

Period Covered: October 1 through December 31, 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

Much of the research effort this quarter has focused on the construction and documentation of six LC-HPC bridge decks in Kansas. The first bridge deck was completed on September 29, 2007, and October 2, 2007 (two placements), for the sixth LC-HPC bridge constructed in Kansas. This was the first of a series of LC-HPC bridges being completed near the intersection of I-435 and US-69 in Overland Park, KS. A qualification slab was completed for the seventh LC-HPC bridge deck on September 26, 2007. The corresponding bridge deck (the second placed this quarter, and seventh placed in Kansas overall) was placed on October 3, 2007 in Linn County. The eighth, ninth, and tenth LC-HPC bridges constructed in Kansas were completed on November 3, November 13, and November 14, 2007, respectively. Each of these bridge decks were also part of the series being constructed at the I-35 and US-69 intersection. The qualification slab for the eleventh LC-HPC bridge to be constructed in Kansas was completed on November 13, 2007. The deck was placed on December 19, 2007 in Overland Park, KS.

Cold-weather casting and curing precautions were used for the decks placed in November and December. This included wrapping of the steel girders and placement of propane gas heaters between the girders to maintain the temperature of the concrete and steel girders as close as possible. Some difficulties have been noted gaining consistent concrete workability at the job site when using a water-cement ratio of 0.42. Raising the ratio to 0.45, which also increases the paste content, has helped alleviate difficulties placing the concrete.

A pre-construction conference was held on September 26, 2007, for the eleventh LC-HPC bridge to be constructed in Kansas, and a post-construction conference was held on October 22, 2007, for the seventh bridge constructed in Kansas. A post-construction conference covering the sixth, eighth, ninth, and tenth bridges is scheduled for next quarter.

The LC-HPC deck in Minnesota was constructed on September 27 and October 1, 2007.

#### LABORATORY ACTIVITIES

Work continues in the materials laboratory. A series of restrained ring test specimens with matching free shrinkage and strength specimens was cast to investigate the effect of reducing the water-cement ratio with constant cement content on cracking tendency. Previous free shrinkage tests that reduced the water-cement ratio by cutting water, replacing that volume with aggregate, and maintaining slump using a superplasticizer were found to produce less free shrinkage. The new series includes water-cement ratios of 0.45, 0.42 and 0.39 with a constant cement content of 535 lb/yd<sup>3</sup>. Twenty-one restrained ring specimens are being monitored with strain gages and a data acquisition system in a standard environmental tent (temperature 70 ± 5°F, relative humidity 50 ± 5%).

## OTHER WORK

Work with the KDOT production department has resulted in the final version of the training video Construction of Low-Cracking High-Performance Concrete Bridge Decks. The video summarizes the primary components of the LC-HPC specifications with video clips and pictures from construction of LC-HPC bridges in Kansas.

Workshops on LC-HPC Bridges Decks were presented in Indiana, Michigan, and Oklahoma in October.

## RESULTS

The free shrinkage series cast during the last quarter to examine the combined effects of class F fly ash (Durapoz) and a shrinkage reducing admixture (SRA) shows that, at 30 days and for mixes cured for 14 days, the mixes containing fly ash (20 and 40% replacements) and SRA exhibited higher shrinkage than the control batch that contained 100% Portland cement and SRA. With 7 days curing and at an age of 30 days, the mixes with a 20% replacement of fly ash showed more shrinkage than the control batch, while the batch with a 40% replacement of fly ash had less shrinkage than the batch containing an SRA alone.

The restrained ring specimens for a KDOT mix with a cement content of 602 lb/yd<sup>3</sup> and a water cement ratio of 0.44 are about 80 days old. No cracking has been observed. The age of the restrained ring specimens for the water-cement ratio series varies from 30 days to 60 days. No cracking has been observed.

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

## ACTIVITIES PLANNED FOR NEXT QUARTER:

A series of restrained rings tests examining different water-cement ratios (0.45, 0.42, 0.39, and 0.36) combined with class F fly ash (20 and 40% replacements) and low absorption aggregate (granite) will be cast. Scaling and freeze-thaw specimens will be cast to examine the effect of granulated ground blast furnace slag (GGBFS). The investigation on whether lightweight aggregates can provide internal curing for LC-HPC will continue. A series of trial batches will be completed, and free shrinkage and strength specimens will be cast with granite coarse aggregate, a 0.42 water-cement ratio, and 0, 20, and 40% replacements of portland cement with GGBFS.

Copies of the training video on Construction of Low-Cracking High-Performance Concrete Bridge Decks will be sent to participating states.

Weather conditions and readiness of bridge contractors to place the last four bridge decks in Kansas for this Phase of the project will continue to be monitored.

A workshop is planned for the New Hampshire DOT in January 2008.

## **STATUS AND COMPLETION DATE**

Percentage of work completed to date for total project is: 95%

  X   on schedule        behind schedule, explain:

Expected Completion Date:   March 31, 2008