

Period Covered: January 1 through March 31, 2008 (Quarterly Report)

KSDOT Progress Report  
for the

## State Planning and Research Program

PROJECT TITLE: Construction of Crack-Free Concrete Bridge Decks		
PROJECT MANAGER: Richard L. McReynolds, P.E.	Project No: TPF-5(051)	Project is: <input type="checkbox"/> PLANNING <input checked="" type="checkbox"/> RESEARCH & DEVELOPMENT
Annual Budget	Multi Year Project Budget \$995,000	

### PROGRESS:

#### CONSTRUCTION ACTIVITIES

The post-construction conference for the eleventh LC-HPC bridge constructed in Kansas was held on March 5, 2008. The main items of discussion included the pace of placing pre-soaked burlap, maintaining consistent and quality concrete properties, and consolidating the concrete more effectively. Slow burlap placement was determined to be a combined result of extended finishing of the deck and the method of bullfloating that was used (completed in the longitudinal direction of the deck instead of transverse). A loss of over 2% in air content was noted after placing the concrete off the end of a conveyor and through a hose. The air content of concrete arriving at the site was kept at the higher end of acceptable properties to compensate for this loss.

The qualification batch and qualification slab were completed in late March for the twelfth LC-HPC bridge to be constructed in Emporia, KS.

#### LABORATORY ACTIVITIES

Work continues in the materials laboratory.

Preparation for scaling and freeze-thaw specimens was completed. A series to examine the effects of using GGBFS Grade 120 (30% and 60% cement replacement) and having 0.45 water-cement ratio (w/c) began at the end of this quarter, and results are expected by next quarter. Scaling tests for the concrete are being performed in accordance with the Canadian standard test NQ 2621-900/2002 Annex B and the American standard test ASTM C672. Freeze thaw tests are being performed in accordance to ASTM C666 Procedure A.

Restrained ring tests continue to be monitored. Eight of the twenty-one ring specimens cast last quarter have cracked. Initial ring specimens with 2.5-in. concrete thickness that were cast last quarter are being compared with new rings having 1.5-in. concrete thickness. The KDOT mix with 602 lb/yd<sup>3</sup> of cement and w/c of 0.44 and the mix with 535 lb/yd<sup>3</sup> of cement and w/c of 0.45 were cast this quarter with 1.5-in. and 2.5-in. concrete thickness.

Free shrinkage specimens to determine the effect of long-term curing on drying shrinkage were cast. The control batch with 535 lb/yd<sup>3</sup> of cement and w/c of 0.45 and the batch containing a mineral admixture (40% replacement of class F fly ash with a paste content equivalent to 535 lb/yd<sup>3</sup> of cement with a w/c of 0.45) were cast. The specimens were cured for 7, 14, 28 and 56 days.

A series of AASHTO T 259 permeability specimens have been cast to examine the effects of using a shrinkage reducing admixture (1% and 2% dosage by weight of cement) in the mixtures containing 535 lb/yd<sup>3</sup> cement with w/c ratios of 0.45 and 0.42 for the 2% dosage, and w/c of 0.42 for the 1% dosage. Ponding with the salt solution for these series will start next quarter.

## OTHER ACTIVITIES

A workshop was held at the New Hampshire DOT on January 10, 2008.

## RESULTS

The preliminary results of restrained ring tests (with 2.5 inches of concrete thickness) for investigating the effect of reducing the water-cement ratio ( $w/c = 0.45, 0.42$  and  $0.39$ ) with constant cement content of  $535 \text{ lb/yd}^3$  show that the batch with  $w/c$  ratio equal to  $0.39$  cracked earlier than the other two batches having 7 days of curing. The three 7-day cured specimens with a  $w/c$  ratio of  $0.39$  cracked at 53, 55 and 55 days. For the batch with a  $w/c$  ratio of  $0.42$ , only one of three specimens cracked at 55 days. No crack was observed for the batch with  $w/c$  of  $0.45$ . For 14 day curing, two of the three specimens for the batch with a  $w/c$  ratio of  $0.39$  cracked at 48 and 99 days. No crack was observed for the batch with a  $w/c$  ratio of  $0.42$ . Two of the three specimens for the batch with a  $w/c$  ratio of  $0.45$  cracked at 65 and 77 days.

The new restrained ring test specimens that were cast using a KDOT mix to check the effect of concrete thickness (1.5-in. versus 2.5-in. concrete thickness) have cracked. The three specimens with the 1.5-in. concrete thickness cracked at 6, 9 and 12 days. The three specimens with 2.5-in. thickness cracked at 22, 27 and 34 days. The batches with  $535 \text{ lb/yd}^3$  of cement and  $w/c$  of  $0.45$  are 17 days old, and no crack has been observed for rings having either 1.5-in. or 2.5-in. concrete thickness.

Project Personnel: David Darwin (Principal Investigator), JoAnn Browning (Co-Principal Investigator)

## ACTIVITIES PLANNED FOR NEXT QUARTER:

Scaling and freeze-thaw specimens will be cast to examine the effect of granulated ground blast furnace slag (GGBFS).

Another series of free shrinkage specimens will be cast to investigate combined effects of class F fly ash and a shrinkage reducing admixture (SRA) to develop low-shrinkage mixes with fly ash. This new series repeats the previous series with the exception that pure class F fly ash was used instead of Durapoz class F fly ash, which contains additional gypsum.

The investigation on whether lightweight aggregates can provide internal curing for LC-HPC will continue. A series of free shrinkage specimens will be cast.

Weather and construction activities will be monitored for the possible placement of three bridge decks during the next quarter.

Crack surveys are scheduled to begin for seven LC-HPC bridges and six control bridges next quarter.

## **STATUS AND COMPLETION DATE**

Percentage of work completed to date for total project is: 99%\*

  X   on schedule        behind schedule, explain:

Expected Completion Date:   March 31, 2010  

\*Total funding has been increased by \$45,000 and the project extended an additional two years to allow the planned deck construction to be completed and the crack surveys to be conducted. The percentage of work completed will be held open at 99% for the balance of the project. Phase II of this project is now underway with funding from the KU Transportation Research Institute and the project has been approved for 100% SPR funding. The Phase II contract with KDOT (with TPF funding) will officially begin on July 1, 2008 with the annual meeting scheduled for July 24, 2008.