

MINUTES OF 2005 STRUCTURE WORKSHOP

The 2005 Structure Workshop was held on March 10th in the Bridge Maintenance Unit Conference Room in Raleigh. Those in attendance included:

Greg Perfetti	State Bridge Design Engineer
Tom Drda	FHWA Division Bridge Engineer
John Emerson	State Bridge Maintenance Engineer
David Henderson	State Hydraulics Engineer
Ron Hancock	State Bridge Construction Engineer
Njoroge Wainaina	State Geotechnical Engineer
Jay Bennett	State Roadway Design Engineer
Ricky Keith	Assistant State Bridge Design Engineer
Allen Raynor	Assistant State Bridge Design Engineer
David Chang	Assistant State Hydraulics Engineer
Henry Black	Assistant State Bridge Maintenance Engineer
Mike Robinson	Bridge Construction Engineer
Tom Koch	Structure Design Project Engineer
Paul Lambert	Structure Design Project Engineer
Gichuru Muchane	Structure Design Project Design Engineer
David Stark	Structure Design Engineer
Max Buchanan	Bridge Construction Engineer
Lee Puckett	Bridge Construction Engineer
Billy Trivette	Bridge Construction Engineer
Rick Nelson	Bridge Construction Engineer
Don Idol	Bridge Maintenance Assistant Inspection Engineer
Rich Lakata	Research Engineer
David Greene	Structural Members Engineer
Jack Cowsert	State Materials Quality Engineer
Steve Walton	Metals Engineer
Owen Cordle	Physical Testing Engineer
Chris Peoples	Chemical Testing Engineer
Brian Hunter	Assistant Physical Testing Engineer
Scott Hidden	Geotechnical Support Services Supervisor
Chris Chen	Geotechnical Technical Support Supervisor
Shane Clark	Senior Geotechnical Engineer
Chris Kreider	Regional Operations Geotechnical Engineer
Hank Schwab	Project Development Engineer
John Williams	PDEA Project Development Unit Head
Bill Goodwin	PDEA Bridge Development Unit Head
Chavonda Pighat	PDEA
Ernesto Villalba	FWHA-North Carolina
Rodger Rochelle	State Alternate Delivery Systems Engineer
Shannon Lasater	Design-Build Engineer
Virginia Mabry	Design-Build Engineer

The following items of business were discussed:

1. INTRODUCTION:

Mr. Koch welcomed all in attendance and introduced Mr. Tom Drda - the new FHWA Division Bridge Engineer. Mr. Perfetti provided some opening remarks noting that the Structure Workshop and Spring Field Tour were unique forums with multi-unit participation.

Mr. Drda, as co-host of the workshop, expressed his appreciation for the warm welcome to North Carolina. He also welcomed everyone and noted that the Structure Workshop was an exceptional forum because of the benefits of having the participation of many of the Departments decision-makers.

2. SCOPING BRIDGE REPLACEMENT PROJECTS: *(STRUCTURE DESIGN)*

Mr. Perfetti stated that over the last few years there had been a steady increase in bridge replacement costs, especially for off-system (non-NHS) projects. Comparatively on-system project costs had remained fairly stable, as supported by the following data:

Unit Bridge Cost per Square Foot			
	2002	2003	2004
Off System	\$68	\$73	\$83
On System	\$73	\$72	\$72

As a result, Structure Design has been reviewing proposed span arrangements on off-system bridges, many of which are cored slab bridge projects. Mr. Perfetti showed examples of several projects where substructure cost savings could be realized by selecting an alternate superstructure type. Mr. Keith noted that Structure Design understands that environmental and context sensitive design issues often place many constraints on the bridge project. However, he noted that on some of the smaller projects, a single spanning structure would diminish many of the constraints.

Mr. Henderson stated that when the Hydraulics Unit chooses a bridge type and span arrangement, the decision is often influenced by the following criteria (in order of importance):

- 1) Hydraulic requirements,
- 2) No Impact on 100 year flood conveyance zone (Flood Insurance Program),
- 3) Eliminating bents at the waterway banks due to scour and stability, and
- 4) Elevated environmental awareness and restrictions, such as bents in the water.

Mr. Henderson noted that cored slab bridges offered a shallow superstructure, which is favorable for hydraulic opening and flood conveyance requirements. He added that the span arrangement was site specific and the Hydraulics Unit considers the cost of the superstructure in addition to potential for debris accumulation around battered piles.

Mr. Hancock stated that spans shorter than 30 feet were problematic and should be reviewed carefully. He added that bridge replacements in the same location often create a conflict with

the existing structure. He inquired if a bridge survey report review between Hydraulics and Structures was warranted.

Mr. Koch stated that the use of drilled shaft foundations on cored slab bridges was an inefficient substructure type that adds significant costs to the bridge project. Mr. Hidden noted that the substructure type is determined by the subsurface soil conditions.

Mr. Chang stated that the Hydraulics Unit would work closely with the Geotechnical Unit to decide on the most suitable type of substructure. He added that the new merger process would work out some of the issues that have been raised. Mr. Keith suggested reviewing the proposed span arrangements once the Geotechnical Unit has completed the subsurface borings. Mr. Keith added that Structure Design Project Engineers would develop some triggers for reviewing span arrangements and would work closely with the Hydraulics Unit to determine the most suitable type of superstructure.

Mr. Perfetti encouraged the Hydraulics Unit to consider other superstructure types such as Box Beams, which can span farther than cored slabs, High performance Steel (HPS), which permits shallow superstructures, and alternate substructure details for shortening spans, such as use of tall end bents.

Mr. Hidden noted that drilled piers were not the problem; it is their use for 30-foot spans. Mr. Koch stated that every bridge is unique and that it should be handled on a case by case basis.

Mr. Perfetti inquired if it was too late to make changes to the structure type after Mr. Keith has reviewed the preliminary general drawing. Mr. Bennett stated that these topics should be discussed early on, but the Roadway Design Unit will accommodate changes where possible.

Mr. Keith went over the main points, noting that the discussion:

- Raised awareness of the importance of span arrangements as it relates to bridge cost,
- Demonstrated the need for closer coordination of bridge layout process between Structure Design, Hydraulics, and Geotechnical Units,
- Raised awareness of the need to educate NCDOT engineers on ways to eliminate piers,
- Demonstrated that continued inter-unit discussions will increase communication between Units
- Demonstrated the need to a trigger for review of unusual span arrangements.

3. BOX BEAM AND CONCRETE OVERLAY DETAILS:

(STRUCTURE DESIGN)

Mr. Koch and Mr. Muchane gave a presentation on the current details for box beam bridge plans. The presentation discussed the following:

- Box beams dimensions, span ranges, permitted skews, and the typical section

- Concrete overlay with fibers or reinforcing steel
- Double post-tensioning rods or strands and the PCI criteria for post-tensioning
- Post-tensioning on skews
- Evazote joints with elastomeric concrete headers at all end bents and bents
- No adhesively anchored barrier rail reinforcement

Mr. Trivette inquired if contractors would have the option to form the barrier rail after placing a concrete overlay. Mr. Muchane responded by stating that the barrier rail must be formed prior to placing the concrete and it was anticipated that contractors would set the screed rails on the barrier rail. He added that longitudinal joints in the overlay would not be permitted unless they were shown on the plans.

Mr. Idol expressed his concerns for the proposed perpendicular post-tensioning for box beam bridges on a skew. He noted that for maintenance reasons, both ends of the post-tensioning rod or strand need to be accessible. One end of the post-tensioning system may be inaccessible in the proposed layout.

The Bridge Maintenance Unit expressed their concerns over utilizing concrete overlays on cored slab and box beam bridges. In general they felt that asphalt overlays have few problems, are easy and quick to place, and are very cost effective.

Mr. Perfetti noted that concrete overlays are more durable, and do not soak up and hold moisture and deicing salts that can then infiltrate and corrode the superstructure. For this reason, over the long term, concrete overlays are very cost effective. Structure Design will develop a policy that will identify bridges where a concrete overlay will be appropriate.

4. INTEGRAL BRIDGE DETAILS: *(STRUCTURE DESIGN)*

Mr. Muchane gave a presentation on the current details for integral abutment bridges. Most of the details were unchanged from the details seen on plans for trial projects, except for the inclusion of a permitted vertical construction joint in the abutment diaphragm. The construction joint was introduced at the request of contractors, and it creates a 10" wide temporary backwall, which allows contractors to place the reinforced approach fill prior to setting the girders. In this way, the cranes used to set the girders can get as close to the bridge as possible.

Concerns were raised with the optional construction joint in the backwall. If/when the 1" deep saw cut leaks, water will seep into that construction joint. Mr. Perfetti stated that when the integral bridge details were finalized Structure Design would send them out to all the appropriate Units for comments and feedback prior to releasing them as standards.

5. DECKED TEE-GIRDER BRIDGE: *(STRUCTURE DESIGN)*

Mr. Koch discussed the use of precast prestressed decked girders on a current project. Mr. Koch displayed some of the details of the superstructure, which included:

- AASHTO Type III girders with a 6'-5½" monolithic precast deck,
- Bridge typical section showing decked tee-girders spaced at 6'-6",
- A shear key between adjacent faces of the precast deck,
- Welded steel connector plates between precast decks and spaced at 5'-0",
- 3 rows of intermediate steel channel diaphragms between girders,
- An asphalt overlay/wearing surface, and
- Integral end bents.

Mr. Nelson suggested increasing the length of bolts used to fasten the diaphragms by at least one inch to ensure adequate projection beyond the bolt hole.

Mr. Idol noted that the steel diaphragms would corrode and stain the girders, galvanizing notwithstanding.

6. PROJECT SCHEDULING OF FINAL FIELD INSPECTIONS: *(STRUCTURE DESIGN)*

Mr. Keith reviewed a memorandum from the State Highway Administrator on the importance of the permit process for TIP projects. The memorandum stressed that the permit process needs to be removed from the project schedule critical path by initiating it earlier.

Mr. Keith also discussed a document titled "Plan & Permit Review Process for Widening and New Location Projects." The discussion focused on the information that should be available at the 4B meeting - Final Design Field Inspection, and the 4C meeting - Permit Drawings Review Meeting. He noted that the review process would require a lot more information to be made available earlier in the process so that decisions and commitments can also be made sooner. As such, representation of all units at the meetings will be very important. Mr. Keith noted that Bridge Construction Engineers (BCE) should attend 4C meetings so that they are available to answer any questions from the agencies. Mr. Keith noted that the process would not permit changes to decisions and commitments, the so-called "pencils down", 18 months prior to letting for most projects.

Mr. Keith briefly discussed another document titled "Plan & Permit Review Process for Bridge Replacement Projects." He stated that this document was currently under revision, but he noted that the process outlined in this document will require Bridge Survey Reports and Structure Recommendations a year earlier than the current practice. In addition, BCEs will be required to attend scoping meetings. Further discussion on this document was deferred until revisions are finalized.

7. GUARDRAIL ATTACHMENTS ON TEMPORARY BRIDGES: *(STRUCTURE DESIGN)*

Mr. Koch stated that the Federal Highway Administration had inquired how contractors attach guardrail on temporary bridges. Mr. Bennett stated that they are required to use a Type III anchor unit. Mr. Koch suggested that the Department require the contractor's temporary bridge submittal include details for the guardrail connection to the temporary bridge.

8. GUEST SPEAKER: DR. EMMETT SUMNER, NCSU

Dr. Sumner presented preliminary results on his current research titled Developing a Simplified Method for Predicting Deflection in Steel Plate Girders under Non-Composite Dead Load for Stage-Constructed Bridges. He also briefly discussed other on-going research work for the Department on Overhang Falsework Hangers for NCDOT Modified Bulb Tee (MBT) girders.

9. APPROACH ROADWAYS FOR BRIDGE REPLACEMENT PROJECTS: (FHWA)

Mr. Drda stated that the national average cost for approach road work on bridge replacement projects is approximately 10% of the total project costs. However, in North Carolina the approach roadway costs are as much as 40% of the project cost, which is considerably more than the national average and warrants a review.

Mr. Bennett responded by stating that the roadway upgrades on bridge replacement projects are often driven by requirements of the 55-MPH statutory speed limit. Other factors that mandate roadway upgrades are bridges in new locations with a design ADT > 500, or bridges on low volume roads, i.e. design ADT < 400, for which the Guide for R-R-R (Resurfacing, Restoration and Rehabilitation) applies.

Mr. Drda stated that he had reviewed numerous projects with a design year ADT < 400. He inquired if the R-R-R criteria should apply to roads where the projected traffic growth is minimal, especially where the majority of the road will not be upgraded.

Mr. Bennett noted that there are inconsistencies in ADT delineations among all of the design guidelines currently in use by the Department. Mr. Bennett stated that Roadway Design Unit would initiate a effort to streamline the design criteria.

Mr. Drda suggested inclusion of a bridge site with approach roadway upgrades for the upcoming spring field tour.

10. BITUMINOUS WEARING SURFACE ON BOX BEAM BRIDGES ON HIGH ADT PROJECTS: (FHWA)

Mr. Drda raised concern with bituminous wearing surfaces on box beams and cored slabs. He stated that the bituminous wearing surface has sponge-like properties that absorb and trap chlorides from salt applied to roads. The chlorides are then continually released during precipitation events. The chloride deteriorates the concrete, eventually working its way to the steel in the girder. Mr. Drda showed pictures of a box beam bridge where longitudinal cracking in the deck had permitted moisture to leak through and stain the underside of the girder ends.

Mr. Idol stated that in his opinion, based on the photographic evidence, the source of the staining was a failed tie rod and not moisture leaking through the wearing surface. Mr. Idol

added that in decades of experience in North Carolina, he has never seen any evidence of the deterioration of a cored slab unit due to sub-standard performance of the bituminous overlay. Mr. Idol noted that the first cored slab bridge in North Carolina was built around 1969.

Mr. Greene suggested obtaining concrete core samples from several structures in service. The consensus was that this was a good idea. The corings would establish whether chloride ingress is a problem. It was decided to add a couple of the older cored slab bridge sites to upcoming spring field tour.

11. TEMPORARY SHORING COMMITTEE UPDATES: (GEOTECHNICAL)

Mr. Hidden stated a committee within the Geotechnical Unit is in the process of updating the Special Provision and Standards for temporary shoring.

12. RETAINING WALL COMMITTEE UPDATES: (GEOTECHNICAL)

Mr. Hidden stated that a committee within the Geotechnical Unit is in process of addressing the following issues on retaining walls:

- Need for a streamlined process for identifying the need for a retaining wall, designing the wall, showing the wall on plans, and possibly writing a design manual,
- Establishing the conditions that are not suitable for a temporary MSE wall, and
- Developing standards for MSE, Fabric and Geogrid walls up to 30 feet tall.

Mr. Hancock inquired if the Department still maintains an inventory of all retaining walls in service. Mr. Peoples stated that his office maintains the wall inventory.

13. REINFORCED BRIDGE APPROACH FILLS: (GEOTECHNICAL)

Mr. Hidden explored ways to reduce the cost of bridge approach fills by discussing the following issues:

- The most economical way to place and wrap the geo-fabric material especially on skewed bridges,
- Limiting the length of the select approach fill to the first 10–15 feet of the 25-foot approach slab.

During the discussion of the above issues there was agreement that the approach slab should be fully supported on the select material approach fill. It was also noted that the geo-fabric was a comparatively inexpensive item, and that cost savings would be realized by optimizing other aspects of the approach fill. There was a consensus that the Structure Design Unit should initiate a review of the policy on approach slab lengths.

14. SPECIAL PROVISIONS DEVELOPMENT STATUS: (GEOTECHNICAL)

Mr. Hidden discussed the progress on revisions to the Special Provisions on drilled piers, cross-hole sonic logging (CSL), and the foundation notes. He added that a new Special

Provision for high mast lighting foundations is near completion and will soon be made available for review.

15. IBRC PROJECT STATUS:

(RESEARCH)

Mr. Lakata provided an overview of the fiscal year 2003 Innovative Bridge Research and Construction (IBRC) program projects. The first project, titled *Fast Clad Paint Application on Three Selected Bridges over US-64 in Wake County* have now gone to construction. The second project, titled *GFRP Rebar in Bridge Decks* was in progress and a preconstruction meeting had been held in February. This project will utilize GFRP rebar for deck reinforcement of a bridge on SR1470 over the Cartoogechaye Creek in Macon County.

Mr. Lakata stated that the Department had submitted two successful applications for federal funding from the 2004 IBRC program. The funds will cover a portion of the project costs for:

- I-4411 - A 100 Ksi high performance steel (HPS) bridge in Iredell County, and
- B-3700 - A prestressed high performance concrete (HPC) decked girder bridge in Stanly County.

The funding will provide research funds to document and critique design and construction activities for each bridge.

16. ONGOING RESEARCH PROJECTS:

(RESEARCH)

Mr. Lakata gave a presentation on the status of the following structure research projects:

- Existing Chloride Exposure in Bridge Decks (Statewide)
- MMFX Steel Rebar (Johnston County)
- Self Consolidating Concrete (Craven and Pamlico Counties)
- Elastomeric Concrete (Technical Assistance)
- FRP Repairs on Concrete Girders

Mr. Black noted that the Bridge Maintenance Unit was anticipating the research on FRP Repairs on Concrete Girders will show that there is a cost savings and reduced turn-around time to re-open damaged bridges to traffic. He added that the Unit and the Division offices would prefer to repair damaged girders in lieu of replacing them.

17. HS-25 FOR ALL CORED SLAB DESIGNS:

(CONSTRUCTION)

Mr. Hancock inquired if all cored slabs bridges with pile bent foundations could be routinely designed for an HS-25 loading. He added that often contractors request permission to construct the bridge by top-down methods in lieu of other access methods. The HS-25 design load will permit approval of such requests when appropriate.

Mr. Drda suggested the Department consider increased use of hammerhead bents to replace some of the smaller 2 or 3 column bents on cored slab bridges.

The Structure Design Unit stated they will investigate the request and issue a policy memorandum.

18. STEEL DIAPHRAGMS ON CONCRETE GIRDER BRIDGES: *(CONSTRUCTION)*

Mr. Hancock stated that the Construction Unit has received several requests to replace cast-in-place concrete diaphragms with steel diaphragms for concrete girder bridges. He added that the Department has approved steel diaphragms on a couple of projects on a trial basis. He reported that the installation was successful and resulted in time-savings for the contractor. He suggested that the Department consider use of steel diaphragms on concrete girder bridges in the future.

The Structure Design Unit stated that they would proceed to develop standard drawings for steel diaphragms on concrete girder bridges.

Mr. Greene noted that the steel diaphragms would need to be inspected during fabrication and installation. He suggested that the Materials and Tests Unit receive a set of shop drawings.

19. OTHER CONSTRUCTION TOPICS: *(CONSTRUCTION)*

Mr. Perfetti stated that in the future the Department may receive more requests to install noise walls on bridges. He added that there was a formula to justify the additional cost of noise walls on bridges should citizens in the vicinity of a new project request the noise wall.

20. ANCHOR BOLT INSTALLATION: *(MATERIALS AND TESTS)*

Mr. Greene stated that he had not received a copy of a memorandum on anchor bolt installation that was dated September 1, 2004. He added that during signal pole or high mast lighting installations, the Materials and Tests Unit inspectors check for properly lubricated and adequate torque on the anchor bolt nuts.

Mr. Greene stated that the projection of anchor bolts above the leveling nut base plate and lock nut was often excessive. As a result, contractors who do not have deep socket wrenches are unable to adequately torque the lock nut in these situations.

Mr. Greene also proposed requiring rodent screens at the base of high mast and signal poles.

21. HIGH STRENGTH BOLTING AND DTI'S: *(MATERIALS AND TESTS)*

Mr. Greene reported that the Materials and Test Unit had recently hosted a high strength bolting seminar. The objective of the seminar was to provide sufficient knowledge to NCDOT personnel to ensure that fasteners are specified purchased, manufactured and installed in accordance with the appropriate specifications.

Mr. Greene stated that some of the inspectors have had concerns with some of the construction practices associated with proper installation of bolted field splices on bridges.

22. BRIDGE MAINTENANCE PAINT SYSTEM:

(MATERIALS AND TESTS)

Mr. Greene noted that the paint systems used by the Bridge Maintenance Unit takes too long to dry between coats. He inquired if IOZ – System 1 with 3 coats of Acrylic paint could be used as an alternate paint system. Mr. Idol had no objections to switching paint systems.

Mr. Greene then suggested that the next step will be to remove the coal tar epoxy and red oil-alkyd primer paint systems from the Standard Specifications.

23. 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.