Period Covered: October 1 through December 31, 2009 (Quarterly Report)

KSDOT Progress Report
for the

State Planning and Research Program

PROJECT TITLE: Construction of Crack-Free Concrete Bridge Decks, Phase II		
PROJECT MANAGER: Rodney Montney	Project No: TPF-5(174)	Project is: ____ PLANNING ___X__ RESEARCH & DEVELOPMENT
Annual Budget	**Multi Year Project Budget** $995,000	

PROGRESS:

LABORATORY ACTIVITIES:

Evaluation of the equipment for the freeze-thaw test and the freezer for the scaling test has been completed. Evaluation of a room for the thawing test cycles of the scaling test was also completed during the quarter.

A series of scaling specimens have been cast to evaluate the effect of Grade 120 slag (0%, 30%, and 60% volume replacements of cement) on the durability of concrete. Scaling tests will start next quarter followed by an air-void system and a freeze-thaw evaluation.

Methods for evaluating the evaporable and non-evaporable water in hardened concrete were developed. The goal is to correlate these values with concrete shrinkage. The control batch was cast using a cement content of 540 lb/yd^3 and a water-cement-ratio of 0.44. Batches were also cast using, respectively, a 40% Class F fly ash and a 60% Grade 120 slag replacement of cement by volume. The test batches were adjusted so as to have the same equivalent cement paste content (24.12%) as the control batch. Free shrinkage specimens, strength cylinders, and 3 in. by 6 in. cylinders for evaluating evaporable water and non-evaporable water were cast. The specimens were cured for 1, 3, 7, and 28 days.

LAB RESULTS:

The two test series evaluating the contribution of lightweight aggregates to reducing free shrinkage continue. The 90-day test results were consistent with results at 30 days. The first series included three replacement levels of lightweight aggregate (8.4%, 11.3% and 13.8% by volume). As expected , as the amount of lightweight aggregate increased, the amount of free shrinkage decreased from 490 microstrain at 90 days for the control mix (no lightweight aggregate, 14-day cure) to 347 microstrain at 90 days for the mix with 13.8% (by volume) of lightweight aggregate and a 14-day cure. The second series evaluated the use of an 8.4% (by volume) replacement of lightweight aggregate in mixes with Grade 100 slag (0%, 30% and 60% slag mixtures). A significant reduction in shrinkage was noted with the addition of lightweight aggregate with the Grade 100 slag. After 90 days of drying, the control mix (14-day cure), without slag or lightweight aggregate, had a free shrinkage of 393 microstrain, while the mixture with 8.4% (by volume) lightweight aggregate and 30% slag exhibited a free shrinkage of only 263 microstrain.

The initial results from the series evaluating evaporable and non-evaporable show that compared with the control batch, both the Class F fly ash batch and Grade 120 slag batch had less non-evaporable water. When cured for 1 day, the control batch had 10.9% (of cement by weight) of non-evaporable water. When cured for 3 days, 7 days, and 28 days, the non-evaporable water was 13.8%, 14.7%, and 17.7%, respectively. For the Class F fly ash batch, non-evaporable water of 9.3%, 11.7%, 12.6%, and 14.3% were observed for specimens cured 1 day, 3 days, 7 days, and 28 days, respectively. For the Grade 120 slag batch, non-evaporable water of 7.8%, 10.6%, 12.6%, and 14.8% were obtained for curing times of 1, 3, 7, and 28 days, respectively.

ACTIVITIES PLANNED FOR NEXT QUARTER:

The evaluation of evaporable water and non-evaporable water in hardened concrete will continue. The relationship between evaporable water and free shrinkage will be evaluated.

Work casting specimens will continue in the laboratory. A series of scaling specimens will be cast to evaluate the combined effects of a shrinkage reducing admixture (SRA) and Class F fly ash on the durability of concrete. A series of freeze-thaw specimens will be cast to evaluate the effects of Grade 120 slag (using cement replacements by volume of 0%, 30%, and 60% replacements) and the combined effects of an SRA and Class F fly ash on durability of concrete.

KU will continue to work with KDOT and other partners to schedule LC-HPC bridge decks for Phase II of the project.

Planning for the Annual Meeting of pooled-fund participants and interested parties will begin in the next quarter.

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

STATUS AND COMPLETION DATE

Percentage of work completed to date for total project is: 30%

__X__ on schedule _____ behind schedule, explain:

Expected Completion Date: June 30, 2013