State Planning and Research Program
Quarterly Report

PROJECT TITLE: Design and Construction Guidelines for Thermally Insulated Concrete Pavements

OBJECTIVES:
The main objective of the proposed research is to develop design and construction guidelines for thermally insulated concrete pavements (TICP), i.e. composite thin HMA overlays of new or structurally sound existing PCC pavements. A secondary objective is to develop recommendations for feasibility analysis of newly constructed TICP or thin overlays of the existing concrete pavements..

PERIOD COVERED: October 1 – December 31, 2008

PARTICIPATING AGENCIES: Minnesota Department Of Transportation, Caltrans, Federal Highway Administration, Local Road Research Board, Washington State Department of Transportation

PROJECT MANAGER: Tim Clyne **LEAD AGENCY**: Minnesota Dept. of Transportation **PRINCIPAL INVESTIGATOR**: Lev Khazanovich	**SP&R PROJECT NO**: TPF 5(149)	PROJECT IS: _____ Planning __X__ Research & Development
ANNUAL BUDGET: The total project budget is $455,000. Of that $16,000 is reserved for pooled fund administrative costs, which leaves $439,000 available for research.	**PROJECT EXPENDITURES TO DATE**: The estimated expenses are $40,400.	

WORK COMPLETED:
The contract award to the University of Minnesota (UMN) was executed in the 1st Quarter of 2008. However, the subcontracts with the University of California-Davis (UC Davis) and University of Washington are still in process. UC Davis wanted to modify some language in the contract which came mostly from the master agreement that UMN has with MnDOT. The negotiation ended without the desire results a decision was made to hire key members of the UC Davis team as consultants for this project. An amendment to the existing contract will be submitted in the first quarter of 2009.

Meanwhile, the University of Minnesota research team concentrated their efforts on two tasks: Task 1 (Literature Review) and Task 3 (EICM Validation and Analysis). A summary of the activities performed under these tasks is provided on the attached page.

SUMMARY OF ACTIVITIES EXPECTED TO BE PERFORMED NEXT QUARTER:
The research team will submit an amendment to the contract. In addition to modifications of the team composition, a request for no-cost time extension for several tasks will be made. The research team will submit a report summarizing the literature review for asphalt overlays of the existing concrete pavements. The EICM analysis will be continued.

STATUS AND COMPLETION DATE:
This project is just getting underway, with completion expected by June 30, 2011. However, completion of
This project is just getting underway, with completion expected by June 30, 2011. However, completion of
task 1 may be delayed due to a delay in the subcontract with UC Davis. The research team may need to ask for a no-cost time extension for these tasks. The research team will submit task 1 report and continue work on task 3.

Task 1. Literature review.

A draft literature review is almost complete. The following topics are covered:

- History and Distresses of Composite Pavements
- Current Rehabilitation Construction Practices
  - Fractured Slab Approach
  - Crack and Seat, Break and Seat
  - Rubblization
  - Interlayers, Grids and Fabrics
  - Interlayer Stress Absorbing Composite
  - Bonding
  - Cold in Place Recycling
  - Bituminous Saw Cuts (Saw and Seal)
  - Modified Binders
  - Ultra Thin Bonded Wearing Course
  - Drainage Considerations
- Design & Modeling of AC Overlays on PCC Pavements
  - Existing Condition Assessment
  - Non-Destructive Testing (NDT)
  - Utilizing the Finite Element Method
  - Caltrans Overlay Design Governed by Reflective Cracking
  - Mechanistic Empirical Design of Rubblized and Crack and Seated PCC Pavements
  - AASHTO Design Guide
  - M-E PDG Design Guide
  - Modeling and Predicting Reflective Cracking
- Performance and Rehabilitation of Composite Pavements
  - Performance & Rehabilitation
  - Survival of 1st, 2nd, 3rd AC/PCC Overlays
- Conclusions and Recommendations
- References – a total of 145 references
- Appendix with 50 pages of annotated bibliography

The literature review and corresponding task report will be completed during early February, 2009.

Task 3. EICM Validation and Analysis

The following EICM aspects were investigated as part of the project work for the last quarter:

1. Minimum AC thickness
2. Time of traffic opening
3. Comparisons of AC overlay and semi-rigid MEPDG models
4. Effect of weather station

A factorial of MEPDG runs was performed for various AC overlay thickness—during these runs, all other parameters were kept constant. The MEPDG software returns a warning message when the AC overlay thickness is less than 2 inches. The predicted transverse cracking in PCC layer from a 2.0-inch and 1.9-inch HMA overlay of JPCP were compared. It was found that a decrease in AC thickness from 2.0 in. to 1.9 in. resulted in an increase in the predicted transverse cracking from 1% to 14.2 %. This indicates that the MEPDG should not be used for analysis of the overlays thinner than 2 in..

A composite pavement with a 4-inch AC overlay of JPCP was modeled by MEPDG with the overlay being input as one 4-inch layer, and two 2-inch layers. No differences in results were apparent.

The difference in the month that a composite pavement structure was opened to traffic was modeled by MEPDG. Several cases of the traffic opening month (June, July, and August) were considered. No significant effect of the month of traffic opening on the predicted pavement performance was found.

The composite pavement structures AC overlay of a PCC pavement and semi-rigid pavement (an AC layer with a stabilized base) were modeled using MEPDG and compared. The same thermal properties were given to the PCC and CTB bases. Predicted pavement performance was significantly different between the two. Based on these results, the researchers do not recommend the use of a semi-rigid alternative for modeling of composite pavements.

The effect of weather stations used to generate an .icm file for MEPDG is being studied. It appears that a station(s) with missing data in close proximity to the pavement location being modeled can cause significantly higher cracking than would otherwise be reasonably expected. A MEPDG run for each location in the US with a complete climate file is being put together.

During the next quarter, the research team will perform the following activities:

- "Global" sensitivity of EICM to weather stations and locations
- Effect of other EICM inputs
- Effect of design features

The research team will also begin comparing MnROAD temperature data with the EICM predictions.