Investigation of Low Temperature Cracking in Asphalt Pavements
National Pooled Fund Study TPF-5(080)

December 12, 2005 Meeting Minutes
Minnesota Department of Transportation – Arden Hills Training Center

In Attendance:

- Tim Clyne, Mn/DOT
- Jim McGraw, Mn/DOT
- Jim Klessig, Mn/DOT
- Ben Worel, Mn/DOT
- Roger Olson, Mn/DOT
- Bill Buttlar, UIUC
- Glaucio Paulino, UIUC
- Andrew Braham, UIUC
- Seong Hyeuk Song, UIUC
- Huiming Yin, UIUC
- R. Chris Williams, Iowa State
- Mihai Marasteanu, UMN
- Joe Labuz, UMN
- Xinjun Li, UMN
- John Turos, UMN
- Erland Lukanen, UMN/PRI
- Hussain Bahia, UW-Madison

Introductions were made and an attendance sheet was passed around for everyone to sign up.

The morning 1.5-hour session consisted of several presentations from researchers from the four participating universities. This material was presented as a research seminar.

- Mihai Marasteanu gave a general overview of the project including background, goals, participating agencies, etc.
- Chris Williams presented work on the lab material preparation being done at Michigan Tech. Jason Bausano is the grad student responsible for making specimens. The limestone and granite mix designs were shown. All gyratory samples have been delivered to the universities except for the 3 PG 58-40 (modifier 1) mixtures; they will be delivered in late December or early January. All the aggregates have been batched for the slabs, which will produce beam samples. These will be produced and delivered in the coming months. Roughly 40 tons of material (aggregate, asphalt) have been sampled and processed, which led to approximately 10 tons of HMA samples produced. Once all the samples have been produced for this project, the extra raw materials will be moved to Minnesota and stored at MnROAD or the Maplewood Lab for future use.
- Hussain Bahia presented work on the glass transition temperature done at the University of Wisconsin. The lab tests basically measure volume change vs. temperature of asphalt binders and mixtures, which leads to the coefficient of thermal expansion, a major parameter in thermal cracking behavior. The low temperature behavior needs to be characterized by both strain tolerance (ductility) and strength parameters. Eight of the ten binders received so far have been aged. The PG 58-40 was recently delivered, and Wisconsin is still awaiting delivery of the last binder. The T_g tests will soon be performed on binders and then on the mixtures.
- Mihai Marasteanu gave an update on the laboratory testing performed to date at the University of Minnesota. 7 of the 28 lab mixtures have been partially tested in the IDT (creep and strength) and SCB arrangements. For each mixture test 3 replicates are tested

at 3 temperatures. The University of Illinois has replicated several of the IDT tests for comparison purposes. Acoustic emission has been used on several specimens. AE sensors have detected microcracks during the IDT creep tests, which indicates that the sample's behavior is nonlinear.

- Bill Buttlar and Glaucio Paulino presented work on the mixture fracture tests and modeling techniques performed at the University of Illinois. The presentation showed that the current laboratory tests are good at predicting low-stress, low-strain performance, but they are deficient once the sample is taken to failure. The Disk-shaped Compact Tension Test and the Single-Edge Notched Beam Test are able to better characterize the fracture properties of asphalt mixtures. There is a need to first verify the numerical models with laboratory test data and then to calibrate the models with field performance. Modeling techniques used in this study include the Cohesive Zone Model using DIANA (a finite element code) and a Micromechanics Model for describing material properties. Some of UIUC's previous modeling work on reflective cracking may be applicable to the thermal cracking problem.

The afternoon session consisted of a business meeting related to discussion of specific tasks in the written contract. The business session lasted 3 hours.

Task 1: The literature review is 99% complete. More information will be added concerning the TSRST test, and then the document will be review by the four Universities. It will be completed by December 31, 2005 so that the task can be approved. Recent developments in testing and modeling procedures may be included in the literature review section of the final report.

Task 2: The raw materials have been collected, and a majority of the field samples have been collected. 12 cores from the North Dakota site were delivered December 8 to the University of Minnesota. The second site in Illinois will be sampled in April 2006. The task report will be completed by December 31, 2005.

Task 3: All but the three PG 58-40 laboratory mixtures have been delivered in gyratory cylinders. The beam samples are ready to be made and delivered to the Universities in the coming months. It is unclear whether or not Wisconsin received the PG 58-40 binder. Wisconsin and Minnesota still need the PG 64-34 binder (modifier 2). Michigan Tech/Iowa State will not do any mixture tests except for bulk specific gravity of the prepared specimens. Minnesota will send one graduate student to FHWA to help perform TSRST tests. Mihai will discuss this testing with Tom Harman at TRB, and testing will commence shortly afterwards. Western Research Institute may do some chemical characterization of the binders or mixtures after Minnesota tests the samples. FHWA or Sangsoo Kim (Ohio University) may do ABCD testing on the binder. All of the work mentioned above will be performed at no extra cost to the contract. This task and what additions/changes that take place will be discussed at the February 2006 participating agency meeting. Mihai will update the tables in the work plan with who is doing what test on what materials so the agencies can direct the Universities on what direction should be taken in the contract (if any at all). Task 3 is expected to be complete in May or June 2006.

Task 4: The data analysis will be performed as experimental results are produced. As stated in the contract a common spreadsheet/database will be developed among the four Universities for the purposes of statistical analyses. Chris Williams will create a spreadsheet, and the other Universities will add worksheets/tabs containing the results of their laboratory testing. This will facilitate each of the Universities testing the same specimens at the same time so that some order can be followed. It is expected that Task 4 will be completed 1-2 months after the completion of Task 3.

Task 5: Once the laboratory tests are completed, more time will be needed to incorporate the results into the numerical models. A lengthy discussion on the goals and direction of the modeling ensued. Further discussion will be held in February concerning how far to go with the models in this current project. It is envisioned that the main goals of the modeling work in this project are twofold: first to better understand the mechanisms behind thermal cracking and second to identify whether or not the existing TCMODEL program used in the AASHTO 2002 Design Guide is sufficient. This project may provide some avenues to explore in terms of applying fracture concepts in an improved model that ties together lab testing and field performance, but a complete overhaul of TCMODEL is beyond the scope of this project. Phase II of this project (currently being posted on the pooled fund website) may include a significant modeling effort, using the techniques developed in Phase I to recalibrate and/or modify TCMODEL.

A 2-day meeting was set up for February 6-7, 2006 at the University of Illinois to further discuss the project with the Universities and participating states. At that point we should have some indication as to whether or not the contract will need to be extended. Depending on when the laboratory testing is completed, the other tasks may need to be pushed back, including the final report. Discussion with the participating states will also review the samples tested and what further actions may or maynot be needed. For example should more samples be tested or should more efforts be put into the modeling? Both table-2 and table-3 in the work plan will be updated and discussed relating to the direction needed to finish this project in December 2006.

The meeting concluded with brief presentations from two University of Illinois researchers. Andrew Braham (PhD student) discussed the sampling of 2 field sections from US Highway 20. 12 cores and 3 beams were taken from each section. He also showed some preliminary results from DCT and SENB testing on field and lab specimens. Huiming Yin (post-doc) discussed modeling techniques relating to material properties.