Period Covered: January 1 through March 31, 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:

Nominations for bridge decks to be constructed using the research specifications continue to be requested. To date, one nomination has been received from Missouri and two have been received from South Dakota. Minnesota has indicated that they will nominate two bridge decks. Kansas has 14 low cracking deck projects with 12 control decks. Two of the low cracking decks and one control deck will be for prestressed concrete girder bridges. States wishing to nominate prestressed concrete girder bridges should include a companion prestressed concrete control bridge for comparison. No additional nominations for potential bridge projects to implement the research specifications were received this quarter.

The motivation and progress in the pooled-fund study was presented at the 50th Annual KU Structures Conference for 350 practicing engineers from the region.

A pre-construction conference was held in Bonner Springs, KS on March 8, 2004 for the first two low-cracking bridge decks and one control bridge to be constructed in conjunction with the project. Representatives from the construction company, concrete producer, and KDOT attended the meeting. The motivation for the project was presented along with detailed comments on the special provisions. A timeline for trial batching, construction of the trial slab, and construction of the actual bridge decks were discussed. It was agreed that KU personnel would be present during all phases of the project and participate as requested by KDOT to resolve any questions during the construction process.

Work has continued in the laboratory. Since December, test programs for free shrinkage tests on concrete with different aggregate types, mineral admixtures and curing times were duplicated. The additional variable in the aggregate tests included the new aggregate type, granite, but results of these tests are inconclusive at this time. The curing batches also differed from the original batches in that they were cast with 5±0.5% air content.

The new tests with mineral admixtures compared the free shrinkage of concrete made with different mineral admixtures and a control batch. Batches were cast with 30% slag, 30% fly ash and 10% silica fume by the volume of cementitious materials. In all cases, these materials were used as a replacement to cement. A low dose of ADVA superplasticizer was used with the silica fume to obtain better workability. For the first set of tests, the highest shrinkage was obtained with fly ash, followed by slag, the control, and finally the silica fume batches. The low relative shrinkage values for the silica fume specimens were inconsistent with previous tests conducted without superplasticizers, so the silica fume tests were duplicated with an additional control batch using ADVA superplasticizer. The results of the duplicate tests showed that the silica fume specimens had higher shrinkage than the control specimens, which agreed with the original shrinkage tests with mineral admixtures.

The test program on the effect of the length of curing on free shrinkage is progressing. Specimens were made using Type I/II cement and cured for periods of 3, 7, 14 or 28 days in groups of three. The results show that the total shrinkage, measured from the casting date, is significantly reduced as the curing time is increased. The results also show reduced shrinkage with increased curing when compared based on drying time only. In addition, the initial rate of shrinkage was lower for the specimens with longer curing times. Similar results have also been obtained with tests using Type II coarse ground cement. When tests with the two cement types are compared, the results show that Type II coarse ground cement produces less shrinkage than Type I/II cement for each curing period used in the study.

Work continues with the permeability specimens. Twelve sets of three permeability specimens each were ponded with NaCl solution. The specimens are being sampled and tested for chloride content. The primary variables in the study include cement type, cement content, length of curing, the use of a shrinkage reducing admixture, and aggregate type. In addition, one Kansas DOT and one Missouri DOT bridge deck mixture are being tested. Chloride sampling and testing is approximately 75% complete should be 100% complete by the end of April. Analysis of the chloride data has begun and will continue through the next quarter.

Work to develop a procedure and program to optimize aggregate gradations for use in bridge deck concrete is currently in the final stages of development. Optimized aggregate gradations facilitate the use of less cement paste in the mixture, thereby reducing the risk of cracking, while maintaining adequate workability.

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

SUMMARY OF ACTIVITIES EXPECTED TO BE PERFORMED NEXT QUARTER:

Bridge deck candidates from the state representatives in the pooled fund project will continue to be sought. The project team will begin coordinating special provisions and seminars with states that have already submitted candidates.

Future work in the laboratory will include comparisons of the free shrinkage of specimens and evaluation of the permeability specimens.

The draft guidelines for optimizing aggregate gradation will be completed and submitted to KDOT for general distribution. By the end of the summer, these guidelines will include a written description of the optimization process, flowcharts for programming use, and a program to optimize a mix based on a set of given aggregate gradations and material properties.

The third meeting of state representatives will be held in Kansas City in May. Details for this conference will be sent to the representatives early in the next quarter.

STATUS AND COMPLETION DATE

Percentage of work completed to date for total project is: 40%

__X__ on schedule _____ behind schedule, explain:

Expected Completion Date: March 31, 2008