



Research Project Statement 24-010 FY 2024 Annual Program

Title:	Developing a Performance-Based Concrete Overlay Mix Design for Improved Resistance to Early-Age Cracking and Increased Durability
The Problem:	<p>Concrete bridge decks are exposed to a wide range of environmental and mechanical distress that can lead to severe deterioration. Typical bridge deck deterioration starts with shrinkage cracks, and additional cracks may occur due to traffic loads and time-dependent effects such as temperature and moisture fluctuations. These cracks can lead to water and chloride ingress, causing corrosion of the reinforcement and further damage to the bridge structure. In Texas, several concrete overlay mix design options are available in their Standard Specification to protect and preserve bridge decks from these types of deteriorations; e.g., concrete or latex modified concrete overlays and multi-layer polymer overlays. Prescriptive options for producing concrete overlays are convenient as they provide bridge contractors familiarity with the products, and they understand their purpose. The challenge is that inconsistencies are observed between overlay mixtures and batches during placement, especially when mobile volumetric mixers are used. Additionally, as individual materials that make up prescriptive concrete overlay mix designs evolve over the years and newer or alternative materials become available; e.g., Type IL cements and alternative supplementary cementitious materials (SCMs), different behavior compared to past mix compositions will continue to be observed and will likely result in early-age cracking. Furthermore, as bridge decks age in the state there will be a need to preserve their service life and ensure long-term performance of concrete overlay mix designs through performance-based specifications.</p> <p>This project is aimed at developing a robust mix design option, a non-UHPC, combined with a performance-based specification for concrete overlays to achieve low cracking potential and superior long-term durability. In addition, a concrete overlay specification that adapts to currently and predominately available cementitious materials will ensure it long-term success in practice.</p>
Technical Objectives:	<p>The focus of this research is to evaluate potential approaches; i.e., materials, mixture proportions, fibers, curing, shrinkage, permeability, construction and placement techniques, and to provide performance-based specifications and guidelines for producing durable and crack resistant concrete bridge deck overlays in Texas. This research will provide TxDOT with a recommended overlay mix design that will improve bridge deck performance, increase service life, reduce the need for and ultimately the cost of bridge deck maintenance, and increase public safety.</p> <p>To meet the objectives of this project, the research team shall:</p> <ul style="list-style-type: none"> • Gather information on material properties, mix designs requirements, and construction specifications that influence concrete overlay performance, with a particular emphasis on early-age cracking. • Formulate concrete overlay mixture candidates or options using a modified void ratio method on a wide range of binders and aggregate combinations with the aim of achieving minimum paste volume for reducing shrinkage and, suitable workability for constructability and placement. • Perform an initial screening evaluation on all candidate mixtures to characterize several fresh and hardened properties; i.e., workability, setting time, mechanical strength, and permeability. • Test high potential mix designs on key engineering properties that influence early-age cracking and durability; i.e., plastic and drying shrinkage, restrained shrinkage, and chloride ingress. • Perform a lab-scale concrete overlay experimental program utilizing instrumented reinforced concrete specimens to replicate a conventional TxDOT bridge deck ("mini deck") and characterize early- and later-age performance as well as perform a full visual inspection to document cracking performance. The selected mixtures will be placed using a full-scale mobile concrete mixer. • Demonstrate field-scale production, evaluation, and long-term monitoring of the newly developed performance-based concrete overlay mix design on an existing bridge structure. • Provide a new performance-based concrete overlay mix design and contribute to the development of specifications as well as guidance best practice documents for TXDOT. <p>The expected technology readiness level (TRL) for this project is 8.</p>

Anticipated Deliverables:	<ol style="list-style-type: none"> 1. Technical memorandum for each task completed. 2. Monthly progress reports. 3. Value of Research (VoR) that includes both qualitative and economic benefits, to be included in the final research report. This is not a stand-alone deliverable. 4. Product P1: Guidance and best practice document to assist key stakeholders producing and delivering a performance-based concrete overlay mix design. 5. Research report documenting the findings of this research, including a performance-based specification for producing and delivering a concrete overlay mix design. 6. Project Summary Report.
Proposal Requirements:	<ol style="list-style-type: none"> 1. Project duration shall not exceed 36 months. 2. Proposal Deadline: 12:00 p.m. Central Time, Monday, March 6, 2023. 3. RFP#1 Q&A Deadline: 12:00 p.m. Central Time, Wednesday, February 1, 2023. 4. Use the current "ProjAgre" and "PA Forms" templates located at the RTI Forms webpage. 5. Proposals will be considered non-responsive and will not be accepted for technical evaluation if they are not received by the deadline or do not meet the requirements stated in RTI's University Handbook. 6. Proposals should be submitted in PDF format; (1) PDF file per proposal. File name should include project name and university abbreviation. 7. This project will be tracked during the life of the project using the Technology Readiness Level (TRL) scale. 8. The 2021 Texas Legislative Session requires that universities be in compliance with Senate Bill 475 by submitting a completed and signed TxDOT Security Questionnaire (TSQ) to RTIMAIN@txdot.gov in advance of a proposal submission. Universities found to not submit a completed and signed TSQ in advance of proposal submitting will be held in non-compliance and unable to participate in the Program.