PROJECT DESCRIPTION FOR PROPOSED POOLED-FUND STUDY

I: Research Project Title: Construction of Low-Cracking High-Performance Bridge Decks Incorporating New Technology

II: Research Project Statement:

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 the low cement paste contents, lower concrete slumps, controlled 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 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. Additional states can be added.

III. Research Objectives:

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 used to achieve this objective:

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.

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

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.

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

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

IV: Benefits:

State departments of transportation expend significant effort and resources on the construction of durable reinforced concrete bridges and bridge decks. Existing data show that the modifications to construction procedures, materials, and design details used in LC-HPC bridge deck construction significantly reduce the degree of cracking and, thus, reduce exposure of reinforcing steel to the corrosive effects of deicing chemicals and decrease freeze-thaw damage. Of the two, corrosion is by far the greater problem. The goal of the project is to combine knowledge from research and practice to develop a comprehensive strategy for constructing of bridge decks. If successful, the result will be a major reduction in bridge deck cracking, an improvement in durability, and an increase in the useful life of bridges.

V. Budget and Schedule:

Estimated project duration: 6 years plus nine-month unfunded no-cost extension (9/1/15 to 6/1/21).

Estimated budget:

Phase I, 3 years, $270,000 for two states: Two states, each providing $45,000 per year for three years beginning approximately September 1, 2015. This will cover Tasks 1, 2, 4, and 5, and a portion of the surveys under Task 3 (decks cast in year 1 – two annual surveys, decks cast in year 2 – one annual survey, decks cast in year 3 – no surveys). Total per state = $135,000.

Additional states may participate at the same rates.

Phase II, 3 years, $270,000 for two states: Each state desiring to do so will provide $45,000 per year for another three years beginning approximately September 1, 2018. This will cover the balance of the surveys under Task 3 (decks cast in year 1 – five total annual surveys, decks cast in year 2 – four total annual surveys, decks cast in year 3 – three total annual surveys) and Task 5. Total per state = $135,000.

Additional states may participate at the same rates.

VI. Project Personnel: The project will be directed by David Darwin, Ph.D., P.E., Deane E. Ackers Distinguished Professor of Civil Engineering and Chair of the Department of Civil. Environmental & Architectural Engineering, and Matthew O'Reilly, Ph.D., P.E., Assistant Professor of Civil Engineering at the University of Kansas. Professors Darwin and O'Reilly will be assisted in this study by student researchers in the School of Engineering at the University of Kansas who have the appropriate training in reinforced concrete and composite structures.

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