TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Minnesota Department of Transportation

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 # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)* TPF-5(269)	**Transportation Pooled Fund Program - Report Period:** ☑ Quarter 1 (January 1 – March 31) ☐ Quarter 2 (April 1 – June 30) ☐ Quarter 3 (July 1 – September 30) ☐ Quarter 4 (October 1 – December 31)	
Project Title: Development of an Improved Design Procedure for Unbonded Concrete Overlays		
Name of Project Manager(s): Tom Burnham	**Phone Number:** 651-366-5452	**E-Mail** tom.burnham@state.mn.us
Lead Agency Project ID: TPF-5(269)	**Other Project ID (i.e., contract #):** 99008 Work Order No. 83	**Project Start Date:** June 17, 2013
Original Project End Date: May 31, 2016	**Current Project End Date:** May 31, 2017	**Number of Extensions:** 1

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	Percentage of Work Completed to Date
$445,824.88	$296,818	55%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$71,818	$101,188	71%

Project Description:

This project was created to address the timely need for an improved mechanistic-empirical based design procedure for unbonded concrete overlays of existing concrete and composite pavements (UCOCP).

The objectives of the projects are:

1. Study and understand the field performance history of UCOCP as demonstrated by various test sections and in-service pavements.
2. Determine suitable separator layer (interlayer) materials and properties to insure long term performance of UCOCP systems.
3. Develop a design procedure for unbonded concrete overlays of existing concrete and composite pavements utilizing existing validated performance models, as well as new analytical models derived to address deficient or missing design parameters in existing methods. The design guide will be based on mechanistic-empirical principles, including the effects of various concrete overlay materials, separator layer (interlayer) types, panel thickness (4" to 10") and panel size, joint load transfer mechanisms, traffic loads, and climates (nation-wide) in which they must perform.
4. Provide improved or supplemental guidance on the suitability of projects for unbonded concrete overlays.

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

The research team extended the structural modeling from the previous quarter through the use of finite element models for structural behavior. This effort addressed key concerns, including:

• The use of the Totsky spring layer to model interlayer behavior was validated using laboratory data. These results were examined by the TAP, and the implications of using this model for design were discussed. This manner of modeling the interlayer does not compromise the design procedure for either asphalt or fabric interlayers.

• The research team explored the response of smaller panels (e.g. 6' by 6' foot panels) to loading. The stress response of these panels was found to be similar to their larger counterpart.

• Modeling of longitudinal cracking in the final design procedure was discounted. As failure in a panel can induce failure (in longitudinal cracking) in neighboring panels, modeling the distress is as much about stochastic processes as it is structural responses.

• As for reflective cracking, the research team found that previous work, most notably TPF(5)-165, supports using other distresses as a design criteria to sufficiently limit reflective cracking, should it be a concern.

• Finally, the research team continued investigations into a faulting model for overlay systems that uses rapid solutions. This investigation included the exploration of both 3D and 2D finite element models of concrete pavements in various configurations.

A TAP meeting was held on February 22. A proposal was made during the meeting to test additional beam samples to increase to knowledge base for interlayer models. It was also proposed to extend the due dates for Tasks 4 and 5. Work began on amending the contract to accommodate the proposed changes.

The Task 3 report was submitted, reviewed and approved for payment.

Anticipated work next quarter:

During Q2 2016, a major focus for the research team will be the structural modeling of faulting in UCOCP. As noted in previous reporting, this model may utilize a new library of rapid solutions for the faulting response of UCOCP to loading, developed with either a 2D or 3D finite element models. These methods will be compared and a final methodology should be established, leading to the development of the rapid solutions and in turn the faulting performance model itself. The Q2 2016 work will also include efforts to account for interlayer erosion on the likelihood of top-down cracking in the transverse cracking performance model.

The contract amendment should be approved this quarter.

Significant Results:

Six existing UBOL design procedures were discovered as being relevant to this effort. There is strong interest in packaging the new UBOL procedure developed under this contract, with the recently developed BCOA-ME product from pooled fund TPF 5-165.

The team has done preliminary investigation on data from MnDOT's pavement management system database, which included some valuable longer term performance of UBOLs. This historical information will be very helpful toward the development of the new design procedure.

A new longitudinal cracking model has been developed, which will be important to the development of the new design procedure.

Laboratory testing of beam samples have revealed some interesting behaviors of interlayers under load, particularly with asphalt-based materials.

The primary failures modes of UBOLs have been identified.

Updated drainage guidelines for UBOLs have been developed.

Significant progress has been made on developing new structural models for UBOLs.

Circumstance 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).

The project work is currently progressing slightly behind the schedule due to complications discovered during the structural model development and use of Task 2 laboratory data. Proposed testing of additional beams will slow the efforts to complete Task 4 and 5. The team has agreed to make every effort toward completing the project by the current contract end date of May 31st, 2017.

The proposed beam sample testing will cost an additional $22,500. The pooled fund began with a balance of $460,000, with $445,824.88 in commitments to date (MnDOT contract and expenses). The leaves a shortfall of $8,324.88 to do the proposed additional work. The FHWA has agreed to contribute this amount to the pooled fund, allowing the proposed work to move forward in an amended contract.

Potential Implementation:

There is great and immediate demand for the product from this project.

Once the design procedure and guidelines are accepted as viable and reliable by the design community, the implementation will occur very quickly.