

## **2015 STRUCTURES WORKSHOP MINUTES**

The 2015 Structures Workshop was held on March 24<sup>th</sup> in the Structures Management Unit Conference Room C in Raleigh, NC. Those in attendance included:

Tom Koch	State Structures Engineer
Earl Dubin	FHWA – Division Bridge Engineer
Kevin Bowen	State Bridge Construction Engineer
John Pilipchuk	State Geotechnical Engineer
David Chang	State Hydraulics Engineer
Chris Peoples	State Materials Engineer
Glenn Mumford	State Roadway Design Engineer
Jay Twisdale	Assistant State Hydraulics Engineer
Brian Hanks	Assistant State Structures Engineer
Rick Nelson	Assistant State Structures Engineer
Cameron Cochran	Bridge Construction Engineer
Aaron Earwood	Bridge Construction Engineer
Aaron Griffith	Bridge Construction Engineer
Corey McLamb	Bridge Construction Engineer
Johnny Metcalfe	Bridge Construction Engineer
Lee Puckett	Bridge Construction Engineer
Darin Waller	Bridge Construction Engineer
Dean Hardister	Geotechnical – Western Regional Operations Engineer
Scott Hidden	Geotechnical – Support Services Supervisor
Michael Valiquette	Geotechnical – Operations Engineer
Eric Williams	Geotechnical – Western Regional Manager
Jack Cowsert	Materials and Tests – State Materials Quality Engineer
Trudy Mullins	Materials and Tests – Prestressed Concrete Engineer
Randy Porter	Materials and Tests – Metals Engineer
Darren Scott	Materials and Tests – Structural Members Engineer
John Williams	PDEA – Project Development Engineer
David Stark	Priority Projects – Project Executive
Paul Lambert	Structures Management – Project Engineer
Dan Muller	Structures Management – Project Engineer
James Gaither	Structures Management – Engineering Supervisor
Todd Garrison	Structures Management – Engineering Supervisor
Madonna Rorie	Structures Management – Engineering Supervisor
William Goodwin	Structures Management – Staff Engineer

The following topics were discussed:

### ***1. STRUCTURES WORKSHOP WELCOME***

Mr. Koch opened the workshop with welcoming comments. His opening was followed by self-introductions by the representatives present at the workshop.

### ***2. REVIEW OF 2014 STRUCTURES WORKSHOP MINUTES***

Mr. Muller briefly summarized each topic from the 2014 Structures Workshop minutes. The progress of each topic was briefly discussed by the representatives responsible for the action items.

### **3. FHWA TOPICS**

Mr. Dubin gave an update on the MAP-21 federal transportation bill and the Every Day Counts (EDC) Initiatives. He mentioned that the rule-making process and a comment period for MAP-21 are underway to determine realistic measures and targets for pavement and bridge performance on the National Highway System. He briefly discussed three examples of EDC initiatives: Accelerated Bridge Construction (ABC), Ultra-High Performance Concrete (UHPC), and Geosynthetic Reinforced Soil (GRS).

He also discussed the importance of inspection and maintenance to ensure that our bridges function properly under operation for their anticipated life span. This may include development of inspection manuals and training requirements for complex structures.

Action Item:

Technical working groups will be formed with representatives of various NCDOT Units to discuss criteria and evaluate the feasibility of these technologies.

### **4. MATERIALS AND TESTS TOPICS**

#### **a) Metallization PSP Revisions**

Mr. Peoples stated that Materials and Tests are revising the Project Special Provision for Metallization to address inadequacies such as metallization amount, seal coating thickness, and uniformity of application in the field.

Action Item:

Materials and Tests will contact suppliers to discuss material specification requirements and appropriate applications. Materials and Tests will provide the revised PSP to the Construction Unit and AGC for comments.

#### **b) Temporary Bridge Program**

Mr. Peoples stated that Materials and Tests started a program to audit temporary bridge material. In the beginning stages of the program, each supplied temporary bridge will require an audit. Suppliers will need to provide documentation for each bridge segment for inspection.

Action Item:

Once the program initiates and temporary bridges are audited and approved, Materials and Tests will begin tracking and documenting bridge segments.

#### **c) Acceptance of Low Corrosion Inhibitor in Prestressed Concrete Members**

Mrs. Mullins discussed a previous Materials and Tests memorandum distributed in October 1999 which states that a concrete mix requiring 3.0 gallons per cubic yard of calcium nitrite will be accepted if C-20 Chemical Test results show the mix has a 5.1 pound per cubic yard nitrite recovery rate. However, the memo also states that if the test results report a recovery between 5.1 pcy and 5.7 pcy, the mix will be "Accepted Low". Mrs. Mullins stated that Materials and Tests laboratories currently use a target recovery rate of 5.8 pcy; any results below this target will be considered low, but will still be accepted. Mrs. Mullins expressed concern that mixes with test results between 5.1 pcy and 5.7 pcy will be subject to a pay reduction because they are considered low based on the current laboratory requirements, even though the mixes are considered acceptable.

Action Item:

Materials and Tests will review the research in which the corrosion inhibitor requirements are based. M&T will investigate revising the provisions for calcium nitrite corrosion inhibitors.

For prestressed concrete members that involve a pay reduction, M&T will provide the appropriate Resident Engineer with corrosion inhibitor test results; the Resident Engineer will discuss pay reductions with the Construction Unit. The Construction Unit will discuss potential limits for pay reductions.

**5. PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS (PDEA) TOPICS**

Mr. Williams discussed recent changes in the PDEA Unit. He stated that the bridge section of PDEA was eliminated in the summer of 2014, that the Unit now consists of three sections (Eastern, Central, and Western), and that Mr. Goodwin had transferred from PDEA to Structures Management.

No Action Item.

**6. CONSTRUCTION TOPICS**

**a) Expansion Joint Detail for Cored Slab and Box Beam Bridges with Asphalt Overlay**

Construction proposed the use of asphalt plug joints to alleviate noticeable transverse cracking in asphalt wearing surfaces that occur at fixed joint locations for cored slab and box beam bridges. It was noted that Contractors have been allowed on some projects to saw cut the asphalt surface along the centerline of fixed joint and fill the saw cut with silicone sealant. Construction discussed using an asphaltic sealant but anticipated issues due to the heating process that would be required on-site. Construction proposed the allowance of a permitted construction joint in asphalt at fixed joints, with the requirement to fill the joint with a crack sealant product.

Action Item:

Structures Management, Construction, and Materials and Tests will discuss this proposal and investigate asphalt plug joint details and review available product specifications.

**b) Link Slabs**

Construction stated that Contractors have expressed concerns regarding continuous for live load bent diaphragms for prestressed concrete girder bridges, in particular the excessive amount of formwork that is required, the limited access that exists, and the bridge deck/diaphragm cracking that commonly occurs.

Currently, the Design Manual states that link slabs may be practically utilized for span lengths less than 75 feet.

Action Item:

Structures Management will continue investigating and comparing details of link slabs from other States, developing design procedures, preparing details, and refining the criteria for when link slabs may be used as an alternative to continuous for live load bent diaphragms.

Construction will investigate the performance of bridges in service with link slabs.

**c) Constructibility Issues with Extreme Bridge Widths**

Construction stated that due to length limitations of commonly used screeds, Contractors have experienced difficulty pouring extremely wide bridge decks for bridges constructed in a single stage. This difficulty can jeopardize the final rideability of the deck surface.

Action Item:

For future single stage-constructed projects with bridge widths exceeding 90 feet measured along the skew, Structures Management will consult with the Area Bridge Construction Engineer to discuss possible deck pour options, such as partial-width pours and closure pours similar to stage-constructed bridges.

**d) Reinforced Approach Fill Detail**

Construction proposed modifications to the reinforced bridge approach fill detail. Currently, the detail shows the bottom of approach fill sloping towards a drainage pipe located directly behind the bottom of the end bent cap. To prevent drainage towards the end bent cap, Construction proposed changing approach fill such that the direction of slope is away from the cap and relocating the drainage pipe to this location. Also, to prevent erosion in front of the end bent cap before completion of the slope protection, Construction proposed to include Type II fabric under the bottom front-face corner of the cap extending a short distance down the front slope under the slope protection.

Action Item:

Structures Management will set up a workgroup with members from Structures Management, Geotechnical, Construction, Roadway Design, and Hydraulics to discuss issues such as approach slab settlement, embankment degradation, etc.

**e) Concrete Collars Below End Bent Caps**

Construction proposed a modification to the Structures corrosion protection detail for steel piles supporting end bent caps. Currently, the detail shows round concrete collars around each pile below the cap. The end bent BOM implies that the collars should be poured monolithically with the cap and lower portion of the wingwalls. However, since the excavated collar holes are exposed prior to the cap pour and commonly collect rain water, Construction proposed that a permitted construction joint be provided between the bottom of the cap and the top of the collars so that the collars could be poured prior to the cap pour.

Action Item:

Structures Management will discuss this proposal.

**f) Temporary Bridge Special Provision, Minimum Length and Alignment**

Construction discussed a stream crossing project with a temporary detour bridge. The skew between the detour survey line and the stream banks appeared to be approximately 45 degrees. The project special provision for the temporary structure specified a minimum bridge length of 200 feet, but the plans called for a bridge length of about 180 feet. The PSP also states that the bridge could be oriented with a 90 degree skew as long as it is lengthened to accommodate the skew. Since the bridge length was 20 feet shorter than required, construction issues with the front slopes tying into the stream banks resulted in extremely steep and unstable slopes.

Action Item:

Structures Management, Roadway Design, and Hydraulics agreed that for future projects with temporary detour bridges, coordination will be improved to ensure that the bridge length and stations are consistent between each Unit. Also, the Units will discuss possible methods to ensure that the Contractor adequately lengthens the bridge to accommodate the maximum required front slope steepness if the bridge ends are built with a skew that differs from the skew of the stream banks.

**g) Girder Deflection Tables**

Construction discussed various projects in which the sign convention for dead load deflection used in the steel girder camber tables was inconsistent with Structures Management Design Manual Section 6.1.3. The Design Manual states that the sign convention should be positive to represent downward deflection. However, some plans showed deflections with negative values which resulted in incorrectly calculated build-ups in the field; the build-up depths were lower than required.

Action Item:

Structures Management will pay closer attention to steel girder camber tables provided on plans produced by in-house production groups, Design Build teams, and Private Engineering Firms to ensure that the correct sign convention for dead load deflections consistently follow the Design Manual, which requires up and down arrows in the camber tables.

**h) At-Grade Backwalls for Rehab Projects**

Construction discussed older end bents built with at-grade backwalls; i.e. the top of the backwall is level with the approach slab wearing surface and the top of the bridge deck. Continuous abuse from traffic has resulted in the top of the backwalls experiencing extreme damage and requiring rehabilitation.

For some rehab projects involving backwall repair, Construction has removed the damaged section of backwall to a depth below the first layer of reinforcement beneath the top of the pavement bracket. Rapid set concrete was then used to repair the damaged section of backwall. However, repaired backwalls are still experiencing damage and requiring further maintenance. Construction proposed removing a portion of the approach slab concrete (with the approach slab reinforcement intact) along with the section of backwall to gain more reinforcement in the repair region with the rapid set concrete.

Action Item:

Structures Management will discuss and investigate this proposal.

**i) Lateral Guides for Cored Slabs and Box Beam Substructures**

Construction proposed the elimination of lateral guides on end bents and interior bents for cored slab and box beam bridges.

Action Item:

Structures Management has removed lateral guides from the Design Manual and the Cored Slab and Box Beam Standard Design Plans.

**j) Possible Elimination of Transverse Construction Joint Keyways in Reinforced Deck Slabs**

Construction proposed that the detailed keyways for transverse construction joints in reinforced bridge decks be eliminated based on construction difficulties.

Action Item:

Structures Management will discuss the proposal and investigate details from other States.

**k) Caps with Continuous Hook Bars**

Construction stated that for bent caps with columns, placement of the main reinforcing bars located near the bottom of the cap is often difficult. The column bars extending into the bottom region of the cap contain hooks which make it difficult to lower the main bars into position and the bent cap bars contain hooks on both ends which often make it challenging to slide them through the column bars and into position. Construction proposed that a lap splice be detailed in the bottom of cap reinforcing bars when reinforced columns are utilized.

Action Item:

Structures Management will discuss this proposal.

**l) Nonparallel MSE Walls and End Bents**

Construction discussed challenges encountered on a bridge project with MSE walls. The skew between the bridge and roadway under was severe (approximated 145 degrees), but the end bents were orientated radial to the curve. The MSE wall was oriented parallel to the roadway under. Due to the major skew difference between the end bent and the wall, the reinforcement zone of galvanized steel straps behind the MSE wall did not extend underneath the full footprint of the approach slab as intended. Tying in the slope protection was also challenging due to the skew difference. Construction suggested that the MSE walls be oriented parallel to the end bents for future projects.

Action Item:

Structures Management will create a workgroup with Construction, Geotechnical, and Roadway Design to discuss issues regarding bridges with MSE walls. The workgroup will discuss topics such as wall orientation.

**m) Possible Roadway and Structures Training by BCE's Regarding Bridge Geometry**

Construction offered to provide training to members of Roadway Design and Structures Management. In this training, the Area Bridge Construction Engineers would discuss bridge geometry that is problematic during construction. These issues would include but would not be limited to combinations of skews, crowned bridge sections, variable superelevations, and vertical curves.

Action Item:

Structures Management and Roadway Design will discuss this training opportunity.

**7. STRUCTURES MANAGEMENT TOPICS**

**a) Oregon and Alaska Rails**

Structures Management briefly discussed the availability of 32" Alaska and 42" Oregon rails. Mr. Hanks stated that these open rails should only be used for bridge replacement projects when

required for State Historic compliance or for storm water conveyance. Details are available for bridges with cast-in-place decks, cored slabs, and box beams.

No Action Item.

**b) Cored Slab and Box Beam Post-Tensioning**

Structures Management discussed the occasional uplift of exterior cored slabs and box beams during post-tensioning. Construction noted possible corrective procedures such as partially post-tensioning the units, pouring the grout in the shear keys between the exterior units and adjacent interior units, then completing the post-tension.

Action Item:

Structures Management and Construction will continue to discuss the issue and search for a trial project to implement the previously described procedure. Structures will investigate the shear key design in an effort to alleviate the occurrence of uplift.

**c) 2'-0" Rip Rap Detail at End Bent Caps**

Structures Management discussed the rip rap detail that is provided on plans for stream crossings. The detail shows the bottom of the rip rap in front of the end bent cap located below the cap bottom. However, Construction stated that when the front slopes are excavated and the area for the end bent cap is graded, no further excavation in front of the cap and below the bottom of the cap is performed. Therefore, the bottom of the rip rap is level with the bottom of end bent cap.

Hydraulics suggested the use of Class B instead of Class II rip rap, but concluded that Class B rip rap may potentially wash away during a flood event due to its small size.

To prevent erosion under the end bent cap, Construction proposed to include Type II fabric under the bottom front-face corner of the cap extending a short distance down the front slope under the rip rap.

Action Item:

Structures Management will discuss this proposal.

**d) Double Saw Cut for Joint Header Demo**

Structures Management discussed bridge preservation projects involving joint repairs with elastomeric concrete. Typically, the existing joint is saw-cut once at the back side of the header before the concrete is chipped out. Construction mentioned a project in which a large amount of concrete surrounding the joint was removed due to the damage caused by the process.

Structures Management proposed to add at least one more saw cut within the repair area to facilitate removal.

Action Item:

Structures Management and Construction will further discuss this topic. Structures will also investigate the possibility of eliminating elastomeric headers for these types of repairs.

**e) Plan Quantities Class II and III Repairs for LMC and Steel Repairs**

Structures Management discussed whether or not to provide fictitious Bill of Material quantities for Class II and Class III repairs for bidding purposes if those types of repairs are not anticipated.

Action Item:

Structures Management and Construction will continue to discuss.

**8. GEOTECHNICAL TOPICS**

**a) Update on Geosynthetic Reinforced Soil – Integrated Bridge System**

Mr. Pilipchuk provided an update on a pilot bridge project located in Anson County that will use the Geosynthetic Reinforced Soil – Integrated Bridge System technology. The bridge plans have been completed and the project will be let for bid later this year. Mr. Pilipchuk briefly discussed the GRS details provided by the Geotechnical Unit that were incorporated into the Structures plans. Mr. Hanks mentioned that this bridge location was selected due to the low probability of scour and overtopping.

Action Item:

Once this pilot bridge is in service, performance will be monitored to determine if the GRS technology is suitable for other projects with similar site conditions.

**b) Wall Alignment and Wall versus Slope Protection Under Bridges**

As discussed at the 2014 Structures Workshop, Geotechnical and Structures Management need to discuss and develop criteria for the use of MSE walls or abutment walls instead of concrete slope protection on bridge projects.

Action Item:

Structures Management will collaborate with Geotechnical, Roadway, Construction, and Hydraulics to form a work group. The purpose of the group will be to discuss criteria and develop a policy for MSE walls, including MSE wall alignment, geometry and other details.

**c) New Grout Specifications**

Mr. Hidden provided an update on revisions to grout specifications. Currently, the NCDOT Approved Products List categorizes grout as “Grouts – Other” and “Non-Shrink Grout”. As a result of the specification revision, grouts will be classified into different types (Type 1 through Type 5) on the Approved Products List. The more commonly used grouts will be Type 3 and Type 2. Type 3 grout will be grout for structures used in above-ground applications. Type 2 grout will be non-shrink grout used in below-ground applications. In the future, Section 1003 of the Standard Specifications will be replaced with the contents of the new grout specification.

Mr. Hidden explained that producers of pre-mixed grout were notified of this revision and were asked to resubmit their products through Value Management as particular grout types. Materials and Tests will review resubmitted products to ensure that the requirements of certain grout types are met. Mr. Bowen stated that there will probably be a grace period during the reclassification process in which products currently on the APL may still be used.

No Action Item.

**d) Footings on MSE Abutments**

Mr. Hidden stated that this topic could be further discussed in the work group for MSE wall policy.

Action Item:

See action item listed in Geotechnical Topic (b).

## **9. HYDRAULICS TOPICS**

Mr. Twisdale briefly discussed the importance of consistency between contract plans and as-built plans. He mentioned that excavation shown on the General Drawing of the Structures plans is particularly significant for as-built verification.

Action Item:

Hydraulics and Structures Management will continue to discuss improvements to Structures plan sheets for as-built certification and ways to verify that critical information is being certified.

## **10. SPRING FIELD REVIEW ITINERARY**

Prior to the Structures Workshop, Mr. Muller and the Bridge Construction Engineers discussed possible bridge sites to visit on the Spring Field Review trip. Structures Management prepared a map including all of the suggested bridge locations in the eastern part of North Carolina. Following the workshop, representatives from the Structures Management, Construction, and Geotechnical Units reviewed this map and discussed potential routes for the trip. Structures Management will continue to discuss bridge sites and routes with Construction and Geotechnical to finalize the trip, which will be scheduled for early May (specific dates to be determined).