TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): ____Kansas DOT_____

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # *TPF-5(336)*	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) 2016 ✕Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)

Project Title: Construction of Low-Cracking High-Performance Bridge Decks Incorporating New Technology		
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Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:** **January 1, 2016**
Original Project End Date: **December 31, 2018**	**Current Project End Date:** **December 31, 2018**	**Number of Extensions:** 0

Project schedule status:

✕ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	**Total Cost to Date for Project**	**Total Percentage of Work Completed**
$270,000	$25,018.08	10%

Quarterly Project Statistics:

Total Project Expenses This Quarter	**Total Amount of Funds Expended This Quarter**	**Percentage of Work Completed This Quarter**
$10.526.69	$10.526.69	5%

Project Description:

Bridge decks constructed using low-cracking high-performance concrete (LC-HPC) have performed exceedingly well when compared with bridge decks constructed using conventional procedures. The LC-HPC decks have been constructed using 100% portland cement concretes with low cement paste contents, lower concrete slumps, controlled concrete temperature, minimum finishing, and the early initiation of extended curing. Methods to further minimize cracking, such as internal curing in conjunction with selected supplementary cementitious materials, shrinkage-reducing admixtures, shrinkage-compensating admixtures, and fibers have yet to be applied in conjunction with the LC-HPC approach to bridge-deck construction. Laboratory research and limited field applications have demonstrated that the use of two new technologies, (1) internal curing provided through the use of pre-wetted, fine lightweight aggregate in combination with slag cement, with or without small quantities of silica fume, and (2) shrinkage compensating admixtures, can reduce cracking below values obtained using current LC-HPC specifications. The goal of this project to apply these technologies to new bridge deck construction in Kansas and Minnesota and establish their effectiveness in practice. Additional states may be added as the study progresses.

The purpose of this study is to implement new technologies in conjunction with low-cracking high-performance concrete bridge specifications to improve bridge deck life through reduction of cracking. The work involves cooperation between state departments of transportation (DOTs), material suppliers, contractors, and designers. The following tasks will be performed to achieve this objective.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

TASK 1: Work with state DOTs on specifications for the construction of six LC-HPC bridge decks per state to be constructed over a three-year period.

Materials for use in upcoming Minnesota Department of Transportation (MnDOT) bridges were obtained for use in casting durability test specimens in the University of Kansas (KU) labs. The contractor's approved mixture proportions were reviewed and material properties were tested in KU labs for verification. The coarse aggregate properties measured in tests at KU according to ASTM C127 closely match to the contractor's specified values for absorption (0.4% in both instances), specific gravity (2.71 at KU compared to the 2.72 value provided), and gradation. Fine aggregate properties were also a close match for absorption (0.5% in both instances) and gradation; the specific gravity obtained at KU, 2.62 was slightly lower than the specified 2.65.

For fine lightweight aggregate, the initial values provided by the contractor indicated that the materials had a specific gravity of 1.68 and an absorption of 25.6%. Multiple tests for material properties were performed in the KU lab per ASTM C1761, which references ASTM C128. Two methods were used to place test samples in a wetted surface dry (WSD) condition. One used paper towels to remove excess moisture, as specified in ASTM C1761/C128. The other used a centrifuge. Test results for the material sample given to KU differed from reported values, with an average specific gravity of 1.59 and an average absorption of 31.0%, independent of the method used to place the aggregate in the WSD condition. Results from the tests using the centrifuge, however, exhibited the smaller variation for tests performed by different personnel over multiple trials, with a shorter time needed to complete each trial. Gradation results also differed from the information provided, with the KU samples containing a higher percentage of finer particles. Tests at KU found 4.8% of the aggregate passed the No. 200 (75 μm) sieve, compared to 0.4% from the supplier's data. Tests for clay lumps and friable particles according to ASTM C142 indicated an average of 2.7% content of such material (compared to 0.5%), but these differences are within the allowable variation between two testing laboratories. Tests for organic impurities according to ASTM C40 were also performed on the fine lightweight aggregate and indicate that such materials were not present in the sample.

KU discussed these test results with the contractor and material supplier, who acknowledged the variability between samples. These results indicate the need to check multiple samples for large-scale concrete mixes.

30% COMPLETE

TASK 2: Provide on-site guidance during construction of the LC-HPC bridge decks.

0% COMPLETE

TASK 3: Perform detailed crack surveys on the bridge decks, 1 year, 2-3 years, and (if approved) 4-5 years after construction. Prior research has demonstrated that it takes at least three years to consistently establish the long-term cracking performance of a bridge deck. The surveys will be performed using techniques developed at the University of Kansas to identify and measure all cracks visible on the upper surface of the bridge deck. If desired, DOT personal will be trained in the survey techniques and may assist in the surveys, as appropriate.

This task will be performed after the construction of the bridge decks. Crack surveys of the internal curing and control decks will be conducted during the summer, one and three years after construction.

0% COMPLETE

TASK 4: Correlate the cracking measured in Task 3 with environmental and site conditions, construction techniques, design specifications, and material properties, and compare with results obtained on earlier conventional and LC-HPC bridge decks.

0% COMPLETE

TASK 5: Document the results of the study. Interim and final reports will be prepared covering the findings in Tasks 1-4.

0% COMPLETE

Anticipated work next quarter:

Trial batches will be cast for testing in third party labs using material properties from the supplier. Additionally, aggregate properties determined in the KU labs will be used to cast batches for comparison. Based on test results, KU will develop recommendations to implement for final mix designs. Pre-construction meetings will be held on the Minnesota bridge decks; representatives from KU, representatives from MnDOT, and the contractor will participate to discuss the details of the construction. The two decks in Minnesota will be constructed with KU personnel onsite. Work with KDOT on revising specifications will also continue.

Significant Results this quarter:

Materials have been obtained for use in casting trial batches and properties have been determined and verified where applicable. Differences in the properties of lightweight fine aggregate compared to properties reported by the aggregate supplier were observed in lab tests, demonstrating the need to account for material variability in final mixture batch weights.

Test results for fine lightweight aggregate material properties resulted in similar values for the two methods used to place test samples in a WSD condition. The use of a centrifuge, as opposed to using paper towels per ASTM C1761/C128, to remove excess surface moisture from samples produced the smallest variation in results with less time needed to complete each test. These test results validate the centrifuge as a practical option for determining the amount of water required in final mixture batch weights.

Circumstances affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Nothing to report.