CRITICAL BRIDGE CONSTRUCTION SPECIFICATION ISSUES

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
STATE CONSTRUCTION OFFICE
CRITICAL BRIDGE CONSTRUCTION SPECIFICATION ISSUES

PURPOSE OF SESSION

- Heighten awareness of widely misunderstood or ignored specifications
- Familiarization with specifications that were introduced for the first time in the 2004
- Preparation for upcoming specification changes that will significantly impact Contractor and CEI efforts

Acosta Bridge - Jacksonville

GENERAL SESSION TOPICS

- Universal Concerns
- Footings
- Bearings
- Beams
- Decks
- Concrete Materials

US 17 over St. Mary's River
Nassau County

Main Street - Jacksonville
CRITICAL BRIDGE CONSTRUCTION SPECIFICATION ISSUES

UNIVERSAL CONCERNS

Non-technical Concerns

Guidelists

- CPAM Chapters
  - 8.4 - Shop Drawings
  - 10.1 - Pile Lengths
  - 10.2 - PS Concrete Components
  - 10.3 - Bridge Decks
  - 10.4 - Paint Removal
  - 10.5 - Drilled Shafts
  - 10.6 - Mass Concrete
  - 10.7 - Post-tensioned Bridges
  - 10.8 - Auger Cast Piles
  - 10.9 - Structural Steel Components

Pre-operations Meetings

Resolving Design and Construction Problems

- Complex Category 2 (CC2) Bridges
- Non-CC2 Bridges

GUIDELISTS - The following bridge construction related Guidelists (GL) can be viewed and printed off at this website address: http://www.dot.state.fl.us/construction/CONSTADM/guidelist/guideindex.htm
GL 8B – Concrete Materials, GL 9 – Structure Foundations, GL 10A – General Concrete, GL 10B – Bearings/Beams/Bolts, GL 10C – Bridge Decks, GL 10D – Post-tensioning

PRE-OPERATIONS MEETINGS – CPAM Chapter 3.2, Quality Control, Section 3.2.7.3(A) Planning

(A) Resident Level Responsibilities

The Contractor's construction operations can often be very complicated and are usually critical in terms of how much time activities take. When things go wrong or when planning is inadequate, it disrupts the progress of construction and can lead to project delays and claims by the Contractor. In order to reduce the likelihood of this happening, a meeting referred to as a pre-operations meeting, should take place before the Contractor performs a major construction activity or operation for the first time. The Project Administrator should clearly establish lines of communication, authority, responsibilities and escalation procedures during this meeting. Where practical, as many Department and Contractor personnel as possible who will actually be involved directly in the activity should attend the meeting. At the meeting, applicable specifications, plans and Guidelists should be available for review with the Contractor. A copy of the Guidelists can be given out at, or before, the meeting so the Contractor has a written document for later reference and to permit review of the Guidelists item-by-item with the Contractor. At the meeting, the applicable specifications should be reviewed with the Contractor and a "What If" discussion should take place with regard to the Contractor's plans if something unexpected happens. All inspectors who will be inspecting the anticipated operation should try to attend the pre-operations meeting; however, if this is not possible then they should thoroughly discuss the operation with the Project Administrator and the Lead Inspector.

CC2 PROJECTS - Consult with State Construction Office (SCO) first for all design and construction problems

NON-CC2 PROJECTS - Always consult the Engineer of Record (EOR) if there are changes of any kind to the plans or specifications affecting the capacity or durability of the bridge and confirm EOR decisions with the District Construction Office and District Structures Design Office
**Technical Concerns**

- Inspecting for cracks in concrete (Guidelist 10A, item 31 and 32)
- Rebar placement issues including upcoming non-metallic provision
- Training and Reference Manuals
- Mass concrete monitoring CPAM 10.6

**Inspection of Cracks in Concrete** – The following Guidelist items cover crack inspection concerns:

**Guidelist 10A - Crack Inspection**

31. Concrete components must have all visible surfaces inspected for cracks on at least the following three occasions: (1) 28 days after a non-precast component has been cast; (2) as soon as possible after the component has been burdened with all dead loads, except for loads from components cast or mounted to the deck, and before Class V finish has been applied; (3) a minimum of 7 complete days after the bridge is fully open to the public for unrestricted use. [Good Practice]

32. The width, length, termination points, and precise location of concrete cracks must be properly documented and crack measuring scopes should be used to measure cracks 25 mils wide or less. Documented cracks must be monitored to determine if they are continuing to grow. Immediately report all cracks to the Project Administrator so that their status can be addressed appropriately. [Good Practice]


**Rebar Placement Issues** – The following specifications apply: 415-3, 415-4, 415-5. Important topics covered by these specifications include: bending, splicing, cutting, spacing, tying, supports, tolerances, chairs and bolsters.

**Training and Reference Publications and Websites**

- Structures Inspection - Self Study Courses (Three Volumes)
- Foundation Construction Qualification Courses and online tutorials (Piles and Drilled Shafts)
- Grouting Video and Manual
- Segmental Bridge Construction and Inspection Manuals
- CPAM Chapter 10 Structures – Pile Lengths, PS/Precast Concrete components, Bridge Decks, Painting, Drilled Shafts, Mass Concrete, Post-tensioning, auger cast piles and Structural Steel
- Structures Related Websites: State Construction Office, Structures Webpage - http://www.dot.state.fl.us/construction/structures/structures.htm,
MASS CONCRETE MONITORING SPECIFICATION

346-3.3 Mass Concrete: When mass concrete is designated in the Contract Documents, provide an analysis of the anticipated thermal developments in the mass concrete elements for all expected project temperature ranges using the proposed mix design, casting procedures, and materials. Use a Specialty Engineer following the procedure outlined in Section 207 of the ACI Manual of Concrete Practice to formulate, implement, administer and monitor a temperature control plan, making adjustments as necessary to ensure compliance with the Contract Documents. Describe the measures and procedures intended for use to maintain a temperature differential of 35°F [20°C] or less between the interior core center and exterior surface(s) of the designated mass concrete elements during curing. Submit both the mass concrete mix design and the proposed mass concrete plan to monitor and control the temperature differential to the Engineer for acceptance. The Engineer will review the submittal for acceptance within ten working days of receipt. Provide temperature monitoring devices to record temperature development between the interior core center and exterior surface(s) of the elements in accordance with the accepted mass concrete plan. For the first placement of each size and type mass component, the Specialty Engineer, or a qualified technician employed by the Specialty Engineer, must personally inspect and approve the installation of monitoring devices and verify that the process for recording temperature readings is effective and accurate. For placements other then the first, designate an employee(s) approved by the Specialty Engineer as qualified, to inspect monitoring device installation, to record temperature readings, to be in contact at all times with the Specialty Engineer if adjustments must be made as a result of the temperature differential being exceeded, and to immediately implement adjustments to temperature control measures as directed by the Specialty Engineer. Read the monitoring devices and record the readings at intervals no greater than 6-hours. The readings will begin when the mass concrete placement is complete and continue until the maximum temperature differential (not maximum temperature) is reached and a decreasing temperature differential is confirmed as defined in the temperature control plan. Furnish a copy of all temperature readings to the Engineer and Specialty Engineer as soon as they become available. If the 35°F [20°C] differential has been exceeded, take immediate action, as directed by the Specialty Engineer who must be available for immediate consultation at any time, to retard further growth of the temperature differential. Use a Specialty Engineer to revise the previously accepted plan to ensure compliance on future placements. Do not place any mass concrete until the Engineer has accepted the mass concrete plan(s). When mass concrete temperature differentials are exceeded provide all analyses and test results deemed necessary by the Engineer for determining the structural integrity and durability of the mass concrete element, to the satisfaction of the Engineer. The Department will make no compensation, either monetary or time, for the analyses or tests or any impacts upon the project.
**FOOTINGS (GL 10A)**

- **Preparation of Cofferdams**
  - No visible seepage
  - No standing water prior to concrete placement
  - Excess primary pump capacity plus backup pump

- **Lift thickness when placing concrete**

- **Planning for cold joints**

**SPECIFICATION FOR LIFT THICKNESS WHEN PLACING CONCRETE**

**400-7.10 Requirements for Successive Layers:** Generally, place concrete in continuous horizontal layers, approximately 12 inches [300 mm] thick. To avoid obtaining a plane of separation between batches, do not allow the time before placing the next successive layer to exceed 20 minutes, unless the Engineer determines that adequate fluidity exists in the underlying layer. Generally, leave each layer of concrete unfinished to secure efficient bonding with the overlying layer. To minimize the visibility of joints on exposed faces, finish the top surface of the concrete immediately adjacent to the forms of the exposed face, smoothing with a plaster mason’s trowel. Where required, use inset form work to eliminate featheredges and to obtain concrete layers with a minimum thickness of 6 inches [150 mm]. Conduct the operation of depositing and consolidating the concrete so as to form a dense, impervious mass of uniform texture with smooth faces on exposed surfaces. Remove, dispose of, and replace defective concrete as directed by the Engineer and at no expense to the Department.
CRITICAL BRIDGE CONSTRUCTION SPECIFICATION ISSUES

BEARINGS (GL 10B)

- Centerline of bearing and centerline of cap
- Deviations between original survey and actual
- Project Engineer must approve adjustments
- Elevations must be verified
- Beam pedestals must be scribed with bearing locations

TYPICAL POT BEARING
Expansion Type

- Sole Plate
- Guide
- Stainless
- TFE
- Piston
- Brass sealing
- Elastome
- Base Pot
- TFE
GUIDELIST 10B
4. Concerns for all beams: damage or flaws such as kinks, warps, bends, cracks, plates out of plumbness or squareness; pickup points in proper location; producer acceptance stamp, certification and beam identification; proper storage; correct beam lengths prior to shipment; and erect beams at fixed bearings first. [Spec. 460-4 & Good Practice, CPAM 10.2.4]
This can happen when bracing methods are inadequate or when handling and lifting are done improperly, particularly for long span skewed bridges.

CONCRETE BEAMS (GL 10B)

- Relationship of camber and vertical profile to buildup thickness
- Beam top vs form top elevation will tell the tale
- Prestressed beam stirrup or steel beam shear stud penetration into deck slab
- Adjustments that can be made if camber predictions are excessively high or low
SPECIFICATIONS FOR PERFORMING ROTATIONAL CAPACITY TESTS AND LUBRICANTS

460-8.1.3 Additional Test Requirements: Perform the rotational-capacity tests indicated below on a minimum of two units of each combination of the LOTs of bolts, nuts, and washers supplied. Test and report zinc coating thickness when galvanized fasteners are required. The manufacturer or distributor who combines the bolts, nut, and washer into assembly will perform these tests.

For high strength fastener assemblies (bolt, nut, and washer), black and galvanized, perform a rotational-capacity test (AASHTO M 64, Section 8.5 [AASHTO M 164M, Section 8.2]), and meet the following requirements:

(a) Perform twice the required number of turns (from snug tight conditions) indicated in the 1988 Interim AASHTO Bridge Specification, Table 10.17B, in a Skidmore-Wilhelm Calibrator, or equivalent tension measuring device, without stripping or failure.

(b) After making the required number of turns, achieve a recorded tension equal to or greater than 1.15 times the Required Fastener Tension, AASHTO Standard Specifications for Highway Bridges, Division II, Table 11.5A.

(c) When measuring the torque to produce the Required Fastener Tension, do not exceed the value obtained by the following equation: Where:

\[
\text{Torque} = \frac{P}{D} \times \frac{12}{\pi}
\]

\( P = \) Measured Bolt Tension in pounds [newtons]
\( D = \) Nominal Diameter in feet [meters]

Perform proof load tests (ASTM F 606 [ASTM F 606M], Method 1) for the bolts. Perform wedge tests of full size bolts in accordance with Section 8.3 of AASHTO M 164 [Section 8.1 of AASHTO M 164M]. Wedge test galvanized bolts after galvanizing. Perform proof load tests (AASHTO M 291 [AASHTO M 291M]) for the nuts. Perform the proof load tests for nuts to be used with galvanized bolts after galvanizing, overtapping and lubricating.

460-8.1.8 Installation:

460-8.1.8.1 General: Perform the rotational-capacity test described in 460-8.1.3 on each rotational capacity LOT prior to the start of bolt installation and at any other time the Engineer orders the test to be performed.

460-8.1.4 Lubricant: Coat fastener assembly components with a lubricant commercially produced for lubricating high strength fastener assemblies. Use a lubricant of a visually obvious color. Use a lubricant that is clean and dry to the touch, and apply it prior to testing and packaging for shipment to the job site. Lubricate all nuts. Lubricate the face of the bolt head when the bolt is the element to be turned in the tightening process. Prior to lubrication, clean fastener elements of dirt, rust, and other deleterious substances. Clean and relubricate fastener elements which are weathered or rusted after lubrication.
The SCO encourages the use of DTI’s so if your contract does not permit the use of DTI’s and your Contractor wants to use them, contact Steven Plotkin or Jeff Pouliotte for a copy of the specification that will be required in order to change the contract to allow the use of DTI’s.
POURING DIRECTION AND CURING

Whenever possible, deck placements that have one end that will be in contact with the face of a previously placed deck section that is cured and hard (cold joint), should begin at the end opposite the cold joint. This procedure should prevent uncontrolled tension cracks from forming in the vicinity of the cold joint. The reason for this is that the beam ends rotate as the wet concrete load is imposed. By ending the placement at the cold joint instead of beginning at the cold joint, all the beam end rotation generated by the concrete load will have taken place and thus tension will not be generated in the top of the deck at the cold joint.

400-16 Curing Concrete.

400-16.1 General:

Cure cast-in-place and precast (non-prestressed) concrete as required herein for a minimum duration of 72 hours. If forms are loosened or removed before the 72 hour curing period is complete, expand the curing to cover these surfaces by either coating with curing compound or extending the continuous moist cure area.

Maintain concrete surface moisture at all times until curing is begun. Prevent water sheen loss on flat work by use of an evaporation retarder and/or by applying supplemental moisture by misting. During the construction of footings and bridge decks when the forecasted or actual wind speed exceeds 10 mph [16 km/hr], evaporation counter measures are required. The Quality Control Plan shall ensure evaporation counter measures which will limit evaporation to less than 0.20 lb/ft²/hr [1.0 kg/m²/hr].
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**CONCRETE DECK PLACEMENT RELATED SPECIFICATIONS**

400-7.13.3 Screeding Operations: Do not add water to the concrete surface to assist in finishing operations unless specifically authorized by the Engineer. If the Engineer permits the addition of water, apply only a fog mist, above the concrete surface, by means of approved power driven spray equipment approved by the Engineer.

400-15.2.5.3 Plastic Finish and Surface Finish for Long Bridges: Do not moisten, manually float or apply texture to the concrete surface after the screed, with attached smoothing device, has passed unless correction of isolated surface irregularities is warranted and this should be done as soon as possible after screeding while the concrete is plastic. Correct all flaws such as cavities, blemishes, marks, or scratches that will not be removed by planing.

If the Engineer permits the addition of water when correcting flaws, apply moisture to the concrete surface only if required and only in the immediate vicinity of the isolated irregularity. Apply a quantity of moisture not greater than what is needed to facilitate correction of the irregularity and apply only a fog mist, above the concrete surface, by power driven spray equipment approved by the Engineer.

400-16.2 (b) Membrane Curing Compound: Apply a white Type 2 curing compound to all surfaces at a uniform coverage as recommended by the manufacturer but not less than 0.06 gal/yd² (1 gal/150 ft²) [0.27 L/m²].

400-16.4 Bridge Decks: Cure bridge decks for a duration of seven days. Immediately after finishing and before the concrete surface moisture evaporates apply a membrane curing compound to the deck top surface in accordance with 400-16.2 using a compressor driven sprayer. In general, apply curing compound to concrete decks only when the surface is damp and before all surface moisture evaporates and do not apply curing compound to a surface with standing water. For Short bridges, begin applying curing compound immediately after the initially placed concrete has been floated, straightedged, textured and a damp surface condition exists and continue applying compound as concrete placement progresses with as little interruption as possible until the initially placed concrete as soon as a damp surface condition exists and continue applying compound as concrete placement progresses with as little interruption as possible until the entire deck surface has been coated with compound. For Long bridges, begin applying curing compound to the initially placed concrete as soon as a damp surface condition exists and continue applying compound as concrete placement progresses with as little interruption as possible until the entire deck surface has been coated with compound. However, for both Short and Long bridges, the elapsed time between the initial placement of deck concrete and the completed application of curing compound must not exceed 120 minutes. The 120 minute limit may be extended by the Engineer if project specific factors (cool temperatures, high humidity, retarding admixtures, etc.) are prolonging wet surface conditions.

Prior to the first deck placement, submit to the Engineer the method that will be used to periodically measure the gallons [liters] of curing compound applied as the deck placement progresses. Prior to the placement of each deck, submit to the Engineer the anticipated quantity of curing compound in gallons [liters] along with the corresponding square feet [square meters] of deck to be covered to meet the coverage rate in 400-16.2. Compute the actual quantity of curing compound applied at the conclusion of each deck placement and submit the quantity to the Engineer. Apply the curing compound from a work platform.
400-10.3 Joint System Installation: Install expansion joints before or after the deck planing required by 400-15.2.5.5 following the manufacturer’s instructions. When installed after deck planing, install the edge rail assemblies in the blockouts on a profile tangent between the ends of the deck and/or approach slab to within a +0 and -1/4 inch [+0 and -6.0 mm] variation. When installed before deck planing, install the edge rail assemblies 3/8 inch [10 mm], plus or minus 1/16 inch [2 mm], below the top surface of the deck or approach slab to compensate for concrete removal during planing.
ACCEPTANCE OF CONCRETE BASED ON SLUMP TESTING AT THE PROJECT SITE

TOLERANCE SLUMP RANGE (3"

1-1/2" DRY

ACCEPT - WATER MUST NOT BE ADDED

1-1/2" WET

ACCEPT - WATER MUST NOT BE ADDED

3/4" DRY

ACCEPT - NOTIFY PLANT TO ADJUST & MAY ADD WATER AT SITE

3/4" WET

TARGET SLUMP

TARGET SLUMP RANGE (1-1/2"

ACCEPT - NOTIFY PLANT TO ADJUST

ACCEPT
CONCRETE MATERIALS (GL 8B)

- Concrete truck drum revolutions and counter device
- Device for measuring volume of water added at the site
- Curing boxes at the project site – 60 to 80 degrees

When to perform a slump test
- Perform a slump test if there is any question about the water content of the concrete
- After water is added at the site, test that truck again
- When truck is between target and tolerance, test the trucks that come after including the first adjusted truck
- Test all trucks that come after a rejected truck including the first adjusted truck and begin a new LOT
- The location of rejected concrete that is accidentally placed, must be documented so that it can be tested

Where to take the slump test sample
- Initial slumps must be taken out of the back of the truck
- Acceptance slumps taken at discharge end of pump or other delivery device
Critical Bridge Construction Specification Issues

Requirements for Technicians Involved with Concrete Materials

Concrete Field Technician - Level I
- Performs acceptance tests such as slump, temperature, air content and making/curing concrete cylinders for Contractors
- Technicians who test concrete material properties or perform Independent Assurance (IA) reviews for FDOT

Concrete Field Technician - Level II
- Contractor's representative who must be responsible for the quality of the concrete being placed on bridge projects
- Department's lead inspector on a concrete structure

- Consult with the Construction Training and Qualification Manual (CTQM) for detailed information about qualification requirements.

- For Concrete Technician Requirements review CTQM Chapter 4.

- For Structures related Technician requirements such as Grouting and Post-tensioning Technicians, review CTQM Chapter 8.
Two Levels of Qualification

Level I - Construction Engineering and Inspection (CEI) personnel and Contractor Grouting Crew Members

Level II - Contractor Grouting Crew Foremen

Level I - Qualification Requirements
- Attend an FDOT accredited Grouting Training Course
- Pass the final examination of the course

Level II - Qualification Requirements
- Attend an FDOT accredited Grouting Training Course
- Pass the final examination of the course
- Three years of grouting operations experience

Video Tutorial and Manual -- Grouting of Bridge Post-Tensioning Tendons

Viewing required for all non-CTQP qualified CEI personnel involved in the grouting inspection, or supervision of grouting inspection

Viewing required for all non-CTQP qualified Contractor personnel involved in grouting operations, or supervision of grouting operations
QUALIFIED POST-TENSIONING (PT) TECHNICIAN REQUIREMENTS

Two Levels of Qualification

- Level I - Construction Engineering and Inspection (CEI) personnel and Contractor PT Crew Members
- Level II - Contractor PT Crew Foremen

Level I - Qualification Requirements

- Attend an FDOT accredited PT Training Course
- Pass the final examination of the course

Level II - Qualification Requirements

- Attend an FDOT accredited PT Training Course
- Pass the final examination of the course
- Three years of PT operations experience

DATES THAT PT TECHNICIAN QUALIFICATION IS EFFECTIVE

Only CTQP Qualified PT Technicians will be permitted to inspect or supervise PT operations as of the following dates:

- CEI Personnel (FDOT and Consultant): April 1, 2005
- Contractor Personnel: April 1, 2005
## Minimum Experience Requirements for Contractor Supervisors on Post-Tensioned Projects (Specification 105-5.8)

<table>
<thead>
<tr>
<th>Position</th>
<th>Experience Requirements</th>
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<tbody>
<tr>
<td>Project Engineer</td>
<td>Registered with 5 years general bridge construction experience, 3 years of which were in Post-tensioned (PT) or Segmental construction</td>
</tr>
<tr>
<td>Project Manager/Superintendent</td>
<td>Registered with 5 years or non-registered with 10 years general bridge construction experience, 3 yrs. of which were in PT or Segmental construction</td>
</tr>
<tr>
<td>Foremen</td>
<td>5 years general bridge construction, 2 years of which were in PT or Segmental construction</td>
</tr>
<tr>
<td>Geometry Control Engineer/Manager (Segmentals)</td>
<td>Registered with 1 year of experience or non-registered with 3 years of geometry control experience in the casting yard and in erection of Segmentals</td>
</tr>
<tr>
<td>Lead Geometry Control Surveyor (Segmentals)</td>
<td>1 year of bridge construction surveying</td>
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</tbody>
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## Minimum Experience Requirements for CEI Personnel on Post-Tensioned Projects (CEI Scope Section 10.2)

<table>
<thead>
<tr>
<th>Position</th>
<th>Experience Requirements</th>
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<tbody>
<tr>
<td>Senior Project Engineer</td>
<td>Registered with 5 years general bridge construction experience</td>
</tr>
<tr>
<td>Project Engineer/Manager</td>
<td>Registered with 5 years general bridge construction and 3 years of Post-tensioning (PT) or Segmental. Non-registered with 8 years general and 3 years PT or segmental</td>
</tr>
<tr>
<td>Senior Inspector</td>
<td>5 years general bridge construction and 2 years PT or Segmental, plus for Segmentals, 2 years of geometry control survey experience if performing casting yard inspection</td>
</tr>
<tr>
<td>Casting Yard Engineer/Manager (Segmentals)</td>
<td>Registered with 1 year of casting yard experience or non-registered with 3 yrs. of casting yard experience</td>
</tr>
</tbody>
</table>