Period Covered: January 1 through March 31, 2007 (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

A meeting with engineers from the City of Overland Park, KS was held on February 7, 2007. An introduction to LC-HPC bridges was provided. Following the meeting, a two-bridge contract for the LC-HPC bridges was established, bringing the total number of bridges for the project to 19. The KDOT LC-HPC specifications were adopted with minor changes. The first of the two bridges was let on March 26.

Two pre-bid conferences were held this quarter: One on January 8, 2007 for the thirteenth LC-HPC bridge (Bridge 69-54, Project K7892-01) in Kansas and the second on March 19, 2007 for the first Overland Park, KS LC-HPC bridge.

The post-construction meeting for the third LC-HPC bridge (34th Street over I-635) in Kansas was held on March 13, 2007. The main items of discussion included improving the efficiency of casting the last abutment to eliminate the delay for initiating curing on the last portion of the deck, the grinding of the deck surface, and emphasizing the importance of the fogging system, and the time to burlap placement. Concrete delivery delays were noted as the primary reason for delays in burlap placement. Leakage of the fogging system was noted. The contractor stated that the concrete had excellent workability (better than the standard mix) and that it pumped well, even for low-slump batches. He suggested that a double-drum screed would require fewer passes than the single-drum screed. The use of a double-drum screed will be evaluated on an upcoming qualification slab based on its ability to allow large coarse aggregate particles to remain at the top surface of the deck – a property that has been demonstrated by the single-drum screeds.

LABORATORY ACTIVITIES

A series of free-shrinkage and strength specimens were cast to determine the combined effect of a low-absorption granite coarse aggregate (0.7% absorption) with different mineral admixtures. Specimens had paste contents equivalent to 535 lb/yd^3 of cement with a 0.42 water-cement ratio and were cured for either 7 days or 14 days in lime-saturated water. A control batch with 535 lb/yd^3 of cement and 0.42 water-cement ratio was also cast. The mixtures contained ground granulated blast furnace slag (GGBFS) (30 or 60% volume replacements), silica fume (3 or 6% volume replacements), or Class F fly ash (20 or 40% volume replacements). This repeats an earlier series in which a porous limestone coarse aggregate (approximately 3% absorption) was used instead of the low-absorption aggregate. A comparison with the earlier results indicates that the absorbed water in the porous coarse aggregate contributes to internal curing, reducing shrinkage for mixes containing mineral admixtures, but not affecting shrinkage for mixes containing only portland cement.

Another series of free-shrinkage and strength specimens with water-cement ratios ranging from 0.45 to 0.41 were also cast with the low-absorption coarse aggregate. For this series, the cement content was constant (535 lb/yd^3) and the water-cement ratio was reduced by reducing the water content (and paste content). This series can also be compared with previous results in which the porous coarse aggregate was used rather than the low-absorption coarse aggregate. Specimens were cured for either 7 days or 14 days in lime-saturated water.

A series of AASHTO T259 permeability specimens to examine the effects of silica fume (0, 3, and 6% volume replacements), shrinkage reducing admixture (SRA; using half of the recommended dosage to limit negative effects on air content), or GGBFS Grade 120 (0 and 30% volume replacements) have started the ponding cycle and will be ready for chloride testing in 3 months. An additional control mixture, commonly used by KDOT, containing 602 lb/yd^3 of Type I/II cement with a 0.44 water-cement ratio has also started the ponding cycle. A series use to examine the combined effects of GGBFS Grade 100 and silica fume has completed the ponding cycle.

Preparation and planning for the upcoming scaling and freeze-thaw tests is complete. For the scaling test a 2.5% sodium chloride (NaCl) solution (shown in earlier studies to cause the greatest scaling) will be used for ponding. The mixtures will be evaluated using ASTM C 672 (visual evaluation) and MTO-LS 412 (mass loss determination). ASTM C 666 – Procedure A will be used for the freeze-thaw tests.

The experimental apparatus for a new round of restrained ring tests will continue to be developed.

RESULTS

The free-shrinkage series cast this quarter to determine the combined effect of a low-absorption coarse aggregate cast with different mineral admixtures (GGBFS, silica fume, fly ash) is ongoing. Preliminary results indicate that specimens cast with GGBFS had the least shrinkage at 30 days for both curing periods examined. Specimens cured for 14 days containing GGBFS or silica fume have lower shrinkage than the control batch at 30 days, whereas mixtures containing fly ash have higher shrinkage. Specimens cured for 14 days consistently have lower shrinkage than specimens cured for only 7 days. These results are similar to the results obtained for the same mixtures cast with a porous coarse aggregate.

Preliminary results examining the effect of reducing the water-cement ratio from 0.45 to 0.41 by reducing the water content (and paste content) indicate that reducing the water-cement ratio slightly reduces free shrinkage.

OTHER ACTIVITIES

A presentation of project work was made on February 15 at the ACI Mid-South (Mississippi) Chapter Symposium in Jackson, MS and on March 1 at the 52nd Annual Structural Engineering Conference at KU. A workshop was held at the Texas DOT on March 26, where KU presented experiences with Low-Cracking High-Performance Concrete (LC-HPC) bridges in Kansas along with current laboratory results.

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

ACTIVITIES PLANNED FOR NEXT QUARTER:

Crack surveys for the first three LC-HPC bridges in Kansas will be performed.

A qualification batch and slab for the next LC-HPC bridge deck are expected to be completed.

The ponding cycle for the permeability specimens containing the SRA (1/2 dosage), KDOT mixture (602 lb/yd^3 Type I/II cement, 0.44 water-cement ratio), 100% Type I/II cement, and Grade 120 GGBFS (30% replacement) will be completed. Coring, sampling, and chloride testing of these specimens will begin.

Scaling and freeze-thaw testing will begin for mixtures containing GGBFS. Preparation for restrained ring tests will continue and will include additional test setup, trial batches, and identifying the initial test program.

STATUS AND COMPLETION DATE

Percentage of work completed to date for total project is: 80%

__X__ on schedule _____ behind schedule, explain:

Expected Completion Date: _____March 31, 2008____