Period Covered: April 1 through June 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: ____ PLANNING ___X__ RESEARCH & DEVELOPMENT
Annual Budget	**Multi Year Project Budget** $950,000	

Progress:

The third annual meeting for the project was held on May 24, 2005 at the Kansas City Airport Hilton. Representatives from eleven states attended the meeting, including Delaware, Idaho, Kansas, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, North Dakota, Oklahoma, and South Dakota. Representatives from the Federal Highway Administration, WR Grace, Silica Fume Association, and HGR, Inc. also attended. The meeting focused on the planned construction of 12 project bridge decks (with 10 control bridge decks) in the state of Kansas, 2 project bridge decks in South Dakota, and the results from free shrinkage and aggregate optimization studies at the University of Kansas. Bridge decks in Minnesota, Missouri, New Hampshire, and Oklahoma were also mentioned for possible inclusion in the study.

A CD with material from the meeting was sent to all meeting participants and state representatives. The CD contained the PowerPoint presentations from the meeting (including a sample presentation that may be used in pre-bid or pre-construction conferences for bridge decks to be constructed using the research specifications), research specifications, KDOT specifications for the first two research bridge decks, meeting minutes, contact information for attendees and research participants, a research report for the latest cracking survey completed at the University of Kansas, and a program developed by KDOT to calculate evaporation rates at construction sites.

Work continues in the materials laboratory. Four sets of free-shrinkage specimens for concrete with a 3-inch slump obtained using different superplasticizers were cast. The four batches include one control mix, two mixes containing polycarboxylate-based superplasticizers, and one mix containing a naphthalene-based superplasticizer. The superplasticizer dosage rate was adjusted for each mix to obtain a 3-inch slump. To date, the results indicate very little difference in shrinkage between mixes containing superplasticizers, although the mixes with superplasticizers have approximately 10% higher shrinkage than the control mix. The control mix, cast without a superplasticizer, did not have a 3-inch slump. Future work will include repeating this series and changing the mix proportions of the control batch (by increasing the water and cement content) to obtain the desired 3-inch slump.

Strength cylinders were cast using a prototypical low-cracking bridge deck mix (0.45 water-cement ratio and a cement content of 535 lb/yd^3) using both Type I/II and Type II coarse-ground cement. A total of twelve cylinders were cast with three each cured for 3, 7, 14, and 28 days. As expected, the largest difference in strength between cement types occurred for specimens that were cured for only three days, where the cylinders cast using Type I/II cement were nearly 10% stronger than cylinders cast using Type II coarse-ground cement. On average, cylinders cast using Type I/II cement and cured for more than three days were less than 5% stronger than the cylinders cast using Type II coarse-ground cement. The average 28-day compressive strengths were 4740 and 4550 psi for cylinders made using Type I/II and Type II coarse-ground cement, respectively.

Preliminary permeability results for a standard bridge deck mix have been completed and compared with typical bridge deck mixes obtained from Missouri and Kansas. In addition, the effects of curing (3, 7, 14, and 28 days) and cement type (Type I/II and Type II coarse ground) have been evaluated. As expected, specimens made using Type I/II cement are less permeable than specimens made using Type II coarse-ground cement, although this difference appears to decrease as the length of curing increases. Specimens made using Type I/II cement cured for 14 days have similar permeability characteristics as specimens made using Type II coarse-ground cement and cured for 28 days. Work is currently underway reducing the water-cement ratios to further improve the permeability characteristics.

The aggregate optimization process is currently being verified in the laboratory and is in its final stages. A beta version of the program to automate this process with a program flow chart and a user manual will be released in the next quarter. KU personnel have corresponded with Oklahoma DOT and concrete producers associated with the Kansas research bridge decks to help attain optimal aggregate gradations.

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

SUMMARY OF ACTIVITIES EXPECTED TO BE PERFORMED NEXT QUARTER:

Construction of the first research bridge deck in Kansas is anticipated to begin in late September or early October, with a trial deck to be cast within a month of the actual bridge deck. Members of the KU research team will observe the construction of the trial deck and the actual bridge deck.

In June, two research bridge decks and three control bridge decks were let in Kansas. A pre-bid meeting will be held to prequalify contractors for the four research bridge decks that will be let in Kansas in August. The presentation will be similar to the PowerPoint presentation that was shown at the 3rd annual meeting in Kansas City in May, 2005. By the end of the next quarter, nine research bridge decks and eight control bridge decks will have been let in Kansas, and one research bridge deck and its control will have been let in South Dakota.

Test programs to be initiated in the lab this quarter include reducing the water-cement ratio of a standard mix (0.45 water-cement ratio and a cement content of 535 lb/yd^3) to 0.43 and 0.41 using both Type I/II and Type II coarse-ground cement. Permeability, free-shrinkage, and strength characteristics will be obtained for these mixes based on 7 and 14-day curing. In addition, new research programs using shrinkage-reducing admixtures and supplementary cementitious materials will be considered.

The aggregate optimization program and procedure will be released at the end of the summer.

STATUS AND COMPLETION DATE

Percentage of work completed to date for total project is: 45%

__X__ on schedule _____ behind schedule, explain:

Expected Completion Date: March 31, 2008