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: April - June, 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, University of Minnesota	**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 in the last quarter are $5,400.	

WORK COMPLETED:
The contract award to the University of Minnesota was executed in the 1st Quarter of 2008. The subcontracts with the University of California-Davis (UCD) and University of Washington are still in the process. The UCD wants to modify some language in the contract. The language comes mostly from the master agreement that UMN has with MnDOT. There are other details which need to be worked out as well, including royalties, intellectual property, and patent issues. There is a meeting scheduled in August where UCD sponsored programs will be on a conference call with the UMN sponsored programs to see if these issues can be resolved.

See attached pages.

SUMMARY OF ACTIVITIES EXPECTED TO BE PERFORMED NEXT QUARTER:
The research subcontracts contracts are expected to be signed and executed. The research team will continue the literature review efforts.

STATUS AND COMPLETION DATE:
This project is just getting underway, with completion expected by June 30, 2011.

Last quarter the research team continued work on the literature review and initiated analysis of the temperature data collected at MnROAD.

Literature review

A first draft of a comprehensive literature review on asphalt concrete overlays was finalized in this quarter. The review includes addresses a number of critical issues related to AC overlays such as: Current Rehabilitation Construction Practices, including 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. The review also includes relevant topics in Composite Pavements as New Construction as well as references related to Design & Modeling of AC Overlays on PCC Pavements as well as Performance and Rehabilitation of Composite Pavements.

Temperature analysis

The research team began analysis of the temperature data collected on a low-volume jointed plain concrete pavement (JPCP) section (Cell 53) and a portion of the concrete pavement utilizing HMA overlays. This data collection for Cell 53 began in August 2000—the opening of the original section to traffic—and concluded in late April 2008, just over one month before the section was demolished (Figure 1).

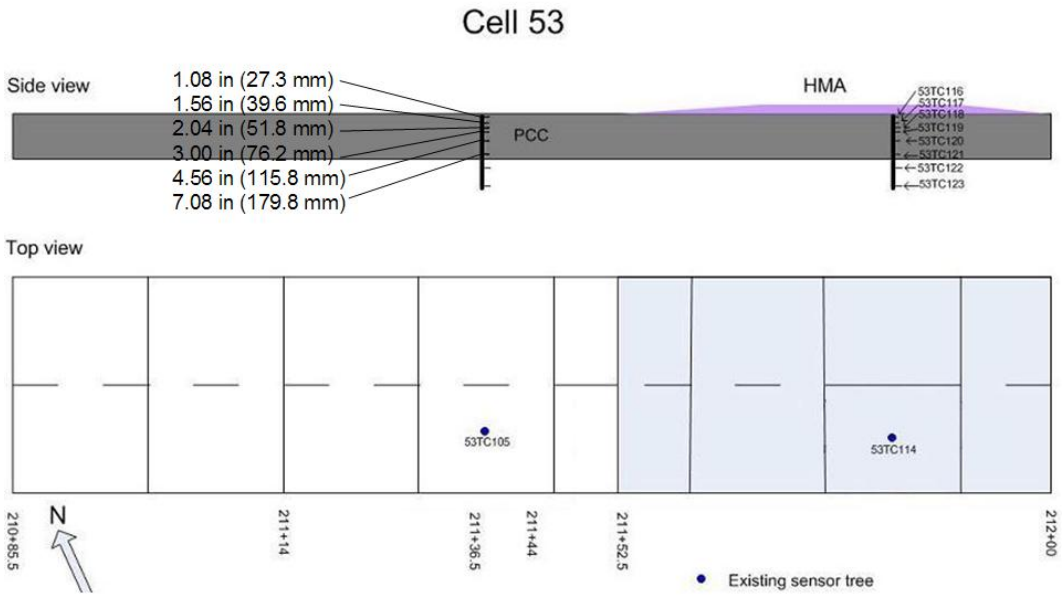

Figure 1. Top-down and cross-sectional sensor locations for the original portion and HMA overlaid portion of Cell 53

In addition to processing and analyzing the MnROAD Cell 53 thermal data on its own, the researchers input specifications for MnROAD Cell 53 into the Mechanistic-Empirical Pavement Design Guide (MEPDG) to obtain simulated thermal data as generated by the Enhanced Integrated Climatic Model (EICM) within MEPDG. There were a number of interesting

comparisons between EICM predictions for temperatures through a PCC slab and field data from the thermocouple tree under the HMA-overlaid portion of MnROAD Cell 53. The comparison with MnROAD field data suggested that EICM may over predict extreme thermal differentials (difference between temperatures at the top and bottom of a slab).

The work related to TPF(5)-149 and a comparison of slab effects between the original (non-overlaid) and HMA-overlaid portions of MnROAD Cell 53 was prevented by complications in the original PCC thermocouple data. It was initially suspected that at least two of the six thermocouples in the tree, relating to temperatures through the original PCC slab, were reporting unreliable data. This suspicion was confirmed using data collected from 2 August 2008 to 12 September 2008, a period of time in which a new thermocouple tree had been installed and was collecting data before the HMA overlay was paved. In this case, the work compared data between thermocouple trees in very similar conditions. Figure 2 illustrates this comparison between the absolute differences in temperature in the old sensor and the new sensor at corresponding positions in adjacent slabs.

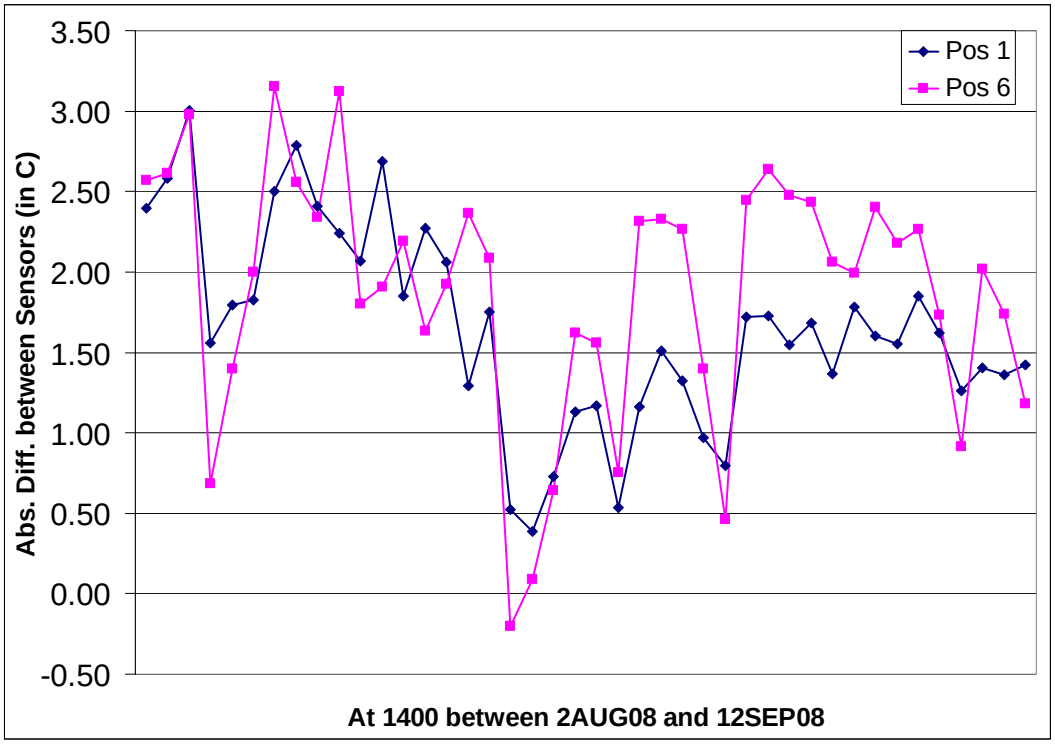

Figure 2. Absolute difference in thermocouple sensors in similar positions in similar slabs on MnROAD Cell 53

In Figure 2, “Pos 1” is the thermocouple sensor in the slab closest to the surface and “Pos 6” is the sensor closest to the base layer. Also, the use of the term “similar” in the figure and above is perhaps understating the near match of conditions for these sensors and their positions in the slab. Figure 2 describes the disparity between the measured temperatures through the slab. Given that these differences are as high as 3 °C, the thermocouples have a margin of error of 2 °C, and that the overall thermal differentials in overlaid and non-overlaid slab can differ by as little as a few degrees centigrade, the research team was uncomfortable using the MnROAD Cell

53 thermal data for any sort of analysis on the effects of HMA overlays on the distribution of temperatures through a PCC slab.

Future slabs slated for overlays should include working thermocouple sensors. These sensors should be properly calibrated well ahead over overlays, and the sensor data should be analyzed to ensure the sensors report accurate, precise, usable data.