Period Covered: October 1 through December 31, 2006 (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: ____ PLANNING ___X__ RESEARCH & DEVELOPMENT
Annual Budget	**Multi Year Project Budget** $950,000	

Progress:

CONSTRUCTION ACTIVITIES

The post-construction meeting for the second LC-HPC bridge in Kansas (cast June 24, 2006) was held on October 17, 2006. The main items of discussion included inconsistencies in aggregate gradations, concrete temperature control methods as a function of the time of year, and grinding and finishing the deck surface. The as-delivered aggregate gradations varied considerably from the gradations reported by the quarry, which made it difficult for the concrete supplier to meet the combined aggregate gradation specifications. This common problem highlights the importance of re-optimizing the combined aggregate gradation based on the as-delivered gradations, rather than locking into a single mix design. A discussion of temperature control resulted in the recommendation that the concrete supplier develop a temperature control plan that would depend on the time of year. Concrete temperature was controlled on this project using bags of ice that were individually opened and emptied into each truck. A conveyor belt (such as used for the LC-HPC bridges over I-635) would have been a more effective method to load the ice into the trucks, alleviating safety and personnel concerns. A smooth finish was obtained on the deck using a bull float – no additional grinding was required. This procedure met the specifications for this bridge, but specifications for bridges following this one had been changed to require grinding the entire deck, regardless of the finish (the change had been recommended by other KsDOT construction personnel as a way to simply inspection). Based on this bridge, however, it was agreed that grinding the full deck surface is not necessary if the finish is smooth and meets surface variation specifications. A change reflecting this observation has been made in the most recent revision of the LC-HPC construction specifications.

The pre-bid conference for a Kansas LC-HPC bridge (K-130 over Neosho River) was held on October 30, 2006.

Due to the weather, the one-year crack survey for the first LC-HPC bridge in Kansas was rescheduled for Spring 2007.

LABORATORY ACTIVITIES

Work continues in the materials laboratory. AASHTO T 259 permeability specimens were cast to evaluate binary and ternary mixtures containing ground granulated blast furnace slag (GGBFS) and silica fume. The mixtures included silica fume (3% and 6% replacement), Grade 100 GGBFS (60% replacement) and silica fume (6% replacement), a shrinkage reducing admixture (half the recommended dosage), and specimens with reduced cementitious material contents reflecting the current specification minimum (497 lbs/yd^3). The series of permeability specimens examining different water-cement ratios (0.36, 0.38, 0.40, and 0.42) and the series examining the effect of GGBFS and silica fume have completed the ponding cycle and are currently being sampled for chloride testing.

Preparation and planning for restrained ring, scaling, and freeze-thaw testing has begun, and the tests are expected to begin in the next quarter.

RESULTS

Results from the previous free shrinkage series investigating the effects of internal curing provided by a porous coarse aggregate indicate that mixtures cast with a high-absorption coarse aggregate (2.5 - 3.0%) and GGBFS (60% by volume of cementitious materials) exhibit a significant reduction in shrinkage at all ages. For mixtures containing GGBFS and a low-absorption aggregate, however, only a slight reduction in shrinkage is observed. Based on these results, it appears that the high-absorption coarse aggregate (limestone) may provide internal curing water, thereby reducing the shrinkage of mixtures containing a mineral admixture that is sensitive to the length of curing. The series cast last quarter to compare the effects of oven-dry and saturated surface dry (SSD) high-absorption limestone, in an effort to better understand the effects of internal curing, indicated that the mixtures cast with the oven-dry aggregate had only slightly higher shrinkage than the mixtures cast with SSD coarse aggregate. It is likely that some water was absorbed by the pores of the oven-dry aggregate during mixing, although not enough to completely fill the pores and bring the aggregate to the SSD condition. This resulted in a small increase in the paste content and slightly less water available in the pores for internal curing, which led to slightly more shrinkage. Additional tests of mixtures containing a low-absorption coarse aggregate with other types of mineral admixtures such as fly ash and silica fume are currently underway.

OTHER ACTIVITIES

A presentation of project work was made on October 10 at the 82nd Annual Meeting of NESMEA, hosted by the Delaware DOT in Newark, DE. A workshop was held at the Minnesota DOT on December 5, where KU presented experiences with Low-Cracking High-Performance Concrete (LC-HPC) bridges in Kansas along with current laboratory results; a shorter presentation on the project followed on December 6 at the 56th Minnesota Concrete Conference.

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

SUMMARY OF ACTIVITIES EXPECTED TO BE PERFORMED NEXT QUARTER:

Chloride testing will begin for permeability specimens cast with different water-cement ratios (0.36 to 0.42) and for specimens cast with GGBFS both with and without silica fume. Mixtures containing a low-absorption coarse aggregate (less than 0.7%) cast with fly ash or silica fume will continue to be evaluated in addition to additional sources of fly ash and GGBFS.

A post-construction meeting for the third LC-HPC bridge in Kansas will occur in the next quarter.

The next Annual Meeting for Pooled-Fund Participants will be scheduled for Summer 2007.

STATUS AND COMPLETION DATE

Percentage of work completed to date for total project is: 75%

__X__ on schedule _____ behind schedule, explain:

Expected Completion Date: _____March 31, 2008_____