

Period Covered: January 1 through March 30, 2010 (Quarterly Report)

KSDOT Progress Report  
for the

## State Planning and Research Program

PROJECT TITLE: Construction of Crack-Free Concrete Bridge Decks, Phase II		
PROJECT MANAGER: Rodney Montney	Project No: TPF-5(174)	Project is: <input type="checkbox"/> PLANNING <input checked="" type="checkbox"/> RESEARCH & DEVELOPMENT
Annual Budget	Multi Year Project Budget \$995,000	

### **PROGRESS:**

#### **LABORATORY ACTIVITIES:**

Tests evaluating the evaporable and non-evaporable water in hardened concrete continue. The control batch with a cement content of 540 lb/yd<sup>3</sup> and a water-cement ratio of 0.44, and batches with a 40% class F ash replacement and 60% Grade 120 slag replacement of cement by volume were repeated to check the reliability of the test. A batch with a shrinkage reducing admixture (SRA) dosage of 0.64 gal/yd<sup>3</sup> and with the same cement content and water-cement ratio as the control batch was also cast. Free shrinkage specimens, 3 in. by 6 in. cylinders for evaluating evaporable and non-evaporable water, and strength cylinders were cast. The specimens were cured for 3, 7, 14, and 28 days.

Restrained ring tests with a 2.5 in. thick concrete wall were cast to determine if severe environmental conditions would increase the effectiveness of the data acquisition equipment for detecting cracks. The control batch had 540 lb/yd<sup>3</sup> cement and a water-cement ratio of 0.44. A test batch with a 40% Class F (Durapoz) fly ash replacement of cement by volume was also cast. All specimens were cured for 14 days and then placed in a room maintained at approximately 86° F and 13% RH.

A series of scaling and freeze-thaw specimens were cast to evaluate the effect of SRA dosage (0%, 0.5%, and 1% replacements by the weight of cement) on the durability of concrete. The scaling evaluation will be performed in accordance with the BNQ NQ-2621 900 Annex B and ASTM C672. Freeze-thaw evaluation will be performed in accordance with the ASTM C666– Procedure B test. Air-void evaluation will be performed in accordance with the ASTM C457 Procedure A: The Linear Traverse Method by the KDOT Materials Laboratory.

Air-void evaluation is also being performed by the KDOT Materials Laboratory on batches that were cast to evaluate scaling of concrete mixes containing slag (0%, 30%, and 60% of slag replacements by volume of the cement).

#### **LAB RESULTS:**

All restrained ring test specimens cast this quarter cracked. The three specimens from the control batch cracked at 8, 15 and 25 days, respectively, and the three specimens from the fly ash batch cracked at 6, 6 and

13 days, respectively. Microcracks with crack width of less than or equal to 0.004 in. were observed. The cracks were not clearly indicated by large jumps in measured strain.

Scaling evaluation of the GGBFS G120 slag series in accordance with the Canadian standard test BNQ 2621-900/2002 Annex B and ASTM C672 is ongoing. The preliminary results after 35 cycles are the following: 0.14, 0.72 and 1.69 kg/m<sup>2</sup> of mass loss for 0%, 30%, and 60 slag replacement of the cement by volume, respectively. The mixture with 60% slag replacement has failed the test by exceeding the 1.5 kg/m<sup>2</sup> cumulative mass loss test parameter.

### **BRIDGE DECK CONSTRUCTION:**

A meeting with the concrete producer, contractor, and KDOT personnel was held to discuss the mixture requirements for three LC-HPC decks that were let in December 2009. The construction schedule calls for two to be completed in 2010 and one in early 2011.

### **ACTIVITIES PLANNED FOR NEXT QUARTER:**

Durability tests, which include freeze-thaw and scaling tests, will begin on various lightweight aggregate concrete specimens that meet the specifications for Low-Cracking High-Performance Concrete. The high absorption of the lightweight aggregate benefits the concrete by adding water for internal curing. These lightweight aggregate specimens will have varying replacement amounts of lightweight aggregate to test their effect on durability. Other specimens will include varying amounts of slag replacement along with the lightweight aggregate to test durability effects. Properties of the specimens, including aggregate moisture content, will match expected field conditions.

Laboratory tests involving Viscosity Modifying Admixtures (VMAs) will be performed to study their effects on concrete free shrinkage, durability, and strength. VMAs have been reported to decrease free shrinkage and concrete cracking by minimizing surface tension, concrete bleed water, and evaporation.

A series of scaling and freeze-thaw specimens will be cast to evaluate the combined effects of an SRA and Class F fly ash on the durability of concrete. A series of freeze-thaw specimens will be cast to evaluate the effects of GGBFS G120 (0%, 30%, and 60% replacements) on the durability of concrete.

Crack surveys will be initiated for this year on the LC-HPC and Control decks that have been constructed in Kansas.

KU personnel will continue to work with the concrete producer, contractor, and KDOT personnel on the first of three LC-HPC decks let in December 2009. Deck construction is scheduled for late during the quarter or early the following quarter.

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

**STATUS AND COMPLETION DATE**

Percentage of work completed to date for total project is: 35%

  X   on schedule        behind schedule, explain:

Expected Completion Date:   June 30, 2013