans is an estimate based on the computed length of the tendons entered into the completed structure and accepted, and is based on the theoretical plan length from anchor plate bearing face to anchor plate bearing face with no allowance made for waste or extension past the anchor plate faces.

The price and payment will be full compensation for furnishing, installing, stressing and grouting all post-tensioning tendons, furnishing and applying epoxy to the joints and end anchorages, and blockouts for post-tensioning ducts. Payment shall also include grout and grouting 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.

Payment will be made under:

Post-Tensioning and Grouting.....Lump Sum

BRIDGE DECK GRINDING (SPECIAL)

1.0 GENERAL

This Special Provision shall govern the longitudinal planing and all other related work associated with obtaining a smooth riding surface of uniform texture, true to the required grade and cross section.

2.0 PLANING

Planning is required over the entire surface of bridge deck and approach slabs. Surface grinding of the bridge deck shall be a minimum of 0.0625" and a maximum of 1.0". A tapered pass or hand grinding shall be used to provide a smooth transition to the surface near the barrier rail that does not receive grinding. Surface grinding of the approach slab shall be a minimum of 0.0625" and a maximum of 0.5".

Longitudinally plane the deck parallel to the roadway centerline. Plane the approach slabs and bridge deck surface by beginning at one end of an approach slab and continuing to the far end of the other approach slab without stopping. Complete each adjacent pass by starting at one end and planing the entire length without stopping. After the entire surface has been planed once, plane centers of spans (highest points of camber) and other areas as necessary to provide a smooth riding surface within the additional guidelines given herein and on the plans.

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

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 onto the ground or body of water under the bridge. Dispose of all residues off the project.

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. Hand grinding may be required adjacent to barrier rail and to remove vertical steps between passes.

The ground surface shall consist of between 50 and 60 grooves per foot of width. The grooves shall be between 0.09" and 0.15" in width and 0.0625" in depth. The area between the grooves shall be between 0.06" and 0.13" in width. The final concrete texture shall be uniform.

Limit planning such that the final reinforcement cover is not less than the plan cover minus 1". Any other corrective work may be required as directed by the Engineer.

3.0 BASIS OF PAYMENT

Bridge deck grinding will be paid as the actual number of square feet shown on the plans. The payment shall include but not be limited to the cost of equipment, planing operation, and removal and disposal of slurry resulting from the planing operation.

Payment will be made under:

Bridge Deck Grinding.....Square Feet

PRESTRESSED CONCRETE CORED SLABS (SPECIAL)

Use 3'-0" X 1'-10" Prestressed Concrete Cored Slabs in accordance with Section 430 of the Standard Specifications.

Payment will be made under:

3'-0" x 1'-10" Prestressed Concrete Cored Slabs.....Linear Feet