**TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

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

**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.*

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| **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)C:\Program Files\Microsoft Office\MEDIA\OFFICE14\Bullets\BD21301_.gif□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:**1/30/08 |
| **Original Project End Date:**1/31/11 | **Current Project End Date:**7/31/12 | **Number of Extensions:**2 |

Project schedule status:

□ On schedule □ On revised schedule □ Ahead of schedule □ Behind schedule

Overall Project Statistics:

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|  **Total Project Budget** |  **Total Cost to Date for Project** |  **Percentage of Work**  **Completed to Date** |
| $455,000 ($439k research, $16k admin) | $340,400 (+ 4 TAP meetings) | ~75% |

***Quarterly*** Project Statistics:

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|  **Total Project Expenses**  **and Percentage This Quarter** |  **Total Amount of Funds**  **Expended This Quarter** |  **Total Percentage of**  **Time Used to Date** |
| 0 | 0 | 89% |

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| **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. |

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| **Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**A TAP meeting was held October 5th in conjunction with the October 4th MnROAD Research Conference. The participants discussed the progress of the project, and the states gave further direction to the research team on how to proceed. Expectations for final deliverables of the project were documented.The research team also met in late November in Sacramento during the SPTC meeting to discuss progress on the project.Task 4 (Pavement Response Models) was completed previously. A paper summarizing the improvement of the MEPDG structural analysis of the PCC cracking was presented at the TRB 2012 annual meeting. The paper was recognized by the Pavement Rehabilitation Committee (AFD40) for an award.The work of Task 5 (Design Guidelines) has been conducted and will be reported in the project synthesis. The CalME rutting model has been completely integrated with the MEPDG. Figure 1 below shows two comparisons of predicted rutting under 1) MEPDG and 2) the modified CalME rutting analysis program. The research team is currently finalizing the calibration of the CalME/MEPDG rutting model using MnROAD and UCD-PRC HVS data collected under the SHRP2 R21 project.**Figure 1. Rutting performance comparison for two examples**The research team is continuing the development of the Construction Guidelines (Task 6), and this material will be reported in the project synthesis. This development includes the revision of sections on existing PCC slab preparation to reflect UCD input. Furthermore, revisions will reflect input from the reporting and specifications from the SHRP2 R21 final report (e.g. information on saw-and-seal in AC-PCC).The Synthesis (Task 7) is being completed. An outline of the current draft of the synthesis is presented in Table 1 below. The Synthesis has gone through many drafts and is being reviewed by members of the project. **Table 1. Synthesis Outline, Jan 2012**

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| * 1. Introduction
		1. TPF-5(149) Project Summary
		2. Brief Overview of AC-over-PCC Implementation and Research
		3. AC-over-PCC as Pavement Preservation, Preventative Maintenance, and Pavement Rehabilitation
		4. Use and Benefits of AC-over-PCC
	2. Existing Concrete Pavement Evaluation
		1. Evaluation Procedure
		2. Structural Evaluation
		3. Functional Evaluation
	3. Pre-Overlay Concrete Pavement Repair and Preparation
		1. Restoring PCC Slab Support
		2. Localized Slab Repair
			1. Partial-depth
			2. Full-depth
		3. Installing Edge Drains
		4. Improving Load Transfer across Transverse, Longitudinal, and Shoulder Joints
		5. PCC Slab Preparation and Cleaning
	4. Asphalt Cement Overlay Mix Design
		1. Asphalt Concrete Mixtures and Selection Criteria
			1. Cold and Warm Mix Asphalts
			2. Hot Mix Asphalt (HMA)
		2. Selection of Asphalt Concrete Mix Type
			1. HMA Mix Design Methods
			2. HMA Design Method Overview
		3. Important Factors in Mix Selection
			1. Traffic Loading
			2. Rut Resistance
			3. Fatigue Resistance
			4. Durability
			5. Environment
			6. Lift Thickness
			7. Appearance
 | * 1. Asphalt Cement Overlay Structural Design
		1. AASHTO93
		2. MEPDG
		3. CALME
		4. CALME/MEPDG
		5. Other Tools
			1. SHRP2 R23 Design
	2. Pavement Performance Evaluation
		1. Importance of Preparation Prior to Overlay
		2. Effectiveness of Saw and Seal
		3. Effectiveness of Rubblization
		4. Importance of Overlay Thicknesses
		5. Summary Evaluation of AC Overlays of PCC
	3. Asphalt Cement Overlay Construction
		1. Sawing and Sealing AC Overlays at PCC Joints
		2. Effectiveness of “Saw and Seal” Treatment for AC Overlays
	4. Case Studies in the Use of AC-over-PCC
		1. ARFC-over-JPCP and CRCP in Arizona (I-10 and US-93)
			1. Noise
			2. Friction
			3. Thermal gradient
		2. SMA-over-JPCP in Germany (A93)
	5. References
	6. Annotated Bibliography
	7. Expanded References
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Work on the Draft Final Report (Task 8) was initiated, and the report is being developed. |
| **Anticipated work next quarter**:Tasks 5 (Design Guidelines), 6 (Construction Guidelines), and 7 (Synthesis) are all expected to be completed next quarter.The research team will finalize a synthesis of AC overlays of concrete pavements and complete the project final report. |

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| **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
* Synthesis will provide comprehensive information on the design and construction of AC/PCC composite pavements, both new and rehabilitated pavements.

Significant progress has been made in the final tasks of the project. Several student theses and publications have resulted from the project work – two of these publications received awards from TRB.  |
| **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.  The State of Minnesota endured a 3-week shutdown in July 2011, during which time the PI was not allowed to work on the research project. This caused delays in the project, but the University should be able to catch up and complete the project on time. |

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| **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.  The Synthesis, as well as other portions of the project, will provide guidelines for: * reducing reflective cracking in the asphalt overlay
* considering traffic control during TICP construction
* ways to lower the costs of composite pavements through staged construction, material selection, and preventive maintenance
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