TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): MnDOT

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(149)	**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: Design and Construction Guidelines for Thermally Insulated Concrete Pavements		
Name of Project Manager(s): Tim Clyne	**Phone Number:** 651-366-5473	**E-Mail** tim.clyne@state.mn.us
Lead Agency Project ID: Contract 89261	**Other Project ID (i.e., contract #):** WO # 90	**Project Start Date:** 1/30/2008
Original Project End Date: 1/31/2011	**Current Project End Date:** 7/31/2012	**Number of Extensions:** 2

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
$455,000 ($439k research, $16k admin)	$219,490.00 (+ 3 TAP meetings)	~70%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$105,355.00 (23%)	$105,355	81%

Project Description:

The research proposed in this pooled fund study aims to develop effective design and construction guidelines for TICPs. The study will focus on the initial questions of life cycle analysis, the effects performance of climate region, pavement design (interaction of concrete and asphalt thicknesses), materials properties for the asphalt and concrete materials and design details such as joint spacing, dowels and joint support. This investigation will determine an initial set of pavement structures that provide the best performance with respect to performance, constructability and cost-efficiency. The investigation will use a review of the literature, extensive mechanistic analysis combined with measured field properties and available information from field and accelerated pavement testing performance to determine the optimized set of pavement structures.

The main objective of the proposed research is to perform life cycle cost analysis comparisons and develop design and construction guidelines for TICPs (i.e. composite thin HMA overlays of new or structurally sound existing PCC pavements). The study also has the following secondary objectives:

1. Validation of the structural and climatic models of the Mechanistic-Empirical Pavement Design Guide (MEPDG) for asphalt overlays of concrete pavements.
2. Investigation of applicability of the MEPDG for design of TICPs.
3. Investigation of applicability of reflection cracking and asphalt rutting models developed in California.
4. Development of recommendations for feasibility analysis of newly constructed TICPs or thin overlays of the existing concrete pavements.

These objectives will be accomplished by collecting field performance data and evaluating the influence of design, material properties and construction on the performance of TICPs.

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

Task 2 (Life Cycle Analysis) was completed this quarter. The work was done primarily by the University of California Pavement Research Center with help from the University of Minnesota. The completed task report describes cases where composite pavements are competitive with conventional concrete pavements, both in terms of cost comparisons and pavement performance.

Task 4 (Pavement Response Models) was completed this quarter. The asphalt was modeled under a dual-modulus approach to account for both traffic and environmental loadings. A finite element (FE) model was developed to analyze a composite pavement that incorporates elastic and viscoelastic layers. A stress computation procedure was developed to calculate stresses in the composite pavement subjected to a combination of traffic loads and temperature curling using two load duration-dependent AC moduli. The stress computation procedure based on the 2-moduli approach demonstrated that the MEPDG may significantly underestimate the stress in composite pavements subjected to a combination of traffic loading and temperature curling. Finally, a framework for the implementation of the proposed stress procedure into the MEPDG was developed such that minimum modifications to the existing MEPDG framework are required.

Significant work was also accomplished on Task 5 (Design Guidelines), Task 6 (Construction Guidelines), and Task 7 (Synthesis) this quarter.

A U of MN PhD student presented her dissertation this quarter, which was essentially the Task 4 work.

Anticipated work next quarter:

Task 5 (Design Guidelines) and Task 6 (Construction Guidelines) are expected to be completed next quarter. Work will continue on Task 7 (Synthesis).

The composite test section constructed at MnROAD in 2008 to validate data for this project will be removed and reconstructed next quarter. Data from this test section will be finalized and delivered to the PI by MnROAD staff.

Significant Results:

A number of important observations have been made on functionality of the Mechanistic Empirical Pavement Design Guide (MEPDG), and several improvements have been developed. These include:

- Improvements to the Enhanced Integrated Climate Model (EICM), mainly due to climate input files
- Development of 2-moduli approach for asphalt material response
- Updates to the concrete fatigue cracking model
- Identification of parameters that would make composite pavements competitive with conventional pavements from the standpoints of cost-competitiveness and pavement performance

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).

There was substantial delay in getting all of the subcontracts in place with the University of California. This has led to delays in the overall project. These awards are now in place, so the project should be on track from this point forward.

Potential Implementation:

MnDOT, participating states, and FHWA will have a tool at their disposal to both design and construct composite pavements, which are a potential long-life, low-maintenance pavement for our road networks.