

Period Covered: July 1 through September 30, 2005 (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	
<p>Progress:</p> <p>The primary focus of the project for the past quarter has been the planning and construction of the Low-Cracking High Performance Concrete (LC-HPC) Bridge Decks in the states of Kansas and South Dakota. Six bridge structures with LC-HPC specifications (out of 13) and six control bridge decks (out of 12) have been let in Kansas. The construction of the first LC-HPC bridge deck located in Wyandotte County, Kansas is scheduled for October. The trial batch for the project was completed on June 23, and the trial slab was placed by the contractor, with KDOT inspection and KU observation, on September 8, 2005. A meeting was held on September 15, 2005 with KDOT officials, contractors, and material suppliers to review the trial slab operation and discuss changes for the actual construction that is to take place in October. A pre-bid conference was held August 2, 2005 for a letting that included four LC-HPC and four control decks in a large interchange construction project located Johnson County, Kansas.</p> <p>One (out of two) LC-HPC bridge decks and one control deck (out of two) have been let in South Dakota. Crack survey training was completed for the state of South Dakota in Rapid City, SD on September 19-20, 2005. The training lasted two days and included a presentation detailing the crack survey procedure and surveys covering 2½ decks.</p> <p>Work continues in the materials laboratory. The series of free-shrinkage tests to determine the effect of superplasticizers while maintaining a constant slump (3 in.) was repeated with some changes. The changes include the use of entrained air ($8 \pm \frac{1}{2}$ percent). The water-cement ratio remained constant at 0.45, but the cement content was decreased from 630 to 535 lb/yd³ to represent a prototypical LC-HPC bridge deck mix. In addition, the paste content of the control mix was adjusted (by increasing cement and water contents at the constant water-cement ratio) to obtain the desired 3-inch slump obtained for the other mixes in the series through the use of superplasticizers. Results are not yet available from these parameter studies.</p> <p>Additional work was completed in the materials laboratory this quarter to identify the combined effects of curing (7 and 14 days), water-cement ratio (0.45, 0.43, and 0.41), and cement fineness on free-shrinkage, permeability, and strength. The average Blaine finenesses for the Type I/II and Type II medium-ground cements used in this test program were 377 and 334 m²/kg, respectively. Twelve sets of free-shrinkage, AASHTO T 259 permeability specimens, and strength cylinders were cast. The prototypical LC-HPC bridge deck mix (0.45 water-cement ratio, cement content of 535 lb/yd³, air content of $8 \pm \frac{1}{2}$ percent, and slump of 3 ± 1 in. using both Type I/II and Type II medium-ground cement was used as the control for this test program. Twelve sets (three specimens per set) of free shrinkage specimens were cast for each water-cement ratio, cement type, and curing period. As in the earlier tests, the results indicate that increasing the curing period decreases shrinkage for concrete made with both cement types. In addition, decreasing the water-cement ratio (and consequently the paste content) also decreases free shrinkage – by as much as 18 percent.</p> <p>The permeability specimens are currently in the 90-day ponding cycle, to be followed by sampling and chloride analysis at the end of the year.</p>		

Twelve cylinders were cast for each water-cement ratio and cement type combination with curing periods of 3, 7, 14, and 28 days. As expected, both the water-cement ratio and cement type have a significant effect on compressive strength. The average 28-day compressive strengths for cylinders cast with Type I/II cement were 4080, 4600, and 4880 psi with water-cement ratios of 0.45, 0.43, and 0.41, respectively. The average 28-day compressive strengths for cylinders cast with Type II medium-ground cement were 3770, 3840, and 4150 psi with water-cement ratios of 0.45, 0.43, and 0.41, respectively.

The aggregate optimization and concrete mix design Excel workbook, KU Mix 1.0 Beta 1, has been completed and is ready for limited release and evaluation.

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

SUMMARY OF ACTIVITIES EXPECTED TO BE PERFORMED NEXT QUARTER:

Construction of the first LC-HPC bridge deck in Kansas is anticipated for next quarter. Members of the KU research team will observe the bridge deck construction. Current LC-HPC specifications will be reevaluated based on the latest field and laboratory results.

A pre-bid conference for a LC-HPC bridge deck in Jackson County, Kansas will be held on October 10, 2005.

Test programs to be initiated in the lab this quarter include free shrinkage tests comparing aggregate types (limestone, granite, quartzite). Free shrinkage tests will be performed to compare mixtures containing mineral admixtures (Class F fly ash, slag, silica fume). All mixes will have an air content of $7 \pm \frac{1}{2}$ percent.

There will be limited release of the aggregate optimization program, KU Mix 1.0 Beta 1, and adjustments based on comments will be made.

STATUS AND COMPLETION DATE

Percentage of work completed to date for total project is: 50%

 X on schedule behind schedule, explain:

Expected Completion Date: March 31, 2008