

Period Covered: April 1 through June 30, 2007 (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 \$950,000	

### PROGRESS:

#### **Construction Activities**

The fourth and fifth LC-HPC bridges in Kansas were constructed this quarter. The qualification batch for the fourth bridge was made on April 11, the pre-construction conference was held on April 17, and the qualification slab was cast on April 26, 2007. The post-qualification slab conference was held by phone on May 1, 2007. The bridge deck was placed on May 17, and a post-construction meeting was held on June 20.

Two qualification batches were made for the fifth bridge, on May 23 and June 7, 2007. The qualification slab was cast on May 25, 2007. The post-qualification slab conference was held by phone on May 29, 2007, and the bridge deck was placed on June 9, 2007. The post-construction meeting will be held in the next quarter.

The qualification batch for the sixth LC-HPC bridge to be constructed in Kansas was made on June 7, 2007. A mix design obtained using KU Mix was used, and the batch met the slump, air, and temperature requirements. The qualification slab and bridge deck are expected to be placed next quarter.

A crack survey was conducted on April 20, 2007 for the second LC-HPC bridge constructed in Kansas. The crack density for the bridge was  $0.01 \text{ m/m}^2$ . On April 27, 2007, crack surveys were completed for the first LC-HPC bridge constructed in Kansas, as well as the control bridge for the first and second LC-HPC bridges constructed in Kansas. The crack density for the first LC-HPC bridge was  $0.03 \text{ m/m}^2$ . The crack density for the corresponding control bridge was  $0.09 \text{ m/m}^2$ . Another crack survey was conducted on June 5, 2007 for the third LC-HPC bridge constructed in Kansas. Only five small longitudinal cracks were observed (at the west end of the bridge) and the crack density was determined to be  $0.003 \text{ m/m}^2$ . In contrast, typical decks have average crack densities between  $0.40$  and  $0.50 \text{ m/m}^2$ . Crack surveys for the control bridge for the third LC-HPC bridge and a monolithic control bridge near Emporia, KS are scheduled to be completed during the next quarter.

#### **Laboratory Activities**

Casting of a series of free-shrinkage and strength specimens has begun and will be finished next quarter to determine the combined effects of Class F fly ash and a shrinkage reducing admixture (SRA). In an earlier series, the combined effects of granite and Class F fly ash (20% and 40% replacements) were investigated; the concrete had higher shrinkage than the control batch, which contained 100% Portland cement. The new series will repeat the previous work with the exception that an SRA will be used.

Preparation for the restrained ring tests continues. The tests are expected to begin next quarter.

The series of AASHTO T 259 permeability specimens that were cast to examine the effects of an SRA ( $0.64 \text{ gal/yd}^3$ ), granulated ground blast furnace slag Grade (GGBFS) 120 (30% replacement), and a mixture containing  $497 \text{ lb/yd}^3$  of Type I/II Portland Cement have completed the ponding cycle. An additional control mixture, commonly used by the Kansas Department of Transportation (KDOT) ( $602 \text{ lb/yd}^3$  Type I/II cement,

0.44 water-cement ratio), has also completed the ponding cycle. Coring, sampling, chloride testing, and analysis of these specimens has started.

A series of scaling and freeze-thaw specimens has been planned to examine the effects of GGBFS Grade 100 (30% replacement), and GGBFS Grade 120 (30% and 60% replacements). Scaling tests for concrete containing GGBFS will start next quarter, followed by freeze-thaw tests in accordance with the ASTM C 666 Procedure A.

### **Laboratory Results**

The free-shrinkage series cast during last quarter to determine the combined effects of different mineral admixtures (GGBFS, silica fume, fly ash) and a low absorption coarse aggregate and the effect of reducing the water-cement ratio from 0.45 to 0.41 are about 150 days old. The results are similar to the preliminary results at 30 days. Specimens cured for 14 days containing GGBFS or silica fume shrink less than the control batch, whereas mixtures containing fly ash shrink more. Reducing the water-cement ratio by reducing water and while holding the constant cement content (at 535 lb/yd<sup>3</sup>) results in reduced free shrinkage.

### **Other Activities**

A meeting was held with Andrew Mackie from Buildex, Inc. on May 31, 2007 to begin evaluating the use of lightweight fine aggregates in LC-HPC mixtures. The analysis of lightweight aggregate properties will begin during the next quarter. Batches will be cast to determine the effectiveness of using saturated lightweight aggregate as an aid for internal curing in conjunction with different mineral admixtures (GGBFS, silica fume, fly ash).

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

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

The chloride testing for the permeability specimens containing an SRA (0.64 gal/yd<sup>3</sup>), KDOT mixtures (602 lb/yd<sup>3</sup> Type I/II cement, 0.44 water-cement ratio), and mixtures containing 100% Type I/II cement and Grade 120 GGBFS (30% replacement) will be completed during the next quarter. Scaling and freeze-thaw testing will continue for mixtures containing GGBFS, and will begin for ternary mixtures containing GGBFS and silica fume. Fabrication of the restrained ring test specimens is expected to begin. Casting a series of free-shrinkage and strength specimens to determine the combined effects of Class F fly ash and a shrinkage reducing admixture (SRA) will be completed. Work with lightweight aggregates will begin.

The qualification slab and bridge deck for the sixth LC-HPC bridge deck in Kansas are expected to be placed during the next quarter. A post-construction meeting for the fifth LC-HPC bridge deck will be held. Crack surveys for the control bridge for the third LC-HPC bridge and the monolithic control bridge near Emporia, KS are scheduled.

### **STATUS AND COMPLETION DATE**

Percentage of work completed to date for total project is: 85%

  X   on schedule \_\_\_\_\_ behind schedule, explain:

Expected Completion Date:   March 31, 2008