

Field Implementation and Monitoring of an Ultra-High Performance Concrete Bridge Deck Overlay

Implementation of an ultra-high performance concrete (UHPC) bridge deck overlay through construction and post-construction assessment

Overlays are placed on existing concrete bridge decks to increase cover for the deck reinforcing steel, improve rideability, and improve skid resistance. Previous research has demonstrated that ultra-high performance concrete (UHPC) has the potential to increase service lives of bridge deck overlays, and subsequently, the underlying concrete deck, because it has exceptional durability properties and contains silica fume that facilitates bond to substrate concretes. This research project will document, monitor, and assess the field implementation of a UHPC overlay produced with local materials on a bridge in Socorro, NM. This will be the first non-proprietary UHPC overlay constructed in the U.S. The research project consists of a comprehensive literature review to identify best practices for UHPC technologies and overlay construction methods. Short and long-term monitoring plans will then be developed for assessing the performance of the constructed UHPC overlay. Data collected during construction will include weather data, construction sequence, and other observations that might influence the quality of the completed project. After construction, the short and long-term monitoring plans that include mechanical, physical, and nondestructive testing, will be initiated, and the assessment of the initial measurements will be reported in the final research report.

inadequate service life expectancy, or limited availability.

Recent research has demonstrated that ultra-high performance concrete (UHPC) may have the ability to increase service lives of bridge deck overlays and reduce maintenance costs. This technology may also extend the service life of the underlying concrete deck. Research at New Mexico State University (NMSU) has shown that UHPC produced with local materials has excellent durability, and materials costs can be decreased by 30 to 70%. Although there is a small reduction (about 10%) in compressive strength of UHPC when using local materials compared to strengths obtained with commercial UHPC mixtures, the reduced cost of the material improves sustainability of UHPC usage.

A 2017-2018 research project at NMSU (funded by Tran-SET) demonstrated that UHPC produced with local materials was able to achieve adequate bond strength with substrate concrete when used as an overlay material in the laboratory (Newtson et al. 2018). Based on these observations, NMDOT is planning to apply a locally produced UHPC overlay to a concrete bridge deck in Socorro, NM. The mixture proportions developed in the 2017- 2018 Tran-SET project, presented in Table 1, have been selected and specified for the NMDOT field implementation project.

Table 1. Mixture proportions for UHPC.

Material	Cement	Silica Fume	Fly Ash	Sand	HRWRA (gal/yd ³ [L/m ³])	Water	Steel Fibers
lb/yd ³	1377	172	172	1702	9.09	258	201
(kg/m ³)	817	102	102	1010	45	153	119

Objectives

The objectives of this proposed project are to assist NMDOT with implementing the UHPC overlay technology by helping them with the planning, preparation, and construction of the UHPC overlay. The project will also include developing and initiating a long-term monitoring program to assess the performance of the UHPC overlay. Portions of this research are expected to be co-funded by NMDOT with a budget of

Problem Statement

Concrete bridge decks are exposed to a wide range of environmental and mechanical distress and are critical bridge elements since they not only provide a comfortable and safe riding surface, but also protect structural elements beneath them. High bridge deck maintenance costs have led agencies to consider more durable materials for bridge deck overlays. Materials currently available for overlay applications include asphalt concrete, high performance concrete, low-slump concrete, latex-modified concrete, and polymer-modified concrete. However, each of these materials has drawbacks such as high cost,

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Lead Institution:
New Mexico State University

Funds Requested to UTC:
\$60,000

Funding Source(s):
Tran-SET
New Mexico State University

Total Project Cost:
\$120,000



\$125,000. The cofunding provided by the NMDOT project will be in addition to the required 100% match from NMSU. However, the NMDOT project has not received final approval yet, so NMSU is unable to guarantee those funds for use as a match.

Intended Implementation of Research

Education, Outreach, and Workforce Development: In addition to the technical aspects of the research, efforts should be made to address education, outreach, and workforce development. To address these issues, the following tasks will also be performed as part of this project:

- Development of a powerpoint presentation containing educational content that can be used in the education and recruitment of high school and community college students considering transportation engineering careers, interested in construction related careers, or interested in pursuing careers in the concrete industry.
- Presentation of the research at conferences, meetings, and workshops associated with Tran-SET and the transportation engineering community to provide workforce development and continuing education opportunities for people considering transportation related careers and transportation professionals.

These activities are expected to occur primarily in the implementation phase of this project. The budget for the implementation phase reflects our anticipated efforts for education, outreach, and workforce development.

Anticipated Impacts/Benefits of Implementation

This project is an implementation project for a technology that was identified as promising in a 2017 project. The implementation phase of this project will focus on dissemination the research to encourage other agencies to consider using UHPC for bridge deck overlay.

Web Links

- [TranSET's website](https://transet.lsu.edu/research-in-progress/)
(<https://transet.lsu.edu/research-in-progress/>)
- [TRB's Research in Progress \(RIP\) database](https://rip.trb.org/View/1644233)
(<https://rip.trb.org/View/1644233>)

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit [Our Website](#), LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Mr. Christopher Melson (Tran-SET Program Manager) directly at transet@lsu.edu.

