

## MINUTES OF 2007 STRUCTURE WORKSHOP

The 2007 Structure Workshop was held on March 22<sup>nd</sup> in the Structure Design Unit Conference Room C in Raleigh. Those in attendance included:

Greg Perfetti	State Bridge Design Engineer
Tom Drda	FHWA Division Bridge Engineer
John Emerson	State Bridge Maintenance Engineer
Dave Henderson	State Hydraulics Engineer
Ron Hancock	State Bridge Construction Engineer
Njoroge Wainaina	State Geotechnical Engineer
Jay Bennett	State Roadway Design Engineer
Victor Barbour	State Project Services Engineer
Ricky Keith	Assistant State Bridge Design Engineer
Allen Raynor	Assistant State Bridge Design Engineer
Dan Holderman	Assistant State Bridge Maintenance Engineer
Ernesto Villalba	FWHA-Assistant Division Bridge Engineer
Tom Koch	Structure Design Project Engineer
Gichuru Muchane	Structure Design Project Design Engineer
David Stark	Structure Design Engineer
Jeff Vones	Structure Design Engineer
David Snoke	Structure Design Engineer
Mike Robinson	Bridge Construction Engineer
Max Buchanan	Bridge Construction Engineer
Lee Puckett	Bridge Construction Engineer
Billy Trivette	Bridge Construction Engineer
Rick Nelson	Bridge Construction Engineer
Moy Biswas	Research and Analysis - Assistant Branch Manager
Neal Galehouse	Research and Analysis - Research Engineer
Jack Cowsert	Materials and Tests - State Materials Quality Engineer
David Greene	Materials and Tests - Structural Members Engineer
Steve Walton	Materials and Tests - Metals Engineer
Chris Peoples	Materials and Tests - Chemical Testing Engineer
Trudy Mullins	Materials and Tests – Prestressed Concrete Engineer
Bill Medford	Materials and Test (Ret.)
Scott Hidden	Geotechnical Support Services Supervisor
David Hering	Geotechnical Investigations Supervisor
K.J. Kim	Geotechnical Eastern Regional Manager
Chris Kreider	Geotechnical Eastern Regional Operations Engineer
James Batts	Geotechnical Eastern Regional Design Engineer
John Pilipchuk	Geotechnical Western Regional Manager
John Fargher	Geotechnical Western Regional Design Engineer
Dean Hardister	Geotechnical Western Regional Operations Engineer
Bill Goodwin	PDEA – Bridge Development Unit Head
John Williams	PDEA – Project Planning Engineer Supervisor
Bryan Kluchar	PDEA – Project Planning Engineer Supervisor
Nilesh Surti	Design- Build Engineer

The following items of business were discussed:

**1. WELCOME:**

The workshop kicked off with self-introductions.

Mr. Drda welcomed all attendees to the meeting, noting that the Structure Workshop and Spring Tour are remarkable meetings that really open up lines of communication between various disciplines within the Department. Mr. Drda also briefly discussed the Department's challenge of building and maintaining the state's transportation structures in a climate of rising costs coupled with reduced funding.

**2. REVIEW OF THE 2006 STRUCTURE WORKSHOP MINUTES** *(STRUCTURE DESIGN)*

Mr. Perfetti began the meeting with a review of the minutes for 2006 Structure Workshop. He suggested a mid-year follow-up meeting to review progress on any action items in lieu of waiting for the annual structure workshop.

The status of the 2006 Structure Workshop action items was reported as follows:

- **CSL Tubes** - The Geotechnical Engineering Unit is not recommending their use in drilled shafts where problems are unlikely. The Unit's long-term goal is to develop a comprehensive CSL Tube policy, which is currently under development.
- **Precast substructure project** (B-3349 – Hyde County) – The project will be one of the sites visited on the 2007 Spring Field Tour.
- **Type, Size, & Location** – The various disciplines within the Department have made a lot of progress in communicating and recommending more suitable structure types. The Hydraulics Unit is a CPI Award winner in the communication category.
- **Studs on Overhead Signs** – The Signing Unit continues to investigate this issue. A meeting is scheduled for May 2007.
- **Cost of Offsite Detours** – FHWA sees the need for action on this item. Mr. Perfetti will bring this issue up for discussion at a Bridge Team meeting.
- **Field Welder Certification** – The program is now underway and is a CPI Award finalist in the Customer Service Category. However, there have been some problems with notifying contractors of the requirement for NCDOT certified welders. Contractual Services Unit will place notification in the letting advertisement.
- **Concrete Issues** – The Materials and Tests Unit added more standard concrete mixes to the 2006 Standard Specifications.
- **Barrier Rail Steel** – The Structure Design Unit has implemented detailing 2-piece "S" bars in the parapet of 2 Bar Metal Rails and Vertical Concrete Barrier Rails.
- **Expansion Joint Details** – The Structure Design Unit is developing an alternate detail for installing the armor angle on armored evazote joints. Submittal of the joint installation plan will still be required as a means to monitor the proposed type of elastomeric concrete for the joint headers.
- **Screeding on skews** – The Roadway Unit has a draft memorandum on how to handle situations with complicated geometric conditions. It was noted that the issue is bigger than just screeding, and will require a lot of inter-unit coordination.

For screeding purposes, the Bridge Construction Engineers requested that Structure Design submit, for their review, a plot of the centerline (control line) elevations at tenth points and

cross-sections along the skew with the superelevation run out and reverse crown on the bridge when applicable. Mr. Trivette will initiate a follow-up discussion with the Structure Design Unit on this action item.

- **Micropiles & Auger Cast Piles** – The Geotechnical Unit has initiated a micropile research project. It was noted that on a recently let project the micropile foundation alternate was not selected due to costs associated with proof load testing.

3. ***EFFECT OF SALT BRINING ON BRIDGES*** *(STRUCTURE DESIGN)*

Mr. Perfetti showed pictures that showed accumulated brine residue (salt) on bridge girders. The source of the salt is the numerous applications of pre-emptive brining by the Division offices. Discussion of this issue noted the following:

- The Bare Pavement Policy provides for direct application of deicing chemicals to routes on the Bare Pavement System, US and NC routes, and paved secondary routes.
- The long-term effects of repeated brining have not been considered.
- The Bridge Maintenance Unit is considering initiating a deck and girder washing program.
- This is a national issue/problem, which is now appearing in NC due to more frequent brining.

**Action Item(s):**

- ▶▶ Mr. Drda will discuss the issue with the Operations staff.
- ▶▶ The Bridge Maintenance Unit will discuss the issue at the Maintenance Conference.
- ▶▶ Mr. Perfetti will raise the issue at a Bridge Team meeting.
- ▶▶ Structure Design Unit will develop a detail for drip beads on steel girders and consider a longer painted section at the ends of weathering steel girders.
- ▶▶ Dr. Biswas will develop an NCHRP problem statement.

4. ***PRELIMINARY BORINGS FOR BRIDGES:*** *(STRUCTURE DESIGN)*

There was a short discussion on how well the new process for early preliminary borings is working. This topic has been an issue at the 4B-4C meetings, and sometimes at the 2A meetings. The Roadway Design Unit initiates the boring request. The Geotechnical Unit (GEU) reported that they have been doing preliminary borings for a long time, but may not have always sent copies of the borings to all Units. Over the last 8 – 9 months Structure Design has been receiving the borings. Borings completed prior to the last 8 or 9 months are available and may be requested from GEU.

**Action Item(s):**

- ▶▶ Structure Design Unit will inform their staff that all preliminary borings are available.

5. ***LRFD IMPLEMENTATION:*** *(STRUCTURE DESIGN)*

Structure Design Unit's progress toward implementing LRFD design specifications was discussed. The discussion noted some anticipated effects of the new specifications on the amount of steel reinforcement in decks and substructure elements. There was also a discussion on the progress toward implementing LRFR bridge ratings for bridges designed by LRFD specifications.

**Action Item(s):**

- ▶▶ Bridges designed by the LRFD specifications shall be rated by LRFR.
- ▶▶ Structure Design will perform the initial LRFR bridge rating after completing the design.

**6. BOX BEAM PERFORMANCE / APPROPRIATE USE:** (STRUCTURE DESIGN)

Box beam girders, which have now been in use for a couple of years, were discussed. It was noted that the upcoming revision to the Bridge Policy will provide some general guidance on their use as a function of the roadway classification. The discussion emphasized that girder bridges with a cast-in-place deck remains as the first choice bridge type, and that box beam bridges are not suitable for locations that require staged construction, have a heavy skew, or have heavy traffic. Box beams are generally utilized in locations where girder bridges with a cast-in-place deck cannot be used. The Structure Design Unit is reviewing the design details for performance enhancements.

**Action Item(s):**

- ▶▶ Structure Design will review the design details to determine if it is possible to improve load sharing between the box beams.

**7. BAT BRIDGES:** (STRUCTURE DESIGN)

The Department frequently receives requests to build bat-friendly bridges, but the lack of an existing policy raises questions on the feasibility of meeting these requests. There was a discussion on funding issues, maintenance concerns, possible construction moratoriums, possible health hazards to maintenance staff, and the possible predicament of endangered species inhabiting the bridge. There was a consensus to suggest the South East Bat Conservatory support building chimney-like bat structures at a suitable location close to the bridges, and discourage bats to building nests on the bridge.

**Action Item(s):**

- ▶▶ Bridge Maintenance and FHWA will each send a letter to Structure Design stating their concerns.
- ▶▶ Structure Design (Ricky Keith), after receiving the letters, will draft a collective statement articulating the Department's policy on constructing bat-friendly bridges.

**8. MINIMIZING RAILROAD FLAGGING:** (STRUCTURE DESIGN)

Railroad flagging cost overruns were discussed. The discussion explored various ideas for containing flagging costs. Suggestions included A+B bidding, where there is a line item for flagging, and bidding similar to "lane rental," where the Department specifies the flagging unit cost and the contractor determines the required number of days for flagging.

**Action Item(s):**

- ▶▶ Structure Design will discuss the issue with contractors at the next AGC-DOT meeting.
- ▶▶ Structure Design will investigate the use of a couple of different methods for flagging payment on a trial basis.

**9. B-77 GRAU - RUBRAIL ATTACHMENT** (STRUCTURE DESIGN)

The B-77 guardrail anchor unit (GRAU), which the Department is now using for attaching guardrail to the New Jersey barrier rail on the bridge, was discussed. The guardrail component of the anchor unit is attached to the barrier rail with a bolt-through detail, and the rub-rail component, which is bent and twisted, is attached with  $\frac{5}{8}$ "  $\phi$  adhesive anchors.

There was a general discussion on the use of adhesive anchor bolts and the testing requirements. For the GRAU application, the Construction Unit recommended larger diameter adhesive anchor bolts, and discouraged the use of mechanical anchors in this application.

**Action Item(s):**

- ▶▶ Structure Design (Gichuru Muchane) will coordinate with Roadway Design to implement 3/4" adhesive anchors for the rubrail.

**10. NEW FEDERAL GUIDELINES ON WASTE AND ABUSE:**

*(FHWA)*

Mr. Drda briefly discussed external reviews of state programs, which are finding more instances of lack of documentation and written procedures. As such, oversight, risk and waste assessment is a current priority for federal auditors.

**Action Item(s):**

- ▶▶ None

**11. JOINTS ON LONG BRIDGES:**

*(FHWA)*

Eliminating joints on long bridges was discussed. The discussion examined the various types of joints the Department uses, their merits with respect to installation and performance, and the relative cost-benefit. The discussion settled on encouraging more jointless / integral abutment bridges and being open to using other types on joints.

**Action Item(s):**

- ▶▶ None

**12. USE OF BRIDGE DEMOLITION DEBRIS:**

*(FHWA)*

The current transportation bill, SAFETEA-LU, mandated that State Departments of Transportation should make bridge demolition debris available to interested state agencies. Possible methods for implementing this mandate were discussed, focusing on various ways to advertise the available debris. This mandate needs to be addressed in a comprehensive manner that includes logistical, legal, and fiscal issues. The consensus was to take the initial step of drafting a policy on advertising the debris.

**Action Item(s):**

- ▶▶ FHWA (Tom Drda), PDEA (Bill Goodwin), and Project Services' Contract Office (Victor Barbour) will draft a policy on how the debris will be made available.

**13. PILE JETTING:**

*(FHWA)*

The status of the completed pile jetting research was discussed. It was reported that the regulatory agencies are open to permitting jetting if they know how it will be performed. There was consensus to proceed with a small trial project and subsequent drafting of a policy to implement the research findings.

**Action Item(s):**

- ▶▶ Geotechnical Engineering will take the lead in developing a preliminary pile jetting policy and finding a suitable trial project.

**14. ONGOING RESEARCH PROJECTS:**

*(RESEARCH & ANALYSIS)*

Mr. Neal Galehouse, who recently joined the Research and Analysis Unit, was introduced. Mr. Galehouse will be managing Structure Design's research projects.

The Research and Analysis Unit gave a presentation on upcoming, current, and recently completed research projects. Structure Design, Construction, and Bridge Maintenance Units were encouraged

to initiate more research. Structure Design noted that the Unit had not initiated more research projects over the past year because the priority has been to prepare to implement the LRFD design specifications.

**Action Item(s):**

- ▶▶ None.

**15. ARMORED JOINTS ON SMITH CREEK PARKWAY:**

*(CONSTRUCTION)*

The Construction Unit initiated a discussion on failures of the armor angle in armored joints. The failures generally involve the armor angle breaking away from the welded studs. The discussion noted that welding the studs on to the angle is a difficult process. In addition, the weld is difficult to inspect when flaws are not visible, and the Standard Specifications lack acceptance criteria. It was unclear whether the failures were related to the performance of the elastomeric concrete in the joint headers.

Dr. Janos Gergely is conducting a research project on elastomeric concrete, and he will be informed about the sites with armor angle failures so that he may conduct some case studies as part of the research. In addition, the Materials and Tests Unit would like to analyze the angles that have failed on Smith Creek Parkway to determine the cause of failure.

It was also suggested that the Department create an internal web-based message board, where various DOT personnel can share information and field experiences.

**Action Item(s):**

- ▶▶ The Construction Unit (Mr. Hancock) will communicate with Dr. Gergerly regarding the location of joint armor angle failures.
- ▶▶ The Construction Unit (Mr. Robinson) will coordinate removal of the failed angle on Smith Creek Parkway and send it the Materials and Tests Unit (Mr. Walton).

**16. INTEGRAL ABUTMENTS:**

*(MATERIALS AND TESTS)*

The Construction Unit displayed and discussed some [pictures](#) that showed various constructibility challenges of bridges with integral abutments. Many of these challenges arise because integral abutment bridges require the approach fill to be placed after the majority of the superstructure has been constructed. The pros and cons of allowing placement of the approach fill prior to construction of the superstructure were discussed. There was consensus to accommodate contractors who devise innovative and acceptable methods of constructing integral abutment bridges, including methods where the approach fill is placed before the superstructure is constructed.

The Construction Unit also reported that the 4"ϕ corrugated PVC drain pipe often gets crushed during placement of the reinforced approach fill. A 4"ϕ Schedule 80 perforated PVC pipe was suggested in lieu of the corrugated PVC pipe.

The Construction Unit noted that our current approach fill detail, which requires the approach slab sub-base to extend beyond the length of the approach slab, creates a pavement section that is susceptible to cracking. It was suggested that the sub-base terminate at the end of the approach slab for all bridges.

**Action Item(s):**

- ▶▶ Structure Design will develop a plan note to permit placement of the reinforced approach fill prior to the deck pour for integral abutment bridges. Contractors will be required to submit their plan for constructing the approach fill and backwall formwork for review.
- ▶▶ Structure Design will revise details on Standard Drawings to show a PVC approach fill drain pipe, and the sub-base material terminating at the end of the approach slab.

**17. EXCESSIVE STEEL GIRDER ROTATION AT END BENTS:** *(CONSTRUCTION)*

The Construction Unit reported that there are more instances of excessive steel girder rotation at the end bents, which causes the partially hardened deck concrete at the header to settle and in some cases tear or crack. After some discussion a closure pour on the trailing end of the deck pour was recommended for long spans. The closure pour should be detailed 3' beyond the first diaphragm on bridges that meet any of the following criteria:

- Simple spans that are greater than 100'.
- Continuous spans that are greater than 150'.
- Spans on a heavy skew.

**Action Item(s):**

- ▶▶ Structure Design will develop a policy for detailing a closure pour for long span steel girder bridges.

**18. ACUTE CORNER CRACKING IN CORED SLAB UNIT:** *(MATERIALS & TESTS)*

The Materials and Tests Unit reported instances where the acute corners of cored slabs have been cracking off while the units are still at the concrete plant yard. The problem is observed most on cored slabs for skews between 60o and 70 o. A bevel to curtail the cracks and spalls was preferred over repairs with a patching material. The Materials and Tests Unit will investigate the issue further.

**Action Item(s):**

- ▶▶ Materials and Tests Unit will investigate this issue and make a recommendation for mitigation.

**19. WELDING SIP FORMS TO THE TOP FLANGE:** *(MATERIALS & TESTS)*

The Materials and Tests Units discussed a current national issue on welding to the top flange of steel girders. It was recommended that the Department move away from welding to the top flange and instead use straps, similar to those used in the tension areas, along the entire length of the top flange. The discussion noted that there were no overwhelming technical reasons for disallowing welding to the top flange, but rather it was better construction practice. However, since the Materials and Test Unit has recently implemented a field welder certification program, it was felt that the Unit should investigate this issue further.

It was also noted that there is now a special provision to notify contractors of the requirement for NC certified welders for all DOT projects.

**Action Item(s):**

- ▶▶ Materials and Tests Unit (Steve Walton) will further investigate this issue and draft a special provision.

## **20. FASTENER INSPECTION CERTIFICATION:**

*(MATERIALS & TESTS)*

The Materials and Tests Unit reported that there is still a lot of confusion over the proper use of direct tension indicators (DTIs) for bolt installation. The Unit would like to implement a certification program, but Contractors are not in favor of an additional certification. The discussion explored various ideas for educating Contractors on proper bolt installation. There was a consensus to develop a special provision and/or plan note to require contractors to attend a bolting class prior to erecting bolted structural steel members. The class would involve M&T personnel going from project to project with a Skidmore on a mobile rig to demonstrate and instruct construction workers on proper bolt installation.

### **Action Item(s):**

- ▶▶ Materials and Tests Unit (Steve Walton) will facilitate the bolting class.

## **21. ANCHOR BOLT TIGHTENING:**

*(MATERIALS & TESTS)*

The Materials and Tests Unit reported that they are still finding anchor bolts that are not tightened sufficiently. In most cases the leveling nuts are not tightened. The discussion noted that the Traffic Unit has a special provision that provides a procedure for proper anchor bolt tightening. The special provision states the minimum period that should elapse after the sign structure is installed prior to tightening the leveling nuts. However, a maximum period is not stated and some contractors fail to return to tighten the bolts. M&T also noted that they are not always called on to inspect sign structures.

There was consensus to correct the special provision to require the leveling nuts be tightened between 48 and 96 hours after the sign structure is installed. It was also recommended that new ASTM specification for large anchor bolts be reviewed for possible additional information. Anchor bolt tightening for sign structures will be handled through direct discussion with the contractors.

### **Action Item(s):**

- ▶▶ Structure Design (Allen Raynor) will request that the Signing and Signals Unit (Debesh & Ron King) correct the special provision, and ensure that the procedure is utilized.
- ▶▶ Structure Design (Paul Lambert) will investigate if the special provision is applicable to structures for signals and signs.

## **22. PAINTING STRUCTURES FOR AESTHETICS:**

*(MATERIALS & TESTS)*

The Materials and Tests Unit reported that more towns and municipalities are painting guardrail, barrier rails, traffic control boxes, and other appurtenances for aesthetic reasons. The paint systems that are often used are not suitable for these applications and often require repainting after a short period of time. M&T wanted to inform everyone so that these situations can be avoided. They also noted that shop painting provides the best quality coating and workmanship. It was recommended that the Department work with paint manufactures to develop a few standard colors that can be recommended to towns and municipalities.

### **Action Item(s):**

- ▶▶ When there is a request to paint for aesthetics, all Units involved should coordinate with the Materials and Tests Unit (Chris Peoples) early in the process so the paint is applied in the shop.
- ▶▶ Materials and Tests Unit (Chris Peoples) will coordinate development of standard paints and colors.



**23. THERMAL SPRAYED COATING:**

*(MATERIALS & TESTS)*

Mr. Bill Medford gave a presentation on the benefits and performance of thermal sprayed coatings (metallizing). It was noted that the Department does specify metallizing in some applications, but he encouraged the Department to consider its expanded use. The number of fabrication shops that are qualified to metallize and the cost of metallizing compared to other corrosion protection measures discourage its expanded use.

**Action Item(s):**

▶▶ None.

**24. MSE WALLS:**

*(GEOTECHNICAL)*

The Geotechnical Engineering Unit gave a [presentation](#) on the Unit's effort to revise the policy and special provision on mechanically stabilized embankment (MSE) walls. The presentation recognized the current state of the retaining wall industry, which includes the widespread use new types of modular block walls by developers,. The revised policy states approved applications for each type of MSE wall and the revised special provision provides guidance on constructing MSE walls.

**Action Item(s):**

▶▶ None.

**25. PAVEMENT SETTLING IN ELIZABETH CITY:**

*(GEOTECHNICAL)*

The Geotechnical Engineering Unit (GEU) gave a [presentation](#) on the issues and challenges of stabilizing pile supported roadway slabs and pavement in Elizabeth City (TIP U-4438). The presentation discussed the history of the project area including previous maintenance initiatives. Information on current preliminary investigations was also presented. The Geotechnical Unit is working in conjunction with the Structure Design Unit to develop feasible solutions.

**Action Item(s):**

▶▶ None.

**26. ABUTMENT SCOUR:**

*(GEOTECHNICAL)*

The Geotechnical Engineering Unit gave a [presentation](#) on abutment scour. Increased awareness and foundation design that accounts for scour has resulted in a significant increase in use of drilled pier foundations. Drilled piers add significant bridge costs to the project. In response, the Geotechnical Engineering and Hydraulics Units are collaborating on interpreting and refining scour prediction models.

**Action Item(s):**

▶▶ None.

**27. PILE TONNAGE VERIFICATION:**

*(STRUCTURE DESIGN & GEOTECHNICAL)*

The Structure Design Unit reported that they have been working with the Geotechnical Engineering Unit (GEU) to transition to higher tonnage piles. Higher tonnage piles will be necessary for deep foundations of bridges designed with the new LRFD Specifications. As such, in the near future construction personnel can expect to see plans with higher tonnage piles. This matter has been discussed at the AGC-DOT Committee and Contractors expect that D-19 hammers or larger have sufficient energy to verify the higher tonnages. However, GEU is reviewing the current policy of requiring verification of the twice the pile capacity for piles bearing on rock.

The Geotechnical Unit recognizes that in many applications Structure Design has a practical minimum number of piles and very high tonnage piles may not be necessary. As such they are evaluating practical limits for foundation recommendations. Their next step will be to develop plan notes for hammer energy ranges and pile tonnage verification.

**Action Item(s):**

- ▶▶ Geotechnical Engineering Unit (Njoroge Wainaina) will continue preparations for the transition to higher tonnage piles and plan to meet with FHWA (Tom Drda) in July.

**28. OTHER:**

*(GENERAL)*

The Construction Unit discussed the issues and challenges of [6 bridge replacements](#) on NC 12 on Ocracoke Island (TIP B-5016). The project will have an 8-week advertisement period and will be let in July 2007. NC 12 is the only major road on the island and it will be closed on January 1, 2008 for construction. The remote location and lack of alternate access necessitates a short road closure period of approximately 75 days. The contractor will be permitted to begin stockpiling precast bridge elements, materials, and equipment in October 2007. Discussions on the logistics are ongoing to ensure a successful project.

**29. SPRING FIELD REVIEW ITINERARY:**

*(STRUCTURE DESIGN)*

Mr. Koch distributed a proposed itinerary for the Spring Field Review tour. He gave a brief overview of the itinerary. He also welcomed suggestions for additional sites of interest that were in the vicinity of the basic itinerary.