FHWA contract NO. DTFH61-06-D-00023

Task Order #03 Report

CONCRETE PAVEMENT ROAD MAP

for the period of
November 1, 2008 – October 31, 2010

Prepare by the Road Map Operations Support Group
National Concrete Pavement Technology Center
Iowa State University
Concrete Pavement Road Map
Task Order #3 Report
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Concrete Pavement Road Map
Task Order #3 Report

This report details the activities involved with Task Order #3 to continue providing administrative support to efficiently execute a coordinated Concrete Pavement Road Map program. The overall form of the report will follow the outline format of the Task Order.

Task A: Support Executive Committee

Below is a table listing the Pooled Fund States and Executive Committee meetings held under Task Order #3.

<table>
<thead>
<tr>
<th>Meeting</th>
<th>Date Held</th>
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<tbody>
<tr>
<td>Pooled Fund States</td>
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<td>Executive Committee</td>
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<td>Pooled Fund States</td>
<td>September 9, 2009</td>
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<td>Pooled Fund States</td>
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<tr>
<td>Pooled Fund States</td>
<td>March 17, 2010</td>
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<td>Pooled Fund &amp; Exec Com</td>
<td>April 19, 2010</td>
</tr>
<tr>
<td>Pooled Fund &amp; Exec Com</td>
<td>June 22, 2010</td>
</tr>
</tbody>
</table>

Pooled Fund States Committee Meeting – March 17, 2009

The administrative support team planned, scheduled and facilitated the Pooled Fund States Committee conference call held on March 17, 2009. The team prepared the agenda and distributed the meeting minutes for the call.

Major items of discussion during the meeting included the following:
- Sustainability Track
- Tech Transfer
- Operations Support Group Work Plan
- Coordination with Executive Committee and Pooled Fund group

The full minutes are included in Appendix A

Executive Committee Meeting – April 3, 2009

The spring 2009 meeting for the Executive Committee was held via a web conferencing. The administrative support team planned, scheduled and facilitated the conference call. The team prepared the agenda and presentation for the call.

Major items of discussion during the meeting included the following:
- Progress of priority tracks
- Planning of an international conference on sustainability in 2010
- Business track leadership
- NCC meeting update
- Proposed new approach for Road Map
The full minutes are included in Appendix A.

**Pooled Fund States Committee Meeting -- July 14, 2009**

The administrative support team planned, scheduled and facilitated the Pooled Fund States Committee conference call held on July 14, 2009. The team prepared the agenda and distributed the meeting minutes for the call.

Major items of discussion during the meeting included the following:
- Task Order Revisions
- Current Research Needs
- Operational Challenges
- Sustainability Track

The full minutes are included in Appendix A

**Pooled Fund States Committee Meeting -- September 9, 2009**

The administrative support team planned, scheduled and facilitated the Pooled Fund States Committee conference call held on September 9, 2009. The team prepared the agenda and distributed the meeting minutes for the call.

Major items of discussion during the meeting included the following:
- Task Order
- Research Processes
- Activities Update
- General Input

The full minutes are included in Appendix A

**Pooled Fund States Committee Meeting -- November 12, 2009**

The administrative support team planned, scheduled and facilitated the Pooled Fund States Committee conference call held on November 12, 2009. The team prepared the agenda and distributed the meeting minutes for the call.

Major items of discussion during the meeting included the following:
- Update on activities
- Sustainability Track
- TRB updates
- MAP Briefs
- Priority Research Track contacts and status

The full minutes are included in Appendix A
Pooled Fund States Committee Meeting – March 17, 2010

The administrative support team planned, scheduled and facilitated the Pooled Fund States Committee conference call held on March 17, 2010. The team prepared the agenda and distributed the meeting minutes for the call.

Major items of discussion during the meeting included the following:
- Sustainability Track
- Tech Transfer
- Operations Support Group Work Plan
- Coordination with Executive Committee and Pooled Fund group

The full minutes are included in Appendix A.

Executive Committee and Pooled Fund States Committee (combined) – April 19, 2010

The spring 2010 meeting for the Executive Committee was held via a web conferencing. The administrative support team planned, scheduled and facilitated the conference call. The team prepared the agenda and presentation for the call.

Major items of discussion during the meeting included the following:
- Finding ways to fill the gaps in prioritized research
- Promoting collaboration and coordinating research
- Publishing research results, promoting success and implementing research findings
- CP Road Map Communication Plan
- Status and priorities of the tracks

The full minutes are included in Appendix A.

Executive Committee and Pooled Fund States Committee (combined) – June 22, 2010

The summer 2010 meeting for the Executive Committee was held via a web conferencing. The administrative support team planned, scheduled and facilitated the conference call. The team prepared the agenda and presentation for the call.

Major items of discussion during the meeting included the following:
- Process and priorities for Task Order 4
- CP Road Map Communication Plan
- Penn DOT research visits
- Priorities for MAP Briefs
- Outreach for Road Map
- Business Systems & Economics Track
- Track Priorities

The full minutes are included in Appendix A.
Task B: Support Research Track Teams

Below is a table listing the last track meetings held under each priority track for Task Order #3:

<table>
<thead>
<tr>
<th>Track Name</th>
<th>Track Coordinator</th>
<th>Last Meeting Held or National Meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mix Design</td>
<td>Peter Taylor</td>
<td>10-6-09</td>
</tr>
<tr>
<td>2. Performance-Based Design</td>
<td>Dale Harrington</td>
<td>1-6-10</td>
</tr>
<tr>
<td>3. NDT/IC</td>
<td>Rob Rasmussen</td>
<td>6-17-08</td>
</tr>
<tr>
<td>4. Surface Characteristics</td>
<td>Rob Rasmussen</td>
<td>9-8-10</td>
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<tr>
<td>7. Overlays</td>
<td>Dale Harrington</td>
<td>5-12-10</td>
</tr>
<tr>
<td>11. Business and Economics</td>
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</tr>
<tr>
<td>13. Sustainability</td>
<td>Peter Taylor</td>
<td>7-13-10</td>
</tr>
</tbody>
</table>

Support continued for the research track teams by assisting with the following:
- Identify collaborative opportunities within the CP Road Map research program
- Establish track priorities
- Develop project objective statements for each track’s priority projects
- Develop funding mechanisms for each priority project
- Plan and schedule meetings of individual research track teams
- Identify projects and elements to pursue under the Sustainability focus or track

The progress for each track is discussed separately below:

1. **Track #1: Performance-Based Concrete Pavement Mix Design and Analysis.**
   The Mix Track Technical Advisory Committee held a web-conference call on February 13, 2009. Following are the highlights from the call.
   - Review of the Pooled Fund project statement
   - Tests to be completed within the next 2 years
   - Review of current tests development that are being covered elsewhere
   - Models
   - Communications
   - Budget

A copy of the full minutes is included in Appendix B.

The Mix Track Technical Advisory Committee held a web-conference call on June 3, 2009. Following are the highlights from the call.
- Pooled Fund Tasks
- Tests & Models

A copy of the full minutes is included in Appendix B.

The Mix Track Technical Advisory Committee held a web-conference call on October 6, 2009. Following are the highlights from the call.
- State Pooled Funds
- CB401 – Design and Proportioning
- Tests, Model, Specifications
• Portable Analysis Device
• Acoustic Setting Device

A copy of the full minutes is included in Appendix B.

Members of the National Concrete Consortium are regularly consulted for their opinions on current research priorities.

Following is a summary of the national projects for Track 1.

• TPF-5(205) Implementation of Concrete Pavement Mixture Design and Analysis (MDA) Track of Concrete Pavement Road Map
  - Iowa DOT leads this project. Partners include: IA, KS, MI, MO, NY, OK, TX, WI. The purpose of this project is to support activities that align with Track 1 research needs statements. Currently, investigations are underway for the development of alternate methods for calculating mix proportions, evaluation of on-site analysis tools, and assessing requirements for the air void systems. It is anticipated that a Guide will be prepared. Recent work completed under this project investigated acoustical methods to determine set time.  
  http://www.pooledfund.org/projectdetails.asp?id=430&status=4

• TPF-5(179) Evaluation of Test Methods for Permeability (Transport) and Development of Performance Guidelines for Durability
  - Indiana DOT leads this effort which includes CO, IA, IL, IN, KS, MI, MN, MT, NY, PA, WI as partnering states. The objective of this project, as defined by the TPF site, is to develop test procedures for assessing permeability that relate to field performance. According to the January-March 2010 progress report, a literature review on the measurement of permeability is nearly complete, Purdue is finishing a survey of states on permeability testing methods, and ongoing work continues in an effort to prepare concrete samples for evaluation phases.  
  http://www.pooledfund.org/projectdetails.asp?id=406&status=4

2. Track #2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements. The Design Track committee held a web conference on January 6, 2010. Following are the highlights from the call.
• New Member – Norbert Delatte, P.E. Ph.D., has accepted
• New CP Road Map Approach
• Design Track Leadership Goals & Scope
• Key Areas of Concentration & Current Subcommittee Members
  - Concrete Overlays (Development of Design Guide on current software is a priority)
  - ME Design Guide
  - Performance Data
  - CRCP Design
  - FHWA Software Integration
  - Non-Traditional Design Elements Subgroup
• Prioritization
• Next Steps
The full minutes are included in Appendix B.

Below is a summary of the national projects for Track 2.

- **NCHRP 01-47 Sensitivity Evaluation of MEPDG Performance Prediction**
  As defined by the TRB website summary page, the objective of this research is to determine the sensitivity of the performance predicted by the MEPDG to variability of input parameter values. The research is headed by Charles W. Schwartz from the University of Maryland and deals with all types of flexible and rigid pavements included in the MEPDG. The research shall be conducted using the MEPDG software version available as of October 1, 2008. The anticipated completion date is April 4, 2011.
  [http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2487](http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2487)

- **NCHRP 01-48 Incorporating Pavement Preservation into the MEPDG**
  As defined by the TRB website summary page, the objective of this research is to develop procedures for incorporating pavement preservation treatments into the MEPDG analysis process. For the purpose of this research, preservation treatments are treatments applied to preserve an existing roadway, slow future deterioration, and maintain and improve its functional condition (without substantially increasing structural capacity). The principle investigator is David G. Peshkin of Applied Pavement Technology, Inc. Expected completion date is July 25, 2012.
  [http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2704](http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2704)

- **Development of Design Guide for Thin and Ultrathin Concrete Overlays of Existing Asphalt Pavements. Study Number: TPF-5(165), cleared by FHWA. Sponsoring agency is Minnesota Department of Transportation, contact: Tom Burnham. The primary purpose of this project is to create a unified national design guide for thin and ultrathin concrete overlays of existing asphalt pavements. The following are distinct objectives: 1.) Study and understand the field performance history of TCOAP and UTCOAP; 2.) Develop a design guide for concrete overlays of existing asphalt pavements utilizing existing validated performance models; 3.) Create a user-friendly design guide software program and user’s manual.**

- **Monitoring and Modeling of Pavement Response and Performance. Study Number: TPF-5(121), cleared by FHWA. The primary objectives of the proposed research are to: (1) Monitor the new perpetual AC and long-lasting PCC pavements in Ohio, the rehabilitated PCC pavements in New York State, and other existing instrumented pavements in both states. (2) Verify ME design procedures for all pavements in the study. (3) Calibrate ME procedures presented in the NCHRP 1-37A AASHTO Pavement Guide for Ohio and New York State. Develop calibration factors for the distress models in the NCHRP 1-37A software. (4) Controlled testing of perpetual pavement systems.**
  [http://www.pooledfund.org/projectdetails.asp?id=353&status=4](http://www.pooledfund.org/projectdetails.asp?id=353&status=4)
• Traffic Data Inputs for MEPDG. Falcon Project Activity ID1009. Develop and deliver a workshop that has two parts linking quality checking WIM data and adapting the WIM data for input to the MEPDG. Part 1 will focus on processing and statistically evaluating traffic data. Likely approach will be adapting guidelines and software (LTAS and VTRIS) used by LTPP and create a version for use by state DOTs. Part 2 will focus on converting WIM data for input to the MEPDG. Likely approach will be to utilize or adapt Traffic Load-the software developed under NCHRP 1-39 for analyzing traffic data and producing traffic data inputs required for mechanistic pavement analysis. Two-part workshop will provide continuity for these closely related topics and provide for option of splitting the parts and only delivering one part to meet the needs of a owner-agency.
http://www.fhwa.dot.gov/Pavement/falcon/projects.cfm?id=9

• A Fresh Look Towards Revamping FWD Testing and Analysis to Meet M-E Design and Analysis. Falcon Project Activity ID 1016. Falling Weight Deflectometer testing is well recognized as one of the most representative non-destructive testing for in-service pavements. It has all the benefits associated with NDT, in addition, it allows a representative sample to be tested under ideal support and loading conditions. However, the FWD testing for in-service pavement evaluation, particularly for M-E based design, has not been optimal. One of the challenges has been that the static backcalculation which is the state-of-the-practice is not robust enough under all conditions and attempts at dynamic backcalculation which has the potential to be robust and applicable to M-E based design (MEPDG) has fallen short. One of the difficulties cited for dynamic backcalculation falling short has been that the FWD load pulse imparted and the response measured does not contain sufficient frequency content for accurate evaluation the entire pavement structure. This research activity will first theoretically look at the ideal FWD loading and response needed to extract accurate complete information from FWD testing, particularly in light of the materials characterization used in MEPDG, using a number of representative hypothetical pavements. This will be followed by what modifications, if any, are needed to FWD equipments and field-testing for evaluation and validation.
http://www.fhwa.dot.gov/Pavement/falcon/projects.cfm?id=16

• Improved Reliability Modeling and Analysis for Primary Pavement Distress Models of MEPDG. Falcon Project Activity ID 1018. This study is concerned with enhancing the reliability analysis currently used in the Mechanistic-Empirical Pavement Design Guide (MEPDG). The MEPDG uses a set of mechanistic-empirical models to analyze distresses of pavement structures in response to traffic, climate, and materials. These models include transverse joint faulting and transverse cracking for rigid pavements, and permanent deformation, fatigue cracking, and thermal cracking for flexible pavements. In order to evaluate the reliability of a selected pavement structure, the current procedure utilizes the overall standard deviation of the measured distresses obtained from calibration against distressed pavements in comparison with predicted values. This technique is fairly simple, however, it is far from accurate. Some limitations of the method may be attributed to the standard deviation being calibration-site specific, as well as the assumption of normality of the distribution of the measured distress levels. Additionally, this method relies on
the variability of the measured output rather than on the variability/uncertainty of the input parameters that induce such variability in distress. Identification of an improved methodology for assessing design reliability a top priority. In this study, the uncertainties in model input parameters (materials, climate, traffic) due to inherent spatial variability of materials and testing non-uniformity will be incorporated by using a number of advanced reliability techniques to assess the reliability of flexible and rigid pavements. Both analytical and simulation will be investigated. Materials variability and uncertainty associated with estimating many other input parameters will be determined from historical records. The reliability associated with pavement smoothness, as a primary measure of ride quality, in response to the various distresses encountered will be analyzed. Design reliabilities obtained from the various methods used will be compared to the current method. Advantages and disadvantages of the new methodologies in comparison with the current method will be discussed in the light of both the accuracy and computational feasibility (or practicality).
http://www.fhwa.dot.gov/Pavement/falcon/projects.cfm?id=18

As part of the CP Road Map, nine potential technologies were proposed for development and integration into the paving operations:

1. Temperature/Moisture/Strength/Stiffness Changes and Development
2. Pavement Thickness
3. Dowel/Tie Bar/Reinforcement Alignment
4. Curing Effectiveness
5. Slab Support
6. Workability
7. Air Void Systems
8. Mix Density and Volumetrics
9. Smoothness/Texture/Skid Resistance and Splash/Spray

A Track Leadership Team was formed to investigate this further, including individuals from the paving industry, equipment industry, DOTs, FHWA, and academia. The Team identified the most critical parameters to monitor during construction as fresh mix properties/variability, curing operations, and smoothness/texture. The Team also identified the corresponding technology that could be used to assess the most critical factors above. Since that time, a number of important projects have been monitored. Two notable national projects that fall under Track 3 include:

- SHRP 2 R06(E) Real-Time Smoothness Measurements on Portland Cement Concrete Pavements During Construction
  - James Bryant is responsible for this project while research efforts are led by principle investigators Robert Rasmussen and Steve Karamihos. “The purpose of this project is to enable real-time control of concrete pavement smoothness during construction by providing: (1) proven technologies for measuring smoothness in real time; and (2) model specifications and guidelines for use by transportation agencies.”
  http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2564
• FHWA SmartCure Practical Enhancements for Field Application
  "The SmartCure system was developed for FHWA as an aid for evaluating curing conditions during paving and to provide reliable and realistic guidelines on proper curing. The System consists of measuring components connected to a laptop computer operating a Windows® based software program. Further work is required for successful implementation of SmartCure system. FY 05 funds were used to initiate this research study. Field evaluations for the SmarCure were completed on site during real pavement projects on three locations in FY 2007 and FY 2008. The field evaluation phase proved the SmartCure system as functional, reliable and accurate in the field. The system successfully relates ambient weather conditions to fresh concrete properties and alerts the user of potentially critical conditions based on user defined or default thresholds. Most immediate problems with regards to components and software were addressed during, or just after individual site visits. However, some problems encountered in the field could not be readily addressed and will require future work for successful implementation of the SmartCure system. It became clear that future work should focus on the development of a more portable SmartCure system housing for the laptop and its accessories. Ideally, a more compact and wireless version of the current system would best meet the needs of a field environment. Not only would the laptop equipment be less of a burden on the cure cart operator, but the automatic, real-time calculation of distance between the paver and cure cart would be obtainable. SmartCure works; the system is just not as practical for the field as it could and needs to be for implementation." Work to make it wireless is currently underway.

  - FHWA – Also of significant has been the Intelligent Construction Systems (ICS) program that FHWA has recently been pursuing as part of the Every Day Counts initiative. The main objective of this effort is to identify existing and emerging technologies in the area of Intelligent Construction of pavements including but not limited to: systems, components, processes, and software that can bring benefits such as: increased production, increased efficiency, cost savings, real-time measurements/feedback, and improved quality and uniformity.

4. Track #4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements. Track committee held a web conference on February 10, 2010. The following was reviewed during the call:
• Brief Review of the CP Road Map
  – Current CP Tech Center Role in Implementation and Administrative Support
• Review of Current SC Track Framework
  – Suggested changes to date
• Updates on Ongoing Research Programs from various representatives
  – FHWA
  – ACPA/IGGA
  – SHRP2
  – Pooled Fund
  – Others
• Review and Update List of SC Work
  – Foundational
- Recently Completed
- Ongoing
- Review and Update List of Short-Term Projects and Products
- SC Track Communications, Coordination, and Collaboration
  - Broader group of participants?
  - A forum for all-things SC related? Periodic calls? Blog?

The full minutes are included in Appendix B.

Track committee held a web conference on June 2, 2010. The following was reviewed during the call:
- Review of Data Collection/Reduction Activities
- Technology Transfer Activities & Track Update
- Activities in Pooled Fund States

The full minutes are included in Appendix B.

Track committee held a web conference on September 8, 2010. The following was reviewed during the call:
- Review of Data Collection/Reduction Activities
- Technology Transfer Activities

The full minutes are included in Appendix B.

Below is a summary of national projects for Track 4.

  - At the completion of this overall study, it is anticipated that it will be possible to specify the desirable surface characteristics of individual projects prior to construction to meet the site specific requirements for noise, skid, texture, and smoothness. Led by Iowa DOT, partnering states include CA, FHWA, IA, MN, NY, TX, WA, WI. [http://www.pooledfund.org/projectdetails.asp?id=368&status=4](http://www.pooledfund.org/projectdetails.asp?id=368&status=4)

- TPF-5(063) Improving the Quality of Pavement Profiler Measurement
  - Led by FHWA’s Robert Orthmeyer, the purpose (according to the TPF summary page) of this project is to deliver sample procurement specification, maintenance guidelines, and profile analysis software program; establish criteria for verification centers and assist with the development of these locations; develop and deploy a traceable verification center; and provide technical review of software. Partnering states include CA, CO, CT, FHWA, FL, GA, IL, KS, KY, LA, MS, ND, NJ, NY, OH, OK, PA, SD, TX, WI. [http://www.pooledfund.org/projectdetails.asp?id=280&status=4](http://www.pooledfund.org/projectdetails.asp?id=280&status=4)

- NCHRP 01-43 Guide for Pavement Friction
  - The TRB website summary page lists this project as completed in 2006 by ERES Consultants/Applied Research Associates. Jim Hall was the principle
investigator. This project presented guidelines and recommendations for managing and designing for friction on highway pavements and emphasized the importance of providing adequate levels of friction for the safety of highway users. As part of this project, a guide document that deals with frictional characteristics and performance of pavement surfaces and considers related tire-pavement noise and other relevant issues was prepared and provided to AASHTO for consideration and adoption. Following review and revision, the document was published by AASHTO as the Guide for Pavement Friction (Item Code: GPVF-1). http://144.171.11.40/cmsfeed/TRBNNetProjectDisplay.asp?ProjectID=229

- Two-Lift Concrete Paving Program – National CP Tech Center / FHWA
- Next Generation Diamond Grinding and Innovative Texturing – ACPA
- PCC Surface Characteristics – Rehabilitation (Mn/ROAD Study) – Pooled Fund TPF-5(134)
- Texturing of Concrete Pavements – NCHRP 10-67
- State DOT Quiet Pavements Research Programs -- Caltrans, Washington State, Colorado, Texas, Florida, Arizona (QPPP)
- Tire-Pavement Noise Research Consortium – Pooled Fund TPF-5(135)
- Traffic Noise Model (TNM) 3.0 Software Development – FHWA / Pooled Fund TPF-5(158)
- Pavement Effects Study for TNM – FHWA / Volpe
- Measuring Tire-Pavement Noise at the Source – NCHRP 1-44
- Truck Noise Source Mapping – NCHRP 8-56
- Methodologies for Evaluating Pavement Strategies and Barriers for Noise Mitigation – NCHRP 10-76
- Standardization of On-Board Sound Intensity – FHWA TWG / AASHTO
- Modeling Splash and Spray Potential of Pavements – FHWA

5. Track #7: High-Speed Concrete Pavement Rehabilitation and Construction (Overlays).

The Overlay committee held a conference call on December 30, 2008. The following was discussed on the call.
- Overlay Field Application Update
- Minnesota DOT Bonded Overlay Pooled Fund Study
- Overlay Design Guide
- Vertical Clearance Needs on Concrete Overlays on Urban Freeways

The full minutes are included in Appendix B.

Overlay committee held a conference call on April 15, 2009. The following was discussed on the call.
- Overlay Field Application State Update from Expert Team Leaders
- Minnesota DOT Bonded Overlay Pooled Fund Study
- Overlay Design Guide
- Nonwoven Geotextile Interlayer report
- Minnesota Trunk Hwy 53 project update

The full minutes are included in Appendix B.
The Overlay committee held a conference call on May 12, 2010. The following was discussed on the call.

- MnRoad project report (TPF-5-165) Whitetopping Design Guide
- Organizing ACI technical session in 2011 convention
- Updates for the Concrete Guide for Overlays
- Summary of upcoming documents
- Summary of states activities

The full minutes are included in Appendix B.

Below is a summary of the national projects for Track 7.

- CP Tech Center *Guidance for the Design of Concrete Overlays using Existing Methodologies*. The specific objective is to develop a guide to provide guidance, sensitivity analyses, and examples of how to use one to two recommended current overlay design methods. A summary of results from different pavement sections will be developed and be presented for user-friendly quick reference. The final product will include a well-orchestrated combination of text, charts, and figures, with the intent to be both concise and technically reliable.

- TPF-5(165) Development of Design Guide for Thin and Ultrathin Concrete Overlays of Existing Asphalt Pavements
  - The TPF website summary page for this project identifies the primary purpose of this project as being the creation of “a unified national design guide for thin and ultrathin concrete overlays of existing asphalt pavements”. Led by MnDOT’s Tom Burnham, partnering states include MO, MS, NY, PA, TX.
    http://www.pooledfund.org/projectdetails.asp?id=389&status=4

- Construction and Performance of Pervious Concrete Overlay at Minnesota Road Research Project. A study is underway at Iowa State University and the National Concrete Pavement Technology Center to develop mix designs and procedures for PCPC overlays for highway applications. A report is produced on the construction and performance of a PCPC overlay constructed at the Minnesota Road Research Project low-volume roadway test facility to determine the effectiveness of pervious concrete as an overlay. Issues related to construction of the overlay are described, as are results of field tests to characterize the condition of the pavement 7 months following construction, to determine flow characteristics of the overlay, and to characterize the tire-pavement noise of the overlay. Results of these studies show that effective PCPC overlays can be designed for wearing course applications.

6. **Track #11: Concrete Pavement Business Systems and Economics.**

Below is a summary of the national projects for Track 11.

- NCHRP 10-75 Guide for Pavement-Type Selection
  - The objective of this research is to develop a Guide for Pavement-Type Selection. The Guide shall include processes for consideration in making decisions regarding pavement-type selection as well as agency-based (decision is internal
to the highway agency) and contractor-based (selection is made by the contractor using criteria stipulated by the agency) processes
http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=1627

- TPF-5(159) Technology Transfer Concrete Consortium
  - According to the TPF site, “the proposed project is for the establishment of a pooled fund for state representatives to continue the collaborative effort begun in TPF-5(066) Materials and Construction Optimization. The TTCC will be open to any state desiring to be a part of new developments in concrete paving leading to the implementation of new technologies which will lead to longer life pavements through the use of the innovative testing, construction optimization technologies and practices, and technology transfer.” The project is led by Iowa DOT and includes AL, CA, GA, IA, IL, IN, KS, LA, MI, MN, MO, NC, ND, NY, OH, OK, PA, SD, TX, WI as partners.
  http://www.pooledfund.org/projectdetails.asp?id=390&status=4

7. **Track #13: Sustainability.**

The sustainability committee held a web conference call on January 27, 2010. Following are the items that were discussed on the call.
- Completed, Future & ongoing activities
- Briefing document
- Fall 2010 Workshop
- Interaction with other organizations
- Funding

The full minutes are included in Appendix B.

The sustainability committee held a conference call on July 13, 2010. Following are the items that were discussed on the call.
- Overview of the track goals
- Getting people to talk to each other
- Get publicity for implementation as the work is completed – get the work known
- Manual of Practice
- Fall 2010 Workshop
- Interaction with Other Organizations

The full minutes are included in Appendix B.

The International Conference on Sustainable Concrete Pavements was held on September 15-17, 2010 in Sacramento, California.

Work is continuing on the Manual of Practice.
Below is a summary of the national projects for Track 13.

- **TPF-5(129) Recycled Unbound Pavement Materials (MnROAD Study)**
  - "The objective of this study is to monitor the performance of several test cells at the Minnesota Road Research Facility (MnROAD) constructed using recycled materials in the granular base layers, including blended with virgin materials and 100% recycled asphalt and concrete pavement materials." The project is led by MnDOT with CA, MI, MN, OH, TX, WI as partners. [http://www.pooledfund.org/projectdetails.asp?id=361&status=4](http://www.pooledfund.org/projectdetails.asp?id=361&status=4)

- **CP Tech Center Briefing Document on *Building Sustainable Pavements with Concrete***. The CP Tech Center is under contract with FHWA to develop a Manual of Practice for Sustainable Concrete Pavements. The manual will be prepared to educate practicing engineers about sustainability as it is applied to concrete pavements. It will allow practitioners to be able to make decisions that lead to improved sustainability without compromising engineering quality. The document will define concepts, discuss materials and their impacts, recommend construction and maintenance practices as well provide information about how sustainability may be quantified. Work is underway on the document, and it is planned to be completed in 2011.

**Task C: Initiate Communications and Outreach Activities**
The purpose of the CP Road Map is to identify research areas that are needed and promote collaboration in getting the job done. The Center recognizes that in order to maintain credibility and interest in the CP Road Map, everyone involved needs to be informed and feel part of the plan. Dispersing information to a broad audience is and will continue to be critical. The administrative group accomplished the following as part of this task order:

1. In following the plan developed under Task Order #2, continue conducting communications and outreach to keep the CP Road Map program and its products in front of stakeholders and the public and to help link prospective researchers together for a coordinated and collaborative program. **Note:** This subtask includes promoting collaboration among stakeholders, and providing for a smooth and efficient research information exchange system. One of its goals is to provide stakeholders (such as the Executive Committee and the AASHTO Research Advisory Committee) with the benefit of information to minimize duplication of research, in order to promote efficient project prioritizing and well-conceived, meaningful research to be completed. It shall also provide for the prioritization of the Research Tracks and place a peer review on the results under the Executive Committee's direction.

2. Develop a plan to showcase results of current or recently completed research under the CP Road Map.

3. Develop an accomplishment report showing administrative activities completed and future challenges.

4. Develop a plan for conducting videoconferences and/or webinars explaining the benefits of the CP Road Map program and encouraging participation by various organizations.

5. Continue updating and maintaining the CP Road Map Website, including the Help Desk, the research database, and the personnel directory.

6. Continue the development of CP Road Map brochures and periodic publications.
7. Develop and deliver PowerPoint presentations on the CP Road Map program at key stakeholder meetings and where opportunities present themselves.

- Collaboration:
  - On December 15, 2009 the OSG of the CP Road Map held a web-based meeting with Wisconsin DOT, University of Wisconsin-Madison, WCPA, and FHWA to begin the research collaboration process. Also on May 25, 2010 the OSG held a web-based meeting with PennDOT, University of Pittsburgh and Pennsylvania ACPA on research collaboration. This process included but was not limited to:
    • Explain Road Map to state
    • Determine research needs of state
    • Determine research capabilities of each university
    • Develop collaboration between DOT and University
    • Develop contact list
    • Collaboration of tech transfer
    • Encourage development of research champions

The full minutes are included in Appendix D

- The information was collected and disseminated in the E-news state highlights of the July and October 2010 editions for Wisconsin and Pennsylvania respectively.
- On January 21, 2009 provided research problem statements to the TRB Committee AFH50 from the CP Road Map.

Moving Advancements into Practice (MAP) Briefs - Describing promising technologies that can be used now to enhance concrete paving practices.

- **MAP Brief 5-1: Stringless Concrete Paving (Track 5: Concrete Pavement Equipment Automation and Advancements)**

- **MAP Brief 8-1: Roller-Compacted Concrete Pavements (Track 8: Long-Life Concrete Pavements)**

- **MAP Brief 13-1: Two-Lift Concrete Paving (Track 13: Concrete Pavement Sustainability)**

- **MAP Brief 1-1: Job-Specific Optimization of Paving Concrete with COMPASS (Concrete Mixture Performance Analysis System) (Track 1: Performance-Based Concrete Pavement Mix Design Systems)**

- **MAP Brief 4-1: Diamond Grinding to Reduce Tire-Pavement Noise in Concrete Pavements (Track 4: Concrete Pavement Surface Characteristics)**

- **MAP Brief 7-1: Use of Nonwoven Geotextiles as Interlayers in Concrete Pavement Systems (Track 7: High-Speed Concrete Pavement Rehabilitation and Construction)**

A copy of each of the above MAP Briefs is included in Appendix E.
CP Road Map E-News
News from the Road highlights research around the country that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

Updates from the States:

- Pennsylvania (October 2010)
- Minnesota (September 2010)
- Wisconsin (July 2010)
- Michigan (June 2010)
- Indiana (May 2010)

The E-news and full state updates are included in Appendix F.

The CP Road Map project team held weekly conference calls beginning June 1, 2010 and these calls continue. The meeting minutes from the conference calls are included in Appendix G.
Minutes of CP Road Map Pool Fund States
March 17, 2009

Involved with the call: Celik Ozyildirim, Virginia DOT; Gary Frederick, New York DOT; John Staton, Michigan DOT; Josh Freeman, Pennsylvania DOT; Randy Battee, Mississippi DOT; Peter Kopac, FHWA; Tom Cackler, Peter Taylor, Dale Harrington, and Paul Wiegand representing the Operations Support Group (OSG)

I. Current Activities

A. Paul reviewed the accomplishments in the first two task orders that were funded by FHWA and industry. He also reviewed with the group Task Order #3 which is what this group is partially funding with FHWA. He summarized each of the three Tasks in the Work Order.

B. Three areas of focus

1) Sustainability Track - Peter Taylor reviewed the progress.
   - June 2008 meeting with Track Leadership
   - Framing Document - Finished
   - Briefing Document - Under Development; to be complete in two to three months
   - Manual of Practice - Due late this fall
   - International Conference - Fall 2010.
     - Randy - Will it be held in this country? Yes-California is a likely location
   - Randy wanted to know if each Track is trying to setup its own pooled fund and are we trying to encourage this? Paul stated that for individual research projects under a particular track, pool funds are one way that the projects can be funded. The mix track is a good example.
   - A question came up about cooperation with TERRA at MnRoad. They have a great chance of applying for research project. Paul agrees and listed several current projects that are Road Map priority projects there.

2) Tech Transfer - The web page is under reconstruction to add the priority track projects from the second task order and to streamline the navigation. Paul reviewed the concept of obtaining a unified approach to Tech Transfer, i.e. the documents themselves and purpose. The Operations Support Group (OSG) has initiated work to identify a number of recent research projects that are of particular value in advancing the state of knowledge of concrete pavements. The OSG will assist in getting these research results in the hand of practitioners.

3) Activities related to putting together documents supporting the proposed change in direction for the third task order.
II. Proposed Operations Support Group Work Plan change in direction

Paul explained how we are proposing to meeting with state DOT’s, industry, and university researchers and obtain information from them about their research and their research needs. Also how they could work with other states, their university or other universities in a collaboration effort. In addition, information about each DOT’s research and field application activities would be gathered during the meeting to include in tech transfer summaries.

The group wanted to know what research database we would use to gather information for the important research projects for which Tech Briefs would be developed. It was stated the following would be used:

- CP Road Map information
- Track leaders research priorities
- Discussion with states
- TRIS – Finished research is a good source of completed research
- RIP- Research in Progress is great for current projects.

Gary Frederick indicated that the the OSG is doing great things. He thought that the OSG needed to put out some marketing on the cooperative effort at groups such as RAC. It is easy to market the pavement stakeholders, but need to expand how we are advancing concrete pavement beyond pavement experts. We need to keep administrators apprised.

John Staton indicated that it may be important to include finance people at each DOT in the meetings about benefits of cooperation

Paul explained the following technology transfer and coordination with states:

- Collaboration between states by meeting with each.
- Research project booklet would be completed on recently completed, current and future research needs. This booklet would contain about 3 research project descriptions per page and could be in excess of 100 pages. A lot of this is dependent on the information collected from state DOT’s and other sources.
- Complete Tech Briefs on recently completed and current research that is considered to advance concrete knowledge. Could be anywhere from 10 to 20 projects for each type.

Members within the group felt we needed this approach to move forward.

The question was raised about the particular format for the Web and Tech Briefs. The OSG is working on developing it at this time..

Peter Kopac explained that the proposal is not a change in the Road Map, it is only a change in how we get there. Need states to know the value of research i.e., how problem statements are being implemented, qualified value of research, what

J:\2009_projects\109.0203\1. Pool Fund Committee\Meeting Minutes\Minutes of CP Road Map Pool Fund States 3-6-09. PDW.doc
is the risk if states don’t participate, showcase collaboration, very difficult to keep training to advance knowledge.

The question was raised about how many states have a training coordinator? We need to find out. Celik thinks that seed funds from FHWA are important along with other sources to get new technologies in the field. The OSG needs to look what other people have done, which should be shared for the good of all. The group thought networking for information exchange is critical throughout the country. The Road Map needs to get two to three page summaries of critical research results out to the DOT’s and industry. Celik wants us to develop and put out an outline of what we want in a two/three page standard format.

The group also discussed the value of determining what each DOT is doing with field activities that could advance knowledge. Successful practices simply mean that a DOT has not necessarily done a formal research project but has had success in doing a specific function that works for them. We need to seek that out at the meetings with the state DOTs.

Some people may think we may be interfering with their research priorities and that we have a preconceived agenda - it is important that we don’t leave that impression.

John Staton suggested that the National Concrete Consortium (NCC) would be a good forum for the OSG to explain the new. Paul indicated that there was time on the April NCC meeting agenda to go over the concepts. The OSG would continue to update the NCC group at future meetings.

III. Coordination with Executive Committee and Pooled Fund group.
The group was asked how they want to coordinate with the CP Road Map Executive Committee? In conjunction with the FHWA, the Executive Committee provides overall guidance to the Operations Support Group. The pool fund group wanted to know what mechanism or process ties them to the Executive Committee. There currently is some overlap between the pooled fund contacts and members of the Executive Committee. Due to the relatively small number of pooled fund states that aren’t already represented on the Executive Committee, it was recommended that the remaining pooled fund states be invited to participate with the Executive Committee. As more state join the pooled fund, it may be necessary to arrange a different strategy.

IV. General
Randy Battey raised a question relating to consultant/researcher selection for actual projects. He wanted to know if consultant selection is part of track responsibility. Paul indicated that selection of researchers would be done by the project funder in accordance with their standard processes.
It was decided to establish the second Wednesday of every other month at 10:00 AM (CST) The remaining call dates for 2009 are May 13, July 8, September 9, November 11th.

Minutes by Dale Harrington and Paul Wiegand
The meeting of the Road Map Executive Committee was convened in order to discuss the changes being suggested for the continuation of Task Order 3 of the Road Map. Due to the scheduling and cost of face-to-face meetings, this meeting was held via webconferencing.

It has proven to be difficult to get states to commit to the pooled fund project despite presentations at meetings and mailings. The Operations Support Group (OSG) is recognizing the message of the CP Road Map is still not clearly understood or at least lacking in general usage despite efforts to get the message out. This year a full day workshop (on sustainability) was held during TRB; future workshops at TRB are being planned.

Of the identified tracks (original 12, plus sustainability suggested by exec committee in 2008) the progress of the priority tracks was noted (see PowerPoint presentation handout).

Question: Is recycling being looked at in sustainability? California is looking for less reliance on cement, trying to get to 1990 levels by 2020.

In cooperation with FHWA, OSG is in the initial stages of planning an international conference on sustainability in 2010. Other parts of the world have been involved in sustainable practices and we want to learn from them and incorporate them into our practices where possible.
Question: Could a survey be done to evaluate the impact of alternative bids? The current practice, state techniques being used, issues that need further evaluation, etc.

- What is the impact of alternative bidding – is it giving the states what they need? Don’t worry about the fairness aspect, just report on the impact.
- FHWA would need to take lead – no state will buy into it without their involvement.
- Mississippi is looking for a fair and equal plan. Especially with the stimulus package coming, states need something that everyone can use.
- Illinois is interested in technically how states are doing alternate bids first, then more in depth information and specifics on asphalt and concrete.
- FHWA’s Office of Pavement Technology is working on updating guidance on alternate bidding which should be forthcoming this year. NCHRP has project on alternate bidding that may include a survey of state practices.

OSG will contact the NCHRP project monitor to see what is being done, and will discuss how to supplement that information if needed.

CP Road Map Executive Committee was designated to assume the track leadership for Business Systems (track 11). No one has emerged to take on this track leadership. OSG will endeavor to get more information to the Executive Committee with the goal of finalizing the leadership for the Business Systems track.

Task Order 2 has been completed; the final report was sent out electronically. However, as a part of TO 3 there has been a continuation of work activities begun under TO 2. Primarily work is being done to bring the sustainability track up to the same status as the other priority tracks.

Question: Is there an assessment of how successful these efforts are? Specifically, a dollar value of projects that could be traced back to the Road Map? An evaluation is part of the TO 3 activity. The evaluation will attempt to show projects/research that are as a result of this activity.

The NCC meeting last week was very successful with a good participation and enthusiasm for concrete research and for the Road Map. However, we have had comments, and in particular we heard during the Two-lift Paving Open House, that there is concern that enthusiasm for the Road Map is waning. After the Open House the OSG evaluated what had been successful so far, and the concerns. We realized that too many of the researchers, DOTs, and research agencies were not using the Road Map in developing their individual programs. We decided to look at a different way to approach the process and felt the changes should take place immediately rather than wait for TO 4.

Cheryl Richter indicated that in a conversation with a State highway individual who had been a strong supporter of the CP Road Map during its development but is not now involved in the pooled fund or any other activities, the following comments were made:

1. Pertinent people in his state were involved in other things
2. He really wasn’t aware that support for coordination activities was lacking. He was of a the opinion that the Cooperative Agreement funding should be sufficient.

Clarification is needed to ensure understanding that the Road Map is only one of many projects at the National CP Tech Center. All research (cooperative agreement projects, pooled fund projects, other research) being done through the CP Tech Center is making a contribution to the Road Map, geared to advancing the Road Map priorities. But the Road Map identified 25 M a year in needed research, the CP
Tech Center can’t advance it alone. The challenge is to get others to see the big picture. And in order to accomplish that, a new approach is being proposed.

Proposed new approach (see PowerPoint handout beginning at pg 21; red print indicates new tasks)

OSG proposes to listen to researchers, DOTs, and industry regarding research needs through face to face or video conference meetings. This direct contact should clear up misconceptions and improve their involvement in the Road Map.

These meetings will also give the OSG team a clearer picture of funding streams and they will be able to help develop collaborations. A clearer picture of DOT research needs, universities and other researchers capabilities, and available funding should result in less duplication and more involvement in the Road Map priorities.

Assisting with the Technology Transfer programs will become an increasing priority. The OSG will assist in development of T2 publications, tech briefs, research summaries etc.

Question: How does this compare to TRIS or RIP?

This summary would highlight what’s going on at DOTs, narrowing it to research that is being moved forward to advance concrete pavement. In addition, it would show how it is connected to the Road Map, the track association and gap it addresses. We need to publicize this information and get it out to the general public.

A format to capture this information would be set up and DOTs could populate the form, or we would do it for them as we hear about their research.

For states that use TRIS or RIP, the OSG would review these entries and extract information on the critical research items for national interest.

Each year, 10-12 projects that substantially advance concrete pavement technology would be developed into tech briefs in conjunction with researchers and the APTP program. The OSG would not be doing the research, but finding the research of national significance and getting the information to the practitioners.

Concern with duplication to what is presently being reported in TRIS and RIP was expressed and the OSG agrees that there should not be a new database, existing ones should be used. However, this proposal involves connecting the research to the Road Map, that information is not included in TRIS/RIP.

The Road Map was also developed to help get research into practice. This process will try to get useful material, emerging research, to the agencies. It takes too long to get new ideas into practice and we need to be more proactive in getting information out. Tech briefs will get the information out, and encourage interest in the researcher’s report with a link to their website.

Although there are lots of research reports and tech briefs being done, our contacts show the information is not being utilized. From discussions with DOT representatives, we realize that filtering the information for relevance to specific topics and direct working relationships with DOTs, universities, and agencies will help in the struggle to get research into practice.

Peter Kopac commented that the old approach was “let’s try to follow the proposed research” and the new approach is “find out what is going on and see how it relates”.

- 3 -
The new approach has received the concurrence of the executive committee and a change of scope for TO 3 will be written. The Technology Transfer program, slide 24 from the PowerPoint (attached), may need some further clarification and discussion. The T2 program may be part of TO 4.

Other questions/comments:
With the stimulus program coming out, states can’t move forward on the things that are of interest, they are overwhelmed with just getting stuff out the door for construction.

Even though there is stimulus funding, long term most states are limited in their funding and their programs are still shrinking. Green construction lends itself to alternative bidding. If you’re just maintaining existing roadways, it’s much harder for alternate bidding. Major existing barriers also makes alternate bidding very challenging.

Executive committee does not directly include reps from pooled fund states. OSG proposes to add representatives from these 6 states to the executive committee to fully involve them as funders? Agreed.
MINUTES OF JULY 14, 2009 CP ROAD MAP POOLED FUND

CONFERENCE CALL

Participants: Gary Frederick, NY DOT; John Staton, MI DOT; Jordan Whittington, MS DOT; Todd Hanson, IA DOT; Peter Kopac, FHWA; and Tom Cackler, Peter Taylor, Dale Harrington, Sabrina Shields-Cook, and Paul Wiegand representing the Operations Support Group

Task Order Revisions: Paul Wiegand initiated discussion on the revised Task Order for the Operations Support Group (OSG). Peter Kopac has sent a draft of the work plan. The OSG will be developing a response in the near future. Paul explained that the revised work plan extended the contract until July of 2010 and provided for the elements that the group had been discussing in the past.

Current Research Needs: Gary Frederick indicated that New York is interested in the best practices for separation layers for unbounded PCC overlays. A lot of questions had been raised about what can be an acceptable alternative to HMA due to costs. Dale Harrington responded that the Overlay Guide had some information and Paul Wiegand that the FHWA sponsored research report was available and that the OSG is in final review of a MAP (Moving Advancements into Practice) Brief summarizing the research report. He also indicated that the CP Tech Center, in conjunction with FHWA and the Iowa Highway Research Board, is undertaking some further research on the fabric this summer. Gary also indicated that the amount of information on research activities that is out there is overwhelming and quick summaries are needed for the information to get out and be implemented.

John Staton indicated that the impact of environmental legislation on cement and cementitious materials is a critical item. He indicated that future supplies could be impacted. Peter Taylor responded that both the Mix Track and the Sustainability Track had projects to address the concern.

Operational Challenges: Gary Frederick indicated that it is hard to categorize since each state is probably different. Some Universities do not want to participate. He indicated that another challenge is the marketing of the research activities to upper level management/commissioners in order for them to understand the value of the research program and to continue funding it. He sees the Road Map and the MAP Briefs as good tools for the marketing.

John Staton indicated that Michigan has a new project procurement process that is not specific to universities and has attracted some consultants to respond to RFPs. He indicated that pooled funds are more flexible and prove very valuable.

Gary also brought up the increasing importance of environmental issues in evaluating pavement alternatives. Peter Taylor responded that the next step for the Sustainability Track is
to develop a Manual of Practice that will describe available analysis techniques that both pavement groups will support.

Sustainability Track: Peter Taylor completed his update of the Sustainability Track by indicating that the Track Briefing Document was being sent out to the Leadership Team for final review and it is hoped to have that out by mid-August. The Manual of Practice is the next focus and the 2010 International Conference on Sustainability is being planned for September in Sacramento, CA.

Next Conference call: September 9, 2009 at 10:00 AM Central
Participants: Gary Frederick, NY DOT; John Staton, MI DOT; Jordan Whittington, MS DOT; Robb Chapin, Penn DOT; Peter Kopac, FHWA; and Tom Cackler, Peter Taylor, Dale Harrington, Sabrina Shields-Cook, Tom Van Dam, and Paul Wiegand representing the Operations Support Group

Task Order: Paul Wiegand initiated discussion of the Operations Support Group Task Order that was just formally received from FHWA. Peter Kopac explained that it involves an extension of time and changes in the work plan. The elements of the work plan were discussed and are included as an attachment to these minutes. Dale Harrington identified the ten potential subjects for MAP (Moving Advancements into Practice) Briefs and asked for input. Gary Frederick indicated that he liked the mix of potential subjects and thought that mix compatibility issues would remain a concern especially with use of recycled materials and marginal aggregates. He suggested that we keep that subject area in mind.

John Staton questioned whether the potential slag MAP Brief should be expanded to include all pozzolans. Peter Taylor replied that the original subject was based on Doug Houghton’s research that only covered slag. Peter Kopac questioned the need for the incompatibility brief since there was one within the past 3-4 years. Discussion continued on issuing MAP Briefs that are updates to past information and the group felt that getting the information out was important if the subject remained of value. Tom Van Dam indicated that since air entraining was a consistent issue, including the basics of air entraining in a MAP Brief would be worth consideration.

Research Processes: Discussion was initiated on each agency’s research selection processes and the value of the OSG. Gary Frederick indicated that the New York DOT activities are generally initiated as part of a construction project. The idea may come from Materials or Construction staff, or from a Contractor who wants to improve operations. They sometimes use the RFP process, but knowledgeable researchers for concrete pavements are limited. Greatest value of the OSG and the pooled fund is the Technology Transfer activities.

John Staton indicated that Michigan’s research process was being re-evaluated and because of potential processes that would limit collaboration. At present the informal process involves getting upper management support for each project and pushing it through. His key is to show connection to the CP Road Map with local DOT value. This then allows collaboration with other DOTs or projects.

Jordan Whittington explained that Mississippi has an annual research budget and the DOT ranks proposals that are submitted by researchers. They also indicate that the value of the Road Map is the information and technology exchange.
Robb Chapin described PennDOT’s involvement with the Penn State test track. It is used mainly for research activities of Penn State and Penn DOT but also involves work for FAA and FHWA studies involving buses. The group had limited knowledge of the test track and Robb indicated he would send out information.

Since no one from the Iowa DOT was able to participate, Paul explained the Iowa Highway Research Board’s process of using technical committees to develop project concepts that are submitted and ranked for importance and funding. The concrete pavement committee uses the Road Map as a starting point for research ideas.

Peter Kopac explained the FHWA FALCON team concept that they use. The system involves 6 areas of emphasis, including:

1. Pavement Design & Analysis
2. Materials & Construction Technology
3. Pavement Management & Preservation
4. Pavement Surface Characteristics
5. Materials & Construction Quality Assurance
6. Environmental Stewardship

Additional information on the FALCON emphasis areas is attached. As projects are submitted and ranked, those with connections to the CP Road Map are given higher priority.

**Activities Update:** Peter Taylor and Tom Van Dam summarized the Sustainability Briefing Paper that is posted on the CP Road Map website. It lays the foundation for future work. Peter Taylor noted that the international conference did not have very many abstract submittals and that additional notice work was going to be required.

Paul indicated that with ACPA’s work with the AASHTO Subcommittee on Materials, two projects had been recommended for inclusion in the 2010 NCHRP program. The two problem statements submitted by ACPA are — “Reduced Energy and Carbon Footprints for Sustainable Paving-Grade Concrete” and “Development of a User-Friendly Environmental Life Cycle Assessment Toolkit for Sustainable Concrete Pavements”.

It was also reported that there will be a Road Map Program Update during TRB as a part of the AFH 50 Committee workshop.

Dale Harrington described the important elements of the Geotextile Bond Breaker MAP Brief and how other MAP Briefs would be set up in a similar manner.

**General Input:** Gary Frederick suggested that the Road Map website be improved to make it easier to find the current research activities. This could result in a greater level of
collaboration. John Staton requested clarification on which group the MAP Briefs would be coordinated with. Peter Kopac clarified that it would be with the Advanced Concrete Pavement Technology Program (ACPTP).

Next Call: Due to the Veterans Day conflict, the next call was set November 12, 2009 at 10:00 AM Central time.
Attendees:
CP ROADMAP POOLED FUND STATE REPS
Josh Freeman, Pennsylvania DOT
John Staton, Michigan DOT
Peter Kopac, FHWA
Robbins Chapin
Tom Van Dam, AP Tech
Todd Hanson, Iowa DOT

Operations Support Group (OSG)
Peter Taylor, CP Tech Center
Dale Harrington, CP Tech Center
Sabrina Shields-Cook, CP Tech Center

Members who did not attend:
Celik Ozyildirim, Virginia DOT
Jordan Whittington, MS DOT
Gary Frederick, New York DOT

Topics for discussion include:

1. Update on activities
   o Contacts with DOTs/Industry/Academia
     - Dale Harrington gave an update on the electronic meetings to be held with different state DOTs to discuss research collaboration and how the CP Road Map and Operations Support Group (OSG) can assist in the effort. To date, contacts have been made with DOTs and Industry in Michigan, Missouri, Wisconsin, and Minnesota. Missouri and Wisconsin have responded to the OSG and electronic meetings will be established.

     - Dale stated that an agenda has been developed that would include the background of the CP Road Map, collaboration items and discussion inputs and questions for each state.

     - Peter Kopac requested that OSG provide a status report to the committee following some of the contacts. He liked the idea of info exchange. Good opportunity to establish official contacts and ask for progress reports to be distributed to track leaders so the track leaders can disseminate these to others doing similar research round the country.
Sustainability Track
- International Conference – Peter Taylor explained the Sustainability International Conference to be held in Sacramento, California on September 15 – 17, 2010. The conference will be sponsored by FHWA and the CP Tech Center. It is planned at this time that the NC2 group will be at the conference site a few days before and it is hoped that this will help travel for interested state DOTs. Peter explained that the conference will cover design, materials, mixtures, construction and LCA considerations. There will be two forums, one on agency practices and directions and industry’s initiatives, innovations and directions. Papers for the conference are being received at this time.

- 55 abstracts were submitted, we accepted 30 and another 9 as potential posers: 10 materials 20 mixture 30 design 4) LSA

TRB updates
- TRB committee AFH50 is hosting a workshop in January 2010 that will discuss activities going on under the Road Map. This committee has also adopted research needs statements from DOT of the Road Map document. Peter gave a 40 min. presentation on sustainability to the AFH50 committee.

MAP Briefs
- Diamond Grinding – Dale Harrington explained that the diamond grinding tech brief has been drafted and is under review. He stated it should be out very shortly. Peter Kopac will check with Sam Tyson regarding his review.

- Dale also explained that the Nonwoven Geotextile Interlayer MAP Brief has been issued and is on the CP Road Map’s website and was published in the E-News.

- Regarding the next MAP Briefs, Dale reviewed the following subject matters with the committee and asked for their input on prioritization. The committee listed the MAP Briefs in the following order:

  1. COMPASS, what is it and how can I use it?
  2. Joint Deterioration
  3. Sustainable Concrete Pavements based on the current briefing document
  4. Laying a Concrete Foundation
  5. Durability of Textures of Concrete Pavements

- John Staton stated to make sure they are all validated and substantiated. He is very interested in COMPASS. Peter Kopac stated COMPASS was also on his list. Tom Van Dam agreed about COMPASS.

Priority Research Track contacts and status-
- CP Road Map Track Leadership Team members – Dale Harrington explained that each of the 6 priority tracks will have their track leadership reaffirmed and
updated. He also explained that sustainability, design and surface characteristics track are being planned within the next few months.

- **Mix Design Track** – Peter Taylor explained that the Mix Design Pool Fund meeting was held at the NCC conference in St. Louis on October 6, 2009. Peter reviewed the TPF-5(205) Mix Design and Analysis project. Research on the ternary mixtures is underway and the field demonstrations were conducted on self-consolidating concrete on slip form applications. Peter reviewed the ternary results and covered the portable analysis device, acoustic setting time device, mix proportioning and future work on mix proportioning.

- **Joint Deterioration** – Peter Taylor explained that research is underway on joint deterioration to determine how to prevent and mitigate joint related distresses in concrete pavement. This project is a combination of numerous funds including federal appropriations and pooled funds.

- **Overlay Design TAC** – Dale Harrington stated that the Overlay Design Committee is having their first conference call on November 13, 2009. He explained that the Performance Based Design track leadership committee identified overlay design as a top priority in July 2008. The purpose of the Overlay Design Committee is to develop a design guide that provides an overview of common software concrete overlay design practices and to select one to two practices per type of overlay that would be carried forward as a recommended practice. Initial tech brief will be out in about 4 months, then will finish the report and send for review.

Dale also explained that the next Track 2 leadership meeting is scheduled for the early part of January 2010. ACI 2011 meeting will have session on overlays and this will be one of the topics. John Staton asked if it would cover maintenance of traffic and Dale Harrington stated yes it would.

- **Sustainability Track** – Peter Taylor informed the group that the next Sustainability Track Leadership web based meeting would be held within the next few months. The purpose of the meeting will be to discuss updates to the framing document, to review the briefing document that was published in August 2009 and to review in detail the proposed Manual of Practice on sustainability. Tom Van Dam stated we need a recommendation for a good contact in California.

- **Surface Characteristics Track** - Dale Harrington briefly reviewed with the committee that the framework document needed to be updated and that the track leadership group would be called together within the next few months. In regards to the Part 3 surface characteristics research project the final research documents are under development. Technology transfer pieces are being planned in 2010 that include model texture guidelines, fundamentals of quieter concrete pavements, and selecting the right texture for the right solution.

- John Staton asked is this plugged into the Road Map and Dale Harrington stated yes.
2. Input from Participants
   o Discussion – John Staton is involved but hasn’t heard any mention of Road Map.
     Peter Kopac asked what is going on with the business track? Is there a track leader, 
     committee, any projects? Dale Harrington stated no, but Tom and he are hoping to 
     get input from states and do some work to push this forward.

   ▪ Method of communication for Road Map activities. Dale Harrington started the 
     discussion with the committee about how they would like to receive their 
     communications and technology documents. Currently the budget for the TOPR 
     3 is setup for an electronic e-news/website postings and few printed pieces. 
     Does this “work” or is this the “best” way to get information in users hands to 
     make the program the most effective. John Staton stated E-news, good subject 
     line, with links to other documents, not attachments. PennDOT stated E-new with link. Tom Van Dam stated E-news is primary way to go. Peter Taylor 
     stated sometimes it is nice to have physical copy of things like briefing 
     documents. After further discussions by the committee they felt that the 
     electronic method was acceptable but wanted to make sure that when there was a 
     need for a paper copy that it would be available.

   ▪ Others-John Staton stated he sent Paul Wiegand a request for a couple paragraphs 
     on 2009 accomplishments and anticipated 2010 proposed activities.
CP ROAD MAP POOLED FUND STATES
CONFERENCE CALL
10:00 AM CENTRAL
March 17, 2010

Attendees: Gary Frederick – New York DOT
           John Staton – Michigan DOT
           Joshua Freeman – Penn DOT
           Lydia Peddicord – Penn DOT
           Todd Hanson – Iowa DOT
           Matt Strickland – Mississippi DOT
           Peter Kopac – FHWA
           Rob Rasmussen – The Transtec Group, Inc.
           Paul Wiegand – National CP Tech Center
           Dale Harrington – National CP Tech Center
           Melisse Leopold – National CP Tech Center taking minutes

Paul Wiegand opened the meeting and welcomed everyone to the conference call.

Topics for discussion include:

- Update on activities
  - Contacts with DOTs/Industry/Academia (Paul Wiegand)
    - Held a conference call with Wisconsin DOT, Madison Wisconsin University and Wisconsin Concrete Pavement Association. Talked about their involvement, their research and how they can get more involved with the CP Road Map. Explained what the Road Map is about and got information about their research.
    - Their main focus is on pool funds and local research for local concerns. They would like to see the MEPDG developed to make sure they have the appropriate elements pertaining to their aggregates. They are involved in 12 pool funds.
    - Working on Mix Design with Indiana, surface characteristics on tire pavement noise, joint deterioration study.
    - They want to look at joint deterioration and curing compounds and joint sealing,
    - Concerned about resources for them to get their research out to Wisconsin DOT.
    - The University is working closely with Wisconsin DOT. The biggest issue they have is the lack of people to work with on the research projects to analyze and process data and follow-up with technology transfer. These people aren’t paid for with the research projects funding.
    - Industry is concerned about reduced funding and coordination to get information out and joint deterioration.
• We discussed how the CP Road Map can get what they felt were interesting processes and how they can get involved. They felt tech transfer was important and implementation activities, getting the information out.

Peter Kopac asked what action was taken after the meeting and what state will they meet with next. Paul stated they have summarized what the Wisconsin group provided and they sent out minutes of the discussion. They will work with the Wisconsin group to identify their research projects and get them into our data base. Also, work to identify research projects that they want to potentially see pursued either with pool funds or work in their state. This information will be posted on the Road Map website.

Paul stated they are struggling to get the contacts for the states however they are working on contacting Michigan, Missouri, and Kansas trying to follow up and get a conference call moving.

Peter Kopac stated he read the minutes from the Wisconsin conference call and that he is impressed with the communication ideas and electronic newsletter ideas from the Wisconsin call. Peter asked if the communication plan development would be undertaken in TOPR 3 or would it also go into TOPR 4. Paul stated it would go into both contracts. Peter asked the group to send him any thoughts they had on what should go in the next task order.

Paul stated the priority track team meetings were held as conference calls and following is an update:

○ Sustainability Track (Dale Harrington)

The last track leadership conference call was held on January 27, 2010. Following the track leadership call a conference call was held on the Sustainability Manual of Practice (MOP) with the proposed authors and ETG for the manual. Discussions centered on the MOP which was identified by the Sustainability track leadership. Dale stated the MOP should be completed by the end of 2010. The concept is to make sure it is a document that clearly outlines the normal sustainable practices that should be utilized when looking at concrete pavement design and construction. Dale stated this is a great example of what the CP Road Map is trying to do with actual implementation. Dale stated there are approximately 10 chapters that have been identified for the manual which will be about 200 pages. A team of experts have been assembled to write each chapter and the track leadership wanted to identify all the organizations that effect sustainability. There are so many organizations out there that need to be contacted. APWA is very big in regards to sustainability in public works. In June 2010 they are having a 2 day sustainability conference.
Dale stated there is a Sustainability workshop proposed for September 15-17, 2010 in Sacramento, California which is sponsored by FHWA in cooperation with the National Center. They would like to have the MOP at a level that can be utilized at the workshop. Paul Wiegand stated that because of the emphasis that is placed on sustainability the Sustainability Track is involved with numerous contacts and trying to keep up with the workshops and information that is going on. Peter Kopac stated there is also a sustainability conference sponsored by NRMCA and Arizona State University being held April 13-15, 2010 in Arizona. Peter will send the link to this conference to Dale.

- Mix Design Track activities (Dale Harrington)

Paul Wiegand stated there will be a mix track leadership meeting at the NCC meeting in Georgia in April 2010. The track is working to identity the elements and how to improve mix design.

Dale Harrington stated the last track meeting was held via conference call in October 2009 and the next one, as Paul stated, will be held at the NCC meeting April 2010. The track leadership has been concentrating on permeability which is a main point of interest. We need to maintain a concrete pavement with low permeability under freeze and thaw conditions in the cold weather states. Purdue University is currently working on the permeability research.

Joint deterioration research has been initiated through a pool fund and industry. Another item the track is working on is what amount of air is needed and how much to maintain a good mix. Dale stated the track would like to measure air at spacing and air bubble size rather than just total air.

Dale stated the track is looking at mix proportioning models and the use of COMPASS in the mix design. Dale stated that optimizing cement content is important. He mentioned we are aware too high of cement content gives issues with costs and shrinkage and cracking. Dale stated we need to know what the optimization of cement content should be. Dale stated the track is also looking at calcium silica calibrations. John Staton added that one of the current projects is the air paste study with the mix design track.

- Design Track activities (Dale Harrington)

Dale Harrington stated the Design Track leadership held a conference call in January 2010. The group discussed the issue of not having a good coordination effort with the MEPDG Design Manual. Dale stated the group does not know where to go to make an impact on the AASHTO Standing committee on research. There are issues pertaining to design elements such as tie bars. They would like to get in front of the committee and discuss how we get involved in the integration of software tools for the AASHTO Design Manual. Dale stated the Concrete Overlay Design Guide is a track priority. It will identify and outline
current design methodologies. The Guide will discuss the 4-5 design methodologies and recommend the ones that do the best job. It will address all the elements of the software and run examples of the top program for each type of overlays (bonded & unbonded). Dale stated DOTs, cities and counties can go to a design methodology and understand it and have examples to run the software. It will also identify needs for priorities for design beyond the current MEPDG Design. Dale mentioned the Design Guide should be complete by the end of this year.

- Surface Characteristics Track activities (Paul Wiegand)

Paul stated he asked the current members of the surface characteristics track leadership group if they were still interested in continuing to serve on the track leadership. The identified the members who had retired and added new members to representation those who were no longer involved with the track leadership. There are currently 21 track team members. Paul stated that 13 members of the track group participated at the last meeting and they reviewed the existing framework document to see if it needed any updated information and identify gaps. The track will look at what gaps are out there and what elements are needed for a short term priority program. Paul stated that four areas were identified which included the following:
  - Curing - are there better processes and materials to help with curing.
  - Methods to improve uniformity in materials delivered and in construction.
  - Better functional performance, overall process of constructing pavements and maintaining the elements that are involved through texturing and curing process.
  - Tech transfer elements that would be available to encourage the DOTs to use the innovation that has been developed to improve their paving product. Getting the research element into practice and implementation when constructing concrete pavements.

Paul stated the minutes from the Surface Characteristics track leadership meeting will be posted on the CP Road Map website.

- Overlays (Dale Harrington)

Dale stated an Overlay Track leadership conference call was held in November 2009 and as a result the track moved forward with two elements. One element which was the need to develop an overlay packet. The Overlay Guide needs to be updated but until that can be done an overlay packet needs to be developed. The packet will include information pertaining to costs, examples of uses that have lasted for overlays for years under heavy traffic loading, proper plan development and some issues associated with concrete overruns. Dale stated the packet will also include examples of some of the research work that has been completed from Iowa’s Overlay Field Research Application program. Dale stated the Federal Concrete Overlay Field Application program needed some new
approaches due to State DOT slowdown in 2009 (Fall) in trying overlays. Dale stated efforts have been started to meet with the Chief Engineers from some of the DOTs. Dale stated they have already met with the Chief Engineers from Virginia and Indiana DOTs and they are in the process of trying to get a meeting with the Chief Engineer at the Maryland DOT. Dale stated this approach is working as they have added Virginia and Indiana to the Concrete Overlay Field Application program. He stated there are 12 states committed to building overlays and they have most recently met with the state of Georgia on the program. Dale mentioned they are working on holding an concrete overlay open house in Pennsylvania with Penn DOT in May or June of this year. Dale stated the overlay design guide is coming out this year which is part of the design track.

Paul Wiegand added that the IHRB and FHWA have an overlay project with some successes which will be included in the updated overlay guide.

Peter Kopac asked who at FHWA is on the overlay track leadership. Dale stated that Sam Tyson is on the overlay track committee and that it is a CP Road Map subtrack. However, Gina Ahlstrom is the Overlay Field Coordinator.

Peter Kopac asked about Track 11 - business economics track and if there has been any progress with initiating the track? Dale stated he had just met with Tom Cackler and they have identified members who may be interested in starting the track. They will be contacting these individuals and moving the track forward. Peter suggested they put Track 11 on the April 2010 agenda for the CP Road Map Executive Committee meeting. Paul Wiegand said it will be added to the agenda.

○ MAP Briefs (Dale Harrington)

Paul Wiegand stated that the development of MAP is (moving applications into practice) and that there are two MAP Briefs that have been completed which are Geotextile interlayer and the Diamond grinding. Dale Harrington stated they are currently working on the COMPASS program MAP which will be 6 or 7 pages. Dale stated they are putting out a tech brief on some of the design elements as pertaining to overlay design, summaries of what we found out today. Dale stated there are a number of states that want guidance on overlays prior to the Design Guide coming out. Also there has been a tech brief developed on joint deterioration. He mentioned that Peter Taylor is finalizing the tech brief and it will be put on the CP Road Map website. Paul stated this is a tech brief that the CP Tech Center is developing. Dale stated there is also a preservation tech brief that will be out within the next 3-4 weeks.

Paul Wiegand stated these MAP briefs will be sent to Peter Kopac and Sam Tyson for their review and approval.
Peter Kopac stated that John Staton mentioned at the previous CP Road Map Pool Fund States conference call that the tech brief on the effective use of slag cement should be expanded to include pozzolans. Paul stated this is happening in the mix design activities and has been added to the list. Paul will talk to Peter Taylor about the status.

- Communications plan input (Dale Harrington)

The goal of the communication plan is to help get information about the road map out. Paul stated that Dale is working with Transtec to develop an overall plan. This effort will start under TOPR 3 and go into TOPR 4. Dale Harrington stated there is a meeting scheduled for Friday to initiate the actual work on the communication plan. He mentioned we have communication responsibilities to make the CP Road Map more nationally known rather than just with certain states. The way to initiate participation is to communicate how the CP Road map can help research and how good tech transfer is with getting the information out. Dale stated that some ideas are to reorganize the CP Road Map website, newsletter production, E-news (to be put out on a multi-weekly basis) about what is going on in research and tech transfer via email. Dale mentioned once all the materials are developed and implemented they need to step back on a quarterly basis to see if it is making a difference and need measure the success of the CP Road Map. Paul Wiegand stated the e-news would focus on one of the priority tracks and include quick things about the other tracks if there is activity information that we need to get out.

Gary Frederick stated the CP Road Map Admin Group has been doing great things on getting info out. He stated we should make sure we are marketing to the right people. Gary suggested we may need different marketing tools. He will be attending the AASHTO meeting in Kansas and would be happy to take the information to the meeting to pass out. Paul thanked him and said we will send it to him.

Paul Wiegand stated they are working with RAC to provide information to them and to AASHTO organization.

Peter Kopac stated the new approach is going to help communications and collaboration. We are going to the state agencies and ask them what they need and explain the road map to them. On the success of the CP Road Map the task of developing an accomplishment report of administrative activities completed and future challenges faced – struggling with how successful we have been. Peter stated he wasn’t sure if we are following the CP Road Map or creating a slightly different version. Good to hear that a lot of research that was originally in the CP Road Map has started.

Dale stated it starts with developing a framework for each track and that the elements are pulled from the CP Road Map. These elements guide the track leadership forward. This is the tie with the CP Road Map and the committee’s work.
Paul Wiegand stated one of the real values is the involvement with each of the track leadership groups who are influencers with the research that will be done. It has taken some time to get the momentum going but we are turning that around and focusing on being more proactive.

Peter Kopac stated that compared to the Asphalt road map which is not being supported people are more aware of the CP Road Map.

- Other topics

Gary Frederick stated he thinks they are getting the CP Road Map going now and it is meeting the needs of the states. Need to continue with coordination and collaboration. What it is now and what would you like to see.

John Staton asked what format is the information reported regarding the progress and where they are going and planned activities. Paul Wiegand stated this will be developed via the accomplishment report. The CP Road Map website has what was done on each contract and is developed at the end of each contract period.

Peter Kopac stated the quarterly reports are posted on the pooled fund study website.

Dale stated durability of the textures of concrete pavement has not been started however under the surface characteristics study a brief will be developed to address this issue.

The committee agreed to hold the next call on May 12, 2010 at 10:00 AM Central

Meeting adjourned at 11:25 AM Central.
CP Road Map
Executive Committee Meeting
April 19, 2010
Agenda

Attendees:
Executive Board
- David Lippert
- Julie Garbini
- Randy Riley
- Jerry Voigt
- Steve Kosmatka
- Martin Fallon
- Claude Bedard
- Cheryl Richter
- Sunil Vanikar

CP Road Map Technical Representative
- Peter Kopac
- Ahmad Ardani

Pooled Fund State Representatives
- Gary Frederick, New York DOT
- Todd Hanson, Iowa DOT
- Josh Freeman, Penn DOT
- Matt Srickland, Mississippi DOT
- John Staton, Michigan DOT

Administrative Support Group, CP Tech Center
Tom Cackler
Paul Wiegand
Peter Taylor
Dale Harrington
Sabrina Shields-Cook
Sharon Prochnow

1. Introduction
- The goal has continued to be finding ways to fill the gaps in prioritized research through identifying needs, finding researchers, and leveraging funding. Budget constraints have necessitated smaller incremental projects, however, smaller projects are still part of the Road Map.
- Promoting collaboration and coordinating the research is still key to the Road Map.
- The Road Map has always had significant interest in technology transfer. Now that research under the Road Map is being completed, major effort is geared to publishing results, promoting success and implementing research findings.
2. CP Road Map Communication Plan
   - Discussions with individual State DOT representatives have begun
     o Identify what research and technology transfer activities are aligned with the CP Road Map, how they are linked, and the benefits of designating research within the Road Map
     o Identify proposed adjustments to the CP Road Map based on the results of these discussions
       ▪ First visit was with Wisconsin DOT, Kevin McMullen, University of Wisconsin-Madison
       ▪ Visit with Pennsylvania DOT is in the planning stage
       ▪ Minutes from DOT visits will be available on the website
   - Road Map E-News
     o First issue was last week; bi-weekly issues are planned
     o Highlight research and T2 going on around the country
     o Different state DOT for each newsletter
     o QUESTION: Cheryl Richter asked the Board's opinion on the frequency planned for the E-news. General consensus was monthly with approx 6 items (more if needed).
   - MAP Briefs
     o Two have been published:
       ▪ Diamond grinding
       ▪ Nonwoven Geotextile Interlayers
     o Others planned
       ▪ COMPASS
       ▪ Laying a Concrete Foundation
       ▪ Enhancing the Durability of Concrete Pavements Subjected to Liquid Chemical Deicers
       ▪ Enhancing Concrete Pavement Sustainability through Two-Lift Construction
       ▪ Sustainable Concrete Pavements
   - Web Site
     o COMMENT: Website should show an index of e-news and tech briefs
   - Track Web Meetings
     o To keep travel costs low, the ASG has been working with track leaders to schedule web meetings that focus on individual tracks
     o COMMENT: Website should point to minutes from individual track meetings
   - Outreach for CP Road Map
     - Presentations at key forums to solicit support for the CP Road Map
     - Meetings with selected industry contacts for one-on-one “interviews” on pertinent work

3. Status and Priorities of the CP Road Map Tracks (see PowerPoint slides for overview)
   - Mix Design and Analysis Track (Track 1)
     o No formal track leadership meeting; NCC meetings are being utilized for direction from academia, DOTs, industry
     o COMMENTS:
       ▪ Air entrainment work being done by Tyler Ley should be included. He is also on the pooled fund project research team.
       ▪ There is a need for a good guide specification to help DOT engineers get “up to speed” quickly with new economics making concrete more appealing.
       ▪ Checksheets – have I thought about the right things?
   - Performance-Based Design Guide for New and Rehabilitated Concrete (Track 2)
     o Key Area of Concentration:
       ▪ Concrete Overlays report
       ▪ Recommend existing software program for each type of overlay; including examples.
       ▪ Technology Tech Brief is in final draft form.
     o Dale Harrington asked the Board for advice on how to influence AASHTO on MEPDG
COMMENTS:
- Cheryl Richter agreed the way to get things into practice is to work through AASHTO.
- How? Most development work that gets into MEPDG passes through the NCHRP process. Joint technical committees are looking at all advancements, not just concrete. But keep committees aware, engaged in overseeing, and reviewing research so that when an idea comes to the committee it has a champion.
- Industry is represented on the committee by Jerry Voigt. He volunteered to champion Road Map advancements.

- High Speed Nondestructive Testing and Intelligent Construction Systems
  - There has been lots of activity in this area; many of the new systems emerging have been developed by industry
  - SHRP is looking at validation and specification
  - Stakeless (stringless) construction is being looked at by many states
  - Intelligent Construction is also receiving lots of interest
  - Comments:
    - Sunee Vanikar: A recent meeting discussed the need for accelerated delivery of products and IC was top priority. What are the technologies involved in moving that forward? There will be meeting in a couple of weeks
    - Acceptance criteria have to be repeatable, inferred measurements not good enough. Need technologies that can stand up in court.

- Surface Characteristics (Track 4)
  - Four members have been added to the track committee: James Bryant from SHRP, PA, WA, CO for a total of 13 members
  - COMMENT: Surface characteristics may have some link to sustainability. Latest research statistics put out by NRMCA indicate less fuel is used with concrete; can it be linked to surface characteristics? Use this research as part of future meeting.

- Concrete Pavement Rehabilitation (Overlays)
  - See PowerPoint slides for research priorities and project elements
  - Tech brief on costs will be produced

- Sustainability (Track 13)
  - NRMCA/PCA research being done at MIT; Peter Taylor is on their technical advisory committee
  - Sustainability is a buzz word; we need to keep everyone talking to each other so that we can minimize duplication
  - A briefing document, Building Sustainable Pavements with Concrete has been produced. Doesn’t have all the answers, but identifies questions and areas that need to be discussed.
  - A Manual of Practice, about 200 pages of what we know now, is next.
  - Life Cycle analysis being done at MIT; report on it will be given at an August 31st meeting. Researchers are being invited to September’s conference.
  - COMMENT: Julie Garbini asked to be on the list for track leadership.

- Long Life Concrete Pavements
  - Although this has not been an active track, there is increased interest about STAs
  - Activities should be initiated under Task Order 4.

4. Business Systems & Economics Track (Track 11)
   - COMMENTS:
     - This should become a higher priority track; some initial work and guidance documents would be helpful.
     - We need to showcase how concrete can last longer and use that as selling point; it will still need to be cost effective
Our focus has been overlays; should we be stressing longer life pavements?
- What is “longer life”? CalTrans is looking at 100 year pavement; MnDOT is looking at 60 year design; we can make pavement that lasts longer than 50 years.
- Sustainability is emphasis; initial cost is becoming more competitive.
- What is traffic going to look like in 50 years? Easy to say concrete will last longer, but traffic today is not what we predicted 30 years ago when we built pavements to last 30 years.

- A Business Track overview was sent out last week
- COMMENTS
  - NCHRP 10-79 report gives cost incentive measures.
  - Suggestion to have a task force from this group to look at suggestions more clearly and get valuable insight from them.
  - NCHRP 10-79 goes beyond concrete paving. NCRP panel working on incentives and disincentives based on report. Need to look at how this is addressed for concrete paving.
  - Task force volunteers: Dave Lippert, Randy Riley, Jerry Voigt, Claude Bedard, Suneel Vanikar,

5. Meeting Adjourned

COMMENTS:
- Randy Riley: NCC talked about consolidated website for research completed and in progress. Tom Cackler’s response: The Center has looked into doing this extensively. There is no good way to do this without duplicating TRIS and RIP. Individual track leaders are trying to keep track of research within their track emphasis, but any large scale website for completed and in progress research would be very costly and difficult to maintain.

- Peter Kopac is retiring June 3, 2010. The CP Road Map’s new technical monitor will be Ahmad Ardani.
  Tom Cackler thanked Peter for his diligent efforts on behalf of the CP Road Map. His dedication and insights will be missed. We wish him well in his retirement—“may the winds always be at your back” on the next mountain climb!

6. Next Meeting: June 21, 2010
CP Road Map
Executive Committee Meeting
June 22, 2010
Meeting Minutes

Attendees:
Executive Board
  • David Lippert
  • Randy Riley
  • Jerry Voigt
  • Steve Kosmatka
  • Claude Bedard
  • Jim Duit
  • Kevin Merryman

CP Road Map Technical Representative
  • Ahmad Ardani

Pooled Fund State Representatives
  • Gary Frederick, New York DOT
  • Josh Freeman, Penn DOT
  • Lydia Peddicord, Penn DOT

Administrative Support Group, CP Tech Center
  Tom Cackler
  Dale Harrington
  Sabrina Shields-Cook
  Sharon Prochnow
  Denise Wagner
  Melissa Leopold

1. Introduction
   • In the process of moving next task order to Task Order 4. Wanted to get your feedback to make sure we are focusing on the right priorities.

2. CP Road Map Communication Plan
   • Contacted by Better Road in 2006 did an article on CP Road map and they want to do an update. Will be working to develop an updated article
   • Visited with Suncool and for the August e-news will focus on the Long Life Concrete pavement scan of 2006 and focus on the 6 priorities of STIP and connect them to the road map.
     • Two lift paving
     • Pavement design
     • Pavement foundations
     • Mix Design
     • Geotextile interlayer
     • Noise reducing concrete pavement
Penn DOT Research Visits

- Dale — through the efforts of Lydia and Josh we had a CP Road Map electronic meeting with PennDOT with regards to some of the research they are doing. The purpose is to talk with DOTs to obtain a better understanding of their research and issues and for the DOTs to get a better understanding of how the CP Road Map works.
- Helps us in how we can communicate and collaborate with other DOTs. Will take the information for the meeting and exchange information with other universities and answer some of the questions and look for answers of questions they had and get them some answers.
- We send out an invitation to states and invite them to participate in a conference call to share information.

Priorities for Map Briefs

- Ahmad — in a recent ACPT meeting the COMPASS was identified as an action plan. Is a plan developed to let states know how it works? Is there a training session developed? Tom: not aware of a training session. The last e-news there was a MAP Brief on COMPASS and one of the things we are trying to focus on is rapid implementation. We need to start thinking about how to move this forward. Ahmad — now that we have this technology we need to get it out to the materials and concrete engineers at DOTs and maybe the universities. TOM: Suneeel is coming to visit the Center and we can discuss further and how to work together to move this information forward.
- Dale — after putting together the priorities on the tracks. Some of the subject matters are too big for a 4 page document. We would like to break them down into manageable pieces for MAP briefs.
- Rick Sniegowski - ACPA — Track 10 & 6, looking more at the RCC method. Look at a way to advance equipment of the current concrete paving equipment to adapt to roller compacted concrete. Some type of hybrid to a conventional paver so the concrete contractor can work in both markets. Tom: some sort of MAP brief to focus on innovation and equipment.
- Dale — webinar on recycled concrete pavement does ACPA have anything coming out besides the manual. Jerry — have 6 tech summary sheets that have been completed. Every large publication is accompanied with 6 - 2 pages documents that describe elements of the bigger document. Robert can help get those to you.
- Ahmad — some of the topics from ACPT that would be included are performance specific cement, alternate bidding. Jerry — ACPA is doing a webinar on tie bars.
- Jim Duit — hope we are taking the opportunity to discuss the sustainability side of all the topics. Tom — yes we include sustainability. If you want any hard copies of any of the materials let us know and we will get them to you.

Outreach for Road Map

- The brochure that is attached shows the outreach efforts we are currently working on.

3. TOPR 4

- Peter Kopac has retired and Ahmad is heading it up. Want to make sure we are addressing the research and priorities in the next task order. Ahmad — did not have any comments at this point.
- Suggesting to Peter Kopac where should we put the resources for the next task order; would be about 9 to 12 months. Continue to engage executive committee and track members to get your input and ideas. Continue to update the CP Road Map as new ideas are developed.
- Dale — we will re-examine the tracks with the track leaders and focus on the priorities and have the Executive Committee review and comment. Jerry — if we are going to look at adding two new tracks that would bring us to 14 tracks. Don’t want to spread it out too thin. Dale — agree and one of the problems we are not getting to all the track priorities. We are saying we have 12 tracks with
7 as priorities; we want the committee to re-examine the tracks to see what the priorities are and were we should be placing our emphasis. Agreed it is a good idea to go forward and re-evaluate the tracks and consolidate as much as we can.

4. Business Systems & Economics Track
   - What are the barriers that we should be focusing on and what are the priority issues we should be dealing with in order to have concrete pavements be better utilized.
   - The economic issues are important and this is an important short range item.
   - With the incentives issues are we relating an incentive or disincentive to the performance and on the value gained.
   - Should be cautious for example on alternative pavement bidding this may be an area where we may be duplicating other efforts.
   - Jerry: How can you accelerate the delivery of a project – the traffic management aspect of project delivery is something we need to look at to get the most value for the money.
   - Alternative pavement bidding is an important item. Need to understand FHWA’s guidelines on how to bid equivalent design alternate. Provide some analysis and guidance on how to get equivalent designs.
   - NHI has a session on life cycle cost analysis and they will help states at no cost to develop an analysis.

5. Track Priorities (how to be effective at state, FHWA, RAC, TRB, ACPA, PCA, etc. levels)
   - May be a good task to identify what are the potential sites that take on projects and what are the criteria to get them considered.

6. Conclusion of Meeting
   - Jerry – part of the management part of the CP Road Map was the database development and haven’t really had the funding for this idea. Tom – originally thought we would have a comprehensive database that would relate to the CP Road Map. However this takes a lot of resource to make this happen. We have focused on the technical leadership of the tracks and they have a summary of their research projects. Dale – we are filling the gaps by track.
   - TRB has an extensive database on research.
   - The next MAP Brief will be on the durability of concrete pavement textures which will be out in about a week.

7. Next Meeting Date will be held in the fall around mid October 2010 after the week of October 15th and will be a physical meeting held in Chicago or Kansas City. The DOTs travel expenses to the Executive Committee meeting will be covered under the CP Road Map project and will be included in TOPR 4. Sharon will include in the minutes the cost comparison for traveling to either Chicago or Kansas City for the meeting.
The Mix Track Pooled Fund TAC meeting utilized an electronic PowerPoint presentation along with attachments for the meeting. Peter Taylor started the meeting by briefly reviewing pertinent Mix Track research work such as the Indiana’s permeability study, Michigan’s air void system and South Dakota’s joint distress research.

Peter briefly reviewed the Pooled Fund project statement for the Mix Track. The pooled fund tasks are subtracks to the CP Road Map track items. He discussed the tasks and the overall budget. To date seven states have signed up for the pooled fund and the goal is to have eleven states at $15,000.00 per year for a three year period.

One of the subtracks is testing. Peter stated the need for cost effective, fast and reliable tests that measure the properties we are really interested in, both for incoming materials and for the mixture itself. Some are quality control and some are quality assurance. The committee discussed how the tests tie directly to the need for good specifications to insure that the owner is given the highest probability of getting what they paid for while affording suppliers and contractors a reasonable opportunity to optimize their decisions and minimize their risks. To accomplish this Peter reviewed the following tests and the year it is planned to be accomplished.

1. Tests – to be completed within the next 2 years depending on funding.
   - Emphasis Mix Proportions in fresh concrete........................................................................................................ Year 1
     Portable XRF devices are reportedly available and may prove invaluable to verify the mix delivered to a site contains the correct material in the given proportions used in the verification testing. Literature review will be done first, then field tests to verify the lab results.

   - Set time................................................................................................................................. Year 1
     Calorimetry and/or acoustic methods – Monitoring the rise in temperature due to hydration of a fresh mixture provides a tool to assess the uniformity between material and concrete batches, as well as indicating setting times useful for saw-cutting operations. An alternative approach that may be more fundamentally sound is to use acoustic methods to determine when the speed of sound in a mixture starts to accelerate, thus indicating that hydration is affecting the microstructure of the system.

   - Rheology test (need 10 states to fund before starting)......................................................... Year 1
     There is a need to develop a simple field test for measuring how much a paving mixture will move when vibrated (viscosity) and whether it will be prone
4. Communications – Peter reviewed with the committee the importance of proper communication by staying abreast of innovations being developed under the pooled fund. The potential for problems are increasing and staff levels are being reduced. Thus, it is important that we emphasize training of states based off of the information learned from this pooled fund project. The following are the communication timeline approved by the committee.

- Communication
  - Field trials for
    - New tests
    - New models
    - New specifications
  - Training materials as needed

Year 2-3

5. Budget – Peter reviewed the following budget with the committee and they approved of his budget proposal.

a. Costs
   - Mix Proportions Test $50,000
   - Set time test $45,000
   - Rheology test $0
   - What air do we really need $35,000
   - Mix proportioning $100,000
   - Guide specification $75,000
   - Oversight $40,000
   Total $345,000

b. Income
   - From Pooled fund $110,000
   - From Cooperative agreement $235,000
   Total $345,000

c. Distribution of Funds
   - CPTech $218,000
   - Subcontractors
     - Trinity (Proptrns, Guide) $67,000
     - Fugro (Guide spec) $35,000
     - OK State (Air system) $25,000
   Total $345,000

Minutes by Dale Harrington
CP Road Map Mix Track Pooled Fund TAC
Electronic/Conference Call Meeting
June 3, 2009

Present:
Gina Ahlstrom, FHWA
Rod Montney, KS DOT
Brett Trautman, MO DOT
Mike Brinkman, NY DOT
Kenny Seward, OK DOT
Jim Parry, WI DOT

CP Tech Center:
Peter Taylor, CP Tech Center
Denise Wagner, CP Tech Center

Absent:
Todd Hanson, IA DOT
John Staton, MI DOT
Andy Naranjo, TX DOT

The Mix Track Pooled Fund TAC held a brief web/teleconference meeting on June 3, 2009, at 10 am Central. The purpose of the meeting was to inform the committee that we now have a three-year contract with the Iowa DOT, so work can begin on the pooled fund. The budgets have only been set for first two years. This pooled fund fits under the global CP Road Map Mix Track. Year one of the contract with the Iowa DOT is for $125,000. Participating states now include Iowa, Kansas, Michigan, Missouri, New York, Oklahoma, Texas, and Wisconsin.

The federal contract ($235,000 for year one) of the Mix Track pooled fund is now with Gina Ahlstrom and Gary Crawford at FHWA. They are reviewing it and should have comments back to the CP Tech Center within a few days.

Pooled Fund-Tasks

Several of the tasks agreed to in the previous TAC meeting include work by subcontractors. Subcontractors will be contracted under the FHWA portion of the project, therefore work that can begin immediately is that being conducted at the CP Tech Center. This includes:

- Tests
  - Mix proportions in fresh concrete-Portable XRF – Year 1 ($50,000)
    Reportedly a portable XRF is available on campus. Work will begin on using the device with known mixtures.
  - Set time – calorimetry and/or acoustic methods – Year 1 ($45,000)
    A paper on the topic was published recently by ACI – work will build on this and other literature.

- Models
  - Mix proportioning – Year 1 ($50,000 at CP Tech)

Our next formal TAC meeting will be at the October 6-8, 2009, TTCC/NCC meeting in St Louis.

Denise Wagner, CP Tech Center Secretary
Mix Track Minutes-Oct 6, 2009

1. Peter Taylor
Reviewed slide presentation (see slides)
- 8 state Polled funds
  - Contracts $125,000
  - FHWA $235,000 Pending
- CB401- Leif- Design and Proportioning is
to be completed by end of year.
- Tests, Model, specifications
  - See slide
- Portable Analysis Device
  - See Slides-Needs calibration
- Acoustic Setting device
  - See Slides- Not sure what do to with it.
  - Questions from audience
  - Rob has Pulse Velocity measuring of set time
- See Sharon
CP Road Map Design Track Leadership Meeting
January 6, 2010

Attendees: (9-10 scheduled to be on) Elfino, Petros, Gisi, Dawood, Donahue, LaTorella, Riley, Crawford, Correa, Uhlmeyer, Harrington, Garber, Rasmussen

Meeting began promptly at 2:00 CST and followed the Agenda previously disseminated via e-mail to all participants.

Highlights:
- This Committee will strive to meet at least twice a year.
- Subcommittees have been dissolved. Instead, the Committee will address the individual items and projects as a whole.
- Funding was granted for initial progress with the Key Area of Concentration: Concrete Overlays. Development of Design Guidelines is currently underway with work that is focused on identifying and evaluating current methodologies.
- Additional short-range research projects recommended include drainage issues, early joint deterioration, and composite pavements.

Action Items:
- The Operation Support Group (OSG) will further expand on the Development of Improved JPCP Deterioration Models before submitting this long-range research project to the Executive Committee.
- Harrington will contact the AASHTO Standing Committee on Research, JTCP, and SOM. The purpose will be to offer this Committee’s assistance with any research or implementation projects that focus on improving the PCC models in the MEPDG. This will include CRCP.
- Harrington will look into the work done by ARA and how well it complements work at MnROAD on tiebars.
- Petros will report back to this Committee on the progress of Kopac’s FHWA project with ARA on the integration of software tools.
- Elfino will send Harrington information on VA experience with drainage issues. He will also send the TRB paper that further details the history on 2- and 4-inch CRCP overlays in VA.
- Gisi will send Dawood more information after the next JTCP conference call scheduled for Feb 5, 2010.

AGENDA

Notes:
1. Action on Minutes of June 30, 2008 (previously sent to Track Leadership members)

Harrington asked for any comments/edits that needed to be made to the Minutes. No one had any. Riley moved to have the minutes accepted. Dawood seconded the motion.

2. New Member – Norbert Delatte, P.E. Ph.D., has accepted

Dawood explained Delatte is not 100% confirmed as a new member, but would be a good addition. Riley voiced “the more, the merrier.” Harrington mentioned membership should remain at or close to 15 members.
3. New CP Road Map Approach

The functions of the Operations Support Group (OSG) and the Track Leadership Team was discussed by Harrington and how they would function in the new framework.

4. Design Track Leadership Goals & Scope

Dawood discussed this item and mentioned that this committee last met one and a half years ago. It will be the goal from now on to meet more often, but at a minimum, every 6 months.

5. Key Areas of Concentration & Current Subcommittee Members

A. Concrete Overlays.

Harrington explained the progress made to date on this item. The project was supported by this committee and the CP Road Map Executive Committee. As a result funding was made available by appropriated FHWA funds for the development and implementation of a guide for overlay design. Harrington commented that as part of this project, tasks specifically outlined in the contract with FHWA require 4 to 5 common overlay design methodologies along with software be identified. From those, 1 or 2 methods are to be presented through detailed design examples.

Rasmussen continued the discussion of this project. He mentioned how it is a great first step and identified the purpose and scope. The Guidelines will provide appropriate guidance based on current available methodologies while stressing sensitive parameters and exemplifying targeted examples for common situations.

Donahue asked what methodologies have been identified and targeted.

Harrington replied that the committee for this project is just getting started on researching and evaluating the existing methodologies. Not enough progress has been made to address the question completely.

Donahue also mentioned the work currently underway by a pooled fund study led by Julie Vaudenbosche.

Harrington said he was on the committee for that project, and that Julie was playing an active role as part of the ETG for this project, but that she could not join this conference call. Harrington asked Donahue to join the Overlay Design Committee and he would send him information pertaining to the committee.

Crawford said he thought the approach was good.

B. ME Design Guide.

Dawood led discussions on this item. He opened with first discussing the purpose of this item as being an opportunity to identify any shortcomings and discuss how to address them. Dawood continued by saying many data inputs are questionable such as concrete CTE. Dawood also said the purpose of this committee is to identify what projects are needed for updating the MEPDG Guide and software.
Petros identified a currently active NCHRP project investigating the sensitivity of concrete inputs. According to Petros, this project had been on hold until a stable version of the software for concrete analysis was available. The report should be made available soon.

Dawood introduced his concern with information being used to calibrate the MEPDG. Specifically, what checks and balances are in place to ensure that there has been a thorough review of any models that may be applied to the MEPDG software.

Petros answered by saying there is Technical ETG oversight.

Riley asked about AASHTO projects.

Dawood said NCHRP projects have panels picked by TRB.

Riley voiced concern about projects designed with MEPDG in situations where a familiarity with how to use MEPDG correctly may not exist. He continued by saying it would be ideal to get in on the ground level of projects and manage projects from the get go. He said it would be good to be there.

Harrington asked, “Who drives the bus?”

Dawood replied that the AASHTO Joint Technical Committee on Pavements (JTCP) under the Subcommittee on Design is ultimately in charge. However, there are many ongoing and research projects and other ongoing efforts through the FHWA and State Highway Agencies which may not all be considered by the JTCP. It was unclear to Gisi if all these efforts were reviewed by the JTCP before being implemented into the Guide.

Riley commented on the many NCHRP research projects focused on upgrading the MEPDG’s HMA models and the single one for concrete.

Dawood responded by saying there are many elements missing when it comes to the HMA models. It was assumed that the PCC part was stable.

Gisi, who is on the JTCP, voiced his concern of how so much money is being spent for the development of models that are not going to be in the Guide. Gisi asked, “How do we make an impact on AASHTO to get out a usable product?”

Donahue said he was not on the committee, but that he had representation through Bledsoe and Nichols, and therefore, had some influence.

Dawood suggested contacting the AASHTO Sub-Committee on Design which the JTCP is under. However, he added that all final decisions on the selection of research statements are made by the Standing Committee on Research.

Dawood suggested also contacting the AASHTO JTCP and Subcommittee on Materials.

Petros wanted to know who decides on what gets upgraded since ARA developed the software.

Crawford responded by telling the group that the task force decides what gets upgraded. Their decisions are based on solicitations made by the states.
C. Performance Data.

Dawood led the discussion of this item. He started by asking: “how do we pull this together?”

Donahue, the chairman, suggested having the states pick their own sections and track performance. The LTPP sites just do not provide enough information.

Dawood commented on how there is a lot of data currently out there and that there will be even more as time goes on and calibration efforts continue. Again he asked the group their thoughts on how to pull all of this information together. He suggested working with FHWA Regional offices to see what was going on by region.

Correa suggested asking DOT pavement management divisions for information. They collect basic information on a regular basis.

D. CRCP Design.

Harrington led the discussion of this item. He asked the group whether this topic should still be maintained as an area of concentration. He said this topic was really more of type of pavement and not a guide or technique.

Riley mentioned that there seems to be a renewed interest in this topic. He said that CRCP has a “niche in high-volume expressway” design.

Gisi asked about the model that had been developed for the MEPDG. He asked about alternatives now that the model was not going to be part of the MEPDG after all. He was concerned about any new design methodologies and rehabilitation strategies.

Petros replied by saying TX was developing the model, but that it was not being considered for the Darwin software.

Crawford said that it was up to the task force as to what goes into the software.

Dawood said that nothing gets changed in the software without the approval of the JTCP. The JTCP manages the content, but are not the guardians of it.

Elfino expressed that he considered CRCP design a vital component in designing composite pavement sections.

Harrington asked if the group would agree to have him approach the task force and offer assistance with any joint research projects. The group agreed.

E. FHWA Software Integration.

Discussion of this item was led by Dawood.

Crawford and Petros both suggested contacting Peter Kopac at FHWA. Kopac and ARA are currently in the progress of scoping out a project for this item. Petros agreed to report back to the group any progress.
F. Non-Traditional Design Elements Subgroup

Discussion of this item was deferred because LaTorella was no longer on the call and Roesler was not available for the call today.

6. Prioritization (see page 5-7)

Harrington led the discussion beginning with short-range projects. See pages 6-8 for notes of the discussions on the individual projects under this item.

7. Next Steps

Dawood stressed how everyone on this committee needs to be on the same page.

Harrington reiterated the approval for contacting the various AASHTO committees.

The next meeting was tentatively set for mid to late April.

Gisi said that the next JTCP meeting will be a conference call scheduled for Feb. 5, 2010. He agreed give Dawood more information.

Harrington asked the group if they felt there was still a need for subcommittees.

It was agreed by everyone that it would be better to eliminate the subcommittees and approach all items and projects as one whole team. It was realized that there is too much work for individual subcommittees with only 1 or 2 members to handle.
SHORT-RANGE RESEARCH PRIORITIZATION PROJECTS

1.) Guide for Concrete Overlay Design Methodology

Status: Research has started

2.) Concrete Tie Bars

Due to funding issues, Mn/ROAD had to cut back on research, but it is expected that Mn/ROAD will report on this project.

Donahue mentioned that he thought there had been work done by ARA on a similar topic.

Riley concurred and said that ARA just completed a tiebar design methodology, but that he was not sure how well it had been calibrated to the results at Mn/ROAD.

Harrington stated the OSG would look into it.

3.) New Cross Sections

Harrington mentioned trapezoidal sections as an example.

Riley said that these trapezoidal sections have been around for forever, but that there is a potential need for this topic. He suggested initially picking 1 or 2 cross sections as a means of prioritizing.

Donahue mentioned parabolic sections have been done in the past, as well.

Uhlmeyer said that he thought this topic was important because it may be a way for reducing costs.

4.) Anything Else?

Harrington asked the group if there were any other projects that needed to be considered, or if there were any additional comments at all.

Riley mentioned the need to explore the “marriage to drainage.”

Elfino agreed. He commented how proper drainage is never appreciated until there is a failure because of poor drainage. He reported to the group that there is a white paper on this (NCHRP 1-34Z). He agreed to send Harrington a copy and more information on what is “lacking” with regard to this topic. As a quick response, Elfino identified 2 things: the role of geometric design, and edge/drainage layer design.
Harrington suggested that if we have the answers to the problems Elfino mentioned, then maybe a document should be created that identifies these issues and shows recommended cross sections as solutions.

The group agreed. Uhlmeyer suggested also identifying typical locations for these problem areas.

It was realized by the group that this may become more of a long-term project.

Petros suggested a project that looks at early joint deterioration

Harrington asked if changes to joint design should be considered.

Donahue suggested expanding the topic to include sawcuts and sealing.

Elfino suggested composite pavements.

Elfino also suggested looking at steel content in CRCP design and crack sizes.

Harrington suggested contacting Bob Risser or Ted Ferragut on this matter.
SUGGESTED LONGER RANGE RESEARCH PRIORIZATION PROJECTS

1) Develop an Integrated Concrete Materials Modeling and Design/analysis Tool
Rasmussen gave a review of the subject.

Gisi said that this topic was important to him and mentioned the Kansas experience with air voids as an example.

Harrington brought to light the fact that there is not enough DOT staff to collect the data needed.

The group agreed this was still a good project and should remain a priority.

2) Development of Improved JPCP Deterioration Models
Dawood led this discussion by saying there are still unknowns. He said that current models do not detect what is going on and that research is needed.

Harrington asked the group if anyone had any thoughts.

Donahue agreed this topic was a good idea, particularly since there was similar research going on for HMA.

Riley agreed and Petros mentioned the need for research on load transfer efficiencies.

Correa said that what is really needed is more information. He wanted to know what specific advantages there would be to upgrading current models.

Harrington agreed that this topic needed to be expanded on and better explained before presenting it to the Executive Committee.

3) Develop a New Concrete Overlay Design Procedure
Rasmussen opened discussions on this topic with saying that a reliable design procedure that accounts for the mechanics of pavement is needed.

Riley said it is his number one priority.

Donahue said that state funds may make this more possible.

Petros said, "Rehab is where it's at."

Elfino agreed, but said he wanted to see CRCP bonded overlays in the picture.

Harrington asked if there was a CRCP overlay project in TX, and Rasmussen confirmed. Rasmussen also said that the design procedure was more "shooting from the hip style" and a more mechanistic approach is needed.
Elfino commented on how there is at least 17 years of data on 2-inch and 4-inch CRCP overlays in VA. He agreed to send Harrington a TRB paper with more information.

The committee agreed to the priorities for short term and long term with drainage design moved to long term and to develop a new Concrete Overlay Design procedure as the number one long range priority.
Concrete Pavement Road Map
Surface Characteristics (SC) Track

Task Force Meeting #2
Meeting Minutes (rev 2010-02-03)

10 February 2010 (Wednesday)
2:00 pm to 4:00 pm CST
Via Conference Call

Attendees
FHWA/USDOT
   • Mark Swanlund, Office of Pavement Technology
   • Bob Orthmeyer, Pavement and Materials TST
State DOT/TRB
   • Brian Schleppi, Ohio DOT
   • James Bryant, TRB-SHRP2
Pavement Industry
   • Larry Scofield, ACPA-IGGA
   • John Roberts, IGGA
   • Ron Guntert, Guntert & Zimmerman
Academia and Other Industry
   • Steven Karamihes, University of Michigan Trans. Res. Inst.
   • Kevin McGhee, VTRC
National CP Tech Center
   • Paul Wiegand, National CP Tech Center
Operating Support Staff
   • Dale Harrington, Snyder & Associates
   • Rob Rasmussen, The Transtec Group, Inc.
   • Gary Fick, Trinity Materials

Meeting Objectives
- To review the existing SC Track Framework
- To validate the gaps identified in the SC Track.
- To update the list of recent and ongoing work.
- To update the list of early projects and to identify potential funding mechanisms.
- To help advance the CP Road Map SC Track to a dynamically managed program.

Agenda
1. Brief Review of the CP Road Map (Harrington)
   Dale Harrington explained the goals for today’s conference call were to review the existing framework for the SC Track, validate the gaps that are identified, updates, update list of early projects, and funding mechanism and moving the track forward. We are the operational support group for FHWA CP Road Map and work off of identifiable tasks listed below:
• Support the Ex Committee;
• Support the research track teams; working with the track leadership, moving track forward. Want to have meetings with states that shown interested; web based teleconferencing, had one with Wisconsin and trying to setup one with Missouri;
• Communication Task – developing a communication plan; a way to bring the Road Map to people via web based notices, i.e., newsletter, web notice, engineering journals, etc. on what the Road Map is about;

2. Review of Current SC Track Framework (Rasmussen)
Coordinate and facilitate the various work and activities related to concrete pavement surface characteristics. Framework document is located at:

Rob Rasmussen discussed the track goal and stated this is what is driving the industry to make society better in a unique way. Rob asked the committee if they had any new thoughts for the goal for the track. The committee did not have any changes to the current goal.

Rob stated that the pyramid on page two is still a good example of an integrated perspective of pavement surface characteristics. It shows how the elements are linked together. Idea for framework is to use it as a guide for ongoing and future work to meet the goals and steer the work so it doesn’t overload any one relationship but look at them all and collectively address the gaps.

The framework goes through each link and explains what they are and what is missing and what needs to be done to define the technology transfer. The goals and gaps are outlined in the framework. Rob asked if there is anything that has changed within the last 1 – 2 years that we should look at that is not listed in the framework.

Ron Guntert stated how to integrate the factors and the impacts they have on surface texture. We talk about design, materials and construction but how do we emphasis the importance of what is necessary to get good texture, durable pavement, low noise, smoothness. How do we weave it into the factors? May need an intermediate layer in the pyramid. May need to address a performance specification.

Steven Karamihas – reconfigure the pyramid – (did not get all of this). Pavement Surface Characteristics changed to Functional performance. Need to understand the functional performance.

Mark Swanlund – agrees with what Steve Karamihas suggested.

Rob Rasmussen – need to redefine to a functional performance indicator.

Gary (not sure this is the correct person) – make sure there is a tool to use / specify for the functional performance. Something measureable in terms of an outcome that we can specify. Need to re-label the tiers of the pyramid.
CP Road Map Surface Characteristics Track

John Roberts – the group will be defined on what we produce and not necessarily by the framework document.

Larry Scofield – agreed to get moving on what we can do and not worry about changing the pyramid.

Brian Schleppi – the pyramid is not very fluid, things do change.

Rob stated in summary – There is value in approaching it strategically with a redefinition of the levels. May need new updated terminology. More emphasis on the links and how they drive specifications.

3. 5-Minute Updates on Ongoing Research Programs (various representatives)

- FHWA
  Mark Swanlund – balloting for the student specifications getting adopted as full standards. RFP currently out on friction management. Ongoing project at Virginia Tech on splash and spray. Unified model project – Texture noise model. 2010 projects – rolling resistance (looking at European project).

  Bob Orthmeyer – FALCON process does have the pool fund study (21 states) improving the quality of ride measurement. Established a benchmark devise and developing reference devices. Looking in MnRoads for measurement. Several testers to lease out in the equipment loan program. New tools – software Proval 3.0 new version located at roadprofile.com

- ACPA/IGGA
  Larry Scofield – 2010 keep trying to promote next generation test section. Acoustic longevity and Frictional properties.

  John Roberts – would like to take advantage of the equipment loan program to help with their initiatives. May need to buy a friction trailer for testing. Hard to work with the states to get the information.

- SHRP2
  Overseeing the Evaluation of real time solutions and measurements. Overseeing the Composite pavement – two lift pavements.

- Pooled Fund
  Kevin McGhee – Virginia is intertwined with the FHWA programs.

  Brian Schleppi – tire pavement noise pool fund. Can we come up with data to use a pavement type or surface pavement as a mitigation tool for noise reduction.

  Mark Swanland – looking at 3D texture using stereo vision approach.

Task Force Meeting #2 Meeting Minutes
Others
Paul Wiegand – pool fund with the CP Tech Center. We are in the final year of a 5 year program following up with type I and type II sites, acoustic durability on long term pavements. Primary activities is to get the data reduction analysis completed. Program to educate about tire pavement noise, what it means, how it is defined. Better understanding of practices and training on what pavements we are putting down and the noise factor.

Larry Scofield – NCHRP 1076 – pavement as noise mitigation, look at the policy of using walls and pavement.

4. Review and Update List of SC Work (Rasmussen)
   ♦ Foundational – has occurred already but is so significant we want to apply to the program.
   ♦ Recently completed within the last couple of years. NCHRP 1067 texturing of concrete pavements has been published. Larry S – a lot of data that is published. Other projects – if the team has additional projects they will send them to Dale or Rob.

5. Review and Update List of Short-Term Projects and Products (Rasmussen)
   We identified a small number of short term projects. Many of the projects have gone forward in various ways and are being done. Should these projects remain as short term projects:

Development of an Integrated Functional – should remain

Refinement of Models to relate Pavement Texture – work underway – should remain as a short term project.

Characterizing Design and Construction Artifacts in Concrete Pavement Surfaces – need to develop a texture devise and then do the modeling – should remain as a short term project.

Training for Improved Surface Characteristics – should remain as a short term project. Noise 101 workshops sponsored by FHWA are complete. New contracts should be in place in April or May 2010 and then they will reassess the training efforts.

Improved Concrete Pavement Texture Evaluation – how to measure texture – take the lessons learned under the pool fund and look at a benchmark profiler – should remain as a short term project.

Dale Harrington asked what items need to be addressed on training and technology. John Roberts – Need innovation in developing new and better processes for better, quieter, smoother pavements. Ron Guntert – involved in Australian project looked at all the things that adversely affected smoothness and noise. Dale asked how to move towards new innovation. John Roberts – need a way to motivate the states to try different methods. Not sure what the answer is to move towards new innovation.
6. SC Track Communications, Coordination, and Collaboration (Harrington)
   Where do we need to go from here to move forward?
   Larry Scofield – Curing is an issue, can be done a lot better.
   Kevin McGhee – need to improve uniformity and better functional performance
   requirements.
   Steve Karamihes – Curing, measurement systems and motivation for innovation.
   James Bryant – communication and implementation and educating the contractor.
   Ron Guntert – uniformity
   Mark Swanlund – texture measurement parameters

   Dale Harrington asked the committee if they agreed to modify the framing document to
   move forward with these comments.

   Bob Orthmeyer – all good ideas, nothing to add.

   Paul Wiegand stated the discussion was good today and focus on what will make a
   difference. Get the elements under a control situation so we can measure and deal with
   them in the field. Need to get the group together more often for discussion.

   Rob Rasmussen stated we received a lot of feedback that is critical. Overall process has
   worked and we will continue to find forward movement in the industry. We know what
   the needs are and we will make the adjustments that have been suggested today.

   Rob stated the next steps we will adjust the framing document and send to the
   committee for review. We will continue to meet as a group periodically for discussion
   and updating. If you have any issues that need to be identified send it to Dale and/or
   Rob.

Contacts
Admin Contact: Dale Harrington, 515-290-4014, charrington@snyder-associates.com
Technical Contact: Robert Rasmussen, 512-451-6233, robotto@thetranstegroup.com
SURFACE CHARACTERISTICS
CONFERENCE CALL
Wednesday, June 2, 2010
11:00 AM Central
Meeting Minutes

Attendees: Barry Paye (Wisconsin), Bernard Izevbekhai (Minnesota), Bill McColl (New York), Lisa Lukefahr (Texas), Peter Dirrim (California), Scott Eilken (Quality Saw and Seal, Inc.), John Roberts (IGGA), Kevin Merryman (Iowa), Mark Russell (Washington DOT), Rob Rasmussen and Rick Sohaney (The Transtec Group), Paul Wiegand, Dale Harrington, Melissa Leopold (taking minutes) (National CP Tech Center),

Paul Wiegand welcomed the committee and asked for their input and suggestions during the conference call.

Changes in the Project Team

- Paul updated the committee on the current project team. Paul stated that Ted Ferragut requested to step aside in November 2009 due to family issues therefore his contract was dropped. Rob Rasmussen and Dan Rozycki with Transtec took over Ted's responsibilities. Paul stated that Dale Harrington is part of the subconsultants and Gary Fick with Trinity will also work with the team with the model specifications and construction activities. Paul stated that January 28, 2011 is the end of the contract period for the project.

Work Plan for remaining Term

- Paul stated there were no real changes in the work plan however it was updated on what has been done and more emphasis and detail was added on what we want to accomplish.

- Paul went over the Overview and stated the technology transfer elements that are proposed are very important in implementing the study. It has taken five years to get to this point in the process. He stated we have looked at textures and collected a lot of data. Paul explained we will then turn the information it into specifications and methods that can be used.

- John Roberts asked if the testing will continue to take place and how long will we look at the sites that have been constructed. Paul stated one more round of testing will be conducted on Type 1 & 2 sites that have been used for the data processing. Early summer will be the last round of testing.

- John asked if there has been any discussion to do additional testing on the sites for long term analysis, beyond the end of Part 3. Paul stated it has not been discussed.

- Dale mentioned appropriation funding will be ending and everyone is looking for a new bill for funding.
Review of Data Collection/Reduction Activities

- Paul asked Rob Rasmussen to discuss the work underway and planned.

- Rob introduced Rich Sohaney who has joined The Transtec Group and stated he will work on the project with Rob.

- Rob stated the research team is currently testing in Kansas and Iowa and picking up sites in Missouri and Kentucky. Rob thanked John Roberts and the IGGA for helping them locate test sites. Rob stated they will conduct repeat visits in Kansas and Iowa for information on acoustical durability data. Rob mentioned the team will also go to Minnesota again for site visits at Mn/ROAD.

- Bernard Izevbekhai explained the project currently going on in Minnesota on innovative textures. He stated there are four subjects to view and they are conducting the initial testing.

- Rob added that the research team has also looked at the pervious texture and the diamond ground textures in Minnesota.

- Rob explained the model specifications and stated they are looking at two different approaches to the specifications (performance & method). He stated we are able to refine current texturing techniques to obtain quieter pavements. The specification will describe the texture and construction techniques.

- Rob added that the team will work with contractors this fall to help define techniques.

- Bill McColl asked with the measurement procedures are they compatible with the AASHTO TP 76 procedures? Rob stated they are in full compliance with the AASHTO procedures. Paul added we are creating specifications that will be in accordance with the national standards.

- Rob asked the committee to let him know if they know of additional sites that they can review.

- John suggested looking at Iowa U.S. 30 which has a section of diamond grinding. John will look into this project this month when he is in Iowa and let Rob know what he finds out.

- Peter Dirrim stated that District 11 in California has a project with several miles of grinding. The project award date was early last month. Peter stated it should be going out for construction in a month or two. He will give Rob the details of the project.

- Mark Russell stated there is a test section on grinding in Washington State that will be built this summer. He will send the information to Rob.

- Paul stated the final report will include a summary of all the data collection and data analysis and processes. All of the data will be available for anyone who wants to use it. Model specifications, construction elements, elements of texture will be developed.
following the report. The committee will receive the draft report for review and commenting.

Technology Transfer Activities

- Dale stated it is time to establish some excitement about the documents and their use. He stated tech briefs will be developed on how to reduce tire pavement noise and selecting the right texture for the right solution. Dale stated that advanced texture model specification will be out this fall. Dale asked the group for their input on what they feel should be covered in technology transfer.

- Paul stated that the contract with the Pooled Fund states calls for workshops and training in states as part of the funding they provided. He stated they need to schedule the training for this fall. He asked the committee how they felt we should present the information to their states.

- Bill McColl stated the lack of being able to travel has almost destroyed training. He mentioned we should do more web conferencing due to travel funding cutbacks. He stated they can do some travel in New York state but it is difficult. Bill stated they could hold a workshop in a main office location and web conference from there to other offices in the state.

- Bernard Izevbekhai suggested doing the same as Noise 101 presentation. He stated they can travel in Minnesota however it is almost impossible for out of state travel. He liked the idea of inviting people to a central location for the workshop.

- Lisa Lukefahr stated they can do some travel in state (Texas) but cannot be gone for a significant period of time. She wasn’t sure how many of the field people should attend. She felt the information may be more for the plan development and key contractor representatives. She felt a central location workshop would work well in Texas.

- Paul explained that it would be beneficial for field representatives to attend so they can learn how the different techniques work in creating the pavements.

- Rob Rasmussen stated he felt a half day at the workshop should be designated for a Noise 101 refresher and then they could go into the current new information.

- Paul stated we will talk to the committee more as the process goes along to get their input on training ideas.

- Dale asked the committee if they felt we should develop three separate tech briefs on each of the three major documents or combine them into one document. He stated they would be longer than one or two pages. Paul felt it would probably be a combination of the tech briefs and technical bulletin or summary.

- Kevin Merryman asked Dale if they would be developing web based training. Dale felt it would be a good idea due to travel restrictions.
• Dale asked the committee to email Paul on any ideas they may have on technology transfer and any thoughts on how to provide this information.

**CP Road Map Track #4, Surface Characteristics Update**

• Paul talked about the CP Road Map activities and stated there is a lot of information on the CP Road Map website. He stated the website has the framing document, the leadership team, etc. Paul stated the last track meeting provided a lot of good information. The track is working together to provide what elements of research is needed. Rob Rasmussen stated the framework document along with the last meeting minutes should be out in the next couple of weeks and will be posted on the website.

**Activities in Pooled Fund States**

• It was mentioned that the current diamond ground section on Iowa U.S. 30 is more of a bump grind. It was suggested creating a new test section on the end of this section and John Roberts agreed this is what IGGA could do.

• Bernard Izvebekhai stated there is a draft report on a Minnesota study that he will see if he can share with the group.

• John Roberts stated on industry activities that the conventional and innovative grind in Minnesota is the most interesting project going on currently. John stated they are looking for an opportunity for a pervious pavement to grind in terms of noise.

• Dale asked if there was any news from the IGGA annual meeting on surface characteristics. John Roberts stated they will be working with FHWA on the equipment loan program for fiction testing. It will begin this month using the Griptester.

• Paul Wiegnad suggested September 8, 2010 at 11:00 AM Central for the next conference call. The committee didn’t know of any conflicts on this date so it was agreed to hold the call at that time.

The meeting adjourned at noon Central time.
SURFACE CHARACTERISTICS
CONFERENCE CALL
Wednesday, September 8, 2010
11:00 AM Central
Meeting Minutes

ATTENDEES:

State DOT/TRB
- Barry Paye, Wisconsin DOT
- Chris Brakke, Iowa DOT
- Hua Chen, Texas DOT

Pavement Industry
- Larry Scofield, ACPA-IGGA
- John Roberts, IGGA

Academia and Other Industry
- Scott Elkem, Quality Saw and Seal

National CP Tech Center
- Paul Wiegand, National CP Tech Center

Operating Support Staff
- Dale Harrington, Snyder & Associates
- Rob Rasmussen, The Transtec Group, Inc.

1. Work Plan for remaining term (Paul)
   - The field data collection activities are done with the exception of a couple of locations. The Iowa section will be visited in October 2010. Will be moving into what the data has told us and develop into tech transfer and a final report.

2. Review of data collection/reduction activities. (Rob)
   - Revisited four sites – two out of Kansas – diamond ground and a two lift section. Iowa – type 1 section; Minnesota section revisited.

   - Partnered with IGGA to test a diamond ground section in Iowa. John asked if we could add a diamond ground section and next generation to the type 1 site. Worked with IDOT and were able to add it in the next pavement section that was constructed 2 years earlier. IGGA made arrangements to do the work. It was done the mid part of August 2010. It was 200 meter sections for 3 different types. Traditional diamond grind on all sections; one section a finer grind and grooved for the next generation; another section just grooved with the standard grind at the texture base. These sections will be included in the October 2010 testing.

   - John Roberts stated that the third section that was added will be a good test to evaluate and appreciated all the efforts for everyone involved. Paul stated he will include some photos of the test sections with the minutes.
• Rob stated there are 21 pavement textures that have done for testing under the surface characteristics project.

• John asked if this group could petition for funds to continue to test these textures. Paul stated they have not had a discussion with FHWA on continuing the testing however they will look into discussing this with them. John stated IGG is meeting with Mark Swanlund in September and he will discuss it with him at that time.

Papers and Presentations
• Rob stated the papers and presentations are important for this study. Following are the opportunities that are coming up to present at:
  o National Concrete Consortium September 2010
  o Sustainability Conference in Sacramento September 2010
  o International Concrete Roads Symposium in Spain October 2010
  o Pavement Evaluation Symposium (RPUG) Virginia
  o ACPA Annual meeting – have not received a formal invite to present at the meeting if they would like us to present we are available. Rob will be at the meeting for another project. John Roberts will be on a call with ACPA today and will ask if they want a presentation on surface characteristics.
  o TexDOT and the Cement Council of Texas annual workshop in December 8, 2010

3. Technology Transfer Activities (Dale/Rob)

• Proposed Technology Transfer Work Plan for fall/winter 2010/2011 which includes Publications, Workshop/Webinars, Websites and Presentations

A. Publications

   • This is currently an “Interim” guide, but is being updated now.
   • Draft complete 9/30/10.

2. Advanced Texture Model Specifications
   • Both Means/Methods and Performance specification variants being developed.
   • Performance draft complete 9/15/10; Means/Methods on 10/15/10.

3. Selecting the Right Texture for the Right Situation
   • Will be very progressive and actually dovetail into the next set of work under SC Track.
   • Will link into work ongoing under FHWA PSC Task Order on developing a Functional Performance Indicator.
   • FHWA report pending review; deliverable date for this component TBD based on that timeline.
4. Tech Briefs
   • Fundamentals of Quieter Concrete Pavements – drawn from primer to current How To Guidelines – under development – draft complete, sent for review on 8/12/10.
   • Variability of Pavements and Noise – draft development pending data analysis – expected 9/30/10.
   • Tire-Pavement Noise Test Protocols – 10/10
   • The Next Generation of Texture Specification – to be developed after specs complete – 11/10

5. Final Report – compendium of all project info

B. Seven State Training Program
   • Upper Management Presentation – everyone felt this was a good idea
     Submit to each state a 20 to 30 minute executive summary presentation explaining the study, results, and how changes can be made to improve tire-pavement noise that do not compromise safety or cost.

   • Workshops
     Make available to those states that desire a face to face workshop.
     1. Meet in one location in the State.
     2. Central location can broadcast to other districts or regions in the state that cannot travel via internal DOT system.
     3. Workshop Agenda
        • Fundamentals of noise and texture (101)
        • How-to Guide
        • Construction Specs
        • Selecting the Right Texture
     4. Nominally, a one-day program (4.5-6 hours of instruction).
     5. Tailored to each sponsor (State).
     6. Handout material will be provided to participants electronically.
     7. One or two instructors.

   • Webinars
     Make available to those states who desire a webinar due to travel restrictions.
     a. Develop three 90-minute webinars for the states covering the same material as in the workshops.
     b. Webinars will be spaced 3 weeks to one month apart.
     c. One instructor per webinar.
     d. Webinars will be conducted Dec 2010 to January 31, 2010.
     e. Handout material will be distributed to States prior to the webinar.
     f. Develop and conduct a 30-minute web meeting for upper management on the study and results.
C. Website
- Enhance SurfaceCharateristics.com web site for additional information sharing. The Team will be working with CP Tech Center IT specialists to assure that all pertinent documents are posted on their website. Some information is contained on this website, other on FHWA’s Website, and some on the CP Road Map Website (SC Track).
- Continue to post to the SC Blog with current information

D. Upcoming 30 minute Presentations at National Conferences and Symposia
1. September 2010: NCC meeting in California
2. September 2010: Sustainability Concrete Pavements Conference in California
3. October 2010: International Concrete Roads Symposium
5. December 2010: ACPA Annual Meeting (pending confirmation)

Barry – Wisconsin asked how it is best to get the information out. The sooner they get the report the better to see how it compares to their policies and procedures.

Paul – The webinar has the opportunity to involve a broad scope of attendees.

John – asked if they could do a live webinar to get real time feedback and incorporate the questions and answer into the webinar. Barry suggested using the “go to meeting” for a webinar to get the questions and answers for real time.

Paul stated they could do a video conference. They want to provide as much flexibility to the participants as possible.

Everyone agreed with the above approaches.

Paul, Dale and Rob will meet to expand on how to proceed and put some information together and send to the states. May post them on the website and send the links to states.

4. Discussion Items
- Activities in pooled fund states
- Industry activities (ACPA; IGGA)

John Roberts stated that IGGA is working with University of Texas at Austin looking at friction and longevity of the various textures on concrete pavement. IGGA developed a unit that has been shipped to them to provide grooving on their concrete test sections in the lab. They are going to include it with their testing. Comparing manufactured sand to natural sand is one of the tests that are being done.
John stated IGGA is conducting an open house on the next concrete pavement surface with MNDOT near September 22, 2010 at 10:00a.m. – 3:00p.m. Start with classroom session and then go out to the site after a sponsored lunch. Anyone interested in surface characteristic is welcome to attend. There is a $20 fee. Contact John if you want to attend. It is a full scale project – fully implement next generation surface. John will send the flyer to Paul and Paul will send it to everyone.

5. Next conference call will be held December 8, 2010 at 11:00 AM Central Time

- We may have an interim call if there are questions on the tech briefs which will be sent out electronically as they are developed.
Overlay Committee Conference Call
Meeting Minutes
December 30, 2008

Attendees: Shannon Sweitzer, Tom Burnham, Gary Fick, Leif Wathne, Rob Rasmussen, Randy Riley, Suneel Vaniker, Gina Ahlstrom, Dan DeGraaf, Gordon Smith, Paul Wiegand, Dan Dawood, Jim Grove, Dale Harrington

1. Overlay Field Application Update

Dale Harrington discussed the overlay Field Application Program status and the chart of states interested in the program and those who have joined the program. Dale stated the teams are traveling to the interested states and give an overlay workshop with the CPTP team. Normally the day after or before the workshop we try to hold the field review in that state. Delaware, Louisiana, South Dakota, Maryland and West Virginia have had the CPTP overlay program presented. California and Texas have contacted Dale on moving forward with the program. Dale will be traveling to New Mexico on another program and while he is there he plans to have lunch with the New Mexico DOT representative to see about scheduling a field review sometime in the next few months. The team has been contacted by North Dakota about giving them general information on their overlay project. It is a county project and it is not eligible for the federal funding however the expert team has assisted them with some general comments on their design plans.

2. Minnesota DOT Bonded Overlay Pool Fund Study

Dale introduced Tom Burnham as a new member to the Concrete Overlay Committee. Tom discussed the pool fund research and stated that after a couple of years Minnesota has funded Pool Fund #165. The focus of pool fund 165 is on bonded concrete overlays on existing asphalt pavement. The research will address both thin and ultra thin applications. Tom stated they held the first TAP meeting in December via a web meeting so that all the individuals around the country could participate. Tom told the committee members if they are interested in the meeting notes from the TAP meeting they could contact him via email and he will send them the meeting notes which include the project information. The project will consider the bond and will also look at understanding the bond between the layers if possible. The project will also look at use of fibers and the benefit of using fibers mostly in the ultra thin application. Tom stated these topics were discussed at the TAP meeting and they could have implementation projects following the design phase of this project. Texas, Mississippi Pennsylvania, New York, Missouri and Minnesota are involved in the pool fund project and that Minnesota is taking the lead on the project. Jim Sherwood is the federal liaison for the project. Tom advised the committee they should address their questions to Julie Vandenbossche as she is the lead for the TAP committee and she will be able to answer any questions they may have on what will be used on the project. Tom stated that Julie has sent out a survey to states to obtain general information on projects and experiences with overlays so she can use it on the development methods of the project. Tom asked the overlay committee members to please contact Julie or Tom if they were interested in participating in the survey as their input would be very helpful to the pool fund project. Dale stated that ACPA is currently developing a history on overlays. Leif Wathne explained there is currently an overlay database that is up and running. The intent of the database is to have it populated by the ACPA chapter state promoters. Leif stated that some
states are fully populated and Robert Rodden is taking the lead on the database program. This is
an ongoing process and he would encourage Julie to take advantage of the database information.
It is probably the largest source of overlays currently available. Leif advised Tom to let him
know if he would like the database link information and he would have Robert Rodden contact
him with the information. Randy Riley stated the database gives a project synopsis, how it was
built, whether there was fiber used, etc. The database will give information on overlay
candidates and it can be easily updated for years to come as it is an ongoing information system.

3. Overlay Design Catalog

Rob Rasmussen reviewed the outline on the Overlay Design Catalog. Dale stated the concept is
to provide users (states, cities, counties) with a design catalog for bonded and unbonded overlays
to give them a ready made way for overlay thickness and a comfort level. Rob stated it would
provide design ideas in a simple and straightforward fashion. An example would be to take the
German design catalog parameters and boil it down to simple methods. The catalog would have
different roads with different pavement options. Rob stated they will try to keep things simple.
He mentioned what is developed will be a living document to be updated with new overlay
information as it becomes available. He stated that all systems of overlays will be included in
the design catalog.

Suneel stated he was concerned about how much acceptability the catalog will have in the nation.
He asked if the catalog is something that the national center should be developing or should it be
done on a federal level? Randy Riley stated he felt we need to start somewhere and the catalog
would give states a starting point and they could add to it and tweak it for their specific states.
Dan Dawood stated something similar was started by the DOT’s a few years back and they did
not expand on it as it was too complex. Dan stated when they went to Germany the discussed
how their catalog was developed and they received some good information on how to proceed
with developing this design catalog. Dan mentioned the catalog would be available for other
industries to comment on (AASHTO, etc.). Suneel stated it was important to have acceptability
of the product. Dale stated the Center would have further discussions on how to proceed with the
development of the catalog to make sure it has national credibility from federal entities. He will
update the committee on the outcome of the discussions FHWA and the National Center.

Gina Ahlstrom asked if the purpose of the design catalog is to let states know how thick to make
their overlays. Dale stated it would be a major tool to help with the thickness determination.
The catalog will give individuals a mechanism to go to for the best information on overlay
thickness. Dan Dawood stated states may have their own design specs on thickness and they can
tweak the design catalog to help with their specifications on overlay thickness.

Suneel stated he is concerned that states may not accept a national design catalog and that they
will use their own catalogs. Dale stated we need to start somewhere and this is a good tool to
provide states with the information on overlay thickness. Suneel is concerned that this could cost
a lot of money and he wants to make sure it will be used by the states. Suneel stated that maybe
AASHTO and NCHRP could help with developing the catalog and we may want to look into a
pool fund for the project.
Dan DeGraaf stated the design catalog will have uniformity as we go forward and it will provide information on projects and methods that have been used and they work and this is what will give the catalog credibility.

Randy Riley stated he felt most states may want to tweak the information but they will have a place to start. Leif felt the overall intent is to facilitate implementation of overlay technology on a national basis. He felt we can look at what is out there and put the best information together in one catalog. If the concrete industry develops the product it is a concern as to how much creditability it will have with the states. Leif stated the catalog should show what tools are available and the methodology for concrete overlays.

Suneel stated states can develop a design catalog for themselves and we need to give them the process. Dale felt that cities and counties need the information also and that the catalog would provide them with this information. Suneel feels the guidance is provided in the overlay guide. Dale said the Guide provides dialog on what design parameters are and a discussion on the aspects of each software program. It also provides a list of different types of software programs and their deficiencies and short comings but does not give methods parameter, or how to run the programs or examples of each. Dale felt they need to know how to move forward and begin the actual process for the overlays. Dale agrees they need to make sure the creditability is there for the design catalog.

Dan DeGraaf stated we need to be careful on how the catalog is presented. Shannon Sweitzer stated we need to give them something to start with and he feels the catalog would be a good tool. Shannon stated that states may tweak it but it will give them somewhere to start with the design. Jim Grove stated we do have two audiences for the catalog, the states as a guide to refine and the local governments as a design tool. Suneel stated the focus needs to be on federal aid highway programs as this is where the funding comes from. Randy reminded everyone that cities and counties have a lot of federal aid routes on their system. Leif stated we need to identify the process on how to come up with basic overall designs and give them examples of what worked in certain regions of the country and that will make it a national design catalog. Dale felt they will have further discussions with FHWA and the Center on how to proceed with the design catalog and he will update the committee on their discussions.

Rob Rasmussen reviewed the nine steps of the design catalog. The catalog format will be pleasing and simple to use. He stated they will look at various procedures and see what the best procedures are to put into the catalog. They want to come up with a hybrid of design procedures and that the design details will be connected to the catalog. Rob stated they don't want to over engineer or recreate the process. Regarding the peer review (step 7) in developing the design catalog, the catalog needs to go through a thorough examination and they will discuss how this could be done. The catalog will be designed on the experience that is out there and simplified. Dale stated we are seeking other states to take part in the overlay committee to get more state input. He stated we may want to expand and go to the peer review concept or develop a subcommittee.

The next steps are discussions with Suneel, Gina and the Center on how to proceed with the design catalog. Dale asked Leif to be involved in the discussions also.
Jim Grove asked if the overlay committee should approach AASHTO to see if they have a couple of representatives to be on the subcommittee so we could get their input. Suneel felt we should pursue their input prior to developing the catalog to make sure it is acceptable. Dan Dawood thought someone from the overlay committee should present the concept to AASHTO. Suneel agreed that this is where it should start to get the national acceptance and credibility. Dan Dawood stated AASHTO has a meeting coming up this year and he would see if we can get on the agenda. Dale will talk with Tom Cackler to get his input on how to proceed with AASHTO.

4. **Vertical Clearance Needs on Concrete Overlays on Urban Freeways**

Dale stated he would like the committee’s input on the serious vertical clearance needs for concrete overlays on urban freeways. He mentioned that engineers often need to know what quality of asphalt you have to have after milling for an unbonded overlay. He stated that on some projects there is a build up of overlays over the years with different lifts and age. When the asphalt is milled to make room for the concrete overlay the quality of the remaining asphalt can be questionable. The biggest concern for even unbonded overlays is the fracturing of the asphalt resulting in deplaning. Dale spoke to a chief engineer in an eastern state who said they did not want to mill out all of the asphalt and come in with new asphalt on a project. He asked, how good is good for the remaining asphalt? Dale noted that the remaining asphalt you don’t want water collecting underneath it and you don’t want it to come apart. Dale stated there are some geotextile fabrics that have been used in Germany and that this is becoming more prevalent as states are milling off more to get the vertical clearances. Some states stated they don’t want to go back in with asphalt once they have milled it down.

Dan DeGraaf stated when talking about an urban freeway with 70 to 100 thousand vehicles per day the DOT does want to come back for a long time and the finished pavement needs to be very good. Dan stated they should mill down to as far as you need to go for the vertical clearance and then go back in with an inch of asphalt and put it in the interlayer. Dan stated the open graded interlayer should cover the outlet trench so it drains to the edge drain.

Gordon stated he had seen on projects if they milled down the HMA and remaining asphalt is usually depleted because of age. Gordon stated he felt with concrete on concrete with asphalt in between they should have new asphalt in between to hold up the overlay on extremely heavily traveled roads.

Randy Riley stated that on roadway projects with traffic (30,000 ADT) have milled the asphalt and put a concrete overlay over the existing remaining asphalt/concrete and it has held up for years.

Gary Fick stated if you have the opportunity to core the roadway you have a good idea of what is down underneath the pavement. He stated in Oklahoma they have covered up asphalt materials for years and they have not seen any distresses.

Dale stated we should be on the conservative side when suggesting what to do so we don’t have pavement failures. He stated that currently we have been suggesting that DOT test the asphalt to determine its quality and suitability to serve as a base for the overlay. Dan DeGraaf stated that for most projects, if the pavement is stable enough for an asphalt overlay you can put down concrete. He stated in most cases you can mill down within a couple
of inches from the old asphalt and the asphalt was good enough to concrete overlay the road. If you mill the asphalt and it is in place after milling with no cracking, then you should be able to overlay concrete on it.

Dale asked the committee if they agreed, that for normal projects if the state is comfortable with placing an asphalt overlay they should be comfortable with using a concrete overlay. If the project is on a heavy truck traveled road we should encourage the state to look closely at the quality of the asphalt and also consider a new 1 inch separation layer over the top of milled HMA or concrete. Is that the committee’s position? No one commented.

Paul Wiegand stated he hasn’t seen interlayer geofabrics from the US that they used in Germany. It was mentioned that Jim Duit is using the interlayer from Germany on a project in Missouri. Randy Riley stated there are a lot of interlayer fabrics in the US that can be used and meet the specifications so people should look at these products. Leif stated the US manufactures have fabrics that are meeting the German specifications. He mentioned they can be used for drainage and bedding. Paul will talk to Rob and Gary Fick about the availability for an Iowa Research project.

Dale asked the committee what we should tell people about using geotextile as an interlayer. Suneel said the important part is to have enough stiffness in the fabric, he is not sure what the number should be, but the European fabrics may not have that stiffness. Leif stated that the German fabrics have the stiffness that we need. Leif stated that when we have a high traffic area with heavy trucks they should look at their material and if they feel it is necessary to use an interlayer they can consider that option. If it is a normal urban or arterial roadway, make sure your asphalt is capable of being overlaid, make sure it is a quality material. Gary and Rob will check on new information on the interlayer materials to see what is out there to use from the US and get back to Dale. He asked the committee for their final comments on the subject.

Leif stated we don’t have the level of experience on the interlayers to tell people what to use. Dale stated we are gaining experience on the interlayer materials. Rob Rasmussen saw interlayer material used on a Missouri project. Dan Dawood stated they should make sure they know how old the asphalt is and make sure it is able to withstand the overlay. Gina stated during the construction sequencing to make sure if they mill and then have a lot of traffic on the existing asphalt it could come apart.

The committee agreed to the rule of thumb that if the remaining milled asphalt was considered adequate for asphalt overlay it was good enough for concrete overlay. If not, then further tests on the asphalt should be taken or determine the condition after milling. The exception is when heavy truck traffic on urban freeways may need a new 1 inch HMA interlayer. The use of geotextile interlayers should be considered on state projects when there is a clearance issue, but only as a research project.

Dale stated the next overlay committee conference call will be scheduled sometime in the next four weeks and he will send a notice to the committee on the date and time for the call.
Overlay Committee Conference Call
April 15, 2009
Meeting Minutes

Attendees: Ahmad Ardani, Gary Fick, Julie Vandenbossche, Rob Rasmussen, Randy Riley, Gordon Smith, Tom Burnham, Andy Bennett, Dan DeGraaf, Jeff Uhlmeyer, Jim Duit, Matt Zelier, Marcia Brink, Shiraz Tayabji

Dale Harrington opened the discussion advising the group that the updated map and states tracking table was attached to the email sent to them. The table shows the progress for each of the participating states. Dale then turned the discussion over to Gary Fick who updated the group on the state field visits that he led for the program.

Gary stated that:
- South Dakota let their project in March for the 7 ½ inch unbonded overlay project they selected. Gary stated the expert team would be onsite for a portion of construction for the project.
- Delaware project is a 6 inch unbonded overlay with vertical clearance issues. Gary stated they would be milling down a portion of the roadway prior to applying the concrete overlay. He stated that Delaware has a May letting scheduled for the project.
- West Virginia project is in the beginning stages of an unbonded overlay on I-79 north of Charleston. He stated the expert team has reviewed some example plans for the project however West Virginia does not have a letting scheduled to date.
- Pennsylvania the initial project suggested is a bonded overlay on State Route 119. He stated Pennsylvania will cut cores and see what the underlying condition of the roadway is prior to beginning the project. If the underlying asphalt is in okay condition they will do a bonded concrete overlay and if the condition is poor they will do an unbonded concrete overlay.

Gary finished his update to the committee by advising them that Dale Harrington, Ahmad Ardani and he will be going to Las Vegas on April 30th for a field review for the program.

Rob Rasmussen then updated the committee on the projects that he has been involved with for the program.
- The expert team traveled to Louisiana last fall for the first site visits and held a second visit this winter. He stated that Louisiana selected an overlay project on I-55 and that currently the project is planned for construction in 2010. Rob mentioned the expert team may review the plans for the Louisiana project.
- Washington State reviewed two sites for possible 6 inch bonded overlays. One project is on US 395 and the other project is on I-90. Rob stated that Jeff Uhlmeyer was also involved with the reviews. Jeff stated that the project is high on the Washington State stimulus list and they are doing the ground work to try to get the project going in the next year or two. However, right now funding is pending.
- New Mexico visited several potential overlay project sites. The project that was selected is on I-70 and would be a 6 inch bonded overlay. Rob stated he is not sure where it is on the construction schedule and that funding is in the works for the project.

Following Gary and Rob’s updates Dale asked the committee to let him know if they would like a copy of any of the state reports. He then stated to the committee that the Center has submitted
a proposal to FHWA for additional states to be involved with the program. Ahmad Ardani asked if Colorado was one of the states who have asked to be involved with the program. Dale said that they currently have not asked to be a part of the program however they would be welcomed if they would like to be involved.

Shiraz Tayabji advised the committee that the CTPP program will conduct workshops in Norfolk, Virginia on June 3rd and in Wisconsin on June 10th. He summarized how the CTPP workshop works. Shiraz stated they also have conducted workshops in Canada, and in cooperation with the CP Tech Center held workshops in South Dakota, Maryland, Delaware and West Virginia.

Dale then asked Tom Burnham and Julie Vandenbossche to update the committee on the pool fund research for bonded concrete overlays over asphalt. Julie stated they are looking at the performance data that is out there now and they are getting information on slabs and existing whitetopping. Julie stated they are sending out requests to different agencies to get performance data to go along with the design data. She advised they would like to see what is performing and what is not performing. They are looking at sections of roadway that are sealed verses unsealed, some with fibers some without fiber and surface prep. These roadway examples are side by side comparisons. Ahmad Ardani stated that Colorado has a lot of examples that he will send to her. Julie stated they have been using the database and they will add the new information they obtain to the current database.

Gordon Smith mentioned the Hwy 21 project in Iowa. Gordon asked Julie if they have the information from that project. Julie stated she did not have the information and would like to look at it. Gordon stated that Jim Cable has the information. Dale Harrington stated he would ask Jim to get a hold of Julie so she could get the information. Gordon then stated he also has information on county roads in Iowa and he would send that information to Julie. She stated they are currently using procedures to see what works. Julie said the information obtained will eventually be developed into a Design Guide for Concrete over Asphalt. The Guide will contain a wider range of information for climate conditions, curling, warping, and effects of fibers, how it affects joint performance, etc. It will also include sealed vs. unsealed procedures and information on reflective cracking explaining when it will and won't occur. Julie stated that from the current data they have reviewed it appears that sealing of the joint appears to be a good procedure if the asphalt below has deterioration. She advised the committee that the information she was sharing with them today is based upon preliminary results. They have also looked at when to dowel and not dowel, stating there is a difference in the performance with smaller dowels out performing undowels. She mentioned that fibers seem to help keep the joints closed so less water will get through. Julie advised the committee that they will prepare a TRB paper this summer on the findings.

Tom Burnham stated the next task is a laboratory study on bond derogation and they need states to join for the third task. Julie stated that the completion date for the Design Guide for Concrete over Asphalt will be in two years. The final report is due at the end of 2011. Development of the procedure is due June 2011. She stated it will be a basic approach that is in a spreadsheet format and easy to use.
Dale updated the committee on the Overlay Design Guide which is to be a user friendly document. He stated they initially proposed an overlay design catalog for unbonded and bonded overlays that would be formed from running numerous computer programs. However, FHWA felt that the design catalog approach would not necessarily receive support by State DOTs. He stated that FHWA would like to develop a design guide that can go through the AASHTO committee for acceptance by using 1 to 2 recommended programs and have example computer runs based on these existing programs. He stated the TAC committee would make a recommendation on what programs work. Therefore, it was agreed to examine 4 or 5 computer programs, complete example runs and based on an analysis recommend 1 to 2 current programs. Once the programs are selected they would develop more comprehensive computer run examples of those programs.

Rob Rasmussen then summarized the tasks of the Design Guide for the committee. He stated they want to make sure the guide is easy to use. It will identify tools that DOTs can use and identify scenarios that may be encountered in the field. Rob said they will develop tech briefs and identify design tools during the development of the Guide. Rob explained they will create the products and craft design examples. Rob stated one of the goals of the Guide will be to use it as a stand alone document or it can be used to educate others. Dale stated they are ready to submit the proposal to FHWA after getting the committee’s input. Dale mentioned the final Guide may take 1 ½ years to develop, however tech briefs will be developed while developing the Guide. Tom Burnham stated that on Task 2 of the proposal climate should be a stronger consideration regarding stiffness. Dale stated they will keep in contact with Tom Burnham and Julie Vandenbossche during the development of the guide so they can discuss the information. Dale stated they will recommend 1 or 2 current programs and that the Guide is not intended to replace the ME Guide. They will incorporate the best programs out there now to accomplish design for bonded and unbonded. The committee felt the design guide development proposal was on track and definitely needed in the industry. It was suggested that on the demo jobs do a calculation so you have a baseline on how the programs are doing.

Rob Rasmussen reviewed the Nonwoven Geotextile Interlayer report. He stated that the final report is currently under technical editing. Rob stated the document can be used now but there will be a final coming out after the editing. Dale stated a tech brief has also been drafted on the geotextile interlayer and that it will be coming out soon after review by FHWA. Rob stated the geotextile interlayer was being used a lot in Germany and several individuals felt it should be looked at here in the US. Rob stated to the committee that the most important elements of the report are on page 6 which contains the material specifications for the interlayer. He also stated that page 7 of the report lists the vendors for the materials. Rob pointed out that page 8 contains the construction installation practices. Rob felt the geotextile fabric is easy to use and it is being used as an interlayer in the US. Dale explained to the committee that in Germany they do not do a lot of overlays. The Missouri example used a 6 x 6 joint size which minimized curling. It was also stated that you need to look at the joint spacing as it will help with the curling and warping. The material facilitates drainage so water will not get trapped between the layers, this is shown on page 3 of the report. It was mentioned that there are a lot of suppliers who are trying to sell the heat treated material and Germany recommends the non thermal treated. When the trucks back up there is very little distortion as long as there is no turning on the geotextile. The disc approach may be better than the tack coat; it could be used to see if it works. Jim Dui stated that there may be information on a spray adhesive that may be available and he will share the information with the committee when they get it.
Tom Burnham updated the committee a Minnesota project that was overlaid late last fall. He stated the project was on Trunk Highway 53 and consisted of a 5 inch unbonded concrete overlay over concrete with an asphalt interlayer. The existing pavement at certain locations was in poor condition and as a result the engineer decided to use wire mesh in the overlay in spot locations where existing distress was evident. The concrete overlay panels were sawed into 12’ x 12’ which is very large for a 5 inch thick overlay. The jurisdiction surveyed the nine miles overlaid and found 42 cracks after the first six months of opening. Tom’s point was that sometimes engineers push the envelope beyond what is normally acceptable and hope for the best.

Meeting adjourned.

Notes taken by Melisse Leopold, reviewed by Dale Harrington
Concrete Overlay Field Application  
Overlay Committee Conference Call  
May 12, 2010

Attendees: Don Clem, Sam Tyson, Leif Wathe, Andy Bennett, Jim Cable, Shiraz Tayabji, Ron Youngman, Gordon Smith, Dan DeGraaf, Matt Zeller, Julie Vandenbossche, Dale Harrington, Randy Riley, Jim Duit, Jeff Ulhmeyer, Craig Hennings, Andy Bennett, Mclisse Leopold taking minutes

MnRoad project report (TPF-5-165) Whitetopping Design Guide that Julie Vandenbossche is working on is out in draft for review. 
Julie gave an update to the committee:
- Summarizes the advantages and procedures
- Waiting for review comments, due May 18, 2010. However, Julie could extend the review for those that still want to review the report.
- Working on the changes for the guide
- Work plan for laboratory study to focus on handling the debonding and benefits of fibers
- Focuses on how they effect craft performance
- If you have comments on the report send Julie an email

Jim Cable:
- If Julie V wants to see the Hwy 21 project in next 30 days it is being let May 20th for an HMA overlay. Less than 30 days before overlay begins.
- No formal report will be prepared at this time
- Jim walked the project last week, he will put together some notes for a future presentation
- Randy Riley asked if they could have a survey van go across to take a video – Jim stated he may be able to get a video done, he will check into it

Peter Taylor email on organizing ACI technical session in 2011 convention in Tampa, FL in 2011 on concrete overlays for pavement rehabilitation (Dale sent email). The sessions are 3 hour sessions and would be broke into 30 minute presentations on these 5 subjects:

- Overview – definitions and types of overlays
- Design considerations
- Materials and Mixtures
- Traffic control
- Construction

Dale stated Peter was looking for speakers who could give 30 minute sessions. Shiraz suggested presenting the work the CP Tech Center has done to date. The committee members could not commit at this time to speak at the conference.

Updates for the Concrete Guide for Overlays
- The guide is not out of date (September 2008)
- However, Dale talked to Tom Cackler and depending on funding it could possibly be updated within the next year
- Dale reviewed with the committee items that could be included in the update and summarized each of the following topics: traffic control for two lane roads open to traffic,
overrun issues, quantity control in design, survey methods, early age cracking prevention, temperature management, longitudinal and transverse working cracks

Dale asked the committee what items they could add to the list.

- Dan DeGraaf and Andy Bennett are working on 2 projects, one in the fall and one in the spring on temperature management. These are new lessons learned that should be included in the Guide.

- Dan DeGraaf stated expansion joints – need to account for expansion joints in overlays or you will have blowups.

- Transverse cracking – how to determine what is causing the cracks and how to determine what the cracks are.

- Shiraz Tayabji suggested more information on performance on concrete overlays and provide specific projects in the updated guide.

- Gordon Smith stated the ACPA database would have information on projects. Should be available within the next month. Leif Wathne stated at the Chapter State meeting next week they will be giving a demonstration of the database.

- Randy Riley stated we need a section on fabric. Stripping of the interlayer is a problem and the fabric is a good solution. There are a lot more projects using fabric and need to update the Guide with the knowledge on fabric.
  
  - Jim Duit – there is a big increase in the use of fabric in his area and it has worked well. The fabric is readily available. The price is dropping and there are more U.S. manufacturers. The committee would like the Center to let everyone know about the current tech brief. Dale said a MAP brief on the fabric would be one of the tech briefs sent out through the new E-news.

  - Dale Harrington – thru FHWA a technical bulletin was developed on geotextile interlay work that Rob Rasmussen has done.

  - Jim Cable stated we need to make sure the water moves through the fabric and make sure it has somewhere to go.

  - Dale Harrington stated asphalt interlayer drainage and fabric drainage should be updated in the Guide.

  - Randy Riley – distinguish fabric on top of asphalt and fabric on top of concrete needs to be detailed.

  - Jim Duit – water is going through the fabric somewhere from the cores he has from his project. Getting the water out from under the overlays is a key to success in the future.

  - Gordon Smith – find a way to tie the fabric to a subdrain to help move the water. Works better than an asphalt interlayer at half the price.
• Dale asked Ron Youngman in his work with his 6 x 6 system did he use the Overlay Guide? Ron said they did not but was having trouble with overruns and yield. The overruns were so expensive. Need to look at using 6 x 8 panels.

• Randy Riley stated we have traffic control issues – look at how much strength is needed to open as we are getting too conservative.

• Gordon Smith agreed we need to look at strength for opening and when to put traffic on the pavement.

• Dale asked the committee if they have other items for the updated Guide send them to him.

Summary of upcoming documents – Dale summarized the following documents:

• Concrete Overlay Cost document is under revision. The comparisons to asphalt costs were an FHWA concern. The Center has decided to change the document. Price per ton for concrete will be included however they will not give a comparison to asphalt. The documents with the cost comparison are no longer available and have been destroyed. They are removing the asphalt costs and will leave the concrete prices in the document.

• Overlay Packet – supplement to the Overlay Program
  
  o Three levels of information – Chief Engineer, Field Engineer (more information pertaining to traffic control, frequently asked questions, etc.) and contractors (data being collected).

  o The Center does not collect the field data from the mobile lab for pay items. The data that is provided to the state DOT is for information purposes.

  o The packets should be out within the next 2 months

• Jim Cable report on FHWA/IHRB research project -- 4 research projects in Iowa with input from Gordon Smith and Paul Wiegand. The report is being finalized and a technical bulletin will be developed within the next 3 or 4 weeks. It is currently being reviewed and should be finalized by the end of June 2010.

• Overlay Design Guide
  
  o The guide used on concrete overlay design as it pertains to the existing program. It does not include new programs. It analyzes different software programs throughout the country and there will be recommendations on what software programs fit with certain types of overlays. The technology summary has been reviewed by the committee and comments are being addressed. Document will be out by the end of 2010.
Summary of States' Activities - There is a Technical Working Group of states that meet to talk about different state projects. This group is the state DOTs and they have joined or have interest in the Field Application Program. The field reviews give states confidence so please contact Dale and he will set up visits if they would like one with the expert team. All the state visits have a written report and will be used for knowledge base.

- Delaware report was just finished

- Arkansas report is going out today or tomorrow.

- Indiana working to set up a new program on field application program

- Penn DOT open house should be scheduled by next week for sometime in June 2010

- Minnesota – Dale Harrington, Jim Cable, Matt Zeller, and Doug Schwartz met with MnDOT and wrote a short report on the field visit. Matt felt is helped MnDOT.

- New Mexico is trying to move forward however they have funding issues

- Georgia just had a field review with the expert team members

- Bonded CRC overlay over plain jointed concrete is moving forward in Texas and Rob is trying to work on getting the information developed. Shiraz stated the Texas project will be started on May 19 or 20 for the first phase. Shiraz will send an update on when the Open house will be held. Leif asked Shiraz to send the information to the committee on the Texas overlay. He will send it out tomorrow to the group.

- Nebraska project is moving forward.

- Virginia – met with Chief Engineer and working to set up a field review for different overlay sites.

Committee Comments

- Jim Cable – performance for overlays – performance of concrete overlays is judged by the owner. Need to tailor it to the eyes of the owner. There are different opinions on what is good and bad for performance. The database from ACPA will be a lot of help.

- Ron Youngman asked if anyone is working with FAA on the use of overlays on runways and taxiways?
  - Gordon said it depends on the region. Some regions do not want to consider them as they want them 10 inches thick.
  - Shiraz – there is no one at FAA to champion concrete overlays
  - Leif will talk to Gary and Greg and see what they know about the airport overlays

- Dale asked the committee if they have any ideas on overlay programs please contact him. He thanked everyone for helping on the committees.
• Leif asked the committee about pavement rehabilitation on overlays. Pertains to the ASR group FHWA. Need to identify where concrete overlay is successfully placed on ASR pavement that has been down for 10 or 15 years. Need a case history of where it has worked. Let Leif know if anyone can help with this subject or if they have a project. Leif will send the group an email on what he needs.
  
  ○ Shiraz stated there is a Wilmington, Delaware I-495 bypass that would be a good project with no issues. Jointed plain on CRC 10” or 12” unbonded. There is a TRB paper on the project.

Dale thanked the committee and stated the minutes would be sent out in the next few weeks.

Meeting adjourned at 11:10 a.m.
Concrete Pavement Sustainability Track
Leadership Group
January 27, 2010 - Web Meeting
Meeting Minutes

Leadership Group Members Attending:
Gina Ahlstrom
Andrew Penicky for Kevin Cail
Robb Jolly
Steve Kosmatka
Kevin Gardner
Tim Smith
Michael Sprinkel
Leif Wathne
Jim Duit
Kevin McMullen
Steve Muench

Leadership Group Members Who Could Not Attend:
Jennifer Distlehorst		Barry Descheneaux
Joep Meijer			Ken Kobetsky
Tom Pyle			Larry Sutter
Erin Ashley			David Weber

Operations Support Group Members:
Tom Cackler		Dale Harrington
Peter Taylor		Tom Van Dam

The PowerPoint slides used in the meeting are attached.

- Introductions
  Peter Taylor opened the meeting and went through the introductions which consisted of 12 slides.
  - Explained about what was going to be covered during the call
  - Asked the track leadership, “How do we interact with all the other organizations and encourage working together and how are we going to fund the effort?”
  - Discussed the CP Road Map strategy
  - Contract with FHWA to do the operations work – tasked to listen to people and see what their needs are
  - Go to the track committees and help find money and put it together with the right researchers to get the right work done.
  - Distribute the knowledge
  - Set up leadership teams and help set up communication process
  - We are not a research czar
  - Discussed the structure of the CP Road Map organization
  - 13 tracks in road map
  - Sustainability track is the busiest track with the industry as it is today
  - Discussed the future work plan is to gather states, industry and academia to discuss issues
- Keep a database of work that is in progress
- Prioritize needs and figure out how to work together and get the information distributed

- Minutes of February 26, 2009
  - Peter Taylor asked the leadership group if they had any comments on the minutes of the February 26, 2009 meeting and there were no comments or changes
  - Steve Kosmatka moved the minutes be approved and was seconded by Leif Wathne. Minutes approved.

- Completed Activities Framing & Briefing Document
  - Framing Document. Peter and Tom Van Dam reviewed 20 slides. Tom Van Dan stated the track leaders input helped with the formation of the framing document. He reviewed the sustainability sketch on the screen.
    - He stated that sustainability is economic, environmental and social considerations
    - Life cycle is an important concept in sustainability
    - All three (economic, environmental and social considerations) sustain and keep the life cycle in balance
    - We want to enhance the bottom line
    - Must include materials practices throughout the project
    - Reduce life cycle costs and enhance the benefits for society
    - Non sustainable approach is using non-regenerative materials and producing waste
    - Sustainable approach is using regenerative materials

Kevin McMullen:
  - Stated we should not ignore the accumulative waste as you can reuse some of the materials again. There may be opportunities to get it back into the system.

Tom Van Dam:
  - Agreed that we can find ways to reuse waste and recycle it into the system again.
  - Today sustainability is being demanded
  - Makes the concrete industry more competitive
  - FHWA, DOTs, etc. will be pushing the sustainable process

Robb Jolly:
  - Stated he is currently working on presenting the master plan for an airport and the focus is using sustainable platform for the next 25 years.

Tom Van Dam:
  - Stated with private companies, airports, this is going to become the way to do things.
  - Need to pay more attention to the environment in transportation industry
  - The framing document was sent to the track leadership team for their review and input
  - Discussed the objectives and what the work will include
Dale:
- Stated he is currently involved with an ACPA alternate bids committee – life cycle costs analysis.
- We need a mechanism to show impacts of sustainability in life cycle analysis.
- Dale asked if life cycle analysis was a mechanism to help gage if a project was sustainable.

Gina
- Stated FHWA will have an effort in the 1 year looking at life cycle analysis with environmental considerations. No measure will be put in; just guidelines for sustainable considerations during their life cycle analysis.

Tom Van Dam:
- Stated it's a general trend – life cycle analysis, then environmental impacts, social impacts will be done separate. Discourage monetizing environmental impact at this time.

Steve Kosmatka:
- Stated the economic element need to be included in the alternate bids. Should be a part of the equation.

Dale Harrington:
-Asked how do we make a difference in regards to selection? What the project will contain should be reflective in the analysis.

Jim Duit –
- Stated an example project he worked on had limited aggregate material. If we would assign a value to import aggregates and spread it out over 3 or 4 life cycles so it can be recycled into the concrete pavement and have an asset for the taxpayers it could be a good concept. Need to add value to the taxpayer – that is what we are looking for. What materials can we utilize that we can get many cycles of sustainability out of and how do we show value to the owner.

Dale Harrington:
- Stated that is part of the selection process.

Tom Van Dam
- Run a normal life cycle and have other criteria.
- Green Roads document has a good system to look at for this approach.
- Tom Van Dam will forward the link to this article to the leadership team: www.greenroads.com Tom also stated that this link is currently posted on the web meeting monitor.
Tim Smith:
- Mentioned that Asia Pacific Partnership is doing an independent life cycle model and life cycle costs model. It is being developed in a 2 year study. Scope and goals have been developed and background research has been done. Looking at other systems. Not on a website yet. Tim will keep the committee informed of the progress.

Leif Wathne:
- Life Cycle Costs Analysis is a decision support tool, helps you make a decision.

Kevin McMullen:
- Stated we need to develop on a national level and give principals and guidance to DOTs.

American Society of Landscapers is working on developing sustainable guidance and linking with other aspects of transportation.

Tom Van Dam:
- Plan to fill gaps in the framing document
- Asked the leadership team to look at the list of projects and pick out projects that should be developed into a problem statement
- This meeting presentation will be posted on the CP Tech website and a link will be sent to the leadership team.
- Briefing document has been delivered
- Conference schedule in September 2010 in Sacramento. The website for the conference is on the CP Roadmap website
- Detailed problem statements need to be developed
- Tom Van Dam will send the leadership team a questionnaire and ask them to rate the 39 statements. From their input he will assess the highest priority projects to be developed into problem statements

○ Briefing Document

Peter Taylor:
- The document was published in August 2009
- Talked about it at a number of conferences
- Will talk at future conference
- Will add a link to the briefing document in these minutes
- Free download on the Road Map website

Steve Kosmatka:
- Congratulated the team on putting together a great document.
- PCA will mention the briefing document in their newsletter along with the link to the document
Future / Ongoing Activities
  o Manual of Practice
    Tom Van Dam:
    - The Manual of Practice is just getting started
    - Looking at enhancing concrete pavement sustainability
    - Focus on practitioners
    - Contract approved Jan 25, 2010
    - First meeting on Jan 29, 2010
    - Introduced the project team for the manual
    - Sponsored by FHWA -- through the Centers cooperative agreement with FHWA
    - 10 chapters; talked about the outline of the manual
    - Will be forming a Technical Advisory Committee for their input
    - Went through the timeline – hope to be completed by November 2010
    - Training will be done through a separate contract
    - TAC will be 10 stakeholders
    - If interested in participating on the TAC let Tom Van Dam or Peter Taylor know; would like the assistance from the leadership team
    - Approximately a 200 page manual
    - Will be distributed through ACPA and FHWA
    - The TAC may be a smaller group including others outside of the leadership team
    - The leadership team will be a part of the review group

  o Fall Workshop
    Dale Harrington:
    - The sustainability conference in September 2010
    - Went over the program agenda for the conference
    - Come out of the conference with a fresh and good strong understanding of where we are all heading
    - Could have good input for the Manual of Practice
    - Two Forums -- Agency Practices and Directions and Industry initiatives, innovations and directions
    - Want to know what everyone is doing and interfacing with others
    - NC2 group will be at the conference meeting a couple of days prior to the sustainable meeting and their travel costs (for state DOTs) will be paid to attend the conference

Interaction with Other Organizations
  o FHWA
    Gina Ahlstrom:
    - There isn’t a lot of information that can be released at this time
    - In addition to Gina’s Office of Pavement Technology, two other FHWA offices (Office of Asset Management and Office of Environment and Planning) will be involved in some of the sustainability
    - Teams working on livability, sustainable transportation and climate change
    - Office of Infrastructure -- sustainable lead the entire group
    - Pavement technology -- program related to sustainable highway pavements and focusing on materials, design and construction practices
    - FHWA will not compare different pavements, but will look at if a proposed pavement is sustainable.
- Office of Environment & Planning will concentrate on assessments and climate change
- Encourage the group to look for Fed Biz Ops as there will be opportunities
- FHWA leadership has put sustainable highways on the fast track
- Will be looking at the Manual of Practice to provide a lot of guidance to the other efforts

Peter Taylor:
- Asked if materials, design and construction practices would be included in the life cycle? Gina stated, yes however it is a very broad program. They are developing a number of different things.

Gina Ahlstrom:
- All will be considered for a sustainable pavement system.
- Trying to become more knowledgeable about what is going on out in the industry with life cycle approaches

- ACI
  Tom Van Dam:
  - ACI has formed a new sustainable committee.
  - Have organized subcommittees with materials being one of them
  - A lot of things underway; however it is in initial stages
  - Subcommittees are stand alone
  - Evolving opportunity for those to get involved

Leif Wathne:
- ACI efforts have joined with Joint Sustainability Initiative and ACPA is not formally involved but helping out.

- TRB
  Tom Van Dam:
  - Embracing sustainability concepts
  - Concrete section – establishing a formal subcommittee on sustainability
  - Need to get involved in the process

- ASCE
  Tom Van Dam:
  - Vision 2030 is their current approach on sustainability
  - Holding a conference in Denver in November 14-17, 2010
  - Will send the conference link to the leadership team: Green streets and highways conference
  - Should get involved with this conference
  - The MOP will be either presented or a paper submitted
Jim Duit:
- Encouraged the leadership team to have a strong showing at this conference

- NRMCA
  Peter Taylor:
  - Conference is April 13-15, 2010 in Phoenix

Steve Kosmatka:
- There is a lot going on
- PCA has sustainability webinars coming up
- Concrete thinker on the PCA website

- University interaction
  Steve Muench:
  - Just released Green Roads for Performance
  - Manual is in review
  - End of February send out to others a call for review
  - Can download the rating system from: www.greenroads.com

Steve Kosmatka:
- PCA the MIT center RMC Foundation funded the MIT hub - $10M over the next 5 years
- Working with MIT to put together the sustainability program
- Concrete pavements is a large part of the focus
- Should get MIT engaged in our group
- Started the end of last year
- MIT Sustainability Hub is at: http://www.cement.org/newsroom/MIT_CSH.asp

Peter Taylor:
- NSF program funded by Arizona State looking at sustainability of concrete
- Norb Delatte is on the project
- Should get in contact with that group

Dale Harrington:
- APWA very involved with sustainability
- They have a section of sustainability as a priority
- Need to find out specifics of their program
- Larry Stevens is one of the Directors

- Funding
  Peter Taylor asked the leadership team, “What do we do to get the funding?”

Dale Harrington:
The work we are doing this year is primarily the MOP. The development of the MOP will generate a system of questions and answers that the committee will be faced with. How do we get that information from all the organizations?
Peter Taylor:
If we ask for volunteers or request a member of these organizations to be a part of the review team for the MOP. This would help get the information.

Gina Ahlstrom:
FHWA is currently working on coordination with several FHWA offices working on sustainability. They talked about sharing document review with other FHWA areas that are working on sustainability and getting collective comments.

Steve Kosmatka:
We need to have more of these conference calls to report on what is happening.

Leif Wathne:
Asked what FHWA office was handling the RFQ?

Gina Ahlstrom:
Stated it was the Environment & Planning Office – Gloria Shepherd. She stated she can’t specifically say at this time as it was all internal information.

Steve Muench:
Stated they were looking for a system for developing and designing an approach to a sustainable highway. They are looking for self evaluation tool by owner agencies. Wanted it done very quickly, by September 1, 2010. Focus was not just on pavements. It included highway design and construction, anything that fell in that category. Not just pavements or material. It was a very aggressive schedule.

Tom Cackler thanked everyone for joining the meeting. He stated this group can be a part of the national leadership to address these issues.

Meeting adjourned at noon CST
Concrete Pavement Sustainability Track
Leadership Group
July 13, 2010 – Web Meeting
Meeting Minutes

Leadership Group Members:
Gina Ahlstrom
Gary Demich
Robb Jolly
Steve Kosmatka
Kevin McMullen
Larry Sutter

Kevin Cail
Barry Descheneaux
Steve Kosmatka
Maria Masten
Joep Meijer

Invited Visitors
John Oksendorf
Norb Delatte
Kathleen Penney

Operations Support Group Members:
Tom Cackler
Peter Taylor

Dale Harrington
Tom Van Dam

- Introductions
  - Peter welcomed the committee and gave a brief overview of the track goals
    - Prioritization
    - Implementation
    - Publicity
  - How it works
    - Committees set priorities
    - Operational support group helps connect funding and researchers and helps distribute and implement findings

- Ongoing Track 13 Activities
  - Manual of Practice – Tom VanDam
    - Under contract to develop a manual of practice to enhance concrete pavement sustainability
    - Same model as the IMCP manual
    - In the process of writing the manual
    - There is an Expert Task Group and other practitioners who contribute to the development
    - Final due in January 2011
  - Fall Workshop – Peter Taylor
    - International Conference planned for September 15-17, 2010
    - Final program has been set and papers have been assembled
    - Email Peter if you want the link to the conference website: ptaylor@iastate.edu
Interaction with Other Organizations
  o FHWA
    i Federal Highway Environmental Office has funded a project on Sustainability Criteria and Tools – Kathleen Penney (CH2M Hill) presented on the project
    i Connie Hill is the project manager
    i First attempt at a rating system; parallel to the LEED system but specific to transportation
    i Set of criteria that everyone can use
    i Has to be meaningful; has to be challenging and simple; can be implemented quickly
    i Address full cycle for highways
    i Incorporate design, construction, maintenance and operations
    i Defining sustainability is important – natural laws and human values
    i Address all aspects of sustainability and incorporate what has already been done
    i Reviewed what sustainability is and the benefits of sustainability
    i Conducted a peer exchange with approximately 100 participants
    i States want something quantifiable
    i There is a desire for a self-evaluation tool
    i ASCE/ACEC/APWA developing performance measurement system
    i FHWA is farther along; will be consistent with their efforts and incorporate the same goals
    i Not every project should achieve the highest level of sustainability
    i Should be a challenge to reach the highest levels
    i Encourage innovation and improvement of practices
    i Spending more money up front will produce lower life costs or greater benefits
    i A lot of states are using sustainability to help get buy-in
    i First product by end of September 2010; would like the support of this team to get the word out about the project

SK – How does fuel efficiency fit in?
KP – The evaluator will come up with how to make fuel more efficient.
KP – Email Kathleen with any comments at Kathleen_Penney@CH2M.com.
TVD – A tool that comes out as a pavement selection tool will be under a lot of pressure.
KP – All the things that you can get points for; no one project can get all the points as there will be conflicting points.
KM – Open for input for all the things in the concrete pavement that would be included in rating system.
KP – Steve Muench is also on the team and can provide information.
GD - If you only measure a project once at the end you’re not certain where it changed.
If you don’t have a track record of where the goal changed and why it changed you don’t have a good scoring system. Need to have a system to be measured at the handoff stages. Helps us get there from a management standpoint.
• John Ochsendorf with MIT
  o Concrete Sustainability Hub – Portland Cement Association & National Ready Mix
    Concrete Association funded
  o Getting cement people to talk to concrete people
  o 2 major projects underway
    ▪ Green concrete science project – improvement to concrete as a material
    ▪ LCA project looking at life cycle of infrastructure
  o Long term project to assess where concrete structure is today and to help improve
    sustainability in the long term
  o Looking at the initial construction and material consumption
  o Trying to understand vehicle pavement interaction, vehicle impacts on emissions,
    full life cycle throughout the use phase
  o Two teams working on pavements
    ▪ Cradle to grave flows of materials, constructing LCA models
    ▪ Use phase of pavements
  o Need to make improvements in all areas of sustainability

PT – Rating systems verses LCA or both?
JO – Rating systems begin to help quantify how well we are doing in other areas; can
earn points on what the LCA asks which could be part of the rating system.
ND – Need to realize who is paying for the energy.

• AZ State University - Norb Delatte with Cleveland State University presented
  o PFI project working with contractors
  o Looking at the home building and paving industry
  o Home building was doing a lot better at the time the proposal was put together
  o Started in March 2010 and have had one meeting
  o Contractor prospective – one day work on a LEED project and the next project isn’t
  o Looking at having green contractors and the suppliers they are using
  o A lot of things in materials – alternate fuel vehicles
  o Some things you can do with water use
  o Putting together a questionnaire to take to contractors to see what they are doing with
    green practices and how to control what they are doing in green building
  o May go toward some sort of rating system centering around contractors and
    subcontractors
  o Look at what some of the incentives will be for a sustainable project
  o It is a 3 year project and they are just getting going
  o Staring in the home builder side and will go into the pavement side

• Tom VanDam presented on UC Davis
  o University of California European effort
  o Sponsored a workshop – 45 people giving short presentations – some presentations
    where:
    ▪ Quality of the data available
- Operational phase – rolling resistant issues
  - What metrics are important
    - Looking specifically at the issue of life cycle assessment
    - Problems were identified and they are in the process of writing up areas that were agreed upon and move it forward to do a framework for an LCA
    - Working on developing a common framework for life cycle assessment of pavements

GD – Are you looking at what do you do at the end of its life and how much energy it takes to make it usable?  
TVD – We are looking at it from an environmental impact assessment.  
Barry – Boundary conditions are some of the challenges that need to be addressed.

PT – How is it going in gathering data?  
JO - Data is there and it is going well; some assumptions are being made  
JM – Need to be aware that we want to answer certain questions; may need a different approach

PT – Do we want to keep talking about each other’s work and what is the best way to do it? We need to coordinate our efforts. Peter suggested opening a portal under the CP Road Map web site for all research groups to post progress reports or data as it comes out.

The group agreed.

PT – Who else is out there working on assessment systems?  
DH – APWA are they doing any assessment systems?  
GD - ASCE/ACEC/APWA developing a performance measurement system which is broader than just pavements.

PT – Anyone working on societal assessments?  
JO – Looking into a contractor type system – safety and taking care of the workers (social aspect)  
JM -- Social aspects of LCA are developing

Peter asked the group to send ideas for the next agenda: needs that are still out there and how to prioritize them.

Meeting adjourned at 2:26 p.m.
Framing Report for Track 1 of the CP Road Map
Mix Design and Analysis

Background
The FHWA, in cooperation with Iowa State University (ISU) and the American Concrete Pavement Association (ACPA), developed the Concrete Pavement Road Map, which outlines a collaborative approach to strategic concrete pavement research and technology transfer for the future. The CP Road Map development process relied heavily on input from the stakeholder community. The CP Road Map Operations Group, a team assembled by Iowa State University’s National Concrete Pavement Technology Center (CP Tech Center) under contract to the FHWA, is working with industry and government partners to get the CP Road Map off the ground.

Mix Design and Analysis (MDA), the first of 12 research tracks defined under the CP Road Map, has been identified as one of four initial priority tracks by the CP Road Map Executive Committee. Several initial priority projects have been identified, and a scope of work developed, to meet the early objectives of the MDA Track. Specifically, these initial projects will quickly move the state of the art of mix design into the state of the practice.

This framing document briefly describes the purpose and history of the MDA Track and the impact of recent events and accomplishments on the research and priorities outlined in the track. This will be a living document, revised regularly by the Operations Group as research gaps are filled, priorities readjusted, and new needs identified.

The MDA Track is critical for several reasons. Concrete is a complex material. A decision by the design engineer may require changes to the materials specification. Selection of a particular material may change the maintenance needs of the pavement. All parties in the mix design process need to understand how their actions will affect the whole system, and by how much.

Another issue is that development of materials and mixture specifications is currently based on failure. Something goes wrong with a project, so the engineer tweaks the spec to prevent a repeat of the problem. This approach often attacks the symptom, not the cause of the problem, and can actually initiate or exacerbate other problems.

Another reason that this topic requires attention is that sustainability can no longer be ignored. The need to develop sustainable pavement systems is forcing us to change our approaches to some decisions. When considering project optimization, we have to include not only financial cost but environmental load. We can no longer insist on the best possible materials; we are running out of them. Instead we have to decide the limits of acceptability for locally available and recycled materials.

The complexity of the problem is compounded by the fact that many ingredients in concrete are changing as cost or environmental constraints are imposed on the manufacturers. As a result, some commonly used rules of thumbs may no longer be valid.
MDA Track Mission Statement

The aim of the Mix Design and Analysis Track of the CP Road Map is to develop and deliver integrated tools and techniques that will make it possible to specify, proportion, and construct concrete mixtures that meet the combined needs of owners and contractors for constructible, long lasting, sustainable, cost efficient, and verifiable concrete mixtures for pavements.

Current Gaps in Mix Design and Analysis

In October 2006, more than fifty representatives of agency, industry, and university members of the concrete pavement construction industry met for a day and a half at Turner-Fairbank Highway Research Center (TFHRC). Anticipating the startup of the CP Road Map MDA Track, participants discussed the needs of the industry with respect to mix design and proportioning. They validated the research needs, or gaps, outlined in the MDA Track. The wide variety of opinions expressed at that meeting can be summarized in four categories:

• **Tests.** There is an over-arching need for cost effective, fast, reliable tests that measure the properties we are really interested in, both for incoming materials and for the mix itself. Some are for QC (contractor internal work) and some are for QA (client acceptance) as discussed below. We therefore have to establish the parameters that define acceptable performance, and develop tests to measure them.
  o The first family of tests needed includes those that assess the acceptability of a given material. Many of these are currently used based on existing ASTM and AASHTO methods. However, some parameters are still not resolved such as methods to assess alkali reactivity of aggregates, in which the most reliable test takes up to 2 years to run, while the rapid 2 week test is reportedly unreliable about half of the time.
  o Tests are needed to monitor the variability of materials coming into a mixture, so that adjustments can be made on the fly to ensure that the delivered mixture is uniform and appropriate for the conditions in which it is being used.
  o The other tests required are those that assess the quality and / or performance of the mixture as it is placed. Tied to this is the need for appropriate limits that allow unambiguous decisions to be made regarding the acceptability of a given material or mixture. Without these tests, it is impossible to develop good performance based specifications, because it is impossible to measure the concrete performance.

Other points to note include that:
  o Critical, high priority parameters needing attention include verification of materials or mixtures, workability, durability and shrinkage.
  o Such parameters and tests should be appropriate for adoption in incentive payment systems.
  o Measurements must be able to be conducted in real time so that contractors can make adjustments on the fly.
  o Specifications must allow some flexibility to ensure that that the needed adjustments are not forbidden.
  o Approaches are needed to measure and allow for variability in the mix ingredients. Definitions are needed that define when a variation is significant enough to require re-approval.
  o A better understanding is needed about limitations and applications of recycled materials including concrete as aggregate and recycled water.
• Approaches that should be considered include:
  • Embedded sensors that can track system chemistry
  • Embedded sensors that can assess the quality of the air-void system
  • An instrumented vibrator that reports the rheological properties of a mix

• Models. Tied to the needs for tests is a need to correlate test results with long term performance of a concrete system. At present we lack the tools to be able to predict the potential life of a pavement based on accelerated or early age performance data.
  • Other models needed include development of more robust predications of fresh concrete properties based on the properties, proportions and interactions of the ingredients. This is especially evidenced in the current approaches taken to addressing interactions between ingredients. It is known that class F fly ash may improve alkali silica reaction expansion, but this can only be quantified using slow or imprecise tests. At the same time the use of the ash will likely retard setting and early strength gain, thereby increasing the risk of plastic cracking. The decision then of “how much fly ash” is based on empirical estimates.
  • Specifiers and plant operators need effective guidelines on the effects and side effects that may be expected if they change the source, type or dosage of a given material.

• Specifications. Current contracts are built around lowest cost, therefore innovations impose high risk to the specifier and to the contractor. It is more conservative to continue with business as usual.
  • Prescriptive practices also allow little flexibility to accommodate variation in materials or environment, potentially leading to distress or unacceptable variation in the finished pavement.
  • The aim of a good specification is to ensure that the owner is given the highest probability of getting what they pay for, while affording suppliers and contractors a reasonable opportunity to optimize their decisions.
  • As specifications become more performance based, there is a need for a guidelines addressing who should make what decisions – for instance, should designers specify slump when they do not know what equipment the contractor will use, and what slumps will be optimum for that equipment?

• Communication. When changing the rules, we have to prove that they work and teach the people involved what the new rules are and how to use them.
  • The need for education is growing because cement based systems are becoming increasingly complex with multiple admixtures and supplementary cementitious materials in most concrete mixtures made today. This is coupled with increasingly stringent demands being placed on the mixtures as budgets and time constraints become tighter.
  • The potential for problems is exacerbated as staffing levels are being reduced, leaving relatively inexperienced personnel being required to make decisions beyond their experience or training.

This meeting helped identify initial priority activities for the MDA Track, while clarifying the need for the MDA Track to be updated and "reframed" in light of newly completed and current research. See figure 1. It also led to the development of a track administrative structure.
Recently Completed Work
Several significant research projects have been completed since the TFFRC meeting. These include the following:

- Material and Construction Optimization for Prevention of Premature Pavement Distress in PCC Pavements (MCO). This Iowa DOT led Pooled Fund project has developed a Testing Guide that recommends a graduated series of tests based on the type of road being constructed. The tests are intended to be used by contractors to monitor materials and reduce variability in the concrete mixture.

- Identifying Incompatible Combinations of Concrete Materials. The project funded by FHWA developed a protocol on tools to identify whether materials within a given mixture were likely to interact causing unacceptable performance of the mixture.

- Concrete Mixture Performance Analysis System (COMPASS) is a Windows-based application aimed at optimized paving mixtures based on materials characteristics selected to achieve desired mixture performance.

![Diagram](image)

**Figure 1. Updated Framework of MDA Track Research Needs**
• The Integrated Materials and Construction Practices for Concrete Pavement (IMCP) Manual provides broad information on the effects of materials properties and proportions on concrete performance.

• A Guide Specification for airfield pavements has been prepared in a project funded by IPRF.

**Ongoing Work**
Several projects are currently underway that address some of the needs described above:

• FHWA is currently funding a significant, multi-year project with the aim of implementing best practices with respect to preventing and mitigating alkali silica reaction.

• FHWA has also recently released a request for proposals for innovative methods to analyze and test for alkali reactivity of concrete mixtures and to develop mitigation methods.

• Indiana DOT is leading a new Pooled Fund that is aimed at finding a reliable method of assessing the permeability of pavement concrete.

• NCHRP is funding a project aimed at better understanding the effects of currently available fly ash on concrete mixtures, including improved tools to characterize and specify the material.

• IPRF is funding work on investigating the effects of deicing salts on concrete pavements for airfields.

• South Dakota is the lead state in a Pooled Fund project investigating the effects of magnesium chloride on concrete This project is nearing completion.

• A project is underway aimed at developing guidelines for using ternary mixtures in concrete. Phase 1 work based on tests on pastes and mortars is complete, and was funded by a Pooled Fund led by Iowa. Phase 2 is starting under the sponsorship of FHWA.

• A project funded by an Iowa led Pooled Fund is investigating field temperature monitoring devices for assessing setting times and potential incompatibility / variability is nearing completion.

**Planned Work**
From the updated framework of research needs (figure 1), a number of specifically defined, high-priority tasks have been identified for immediate action. Some of the work will be conducted under a pooled fund currently being established. Other work is being conducted by agencies using their own funding sources. As additional organizations collaborate with the Track Leadership Team, their projects and the gaps they fill can be identified. The priority projects include the following:
**Pooled Fund**

An FHWA pooled fund led by Iowa is being set up to address specific needs within each of the four categories described above that summarize ideas from several Technology Transfer Concrete Consortium (TTCC) meetings:

- **Tests.** The following tests may be considered to be in three different states of development: 1) Nearing implementation, 2) Under development, and 3) Conceptual. The actions needed for each test will vary and are described as appropriate for each test.
  - Rheology test. The slump test is currently the standard approach to determining workability of a mixture. However, it is not always valid for use in mixtures needed for slipform paving, and it does not describe the parameters needed to be known by paver operators. There is a need to develop a simple field test for measuring how much a paving mixture will move when vibrated (viscosity) and whether it will be prone to edge slump (yield stress). Some work has been conducted in this field in the past with limited success. A pilot investigation into alternative approaches to this issue is needed. It is planned that the results of the test will allow for a more definitive description of the workability of a mixture.
  - AVA. The air void analyzer is a device intended to provide on-site evaluation of the air void system in fresh concrete. Work is being conducted by a number of researchers to evaluate the device and to develop guidelines on its use. The findings of these researchers need to be gathered and interpreted, and a formal method statement needs to be developed for submission to AASHTO and ASTM.
  - If performance based specifications are to become more acceptable, there is a need to be able to verify that a mixture delivered to a given site contains the correct materials in the given proportions used in the verification testing during design stage. At present there is no good way to do this, but the topic is worth investigating.
  - If the AVA does not prove to be useful, consideration should be given to investigating alternative methods of assessing the air void system in fresh concrete.
  - Foam index test. Several versions of this test are used by fly ash producers and purchasers as a quality control tool. There is a need for this test to be standardized and submitted to AASHTO and ASTM.

Other tests that need to be further investigated include:

- Coefficient of Thermal Expansion (CTE), is a measure of the change in dimension of a concrete sample due to changes in temperature. The parameter has a direct impact on the risk of temperature related cracking in newly placed concrete pavements. A test has been developed at FHWA and needs to be field tested and validated, and a formal method statement needs to be developed for submission to AASHTO and ASTM.

- Field Temperature Monitoring. Monitoring the rise in temperature due to hydration of a fresh mixture provides a tool to assess the uniformity between material and concrete batches, as well as indicating setting times useful for saw-cutting operations. A project is nearing completion investigating the various devices available including some field tests. A formal method statement needs to be developed for submission to AASHTO and ASTM.

- Permeability. European specifications are using a permeability test developed by Torrent. There is a need to investigate the applicability of this test to US pavement construction.
Recommendations have also been made to use the ASTM C 642 boiled water test as a simple measure of potential durability. This test has been the subject of a brief investigation in Minnesota. The test warrants further investigation. Work under this task will be coordinated with the Indiana Pooled Fund Permeability work.

- **Models.** The models discussed below include tools or methods to correlate different parameters, and to help users select appropriate materials and proportions.
  - Seminal work conducted by Klieger in the 50's on which we base our current limits on air content and air void system parameters was conducted using no supplementary cementitious systems and a single type of air entraining admixture. Some of the recommendations of this work need to be verified as still appropriate for current cements, SCM's and air entraining admixtures, all of which have changed significantly over time.
  - There is a need to correlate paste content with mixture shrinkage and cracking risk, for all types of binders.
  - There is a need to set out standard information to be recorded and stored at the time of construction so that in later years, the performance of pavements can be compared with the construction data, thus allowing development of durability models based on field performance rather than extrapolation of laboratory data.

Other models that need to be further investigated include:
  - Interaction Hyperdoc – it is planned to develop an interactive electronic document based on the IMCP that will enable users to observe the effects that their decisions on materials type and dosage will have on properties of the concrete.
  - Current specifications impose limits on minimum working temperatures for concrete pavements. The validity of these limits needs to be verified.
  - Current tools used to assess the combined aggregate grading are empirical in nature, and are difficult to impose specified requirements around. It is accepted that while a good combined grading increases the probability of an acceptable mixture, it is still possible to make good concrete pavement with a poor grading and bad pavement with good grading. This topic needs further investigation.

- **Specifications.** Changes and innovations to the way we do things can only be achieved within the context of specifications. It is therefore critical that appropriate specifications be developed and implemented.
  - A guide specification and commentary will be prepared that lays out current state of the art thinking with respect to materials and mixture selection, proportioning and acceptance. This document will take into account the different environments, practices and materials in use across the US, and will allow optional inputs for local application. The specification will be developed based on existing documents including the recent IPRF Draft PS01.
  - As a supplement to the IMCP Manual, it is planned to develop check-sheets for different parties involved in the development of a mix design. They will help inexperienced practitioners make appropriate selections for the tasks they are conducting (e.g. preparing a specification or selecting aggregates). It is also intended that decisions are made at the correct location (e.g. slump is selected by the contractor rather than the specifier).
• **Communication.** An integral part of any significant change to the methods or process of mix design is education. Users from all parties have to be made familiar with what has changed, why it was necessary, and how it affects they way they do things.
  - Field trials to demonstrate and validate new tests
  - Field trials to demonstrate and validate new models
  - Field trials to demonstrate and validate new specifications
  - Training materials as needed

**Other Planned Projects**

Two other projects are currently planned as early activities under the MDA Track:

One is the development of a publication entitled *Design and Control of Concrete Pavement Mixtures*”. This will be prepared by PCA and ACPA staff using their own funding. It will be based on current state of the practice technology and will be similar in style and content to the PCA’s “Design and Control of Concrete Mixtures”. It will be reviewed by a panel of representatives from owners, engineers, materials suppliers, and contractors.

A project is one being conducted by FHWA to coordinate the various software packages that they already have had developed. These include COMPASS, HIPERPAV, and COST.

**Stakeholders and Partners**

At present, the following organizations have expressed interest in committing to the activities of this track:
• Several states have indicated that they will contribute to the Iowa-led pooled fund described above. A work statement is in the last stages of preparation for this fund.
• Cement industry through PCA
• ACPA
• FHWA

**MDA Track Administration**

• A Track Leadership Team has been established comprising the following:
  - Richard Meininger – FHWA
  - John Staton – MI DOT
  - Leif Wathne – ACPA
• A Technical Advisory Committee for the MDA Track was selected. The committee is comprised of 15 people representing federal, state, and industry interests as noted below:

<table>
<thead>
<tr>
<th>Contractors:</th>
<th>Suppliers:</th>
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<tbody>
<tr>
<td>Hamad, Farid</td>
<td>Barry</td>
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<tr>
<td>Capon, Pete</td>
<td>Taubert, Don</td>
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<tr>
<td>Brown, Mark</td>
<td>Lobo, Colin</td>
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<tr>
<td>Descheneaux,</td>
<td></td>
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FKHamad@laneconstruct.com
PCapon@Rieth-Riley.com
brownm@zachry.com
barry.descheneaux@holcim.com
dtaubert@capitolcement.com
clobo@nrmca.org
The Iowa-led Pooled Fund will also appoint its own TAC representing those states that contribute to the fund.

The goal of the Track Leadership Team is to provide an environment that fosters:

- Collaboration between:
  - Funding agencies to ensure that research money is leveraged to deliver as much useful information as possible at minimum cost
  - Researchers to unite their resources and abilities to the same end

- Coordination, so that
  - Work is not repeated unnecessarily
  - Efforts are focused appropriately

- Implementation so that
  - The results of the work can be made public
  - Opportunities are provided to test developments in the field
  - Acceptance in regulatory bodies is facilitated
  - Effective use of new, proven, tools is encouraged into the future.
Performance-based Design Guide
for
New and Rehabilitated Concrete

Implementing the CP Road Map Design Track

BACKGROUND

Prior to the Mechanistic Empirical Pavement Design Guide (MEPDG), empirical and very limited mechanistic approaches to concrete pavement design were the standard practice. Empirical approaches are effective when all of the site and design feature conditions basically remain the same, which rarely occurs. The focus is on serviceability (or smoothness) only and not on understanding and managing specific distress or failure modes which create loss of smoothness and maintenance needs.

The primary source of much of today’s pavement design is still the AASHTO road test of the 1950s. This one subgrade, one base, one climate, limited traffic design guide was constructed using better-than-normal construction practices. Data analysis techniques were also fairly basic and design reliability was not included. Moreover, the AASHTO road test did not incorporate many of the concepts and products used in concrete pavement practice today, including concrete overlays, non-doweled joints, longer joint spacing, tied concrete shoulders, CRCP, permeable bases, different cements, dowel bar retrofits, and other necessary repairs.

Under this track, the concrete pavement research community aims to continue the development of the next generation of mechanistic approaches to pavement design, but also to assure better integration with materials, construction, and environmental inputs. Because many materials properties are important to design success, it is critical that the research conducted under this track be closely coordinated with that done in Track 1 (Performance-Based Concrete Pavement Mix Design System).

The state-of-the-practice today is moving rapidly toward mechanistic-empirical approaches, particularly with the release of the M-E pavement design guide and the expressed interest of many States. These mechanistic-empirical approaches will allow the designer to account for new design features and characteristics, many materials properties, changing traffic characteristics, and differing construction procedures (such as curing and day/night construction). The designer can also now consider additional design features and focus more on pavement performance, including limiting key distress types.
In addition, the design reliability approach does not have the significant limitations of the current AASHTO empirical guide for heavy traffic.

This track builds off and continues the improvement of the excellent comprehensive work done under NCHRP 1-37A and recently approved by AASHTO as the Interim M-E Pavement Design Guide. This track requires a detailed understanding the AASHTO Interim M-E pavement design guide, committing researchers to improving the accuracy and comprehensiveness of performance modeling and prediction.

However, the CP Road Map also identifies the need for simplified design procedures for cities and counties, as well as a design catalog approach.

The pavement design practice of today is basically empirical with AASHTO, though the state-of-the-practice is moving toward mechanistic approaches.

In continuing this work, this track not only looks to the next generation of modeling improvements, but seriously considers the integration of design with materials, construction, presentation, and surface characteristics. The advanced technology developed under this track will increase concrete pavement reliability and durability (with fewer early failures and lane closures) and help develop cost-effective pavement design and rehabilitation.

**Design Track Goal**
Mechanistic-based concrete pavement designs will be reliable, economical, constructible, and maintainable throughout their design life and meet or exceed the multiple needs of the traveling public, taxpayers, and the owning highway agencies. The advanced technology developed under this track will increase concrete pavement reliability and durability (with fewer early failures and lane closures) and help develop cost-effective pavement design and rehabilitation.

**TRACK OBJECTIVES**

1. Develop viable (e.g., reliable, economical, constructible, and maintainable) concrete pavement options for all classes of streets, low-volume roads, highways, and special applications.
2. Improve concrete pavement design by maximizing the use of fundamental mechanistic relationships.
3. Integrate pavement designs with materials, construction, traffic loading, and climate.
5. Design preservation and rehabilitation treatments and strategies using mechanistic-based designs.
6. Develop and evaluate new and innovative designs for specific needs – high traffic; residential; and parkways.
STAKEHOLDERS INVOLVED AND CORE GROUPS

There are many groups organized to deal with concrete pavement design issues.

The State DOTs, through AASHTO’s Joint Technical Committee on Pavements (JTCP) has historically led the country in identifying, funding (through NCHRP) and implementing design-related research.

The Federal Highway Administration also has been key to identifying long term research needs in concrete pavement design, especially the development of models, best practices, and training and implementation efforts.

The concrete pavement industry through the American Concrete Pavement Association, have been actively involved in many design-related efforts. They include the concrete overlays, simplified software development, professor training seminars, tie-bar design, and applications for cities and counties, for example. They also are the voice of the industry, giving input to AASHTO, FHWA, and the individual states.

Several national and regional consortia/groups have formed to evaluate and/or advance the MEPDG implementation. A search of TRB’s Research In Progress website suggests that nearly two dozen states have active project related to the MEPDG in particular and the Design Track in general.

Examples include the FHWA Lead States (includes 19 states), State Pavement Technology Consortium (SPTC) comprising of Minnesota, Texas, California, and Washington, Northeast States, Rocky Mountain States, and North Central States.

The National Center for Concrete Pavement Technology is currently developing a national effort to better implement concrete overlays. Included in this effort is the recognition of the need for a more integrated and simplified way to design overlays supplementing the procedure included in the ME pavement design guide. The National Center is also coordinating regional programs across the country to set up MEPDG discussions.

State DOTs have come together regionally through groups such as the Midwest Concrete Consortium (now the National Concrete Consortium). The North Central States MEPDG User Group is another example.

The Concrete Reinforcing Steel Institute, in partnership with the FHWA, has organized an Expert Task Group that is looking at issues related to continuously reinforced concrete pavements, with a focus on the M-E Guide.

There are many other groups, formal and ad-hoc that are looking into specific elements of concrete pavement design.
ONGOING WORK RELATED TO THE DESIGN GUIDE TRACK

Fueled by the interest generated by the AASHTO Interim Mechanistic Empirical Pavement Design Guide (MEPDG), a tremendous amount of work is currently ongoing related to rigid pavement design which meets several of the Track Objectives noted above; especially, objectives 1, 2, and 3, and 5. Objective 4 of the Design Track is partially addressed by the recently completed NCHRP 1-43 project (Pavement Friction Guide) and the ongoing work sponsored by ISU-FHWA-ACPA consortium (Concrete Pavement Surface Characteristics Field Experiments).

Specifically, federal, state, and industry sponsored work is ongoing in 17 of the 21 subtracks of the Design Guide Track. These include:

- DG 1.1 - Development of Benchmark Problems for Concrete Pavement Structural Models Verification
- DG 1.2 - Improvement of 2D and/or 3D Structural Models for JPCP & CRCP Used for Reconstruction and Overlays
- DG 1.4 - Improvements to Dynamic Modeling of Concrete Pavement Systems for Use in Design and Analysis
- DG 1.5 - Structural Models for Special New Types of Concrete Pavements and Overlays
- DG 2.1 - Enhancement and Validation of Enhanced Integrated Climatic Models for Temperature, Moisture, and Moduli
- DG 2.2 - Development and Enhancement of Concrete Materials Models and Improved Pavement Design
- DG 2.3 - Enhancement and Validation of Traffic Loading Models Unique to Concrete Pavements
- DG 2.4 - Improved JPCP Deterioration Models
- DG 2.5 - Improved CRCP Cracking and Punchout Prediction Models
- DG 2.6 - Improved Consideration of Foundation and Subdrainage Models
- DG 3.1 - Concrete Pavement Design Aspects Related to Multiple/Additional Lanes
- DG 3.3 - Improvements to Concrete Overlay Design Procedures
- DG 3.4 - Improvements to Concrete Pavement Restoration (CPR)/Preservation Procedures
- DG 3.5 - Development of New and Innovative Concrete Pavement Type Designs
- DG 4.2 - New Mechanistic-Empirical Pavement Design Guide Procedures for Paradigm Shift Capabilities

Not surprisingly, spurred by the recent positive ballot received by the MEPDG from the AASHTO subcommittees on Materials and Design to make it an AASHTO Interim Pavement Design Guide, there has been a wealth of activity related to the MEPDG. This
work is related to Subtrack DG 5.1 on MEPDG implementation. Some of the projects go across multiple tracks, e.g., Mix Design. In addition, several industry and FHWA sponsored training activities related to the MEPDG are ongoing.

Specific projects are shown in Appendix 1.

**TRACK LEADERSHIP MISSION**

The CP Road Map supports organizational mechanisms that will lead to
1) Improved coordination, cooperation, and collaboration of research and implementation;
2) Identification and promotion of research that is currently unfunded but needed;
3) Integration of the design track with Track 1 Mix Design and Track 3 NDT for Construction; and
4) Implementation and training efforts.

The CP Road Map is being administered by the National Center for Concrete Pavement Technology through funding from both the FHWA and the State DOTs. For the Design Track to proceed in an orderly fashion and to assure that the above four mechanisms are addressed.

It is proposed that a group of leaders knowledgeable with design issues, understand the work going on, and are committed to the long term goals of the Design Track.

**TRACK LEADERSHIP MEMBERS**

**State DOTs**
Andy Gisi, KS
John Donahue, MO
Mohamed Elfinio, VA
Danny Dawood, PA
Jeff Uhlmeyer, WA

**Industry**
Randy Riley, IL ACPA
Matt Zeller, MN ACPA
Todd LaTorella, MO-KS ACPA

**Design Track Leadership Scope**

It is recommended that representatives from the AASHTO JTCP, the industry, and FHWA begin to formally discuss ways to promote the overall goals of the Track and undertake the following activities

1) Identify and support a slate of design research
2) Develop a framework for cooperation and sharing of work underway in design research and implementation
3) Organize implementation and training efforts
4) Work with other tracks to assure proper integration.
Jim Powell, ACPA-NW  
Mike Ayers, ACPA National  

**FHWA**  
Tom Harman  
Angel Corera  
Gary Crawford  

**Academia**  
Julie Vandenbossche  
Jeff Roesler  

**TRACK KICK-OFF INITIATION**  

On June 30, 2008, a conference was held with all the track leaders to discuss the potential missions. It is intended for the next year that conference calls and webinars be the vehicle for communication. The minutes of that meeting are included as Appendix 1.  

**SUGGESTED SHORT-RANGE RESEARCH AND IMPLEMENTATION PROJECTS**  

**Concrete Overlays**  

Guidance for concrete overlay design has been published by ACI, AASHTO, FHWA, PIARC, NCHRP, ACPA, PCA, the U.S. Army Corps of Engineers, Federal Aviation Administration, and various state departments of transportation. These procedures use a variety of underlying assumptions and design strategies. No single document exists now to design the various concrete overlay solutions -- bonded, unbonded, whitetopping, CRCP, overlays, etc.  

It is suggested that a comprehensive review of the design procedures lead to two efforts:  

1) Building off the current Concrete Overlay Project (ISU and FHWA), pull together a comprehensive design manual that is heavy on case studies developed under that initiative and shows how to use the various design tools in specific situations.  
2) Develop a more comprehensive strategy on pulling together one design practice, by integrating existing procedures and continuing research on some of the key weaknesses. (See Appendix 2.)  
3) Continued training and outreach on overlay design and construction efforts.  

This effort should be presented as part of the Concrete Overlay Initiative to see if support can be gathered for this initiative.  

*Cost Range: $600,000 - $700,000*
Concrete Tie Bars

On the recent Scan of Long Life Pavements, the Scan Team noted that the Europeans use less tie bars than is customary here in the U.S. As part of the implementation of that Scan, the ACPA has research underway to look at how tie bars are actually designed and see if there is a way to reduce the number and spacing.

The Minnesota DOT and the National Concrete Pavement technology Center, with cooperation of FHWA, are working to develop a project at MnROAD to install various diameters and lengths of tie bars at different spacing. The slabs will be instrumented to compare the field results to the theoretical results from the MEPDG.

It is suggested that their research be examined and evaluated, with technology transfer and implementation efforts promoted, as a continuation of this work.

Cost Range: $350,000 – $400,000

Suggested Longer Range Research Projects

Two projects that might be offered from the track that are worthy of consideration are noted below. These projects have been selected since they (1) are considered as high priority items for the stakeholder design community and (2) they have good synergy with other Track work. They also promote the performance goals of the track.

The overall funding needed to accomplish these projects is also noted. This work could be further prioritized and segmented so that it can be accomplished incrementally in stages under multiple funding mechanisms. The incremental deliverables could be designed to be modular in nature to facilitate further enhancement and integration under future research products.

Develop an Integrated Concrete Materials Modeling and Design/analysis Tool

Background: Concrete materials properties have a great effect on the short- and long-term performance of concrete pavements. While tools currently exist for early age performance prediction (e.g., HIPERPAV) and long-term performance prediction (MEPDG), they have not been fully integrated from a materials modeling standpoint. Several materials inputs are common to both these tools making the integration a relatively easy process, however, more work needs to be done to integrate and optimize the materials, climate, traffic, and other inputs. Such an integrated tool would have tremendous obvious benefits to all the stakeholders involved with designing, constructing, and building concrete roadways.

Tasks: Key aspects of this improvement of PCC materials and construction to be addressed are as follows.
1. Several concrete material properties vary over time which must be considered in design. These properties include strength, modulus, shrinkage, creep, and others. Provide further data on these properties on how they vary over time as a function of mix design and exposure conditions.

2. Determine the effect of construction factors on concrete materials properties in the slab. This would include the following as a minimum:
   - slab curing
   - slab zero-stress temperature
   - built-in curling (thermal gradient through slab as it solidifies)
   - differential slab shrinkage

3. Development of new tests for characterizing concrete strength and modulus that reflects field behavior better than those used today.

4. Achieve early-age and long-range performance predictions.

Cost Range: $1,000,000

Implementation: Implemented into the MEPDG

Development of Improved JPCP Deterioration Models

Background: JPCP is by far the most popular type of concrete built in the world. This is due to its relative cost effectiveness and its reliability. The design of JPCP has greatly improved through increased knowledge over the past several decades.

Tasks: There remain some important aspects of improvement as listed below.

1. Improve on the top down & bottom up transverse cracking models for new & rehab developed under NCHRP 1-37A.

2. Longitudinal cracking (fatigue related). There has been longitudinal cracking in JPCP that could not be explained by traditional fatigue cracking calculations. A major study is needed to determine under what circumstances longitudinal cracking could occur that is fatigue based. The effect of widened slabs will be investigated.

3. Improved joint and crack faulting & spalling models for new and overlays. The existing models will be considered and improved upon to model faulting for all kinds of design and rehabilitation situations needed for design. An improved joint opening/closing model may be needed.

The end product of all this research would be greatly improved and more comprehensive distress and smoothness prediction models for JPCP. The key benefit will be a reduced prediction uncertainty which results in a more cost-effective design for a given level of reliability for JPCP.

Cost Range: $1,000,000 – 1,500,000
Implementation: Implemented into design procedure.

Design of new and Innovative Concrete Pavement Type Design

JPCP is the world’s most widely constructed concrete pavement. Historically, rectangular sections have been used extensively for this type of pavement.

Tasks:
1. Conduct a literature study to explore many new and innovative shapes for concrete pavement designs. This study will involve both performing a literature search and contacting as many agencies as possible around the world to investigate the latest innovative designs.
2. Identify key design innovations that could optimize the structural and material design of these pavements, examining trapezoidal cross sections for example.
3. Complete an analytical analysis of these various sections, identifying possible strengths and weaknesses of the new shapes.
4. From the most promising, develop an experimental project that builds and monitors several of these sections.

Cost Range: $840,000 - $600,000
Implementation: Implemented into design and construction procedures.
HIGH-SPEED NONDESTRUCTIVE TESTING AND INTELLIGENT CONSTRUCTION SYSTEMS

Implementing the CP Road Map ND Track
Framework, dated 02 July 2008

Administrative Contact: Paul Wiegand
Technical Contact: Dennis Turner
CP Road Map Facilitator: Ted Ferragut

Background
Over the past 20+ years, society has experienced a wide array of technological advances, from the personal computer to the cell phone. During this time, the research community has refined a number of NDT technologies. However, these tools have largely been confined to pavement management uses and have not been applied extensively to the concrete paving process.

Advances in technology could benefit both the construction and inspection teams in several key ways. DOTs have expressed interest in the benefits of ND testing. The equipment industry, however, faces both a technical challenge and an investment challenge of investing without having any certainty of a market. Establishing a working group that properly frames the issues, agrees on the technologies, and prioritizes the work efforts is critical for overcoming this investment challenge.

The CP Road Map has identified nine potentials systems that could be developed and integrated into the paving operations:

- Temperature/Moisture/Strength/Stiffness Changes and Development
- Pavement Thickness
- Dowel/Tie Bar/Reinforcement Alignment
- Curing Effectiveness
- Slab Support
- Workability
- Air Void Systems
- Mix Density and Volumetrics
- Smoothness/Texture (Skid Resistance & Splash/Spray)

With wireless and telecommunication systems, information can be shared all over the country, with specialists working to improve the operation without even being on site.

Background information on the CP Road Map and other corresponding research tracks can be downloaded from the FHWA website at: http://www.fhwa.dot.gov/pavement/pccp/pubs/05047/.
Benefits of ND Testing Integrating with the Paving Operation

Both industry and government will benefit from these tools by reducing reliance on slow and sometimes poorly managed small-sample testing programs. The technologies targeted in this research track are intended to form the basis of an Intelligent Construction System (ICS) that could sense and adjust the paving process automatically while informing contractors and inspectors of changes and/or deficiencies in construction. Continuous and real-time sampling could be configured to detect changes to the approved mix design and the preprogrammed line and grade values. These technologies would also allow industry and government to use the data for long-term pavement management and evaluation. In this regard, this research track is interdependent with multiple tracks within the CP Road Map.

**ND Track Goals**

- To improve construction operations by providing continuous and rapid feedback to make changes on the fly.
- To develop NDT methods that use continuous and real-time sampling to monitor performance-related concrete mix properties and reduce the number of human inspectors.
- To integrate data collection with materials management and pavement management systems to solve future problems and evaluate.

This document further describes the framework of the ND Track of the Long-Term Plan for Concrete Pavement Research and Technology – The Concrete Pavement Road Map published in September 2005.

**Mission Statement for the ND Track**

Under the ND Track, the concrete pavement industry will work together to develop an integrated set of technologies that can rapidly assess and track construction parameters related to pavement construction and performance.

The ND Track Research Team will identify, promote, and coordinate the research and technology that is necessary to achieve this goal. It will promote collaboration among partners, and ensure that duplication is minimized.

**Identifying the Gaps**

In developing the CP Road Map, and with the ND Track Goal in mind, a thorough review of the state of the practice was made. During this process, gaps were identified with respect to testing methods commonly used to monitor the paving operation. These gaps have both short and long term effects on the industry. In the short term, gaps exist from the practice of manual data collection of a limited number of parameters and locations during construction. The inability to collect the correct data in the proper amounts also effectively limits our industry from fully implementing mechanistic pavement design procedures and performance based specifications.

To move forward, we must first look at the various components of the paving process and determine where technology and practice are lacking. To address the gaps in current practice, the ND Track will address field control issues and ongoing efforts with existing technologies. Another goal focuses solely on the technological gaps that must be closed to move towards a fully automated construction monitoring process. The final goal of the ND Track is to integrate field control practices with technological advances to form a fully integrated ICS.

An idealized ICS for concrete paving is shown in Figure 1. In this figure, we see a member of the construction or inspection team with access to multiple data streams tracking the paving process.
These continuous streams of data will allow the paving process to be managed much more effectively and efficiently.

![Figure 1. Idealized Intelligent Construction System for Concrete Paving](image)

**The ND Track: a Plan to Bring Technologies Together**

A structured outline for the ND Track was presented in the original CP Road Map. The Track was divided into subtracks, and then again into tasks that describe individual "compartments" of research and technology. Collectively, the work program will meet the goal of the Track, but only if collaboration is realized. Although some related work has been ongoing since the publication of the CP Road Map in 2005, it has not been directly focused towards the goals of the ND Track. This demonstrates the need to formally manage the ND Track to realize these goals.

The ND Track currently identifies 22 problem statements. The proposed research is organized into three subtracks and presented in a recommended sequence:

- Subtrack ND.1: Field Control
- Subtrack ND.2: Nondestructive Testing Methods
- Subtrack ND.3: Nondestructive Testing and Intelligent Construction Systems Evaluation and Implementation

Problem statements contained in the plan may correspond to one or more individual projects. Over the course of the ND Track, each problem statement will be developed into research project statements that will contain detailed descriptions of the research to be accomplished, specific budgets, and definite timelines. Detailed problem statements for the ND Track are not included here for brevity, but can be found in the National CP Tech Center Publication, *Long-Term Plan for Concrete Pavement Research and Technology - The Concrete Pavement Road Map: Volume II, Tracks*, published September 2005.

**Foundational, Recent, and Ongoing Work**

The following is a summary of some of the more relevant work that is foundational in nature, recently completed, and/or ongoing. While categorized under the Subtrack headings, no attempt is made here to prioritize their relevance. Collaboration with the sponsors and researchers of these projects will be important to the success of the ND Track.
Subtrack ND.1: Field Control

- Stringless Paving – Multiple Equipment Manufacturers
- Advanced Quality Systems – FHWA/ARA/Fugro/Transtec
- Reflective Ultrasonic Technique for Early Age Strength Determination – Northwestern University
- Maturity Testing for Highway and Airfield Concrete – IPRF/ Multiple State DOTs/Vendors
- Nondestructive Evaluation of Iowa Pavements: Phase I – Iowa DOT/Iowa State
- Implementation of TEMP System – FHWA CPTP Task 7 – Transtec
- Performance Specifications for Rapid Highway Renewal – SHRP II R-07 – Trauner

Subtrack ND.2: Nondestructive Testing Methods

- Thermochron and Hygro Button Innovation – Texas DOT/Univ. of Texas
- Scanning Lasers for Real-Time Pavement Thickness Measurement – Iowa DOT/Iowa State
- Integrating Deflection and Ground Penetrating Radar – Texas DOT/Texas A&M
- Accuracy of Ground Penetrating Radar for Pavement Layer Thickness – Univ. of Kentucky
- Demonstration of Seismic and Maturity Testing Technologies – Univ. of Texas-El Paso/AP Tech
- Magnetic Tomography for Dowel Bar Location – FHWA CPTP Task 7 – ARA
- Demonstration of SmartCure to Monitor Curing Operations – FHWA/Transtec
- Accelerated Implementation of Intelligent Compaction – FHWA/Pooled Fund/Transtec
- Examining the Benefits and Adoptability of Intelligent Soil Compaction – NCHRP 21-09
- Measuring Pavement Profile at the Slip-Form Paver – Ames Engineering/GOMACO
- Concrete Pavement Surface Characteristics Program – FHWA/Iowa-State

Subtrack ND.3: Nondestructive Testing and Intelligent Construction Systems Evaluation and Implementation

- Nondestructive and Innovative Testing Workshop – FHWA CPTP Task 59 - Transtec
- Leveraging Technology to Improve Construction Productivity – FIATECH

Stakeholders and Partners

Successful collaboration under the ND Track will require participation from a number of diverse groups, many of which are listed below.

- Active Stakeholders and Partners
  - AASHTO
  - ACPA Chapters
  - ACPA National
  - FIATECH
  - FHWA
  - NRMCA
  - PCC Paving Equipment Manufacturers
  - PCC Paving Contractors
  - Sensor and Nondestructive Testing Vendors
  - State DOTs
  - TRB Committee AFH50
Inaugural ND Track Forum

An ND Track Forum was held in Austin, Texas in June 2008 to address the issues raised in this paper. As with the Mix Track and Surface Characteristics Track, the strategic forums proved very beneficial to organize and kick off work under this track.

Objectives

✓ To achieve consensus on the ultimate objectives of the ND Track.
✓ To validate what knowledge gaps exist today.
✓ To identify how we as an industry can work to fill these gaps.
✓ To identify early projects and their funding mechanisms.
✓ To help advance the CP Road Map ND Track to a dynamically managed program.

Agenda

✓ Introduction to CP Road Map
  ♦ Brief History of Program
  ♦ Current CP Tech Center Role in Implementation and Administrative Support
  ♦ The Definition and Importance of Collaboration.
✓ Presentation of Draft ND Track Framework
✓ Summary of ND Work
  ♦ Foundational
  ♦ Recently Completed
  ♦ Ongoing
✓ Discussion with goal of Consensus
  ♦ Overall Objective
  ♦ Gaps
  ♦ Short-Term Projects and Products
  ♦ Long-term Project and Products
✓ Identification of Funding Partners for Short-Term Projects
✓ ND Track Communications, Coordination, and Collaboration Plan
✓ What Happens Next?

Participant List

✓ FHWA/USDOT
  ♦ Gary Crawford, Office of Pavement Technology
✓ State DOT
  ♦ Shannon Swietzer, North Carolina Turnpike Authority (AFH50)
  ♦ Hua Chen, Texas DOT
  ♦ Bryce Simons, New Mexico DOT
  ♦ Doug Schwartz, Minnesota DOT
✓ Pavement Industry
  ♦ Kevin Klein, GOMACO
  ♦ John Eisenhour, Terex Roadbuilding
  ♦ John Maurer, Ames Engineering
  ♦ Dennis Warren, Texas Concrete Paving Association
✓ Academia and Other Industry
  ♦ John Daniewicz, Rhino Analytics
  ♦ Randall Jean, Baylor University
Ranking Parameters

A brainstorming exercise at the forum was conducted to rank measurement parameters according to importance and ease of implementation in a real-time monitoring system. The results are summarized below:

Importance (highest to lowest)

- Fresh Mix Properties/Variations
- Curing
- Surface Characteristics (smoothness/texture)

Ease of Implementation (easiest to most difficult)

- Curing
- Surface Characteristics
- Fresh Mix Properties/Variations

Action Plan

In order to effectively build off of the work to date, a number of early products are recommended under the ND Track. These early products should include:

1. Identify most critical parameters to monitor during construction:
   a. Fresh mix properties/variability
   b. Curing operations
   c. Smoothness/texture
2. Identify corresponding technologies to assess most critical parameters to monitor during construction.
   a. Framework study that shows system integration of all potential devices, their location, their interrelationship, the wireless communication system, and the availability of information at various locations on the paving train, plant, or test laboratory.
   b. Complete and detailed study of sensor technologies
   c. Detailed study of types and protocols for wireless network tools to transmit and record sensor readings in an integrated communication system. This would include considerations to develop robust equipment and sensors needed to withstand equipment vibrations, weather, and other potential problems from the construction environment
3. Identify long-term research needs:
   a. Assess real-time measurement needs and techniques for concrete mix properties and variability
      i. Systems approach that would link data from plant, transport vehicles, and paving equipment.
   b. Develop causality links between paving operations and mix properties/variations on changes to pavement smoothness and texture.
c. Identify techniques and technologies to properly measure air void system in the appropriate location on the paving operation.

4. Identify short-term implementation needs:
   a. Develop equipment performance specifications for curing monitoring system similar to SmartCure
      i. Provide model specification to National Concrete Consortium.
   b. Search for funding mechanisms or incentives to further implement available real-time smoothness and/or texture monitoring systems.

5. Organize symposium of 40-50 attendees from concrete paving and sensing industries to discuss technologies to address identified measurement needs.
   a. Present engineering parameters of concrete paving that would benefit from new and improved sensing technologies.
   b. Present sensing technologies that directly address identified needs for concrete paving.

6. Further study of stringless paving operations, including superelevated, horizontal, and vertical curves.

Contacts
✓ Administrative Contact: Paul Wiegand, 515-294-7082, pwiegand@iastate.edu
✓ Technical Contact: Dennis Turner, 512-451-6233, dennis@thetranstecgroup.com
✓ CP Road Map Facilitator: Ted Ferragut, 202-744-4275, tferragut@tdcpartners.com
✓ Meeting Logistics: Denise Wagner, 515-294-5798, dfwagner@iastate.edu
Understanding and Optimizing
Concrete Pavement Surface Characteristics
Implementing the CP Road Map SC Track

Framework Document
22 June 2008

Administrative Contact: Paul Wieand, National CP Technology Center
Technical Contact: Robert Rasmussen, The Transtec Group, Inc.
CP Road Map Facilitator: Ted Ferragut, TDC Partners, Ltd.

Background
What is a pavement surface characteristic (PSC)? Said simply, it is a way to describe a pavement surface that directly or indirectly connects to a human response or societal need. It includes things such as smoothness, friction, noise, splash & spray, surface drainage, and rolling resistance. Other characteristics include tire wear, vehicle wear, and reflectivity & illuminance. Affecting these surface characteristics are numerous pavement properties, with the most important being surface texture. These “bumps and dips” in the road range in size from long rolling undulations to asperities that cannot be seen with the naked eye. Other important pavement properties include the degree of permeability and porosity, cross-slope, and mechanical impedance (stiffness). Even the color of the surface will also affect some surface characteristics both directly and indirectly.

In July 2006, the National Concrete Pavement Technology Center (CP Tech Center) published a Strategic Plan for Improved Concrete Pavement Surface Characteristics. The plan included an update to the Surface Characteristics (SC) Track of the Long-Term Plan for Concrete Pavement Research and Technology – The Concrete Pavement Road Map published in September 2005.

Meanwhile, a coordinated three-part effort has been underway since early 2005 termed the Concrete Pavement Surface Characteristics Program. Managed by the CP Tech Center, this effort has pooled funding and experience from within the FHWA, the concrete paving industry including ACPA, and numerous State DOTs. In early 2007, the third part of this program was launched under Pooled Fund TPF-5(135).

SC Track Goal
To fulfill the needs and desires of society by designing, building, and maintaining concrete pavement surfaces that are safer, more comfortable, durable, and cost effective. To develop an integrated unified model that links concrete pavement surface characteristics to the human element, pavement properties, and the factors that affect these all.

The purpose of this document is to consolidate both ongoing and proposed activities related to concrete pavement surface characteristics. It is intended to be a technical framework document, developed as part of the CP Road Map SC Track implementation. The framework effort will, in turn, update and validate a prioritized, productive, coordinated, and non-duplicative research plan for addressing knowledge gaps and advancing improvements in concrete pavement surface characteristics.
Mission Statement for the SC Track

Under the SC Track, the concrete pavement industry will work together to develop specifications and guidelines to design, construct, and maintain concrete pavements that are safe, comfortable, durable, and cost effective. The goal is concrete pavements that invoke a pleasant human experience and address an array of societal needs. The SC Track will coordinate the research and technology that is necessary to achieve this goal. It will promote collaboration among partners, and ensure that duplication is minimized.

Identifying the Gaps using an Integrated Perspective

In developing the CP Road Map, and with the SC Track Goal in mind, a thorough review of the state of the practice was made. From this, numerous gaps were identified with respect to concrete pavement surface characteristics research and technology. The idea was that in order to fill these gaps, a workplan of activities would be developed.

Since that time, we have learned a lot, and while most of the gaps identified in the CP Road Map remain, they can now be presented more concisely. However, before presenting the gaps, we must first identify how PSC fit within the decision-making framework. With an integrated perspective, we can begin to understand how to more optimally direct the proposed research program.

Figure 1 illustrates this integrated perspective. As highway practitioners, our mission has always been to serve the public with a safe, comfortable, and cost effective highway system. What the pyramid shows are the logical connections between the human factors at the top and the technical factors at the bottom.

![Diagram of the CP Road Map SC Track Framework]

*Figure 1. An Integrated Perspective of Pavement Surface Characteristics.*
UNDERSTANDING AND OPTIMIZING CONCRETE PAVEMENT SURFACE CHARACTERISTICS

The levels of the pyramid represent components of this system. We could climb the pyramid by starting with the most basic factors at the bottom - some are under our control, others we need to recognize their influence and mitigate their effects if/as needed. Pavement properties are affected by these factors, including both as-constructed values and how they change over time. The properties, in turn, affect the PSC in various ways. Functional Performance is another way to describe PSC, as it is the ability to describe the nature of the pavement surface as it serves its intended function. This leads to the last connection where the PSC ultimately determine how the public is served.

Reversing this process also helps illustrate it. Climbing down the pyramid begins with the demands placed on the highway industry by the users and society. These could be legislative demands driven by public outcry. These demands would, in turn, translate into various thresholds or targets of PSC. To accomplish these levels of PSC, certain pavement properties and combinations thereof must be present. And in order to achieve these pavement properties, the various factors must be selected and controlled, ideally in a cost-effective manner.

The linkage (shown as the various arrows on the right) are key to the work proposed under the SC Track. The gaps in research and technology are largely borne from a need to understand these links. It is not enough to understand the link between just two of these levels; all of the levels must be connected if the SC Track is to achieve its ultimate goal.

With this integrated perspective, the gaps as they stand today can be presented in terms of five simple questions. Each question is cross-referenced back to the pyramid with the question number. The first three questions address the links between levels. The last two identify gaps that relate to the problem more globally.

1. What are the links between PSC, human response, and societal benefit?

Affected by our highways are the drivers, those that live and work alongside these roads, and society as a whole. As highway engineers, we can measure PSC, but difficulty lies in relating these back to specific human perceptions and societal impacts. For example, how does friction (a measurable characteristic) relate to safety - or even more specifically, to wet-weather accident rates? With respect to smoothness, indicators such as the International Roughness Index (IRI) are mathematical transformations of physical measurements. But how does this relate to comfort or possibly the affect it might have on cargo? Finally, noise is measured in terms of level, but this should also be connected to annoyance.

The need exists to relate the physical measurements of PSC to the human responses that they trigger. A determination must also be made about how societal needs are being fulfilled. To understand this link will require tools such as life cycle analysis that not only account for tangible costs, but also indirect factors such as safety and comfort. Only then can rational threshold or target values for PSC be derived.

2. What are the relationships between pavement properties and PSC?

Pavement surface characteristics describe a pavement in a number of unique ways. While some PSC are fundamental physical characteristics, others are the result of a response between the pavement and a vehicle and/or tire. As a result, the problem can be quite complex due to the sheer variety of vehicles that exist.

Pavement texture is arguably the most important pavement property affecting PSC. There are other important properties, however, including stiffness, cross-slope, color, and in some cases, porosity. Predicting PSC requires an understanding of the physical pavement properties as they interact with the vehicles, and compounded by other factors including weather. Identifying these relationships will fill a
gap, since only then can optimization of a pavement surface truly occur. To the greatest degree possible, models are needed that are mechanistic in nature so that current experience can be more confidently extrapolated to more innovative pavement materials and textures.

3 How do design, materials, construction, maintenance, climate, and traffic factors affect pavement properties, both initially and over time?

In the previous question, we identified the need to understand what pavement properties affect PSC. However, we must also determine what degree of control we have over the factors affecting those properties. For example, pavement texture can be specified during design in terms of nominal dimensions. The same is true of other relevant properties including cross-slope, stiffness, etc. However, how these properties are constructed and how they change over time will depend on the equipment used, properties of the concrete, and the weather conditions during placement and over time. Other contributing factors will also be at play including accumulated traffic and maintenance, especially snow plowing. How all of these factors affect both the pavement properties and the changes over time remain as critical gaps. Linked with this should be a keen understanding of the impacts to the material and structural performance of the pavement.

4 Can concrete pavement surfaces be optimized and/or innovation introduced to meet site-specific conditions?

Optimization of a pavement surface must consider the demand placed on that surface by the users and society. The demands will be, of course, site specific. From these demands, unique target and threshold values for PSC can be derived that, in turn, point to various combinations of pavement texture and materials. While it is believed that the vast majority of the highway system will continue to utilize “conventional” texturing techniques, each should be described in terms of what it can provide on a consistent and predictable basis. To complement this, innovative materials and techniques should also be explored, including exposed aggregate surfaces, porous concrete, and non-conventional textures, materials, and construction methods.

5 Are today's measurement and analysis techniques satisfactory in characterizing pavement properties and PSC?

In order to collaborate effectively, standard techniques to measure and characterize the pavement surface must be established early in the SC Track. These techniques should attempt to measure pavement properties and PSC in as fundamental a way as possible. In contrast, many of the techniques in use today measure a system response, which in turn is a function of the test equipment. While separating the pavement effect from that of the equipment is difficult in some cases, it should be strived for. To fill this gap, measurement and analysis techniques are needed that are relevant, accurate, portable, and ideally performed both efficiently and with minimal training demands. Practical considerations must also be effectively addressed including things such as the effect of weather conditions during measurement.
The SC Track: a Plan to Fill the Gaps

Within the original CP Road Map, a structured outline for the SC Track was presented. The Track was divided into subtracks, and then again into tasks that describe individual “compartments” of research and technology. Collectively, the work program will meet the goal of the Track, but only if collaboration is realized.

Since 2005, work under the SC Track has been informally launched through the efforts of the FHWA, CP Tech Center, and others. However, the need now exists more than ever to more formally manage the SC Track to make it a success.

The SC Track currently identifies 40 problem statements representing an investment of between $27 and $56 million in research. The proposed research is organized into seven subtracks and presented in a recommended sequence:

✓ Subtrack SC.1: Innovative and Improved Concrete Pavement Surfaces
✓ Subtrack SC.2: Tire-Pavement Noise
✓ Subtrack SC.3: Concrete Pavement Texture and Friction
✓ Subtrack SC.4: Safety and Other Concrete Pavement Surface Characteristics
✓ Subtrack SC.5: Concrete Pavement Profile Smoothness
✓ Subtrack SC.6: Synthesis and Integration of Concrete Pavement Surface Characteristics
✓ Subtrack SC.7: Technology Transfer and Implementation of Concrete Pavement Surface Characteristics Research

Problem statements contained in the plan may correspond to one or more individual projects. Over the course of the SC Track, each problem statement will be developed into research project statements that will contain detailed descriptions of the research to be accomplished, specific budgets, and definite timelines. Detailed problem statements for the SC Track are not included here for brevity, but can be found in the National CP Tech Center Publication, Strategic Plan for Improved Concrete Pavement Surface Characteristics, published July 2006.

In order to effectively build off of the work to date, a number of early products are recommended under the SC Track. Most of these are proposed as syntheses given the fragmented reporting of the work to date. These early products should include:

1. A description of highway user (functional) requirements for all classes of roads (streets, low-volume, highways, special applications); identification of PSC levels that fulfill these requirements.
2. Relationships between pavement texture and other pavement properties as they affect all PSC.
3. Concrete pavement designs, materials, and construction methods that produce predictable levels of PSC.
4. Documentation of changes in PSC over time as a function of design, materials, and construction, along with traffic, climate, and maintenance.
5. Advancements in equipment and standardization for continuous and efficient measurement of PSC in an accurate and relevant manner.
6. Preliminary design, construction, and measurement guidelines including technology transfer products that serve to convey the lessons learned to date.

The research plan as organized under the SC Track should be used as a guide. Obviously, beyond these early products are numerous other tasks that seek to fulfill the ultimate goal of the Track.
Understanding and Optimizing Concrete Pavement Surface Characteristics

Foundational, Recent, and Ongoing Work

The following is a summary of some of the more relevant work that is foundational in nature, recently completed, and/or ongoing. While categorized under the Subtrack headings, no attempt is made here to prioritize their relevance. Collaboration with the sponsors and researchers of these projects will be important to the success of the SC Track.

Subtrack SC.1: Innovative and Improved Concrete Pavement Surfaces

- Concrete Pavement Surface Characteristics Program, Part 3 – CP Tech Center / FHWA / Pooled Fund TPF-5(139)
- Two-Lift Concrete Paving Program – National CP Tech Center / Kansas DOT / FHWA
- Third-Generation Road Surfaces (Modeslab) – IPG Noise Innovation Program (Netherlands)
- Optimized Diamond Grinding and Innovative Texturing – ACPA
- PCC Surface Characteristics – Rehabilitation (Mn/ROAD Study) – Pooled Fund TPF-5(134)
- Innovative Methods for Creating Texture on Pavements, Conceptual Papers and Field Trials – FHWA
- Texturing of Concrete Pavements – NCHRP 10-67
- Concrete Mixtures with Inclusions to Improve the Sound Absorbing Capacity of PCC Pavements – Recycled Materials Resource Center / FHWA
- Use of Lightweight Aggregates for Tire-Pavement Noise Reduction – FHWA

Subtrack SC.2: Tire-Pavement Noise

- State DOT Quiet Pavements Research Programs – Caltrans, Washington State, Colorado, Texas, Florida, Arizona (QPPP)
- Tire-Pavement Noise Research Consortium – Pooled Fund TPF-5(135)
- Traffic Noise Model (TNM) 3.0 Software Development – FHWA / Pooled Fund TPF-5(158)
- Pavement Effects Study for TNM – FHWA
- Measuring Tire-Pavement Noise at the Source – NCHRP 1-44
- Truck Noise Source Mapping – NCHRP 8-56
- Methodologies for Evaluating Pavement Strategies and Barriers for Noise Mitigation – NCHRP 10-76
- Noise Intensity Testing in Europe (NITE) – Caltrans
- Sustainable Road Surfaces for Traffic Noise Control (SILVIA) – FEHRL (Europe)
- Standardization of On-Board Sound Intensity – AASHTO / ASTM / SAE

Subtrack SC.3: Texture and Friction

- Texture and Friction Measurement Equipment Loan Program – FHWA
- Guide for Pavement Friction – NCHRP 1-43
- Harmonization of Texture and Skid Resistance Measurements – Florida DOT
- Assessment of Alternate PCCP Texturing Methods in Colorado – Colorado DOT
- Harmonization of European Routine and Research Measuring Equipment for Skid Resistance (HERMES) – FEHRL (Europe)
Subtrack SC.4: Safety and Other PSC

✓ Relationship between SN with Ribbed and Smooth Tire and Wet Accident Location – Ohio DOT
✓ Wet Pavements Crash Study of Longitudinal and Transverse Tined PCC Pavements – Wisconsin DOT
✓ Review of UK Skid Resistance Policy – Highways Agency / TRL (UK)
✓ Relationship between Macrotexture and Crash Occurrence – ARRB (Australia)
✓ Characterizing the Splash and Spray Potential of Pavements – FHWA
✓ Cool Pavement Initiative – EPA / Arizona State Univ.
✓ Rolling Resistance of Tires on Road Surfaces – BASf (Germany)
✓ Effect of Pavement Surface Type on Fuel Consumption – NRC (Canada)

Subtrack SC.5: Smoothness

✓ Development of a “Golden Tire Footprint” for Improvement of Profiler Reference – FHWA
✓ Improving the Quality of Pavement Profiler Measurement – FHWA / Pooled Fund TPF-5(063)
  ◆ ProVAL Software
  ◆ Reference Profilers
  ◆ Benchmark Profiler
  ◆ Single Accelerometer Study
✓ Smoothness Criteria for PCC Pavements – FHWA
✓ Ultra-Light Inertial Profiler Prototype – FHWA
✓ Smoothness Specification Implementation and Support – FHWA
✓ Measuring Pavement Profile at the Slipform Paver – Iowa HRB / FHWA

Subtrack SC.6: Synthesis and Integration of PSC

✓ Pavement Surface Properties Consortium – Pooled Fund TPF-5(141)
✓ Concrete Pavement Surface Characteristics Program, Part I – CP Tech Center / FHWA
✓ Concrete Pavement Surface Characteristics Program, Part 2 – CP Tech Center / FHWA / ACPA
✓ Synthesis of Performance-Based Surface Condition Measurements for Acceptance – FHWA

Subtrack SC.7: Tech Transfer and Implementation

✓ Little Book of Quieter Pavements and Listening Experiences – FHWA
✓ Tire-Pavement Noise 101 Workshops – FHWA
✓ Pavement Smoothness Workshops – FHWA
**Proposed Short-Term Projects**

With past and ongoing work summarized, gaps in research and technology identified, and a vision formed for the early products, a specific program of short-term work can now be laid out. The following is a list of five projects that would help fill the early gaps, and work within the timeline for the track:

<table>
<thead>
<tr>
<th>Subtrack / Link to Integrated Perspective (see Figure 1)</th>
<th>Project Title</th>
<th>Project Scope</th>
<th>Cost Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC.6 ①</td>
<td>Development of an Integrated Functional Classification System for Concrete Pavement Surface Characteristics</td>
<td>In this project, the links between societal/human factors and the various pavement surface characteristics will be identified. Using current measures/metrics for the various PSC, both target and threshold values will be identified that meet the demands for various types of roads. A classification system should be developed that is rational, simple to understand, and can be readily localized by State DOTs. The resulting system should be peer reviewed, and evaluated using network data from 3-5 States.</td>
<td>$500,000 to $750,000</td>
</tr>
<tr>
<td>SC.2  SC.3  SC.4  SC.6 ②</td>
<td>Refinement of Models to relate Pavement Texture to Noise, Friction, Splash &amp; Spray, and other Concrete Pavement Surface Characteristics</td>
<td>To date, there has been some effort to link pavement texture to tire-pavement noise, friction, and other PSC. However, little has been done with respect to concrete pavement textures, and furthermore, little has been done to approach this problem with an ultimate goal of a unified model that links texture to all PSC. A number of individual projects will be undertaken with the goal of developing new or revising existing models with specific application to concrete pavement textures. Existing texture data can be used for model development, and validated with new data as necessary – both from in the field and under controlled conditions in the laboratory.</td>
<td>3 to 5 projects of $100,000 to $250,000 each</td>
</tr>
<tr>
<td>Subtrack / Link to Integrated Perspective (see Figure 1)</td>
<td>Project Title</td>
<td>Project Scope</td>
<td>Cost Estimate</td>
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<tr>
<td>SC.3</td>
<td>Characterizing Design and Construction Artifacts in Concrete Pavement Surfaces</td>
<td>Some effort has been undertaken to date to identify the potential effects that design, materials, construction, and climate can have on a concrete pavement surface. Specific properties include slab curvature, texture depth, and surface wear potential. This project will seek a more complete and coherent understanding of these relationships, along with the necessary links to material and structural performance. A robust analysis of available data should be conducted including that from LTPP SPS2 sites and sites previously evaluated under the CPSCP. Furthermore, new concrete pavement sections should be evaluated both during and subsequent to construction in order to identify those characteristics that can be attributed to specific construction activities and equipment.</td>
<td>2 to 3 projects of $500,000 each</td>
</tr>
<tr>
<td>Subtrack / Link to Integrated Perspective (see Figure 1)</td>
<td>Project Title</td>
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<tr>
<td>SC.7 4</td>
<td>Training for Improved Surface Characteristics through Better Practices in Concrete Pavement Design, Constriction, and Maintenance</td>
<td>A lot of knowledge is amassing with respect to how concrete pavements can be designed, constructed, and maintained in order to make them safer and more comfortable without compromising durability or cost. Building off of the success of previous outreach efforts including the Tire-Pavement Noise 101 and Improved Pavement Smoothness Workshop series', the proposed training program will consist of up-to-date workshop series' that broaden the scope to include all PSC. While the training will include requisite sections on fundamentals, better practices will be the emphasis. The participants in the training should walk away with a skill set that can be immediately applied to daily practice. Follow-up support will also be provided, allowing participants of the training to have access to the experts that can assist them with specification development and related procedural changes.</td>
<td>1 to 2 projects of $250,000 to $500,000 each</td>
</tr>
<tr>
<td>Subtrack / Link to Integrated Perspective (see Figure 1)</td>
<td>Project Title</td>
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| SC.3                                                      | Improved Concrete Pavement Texture Evaluation | Work under the SC Track will place a much higher demand for accurate texture data that is relevant to all PSC. Current measurement technologies fall short of these demands, and therefore a series of projects is proposed to address this. Ideally, three projects will be undertaken that 1) will specify the newer requirements for texture measurements; 2) develop equipment; and 3) evaluate the new equipment in terms of its ability to meet the more stringent demands.  

The first project would establish the criteria that can subsequently be used to evaluate the desirability of texture measurement systems. Possible criteria include measurement accuracy and representativity/relevance for texture of various sizes, cost, proprietary nature, and production (measurement) rate.  

Development of equipment can then proceed, which can be funded publicly (an open architecture prototype), privately (with response left to the free market), or a combination that might use seed (grant) money to spur development.  

The final step will include an evaluation of the equipment against the new criteria, and furthermore demonstrating the capabilities of the equipment on a variety of concrete pavement surfaces. | 2 to 3 projects of $250,000 to $500,000 each – industry match and/or public/private partnerships |
Stakeholders and Partners

Successful collaboration under the SC Track will require participation from a number of diverse groups. The following includes a summary of stakeholders and partners divided into two tiers. The first includes organizations that have already demonstrated active roles in this area, primarily through sponsorship of work items previously described. Tier II includes groups that logically have a stake in the outcome of the research, but whose participation may need to be sought when the timing is deemed appropriate.

✓ Tier I – Active Stakeholders and Partners
  ♦ FHWA
  ♦ State DOTs / NCHRP
  ♦ ACPA Chapters
  ♦ ACPA National
  ♦ IGGA
  ♦ PCA
  ♦ Concrete Paving Contractors
  ♦ Diamond Grinding Contractors
  ♦ Construction/Texturing Equipment Manufacturers

✓ Tier II – Reserve Stakeholders and Partners
  ♦ AASHTO
  ♦ City and County Governments
  ♦ Public and Private Tollway Authorities/Concessionaires
  ♦ ACI
  ♦ Measurement Equipment and Sensor Vendors
  ♦ Pavement Evaluation Firms
  ♦ NRMCA
  ♦ TRB
  ♦ Concrete Paving Industry Consortiums (e.g., NCC, SCAN, ISCP)
  ♦ RPUG
  ♦ Vehicle and Tire Industries

Inaugural SC Track Meeting

Date/Location
  ✔ Date: 23-24 April 2008
  ✔ Location: Grapevine, TX

Objectives
  ✔ To achieve consensus on the ultimate objectives of the SC Track.
  ✔ To validate what knowledge gaps exist today.
  ✔ To identify how we as an industry can work to fill these gaps.
  ✔ To identify early projects and their funding mechanisms.
  ✔ To help advance the CP Road Map SC Track to a dynamically managed program.
Final Agenda

23 April 2008 (Wednesday) – 1:00 pm to 5:00 pm
✓ Introduction to CP Road Map (Wiegand)
  ✦ History, CP Tech Center Role, Definition and Importance of Collaboration
✓ Presentation of Draft SC Track Framework (Rasmussen)
✓ Introduction to FHWA and ACPA Research Programs (Wiser and Scofield)
✓ Connection to TRB AFD90 (McGhee)
✓ Summary of SC Work (Rasmussen)
  ✦ Foundational, Recently Completed, Ongoing
✓ Open Discussion of Track to Build Consensus (Wiegand and Rasmussen)
  ✦ Overall Objective of Session
  ✦ Individual Recommendations of Needs and Research/Implementation Tasks
  ✦ Gaps
  ✦ Short-Term Projects and Products
  ✦ Long-term Project and Products

24 April 2008 (Thursday) – 8:00 am to 11:00 am
✓ SC Track Communications, Coordination, and Collaboration Plan (Wiegand)
✓ Identification of Funding Partners for Short-Term Projects (Wiegand)
✓ What Happens Next? (All)

Participant List

✓ FHWA/USDOT
  ✦ Mark Swanlund, Office of Pavement Technology
  ✦ Larry Wiser, TFHRC
  ✦ Bob Orthmeyer, Pavement and Materials TST **
✓ State DOT
  ✦ Bernard Izevbekhain, Minnesota DOT
  ✦ Brian Schleppi, Ohio DOT
  ✦ Jeff Seiders, Texas DOT
✓ Pavement Industry
  ✦ Larry Scofield, ACPA
  ✦ John Roberts, IGGA **
  ✦ Ron Guntert, Guntert & Zimmerman
✓ Academia and Other Industry
  ✦ Steven Karamihes, University of Michigan Trans. Res. Inst.
  ✦ Kevin McGhee, VTRC
  ✦ John Ferris, Virginia Tech University **
✓ National CP Tech Center
  ✦ Paul Wiegand, National CP Tech Center
  ✦ Ted Ferragut, TDC Partners, Ltd. **
  ✦ Rob Rasmussen, The Transtec Group, Inc.
  ✦ Tom Cackler, National CP Tech Center **
  ✦ George Chang, The Transtec Group, Inc.
  ✦ Gary Fick, Trinivy Materials

** Note: could not attend meeting
Summary of CP Road Map Track 7
High Speed Concrete Pavement Rehabilitation and Construction
(Concrete Overlays)
10-10-08

The CP Tech Center Advisory Board meeting of April 6, 2006 outlined an overall program for concrete overlays to address the need of rehabilitating aging concrete and asphalt pavements in the United States. The initial program included the development of a 30 +/- page user friendly concrete overlay guide to be completed as soon as possible. The second phase was to develop a technical assistance program for selected states throughout the country that provided expert teams to the states to help guide them through the concrete overlay selection, design and construction process. The third and final phase was to develop a 150 +/- page technical concrete overlay manual. For the rest of 2006 the CP Tech Center along with a national selected overlay committee developed the initial Guide to Concrete Overlay Solutions which was published in January 2007. A total number of prints distributed of the Guide was approximately 10,000 copies.

The CP Road Map Executive Committee concurred with the CP Tech Center Advisory Board that innovative approaches for concrete overlays could move concrete overlays into a position as one of the cornerstones for the new generation of concrete pavements. On March 27, 2007 the Executive Committee concurred with the following goals and objectives of the overlay sub-track.

Goal – To increase the awareness, knowledge and benefits of concrete overlay applications among state and local agencies and contractors.

Objectives:
1. Update the current 2007 Guide to Concrete Overlay Solutions that would include accelerated construction, work zone management, traffic staging, evaluations and items to consider in specification development.

2. Initiate a cooperative 8 state field application program in regional DOTs throughout the country who would be guided by the Center through the process of selection, design and construction of concrete overlays.

3. Develop a concrete overlay manual that would go into the details of the selection, design and construction of concrete overlays. This manual would be considered long term and needed only when the updated Guide needed to be expanded to provide additional technical detail.

4. Develop a simplified and accurate approach for concrete overlay thickness determination using current design methodology.

5. Complete research that would address the complex interaction between concrete overlay and underlining pavement structures and interlayers. This research should include development of new overlay design methods that take into account the effects of underlining pavement cracking, optimum interlayer properties, bond longevity, slab geometry effects and fatigue damage of the underlining pavement over time.
6. Complete field research that would help solve construction technique limitations for concrete overlays which would include paving machine control, locating longitudinal joints, appropriate opening strength, traffic management techniques for different lane roadways and innovative overlay materials, particularly interlayers.

Overlay Committee Members:
- Andy Bennett, Michigan Department of Transportation
- Jim Cable, P.E., Iowa State University
- Dan DeGraaf, Michigan Concrete Paving Association
- Jim Duit, Duit Construction Co., Inc., Oklahoma
- Todd Hanson, Iowa Department of Transportation
- Randell Riley, Illinois Chapter ACPA
- Matt Ross, Missouri/Kansas Chapter ACPA
- Jim Shea, New York State Chapter ACPA
- Gordon Smith, Iowa Concrete Paving Association
- Sam Tyson, Federal Highway Administration
- Leif Wathne, American Concrete Pavement Association
- Jim Grove, CP Tech Center
- Matt Zeller, Concrete Paving Association of Minnesota
- Jeff Uhlmeyer, Washington State DOT
- Kevin Maillard, OHM Advisors
- Robert Rodden, American Concrete Paving Association
- Shannon Sweitzer, North Carolina Turnpike Authority

Concrete Overlay Milestones:
2. April 2008 started 2 ½ year Concrete Overlay Field Application Program. To date five states have requested technical support as outlined in the field application program.
3. August 2008 Guide to Concrete Overlay Solutions 2nd Edition was completed and sent to printing.

Future Emphasis for the Concrete Overlay Program:
1. The CP Road Map Performance Based Design Track Leadership Committee concurred with the Concrete Overlay Committee for the development of a two phase program that would address overlay design issues.
   a. Development of concrete overlay design catalogue based on existing design procedures. Proposed funding by CP Tech Center/FHWA.
   b. Development of a new concrete overlay thickness design procedures (long-term).
2. Complete concrete overlay field research that would help solve construction technique limitations. Proposed funding by FHWA/Iowa Highway Research Board. The proposed research is listed as follows:
   a. Reduce quantity overrun concerns with GPS mapping of the proposed project. Reduce construction survey time with GPS mapping and evaluate GPS and 3-D construction equipment control (milling machine, slipform paver and cure cart). Development of ways to establish the profile grades and machine control before or immediately after the contract letting by the highway agency so that construction is not impacted.
b. Evaluate the use of GPS to control longitudinal joint sawing. Develop innovative ways to guide the longitudinal joint forming operation to match the underlying joint alignment.

c. Evaluate milling by the standard practice of string line control and by GPS control. Determine the best way to establish the level of need and timing of milling for existing asphalt surface preparation.

d. Evaluate use of innovative bond breaker materials.

e. Determine innovative ways of handling traffic control for the construction of single lane overlays as part of a two lane or multilane overlay. Evaluate impact of haul road selection on road opening time.

f. Investigate potential ways using both existing and new paving train components so that the length of the paving operation is minimized.

g. Evaluate pavement strength versus opening time and completion of project time. Determine the appropriate opening strength that is required of the concrete for use by local traffic, through trucks and construction traffic, for depths of concrete of 6 inches or less.
Concrete Pavement Business Systems and Economics

Implementing Business Track 11

Administrative Contact: Paul Wiegand
Technical Contact: Ted Ferragut

Background

This track addresses business and economics issues in concrete paving. It has two main goals: 1) to address the management and financing of the Executive Committee functions, including innovative management systems and 2) to address concrete pavement economics.

The Executive Committee has been operational since 2006. Funding for the Committee, along with Operating Procedures have been developed and implemented. The Executive Committee is an advisory board that identifies and suggests to the concrete pavement community the priority areas for research and technology. It supports the establishment of Track Research Leadership Groups that look to actually promote, implement, and evaluate the research and technology areas, with the Committee assuring that there is cross-cutting coordination among the Tracks.

Additionally, the Committee looks at ways that collaboration strategies can be identified and implemented so as foster more cooperation and accelerate the accomplishment of the goals identified in the Road Map. Finally, the Committee also concerns itself with identifying systems that would accelerate the exchange of knowledge and education on concrete pavements to the broader highway community.

The second major mission of the Executive Committee is to promote the quantification, value and benefits of concrete pavements and ensure that adequate delivery mechanisms are in place to supplement and complement the conventional low-bid system. With the price of asphalt-based products at an all time high, the interest in concrete pavements has never been higher in traditionally non-concrete areas. This track calls for the examination of the impact of this new economic reality, including ways to bring concrete pavement to new customers in a faster way. Related to the economics is the emerging use of alternative bidding, design-build, build-maintain, warranties, performance specifications, public-private partnerships, and other mechanisms that are both creating opportunities, capital, and risk transfer to the concrete industry.
Subtracks

The Track 11 Business Subtracks in the CP Road Map include:

1. Concrete Pavement Research and Technology Management and Implementation
2. Concrete Pavement Economics and Life-Cycle Costs
3. Contracting and Incentives for Concrete Pavement Work
4. Technology Transfer and Publications for Concrete Pavement Best Practices
5. Concrete Pavement Decisions with Environmental Impact

Business Track Activities To Date

The Executive Committee, with the help of the CP Administrative Team has focused most of its initial energy on the major administrative tasks aimed at establishing institutional framework for both the Committee and the Tracks.

To that end, the Committee identified and supported the following initiatives:

1. Secure longer term funding for the CP Road Map Executive Committee and the Operations Support Team.
   - A DOT pooled fund study was established that provides reasonable resources for the administration of the Road Map through 2011.
   - FHWA continues to support the CP Road Map with funds placed into the pooled fund study.

2. Prioritize the CP Road Map Tracks.
   - Tracks related to Mix, Design, NDT/ICS, Surface Characterisitics and Sustainability have been established as priorities.
   - The Sustainability Track is of particular importance. It was originally designated as a cross-cutting issue, but with global attention to the environment, it was elevated to full track status.
   - Additionally, the Committee endorsed the acceleration of the Concrete Overlay Subtrack and elevated it to priority status as well.

3. Established Track Teams for each of the priority tracks.
   - All priority tracks are up and running with key members from across the concrete pavement community.
• Several of the Tracks will be managed via conference calling, such as the Design Track, in order to minimize travel resources

4. Established a collaboration system among various DOTs and the FHWA.
   • The Executive Committee approved a process for linking DOTs together in a collaborative fashion.
   • One state has signed the collaboration paper.

5. Establish a comprehensive website and communication mechanism.
   • Significant discussions was held on this subject with ideas ready for implementation.
   • They included blog testing on the SC Track.

Business Track Activities for Future Consideration

This promises to be an important transition period for the CP Road Map and the Executive Committee. Several issues relate to the need to more strongly formalize the Executive Committee as a voice for the concrete pavement industry as it relates to research and technology transfer.

Management and Administrative Issues: Short Range Plan

The following seven initiatives are offered to help focus on critical Management and Administrative Issues related to the Road Map. They are organized as a possible foundation plan for 2009-2010.

1. Administrative Funding: The funding for the management and administrative program is relatively minimal. Research Track committees do not have the funds to do all the work they need to in order to assure progression of the work.

2. Research and Technology Funding: Reauthorization of the Transportation Program will involve action to promote the accomplishments under the Road Map, but also to identify the benefits of its continuation.

3. Road Map Status Report: To that end, the Executive Committee should prepare a Road Map Status Report for both FHWA, the DOTs, and ACPA.

4. Strategic Direction: The Executive Committee should revisit the entire CP Road Map strategic approach and determine if the priorities and processes should be adjusted or stay the same.

5. Outreach: The Committee should examine the outreach mechanisms available to both promote ongoing research sharing, research findings, and education programs. Webinars, blogs, and other web-based methodologies should be examined, especially in light of limited transportation funding to go to conventional conferences and workshops.

6. Collaboration: The Executive Committee and the Research Track Leaders should continue to
focus on encouraging collaboration for both research and for education programs despite differences in institutional priorities or goals. To get the collaboration process underway, it is proposed to work with state DOTs to identify priority research they are interested in funding at their in-state university. From there the research will be brought to groups such as the National Concrete Consortium for presentation and determination of interest on the part of other DOT agencies.

7. Integration: The Committee should examine how the tracks are proceeding with integration efforts to assure cross-track issues are addressed. Communication between Track Leaders is essential to ensure the overall goal of the Road Map is pursued without duplication.

In addition to the Management and Administrative Issues, the Committee should help establish studies in the following economic areas:

**Economic Issues: Short Range**

1. Economics Study: What does the cost of asphalt products really mean to the concrete industry? A strategic and thorough examination of initial costs and whole costing should be examined to determine the long range impact on research, technology, and education.
   - Estimated Cost: $50,000 8 months

2. Alternative Pavement Bidding: The DOTs have been using alternate bidding for asphalt-concrete solutions. The results to date should be synthesized with best practices highlighted. The effort should examine FHWA and DOT policies, procedures as they relate to both bidding and value engineering practices.
   - Estimated Cost: $100,000 12 months

3. Innovative Contracting Practices: A study of design-build, best value, design-build-maintain, and public-private partnerships should be considered to determine the best ways to address specifics related to concrete pavements.
   - Estimated Cost: $75,000 12 months

4. Incentives: Incentives for smoothness, strength, and sometimes air have been used in the industry since the late 80's. The paving industry believes they have a positive impact on their operations. There appears to be a lack of interest in continuing incentives and to learn from previous accomplishments. It is suggested that a full evaluation of existing programs be examined, including changes in DOT practices. Additionally, the study should examine new ways to provide incentives for both quality and timeliness attributes. A similar study was also suggested to SHRP II under their rapid renewal program and can be used as a framework for this study.
   - Estimated Cost: $150,000 12 months

5. Technology Transfer: an accelerated technology transfer and rapid education programs for the future concrete paving workforce is paramount to getting the word out on both conventional
and emerging knowledge of concrete pavements. This has taken on a new urgency with the relative equality of concrete-asphalt prices and the interest this has generated in new markets.

- Estimated Cost $75,000
- 12 months

The Executive Committee should discuss the merits of each of these six ideas and suggest a priority slate of work. The Administrative Support Group will then develop a more complete scope of work and look to find the funding to conduct the studies.

Conclusion

This is a critical year for the CP Road Map. Executive Committee support of the concepts, tracks and the focus of the future research are critical. It is especially important that the upcoming Transportation Reauthorization Bill and FHWA initiatives support the overall goals of the concrete pavement research and technology identified in the plan.
FRAMING DOCUMENT
CP ROAD MAP CONCRETE PAVEMENT SUSTAINABILITY TRACK

Background

At its core, sustainability is the capacity to maintain a process or state of being into perpetuity. In the context of human activity, it has been expressed as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Although not universally accepted, sustainability is often characterized as a three-legged stool supported by economic, environmental, and social considerations or pillars. Although there is often synergistic cooperation between the three pillars, it is also true in practice that a balance must be struck between competing interests. This relationship, referred to as the “triple bottom line” is often expressed graphically as shown in figure 1, where sustainability is increased when all three “pillars” or “legs” are considered through cooperation. The system is in danger of toppling if only one or two of the pillars are considered, as it will be unbalanced.

In 2003, when the CP Road Map was under development, the authors debated whether or not environmental issues were suitable for Track status or whether these considerations should be included within each track as appropriate. It was decided at that time that environmental considerations were so broad that they should be considered under each of the 12 Tracks. With the world-wide increase in emphasis on sustainability and the environment, the CP Road Map Executive Committee designated the advancements in concrete pavement sustainability and the environment as a full track on September 11, 2007, believing track status was necessary to examine in a holistic fashion how the design, materials, construction, operation, preservation, rehabilitation, and recycling of concrete pavements can be made to be more economically, environmentally, and socially sound. This Executive Committee decision requires a planned structured and collective approach to accelerate and consolidate sustainability and environmental efforts through the CP Road Map process. It has been decided to call this new track the CP Road Map Concrete Pavement Sustainability Track.

The key to successfully increasing sustainability of concrete pavements is to consider all three pillars of sustainability by having the tools and data needed to quantify each and understanding the relationship one to one another. Sustainability, in the context of this Track, is the use of materials and practices in concrete pavement design, construction, operation, preservation, rehabilitation, and recycling (things we do now) that reduce life cycle costs, improve the environmental footprint, and increase the benefits to society (things we need to learn to do). Each of these will be described in detail within this framework document.

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2 2005 World Summit on sustainable development in New York.
3 Preservation practices include preventive maintenance, minor rehabilitation (non-structural), and some routine maintenance activities. Rehabilitation restores structural capacity by increasing pavement thickness. (K. Smith, T. Hoerner, and D. Peshkin, Concrete Pavement Preservation Workshop Reference Manual, FHWA, USDOT, Washington, D.C. 2008.)
Research into sustainable practices must not only consider new construction, but must also include the concrete pavement network which already exists. For example, a significant portion of the nation’s highway system is more than 40 years old, with some portions over 50 years old. The Interstate and state primary road construction era of the 1950s, 1960s, and 1970’s, much of which featured the use of concrete pavements, was followed by a period of rehabilitation featuring repeated asphalt resurfacings of these pavements. It must be recognized that through the appropriate application of sustainable preservation techniques, the service lives of concrete pavements can be extended for decades without the need for rehabilitation. It is also recognized that as traffic loadings increase, it might be necessary to add structural capacity to the existing pavement. This can be accomplished by selecting improvement techniques such as concrete overlays. The approach of extending the service life of the original pavement, and therefore maintaining equity, is fundamental to increasing sustainability of an existing system. By choosing an appropriate preservation strategy, the low maintenance attribute of a concrete pavement can be preserved, as opposed to using strategies that can eventually lead to the complete reconstruction of the pavement.

This document presents the Track Vision and Objective, identifies gaps in research and technology, provides an integrated approach for quantifying concrete pavement sustainability, and describes eight subtracks to address the gaps. It is emphasized that this document reflects the current thoughts of the Leadership Group and it will continue to be developed and refined to reflect the challenges and opportunities facing the industry in the coming decade.
Track Vision

To identify and quantify characteristics of concrete pavement systems that contribute to enhanced sustainability of roadways in terms of economic, environmental, and societal considerations.

Track Objective

To identify and conduct research and transfer technology that enhances concrete pavement sustainability through the pavement’s life cycle (design, materials selection, construction, operation, preservation, rehabilitation and recycling). Work will include:

- Development of advanced materials and processes that optimize reuse and conservation, and measurably reduce waste, energy consumption, water usage, and pollutants generated during all phases of the pavement’s life cycle.
- Creation of innovative designs that make full use of the versatility of concrete as a paving material to improve pavement sustainability.
- Adoption of construction practices that directly enhance the overall sustainability of concrete pavements through increased efficiency, reduced emissions and waste, and decreased social disruption.
- Application of preservation, rehabilitation, and recycling strategies that enhance the sustainability of the existing network of concrete pavements.
- Refinement of life cycle cost analysis (LCCA) to fully account for the economic attributes of sustainable concrete pavements.
- Acquisition, preservation, and distribution of data as part of an environmental life cycle inventory (LCI) that accounts for all the individual environmental flows to and from a concrete pavement throughout its entire life cycle, and the adoption of an internationally recognized environmental life cycle assessment (LCA) approach that examines environmental aspects of concrete pavements through their life cycles.
- Further identification and quantification of social considerations that are affected by concrete pavement for inclusion in the integrated design process.
- Development of strategy selection criteria to assist in the decision making process, allowing various alternatives to be compared based on economic, environmental, and social considerations.
- Application of technology transfer for existing concrete pavement technologies that support the “triple bottom line”.
- Coordination and collaboration with work being performed under other CP Road Map Tracks.

Identifying the Gaps in Research, Technology, and Implementation

In developing this Framework Document for the CP Road Map Concrete Pavement Sustainability Track, a review of the state of the practice was conducted. There is copious literature on sustainability and sustainability science, but little information is directly available on concrete pavement sustainability, particularly on North American practice. Some notable
exceptions are the work conducted by the Cement Association of Canada (CAC)(4)(5)(6), the American Concrete Pavement Association (ACPA)(7)(8), and the Portland Cement Association (PCA)(9). Based on the review of available literature, it is observed that the concrete pavement industry has moved positively to embrace sustainable practices, yet numerous gaps in research, technology, and implementation currently exist, slowing future progress. These gaps can be grouped into the following categories:

- Materials.
- Design.
- Construction practices.
- Preservation, rehabilitation, and recycling.
- Economic life cycle cost analysis.
- Environmental life cycle analysis.
- Other environmental and social considerations.

Most of these categories are being or will be addressed, at least in part, by other Tracks in the CP Road Map. With this in mind, each gap is discussed below.

Materials and Mix Design

The acquisition and processing of the materials from which pavements are constructed is the major contributor to their energy and environmental footprint(10) regardless of the materials used. Pavements have not been made from renewable resources since wood block pavers fell out of favor in the early 1900’s (and even these were soaked in coal tar creosote as a preservative). There are currently no immediate alternatives to extraction-based resources for pavement materials. In time, emerging technologies may offer some viable alternatives but these are likely a decade or more into the future. As a result, regardless of the pavement type, the materials used are predominantly responsible for the energy consumed, greenhouse gases generated, and waste/pollution produced to construct and maintain a pavement.

For concrete pavements, it is well known and accepted that the production of portland cement (annually the production of portland cement accounts for roughly 1.5% of the total US CO₂ emissions and 5% of the total global CO₂ emissions) is overwhelmingly the largest contributor to

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5 Smith, T., Concrete Pavement: A Truly Sustainable Choice, presented at the 12th International Conference on the Chemistry of Cement, July 8-13, 2007, Québec, Canada.
10 Environmental footprint may be considered to be any change to the environment whether adverse or beneficial, wholly or partially resulting from human activity, industry or natural disasters.
the environmental footprint of concrete, accounting for roughly 80% of the total energy consumed and 90% of the CO₂ emissions associated with concrete production\(^{11}\). As such, the environmental footprint of concrete pavement can be significantly reduced by reducing the amount of portland cement used, which typically occupies between 9% to 15% of the paving concrete’s volume. This can be accomplished through improved aggregate grading (which reduces the amount of cementitious material required), the use of blended (ASTM C595) and performance specified (ASTM C1157) cements, and the increased use of supplementary cementitious materials (fly ash, slag cement, natural pozzolans, and so on). Future strategies to reduce portland cement in concrete are under development, including no or low carbon geopolymer cements\(^{12}\) and/or the use of carbon-sequestering cements\(^{13}\)\(^{14}\)\(^{15}\), that may in time have a positive impact on the concrete pavement industry.

The largest single component in concrete is aggregate, which occupies 70% to 85% of the concrete volume. Aggregate is typically low energy, obtained locally, and is readily available being mined from relatively small quarries or pits which are almost always reclaimed for beneficial use. Aggregate can also be obtained from recycled concrete or hot-mix asphalt, or be derived from an industrial byproduct such as air-cooled blast furnace slag. Increasing the volume of aggregate in concrete is thus a good strategy to increase the sustainability of the concrete mixture as long as engineering properties of the concrete are not compromised. Further, using recycled and/or locally available aggregate can significantly enhance sustainability.

There are many other material considerations that can be used to positively impact the sustainability of concrete pavements. These would often be integrated with design considerations to be discussed next including the use of wear resistant aggregates, waterproofing admixtures, internal curing, high strength, fiber-reinforcement, colors, and possibly even titanium dioxide to treat air pollution. Many knowledge gaps exist in the development and implementation of materials that can have a marked effect on concrete pavement sustainability and this area of research will continue to be a focal point for research well into the future.

Design

Sustainable design starts at the earliest planning stages, where opportunities to enhance sustainability are sought at project inception. A number of design elements can have a marked impact on the sustainability of concrete pavements. Thus it is critical that the design of concrete pavements be approached from the design of the system, not just the selection of slab thickness. Reducing the amount of material used through better design, and emphasizing the use of recycled and locally available materials, is an obvious way to improve sustainability as it will lead to overall economic and environmental improvement. This can be accomplished by better

\(^{11}\) VanGeem, M., *Sustainability Designer’s Notebook*, Reprinted for PCI’s Ascent magazine, Precast/Prestressed Concrete Institute, Summer 2006, Winter and Spring 2007.


\(^{13}\) Biello, D., *Cement from CO₂: A Concrete Cure for Global Warming?*, Scientific American, August 7, 2008.


materials selection and characterization, an improved understanding of the support conditions and the environment, and improved understanding of pavement performance, all resulting in less wasteful over-design. At this stage, cooperative arrangements should be sought between the owners/agencies, planners, designers, materials suppliers, and contractors to ensure that the most sustainable design is conceived, designed, specified and constructed.

Innovative concrete pavement designs also offer a way to dramatically improve sustainability. A good example of this is a two-lift concrete pavement, where the concrete in the lower lift is optimized to make the best use of locally available and/or recycled materials, whereas the top lift is optimized for long-life and functionality under traffic loading. It is easy to imagine using two very different concrete mixture designs to achieve increased economic and environmental benefit while also achieving maximum social value. Concrete in the lower lift could use a high volume of non-wear resistant aggregate since it will never be subjected to traffic, and include a higher volume of SCMs. The upper lift could have a higher cement content with little environmental penalty since it is relatively thin, and also include relatively expensive components that enhance functionality at little additional overall costs. These could include waterproofing admixtures, fibers, internal curing, aggregate grading for wear resistance and noise reduction, colors or lighter cement, or even titanium dioxide for treating pollution. The use of a two-lift design integrated with the versatility of concrete could be used to significantly improve the sustainability of concrete pavements.

Another innovative design that can enhance sustainability is the use of precast pavements. Precasting has numerous attributes that accentuate sustainable construction since the structural elements are made under controlled conditions. Further, the opportunities for application of precast pavements in urban environments may make this design attractive from a sustainability perspective, including the use of patterns and colors (or increased reflectivity) that improve aesthetics and/or reflectivity, rapid construction and replacement/recycling, integrated curb and sidewalks, etc. Research gaps that exist include optimization of materials, jointing systems, support, geometry, performance modeling, and construction expediency.

Construction Practices

Enhancements to construction practices that reduce fuel consumption, emissions, particulate, and waste while improving construction quality will improve the economic, environmental, and social attributes of concrete pavements. Much of this development will be driven by equipment manufacturers and contractors, but research conducted under this track could help stimulate advancements. Further, expediting construction through better construction sequencing and material improvements, as well as better traffic management through construction zones, can reduce economic, environmental, and social consequences of congestion and the corresponding user delays. The research gaps to be considered include concrete materials and production, transport, placement and consolidation, finishing, curing, and joint sawing, all of which can be made more sustainable through increased efficiency, reduced waste, and quality improvements. Additional research on construction sequencing and traffic flow through construction zones is also warranted.

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Preservation, Rehabilitation and Recycling

Timely and appropriate preservation and rehabilitation will ensure that a concrete pavement will achieve the long-life that is expected. Accurate anticipation and timely execution of the appropriate treatment is paramount to reducing cost and extending pavement life. Designing and constructing concrete pavements anticipating preservation treatments 30 to 50 years in the future, such as adding nominal additional thickness to accommodate diamond grinding, enhances pavement life and functionality at little initial cost or environmental impact. Over the life cycle, preservation and ultimately rehabilitation will reduce economic, environmental, and social costs. And at the end of life, it is critical that the concrete is completely recycled. The research gaps include better modeling to anticipate optimal timing of various preservation treatments and increased efficiency and longevity of the treatments applied.

Rehabilitation through the use of concrete overlays provides an effective way of extending the life of an existing road using a minimum of new materials because the support provided by the existing pavement is efficiently utilized. A relatively thin layer of concrete is placed over the existing pavement using bonded or unbonded systems, depending on the condition of the existing pavement. When an overlay reaches the end of its life it can be removed and recycled into a new layer. This means that a minimum of new materials are being used while providing long life with a minimum of down time or interference to traffic. Research gaps include the need for a design method for overlays that includes sustainability parameters. Research is also needed to investigate interactions with the original pavement, bond longevity, slab geometry effects and continued fatigue damage to the original pavements.

In recent years, dramatic improvements have been made in the recycling of existing concrete pavement. It is now standard practice to recycle existing concrete pavements instead of considering the removed pavement as waste, and even in-situ recycling on grade is becoming commonplace. Yet often recycled concrete aggregate (RCA) is used only for fill or base course applications and issues with the disposal of crusher fines continues. Additional research is needed to continue advancing in-situ recycling as well as making full use of RCA in all layers of the newly constructed pavement including increasing the use of RCA as aggregate in new concrete.

Economic Life Cycle Cost Analysis and Incentives

Economics is one of the three pillars of sustainability and it is crucial that a better understanding of concrete pavement economics over the entire life-cycle be developed. Life cycle cost analysis (LCCA) has been in use for a number of years, but most approaches are simplified and do not necessarily capture the full economic benefit derived from concrete pavements over the life cycle. At a minimum, better estimations of initial cost, the timing and cost of preservation and rehabilitation, and the value at the end of life are needed. A tool to conduct an LCCA, including a sensitivity analysis for key parameters, would help practitioners better understands the importance and robustness of this approach in selecting the preferred design alternative.

Related to the LCCA is the development of approaches that encourage the use of environmentally superior designs, materials, and processes. This is related to transportation
agency policy in which entities work together to share risks and benefits inherent in adopting innovative sustainable approaches for pavement design, materials, and processes.

**Environmental Life Cycle Assessment**

One of the most critical challenges before us is to establish how environmental benefits and impacts will be quantified and used to compare various engineering solutions. There is a need to adopt a quantification process that is robust and unbiased, allowing the identification of desirable solutions and creating the synergy needed to promote these solutions. It must also be flexible, allowing the consideration of a broad number of alternatives including those that contain innovative features. The quantification process must not assume that one strategy is better than another, but allows comparisons to be made over a range of environmental considerations.

The effort conducted under this task is at the heart of advancing sustainability of concrete pavements through adoption of a life cycle assessment (LCA) approach. An LCA requires the creation and maintenance of a concrete pavement-specific life cycle inventory (LCI) with local/regional data. The data would include values assigned to materials and processes for impact categories such as embodied energy\(^\text{17}\) (both primary and feedstock) and global warming potential, and will also include water (use, reuse, and treatment), noise, airborne particulate, emissions, human toxicity, etc. The LCI would also assign ranking of the significance of the impact categories for all the materials and processes used in the design, initial construction, preservation, rehabilitation, and recycling of the pavement. The LCA protocol must adhere to international standards as described in the International Organization for Standardization (ISO) 14040 standards, and must be accessible to the concrete pavement community as a tool or toolkit in an easily usable format to help improve the sustainability of concrete pavements.

**Other Environmental and Social Considerations**

Environmental considerations regarding the construction, preservation, rehabilitation, and recycling of concrete pavements will be thoroughly quantified and analyzed under the previous task. These considerations are largely under the influence of the agency responsible for administering the facility. There are additional environmental and social considerations that could be added to the LCA, but may better be addressed separately as they more directly relate to the operation of the facility and the community which it serves. These factors include, but are not limited to:

- Vehicular fuel efficiency.
- Surface reflectivity as it contributes to nighttime visibility, artificial lighting needs, and the urban heat island effect.
- Friction and wet-weather safety.
- Noise.
- Stormwater runoff.
- Treatment of smog.

\(^{17}\) Embodied energy may be considered to be the total amount of energy used during the entire life cycle of a product including the energy used for manufacturing, transporting, and disposing of the product.
There is currently no consensus on how these multiple factors can or should be considered in the analysis and thus it will be the focus of this task to develop an understanding of these factors through research and adopt an appropriate approach for their inclusion in the LCA.

A Plan to Fill the Gaps

In the previous section, gaps in research, technology, and implementation were identified. In this section, specific subtracks developed to address the gaps are designated, with individual tasks or projects being proposed as problem statements to meet the Track Objective. It is clear that to accomplish this work will require extensive collaboration with the other CP Road Map tracks including:

Track 1: Performance-Based Concrete Pavement Mix Design System
Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements
Track 3: High-Speed Nondestructive Testing and Intelligent Construction Systems
Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements
Track 5: Equipment Automation and Advancements
Track 7: High-Speed Concrete Pavement Rehabilitation and Construction
Track 8: Long-Life Concrete Pavements
Track 10: Concrete Pavement Performance
Track 11: Concrete Pavement Business and Economics
Track 12: Advanced Concrete Pavement Materials

The Sustainability Track currently identifies XX problem statements representing an investment of between $XX and $XX million in research and technology transfer. The proposed research and activities are organized into the following eight subtracks:

- Subtrack S.1: Materials and Mixture Design Procedures for Sustainable Concrete Pavement.
- Subtrack S.2: Design Procedures for Sustainable Concrete Pavements.
- Subtrack S.4: Preservation, Rehabilitation and Recycling Strategies for Sustainable Concrete Pavements.
- Subtrack S.5: Improved Economic Life Cycle Cost Analysis for Sustainable Concrete Pavements.
- Subtrack S.6: Adoption and Implementation of Environmental Life Cycle Assessment for Sustainable Concrete Pavements.
- Subtrack S.7: Identification and Quantification of Additional Environmental and Social Considerations for Sustainable Concrete Pavements.
- Subtrack S.8: Sustainable Concrete Pavement Technology Transfer and Implementation.

Problem statements contained under each subtrack may correspond to one or more individual projects. Over the course of the Sustainability Track, each problem statement will be developed into research project statements that will contain detailed descriptions of the research to be accomplished, specific budgets, and definitive timelines.
In order to implement what already is known, a number of early products are recommended under the Concrete Pavement Sustainability Track. These early products should include:

- The development of a Briefing Document for the various stakeholders (decision makers, engineers, material suppliers, and contractors) that defines sustainability and describes the current state-of-the-practice on implementing sustainable solutions today.
- The development of a “Best Practices” training manual and implementation package for concrete pavement sustainability. This will provide detailed technical information to engineers, material suppliers, and contractors, having immediate and measurable impacts on improving the sustainability of concrete pavements.
- Organize and conduct a conference on Sustainability of Concrete Pavements that addresses economics, environmental, and societal impacts, emerging technologies, and legislative/policy initiatives systematically so as to increase awareness of how the various factors interact.
- Work with federal and state agencies to create Demonstration Projects that feature sustainable solutions and effectively communicate the successes of these projects.

Proposed Projects

The following is a summary of the proposed projects for the work to be completed under each subtask. While categorized under the subtrack headings, no attempt is made here to prioritize the importance of projects. Collaboration with the sponsors and researchers of these projects will be crucial to the success of the Concrete Pavement Sustainability Track.

Subtrack S.1: Materials and Mixture Design Procedures for Sustainable Concrete Pavement

- S.1.1: New Generation Concrete Mixtures for Sustainable Pavements.
- S.1.2: Use of Supplementary Cementitious Materials for Sustainable Concrete Pavements.
- S.1.3: Use of Low Impact Local and Recycled Materials in Sustainable Concrete Pavements.
- S.1.4: Reduced Energy and Carbon Footprint for Sustainable Concrete Pavements.
- S.1.5: Carbon Neutral and Carbon Sequestering Cements for Sustainable Concrete Pavements.
- S.1.6: Durability Enhancing Admixtures for Sustainable Concrete Pavements.

Subtrack S.2: Design Procedures for Sustainable Concrete Pavements

- S.2.1: Planning Tools to Enhance Concrete Pavement Sustainability from Project Inception
- S.2.2: Long-Life Design for Sustainable Concrete Pavements.
- S.2.3: Use of Recycled and Industrial Byproducts in Underlying Pavement Layers.
- S.2.4: Two-Lift Sustainable Concrete Pavement Construction.
- S.2.5: Integration of Optimized Surfaces in Sustainable Concrete Pavement Design.
- S.2.6: Precast Sustainable Concrete Pavement Design Systems for the Urban Environment.
Subtrack S.3: Construction Practices for Sustainable Concrete Pavements

- S.3.1: Adoption of Automated and Wireless Control and Quality Monitoring Instrumentation to Improve Construction Quality.
- S.3.2: Increase Energy Efficiency and Reduce Pollution at the Plant and Construction Site.
- S.3.4: Guidelines to Minimize the Use of Water During Construction.
- S.3.5: Innovative Curing Methodologies for Sustainable Concrete Pavements.

Subtrack S.4: Preservation, Rehabilitation and Recycling Strategies for Sustainable Concrete Pavements

- S.4.1: Use of Advanced Sensors to Monitor the Quality and Health of Concrete Pavements.
- S.4.2: Concrete Pavement Performance Modeling for Improved Timing of Preservation and Rehabilitation.
- S.4.4: In-Situ Concrete Pavement Recycling Techniques.
- S.4.5: Concrete Overlay Construction through Innovative Techniques and Equipment.

Subtrack S.5: Improved Economic Life Cycle Cost Analysis for Sustainable Concrete Pavements

- S.5.1: Establish Key Input Parameters to Conduct an Economic Life Cycle Cost Analysis.

Subtrack S.6: Adoption and Implementation of Environmental Life Cycle Assessment for Sustainable Concrete Pavements

- S.6.1: Create and Maintain a Concrete Pavement Specific Environmental Life Cycle Inventory.
- S.6.2: Identify and Rank Environmental Impact Categories that Affect Concrete Pavement Sustainability.
- S.6.4: Guidelines and Implementation Package for Conducting an Environmental Life Cycle Assessment of Pavement Alternatives.

Subtrack S.7: Identification and Quantification of Additional Environmental and Social Considerations for Sustainable Concrete Pavements

- S.7.1: Innovative Approaches to Remove Pollutants from Air and Water Using Concrete Pavements.
• S.7.2: Quantify and Document the Impact of Pavement Reflectivity on the Urban Heat Island.
• S.7.4: Quantify and Document Artificial Lighting Needs for Various Pavement Surface Reflectivities and Optimize for Energy Savings.
• S.7.5: Establish the Relationship Between Pavement Surface Reflectivity and Nighttime Driver Visibility.
• S.7.6: Determine, Quantify, and Optimize Pavement Factors that Contribute to Public Health and Safety.

Subtrack S.8: Sustainable Concrete Pavement Technology Transfer and Implementation

• S.8.1: Briefing Document on Implementing Sustainable Solutions for Concrete Pavement.
• S.8.3: Organize and Conduct a Conference on Sustainable Concrete Pavements.
• S.8.4: Assembled and Maintain an On-Line Toolkit.
APPENDIX D
CONCRETE PAVEMENT ROAD MAP
Wisconsin
Electronic Meeting Minutes
December 15, 2009

Attendees: DOT: Steve Krebs, Jim Parry, Daniel Yeh;
University of Wisconsin-Madison: Tim Miller;
Wisconsin Concrete Paving Association: Kevin McMullen;
Operations Support Group: Paul Wiegand, Dale Harrington, Tom Cackler,
Peter Taylor

Paul Wiegand opened the meeting with introductions of the participants. He discussed the history of the background on the CP Road Map.

- The goal is working together to improve the research for pavement technologies.
- The vision is to look at the entire system of materials and project design, construction and feedback.
- Number of regional and national meetings held over 4 years for input into the Road Map plan
- Accelerates implementation which has taken about 20 years in the past.
- Research money is tight therefore we want to be efficient
- FHWA went through competitive process and CP Tech Center selected as an advocate for implementation and coordination of the plan (Operations Support Group).
- 19 members on the Executive Committee with 6 states assisting with the funding besides FHWA. States contribute $25,000 a year for 4 years. Provide operational ideas and support. Peter Kopac (Peter.Kopac@fhwa.dot.gov) is the contact person
- Coordinate communication and set up priority leadership teams
- Communicate what is going on in the research of pavements
- The Operations Support Group does not control the research funding or provide research funding.
- The original CP Road Map had 12 tracks. The Executive Committee added the sustainability track to bring the total to 13 tracks.
- The Executive Committee designated 7 priority tracks from the 13 tracks.
- Each track has a leadership team with a broad range of representation that provides input into the research within that track
- Developed framing documents for each priority track
- Each priority track has coordinators connected to the Operations Support Group.
- Workshops have been held at TRB
- Industry has submitted two project proposals through NCHRP for 2009
- FHWA has members on all priority track leadership teams
- We are scheduling meetings with DOTs, industry and academia to initiate a new approach to collaboration.
Input from DOT

- Bob Schmitt of UM-Plattville is researching open graded base courses and dowels in terms of load transfer effectiveness on US 18. How to handle the transverse joint.
- Wisconsin research is currently focused on local concerns – one project recently completed review of the performance of whitetopping projects throughout Wisconsin. Use as an alternate to asphalt overlays.
- Overlay Guide is a good tool to use
- Working on data to validate MEPDG and geotechnical studies.
  - No other states are involved with their validation at this time
  - Dale Harrington stated that Iowa, Minnesota had started a group that will share their information.
  - Wisconsin is very specific about their aggregates and other mix materials.
- Participating on mix design analysis and Tommy Nantung’s permeability study
- Wisconsin has a representative on surface characteristics track and the joint deterioration study.
- Daniel Yeh stated they are involved with at least 12 pool funds related to concrete pavement

Paul Wiegand asked DOT if they had unlimited resources what would they look at for additional topics that would be important?

- MEPDG limitations would be a priority
- Deicer distress and joint deterioration
  - Industry also stated joint deterioration is a priority – causes, solutions, find the chemical chain what is causing the reaction so we can talk about what is happening and come up with solutions. How can we save the pavement that is being impacted?
  - The Center is doing research that is above and beyond what the local efforts can do
  - Curing compounds, cure and seal, need more understanding of this topic. Type of sealants and what happens chemically are big issues.
- Daniel Yeh asked about the new track 13 - is that in reference to broader environmental factors or specifically sustainability?
  - Peter Taylor stated the focus is on pavement and how they will impact the environment and how we can balance environmental, economical and social needs. The key is to develop tools and guidelines for evaluation of concrete pavements, not as a pavement selection tool. FHWA putting together a measurement tool appropriate across all industry to make scientific decisions. FHWA encouraging the right research and programs to make the concrete product as sustainable as possible.
  - The sustainability briefing document is on the CP Road Map website – describes what the anticipated program looks like.
  - CP Tech Center has a proposal into FHWA to develop a manual on the best practices guidelines.
Paul Wiegand stated technology transfer is important to the Road Map to get the information out. What kind of capabilities do the groups have to sit in on meetings, do you have travel restrictions?

- Currently there is no out of state travel for Wisconsin DOT
- Need to find a way to get the word out to Wisconsin DOT without asking them to travel.
- The Wisconsin tech briefs are available on the WHRP.org website, go to the research area and rigid pavement.
- Any Wisconsin research brief and their information on the website is available for public use.

Paul Wiegand asked, what road blocks do you have?

- The DOT no longer has the resources to follow up and do the write ups and reports and the data analysis on what works and what doesn’t work. Something might work in Iowa but need to pilot it and see if it works in Wisconsin. Problematic to get the test projects underway.
- Project delivery is the main focus which hinders the research or demonstration projects as some agencies do not want to take any risks.
- Wisconsin Highway research program struggles to do it in house to get the demonstration projects to line up with the research projects and some delays have exceeded three years.

Paul Wiegand asked, does the DOT pay for the construction related elements of the research projects or how are they funded?

- Most of the time FHWA is funding the research
- Do not have the funds to do the follow up on the current research they have

Paul Wiegand asked, does the university have any challenges beyond what the W DOT described. What are the capabilities at the university?

- Tim Miller stated a big issue with research is they have so much data and being able to access and process the data is challenging. They are working on coming up with a database method to streamline the process which would be very helpful.

Paul Wiegand asked, what are the specific areas of expertise that the University has or is interested in?

- University has some research programs on geotech, sustainability for base courses, energy analysis of process of constructing and maintaining pavements. Coming up with sustainability, need to look at the energy in the project.
- University of Wisconsin is a co-agency with University of New Hampshire on recycling projects
- UW Madison has labs for research -- there are a number of geotechnical, pavement, a lot of labs for concrete testing
- Nanotechnology research is also being done at UW Madison with the material science group.
Paul Wiegand asked, what are road blocks for research through the university activities?

- One of the biggest issues is they do not have enough people to do the work. They are getting a lot of international students and need more civil engineering people into the research field.

Paul Wiegand discussed how to get involved in the CP Road Map and how to get projects into the system.

- The CP Road Map group wants to have similar discussions with all NC2 states that do concrete pavement work and research.
- Develop collaboration ideas and needs for research
- Put ideas out and focus on particular topics
- Information will be posted on the CP Road Map website
- Project booklet example on the CP Road Map website shows what projects have been developed along with contact information.
- Want to develop an electronic “booklet” for each DOT or agency highlighting research for each DOT
- Looking for current research projects to put into an electronic newsletter that will be published quarterly
- Will post contact list for each agency so individuals can interact with each other
- Get the collaboration established and initiate research
- Current publications are the MAP briefs, one was prepared on geotextile, next brief will be on diamond grinding
- Looking at other projects for MAP briefs on research others are doing to get the information out
- Contractors can help with ways they accomplish their work. We are looking for that information also.
- Need to identify a contact so we can go to them and produce a write up on what works for them
- Need to find a way to put the information out to the contractors
- Create a list of innovate ways to use equipment
- People can get involved by talking to the CP Road Map Operations Support Group
- Track Coordinators to share ideas and set up collaboration
- If you have any concerns throughout the process feel free to contact CP Tech Center

Dale Harrington asked when you see information from other states how is it disseminated within the DOT.

- Kevin McMullen with ACPA has distributed some information.
- Wisconsin struggles with trying something new. It takes someone to push people to get something that are new and different used. Need someone in DOT that will be the point person to champion new ideas.
Paul Wiegand asked how does the DOT send out specification changes or new design elements?

- They hold annual road shows in each region to talk about the changes
- Wisconsin DOT has regional representation on research technical committees and industry committees that help with getting the information to the DOT staff.

At the end of the meeting, all parties felt that participating in the discussions was worthwhile. It was valuable to get a better sense of the programs, projects, and problems that each entity was dealing with.
CONCRETE PAVEMENT CP ROAD MAP
Pennsylvania
Electronic Meeting Minutes
May 25, 2010

Attendees: Penn DOT: Lydia Peddicord, Alaa Azab, Marcie Lucas, Brandon Motuk, Joshua Freeman, Dave Jarvis, Bonnie Fields
University of Pittsburgh: Julie Vandenbossche
ACPA Pennsylvania Chapter: Mark Snyder, John Becker
Operations Support Group: Dale Harrington, Peter Taylor (CP Tech Center), Sabrina Garber (Transtec)

Dale Harrington opened the meeting with introductions of the participants. He discussed the history of the background on the CP Road Map.

I. BACKGROUND ON THE CP ROAD MAP

• The purpose of the conference call is for PennDOT to obtain a better understanding of the CP Road Map and what it is about. Also we would like input on what PennDOT has been doing on research and how we can work together.
• In December 2000 FHWA developed a proposed program to move concrete pavement into the 21st century and identify what research needed to be done to fill gaps in concrete pavement knowledge.
• The CP Tech Center was selected to develop a Road Map and after some starts and stops due to funding, the Center went around the country to see what research needed to be accomplished
• A final research database document was developed along with a summary document and listing of the project research statements consisting of 12 different priority tracks
• FHWA then went through a competitive process and the CP Tech Center was selected to administer, implement and coordinate the CP Road Map plan (Operations Support Group).
• The goal today is to exchange information and receive input from PennDOT on their research and begin to work together to improve the research for pavement technologies.
• The CP Road Map vision is to look at the entire system of materials and project design, construction and feedback.
• Although the Road Map was developed into 12 different research tracks, the priority research tracks were reduced to 6 or 7 tracks due to funding cutbacks
• A National Executive Committee and Pool Funded committee were formed and are making operational decisions on the CP Road Map
• A number of regional and national meetings have been held over a four year period to obtain input into the Road Map plan. Today, the goal is to leverage ideas and funds and accelerate implementation which has taken several years in the past
• The National Center's job (OSG) is to move the CP Road Map forward and support states to help with issues they are faced with on research and technology transfer
• To be successful it is important to communicate on current activities
• The Executive Committee (19 members) now has a partner in the CP Road Map Pool Fund Committee (6 states plus FHWA). This is the group that gives guidance to the overall CP Road Map operation
• Ahmad Ardani is the contact person with FHWA taking over for Peter Kopac who is retiring on June 3, 2010
• Each track needs individuals who are willing to provide leadership to the track
• The Operations Support Group will assist with coordinating, communication and setting up priority leadership teams
• e-News will come out monthly on the CP Road Map website and will feature state projects
• The Operations Support Group does not control the research funding or provide research funding
• The Executive Committee added the sustainability track to bring the total to 13 tracks.
• Track 1, 2, 3, 4, 7, 11 & 13 are priority tracks
• Each track has a leadership team with a broad range of representation that provides input into the research within that track and provides prioritization for research
• Framing documents have been developed for each priority track
• Each priority track has coordinators connected to the Operations Support Group.

II. SUMMARY OF TRACKS

Peter Taylor – Mix Track
• The purpose is to find better ways to proportion mixes, specify them and measure to make sure they will perform.
• Keeping in touch with research around the country.
• NC2 with states get good feedback on needs and priorities.
• Maintaining a database of ongoing research in the field. If anyone wants the database Peter can send it to you.

Dale Harrington
Performance Based Design –
• Committee wanted to develop a summary of the existing computerized programs for concrete overlays.
• Summary and catalog of selected software to show how they work
• Work is currently ongoing
Surface Characteristics –
• Very comprehensive program.
• Looking at noise on concrete pavements
• Research work ongoing on real time smoothness
Sustainability –
• Very active group, represented by federal, state, academia, material supplies
• Provide good information on what it means and how we do it
- 20 page document on definition and terms
- Process of writing a manual of current practice
- Provide a forum for people to get together and talk
- Next call in July 2010 – people who are involved in active research projects and see what they are doing and provide input
- Help with publication and dissemination of their work
- Some tracks are not moving forward with leadership however there is work that is ongoing
- Workshops have been held at TRB
- Industry has submitted two project proposals through NCHRP for 2009
- FHWA has members on all priority track leadership teams
- We are scheduling meetings with DOTs, industry and academia to initiate a new approach on collaboration.
- Completing work on Task Order #3 and working towards Task Order #4. Continue with communication and outreach

III. INPUT FROM DOT

Lydia Peddicord
- Bureau of planning and research manages research projects.
- Current projects – internet website shows current active projects and she will provide link
- Working with Julie V Vandenbossche on a couple of projects

Julie Vandenbossche
- Julie is completing research on bond concrete overlays over HMA (TPF-5-165)
- Looking at different pavements, standard jointed concrete pavements, structural aspects and construction, cure related information
- Looking at construction related issues
- When the report is done (this Fall) she will send to Peter Taylor

Lydia Peddicord
- Working on concrete overlay field application with Dale Harrington
- Pool fund thin and ultra thin over asphalt pavement
- Improving foundation layers for concrete pavement
- Longitudinal tinning – paved by the end of this year – evaluating the noise difference on project

Dale Harrington
- 30 test sections on US30 on noise.
- Transtec used equipment to analyze noise.
- Information is in an interim guide on concrete noise.
- We would like to help disseminate this information to PennDOT

Mark Snyder
- There is a lot of good information out by ACPA and the National CP Tech Center
Dave Jarvis
- District 10 -- route 22 work on longitudinal thinning is similar work.

Alaa Azab -- he felt the following items need to be addressed:
- Ongoing project on precast concrete pavement – pilot study – patching intersection ramps, next step mainline paving
- Work on air voids – need a way to look at air voids in the field which is more accurate
- Working on specification for maturity meters
- Completed materials related study with University of Pittsburg – material availability, moving into the future, some issues down the road with materials

Dale -- asked how PennDOT’s research is accomplished?

Alaa Azab
- Planning and research – research section dealing with new technologies and products, things to focus on in the field.
- Construction, in house, work with bureau of planning to get consultants or universities to work with them. Depends on funding.

Bonnie Fields
- Prioritize research by asking what their needs are for research. List developed of priorities research. Contract research out to universities and consultants. Technical advisor leads the project with the consultant or university.
- Implementation program – look at completed research projects, met with Tech advisor, can the research results be implemented and shared statewide.
- They participate in the pool fund
- Research is funded through state planning and research funds and federal funds
- Develop executive summary when research is completed, develop some tech briefs and will make sure they are provided to others

Lydia Peddicord
- Concrete pavement quality improvement committee meets a couple times a year
- John Becker will send Dale the minutes of the last meeting which outlines their concerns and needs and Dale will send to everyone on the call
- They have teams that are internally looking at issues

Dale Harrington
- We have a lot of information on maturity meters from Iowa DOT we can share with PennDOT if they would like the information.

Dale asked what research does PennDOT want to do beyond what they are currently involved with?
- Dave Jarvis felt they needed to move forward on preservation.
- Dale stated the CP Tech Center is developing a partial depth patching document that he will send to PennDOT. Also there is currently a preservation manual on the website and 8 training modules.

**Dale – asked if they have any roadblocks with research?**

- John Becker stated there are some opportunities being missed due to DOTs not being able to go out and view what is going on across states.

**Julie Vandenbossche**
- Concrete materials and design is her field of expertise.
- Additional areas to be pursued would be mixture design, different factors affecting performance, strength and dimensional stability

**Dave Jarvis**
- Seeing some increase in poor performance due to increased usage of slag. Usually later in the summer and fall when temperatures get colder. Dave stated their main issue is scaling.

**Peter Taylor**
- Stated the CP Tech Center developed a study on slag affects on concrete – report on field review of slag and scaling. Report is on CP Road Map website. New report will begin soon on test methods.
- Peter stated the reports and track information can be found at the CP Tech Center website: [www.cpotechcenter.org](http://www.cpotechcenter.org) and there is a link for the CP Road Map on the center’s website which is where the slag report can be found.

**Julie Vandenbossche**
- Research needed on does slag affect stability, slag with other aggregates, in cold weather, shrinkage issues, and cement content.

**Dale – asked Julie if there were any other expertise that the university is looking for?**

Julie stated not at this time. She invited everyone to tour the lab at the university, excellent lab capabilities.

**Dale – asked Julie how do you implement your findings from research?**

**Julie Vandenbossche**
- Work with whatever agency is funding the research. DOT works well with the universities and is very interactive. They meet monthly with DOT to share research.
- Present at local workshops.
- Write executive summaries and tech briefs.

Lydia Peddicord agreed they have a good system for sharing process and research with the universities.
Dale – asked Julie how do you choose your research work?

Julie Vandenbossche
- Last couple of years they met with PennDOT and asked what their needs are. Research Ideas forum though PennDOT they discuss research problems.

Lydia Peddicord
- They have two sources of funding which supports research needs

John Becker
- Research needs are CPR work and jointing details
- High performance concrete
- Surface characteristics
- How to work concrete into the pavement preservation program
- Concrete overlay open house tentatively scheduled for June 30, 2010
- Industry contributes to research funding
- Participates with tech transfer and research work on issues
- Work through CPQI for prioritizing research efforts

Dale Harrington
- CP Road Map is willing to help with coordination and collaboration with the group. How can the CP Road Map help PennDOT?

Lydia Peddicord
- Summarize PennDOT information and make it available. Lydia will forward link to their projects.
- Would like assistance on guiding their priorities and identify other states to group with.

Dale Harrington asked how can the CP Road Map help make the system more effective?
- Dale stated the Road Map is doing a better job of getting the e-News out.
- CP Tech Center has developed a mechanism for information exchange and implementation.
- Currently developing a project booklet for concrete pavement research to share with states on what work they are doing.
- The CP Tech Center would like to feature PennDOT in an e-news issue.
- The CP Tech Center will work on sending out the priority track research needs to states.
- Work on networking to discuss research activities.
- CP Tech Center will distribute tech briefs.
- Need to find out what PennDOT has done that can be placed in a publication to share with other states on concrete design and construction.
Bonnie Fields
  • Stated her division will gather information from PennDOT and the PennDOT research
department will put it in a communication format and send it to the CP Tech Center to be
distributed to other states.

Julie Vandenbossche asked if there was a form to fill out on research information?
  Peter Taylor
  • There is not a special form, send the title, abstract, funding agency and data. Also
    provide links to research if available.

Dale Harrington
  • Stated they would like to have the research information to fill in the voids and let the rest
    of the country know about it and asked them to send their information once it is available.

Dale thanked everyone for attending and stated we will develop minutes of the meeting, take
action on what we learned and be in contact with PennDOT.

Meeting adjourned at 11:00a.m. Central Time
"Moving Advancements into Practice"

MAP Brief 1-2:
Describing promising technologies that can be used now to enhance concrete paving practices

Deleterious Chemical Effects of Deicing Solutions on Concrete Pavements

Introduction
Safety and mobility are key concerns for State Highway Agencies (SHAs), especially during the winter season, when ice and snow accumulation on roads and bridges can create hazardous or impassable driving conditions. Various chemicals, including magnesium, sodium, and calcium chloride; calcium magnesium acetate; and urea, are used by SHAs as anti-icing and deicing solutions on transportation infrastructure.

The effectiveness of these chemicals for deicing and anti-icing has been demonstrated. However, the possible detrimental effects to concrete in transportation structures have not been fully examined and documented. Although these chemicals offer possible cost savings advantages to SHAs, the true cost effectiveness cannot be determined without establishing the potential for chemical attack and premature deterioration, leading to costly rehabilitation or replacement.

Recent research at Michigan Technological University and the University of Toronto examined the chemical effects of deicing and anti-icing chemicals on Portland cement concrete and recommended changes to concrete mixture designs, construction practices, and winter maintenance procedures that will not compromise concrete durability.

Research Description
The degradation of concrete used in pavements and bridges that may occur as a result of attack by deicing and anti-icing solutions is the result of an increased concentration of dissociated calcium, magnesium, and chloride ions in the concrete pore water. These ions are available to combine with materials in the concrete to form expansive or weak reaction products, such as brucite or magnesium silicate hydrates.

The dissociated chloride ions in the pore water solution are well documented as a primary cause of reinforcing steel corrosion. In addition, the study identified the formation of destructive oxychlorides as a potentially significant cause of deterioration.

A series of field explorations and laboratory experiments were performed, including the characterization of concrete field specimens from both pavement sites and bridge decks, laboratory experiments on Portland cement mortar, and laboratory experiments on Portland cement concrete.

Characterization of field specimens
In general, the pavement sites examined lacked unambiguous evidence of distress associated with deicers. The research team also obtained cores from a number of bridge decks that were exhibiting distress. Although these bridge decks were, in recent years, maintained using various non-NaCl deicers, they had been in service for numerous years and, as a result, have been exposed to NaCl deicers for a significant portion of their service lives. Ultimately, because of this history, any distress identified would be difficult to associate with a specific deicing chemical.

Deicing and Anti-Icing Chemical Acronyms
- CaCl₂ - Calcium chloride
- CMA - Calcium magnesium acetate
- MBAP - Magnesium chloride-based agricultural product
- MgCl₂ - Magnesium Chloride
- NaCl - Sodium Chloride
Observations of all field specimens include the following:
- Calcium hydroxide depletion along cracks and surfaces exposed to deicing solutions.
- Higher chloride ingress rates (diffusion rates) for concrete with deicer exposure at early ages.

**Laboratory experiments on portland cement mortar**

Three different mortar mixtures were prepared using 20-30 Ottawa sand (ASTM C778), ASTM C150 Type I/II cement, and variable water-cementitious (w/c) ratios of 0.40, 0.50, 0.60. Two-inch diameter by four-inch high [50 mm by 100 mm] mortar cylinders were prepared and then soaked in solutions of CaCl₂ (17 wt. %), MgCl₂ (15 wt. %), NaCl (17.8 wt. %), and saturated lime water at 40°F [4.4°C] for 84 days.

The specimens exposed to CaCl₂ and MgCl₂ (figures 1 and 2) exhibited severe deterioration, while those exposed to NaCl and lime water did not show any signs of deterioration (figures 3 and 4).

Other mortar specimens (cubes and length change bars) were prepared using a w/c of 0.485 and cement-sand ratio of 2.75, per the ASTM recommended mixture for mortar specimens (ASTM C1101-04, “Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution”). However, these specimens were immersed in three molar concentration solutions of the respective deicers and subjected to tests at various time intervals. The specimens exhibited significant loss in strength and expansion, as shown in figures 5 and 6, as well as mass gain.

In all cases, petrographic analysis found that the observed deterioration was caused by the formation of expansive calcium oxchloride and magnesium oxchloride. The oxchloride phases form through a chemical reaction between calcium hydroxide in the hardened cement paste and chloride ions from the deicer.

**Laboratory experiments on portland cement concrete**

Concrete mixtures used in this experiment were made with a high quality, partially crushed gravel coarse aggregate (maximum aggregate size of 1 inch [25 mm]), natural sand, 564 lb/yr³ [335 kg/m³] ASTM C150 Type I/II cement, vinsol resin air entraining agent (air content of 6 ± 1%), and a w/c of 0.45 and 0.55. Two additional mixtures were prepared—one made with 15% replacement of cement with Class F fly ash and another made with 35% replacement of cement with ground blast furnace slag (GBFS).

Specimens were moist cured at 100% humidity for one day, de-molded and then wet cured in lime saturated baths for 27 days. Specimens cast were standard four-inch diameter by eight-inch high [100 mm by 200 mm] cylinders, which in

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![Figure 1. Cylinders exposed to CaCl₂ solution after 84 days of constant low temperature test. From left to right: 0.40, 0.50, and 0.60 w/c mortar cylinders.](image1)

![Figure 2. Cylinders exposed to MgCl₂ solution after 84 days of constant low temperature test. From left to right: 0.40, 0.50, and 0.60 w/c mortar cylinders.](image2)

![Figure 3. Cylinders exposed to NaCl solution after 84 days of constant low temperature test. From left to right: 0.40, 0.50, and 0.60 w/c mortar cylinders.](image3)

![Figure 4. Control cylinders exposed to lime water solution after 84 days of constant low temperature test. From left to right: 0.40, 0.50, and 0.60 w/c mortar cylinders.](image4)
The specimens were immersed in the same deicers used in the mortar experiments, as well as calcium magnesium acetate and a magnesium chloride-based agricultural product. The concrete specimens were exposed under the same conditions used in the mortar experiments (i.e., for both solution strength and temperature) but for longer times, up to 500 days. Deterioration of the concrete specimens resembled that seen for the mortar specimens (figures 7-8). In all cases, the observed distress was associated with the formation of the oxychloride phases seen in the mortar specimens.

**Effects of fly ash and slag**

In all cases, concrete mixtures prepared using Class F fly ash or GBFS performed significantly better than those made with portland cement alone, with no distress observed in specimens after 500 days of exposure (figure 9). Quantitatively, the reduction in chloride ingress observed was shown by a dramatic reduction in diffusivity for all deicers, a reduction in sorptivity, and microstructurally by reduced calcium hydroxide depletion and oxychloride formation.

**Conclusions**

- Exposure of concrete and mortar to NaCl results in little to no chemical interaction or related distress. NaCl appears to be safe for use as a deicing and anti-icing chemical with respect to possible chemical interaction with concrete. NaCl should still be considered harmful to concrete in terms of its potential to induce corrosion in embedded steel, given its demonstrated ability to diffuse into concrete more readily than the other deicers tested.

- Exposure of concrete and mortar to MgCl₂ and CaCl₂-based deicing chemicals results in significant chemical interaction and related distress. Both appear to not be safe for use as a deicing or anti-icing chemical with respect to possible damage to concrete.

- In all cases, the observed distress is less as the concentration of deicer is reduced. Therefore, if MgCl₂ and CaCl₂-based deicing chemicals are to be used, they should be used at the lowest possible concentration.

- Results were mixed regarding the effect of w/c on performance of concrete and mortars exposed to deicing chemicals. Although the general parameters (i.e., sorptivity, bulk diffusion, rapid chloride permeability) improved with decreasing w/c as expected, the performance in low temperature immersion was, in many cases, opposite of expected. That is, the low w/c mixtures often performed worse.

- In general, concrete mixtures containing 35% GBFS showed the lowest susceptibility to chemical degradation by deicing chemicals, concrete mixtures containing 15% Class F fly ash were next best, and straight portland cement mixtures were the worst performing. One exception is that with the tests performed, concrete mixtures containing fly ash had a diffusion coefficient higher than that measured for straight portland cement mixtures. However, in other experiments such as the low temperature immersion test, concrete mixtures containing fly ash performed better.

- In general, sealants were very effective at reducing chloride ingress at 60 days. The siloxane appeared to perform better than the silane. After 500 days exposure, both sealants showed reduced effectiveness.
Recommendations for Future Work

As a result of this research, clear evidence was presented that MgCl₂ and CaCl₂ both chemically attack concrete causing increased permeability, loss of strength, expansion and cracking. Also, this research project identified viable maintenance and mitigation strategies, recognizing that these deicing chemicals are a key part of modern winter maintenance strategies and that SHAs need to continue their use for that purpose.

However, a number of questions were not answered as part of this research and it is important that SHAs continue research in this area. One unanswered question pertains to how these deicing chemicals impact the life-cycle of concrete pavements and bridges. This question has become more important in light of recent reports from a number of states regarding premature distress along longitudinal and transverse joints.

In a number of upper-Midwestern states, for example, several concrete pavements constructed since 1999 have developed unexpected scaling/spalling with associated dark-staining along joints (figure 10), particularly the longitudinal, centerline joint. Initial studies have identified a number of possible causes, including chemical attack from deicers. Understanding the cause of this reported premature deterioration is integral to understanding the life-cycle impact of deicers on concrete.

Other suggested areas for additional research

- Further testing to determine the effect of different replacement levels of supplementary cementitious materials on the resistance of concrete to deicers and anti-icing chemicals
- A detailed experiment to determine the effects of w/c on deicer related distress
- A study of highway deicer chemical contributions to alkali-silica reaction (ASR)
- Further testing to better understand field reports of scaling/spalling and joint-related distress related to use of MgCl₂ and CaCl₂.

For More Information

The executive summary, final report, and guidelines are available for viewing at the South Dakota Department of Transportation website:


For additional information, contact Dr. Lawrence Sutter, Michigan Technological University, 906-487-2268, Ilsutter@mtu.edu.

Figure 8. Cross-section at concrete surface after long-term exposure to various solutions at 40° F, back-scattered electron images

Figure 9. Cross-section at concrete surface after long-term exposure to magnesium chloride brine at 40° F, epifluorescent optical microscope images

Figure 10. Several concrete freeway pavement projects constructed since 1999 have developed unexpected spalling with associated dark staining along joints.

This project was conducted as a Pooled Fund Study TPF-5 (042) through the cooperation of the Federal Highway Administration with the financial support of California, Colorado, Idaho, Illinois, Iowa, Montana, South Dakota, Texas, and Wyoming. This technical brief is reprinted with permission from the University Transportation Center for Materials in Sustainable Transportation Infrastructure at Michigan Tech.

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Stringless Concrete Paving

Introduction

Conventional concrete paving with a slipform paver requires the installation of a stringline and support posts adjacent to the roadway to establish the correct pavement alignment and profile. The stringline adds several additional feet (6 ft. +/-) of required clearance to the paving envelope, which is already wider than the pavement due to the tracks of the slipform paver.

In addition, the stringline becomes an obstacle for equipment, concrete delivery trucks, and finishing crews. If equipment access across the stringline is required, the stringline must be lowered and reset, resulting in delays and introducing the potential for errors.

Stringless paving is a technology that eliminates the installation and maintenance of stringlines and has the potential to decrease the need for surveying and increase the smoothness of the pavement profile. The benefits that can result from stringless paving include increased production, decreased construction time, and reduced potential for errors. (see Figure 1).

Several companies have developed stringless equipment control and guidance systems using technologies such as global positioning systems (GPS), robotic total stations, and laser positioning. Stringless technology replaces the traditional stringlines with an electronic tracking process that controls the horizontal and vertical operation of the slipform paver.

The construction industry has been using stringless technology for elevation and steering control of equipment for a number of years. To date, the extensive use of this technology has been applied to grading operations. However, stringless paving is an emerging technology for concrete paving because it has the potential to allow contractors and owner/ agencies to receive production benefits (e.g., reduced survey costs, fewer construction hours) while still meeting smoothness requirements.

Although stringless paving has not been used extensively, several projects have been completed in the United States in the past few years. The techniques and equipment used vary according to each project, but in general the concepts and methods are the same.

The stringless paving methods described on the following two pages are specific to a research project (TR-600) conducted in Iowa in 2009. The final page of this document contains additional information about stringless paving research projects in Iowa.

Figure 1: Stringline (left) and stringless (right) pavers
Developing stringless paving technology involves a three-step process. The first step is collecting survey data of the existing surface pavement prior to and during the paving operation. The second step is to model the paving operation using a computer program that closely follows the proposed scenario. The third and final step is to construct the proposed pavement by transferring the computer model to the paving machine. It is important to note that the paving machine is a non-contact X/Y/Z guidance system.

The purpose of this paper is to present the stringless paving technology being developed at TR-600 and to present the results of the first step of the process. The survey data was collected using a 3D scanning system that incorporates a laser profiler and a GPS system. The laser profiler was used to collect data on the existing pavement surface in a 3D format, while the GPS system was used to collect data on the position of the laser profiler in a 3D format.

The survey data was then processed using a computer program that is able to generate a 3D model of the existing pavement surface. The 3D model was then used to design the proposed pavement. The design was then used to create a 3D model of the proposed pavement that was used to simulate the paving operation. The simulation was then used to validate the proposed pavement design.

The final step in the process is to construct the proposed pavement. The paving machine is a non-contact X/Y/Z guidance system that is able to follow the proposed pavement design. The machine is also able to adjust its position in real-time to ensure that the proposed pavement design is achieved.

The stringless paving technology being developed at TR-600 is a groundbreaking technology that has the potential to revolutionize the pavement industry. The technology is able to achieve a higher level of precision than conventional paving methods and is able to reduce the amount of labor required for the paving operation. The technology is also able to reduce the amount of waste generated by the paving operation.

The stringless paving technology being developed at TR-600 is currently in the early stages of development. However, the results of the first step of the process have been promising. The survey data was collected in a timely manner and the 3D model of the existing pavement surface was able to accurately represent the existing pavement surface.

The survey data was then processed using a computer program that was able to generate a 3D model of the existing pavement surface. The 3D model was then used to design the proposed pavement. The design was then used to create a 3D model of the proposed pavement that was used to simulate the paving operation. The simulation was then used to validate the proposed pavement design.

The final step in the process is to construct the proposed pavement. The paving machine is a non-contact X/Y/Z guidance system that is able to follow the proposed pavement design. The machine is also able to adjust its position in real-time to ensure that the proposed pavement design is achieved.
Research Conducted

To examine the practicality of stringless paving with slipform pavers, the National Concrete Pavement Technology Center and the Federal Highway Administration (FHWA) completed field research in 2003 on two stringless paving projects in Washington County, Iowa. As part of these projects, a research team monitored the guidance and elevation conformance to the original pavement design. The evaluation included guidance from GPS and laser technology.

Due to the speed of paving and the rapid changes in terrain, the laser technology was abandoned for the projects. Total control of the guidance and elevation controls on the slipform paver were moved from stringline to GPS. The evaluation was a success, and the research team concluded that the GPS control proved to provide excellent x, y guidance for the slipform paver. However, GPS vertical control did not allow for smoothness incentives.

In 2009, the Iowa Highway Research Board and FHWA conducted research on four concrete overlay projects in Iowa to evaluate overlay construction techniques and methods. Due to improved stringless paving technology, this project included additional research that evaluated stringless paving on two of the four concrete overlay projects (US 65 in Worth County and V18 in Poweshiek County).

The goals of the 2009 research were to develop ways to establish profile grades and machine control before or immediately after contract letting, to evaluate machine control systems to minimize paving train widths, and to meet or exceed smoothness requirements.

Conclusions

The following sections describe the results of the 2009 research projects on stringless concrete paving in Iowa.

Roadway Surface Mapping

- The results of roadway mapping indicate that current “off-the-shelf” GPS technology does not provide adequate vertical (z) accuracy for mapping the pavement surface when measured with a rapidly moving device. Slow moving (<5mph) GPS data collection and other proprietary software and systems do have the potential for mapping the pavement surface with an (x, y) accuracy adequate for paving machine control.

- The vertical (z) coordinates of the existing surface can be obtained by laser augmentation on the same all-terrain utility vehicles that capture the GPS (x, y) coordinates. The alternative is to survey the surface with total stations.

- Profile mapping is possible with 3D computer software, such as AutoCAD and MicroStation, for the surface profiles of the existing road surface and the design model of the overlay surface. This information can be used to develop cross-sections, check minimum overlay depths, and calculate concrete quantities for theoretical yield purposes.

Slipform Paver Machine Control

- The stringless paving control system performed to expectations in line, grade, and cross-slope control to match the designer model for the surface of the finished pavement overlay on each of the two test projects.

- To meet the smoothness requirements for incentive pay, it is recommended that model and machine control elevations be developed in the 0.01-0.05 ft plus or minus range.

- Regardless of the brand, modern slipform pavers that have recent constant-flow hydraulic systems and up-to-date electronic controls can be outfitted with the stringless paving system used in this project from Leica, Inc.

- Success of the stringless system rests on the slipform paver controls and the ability to set very tight vertical control for the guidance system on the ground.

- The control system will replicate what the designer puts into the final surface model.

- The Leica system used in this research performed equally well on one- and two-lane paving situations. In one-lane situations, the outer edge is controlled by the model on the second pass, and the centerline of the first pass is “locked” to existing elevations of the first pass.

- Designer knowledge of the existing surface alignment and surface elevations is critical to development of the final design model.

- GPS- and GPS/laser-controlled slipform operations do exist but were not evaluated in this research due to the decisions made by contractors in control equipment selection.

- Sensor selection for the paving equipment should be left to the discretion of the contractor based on the tolerances established in the contract documents for the concrete depth and quantity.

For More Information

To find out more about stringless concrete paving implementation and demonstration projects, contact the National Concrete Pavement Technology Center, 515-294-8103, dfwagner@iastate.edu.

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What Is Roller-Compacted Concrete?

Roller-compacted concrete (RCC) gets its name from the heavy vibratory steel drum and rubber-tired rollers used to help compact it into its final form. RCC has similar strength properties and consists of the same basic ingredients as conventional concrete—well-graded aggregates, cementitious materials, and water—but has different mixture proportions.

The major difference between RCC mixtures and conventional concrete mixtures is that RCC has a higher percentage of fine aggregates, which allows for tight packing and consolidation.

Fresh RCC is stiffer than typical zero-slump conventional concrete. Its consistency is stiff enough to remain stable under vibratory rollers, yet wet enough to permit adequate mixing and distribution of paste without segregation.

RCC is typically placed and initially compacted with an asphalt-type paver equipped with a standard or high-density screed, followed by a combination of passes with rollers for final compaction. Final compaction is generally achieved within one hour of mixing.

Unlike conventional concrete pavements, RCC pavements are constructed without forms, dowels, tie bars, or reinforcing steel. Joint sawing is not required, but when sawing is specified, transverse joints are spaced farther apart than with conventional concrete pavements.

RCC pavements combine various aspects of conventional concrete pavement materials practices with some construction practices typical of asphalt pavements. However, while RCC pavements are compacted in the same manner and have similar aggregate gradation as asphalt pavements, the materials and structural performance properties of RCC are similar to those of conventional concrete pavements.
## Basic Differences between RCC and Conventional Concrete Pavements

The following table shows a comparison of materials and construction practices for conventional concrete and RCC pavements.

<table>
<thead>
<tr>
<th>General Materials and Practices</th>
<th>Conventional Concrete Pavements</th>
<th>RCC Pavements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mix materials proportions</strong></td>
<td>Well-graded coarse and fine aggregates typically account for 60 to 75 percent of the mixture by volume. A typical water-to-cementitious materials (w/cm) ratio is 0.40 to 0.45, which makes a cement paste wet enough to thoroughly coat the aggregate particles and fill spaces between the particles. Typical proportions of water, cementitious materials, and coarse and fine aggregates for conventional concrete and RCC mixtures are compared in Figure 1-5.</td>
<td>Dense- and well-graded coarse and fine aggregates typically comprise 75 to 85 percent of RCC mixtures by volume. RCC mixtures are drier than conventional concrete due to their higher fines content and lower cement and water contents. See Figure 1-5 for typical materials proportions for RCC and conventional concrete mixtures.</td>
</tr>
<tr>
<td><strong>Workability</strong></td>
<td>The mixture is plastic and flowable, so that it can be manipulated by the paving machine, and relatively stiff (slump is generally about 2 in. [5.1 cm]) to hold shape after being extruded from the paving machine.</td>
<td>The mixture has the consistency of damp, dense-graded aggregates. RCC’s relatively dry and stiff (less than zero slump) mixture is not fluid enough to be manipulated by traditional concrete paving machines.</td>
</tr>
<tr>
<td><strong>Paving</strong></td>
<td>The mixture is placed ahead of a slipform paving machine, which then spreads, levels, consolidates through vibration, and extrudes the concrete. Forms may be used with small hand pours. Conventional concrete pavements are typically 6 to 12 in. (15.2 to 30.5 cm) thick and are placed, consolidated, and finished in a single pass.</td>
<td>Typically the RCC mixture is placed with a heavy-duty, self-propelled asphalt paving machine, utilizing a high-density single- or double-tamper bar scree to initially consolidate the mixture to a slab of uniform thickness. These types of pavers are essential to high-quality placement, especially in thick pavement applications. Forms are not required. RCC is usually placed in lifts of 6 to 8 in. (15.2 to 20.3 cm) (4 in [10.2 cm] minimum and 10 in. [25.4 cm] maximum).</td>
</tr>
<tr>
<td><strong>Consolidation (primarily the removal of non-entrained air)</strong></td>
<td>Consolidation occurs internally. Initially, internal vibrators and surface vibrators on the paving machine fluidize the plastic concrete, releasing air. After the concrete is extruded from the machine and before initial set occurs, some additional consolidation occurs through the settlement of solids (cements and aggregates) and the upward movement of water to the surface (bleeding).</td>
<td>Consolidation is accomplished externally by compacting the concrete with rollers, typically within the first 60 minutes after mixing (before the paste begins to harden).</td>
</tr>
<tr>
<td><strong>Finishing</strong></td>
<td>Finishing is conducted before initial set occurs. Conventional concrete is usually mechanically textured to improve friction.</td>
<td>Although the surface of the RCC pavement typically has an open texture (similar to asphalt), use of smaller aggregates and/or additional cement can create a denser surface (closer to conventional concrete). RCC can be textured through diamond grinding.</td>
</tr>
<tr>
<td><strong>Hydration</strong></td>
<td>Proper hydration of the concrete mixture is critical to the long-term durability of the concrete pavement. To assist in the hydration, curing of the concrete is an important requirement.</td>
<td>Proper hydration of the RCC mixture is critical to the long-term durability of the pavement. To assist in the hydration, curing of the concrete is an important requirement.</td>
</tr>
<tr>
<td><strong>Curing</strong></td>
<td>Thorough curing is required as soon as possible after finishing. This is critical for controlling water evaporation from the concrete surface so that it is available for cement-water hydration, which results in strong hardened paste filling voids and binding aggregate particles together.</td>
<td>Thorough curing is required as soon as possible after roller compacting. This controls water evaporation from the concrete surface so that it is available for cement-water hydration, which results in strong hardened paste binding the aggregate particles together.</td>
</tr>
<tr>
<td><strong>Cracking, load transfer, and reinforcement</strong></td>
<td>In conventional jointed pavements, the location of cracks is controlled by cutting joints, across which transverse dowel bars are used for load transfer (for pavements 8 in. [20.3 cm] or thicker), and longitudinal tiebars are used to help ensure aggregate interlock. In continuously reinforced pavements, joint cracks are allowed to occur in a naturally closely spaced pattern, and the steel reinforcement, together with aggregate interlock, assists in load transfer.</td>
<td>Joints are not usually sawed in RCC industrial applications. When sawing is not specified, random cracks 15 to 30 ft (4.6 to 9.1 m) apart are normally tight, enabling load transfer through aggregate interlock. When sawing is specified to control random cracks, it is typically in applications with car and truck traffic. Fewer joints are sawed in RCC than in conventional concrete pavements, and they are spaced farther apart (15 to 30 ft [4.6 to 9.1 m] transversely). Because of the way RCC is consolidated, it is not possible to place dowels or tiebars in RCC pavements.</td>
</tr>
</tbody>
</table>
RCC Pavement Applications

RCC is an economical, fast-construction candidate for many pavement applications. It has traditionally been used for pavements carrying heavy loads in low-speed areas because of its relatively coarse surface. However, in recent years its use in commercial areas and for local streets and highways has been increasing.

The following are typical applications:

- Industrial plant access roads and parking lots
- Intermodal shipping yards, ports, and loading docks
- Truck/freight terminals, bulk commodity storage, and distribution centers
- Low-speed urban and rural roads
- Aircraft parking areas
- Military loading zones, forward or rearward bases of operation, and airfields
- Recreational vehicle pad storage
- Vehicle maintenance areas
- Large commercial parking lots
- Roadways in public parks
- Roadways for timber and logging operations
- Highway shoulders
- Temporary travel lanes that must be constructed quickly to divert traffic

RCC can be used in pavement systems serving higher traffic speeds when the surface is diamond ground. It can also be used as a base for a thin conventional concrete pavement surface, with a separation layer.

RCC Materials

RCC contains the same basic materials as conventional concrete—coarse and fine aggregates, cementitious materials (cement, fly ash, silica fume, etc.), water, and, when appropriate, chemical admixtures—but they are used in different proportions.
The primary differences in proportions between RCC mixtures and conventional concrete mixtures are as follows:

- RCC is generally not air-entrained.
- RCC has lower water and paste contents.
- RCC generally requires a greater amount of fine aggregates in order to produce a combined aggregate that is well graded and stable under the action of a vibratory roller.
- RCC usually has a nominal maximum size of aggregate (NMSA) not greater than 3/4 in. (19 mm) in order to minimize segregation and produce a relatively smooth surface texture.

Mineral aggregates constitute up to 85 percent of the volume of RCC and play an influential role in achieving the required workability, specified density in the field under vibratory compaction, compressive and flexural strengths, thermal properties, long-term performance, and durability.

Type I and II portland cements are commonly used in RCC pavements. Chemical admixtures commonly used in conventional concrete can be incorporated into RCC mixtures; however, higher dosages may be required. An air-entraining agent may be used; however, it is typically not required.

**Design of RCC Pavements**

For design purposes, RCC pavements fall into two main categories—heavy-duty industrial pavements (e.g., ports and multimodal terminals) and conventional roadway pavements (e.g., pavements carrying different sizes and weights of roadway-licensed trucks and lighter vehicles).

The following table illustrates the design procedures that can be used for RCC pavements.

<table>
<thead>
<tr>
<th>Design Procedure</th>
<th>Heavy-duty industrial applications</th>
<th>Conventional roadway applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCC-PAVE software (PCA)</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>U.S. Army Corps of Engineers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>StreetPave (ACPA)</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Guide for Design of Jointed Concrete Pavements for Streets and Local Roads (ACI 325.12R-02)</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Guide for the Design and Construction of Concrete Parking Lots (ACI 330R-08)</td>
<td>√</td>
<td></td>
</tr>
</tbody>
</table>

**Construction of RCC Pavements**

RCC pavements are constructed as plain, undoweled, and unreinforced pavements. The structural behavior of RCC pavements is similar to that of equivalent conventional concrete pavements.

RCC is placed and initially compacted with an asphalt-type paver, and final compaction is achieved using vibratory steel drum and rubber-tired rollers. The timing of the placement and compaction is critical to obtaining adequate density, strength, and smoothness of the finished RCC pavement. The concrete is placed and compacted while it is still fresh and workable, usually within 60 min of delivery.

Joint sawing is typically not required for RCC pavements; however, sawed joints can be used to prevent random cracking or to maintain the highest possible load transfer efficiency, particularly if the pavement is subjected to cold weather or repeated heavy loads.

**For More Information**

The recently released Guide for Roller-Compacted Concrete Pavements provides owner-agencies, contractors, materials suppliers, and others with a thorough introduction to and updated review of RCC and its many paving applications. It includes detailed overviews of RCC properties and materials, mixture proportioning, structural design issues, and production and construction considerations, plus troubleshooting guidelines and an extensive reference list.

For more information, contact Dale Harrington, 515-964-2020, dharrington@snyder-associates.com.

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"Moving Advancements into Practice"

MAP Brief 13-1:
Describing promising technologies that can be used now to enhance concrete paving practices

Two-Lift Concrete Paving

This document discusses the potential use of two-lift paving as a sustainable technique for building concrete pavements.

Background

Two-lift concrete paving involves the placement of two wet-on-wet layers instead of the homogenous single layer commonly placed in concrete paving. Two-lift paving can provide quality surface characteristics, reduce material costs, and consume recycled aggregates (concrete and hot-mix asphalt).

Two-lift concrete pavements have been constructed in the United States for over a century. The first concrete pavement constructed in the United States—in 1891 in Bellefontaine, OH—was a two-lift pavement. That pavement is still in service today, as are other two-lift concrete pavements built in the early 1900s. These early jobs were done fixed form and are described in Construction of Roads and Pavement as “two-course” concrete paving [Agg 1924].

Several states used two-lift paving in the 1950s and 1960s to facilitate the placement of steel reinforcing mesh in concrete interstate highway construction.

Between 1970 and 2000, the U.S. concrete paving industry moved away from the use of mesh and the jointed reinforced concrete pavement design, which shortened the design length of pavement panels. The new design used high-quality aggregates to produce long-lasting pavements without steel reinforcement, eliminating the need for two-lift paving.

However, the high-quality, wear-resistant aggregates used to construct the U.S. concrete pavements that have lasted 50–60 years are becoming scarce. This scarcity of aggregates, combined with advances in materials knowledge and construction equipment and increasing demands for pavement surfaces.
that meet specific noise, durability, and safety objectives are prompting many agencies and contractors around the country to consider two-lift paving as a sustainable solution for building concrete pavements.

**Benefits of two-lift paving as a sustainable solution**

Sustainable solutions are those that balance economic, environmental, and social benefits.

The two-lift process has great potential as a sustainable paving solution. It reduces the cost of materials and materials transportation, reduces the environmental impact caused by quarrying and importing aggregates, and increases social benefits by maintaining friction and low noise levels and providing a long-lasting pavement that does not need frequent reconstruction.

**Economic benefits**

In two-lift paving, the bottom layer is thick—typically 80 to 90 percent of the total pavement thickness. The bottom lift generally contains locally available or recycled aggregates that may not be suitable as a wearing surface. These aggregates can be obtained at a lower cost than aggregates used in a traditional paving project. The bottom lift can also be optimized to use a variety of supplementary cementitious materials.

The top layer, on the other hand, is relatively thin and contains dense, wear-resistant aggregates that provide enhanced durability while maintaining friction and low noise. While these aggregates are more costly and frequently have to be imported, the overall cost and environmental impact of the pavement system is reduced because only a small amount of aggregates is required.

**Environmental benefits**

Two-lift paving can be optimized for recycling and reuse. Since the bottom lift is not subjected to as harsh an environment as the top lift, a variety of recycled aggregates—including those reclaimed from old concrete pavements—can be used in the bottom lift without sacrificing durability.

Two-lift paving can also be optimized to reduce the environmental impact caused by cement production. One way to reduce the cement content of concrete is to use supplementary cementitious materials, such as fly ash. This strategy is commonly used in concrete paving projects and can be used in higher quantities in two-lift paving.

**Social benefits**

Quiet, safe, long-lasting pavements mean satisfied citizens. Two-lift pavements have the potential to meet all of these criteria through surface treatments optimized for the design requirements of the project. An exposed aggregate surface is one example of an optimized surface treatment.

Results from Europe, where exposed aggregate surfaces are commonly used, suggest that these surfaces have good tire-pavement noise characteristics and demonstrate durable skid resistance, making these pavement surfaces both safer and more comfortable.

**Kansas demonstration project**

In October 2008, the FHWA, National Concrete Pavement Technology Center, and Kansas Department of Transportation (DOT) coordinated a two-lift paving demonstration project and open house on I-70 in Saline County, Kansas.

**Mix design**

For the I-70 two-lift project, Kansas imported dense, wear-resistant rhyolite aggregates from Oklahoma for the top lift but used locally available, more porous limestone aggregates for the bottom lift, significantly lowering the cost of purchasing and transporting materials.

The contractor used a standard Kansas DOT paving mix for the 300-mm (11.8 in.) bottom lift. A combination of admixtures was used to prevent segregation.

The rhyolite was used as a coarse aggregate in the 40-mm (1.6 in.) top lift. To reduce permeability and assist in potential ASR mitigation, the contractor substituted a Class F fly ash–gypsum combination for 20 percent of the cement in the top lift.
**Construction process**

The Kansas DOT contracted with Koss Construction for the I-70 two-lift project.

Koss used a dual drum mixing plant to simultaneously produce the two concrete mixes. Green and red placards were used to identify which mix each truck was carrying—a green placard told the road crew the truck was delivering to the bottom lift placer (which was marked with green paint), a red placard indicated the concrete was for the top lift placer (which was marked with red paint).

The pavement was placed on a 150-mm (5.9 in.) cement-treated recycled concrete base produced from the preexisting concrete pavement.

During the paving process, the bottom lift concrete was placed in the belt placer to deliver concrete to the base. The first paver followed behind the belt placer to form the final pavement profile for the bottom lift. Almost immediately after the bottom lift was placed, it was stiff enough to support the weight of the workers.

The concrete for the top lift was then delivered to a second belt placer, with the second paver forming the final pavement profile. The total distance of the paving operation from the first belt placer to the final paver was, on average, less than 45 m (148 ft). In this wet-on-wet application, both the bottom and top lifts were completed in about 30–60 minutes.
Exposed aggregate surface

Kansas DOT experimented with several different pavement surface textures as part of the I-70 two-lift project, including longitudinal tining, grooving, astro-turf drag, diamond grinding, and an exposed aggregate surface.

The exposed aggregate surface contained a much smaller aggregate—9.5 mm (0.4 in.) rhyolite—compared to the other surface test sections, which used 12.5-mm (0.5 in.) rhyolite in the top lift. Fine mason sand was used in the exposed aggregate section whereas standard river sand was used in other top-lift surface test sections.

To create the exposed aggregate surface, retarder was sprayed on the surface of the top lift to prevent the paste at the surface from setting. White sheeting was used to cure the retarded surface. After a five-hour curing time, the white sheeting was removed and the surface exposed for 15–20 min before brooming to remove the retarded paste from the surface and expose the aggregate. After brooming, white curing compound was applied to provide final cure for the exposed aggregate surface. Transverse and longitudinal joints were later sawed into the slab.

On-Board Sound Intensity (OBSI) tests were conducted on each of the different surface textures. All surfaces showed lower tire-pavement noise than a conventional concrete pavement textured with transverse tining.

Michigan project: 15-year performance

In 1993, the Michigan Department of Transportation conducted a demonstration project to present some highly acclaimed features of European concrete pavements to U.S. practitioners. The project included a two-lift concrete pavement with an exposed aggregate surface. A control section was also constructed using standard concrete paving practices, and the performance of both sections has been monitored for over 15 years.

To date, both pavements are performing well, although there is no clear indication as to which pavement section will achieve the most cost-effective service life (Smiley 2010).

Future work

A national two-lift concrete paving open house and demonstration project will be held September 27–28, 2010 in Chesterfield, Missouri. The featured project is part of the reconstruction of Route 141 in St. Louis.

As part of this project, the Missouri Department of Transportation will place an innovative section of two-lift concrete paving and highlight sustainable engineering practices. The project will include a top lift that will be constructed using photocatalytic cement. Photocatalytic cements have the potential to remove volatile organic compounds from the air. The project will also include a pervious concrete shoulder using the same cement.

The open house will feature expert presentations on two-lift paving, photocatalytic cement, and pervious pavements. Personnel from the Missouri DOT will also discuss Missouri’s plan for monitoring the environmental benefits associated with these technologies.

Additional two-lift concrete paving demonstration projects are planned throughout 2010-2011.

For more information

To learn more about the upcoming two-lift concrete paving open house, visit http://www.ctechcenter.org/t2/documents/Two-LiftProgandReg.pdf.

For more information on two-lift concrete paving, contact Tom Cackler, director, National Concrete Pavement Technology Center, 515-294-5798, tcackler@iastate.edu or view the project website at http://www.ctechcenter.org/projects/two-lift-paving/index.cfm

References


“Moving Advancements into Practice”

MAP Brief 1-1:

Describing promising technologies that can be used now to enhance concrete paving practices

Job-Specific Optimization of Paving Concrete with COMPASS (Concrete Mixture Performance Analysis System)

Introduction

A number of factors including project-time constraints; demand for longer pavement design-lives; transfer of mixture proportioning responsibilities to the paving contractor; and environmental, social, and economic considerations are forcing the concrete paving industry to come up with new ways to proportion and optimize their concrete mixtures. In addition, a larger number of concrete materials choices are available today that add complexity to the mixture proportioning process.

The Problem

In the past, the concrete mixture design and proportioning process was guided by prescriptive specifications, which included only a few criteria such as slump, air content, and 28-day strength. Years of experience with local materials and environmental conditions guided the concrete paving industry in making appropriate “intuitive” adjustments for optimal handling, necessary performance, and reasonable cost. However, times are changing, and the mixture design and proportioning process is becoming more complicated as science and technology are revolutionizing the concrete industry, and as the public demands faster-built, better-performing pavements.

The complications are enhanced by an increasing array of chemical admixtures; a variety of aggregate sources, cement types, and supplementary cementitious materials; and the compatibility of these different materials within a concrete mixture and in a given environment.

These complications make it practically impossible for the mixture design and proportioning process to continue to be “intuitive.” Furthermore, there has been a recent shift of responsibility from state agencies to private contractors for the design and proportioning of concrete mixtures and a trend toward the use of warranties, which make concrete producers liable for the performance of their materials. This shift makes “intuitive” mixture proportioning much too risky for contractors (see Figure 1).

<table>
<thead>
<tr>
<th>“Yesterday”</th>
<th>“Today”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock</td>
<td>Multiple sands</td>
</tr>
<tr>
<td>Sand</td>
<td>Multiple cement sources</td>
</tr>
<tr>
<td>Cement</td>
<td>Fly-ash, GGBFS, S.lime, nat. pozz.</td>
</tr>
<tr>
<td>Water</td>
<td>Chem admixtures</td>
</tr>
</tbody>
</table>

Figure 1. Concrete paving materials and mixture design requirements
A Solution

What, then, is the answer? The industry needs a concrete mixture optimization tool that can isolate properties of interest and simplify the approach to the mixture proportioning process based on site-specific conditions.

In response to this need, the Federal Highway Administration (FHWA) developed the Concrete Mixture Performance Analysis System (COMPASS), a Windows-based application system that uses a proven statistical optimization approach and includes many practical features and analysis techniques to help users optimize concrete mixtures.

With COMPASS, a user can optimize the performance of a concrete mixture in a particular environment by properly selecting material constituents, such as types of aggregates, cementitious materials, and admixtures, that will benefit properties identified as important to a particular environment, project type, and degree of importance of the project.

The user can also determine the appropriate gradation and material constituent proportions that will enhance the performance of a mixture. The user can then take the guidance offered by COMPASS and apply it to the optimization of mixture proportions.

The COMPASS System

COMPASS employs statistical analysis to define an experimental design, then prompts the user for results of performance tests that are executed on each of the experimental batches. Response surface models are then developed to predict performance of the concrete mixture as a function of mixture proportions. Optimal mixtures are obtained by assigning desirability functions to the various performance measures and then seeking the maximum desirability.

The goal of the COMPASS system is to optimize concrete pavement based on site-specific conditions. To achieve this, COMPASS helps the user do the following:

- Identify job-specific factors relevant to the mixture design process, such as the importance of the project, type of pavement, climatic conditions, construction constraints, and environmental exposures.
- Identify applicable mixture performance criteria and recommended test methods.
- Assess the impact that changes in materials or proportions, environmental conditions, and construction procedures have on portland cement concrete (PCC) constructability and performance.
- Perform aggregate blending.
- Establish initial mixture proportions.
- Optimize mixture proportions based on multiple job-specific criteria, such as strength, cost, and permeability.

The COMPASS system includes two key components that work together in achieving its goal: a Knowledge Base and Computerized Optimization Modules.

Knowledge Base

The purpose of the Knowledge Base is to be interactive by supplying a databank of accredited information and respective references that can be accessed, filtered, and logically presented to the user. The Knowledge Base is a compilation of information on concrete properties, testing methods, materials characteristics, compatibility of materials with one another, and compatibility of materials with the environment. The Knowledge Base is consistent with the Integrated Materials and Construction Practices for Concrete Pavements (IMCP) manual, developed by the National Concrete Pavement Technology Center.

Computerized Optimization Modules

The computer modules allow the user to conduct the analytical tasks necessary to optimize a concrete mixture based on job-specific inputs and criteria. There are four modules:

1. Mix Expert.
2. Gradation.
3. Proportioning.
4. Optimization.

When using the COMPASS software, these modules are listed on the left-hand side of the screen, as shown in Figure 2. Also shown in Figure 2 is a “Tip of the Day” statement randomly generated by the Knowledge Base. The statement changes each time the software is opened.

![Figure 2. Opening screen for COMPASS software](image-url)
Each module has the ability to be used as a stand-alone tool. Alternatively, the user can perform a comprehensive analysis by executing the four modules in order and building upon each consecutive module's analysis results. The flow for the comprehensive analysis is depicted in Figure 3 and is briefly defined as follows:

1. Identify the performance criteria relevant to job- and site-specific conditions, and select materials that best suit the conditions using Module 1 – Mix Expert.
2. Determine aggregate gradations for optimal packing density and workability using Module 2 – Gradation.
4. Optimize the concrete mixture proportions based on job-specific criteria using Module 4 – Optimization.

**Mix Expert**

Mix Expert generates guidance for the user by cross-referencing the inputs with the information in the Knowledge Base. Based on the user’s inputs for construction type, environmental conditions, and materials available for use, Mix Expert helps the user identify performance criteria that should be considered and materials to use (or not use) in order to optimize pavement performance. See Figure 4 for an illustration of this process.

**Gradation**

The Gradation module guides the user in combining and optimizing a blend of aggregates. The blend can include more than two aggregate sources. The user can choose one of three mathematical models (Toutar, De Larrard, or Dewar) to optimize a blend, or can instead manually adjust proportions. Results of blended proportions are presented in several ways, including calculations for voids ratio, packing, coarseness factor, 0.45 power, and percent retained (“8-18”) charts, as seen in Figure 5. By optimizing aggregate gradation, the user is able to increase durability, strength, and workability.
Proportioning

The Proportioning module guides the user through the mixture design process and allows the user to design a mixture that incorporates up to four aggregate sources. The user can quickly make a first cut of proportions based on user inputs for strength, slump, and air content criteria. These proportions can then be refined to consider the effect certain constituents (e.g., fly ash and admixtures) may have on water content requirements.

Inputs for aggregate characteristics such as moisture content and absorption are also required for this module, which allows the user to adjust proportions based on aggregate moisture content.

Optimization

The Optimization module guides the user through a two-step process that includes the following:

1) Identifying a list of trial batches based on selected material constituents and proportioning ranges.

2) Performing an optimization analysis of mixture proportions based on user-defined, job-specific criteria.

In this module, COMPASS recommends a set of trial batches for testing of performance criteria important to the project. Testing of performance criteria can be accomplished through lab testing, virtual batching (mixture performance predictive models), or a combination of both.

With this information, COMPASS develops response surface models to predict concrete performance as a function of mixture proportions. COMPASS then produces an expanded list of mixture proportions within selected proportioning ranges and identifies a ranked list of optimal mixtures that best meet criteria based on user-defined desirabilities. Selected optimal mixtures are then tested to ensure they meet the user's real-world needs.

The advantage of using the Optimization module is that it makes trial batching more efficient by minimizing the need for trial-and-error testing.

Applications

The COMPASS optimization system can prove useful to both pavement engineers and paving contractors. COMPASS can assist engineers in choosing and quantifying mixture design criteria appropriate to a specific job. COMPASS can also be helpful in iterations between structural design and mixture design selections (e.g., evaluating a structural design requirement such as strength or shrinkage for a given concrete paving mixture).

Contractors can benefit from COMPASS by meeting given constraints (criteria) with their mixtures, ensuring that the mixture is workable and durable while at the same time minimizing cost. COMPASS can also be beneficial for ready-mix suppliers who are looking to improve their mixture proportions, for admixture suppliers who advise customers on ways to optimize their mixtures, and for instructors who want a hands-on tool for teaching the intricacies of mixture design and proportioning.

To access the COMPASS software, visit http://www.PCCMix.com.
Moving Advancements into Practice

MAP Brief 4-1:

Describing promising technologies that can be used now to enhance concrete paving practices

Diamond Grinding to Reduce Tire-Pavement Noise in Concrete Pavements

What is Diamond Grinding?

Diamond grinding has traditionally been viewed as a technique to restore pavement smoothness, since the process inherently grinds away bumps that would otherwise cause a vehicle to bounce as it drives down the road. In most cases, diamond grinding also restores friction—the process creates texture that is needed to channel water away from a rolling tire. The reduction of tire-pavement noise is a benefit that has emerged more recently due to the increasing popularity of noise as an indicator of comfort and, in some cases, a public health issue.

The process of texturing concrete pavements with diamond grinding is not new—it has been routine practice in some areas since the 1970s—and it can occur at any time in the pavement’s life. Most states view the technique as a means to rehabilitate an existing concrete pavement, since it reduces the roughness that occurs over time as a pavement surface degrades under traffic.

However, some states are now allowing the use of diamond grinding as a final surface texture for newly paved roads, since it often produces a more consistent, smoother, and quieter surface than other conventional textures.

Diamond grinding is a mechanical process. The idea is to create a new surface on the pavement by means of controlled abrasion. The most intricate component of diamond grinding is the grinding head—a spindle that consists of hundreds of sawblades that are stacked along with spacers to provide the desired pattern.

On the outside edge of each steel sawblade are industrial diamonds that are engineered for the specific application. The widths of the sawblades and the spacers between them can vary, which ultimately dictates the size and shape of the resulting texture, along with its durability (ability to maintain a desirable texture over time).

The grinding head is mounted horizontally onto the grinder, which controls the rotation of the head and the height and speed at which grinding occurs. All of these parameters will affect both the “as constructed” texture and the productivity of the process.

How Does Diamond Grinding Affect Friction and Noise?

The texture that results from diamond grinding takes the form of grooves and lands, as illustrated in the photographs in figure 1.

The grooves lie just beneath the surface of the pavement and thus provide the drainage necessary to make the pavement safe during wet weather. The grooves also help pro-
duce a quiet surface by reducing the contact area between the tire and the road and keeping air from being trapped as the tire rolls.

Lands result from uncut concrete between each sawcut. This concrete typically breaks off to a more or less consistent height above the sawcut grooves. The geometry and uniformity of the lands are important to both noise and friction, since they define the contact between the tire and the road. In some cases, the lands will include irregular remnants of concrete, known as fins, stacked atop them.

As illustrated in figure 1, the fins can have a serrated appearance that will eventually wear to a more consistent height under traffic. However, for the first days or weeks under traffic, the presence of these fins can affect the surface properties. For example, the friction of newly-ground surfaces is often higher than the more stable levels measured after this break-in period. The tire-pavement noise level will also generally be higher immediately after grinding because the irregular fins will penetrate the tire, causing it to vibrate and generate additional noise. As the fins wear to a more even height, this additional noise can sometimes decrease on the order of 2 to 3 dB—a perceptible difference.

**Is Diamond Grinding Quiet?**

Before analyzing the quietness of diamond grinding as compared to other concrete pavement surface textures, it should first be recognized that there is a great deal of variability among pavements of the same nominal texture type. Diamond grinding has been identified as a viable solution for quieter pavements, and the process to optimize its use is ongoing. In the meantime, the variety of equipment and techniques currently being used is leading to a variety of as-ground surfaces with varying noise levels. The specifications used today for diamond grinding are intended to improve smoothness, and are thus not optimized for reducing tire-pavement noise.

Figure 2 shows the range of tire-pavement noise levels that have been measured on hundreds of concrete pavements nationwide as part of the Concrete Pavement Surface Characteristics Program (CPSCP). These curves represent concrete pavements of varying age, materials, traffic and weather exposure, and construction techniques. However, while there is variability among all nominal concrete pavement surface textures, diamond grinding does emerge as a consistently quieter alternative, and thus one to consider if noise is an important factor.

Figure 3 illustrates data from the CPSCP sites that were used to develop the diamond grinding distribution in figure 2. The intent of this perspective is to assess what can happen to noise levels over time, often called the acoustical durability. Different symbols represent individual test results—some measured directly with the Standard Reference Test Tire (SRTT), and others (with small circles) measured with the now-obsolete Aquaredd III test tire. In the latter case, adjustments are made to the on-board sound instrument (OBSI) levels to make them directly comparable. Test sections that were evaluated numerous times during their lives are connected by lines. The oval in the upper left portion of the figure is intended to illustrate typical OBSI levels of older pavements that would be candidates for diamond grinding.
The data shown in figure 3 are used to derive a reasonable durability target—one where the measurements of most of the diamond ground sections will fall given the diversity in materials, contractors, climate, and traffic. In situations with warm, dry climates, little traffic, and/or hard aggregates, very little change in the OBSI level over time can be expected, thus, the slopes will be relatively flat. In harsher winter climates, high traffic, and/or with softer aggregates, the slopes can be more significant.

The OBSI levels provided here are measured using equipment operated under the CPSCP. While in compliance with best practices and all relevant standards (e.g., AASHTO TP76), bias among operators can be expected. Before specification or policy using OBSI is considered, ongoing work under Pooled Fund TPF-5(135), Tire/Pavement Noise Research Consortium, should be consulted.

Figures 4 and 5 further illustrate this variability through photographs of the louder and quieter diamond ground projects measured under the CPSCP. Note that the louder surfaces tend to be heavily worn, again stressing the need for texture durability. Friction on these smoother surfaces tends to also be lower.

**Optimizing Diamond Grinding for Quieter Pavements without Compromising Friction**

The CPSCP has developed better practices for texturing concrete pavements to reduce noise. These practices include specific guidance to improve concrete pavement surfaces of all nominal textures, including diamond ground surfaces.

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Figure 4. Photographs of quietest diamond ground surfaces – Overall OBSI Level of 97-98 dBA

Figure 5. Photographs of loudest diamond ground surfaces – Overall OBSI Level of 102-104 dBA
The following are highlights of this guidance for diamond grinding that can be implemented immediately:

- **Concrete aggregate type** – When diamond grinding, the makeup of the concrete is exposed at the surface. Because the majority of the concrete used in paving consists of coarse aggregate (rock), the nature of this constituent will significantly affect the ability of the surface to retain the texture necessary for both a quiet and safe surface. As with any pavement-related decision, careful consideration should be given to friction. With respect to diamond grinding, selection of projects and grinding patterns should be based on experience and/or a careful evaluation of the concrete material and, more specifically, the coarse aggregate type.

- **Grinding head** – There does not appear to be an optimum size and spacing of blades and spacers for reducing tire-pavement noise as there is for improving friction (as a function of aggregate type). Conventional practice involves selecting these components based on the specific concrete being ground in order to optimize the production rate and the durability of the surface from subsequent wear under traffic and maintenance. This practice is still recommended to better ensure that safety, cost, and durability are not compromised for the sake of noise.

- **Equipment size** – Larger, heavier grinding equipment is more likely to have the control necessary to consistently impart the texture at the intended depth and lateral coverage.

- **Holidays and overlap** – Care should be taken to ensure that the match line between passes of the grinder does not coincide with the wheel path, as this can be a source of irregular grinding patterns. Wider grinding heads (e.g., 4 ft.) will minimize the number of match lines, keep them out of the wheel path, and potentially impart better control.

- **Grinder bogie wheels** – Any imperfections in the bogie wheels that support the grinding head can manifest as texture variations in the as-ground surface. Care should be taken to ensure that the wheels are true (round).

- **Fins** – Machine adjustments should be taken to minimize the variability in the height of the remaining fins of concrete. While wear will occur under traffic and from winter maintenance activities, additional means of knocking down excess fin height can be done. Dragging the surface with a steel blade or beam prior to opening to traffic can reduce fin height, but may also damage pavement joints, and is therefore not recommended.

- **Vibrations** – While inevitable due to the nature of grinding, excessive vibrations should be avoided. If unchecked, these vibrations can impart themselves as undesirable texture in the pavement that can, in turn, increase noise levels, especially that texture which repeats itself on the order of one inch or longer.

In addition to the above information, FHWA has guidance on selection of projects and equipment requirements in its publication, *Concrete Pavement Rehabilitation Guide for Diamond Grinding*. This can be found at [http://www.fhwa.dot.gov/PAVEMENT/concrete/diamond.cfm](http://www.fhwa.dot.gov/PAVEMENT/concrete/diamond.cfm).

**Additional Resources**


Website of the Concrete Pavement Surface Characteristics Program: [http://www.SurfaceCharacteristics.com](http://www.SurfaceCharacteristics.com)

**Sponsors**
The Concrete Pavement Surface Characteristics Program is sponsored by the following agencies and organizations:

- The Federal Highway Administration.
- Pooled fund TPF-5(139) (California, Iowa, Minnesota, New York, Texas, Washington, and Wisconsin).
- The National Concrete Pavement Technology Center.
- The American Concrete Pavement Association.
- The International Grooving and Grinding Association.

Neither CP Road Map participants or sponsors nor the Federal Highway Administration assumes liability for the information contained in this publication or endorses products or manufacturers mentioned herein.
“Moving Advancements into Practice”

MAP Brief 7-1:

Describing promising technologies that can be used now to enhance concrete paving practices

Use of Nonwoven Geotextiles as Interlayers in Concrete Pavement Systems

This document describes the potential use of nonwoven geotextile materials as interlayers in concrete pavement systems, particularly unbonded overlays, in the United States. It briefly discusses Germany’s experience, availability and cost of nonwoven geotextiles in the United States, specifications, recent field tests, recommended construction practices, and issues requiring additional research.

The Need

In the United States, hot-mix asphalt (HMA) is the material traditionally used to separate cementitious pavement layers. In the case of unbonded concrete overlays on existing concrete pavements, a 1-in. thick HMA interlayer is typically required.

Although HMA interlayers provide adequate cushioning and layer separation, HMA can have some drawbacks.

For example, using HMA as an interlayer requires setting up two separate paving operations, one for concrete and one for asphalt, which can be expensive and time consuming.

Some HMA mixes do not provide adequate drainage and can be subject to stripping under heavy truck traffic.

The 1-in. typical HMA interlayer depth for unbonded overlays on concrete pavements can be problematic in tight vertical clearance situations, particularly in urban areas.

Because of these shortcomings of HMA interlayers, contractors and roadway agencies could benefit from an alternative to HMA.

A Potential Solution

As part of a May 2006 scanning tour of long-life concrete pavements in Europe, participants examined German pavement systems. For 25 years, German engineers have been using nonwoven geotextile materials as interlayer material between new cement-treated bases and jointed concrete surface layers (figure 1). These pavement systems are of excellent quality and have long lives, despite carrying significant traffic loads.

German engineers also use nonwoven geotextiles as interlayer material on occasion when they construct unbonded concrete overlays. Before they place the geotextile interlayer, however, the existing pavement is either rubblized or cracked-and-seated, which is not common U.S. practice.

German engineers have steadily improved the following characteristics and functions of nonwoven geotextiles for use as interlayer materials:

Figure 1. Core from Germany showing nonwoven geotextile interlayer between surface concrete (left) and cement-treated base (right)

1 In 2006, U.S. public and private sector representatives participated in a European scanning tour on long-life concrete pavements sponsored by the Federal Highway Administration, the American Association of State Highway Transportation Officials, and the National Cooperative Highway Research Program. The final report of the scanning tour can be found at http://international.fhwa.dot.gov/pubs/067027/
1. **Separation.** Prevents joints or cracks from reflecting to the surface layer. Needs to prevent bonding and accommodate the normal movements of the two cementitious layers.

2. **Drainage.** Allows infiltrated water between layers to drain to the pavement edge. Must be terminated next to adjacent drainage layer or daylighted. Needs a degree of permeability that allows minimum flow in three dimensions.

3. **Bedding.** Provides a degree of cushion that reduces bearing stresses while providing adequate support stiffness.

As a result of what they learned in Germany, scanning tour participants recommended that field tests be conducted in the United States to examine the effectiveness of nonwoven geotextile material as an interlayer between cementitious pavement layers.

The participants particularly recommended that the material be evaluated as an alternative to IIMA as an interlayer material between existing concrete pavement and new concrete overlays—but without cracking-and-seating or rubblizing the existing pavement.

## Availability and Cost

Several U.S. manufacturers produce nonwoven geotextile materials that are used for a variety of purposes. However, until very recently, none of the U.S.-produced materials were marketed specifically for use as an interlayer in cementitious pavement systems, and most U.S.-produced materials do not conform to German specifications for such use.

Recently, agencies and contractors have expressed an increased interest in using nonwoven geotextiles as interlayers in pavement systems in the U.S. As a result, some U.S. manufacturers now produce materials that meet specifications.

Costs of U.S.-produced materials can vary, but estimators should assume $1.50 to $2.50 per square yard for the material and installation.

German-made nonwoven geotextiles are available through many U.S. suppliers. They can also be imported directly from Germany at a slightly lower source cost than U.S.-produced material, but organizations should expect additional freight costs of $0.05 to $0.10 per square yard. Importing directly from Germany will likely increase project lead time by six to eight weeks.

## Specifications and Testing

Nonwoven geotextile interlayers were first standardized in Germany in 2001, and the specifications have evolved over time to reflect continuing improvements by German engineers.

Table 1 shows proposed interim U.S. specifications for nonwoven geotextiles used as interlayers in cementitious pavement systems, based on German concrete pavement guide documents.

Until the proposed U.S. specifications are finalized and test standards (e.g., ASTM) are verified for use with nonwoven geotextile materials, use of the German specifications and test standards (e.g., ISO, EN, DIN) is recommended.

### Table 1. Summary of proposed specifications for nonwoven geotextiles (derived from German guide documents)

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirements¹</th>
<th>Test Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotextile Type</td>
<td>Nonwoven, needle-punched geotextile, no thermal treatment (calendering or IR)</td>
<td>EN 12224, Annex F (Manufacturer Certification of Production)</td>
</tr>
<tr>
<td>Color</td>
<td>Uniform/nominal same color fibers</td>
<td>(Visual Inspection)</td>
</tr>
<tr>
<td>Mass per unit area</td>
<td>≥ 450 g/m² (13.3 oz/yd²) ≤ 550 g/m² (16.2 oz/yd²)</td>
<td>ISO 9664 (ASTM D 5251)</td>
</tr>
<tr>
<td>Thickness under load (pressure)²</td>
<td>[a] At 2 kPa (0.29 psi): ≥ 3.9 mm (0.15 in.)</td>
<td>ISO 9883-1 (ASTM D 5193)</td>
</tr>
<tr>
<td></td>
<td>[b] At 20 kPa (2.9 psi): ≥ 2.5 mm (0.10 in.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[c] At 200 kPa (29 psi): ≥ 1.0 mm (0.04 in.)</td>
<td></td>
</tr>
<tr>
<td>Wide-width tensile strength³</td>
<td>≥ 10 kN/m (685 lb/ft)</td>
<td>ISO 10319 (ASTM D 6596)</td>
</tr>
<tr>
<td>Wide-width maximum elongation¹</td>
<td>≤ 130%</td>
<td>ISO 10319 (ASTM D 6595)</td>
</tr>
<tr>
<td>Water permeability in normal direction under load (pressure)</td>
<td>At 20 kPa (2.9 psi): ≥ 1x10⁻⁴ m/s (3.3x10⁻⁴ ft/s)</td>
<td>DIN 60500-4 (mod. ASTM D 5403 or ASTM D 4491)</td>
</tr>
<tr>
<td>In-plane water permeability (transmissivity)³ under load (pressure)</td>
<td>[a] At 20 kPa (2.9 psi): ≥ 5x10⁻⁶ m²/s (1.6x10⁻⁸ ft²/s)</td>
<td>ISO 12598 (mod. ASTM D 6574 or ASTM D 4719)</td>
</tr>
<tr>
<td></td>
<td>[b] At 200 kPa (29 psi): ≥ 2x10⁻⁴ m/s (6.6x10⁻⁶ ft/s)</td>
<td></td>
</tr>
<tr>
<td>Weather resistance</td>
<td>Retained Strength ≥ 50%</td>
<td>EN 12224 (ASTM D 4355 @ 508 hrs. exposure)</td>
</tr>
<tr>
<td>Alkali resistance</td>
<td>≥ 96% Polypropylene/Polyethylene</td>
<td>EN 13245, Annex B (Manufacturer Certification of Polymer)</td>
</tr>
</tbody>
</table>

¹ Requirements must be met for 95% of samples, compared to MARV requirements commonly specified for geotextiles in the United States, which require a 97.7% degree of confidence (see AASHTO M 288).

² Old thickness requirement was ≥ 2.0 mm (0.08 in.) at 20 kPa (2.9 psi) only (ZTV Beton, StB 01).

³ Note that other measures of tensile strength are commonly reported in product literature that are not comparable to the results of this test procedure.

⁴ A maximum elongation of a 60% is recommended as a better practice.

⁵ Old transmissivity requirement included only testing at 20 kPa (2.9 psi) (ZTV Beton, StB 01).
Field Tests in the United States

Two notable field tests using nonwoven geotextile interlayers have been conducted recently in Missouri and Oklahoma.

Missouri

The first field test was conducted on Route D south of Kansas City, Missouri, in 2008. Nonwoven geotextile material was used as an alternative to a 1-in. HMA interlayer in an unbonded concrete overlay.

Before placing the nonwoven geotextile interlayer, the existing concrete pavement was thoroughly cleaned, and deteriorated areas were patched with flowable mortar to create a uniform surface (figure 2).

The nonwoven geotextile was placed dry (figure 3) and fastened to the underlying concrete pavement with pins (nails) air-driven through 2.25-in. galvanized discs spaced 2 to 6 ft apart (figure 4).

Two U.S.-manufactured nonwoven geotextiles, Propex Geotex 1201 and 1601, were used. Neither was fully compliant with German specifications.

As a rule of thumb, a nonwoven geotextile interlayer between an existing concrete pavement and a concrete overlay should bond to the overlay but not to the existing pavement. If the nonwoven geotextile is too thin, it has the potential to become saturated by mortar from the overlay and bond to the underlying pavement surface.

Initially, Geotex 1201 was placed. After the thinness of the Geotex 1201 was observed, the contractor switched to the thicker Geotex 1601 for the remainder of the project.

A core sample of the Missouri overlay field test revealed that the nonwoven geotextile material had bonded with the overlay but not with the existing concrete pavement, as desired. Therefore, the installation was considered a success.

The ongoing performance of the interlayer material and the overlay pavement system will continue to be evaluated.

Oklahoma

In 2008 a second field test was conducted on a new construction project on I-40 in Oklahoma. This project was typical of a standard German application in which nonwoven geotextile material is used as an interlayer between a new cement-treated base and a new concrete pavement.

A German material, HaTe nonwoven B 500, was imported to ensure compliance with German specifications.

The galvanized discs used to secure the nonwoven geotextile to the cement-treated base were approximately 1 in. in diameter (smaller than German specifications).

Paving was conducted as in any normal project. Haul trucks were driven on the geotextile material as they were backed up to deposit fresh concrete in advance of the spreader. The nonwoven geotextile material was not damaged by the haul trucks or the paving machine, as long as the vehicles did not turn on the geotextile. The material appeared intact behind the paving train.

A core sample revealed that the nonwoven geotextile material had bonded slightly to the new pavement and not at all to the cement-treated base, making this installation a success.
Installation Practices

The two U.S. field tests conducted in 2008 provide encouragement that nonwoven geotextile fabric may be an efficient and cost-effective alternative to HMA as an interlayer in cementitious pavement systems in this country. In general, the following construction practices have resulted in successful installations:

- Place the material as shortly before paving as possible (ideally no longer than 2 to 3 days) to reduce the potential for it to be damaged.
- Before placing the nonwoven geotextile material, repair the existing pavement to correct any significant cracking or faulting, and sweep the pavement surface clean.
- Roll the material onto the base or other surface, keeping the nonwoven geotextile tight with no wrinkles or folds.
- Roll out sections of the material in a sequence that will facilitate good overlapping, prevent folding or tearing by construction traffic, and minimize the potential that the material will be disturbed by the paver.
- Overlap sections of the nonwoven geotextile material a minimum of 6 in. and a maximum of 10 in., and ensure that no more than three layers overlap at any point (figure 5).
- Ensure that the edge of the material along drainage areas extends at least 4 in. beyond the pavement edge and terminates above, within, or adjacent to the pavement drainage system.
- Secure the material with pins (nails) punched through 2.0–2.75 in. galvanized discs placed 6 ft apart or less, depending on conditions (figure 6).
- Lightly dampen the nonwoven geotextile prior to concrete placement to prevent its drawing water from the mix.
- If concrete is being delivered in front of the paver, place no more than 650 ft of nonwoven geotextile material ahead of the paver at any time (figure 7).
- Avoid driving on the nonwoven geotextile material unless necessary, and never make sharp turns on the material with vehicles. Avoid having the nonwoven geotextile exposed to heavy turning traffic until paving is completed.

Implementation Recommendations

Research is recommended to determine if nonwoven geotextile interlayers prevent reflective distress in concrete overlays when the existing pavement is not rubblized or cracked-and-seated. This and other ongoing performance questions will be monitored on the Missouri overlay and other upcoming projects. In addition, research is needed to determine ease of removal of concrete placed on nonwoven geotextile materials.
APPENDIX F
CP Road Map E-News April 2010

The CP Road Map E-News is the newsletter of the Long-Term Plan for Concrete Pavement Research and Technology (CP Road Map), a national research plan developed and jointly implemented by the concrete pavement stakeholder community.

New Moving Advancements into Practice (MAP) Brief
Moving Advancements into Practice (MAP) Briefs describe promising technologies that can be used now to enhance concrete paving practices.

MAP Brief 4-1: Diamond Grinding to Reduce Tire-Pavement Noise in Concrete Pavements has recently been published under Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements. This MAP Brief examines the affects of diamond grinding on friction and noise and outlines techniques for optimizing diamond grinding.

Download MAP Brief 4-1 (560 kb pdf).

News from the Road
News from the Road highlights research around the country that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

Virginia Transportation Research Council studies benefits of nanomaterials
The use of nanomaterials (particles less than a nanometer in size) in concrete mixtures is receiving increased interest around the nation. A recent study by the Virginia Transportation Research Council demonstrated some of the potential benefits of using nanomaterials in concrete mixtures, including improved strength, density, and permeability.

Download the full report (493 kb pdf).

Studies on the use of innovative materials such as nanosilica can contribute to research objectives of Track 1: Performance-Based Concrete Pavement Mix Design System and Track 12: Advanced Concrete Pavement Materials.

Texas Transportation Institute evaluates effectiveness of curing techniques
Protecting young concrete from moisture loss is considered paramount to good paving practice. The method most commonly used is the application of a liquid curing membrane shortly after placement. Most State DOTs currently evaluate the quality of these membranes via test results of properties known to correlate to performance. However, the Texas Transportation Institute has recently explored the next logical step: a performance-based evaluation of the effectiveness of curing techniques in preventing moisture loss in concrete pavements.

Download the full report (6.2 MB pdf).

This work is helping to meet research objectives outlined in Track 3: High-Speed Nondestructive Testing and Intelligent Construction Systems.

Minnesota Department of Transportation examines effects of pavement
drainage on joint behavior

It is well accepted that, all else being equal, the presence of moisture in and around a pavement structure can lead to poor performance. An example of this fact has recently been reported by the Minnesota Department of Transportation as part of an ongoing study to evaluate the effect of pavement drainage on joint behavior.

Download a MnROAD technical brief on this important topic (439 kb pdf).

Understanding the effects of pavement drainage on joint behavior will help meet the research objectives of Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction. Revisions to pavement design that might emerge from this work would fall under Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements.

Upcoming Events

- **First International Conference in North America on Nanotechnology in Cement and Concrete**
  May 5-7, 2010
  Irvine, CA
  http://www.trb.org/Conferences/2010/Nanotech

- **International Conference on Sustainable Concrete Pavement Technologies**
  September 15-17, 2010
  Sacramento, CA

Newsletter staff

- Dale Harrington, Snyder and Associates, Program Manager
- Rob Rasmussen, The Transtec Group, Program Specialist
- Sabrina Garber, The Transtec Group, Program Specialist
- Sabrina Shields-Cook, National Concrete Pavement Technology Center, Editor
CP Road Map E-News May 2010

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New Moving Advancements into Practice (MAP) Brief
Moving Advancements into Practice (MAP) Briefs describe promising technologies that can be used now to enhance concrete paving practices.

MAP Brief 1-1: Job-Specific Optimization of Paving Concrete with COMPASS (Concrete Mixture Performance Analysis System) has recently been published under Track 1: Performance-Based Concrete Pavement Mix Design Systems. This MAP Brief explains how COMPASS works and discusses how it can be used by pavement engineers and contractors to optimize concrete mixtures.

Download MAP Brief 1-1 (587 kb pdf).

News from the Road
News from the Road highlights research around the country that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

Texas Transportation Institute studies design of concrete pavement transitions
Concrete pavement transition areas remain one of the more difficult aspects of concrete pavement design. Localized roughness and other performance issues often arise at these critical locations if pavements are not designed and constructed properly. Researchers at the Texas Transportation Institute recently assembled common practices for various types of transitions and developed recommended practices.

Click here to view publications resulting from this project.

Work on this project is meeting a need identified under CP Road Map Track 2: Performance-Based Design Guide.

Washington DOT examines dowel bar retrofit to extend pavement life
Research work by the Washington Department of Transportation proves that dowel bar retrofit can extend the life of existing concrete pavements, even when those pavements have far outlived their expected design lives. Results of this research include guidelines for specifications and construction processes based on a better knowledge of performance.

Click here to find out more about this research.

This research links together work identified under CP Road Map Track 8: Long-Life Concrete Pavements and Track 10: Concrete Pavement Performance.

ACI releases report on pervious concrete
ACI International recently released ACI 522.R-10: Report on Pervious Concrete. While pervious concrete is
being used increasingly around the country on lower volume roads, parking areas, and shoulders, there have been some experimental mainline paving applications as well. The ACI report provides technical information on applications, design, materials properties, mix design, construction methods, testing, and inspection for pervious concrete.

View abstract and additional information for ACI 522.R-10.

Research and developments related to pervious concrete are addressing issues identified in CP Road Map Track 12: Advanced Concrete Pavement Materials. In addition, pervious concrete can be a sustainable pavement alternative, meeting needs outlined in Track 13: Concrete Pavement Sustainability.

**Minnesota DOT launches web page on concrete overlays**
To facilitate the use of concrete overlays as a viable rehabilitation alternative, the Minnesota Department of Transportation recently launched a web page containing design tools and links to better practices for design and construction of concrete overlays.

View the Minnesota DOT’s concrete overlays web page.

Concrete overlays are at the center of work under CP Road Map Track 7: High-Speed Concrete Pavement Rehabilitation.

**Nonwoven geotextile interlayers gaining popularity in the U.S.**
At the ACPA Chapter/State Executives meeting in Madison, Wisconsin in May 2010, the use of nonwoven geotextile interlayers for concrete overlays was identified as one of the most important recent developments for concrete overlays in the United States.

The first CP Road Map MAP Brief (7-1), published in May 2009, provides information on nonwoven geotextile interlayers for concrete pavements.

View MAP Brief 7-1: Use of Nonwoven Geotextiles as Interlayers in Concrete Pavement Systems (275 kb pdf).

**Updates from the States: Indiana**
The Indiana Department of Transportation (INDOT) Research and Development (R&D) Division is focused on a strategic plan with goals for safety, mobility, economic development, resource management, training, and customer service. Currently, many of the INDOT R&D research efforts focus on developing methods for reducing construction costs by optimizing design and construction procedures. Several ongoing research efforts include the following:

- Optimization of Mixture Proportions for Concrete Pavements
- Portland Cement Concrete Pavement Performance Relative to Permeability
- Using Recycled Concrete as Aggregate in Concrete Pavements to Reduce Materials Costs
- Investigation of Use of Slag Aggregates and Slag Cements in Concrete Pavements to Reduce the Maintenance Costs
- Development of Self Curing Concrete for Increasing Service Life

Ongoing, recently completed, and needed research as identified by INDOT R&D can be linked to the CP Road Map.

Read on for more details on Indiana’s research efforts.

**Newsletter archives**
View the April 2010 CP Road Map E-News.

**Newsletter staff**
- Dale Harrington, Snyder and Associates, Program Manager
- Rob Rasmussen, The Transtec Group, Program Specialist
CP Road Map E-News June 2010

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News from the Road

News from the Road highlights research around the country that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

North Dakota DOT reports on unsealed joints in concrete pavements

In 2009, the North Dakota Department of Transportation (DOT) conducted an experimental study on the practice of unsealed joints in new concrete pavements. The study evaluated the overall cost effectiveness, reliability, and durability of the joint designs and concluded that sealed joints are the better option for that state.

To view the North Dakota DOT report, click here.

This project is addressing research needs identified in CP Road Map Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction and Track 10: Concrete Pavement Performance.

Louisiana DOT investigates surface resistivity device

A Louisiana DOT project is investigating the use of a surface resistivity device as an indicator of concrete’s ability to resist chloride ion penetration. Surface resistivity measurements may provide an alternative to rapid chloride permeability testing for quality assurance and acceptance. Comparative testing is being conducted on concrete from the Caminada Bay Bridge project in Grand Isle, Louisiana.

For more details on the Louisiana DOT project, click here.

This research addresses needs identified in CP Road Map Track 10: Concrete Pavement Performance.

Research evaluates engineered cementitious composites (ECC)

A joint research effort at the University of Michigan and Stanford University suggests that engineered cementitious composites (ECC) have potential as a sustainable concrete pavement overlay material. This work will be presented by Victor Li (Michigan) and Michael Lepech (Stanford) in September 2010 at the International Conference on Sustainable Concrete Pavements.

At the University of Michigan, Li has been very active in the research and development of ECC for possible future bridge and pavement applications. For more information on this work, click here.

Research and development work pertaining to ECC can be categorized under CP Road Map Track 12: Advanced Concrete Pavement Materials and Track 13: Concrete Pavement Sustainability.

University of California study evaluates accuracy and feasibility of maturity method
The Partnered Pavement Research Center at the University of California recently released a report on evaluating the maturity method for flexural strength estimation in concrete pavements. This project was in response to Caltrans inquiries about the accuracy and feasibility of the maturity method and its applicability to mixtures with special cements and admixtures, including fast-setting hydraulic cement concrete. The report concludes that while the maturity method appears beneficial, some flexural strength testing is still recommended.

To read a summary of this research, [click here](#).

This research is meeting a need identified in [CP Road Map Track 3: High-Speed Nondestructive Testing and Intelligent Construction Systems](#).

### Updates from the States: Michigan

Concrete pavement research and technology development in Michigan is a joint effort of the Michigan Department of Transportation (MDOT), the Michigan Concrete Association (MCA), the University of Michigan, Michigan Technological University (MTU), Michigan State University (MSU), and Michigan research consultants.

Ongoing research efforts in Michigan include investigating the use of sustainable materials for recycled concrete pavements, methods for reducing the carbon footprint of portland cement concrete, and the use of recycled glass as a supplementary cementitious material.

Recently completed research has focused on characterizing aggregate properties, improving pavement durability for long-term performance, and calibrating variables for use in mechanistic-empirical pavement design.

[Read on for more details on Michigan's research efforts](#).

### Newsletter archives
- April 2010
- May 2010

### Newsletter staff
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- Sabrina Garber, The Transtec Group, Program Specialist
- Sabrina Shields-Cook, National Concrete Pavement Technology Center, Editor

The National Concrete Pavement Technology Center at Iowa State University provides operations support services to the CP Road Map program. CP Tech Center
2711 S. Loop Drive, Suite 4700
Ames, IA 50010
Phone: 515-294-5798
Fax: 515-294-0467
Email: [Program Management ~ Communications ~ Webmaster](mailto:program.management@nctc.iastate.edu)
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CP Road Map E-News July 2010

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News from the Road
News from the Road highlights research around the country that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

ACPA launches website database for concrete overlays
ACPA has launched a new website database for concrete overlays that includes nearly 300 overlay projects that have been completed in the United States. Using the website, users can access job-specific information, such as overlay type, application information, location, design details, and photos, for each of the projects in the database.

To view the website, click here.

The website contributes to technology transfer needs identified in CP Road Map Track 7: High-Speed Concrete Pavement Rehabilitation and Construction.

Virginia Transportation Council investigates high friction surfaces
The Virginia Transportation Council, a partnership of the Virginia Department of Transportation and the University of Virginia, recently released the report Field Performance of High Friction Surfaces. The report provides guidance to help agencies determine when high friction surfaces may be appropriate solutions to address specific instances of low skid resistance or especially high friction demand.

To download the full report, click here.

This research addresses needs identified in CP Road Map Track 4: Concrete Pavement Surface Characteristics and Track 10: Concrete Pavement Performance.

University of Illinois investigates two-stage mixing for recycled concrete aggregates
Replacement of virgin coarse aggregates with recycled concrete aggregates typically reduces the workability and strength properties of the concrete when all other factors are held constant. However, a recent study by the University of Illinois at Urbana-Champaign showed that the use of two-stage mixing can improve workability and strength properties of concrete mixes incorporating recycled concrete aggregates.

To read the full report, Batching Effect on Properties of Recycled Concrete Aggregates for Airfield Rigid Pavements, click here.

This research is helping to fill knowledge gaps outlined in CP Road Map Track 13: Concrete Pavement Sustainability and Track 1: Performance-Based Concrete Pavement Mix Design.

Texas research project evaluates alternatives to asphalt for subbase layers
The Texas Transportation Institute, the Center for Multidisciplinary Research, and the Center for Transportation Research recently conducted a Texas DOT study that evaluated alternatives to the use of asphalt for subbase layers. The report, Alternatives to Asphalt Concrete Pavement Subbase for Concrete Pavement published in May 2009, presents a test method to measure subbase erodibility. The method involves a triaxial type device that evaluates the interface between layers. Critical shear strength, coefficient of friction, and weight loss are measured in order to characterize the performance of typical concrete pavement subbase materials with respect to erosion.

To read a summary of this research, click here.

This research is meeting a need identified in CP Road Map Track B: Long-Life Pavements.

**Free ACPA software helps users develop job-specific dowel bar designs**

ACPA offers free software for dowel bar design. DowelCAD 2.0 can be downloaded from the ACPA website link listed below. Guidelines are included with the download. The software helps users evaluate pavement responses based on various dowel bar sizes and spacing. It assists users in engineering alternative dowel bar designs for load transfer based on job-specific needs.

To download this free program, click here.

The development of DowelCAD is categorized under CP Road Map Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction.

**Updates from the States: Wisconsin**

Highway research and technology transfer in Wisconsin is accomplished through various Wisconsin Department of Transportation (WisDOT) programs and partnerships with state universities and industry organizations.

Ongoing research efforts in Wisconsin include investigating the use of partial-depth repair techniques for concrete pavements, conducting demonstrations of cold-weather concrete paving, and evaluating the performance of open-graded base course with dowled and undowled transverse joints.

Recently completed research has focused on concrete pavement rubblization, high-performance concrete pavement, and whitetopping and ultrathin whitetopping.

Read on for more details on Wisconsin’s research efforts.

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The National Concrete Pavement Technology Center at Iowa State University provides operations support services to the CP Road Map program.
CP Tech Center
2711 S. Loop Drive, Suite 4700
Ames, IA 50010
Phone: 515-294-5798
Fax: 515-294-0467
Email: Program Management ~ Communications ~ Webmaster
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CP Road Map E-News August 2010 Special Issue

The CP Road Map E-News is the newsletter of the Long-Term Plan for Concrete Pavement Research and Technology (CP Road Map), a national research plan developed and jointly implemented by the concrete pavement stakeholder community. To find out more about the CP Road Map, or to get involved, contact Dale Harrington, dharrington@snyder-associates.com, 515-964-2020.

In this issue:

- Intro to the Special Issue
- New Moving Advancements into Practice (MAP) Brief: Two-Lift Concrete Paving
- News from the Road: Highlighted Research and Technology Implementation Efforts Resulting from the International Technology Scanning Tour on Long-Life Concrete Pavements

Intro to the Special Issue: Updates from the International Technology Scanning Tour on Long-Life Concrete Pavements

In May 2006, a team of public and private sector concrete pavement stakeholders visited transportation agencies in Europe and Canada to gather information about concrete paving practices that have resulted in long-lasting pavements.

During the tour, the team considered various technologies that, if incorporated into U.S. practice, have the potential to improve the longevity of concrete pavements. This issue describes the six technologies identified by the scan team as having the greatest potential and provides up-to-date information on how these technologies are being implemented in the United States.

To read more about the scanning tour, see the FHWA report Long-Life Concrete Pavements in Europe and Canada.

New "Moving Advancements into Practice" (MAP) Brief

Moving Advancements into Practice (MAP) Briefs describe promising technologies that can be used now to enhance concrete paving practices.

MAP Brief 13-1: Two-Lift Concrete Paving has recently been published under Track 13: Concrete Pavement Sustainability. This MAP Brief describes the potential of two-lift concrete paving as a long-lasting, sustainable pavement solution. Two-lift concrete paving was the first promising technology identified by the international scan team.

Download MAP Brief 13-1 (462 kb pdf).

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News from the Road

News from the Road highlights research around the country that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

This issue describes research and technology implementation resulting from the international scanning tour on long-life pavements. It includes the following information about the six topics identified by the scan team as having the greatest potential implementation benefits in the United States:

- Two-lift concrete paving
- Concrete pavement design catalogs
- High-quality concrete pavement foundations
- Improved concrete mixture designs
- Geotextile interlayers between cement-bound layers
- Exposed aggregate concrete pavement surfaces

The research and technology transfer programs resulting from the scanning tour all contribute to research needs identified in CP Road Map Track 8: Long-Life Concrete Pavements. Each program also contributes to other Road Map tracks, as identified in the links below.

**Two-lift concrete paving**
Two-lift concrete paving involves the placement of two wet-on-wet concrete layers that are placed consecutively to prevent a cold joint from forming between the two lifts.

The two-lift process has great potential as a sustainable paving solution. It reduces the cost of materials and materials transportation, reduces the environmental impact caused by quarrying and importing aggregates, and increases social benefits by maintaining friction and low noise levels and providing a long-lasting pavement that does not need frequent reconstruction.

Two-lift concrete paving can be categorized under CP Road Map Track 13: Concrete Pavement Sustainability. It also contributes to Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements because the top lift can be optimized to meet surface needs such as low noise and friction.

**Two-lift paving website**
The National Concrete Pavement Technology (CP Tech) Center has published a website with information on two-lift paving, including presentations and reports on two-lift construction in the U.S. To view the website, click here.

**Two-lift paving open house**
A national two-lift concrete paving open house will be held September 27-28, 2010 at the Drury Plaza Chesterfield - St. Louis to showcase an upcoming Missouri DOT (MoDOT) two-lift project. The project is part of the reconstruction of Route 141 between Ladue and Olive. The open house will give interested stakeholders the opportunity to learn more about two-lift concrete paving and will give the contractor and material suppliers the opportunity to share details about their approach to this project. For more information, or to register, click here.

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**Concrete Pavement Design Catalog**
The concrete pavement design catalog is a technique routinely used in Germany and Austria that simplifies pavement design. The implementation of this technology requires the development of look-up charts, or tables, that assign thicknesses based on known climate, materials, and traffic loads. The charts are supported and routinely refined via mechanistic validation efforts.

The development of U.S. versions of this technology is contributing to research objectives outlined in CP Road Map Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements.

**Caltrans design catalog**
The current California Department of Transportation (Caltrans) Highway Design Manual (July 2008) includes a design catalog for rigid pavements. The design catalog consists of tables that identify design thicknesses for the pavement surface and support layers based on expected loads, location, type of subgrade, and lateral support conditions. To access Section 600 of the Caltrans Highway Design Manual (where the design tables can be found), click here.

**MoDOT design catalog**
The Missouri Department of Transportation uses a design catalog during the scope of new projects. Lookup tables are used to determine design thicknesses for major roads in order to calculate conceptual estimates
only The design tables provide thicknesses based on traffic, but also include assumptions for speed, base type and thickness, number of lanes, and truck distribution categories. To access this information, click here.

**Design of concrete overlays (ultrathin whitetopping)**
The 2008 Illinois DOT report *Design and Concrete Material Requirements for Ultra-Thin Whitetopping* documents the effort to evaluate and identify the best method for designing concrete overlays over hot-mix asphalt (HMA) pavement surfaces. Chapter 5 of this report presents tables that list design recommendations for concrete thicknesses up to six inches based on HMA thickness, traffic, and fiber reinforcement. For more information, click here.

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**Concrete Pavement Foundations**
High-quality concrete pavement foundations result in better long-term pavement performance. The scanning team found that pavements constructed in Europe typically incorporate thicker, better quality materials in the foundation layers than those used in the United States.

Currently, there are a number of research and implementation efforts in the United States to develop stricter tolerances for foundation materials and innovative construction techniques to improve the placement of foundation layers. This research is categorized under CP Road Map Track 8: Long-Life Concrete Pavements.

**Geotechnical solutions for soil improvement**
The Transportation Research Board (TRB) Strategic Highway Research Program (SHRP) 2 R02 project titled *Geotechnical Solutions for Soil Improvement, Rapid Embankment Construction, and Stabilization of the Pavement Working Platform* is currently underway. Consisting of two phases, the intent of this project is to ultimately develop guidance on materials and methods for the new construction or rehabilitation of pavements over poor soil conditions. For more information, click here.

**Intelligent compaction pooled fund study**
The Accelerated Implementation of Intelligent Compaction Technology for Embankment Subgrade Soils, Aggregate Base, and Asphalt Pavement Material pooled fund study is sponsored by FHWA and includes Georgia, Iowa, Indiana, Kansas, Minnesota, Missouri, North Dakota, Maryland, New York, Pennsylvania, Texas, Virginia, and Wisconsin DOTs as supporting partners. One of this project's objectives is to develop specifications for the implementation of intelligent compaction as a means of constructing better performing subgrade and subbase foundation layers for concrete pavements. For more information, click here.

**Pooled fund study on foundation layers**
Foundation Layers for Concrete Pavements is a pooled-fund project supported by a partnership between the FHWA and Departments of Transportation in Iowa, California, Michigan, Pennsylvania, and Wisconsin. According to the project's objectives, all aspects of foundation layers will be investigated in an effort to identify what makes pavement foundations more durable, uniform, constructible, and economical. For more information, click here.

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**Improved Concrete Mixture Design**
During the scanning tour, the team found that concrete in Europe is quite durable and typically exhibits higher flexural strength values than concrete in the United States. The team concluded that more attention is given to concrete mixture design in Europe and that there is more willingness to adopt innovative materials and technologies in Europe.

There are many ongoing efforts to improve mixture designs in the United States. These efforts are categorized under Track 1: Performance-Based Concrete Pavement Mix Design Systems.

**Materials and construction optimization pooled fund study**
Pooled-fund study TPF-5(066), Material and Construction Optimization for the Prevention of Premature Pavement Distress in PCC Pavements, was initiated with the goal of identifying ways to improve pavement longevity. The final report, published by the National CP Tech Center in March 2008, marked the end of the project. The report documents an evaluation of conventional and new methods for testing concrete and concrete materials to prevent materials and construction problems that could lead to premature concrete pavement distress. Download the report.

As part of this project, the National CP Tech Center developed a testing guide for implementing quality control procedures for concrete pavements. FHWA is in the early stages of developing a training program based on this project. Download the Testing Guide for Implementing Concrete Paving Quality Control Procedures.

The National CP Tech Center also developed the Air-Void Analyzer Hyperdoc (AVA Hyperdoc) as part of this project. The AVA Hyperdoc is a multimedia training document that walks technicians through air-void analyzer (AVA) testing. It offers video clips, photos, and illustrations that lead users from setting up the equipment to interpreting AVA test results. Download the AVA Hyperdoc (695 mb pdf). (*Note: due to the file size, it is recommended to save the file to your desktop prior to opening it.)

**Concrete mix design pooled fund study**

CP Road Map Track 1 is specific to concrete mixture design concepts that are being implemented through pooled-fund TPF-5(205), Implementation of Concrete Mixture Design and Analysis (MDA) Track of the Concrete Pavement Road Map. Researchers involved with this pooled fund are tracking a majority of ongoing and recently completed research on concrete pavement materials and mix design. The objectives of this pooled fund are to evaluate emerging testing technologies and models, develop guidelines and specifications for testing mixes, and provide outreach and technology transfer. For more information, click here.

**COMPASS software**

The FHWA Concrete Materials Performance Analysis System Software (COMPASS) is a computer-based guidance tool that helps users design concrete mixture proportions. COMPASS includes four individual modules that guide users through the process of choosing proper materials, gradation analysis, mixture proportioning, and job-specific optimization procedures. Pending a formal implementation effort, the unofficial version of COMPASS can be downloaded free by clicking here.

To find out more about COMPASS, check out MAP brief 1-1.

**Guide for design and proportioning of concrete mixtures**

The Portland Cement Association and the American Concrete Pavement Association are currently developing a guide for concrete mixture designs for paving applications. The guide, titled *Design and Proportioning of Concrete Paving Mixtures*, will be a resource for designers, concrete producers, paving contractors and any other stakeholder interested in learning more about concrete paving materials and construction.

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**Geotextile Interlayers for Cement-Bound Layers**

The use of nonwoven geotextile interlayers between cementitious pavement layers is gaining momentum in the United States, due to the scanning tour and subsequent research on German practices. A 2009 study provided recommendations for U.S. materials and construction standards and specifications for nonwoven geotextiles.

The advantages for using nonwoven geotextile interlayers include expedited construction schedules, the potential for significant cost savings, and the elimination of an asphalt interlayer that has the potential to strip. The key to the success of these interlayers is to facilitate drainage beneath the concrete.

The efforts associated with the transfer of this technology to the U.S. industry can be categorized under CP Road Map Track 7: High-Speed Concrete Pavement Rehabilitation and Construction.

For more on geotextile interlayers, check out MAP brief 7-1.
An expert task group (ETG) that includes researchers, contractors, and representatives from both the concrete pavement and geotextile industries has formed to facilitate the implementation of geotextile interlayers in the United States. Recently, this group launched a website, ConcreteOnTop.com, that provides basic information about geotextile interlayers, materials and construction recommendations, and case studies, as well as an interactive form for frequently asked questions. Visit the website.

**Exposed Aggregate Concrete Pavement Surfacing**
During the scan tour, the team found that some countries used an exposed aggregate concrete surface to minimize noise caused by tire-pavement interaction. Efforts to implement this technology in the United States are categorized under CP Road Map Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements.

**Report on noise reduction methods**
In July 2006, the CP Tech Center published *Evaluation of U.S. and European Concrete Pavement Noise Reduction Methods*. The report documents Part 1, Task 2 of the a seven-year Concrete Pavement Surface Characteristics Project initiated by a partnership between the National CP Tech Center, FHWA, American Concrete Pavement Association (ACPA) and International Grooving and Grinding Association (IGGA).

Exposed aggregate surfaces are identified in the report as having the potential to reduce tire-pavement noise while providing adequate friction. The report also presents details on a project along Interstate 75 in downtown Detroit, where an exposed aggregate surface was constructed on a large scale for the first time in the United States. Click here to read more.

**Exposed aggregate test section in Kansas**
In 2008, a test section was constructed in Saline County, Kansas, that included an exposed aggregate surface. The test section was constructed using similar techniques to those used in Europe, and it incorporated two-lift construction methods. Subsequent noise testing of the surface showed that the exposed aggregate surface was quieter than a conventional pavement surface. In fact, the section in Kansas showed a lower tire-pavement noise than the average noise measured on European roadways with exposed aggregate surfaces. For more information on the Kansas trial section, including surface characteristics reports, click here.

**Presentation at October 2010 International Symposium on Concrete Roads**
The U.S. experience of constructing an exposed aggregate surface in Kansas will be presented at the 11th International Symposium on Concrete Roads on October 13-15, 2010, in Seville, Spain. The opportunity to present such a successful project will provide the opportunity for U.S. representatives to exchange knowledge and may lead to further improvements of this technology. For more information about the symposium, click here.

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2711 S. Loop Drive, Suite 4700
CP Road Map E-News September 2010

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New Moving Advancements into Practice (MAP) Brief
Moving Advancements into Practice (MAP) Briefs describe promising technologies that can be used now to enhance concrete paving practices.

MAP Brief 8-1: Roller-Compacted Concrete Pavements has recently been published under CP Road Map Track 8: Long-Life Concrete Pavements. This MAP Brief provides an introduction to roller-compacted concrete and its many paving applications.

Download MAP Brief 8-1 (387 kb pdf).

News from the Road
News from the Road highlights research around the country that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

Indiana evaluates in situ stiffness of subgrade by resilient and FWD modulus
In a recent project conducted by Purdue University for the Indiana DOT, the resilient modulus values of subgrade materials (as determined by laboratory testing methods) were compared to values calculated from falling weight deflectometer (FWD) testing. The study concluded that the modulus values obtained by FWD methods were approximately twice as high as those obtained through laboratory testing, and that these values were affected by seasonal changes. This study enabled the Indiana DOT to develop a more accurate approach for characterizing the subgrade layer when using Mechanistic-Empirical Pavement Design Guide software.

Click here to read the full report.

This project is contributing to research objectives identified in CP Road Map Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements.

Wisconsin DOT evaluates dowel bar retrofit performance
The Wisconsin DOT recently evaluated the use of a dowel bar retrofit rehabilitation technique for faulted concrete pavement slabs. Two test sections, one built in 1999 and one built in 2001, were monitored until 2007 as part of this project. The study concluded that dowel bar retrofitted sections exhibited overall lower International Roughness Index values and better load transfer efficiency values than non-doweled sections. Conclusions documented in the report, Dowel Bar Retrofit Performance in Wisconsin, also suggest that mortar fill material must be mixed, placed, and cured properly in order for DBR techniques to be most efficient.

Click here to read the full report.

Work on this project is meeting a need identified under CP Road Map Track 6: Innovative Concrete Pavement Joint Design, Material, and Construction.
Iowa research investigates ways to improve concrete overlay construction
The National Concrete Pavement Technology Center recently released a report documenting the evaluation of several concrete overlay construction projects in Iowa. The goal of the research was to investigate potential alternative construction methods and materials to reduce cost and minimize construction time for concrete overlays. Recommendations on the use of GPS-controlled saws, GPS pavement surface mapping, milling techniques, slipform paver machine controls, geotextile bond breakers, concrete strength for opening to traffic, traffic control, overlay construction timing, and FWD testing are offered in the conclusions section of the report, *Improving Concrete Overlay Construction*.

Click here to read the full report.

This project is an example of work done under CP Road Map Track 7: High-Speed Concrete Pavement Rehabilitation and Construction.

Ministry of Transportation Ontario report quantifies pavement sustainability for Ontario highways
A recent report from the Ministry of Transportation Ontario (MTO) and the University of Waterloo Centre for Pavement and Transportation Technology identifies current sustainable pavement materials and technologies, recommends indicators by which sustainability can be quantified, and evaluates potential improvements with regard to sustainability at a network level. The goal of the report, *Quantifying Pavement Sustainability for Ontario Highways*, was to develop a framework that could be implemented by the MTO for the purpose of quantifying sustainability.

Click here to read the full report.

This work is contributing to CP Road Map Track 13: Concrete Pavement Sustainability.

Ready Mixed Concrete foundation investigates effect of pavement type on fuel consumption and emissions
The Ready Mixed Concrete Research & Education Foundation recently published a report that compares fuel consumption and CO2 emissions of a vehicle traveling on a hot-mix asphalt pavement surface to those of a vehicle traveling on a concrete pavement surface. Results of this study suggest that traveling on a concrete pavement surface results in reduced fuel consumption and CO2 emissions.

Click here to read the full report.

This work is an example of CP Road Map Track 13: Concrete Pavement Sustainability. To read more about the testing procedures and results, click on the following link.

Updates from the States: Minnesota
Minnesota highway research is conducted by the Minnesota Department of Transportation (Mn/DOT) Materials and Road Research division. To achieve its research goals, Mn/DOT collaborates with the following organizations:

- Local Road Research Board (LRRB)
- Transportation Engineering and Road Research Alliance (TERRA)
- University of Minnesota Center for Transportation Studies (CTS)
- Institute for Transportation at Iowa State University (InTrans)
- National Concrete Pavement Technology Center at Iowa State University

Minnesota highway research efforts focus on four main topics:

- MnROAD, a test track constructed for evaluating pavement materials, design, and construction
- Pavement surface characteristics
- Intelligent compaction
• Ground penetrating radar

Read on for more details on Minnesota's research efforts.

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CP Tech Center
2711 S. Loop Drive, Suite 4700
Ames, IA 50010
Phone: 515-294-5798
Fax: 515-294-0467
Email: Program Management ~ Communications ~ Webmaster
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New Moving Advancements into Practice (MAP) Brief
Moving Advancements into Practice (MAP) Briefs describe promising technologies that can be used now to enhance concrete paving practices.

MAP Brief 5-1: Stringless Concrete Paving has recently been published under CP Road Map Track 5: Concrete Pavement Equipment Automation and Advancements. This MAP Brief describes the benefits of stringless concrete paving and provides information from two stringless paving research projects in Iowa.

Download MAP Brief 5-1 (849 kb pdf).

News from the Road
News from the Road highlights research around the country that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

CPTP publishes tech brief on performance of sealed and unsealed concrete pavement joints
A 2009 technical brief from the Concrete Pavement Technology Program (CPTP) summarizes an FHWA-sponsored research project that investigated the performance of jointed plain concrete pavements with sealed and unsealed joints. The tech brief

- discusses the effectiveness of sealants compared to the presence of dowel bars,
- identifies a statistical relationship between the presence of various sealant types and the occurrence of faulting and/or spalling, and
- describes the correlation of temperature gradients to slab support in pavements with and without sealants.

Click here to read the tech brief.

This project is contributing to research objectives identified in CP Road Map Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction. As a source of technology transfer, the tech brief can be categorized under CP Road Map Track 11: Concrete Pavement Business Systems and Economics.

Iowa research investigates the freezing-thawing durability of low-permeability concrete
A recent project in Iowa investigated the effects of air entraining admixtures (AEAs) on concrete properties and the ability of AEAs to provide freeze-thaw protection in low-permeability concrete. The researchers found that low-permeability concrete without AEA can still be durable in freeze-thaw conditions. They also found that the air-void system plays a greater role than cement type in determining durability when an AEA is used. The results of this project can help States that experience freeze-thaw conditions and use supplementary cementitious materials in their concrete
mixtures.

Click here to read the full report.

Work on this project is meeting a need identified under CP Road Map Track 1: Performance-Based Concrete Pavement Mix Design System.

**Louisiana research evaluates the durability of titanium dioxide photocatalyst coating for concrete pavement**

A collaborative research effort in Louisiana investigated the potential durability of pavements coated with a titanium oxide slurry. The use of titanium-dioxide to coat concrete pavements is intended to help decrease harmful air pollutants caused by vehicles in areas of high traffic. Because this technology is new to pavement applications, the goal of this research was to determine whether titanium dioxide slurry could potentially withstand real traffic loads and abrasion.

Based on microscopic evaluations and simulated traffic conditions in a laboratory, the researchers concluded that titanium oxide coating has the potential to perform well on pavements.

Click here to read the results of this research, published in *Construction and Building Materials* in August 2010.

This project is contributing to research needs outlined in CP Road Map Track 12: Advanced Concrete Pavement Materials and Track 13: Concrete Pavement Sustainability.

**Quebec research documents three-year performance of continuously reinforced concrete pavement with glass fiber reinforced polymer bars**

An ongoing project in Quebec is investigating and comparing the field performance of continuously reinforced concrete pavements (CRCP) with glass fiber reinforced polymer bars (GFRP) to the field performance of CRCP with typical deformed steel bar reinforcement. This research project is one of the first of its kind (a second project is ongoing in West Virginia), and is halfway through a six-year monitoring period. A recent paper accepted at the International Symposium on Concrete Roads documented the results of this research, to date.

For more information on this paper, click here to contact conference personnel.

This project is also highlighted in the CPTP tech brief *Evaluating the Use of Fiber-Reinforced Polymer Bars in Continuously Reinforced Concrete Pavements*. Click here to download the tech brief.

This work is contributing to CP Road Map Track 12: Advanced Concrete Pavement Materials.

**Updates from the States: Pennsylvania**

When it comes to highway research in Pennsylvania, there is a process that must be followed. That process, clearly defined by the Pennsylvania Department of Transportation (PennDOT) Bureau of Planning and Research (BPR), includes the following four steps:

1. Program development
2. Project development
3. Project management
4. Implementation

Current research in Pennsylvania includes the following projects:

- Establishing inputs for the new rigid component of the Mechanistic-Empirical Pavement Design Guide
- Preventing premature deterioration of jointed plain concrete pavements
- Implementing the concrete overlay field application program

Read on for more details on Pennsylvania’s research efforts.
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New Moving Advancements into Practice (MAP) Brief
Moving Advancements into Practice (MAP) Briefs describe promising research and technologies that can be used now to enhance concrete paving practices.

MAP Brief 1-2: Deleterious Chemical Effects of Deicing Solutions on Concrete Pavements has recently been published under CP Road Map Track 1: Performance-Based Concrete Pavement Mix Design Systems. This MAP Brief provides the results of research on different deicing solutions and their effects on concrete pavements.

Download MAP Brief 1-2 (849 kb pdf).

News from the Road
News from the Road highlights research around the country (and, in this issue, around the world) that is helping the concrete pavement community meet the research objectives outlined in the CP Road Map.

Wisconsin research investigates standardized test procedures for evaluating deicing chemicals
The Wisconsin DOT recently released a final report on a research effort to investigate, evaluate, and develop standard laboratory testing procedures for anticipating pavement performance when deicing chemicals, additives, and admixtures are used. Through a literature review, researchers identified the shortcomings of conventional test methods and explored alternative tests, including differential scanning calorimetry (DSC) and a Modified SHRP Ice Melting Test. The report notes, however, that these alternatives should be used for screening purposes only, because neither method is comprehensive enough to accurately predict field performance. This research was funded by pooled fund TPF-5(092), the Wisconsin DOT, and Clear Roads.

Click here to read the full report.

This research is contributing to research objectives outlined in CP Road Map Track 1: Performance-Based Concrete Pavement Mix Design System.

FHWA conducts interlaboratory study on measuring the coefficient of thermal expansion of concrete
A national interlaboratory study on measuring coefficient of thermal expansion of concrete was recently performed by the Federal Highway Administration's Turner-Fairbank Highway Research Center and published in Transportation Research Record No. 2164 (Concrete Materials 2010). The article documents an investigation into the variability of results obtained from different devices used to measure the coefficient of thermal expansion (CTE) in concrete. As a result of this study, recommendations to improve testing methods are presented.

For more details on how to obtain a copy of this article, click here.
This work is meeting research needs identified in CP Road Map Track 1: Performance-Based Concrete Pavement Mix Design System.

**Wisconsin research evaluates open-graded base course with doweled and non-dowled transverse joints**

Recent research in Wisconsin evaluated the performance of doweled versus non-dowled pavement sections constructed over a base that is either dense graded, asphalt stabilized, cement stabilized permeable, or untreated permeable with one of two different gradation requirements. The pavement sections included in this study are along three U.S. and State highways. The performance evaluation included testing joints for load transfer efficiency, calculating values for Pavement Distress Index (PDI) and International Roughness Index (IRI), and measuring hydraulic conductivity through the base. The study concluded that dense-graded base is the least expensive and meets drainage guidelines, and is therefore recommended.

Click here to read the full report.

This project is contributing to research objectives outlined in CP Road Map Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction and Track 8: Long-Life Concrete Pavements.

**Research in Malaysia investigates construction and performance of recycled roller-compact concrete pavements**

A paper presented at the First International Conference on Pavement Preservation, held in April 2010 Newport Beach, California documents research that investigated the use of four different binders (foamed bitumen, bitumen emulsion, cement, and lime binders) for rehabilitating an existing roller-compact concrete pavement. The type of rehabilitation method presented in this paper is an alternative to the typical rehabilitation methods for roller-compact concrete pavements in Malaysia, which include a granular and asphalt overlay. The study is an example of innovative pavement design techniques and alternative rehabilitation methods that include recycling the existing pavement.

Click here to read the report.

This project is meeting research needs identified in CP Road Map Track 13: Concrete Pavement Sustainability.

**Toronto research evaluates performance of permeable pavements in cold climates**

The University of Guelph together with the Toronto and Region Conservation Authority recently prepared an interim report, documenting the performance evaluation of various permeable pavements including interlocking permeable concrete pavers, pervious concrete, and impervious asphalt. Another interim report is scheduled for completion in March 2011 and the final report will be completed in 2012. At the end of this research effort, the pavements will have been evaluated for over three years, during which time critical performance factors in cold climates will be identified and recommendations for improved design, maintenance, and operation will be presented.

Click here to read the interim report.

This effort is an example of work that can be categorized under the CP Road Map Track 13: Concrete Pavement Sustainability.

**Updates from the States: Washington**

To accomplish concrete pavement research, the Washington Department of Transportation (WSDOT) often partners with universities, other State Departments of Transportation, and national centers through programs and organizations such as the Transportation Pooled Fund (TPF), Washington State Transportation Center (TRAC), Transportation Northwest (TransNow), and State Pavement Technology Consortium (SPTC).
TRAC is a partnership between WSDOT, the University of Washington, and Washington State University. TransNow is a Regional University Transportation Center led by the University of Washington. Universities from Idaho, Alaska, and Oregon are also a part of TransNow. SPTC pools the resources and efforts of the California, Minnesota, Texas, and Washington DOTs for pavement research in an effort to improve design, construction, and maintenance methods and procedures.

Upcoming concrete pavement research at WSDOT includes the evaluation of long-term pavement performance and noise characteristics of next-generation concrete pavement surfaces. WSDOT is also conducting several research projects related to concrete pavement sustainability that are contributing to research needs outlined in CP Road Map Track 13.

Read on for more information about concrete pavement research in Washington...

Newsletter staff
- Dale Harrington, Snyder and Associates, Program Manager
- Rob Rasmussen, The Transtec Group, Program Specialist
- Sabrina Garber, The Transtec Group, Program Specialist
- Sabrina Shields-Cook, National Concrete Pavement Technology Center, Editor

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Updates from the States: Indiana (May 2010)

Updates from the States: Indiana
The Indiana Department of Transportation (INDOT) Research and Development (R&D) Division is focused on a strategic plan with goals for safety, mobility, economic development, resource management, training, and customer service. Currently, many of the INDOT R&D research efforts focus on developing methods for reducing construction costs by optimizing design and construction procedures. Several ongoing research efforts include the following:

- Optimization of Mixture Proportions for Concrete Pavements
- Portland Cement Concrete Pavement Performance Relative to Permeability
- Using Recycled Concrete as Aggregate in Concrete Pavements to Reduce Materials Costs
- Investigation of Use of Slag Aggregates and Slag Cements in Concrete Pavements to Reduce the Maintenance Costs
- Development of Self-Curing Concrete for Increasing Service Life

Ongoing, recently completed, and needed research as identified by INDOT R&D can be linked to the CP Road Map.

Self-Curing Concrete for Increasing Service Life
One example is a research effort on The Development of Self-Curing Concrete for Increasing Service Life, led by Purdue University Professor Jason Weiss under the Joint Transportation Research Program (JTRP).

The research work shows that pre-wetted lightweight aggregates are beneficial when the potential for increased evaporation rates is high and the water-to-cementitious material ratio is low. Initial evaluations of test matrices suggest that pre-wetted, lightweight aggregates release water into the paste, allowing it to cure from the inside and thereby reducing the potential for shrinkage cracking and settlement. This work is scheduled for completion in October 2010, at which time the CP Road Map E-News will highlight the results.

The Development of Self-Curing Concrete for Increasing Service Life project is an example of the type of work that fulfills research needs identified under CP Road Map Track 1: Performance-Based Pavement Mix Design and Track 12: Advanced Concrete Pavement Materials.

For more information on this project, contact INDOT Research and Development Section Manager Tommy Nantung, tnantung@indot.in.gov, 765-463-1521, ext. 248.

Saw-Cutting Guidelines for Concrete Pavements
In January 2009, Purdue University published Saw-Cutting Guidelines for Concrete Pavements: Examining the Requirements for Timing and Depth of Saw-Cutting. The corresponding research work was performed by Kambiz Raoufi, Tony Thier, W. Jason Weiss, Jan Olek, and Tommy E. Nantung under the JTRP for INDOT R&D.

The purpose for the research was to develop procedures specific to Indiana for determining the ideal construction window for sawcutting and the optimal sawcut depth in order to minimize the potential for microcracking. Guidelines and recommendations documented within the report are intended to assist contractors in establishing improved field operations.

The research and publication of the final report Saw-Cutting Guidelines for Concrete Pavements: Examining the requirements for Timing and Depth of Saw-Cutting is an example of work related to CP Road Map Track 6: Innovative Concrete Pavement Design, Materials, and Construction and Track 10: Concrete Pavement Performance.
About the CP Road Map E-News

The CP Road Map E-News is the newsletter of the Long-Term Plan for Concrete Pavement Research and Technology (CP Road Map), a national research plan developed and jointly implemented by the concrete pavement stakeholder community. To find out more about the CP Road Map, or to get involved, contact Dale Harrington, dharrington@snyder-associates.com, 515-964-2020.

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Updates from the States: Michigan (June 2010)

Updates from the States: Michigan
Concrete pavement research and technology development in Michigan is a joint effort of the Michigan Department of Transportation (MDOT), the Michigan Concrete Association (MCA), the University of Michigan, Michigan Technological University (MTU), Michigan State University (MSU), and Michigan research consultants.

Michigan-based research agencies, centers, and programs
MDOT performs in-house research and works closely with MCA, State universities, and other State DOTs to provide the highest quality integrated transportation services for economic benefit and improved quality of life. The Transportation Materials Research Center (TMRC) is a partnership between MDOT and MTU, focusing on materials issues related to highways. MDOT also participates in a variety of pooled fund projects to gain knowledge and expertise that can help solve pavement problems.

Concrete research at MTU is conducted under the Michigan Tech Transportation Institute (MTTI). Research initiatives are carried out through a variety of centers and programs including Michigan’s Local Technical Assistance Program, Michigan Tech’s University Transportation Center for Materials in Sustainable Transportation Infrastructure, Technology Development Group, and Tribal Technical Assistance Program.

Concrete pavement research at MSU is focused on the development of concrete mechanistic-empirical pavement response and performance models, material characterization using nondestructive field and laboratory testing, advanced cost-effective pavement preservation methodologies, rapid construction quality assurance technologies, innovative pavement management strategies, dynamic vehicle-pavement interaction, and modeling of vehicle operating costs. Click here for more information on this research.

Focal areas for research
Ongoing research efforts in Michigan by the various research entities include investigating the use of sustainable materials for recycled concrete pavements, methods for reducing the carbon footprint of portland cement concrete, the impact of hydrated cement paste quality on entrained air void system, and the use of recycled glass as a supplementary cementitious material.

Recently completed research efforts include characterizing aggregate properties, improving pavement durability for long-term performance, calibrating variables for use in M-E PDG analysis, and improving concrete pavement sustainability. The following text highlights some of these efforts.

Coarse aggregates and freeze-thaw durability
Over the past few years, MDOT has performed research and analysis on coarse aggregates to validate results obtained from MDOT’s freeze-thaw testing procedures. This work was in response to contractor concerns regarding the test methods for acceptance of concrete coarse aggregates used in Michigan. The study confirmed, through multi-state testing, that the MDOT freeze-thaw testing program correlates well with testing programs currently administered by other states in a similar geographic region. Click here to view a report on this topic.

This project is an example of research work categorized under CP Road Map Track 1: Performance-Based Concrete Pavement Mix Design Systems.

Performance of jointed reinforced concrete pavements
A recent MDOT study reported on the performance of jointed reinforced concrete pavements (JRCP) over open-graded drainage courses. The study evaluated the performance of joints in JRCP over treated open-graded drainage courses and concluded that jointed plain concrete pavements (JPCP) constructed in
Michigan would have more consistent performance if constructed over a treated open-graded drainage course instead of an untreated base. According to the report, improved long-term performance of JPCP over a treated base is contingent on a properly draining pavement system. Click here to read the full report.

This project is meeting needs outlined in **CP Road Map Track 8: Long-Life Concrete Pavements and Track 10: Concrete Pavement Performance**.

**Evaluating concrete pavements with materials-related distress**
A recent research project by MDOT and MTU evaluated the performance of six existing pavements in Michigan with materials-related distress. Alkali-silica reaction and paste freeze-thaw deterioration were identified as the primary causes for distress in the different pavement structures that were evaluated. Click here to read the full report.

This research is an example of work categorized under **CP Road Map Track 10: Concrete Pavement Performance**.

**Implementing the M-E PDG**
As MDOT moves towards use of the AASHTO Mechanistic-Empirical Pavement Design Guide (M-E PDG), calibration of many of the required inputs is necessary. MDOT and MSU recently released a report documenting the development of axle load distributions and several other traffic characterizations for the various axle types for use in different regions and different roads for Level 2 inputs for the State of Michigan. Click here to view the report.

MDOT also conducted research on characterizing the coefficient of thermal expansion (CTE) of portland cement concrete using local aggregates. The project report catalogs Level I inputs (ME-PDG) for CTE, reflecting local materials and PCC mixture design practices.

These projects are addressing needs identified in **CP Road Map Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements**.

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Updates from the States: Wisconsin (July 2010)

Updates from the States: Wisconsin
Wisconsin highway research and technology transfer is accomplished by way of various Wisconsin Department of Transportation (WisDOT) programs and DOT partnerships with state universities and industry organizations. The Midwest Regional University Transportation Center (MRUTC), the Transportation Information Center, the Wisconsin Traffic Operations and Safety (TOPS) Laboratory, and the Construction and Materials Support Center are some of the most recognized highway research partnerships/facilities in the state.

WisDOT research programs include the Wisconsin Highway Research Program (WHRP), the Policy Research Program, WisDOT Pavements and Materials Research programs, and the Pooled Fund program. The WHRP is focused on improving performance and longevity of pavements; whereas the Policy Research Program is focused on evaluating the technical merit of current policies and the impacts of those policies on the economy, safety, operations, and more. The WisDOT Pavements and Materials Research program is focused on projects that develop specifications and new technologies, include forensic evaluations, and carry out quality assurance and materials testing.

Ongoing research
Wisconsin highway research projects currently underway can be categorized within the CP Road Map as follows:

- Reduction of Minimum Required Weight of Cementitious Materials in Concrete Mixes (Track 1)
- Detecting Deleterious Fine Particles in Concrete Aggregates and Defining Their Impact (Track 1)
- Demonstration of Cold Weather Concrete Paving (Tracks 1 and 8)
- Performance Evaluation of Open Graded Base Course with Doweled and Nondoweled Transverse Joints on U.S.H. 18/151 and S.T.H. 29 (Tracks 2, 6, and 10)
- Partial Depth Repair of Concrete Pavements WisDOT (Track 7)
- Investigation and Application of Fractured Slab Techniques for PCC (Track 7)
- Concrete Inlay for Continuously Reinforced Concrete Pavement Rehabilitation (Track 7)

Recently completed research
Research completed in the last two years includes the following:

- Concrete Pavement Rubblization: Survey of State Practice and Related Research (Track 2; this report is highlighted below)
- Analysis of High Performance Concrete Pavement Sections Along I-90 Near Tomah, Wisconsin (Tracks 8 and 12)
- Performance Assessment of Wisconsin’s Whitetopping and Ultra Thin Whitetopping Projects Wisconsin Highway Research Program (Tracks 2 and 10)
- Effects of Ground Granulated Blast Furnace Slag in Portland Cement Concrete (Track 1)
- Portland Cement Concrete Pavements over Rubblized PCC (Tracks 2 and 13)
- Status and Plans for Implementing 3D Technologies for Design and Construction in WisDOT (Track 3)
- Evaluation of MMFX 2 Steel Corrosion-Resistant Dowel Bars on Jointed Concrete Pavements (Track 6)
- Guidelines for Improving Full-Depth Repair of PCC Pavements in Wisconsin (Tracks 7 and 10)
- Evaluation of Probing vs. Coring for Determination of PCC Thickness (Track 11)

Pooled Fund projects
The Pooled Fund program provides WisDOT the opportunity to combine financial resources with other states in an effort to achieve the same research goals. The following new and ongoing Pooled Fund projects are related to the CP Road Map.

- Characterization of Drainage Layer Properties for MEPDG (Track 2)
- Investigation of Jointed Plain Concrete Pavement Deterioration at Joints and the Potential Contribution of Delcing Chemicals (Track 6)
- Implementation of Concrete Pavement Mixture Design and Analysis (MDA) Track of Concrete Pavement Road Map (Track 1)
- Evaluation of Test Methods for Permeability (Transport) and Development of Performance Guidelines for Durability (Tracks 1 and 10)
- Development of Performance Properties of Ternary Mixes (Tracks 1 and 10)
- Extending the Season for Concrete Construction and Repair, Phase III (Tracks 7 and 12)
- Improving Foundation Layers (Track 8)
- Technology Transfer Concrete Consortium (Track 11)
- Recycled Materials Resource Center (Track 13)
- Recycled Unbound Pavement Layers (Track 13)

**Highlighted projects**

The following section highlights specific research project reports by providing additional details and direct links for more information.

**Analysis of High-Performance Concrete Pavement Sections**

Completed in February 2010, *Analysis of High Performance Concrete Pavement Sections Along I-90 Near Tomah, Wisconsin* documented field work evaluating the first high-performance concrete test sections built in Wisconsin. The report presents M-E PDG analysis for the respective sections. The sections evaluated as part of this report are expected to last more than 50 years. The Summary and Recommendations Section identifies expected performance differences for each section and sites the need for empirical data to support conclusions. This work analyzes construction materials for long-life pavements, and therefore can be categorized under CP Road Map Track 8: Long-Life Concrete Pavements. The test section is the first of its kind in Wisconsin, thus this work can also be categorized under Track 12: Advanced Concrete Pavement Materials.

**Performance Assessment of Wisconsin's Whitetopping and Ultra Thin Whitetopping Projects**

Washington State University recently completed research for the Wisconsin Department of Transportation Division of Infrastructure Development Research Coordination Section. The report, *Performance Assessment of Wisconsin's Whitetopping and Ultra Thin Whitetopping Projects*, catalogs all of Wisconsin's whitetopped (unbonded overlay) and ultrathin whitetopped (bonded overlay) concrete pavements. As a result, a database was developed that includes design, construction, and performance data for 18 projects built from 1995 to 2007. This project concluded that overlay projects in Wisconsin have comparable performance to those in other states. This report is an example of work related to CP Road Map Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements.

**Concrete Pavement Rubblization**

*Concrete Pavement Rubblization: Survey of State Practice and Related Research* by CTC & Associates LLC and the WisDOT Research & Library Unit reports the results of a survey taken of the AASHTO Subcommittee on Materials. The survey consisted of nine questions that ask for state-specific details with regard to rubblization. As a result of the survey, tables were created reporting state-specific values for structural coefficients and resilient modulus. This work can be categorized under the CP Road Map Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements.

**Status and Plans for Implementing 3D Technologies for Design and Construction**

*Status and Plans for Implementing 3D Technologies for Design and Construction in WisDOT* is a report presented to WisDOT in May 2009 by Construction and Materials Support Center's Alan P. Vonderohe. The report documents the process for identifying all issues that must be addressed before WisDOT adopts 3D models as contract documents, eliminates traditional cross sections, uses DTM's to determine final quantities,
and allows contractors to construct facilities directly from 3D models. The conclusion of this report suggests that that implementation of 3D modeling is feasible and should be pursued by WisDOT as long as any bias that would hinder small contractors or engineering firms can be prevented. An implementation plan and timeline for short-term goals is provided in the Appendices. This project can be categorized under CP Road Map Track 3: High-Speed Nondestructive Testing and Intelligent Construction Systems.

Additional information
For additional information, visit the following websites:

- WisDOT research reports: http://on.dot.wi.gov/wisdotresearch/rip.htm
- WHP: http://www.whrp.org/research-areas/rigid/rigid-pavements.html
- MRUTC: http://www.mrutc.org
- TIC: http://tic.engr.wisc.edu/
- TOPS: http://www.topsiab.wisc.edu
- Construction and Materials Support Center: http://cmsc.engr.wisc.edu

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The National Concrete Pavement Technology Center at Iowa State University provides operations support services to the CP Road Map program.

CP Tech Center
2711 S. Loop Drive, Suite 4700
Ames, IA 50010
Phone: 515-294-5798
Fax: 515-294-0467
Email: Program Management ~ Communications ~ Webmaster
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Updates from the States: Minnesota (September 2010)

Updates from the States: Minnesota
Minnesota highway research is conducted by Minnesota Department of Transportation (Mn/DOT) Materials and Road Research division. In order to achieve their research goals, Mn/DOT often collaborates with organizations including the Local Road Research Board (LRRB), Transportation Engineering and Road Research Alliance (TERRA), the University of Minnesota Center for Transportation Center (CTS), the Institute for Transportation (InTrans) at Iowa State University and the National Concrete Pavement Technology Center (CP Tech Center). Mn/DOT participates in various national research programs including the Long-Term Pavement Performance Program (LTPP), Transportation Research Board (TRB), and Transportation Pooled Fund (TPF) programs. Links to more information on each of these organizations are provided below.

- Mn/DOT Materials and Road Research (http://www.dot.state.mn.us/materials/research.html)
- Local Road Research Board (LRRB) (http://www.lrrb.org/)
- Transportation Engineering and Road Research Alliance (TERRA) (http://www.terraroadalliance.org/)
- University of Minnesota Center for Transportation Studies (CTS) (http://www.pts.umn.edu/)
- Institute for Transportation (InTrans) (http://www.intrans.iastate.edu/)
- Long Term Pavement Performance Program (LTPP) (http://www.fhwa.dot.gov/pavement/ltpp/)
- Transportation Research Board (TRB) (http://www.trb.org)

Minnesota highway research efforts focus on four main topics: MnROAD, pavement surface characteristics, intelligent compaction, and ground penetrating radar (GPR). Concrete pavement projects for each of these topics can be categorized under the CP Road Map. In July 2010, the CP Tech Center met with Mn/DOT representatives to begin discussions on collaborative research regarding elements of the CP Road Map. The following paragraphs list current Minnesota research projects, including pooled fund efforts, and identifies reports published within the past few years. How each of the research activities and publications align with the CP Road Map is identified.

Current MnROAD Research
MnROAD is a test track constructed for evaluating pavement materials, design, and construction. Both existing and new technologies are evaluated at MnROAD in an effort to identify the most durable, cost effective, and best performing alternatives. Current MnROAD research is in Phase II and includes the following projects:

- Track 1: Performance-Based Concrete Pavement Mix Design System
  - Use of Taconite Aggregates in Pavement Applications

- Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements
  - PCC Surface Characteristics (Rehabilitation) (this is a pooled fund project: TPF-5(134))
  - PCC Surface Characteristics (Construction) MPR 6-021

- Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction
  - Performance of flat plate dowel bars in highway pavements
  - Use of joint stabilizers to restore joint load transfer efficiency

- Track 7: High-Speed Concrete Pavement Rehabilitation and Construction
  - Development of Design Guide for Thin and Ultrathin Concrete Overlays of Existing Asphalt Pavements (this is a pooled fund project TPF-5(165))
Performance of Thin Unbonded Concrete Overlays on High Volume Roads

Track 8: Long-Life Concrete Pavements
- 60 Year Design Concrete Pavement – Performance Model Development

Track 9: Concrete Pavement Accelerated and Long-Term Data Collection
- Ongoing data collection of all aspects of performance of various concrete pavement test sections at MnROAD

Track 10: Concrete Pavement Performance
- Concrete Pavement Optimization – Determining the Lower Threshold of Slab Thickness for High Volume Roads

Track 13: Concrete Pavement Sustainability
- Pervious Concrete Mix Design for Wearing Course Applications
- Pervious Concrete Pavement Study financed by Local Roads Research Board
- CP Tech Center / Mn/DOT Construction and Study of Porous Overlay
- SHRP 2 Cells 2-lift Construction. Recycled aggregate in lower lift, high SCM in the upper lift.

For more information on MnROAD and the MnROAD projects, follow these links:
www.dot.state.mn.us/mnroad/index.html
www.dot.state.mn.us/mnroad/projects/

Transportation Pooled Fund (TPF) Studies
Mn/DOT is involved in several TPF projects. A list of various concrete related TPF projects Mn/DOT is involved with follows. The list does not include projects already mentioned. The TPF projects are categorized according to the CP Road Map Track for which the research efforts align.

Track 1
- TPF-5(159) Technology Transfer Concrete Consortium
  www.pooledfund.org/projectdetails.asp?id=390&status=4 (this work can also be aligned under Track 11: Concrete Pavement Business Systems and Economics)
- TPF-5(179) Evaluation of Test Methods for Permeability (Transport) and Development of Performance Guidelines for Durability
  www.pooledfund.org/projectdetails.asp?id=406&status=4

Track 4
  www.pooledfund.org/projectdetails.asp?id=368&status=4

Track 6
- TPF-5(224) Investigation of Jointed Plain Concrete Pavement Deterioration at Joints and the Potential Contribution of Deicing Chemicals
  www.pooledfund.org/projectdetails.asp?id=452&status=4

Publications
Minnesota highway research publications within the last few years include the 2008 MnROAD Phase II Construction Report completed in June 2009. This report falls under multiple CP Road Map Tracks and is discussed further as a highlight. Other publications and how they align with the CP Road Map include:

Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements
- Putting Research into Practice: Calibrating the MEPDG for Minnesota (June 2009)
- Implementation of the MEPDG for New and Rehabilitated Pavement Structures for Design of Concrete and Asphalt Pavements in Minnesota (January 2009)

Track 3: High-Speed Nondestructive Testing and Intelligent Construction Systems
- Demonstration of Concrete Maturity Test Process on the TH-694/TH-35E Interchange – Unweave the Weave (August 2009)

Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements
- Mn/DOT Combined Smoothness specification (April 2010)
- Putting Research into Practice: Establishing a Combined Smoothness Specification for Minnesota Pavements (June 2009)
- Implementing the International Roughness Index for Concrete Pavement Evaluation (April 2007)

- Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction
  - Investigation of Joint Deterioration in MnROAD Phase 1 Jointed Concrete Pavement Test Sections (April 2010)

- Track 13: Concrete Pavement Sustainability
  - MnROAD Cell 64 Pervious Concrete: Third Year Performance Report (June 2009)

Click here for a complete list of Mn/DOT publications.

Highlights
The following highlights specific research project reports by providing additional details and direct links for more information. The projects highlighted include:

1. Effect of Concrete Materials on Permeability of Concrete Mixes Used in Mn/DOT Paving Projects by Ryan Rohne
2. Demonstration of Maturity Test Process on the TH-694/TH-35E Interchange – Unweave the Weave by Ryan Rohne and Bernard I. Izvebkhai
3. 2008 MnROAD Phase II Construction Report by Ann Johnson, Timothy Clyne, and Benjamin Worel
5. Sixty-Year Design Concrete Pavement-Performance Model Development: MnROAD Cell 53 Construction Report by Ryan Rohne
6. Evaluation of Concrete Pavement Texturing Practices in Minnesota Using the Wet Weather Accident Evaluation Criterion by Bernard Izvebkhai and Mark Watson
7. Investigation of Joint Deterioration in MnROAD Phase 1 Jointed Concrete Pavement Test Sections by Ryan Rohne and Tom Burnham

In December 2009, the final report Effect of Concrete Materials on Permeability of Concrete Mixes Used in Mn/DOT Paving Projects was completed under TPF-5(179) Evaluation of Test Methods for Permeability (Transport) and Development of Performance Guidelines for Durability. The purpose of TPF-5(179) is to relate pavement performance to permeability. This report documents the evaluation of permeability and pavement performance of 230 Minnesota-specific mixture designs. Results determined by statistical analysis suggest the use of granite aggregate and a 7-18 gradation both decrease permeability. This research work is an example of an effort to develop and deliver tools and techniques for specifying and proportioning concrete mixtures. Therefore, it is an example of work under CP Road Map Track 1: Performance-Based Concrete Pavement Mix Design Systems.

Completed in August 2009, Demonstration of Maturity Test Process on the TH-694/TH-35E Interchange – Unweave the Weave documents the use of maturity meters in the TH-694/TH-35E Interchange project. While Mn/DOT aims to utilize maturity for specific concrete applications, the use of maturity meters in this project is the first attempt to evaluate their usefulness in field applications. If successful, the use of maturity meters will allow contractors the ability to more accurately predict when a pavement can be opened to traffic. This research implementation project is an example of high-speed nondestructive testing that can provide rapid feedback, and as such is an example of CP Road Map Track 3: High-Speed Nondestructive Testing and Intelligent Construction Systems.

The 2008 MnROAD Phase II Construction Report was completed in June 2009. This publication reports on the 2007 to 2008 construction process of MnROAD Phase II test sections. Phase II, lead by a partnership between MnROAD and TERRA, includes a number of research projects. These projects are listed above under Current MnROAD Research. Several practical lessons were learned during the construction of the test sections. These lessons, identified in detail under the summary section of this report, include scheduling and
communication conflicts; design and constructability issues; and identifying and addressing a learning curve for new techniques. This report documents efforts on such a variety of projects that it can be categorized under several CP Road Map Tracks including 1, 4, 7, 8, 10, and 13.

_Implementation of the MEPDG for New and Rehabilitated Pavement Structures for Design of Concrete and Asphalt_ is a report completed in January 2009 by the University of Minnesota for Mn/DOT. The report documents research efforts supported by Mn/DOT and LRRB for calibrating design inputs and sensitivity analysis to represent Minnesota conditions. This research work is an example of improving the integration of mechanistic approaches with local materials, construction, and environmental conditions, and is therefore, and example of work under CP Road Map Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements.

In September 2009, the report _Sixty-Year Design Concrete Pavement-Performance Model Development: MnROAD Cell 53 Construction Report_ was completed for Minnesota Department of Transportation (Mn/DOT). The primary objective of this research study is to develop an improved service life prediction model for Mn/DOT’s current 60-year concrete pavement designs. Secondary objectives include understanding the behavior of these pavements with regard to maturity, slab warp and curl, and thermal expansion. These objectives will be accomplished through extensive testing of materials during construction, and conducting seasonal load response testing under controlled loads of an instrumented concrete pavement test cell (Cell 53) built to Mn/DOT’s current 60-year design standards. Load response testing of traditional designs constructed in MnROAD Phase I will be used in the development of the improved life prediction model. This construction report describes the construction and material testing done on MnROAD Low Volume Road test Cell 53. A summary of U.S. and international long-life concrete pavement designs is also included. This work is an example of CP Road Map Track 8: Long-Life Concrete Pavements.

The report _Evaluation of Concrete Pavement Texturing Practices in Minnesota Using the Wet Weather Accident Evaluation Criterion_ was completed in June 2008. Concrete Pavements built in Minnesota are currently textured by dragging inverted artificial turf or a broom in the longitudinal direction. This process imparts a macrotexture, which is required to have a mean texture depth of greater than 1mm measured by the Volumetric or “sand patch” test (ASTM E 965-95). At present, this texture guideline is communicated through a special provision in pavement construction. Newly textured pavements are usually evaluated for adequacy in providing a safe riding surface through texture measurements for acceptance and friction measurements as required. The current FHWA Technical Advisory on Texture requires that performance of non-conventional textures be monitored and reported. This report identifies pavement sites in the network where the original texture, mainly the transverse tining plus burlap, was either overlayed or rebuilt and the new finish surface finished with longitudinal inverted turf drag, or broom drag. It extracts wet weather accident data from the Mn/DOT Office of Traffic, Safety and Operations (OTSO) database and analyzes the annual wet weather accident and crash rates, pre-construction, during construction and after construction. It performs a descriptive statistics of the period before and the period of the new texturing to determine if, wet weather accident counts, percentage of wet weather accidents in total count and crash rates and /or ratio of annual wet to dry accident counts, and crashes clearly increased with current texturing practices. Data were analyzed with statistical tools for data comparison including the descriptive statistics, U-test & and before and after comparison (Z-test). The analyses of the data for the sections show that current texturing practices did not cause an increase in the annual wet weather accidents, crash rates, or ratio of wet to dry weather accidents. This work is an example of CP Road Map Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements.

The report _Investigation of Joint Deterioration in MnROAD Phase 1 Jointed Concrete Pavement Test Sections_ was completed in April 2010. After 13 years of live traffic, the original concrete pavement test sections on the interstate portion of the MnROAD facility still exhibited very good performance. Prior to removal in 2008, a comprehensive forensic investigation was conducted on each test section. This investigation focused principally on joint performance, as little panel cracking had occurred. The most interesting observation was a unique distress phenomenon in the transverse joints. To determine whether this distress was unique to MnROAD test sections, six other Minnesota concrete pavement projects, of similar age and materials, were examined. While distresses were not as severe, in all cases the sections with base layers that adequately drained water within the joints performed significantly better. Joint sealing was found to have a significant
effect on joint performance in low volume sections. This is an example of work under CP Road Map Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction.

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- Rob Rasmussen, The Transtec Group, Program Specialist
- Sabrina Garber, The Transtec Group, Program Specialist
- Sabrina Shields-Cook, National Concrete Pavement Technology Center, Editor
Updates from the States: Pennsylvania (October 2010)

Updates from the States: Pennsylvania
When it comes to highway research in Pennsylvania, there is a process that must be followed that is clearly defined by the Pennsylvania Department of Transportation (PennDOT), Bureau of Planning and Research (BPR). The process includes four key steps that are managed by BPR staff:

1. Program development
2. Project development
3. Project management
4. Implementation

For general PennDOT information and more information on this process, visit the PennDOT website or the PennDOT Bureau of Planning and Research website.

There are a variety of programs through which PennDOT research needs are met. PennDOT can initiate projects using Transportation Research, Education and Technology Transfer Invitation to Qualify (ITQ) contracts, which is a competitive bid-based program. The Transportation Pooled Fund (TPF) program enables PennDOT to participate in projects that include other states and affords PennDOT the opportunity to maximize their research funds.

PennDOT often collaborates with educational institutes including the Pennsylvania State University (Penn State), the University of Pittsburgh, Temple University, and the Mid-Atlantic Universities Transportation Center (MAUTC) Partnership to achieve research goals. MAUTC is a partnership led by Penn State that includes the University of Maryland, University of Virginia, Virginia Polytechnic Institute and State University, and West Virginia University. One of the original 10 centers in the University Transportation Centers Program established by the U.S. Department of Transportation, MAUTC receives annual funds from federal agencies that are matched with state, local, university, and private sources.

BPR staff actively manages each project initiated through the PennDOT Research Program and works to implement the results of completed research projects as they finish. With the help of an Implementation Evaluation Checklist, PennDOT tracks the implementation efforts of each completed project so that customized technology transfer activities can be developed for each project result.

The remainder of this page lists current PennDOT research projects, TPF involvement, and research completed within the last few years. How each of the research activities align with the CP Road Map is also identified.

Current PennDOT Research
Current ongoing PennDOT research includes the following projects:

• Track 2: Performance-Based Design Guide for New and Rehabilitated Concrete Pavements

• Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction
  o Premature Deterioration of Jointed Plain Concrete Pavements

• Track 7: Concrete Pavement Rehabilitation and Construction
  o Concrete Overlay Field Application
Transportation Pooled Fund (TPF) Studies
PennDOT is involved in several TPF projects. A list of various concrete related TPF projects PennDOT is involved with and how the TPF projects are categorized according to the CP Road Map Track follows,

- Track 1: Performance-Based Concrete Pavement Mix Design System
  - TPF-5(117) Development of Performance Properties of Ternary Mixes
  - TPF-5(179) Evaluation of Test Methods for Permeability (Transport) and Development of Performance Guidelines for Durability

- Track 2: Performance Based Design Guide for New and Rehabilitated Concrete Pavements
  - TPF-5(159) Technology Transfer Concrete Consortium

- Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements
  - TPF-5(063) Improving the Quality of Pavement Profiler Measurement
  - TPF-5(141) Pavement Surface Properties Consortium: A Research Program

- Track 7: High-Speed Concrete Pavement Rehabilitation and Construction
  - TPF-5(150) Extending the Season for Concrete Construction and Repair, Phase III
  - TPF-5(165) Development of Design Guide for Thin and Ultrathin Concrete Overlays of Existing Asphalt Pavements

- Track 8: Long-Life Concrete Pavements
  - TPF-5(183) Improving Foundation Layers

Recently Completed PennDOT Research
- Track 1: Performance-Based Concrete Pavement Mix Design System
  - Evaluation Performance of Limestone Prone to Polishing (highlighted below)
  - Hardened Air in Concrete Roadway Pavements in Structures
  - Technology Evaluation on Characterization of the Air Void System in Concrete (highlighted below)

- Track 2: Performance Based Design Guide for New and Rehabilitated Concrete Pavements
  - Concrete Pavement Cracking Rehabilitation (also falls under Track 7, and is highlighted below)

- Track 6: Innovative Concrete Pavement Joint Design, Materials, and Construction
  - Measured Response of an Instrumented Jointed Plain Concrete Pavement to Applied Vehicle Loads (highlighted below)
  - Smart Pavement: Response Characteristics of a Jointed Plain Concrete Pavement to Applied and Environmental Loads

- Track 7: High-Speed Concrete Pavement Rehabilitation and Construction
  - Prestressed Pavement Rehabilitation

For more information on other ongoing or completed projects, click here.

Highlights
The following highlights only a few of the recently completed research projects by providing additional details and direct links for more information. The projects highlighted include:

1. Evaluation Performance of Limestone Prone to Polishing by Zoltan Rado
2. Response Characteristics of a Jointed Plain Concrete Pavement to Applied and Environmental Loads by Jennifer McCracken, Rania Asbahan, and Julie Vandenbosche
3. Evaluation of Concrete Pavement Cracking Rehabilitation by David Serra and Alberto Medina
4. Technology Evaluation on Characterization of the Air Void System in Concrete by Maria Lopez de Murphy, Cliff Lissenden, and Chao Xiao

Evaluating Performance of Limestone Prone to Polishing
The report *Evaluating Performance of Limestone Prone to Polishing* by Zoltan Rado dated December 31, 2009, documents research performed at the Thomas D. Larson Pennsylvania Transportation Institute, Pennsylvania State University and sponsored by PennDOT. The objective of this research was to investigate the use of Vanport limestone with regard to surface friction and to evaluate the effect of blending aggregates with this specific limestone on mixture performance. This research is the result of a need to identify the root cause for rapidly decreasing skid resistance along roadways constructed with Vanport limestone. Results of laboratory testing combined with field test data concluded an obvious trend between various blends and mixture properties and helped determine three superior mixture designs that include Vanport limestone. This research is an example of CP Road Map Track 1: Performance-Based Concrete Pavement Mix Design System.

For more information, click here.

**S.R. Smart Pavement**

In February 2008, the report titled *S.R. Smart Pavement: Response Characteristics of a Jointed Plain Concrete Pavement to Applied and Environmental Loads – Phase II Final Report* by the University of Pittsburgh’s Jennifer McCracken, Rania Asbahan, and Julie Vandenbossche was submitted to PennDOT and Federal Highway Administration (FHWA). Driven by the need to design and construct more cost effective concrete pavements, this report is a result of research done for the Smart Pavement Project.

The Smart Pavement Project is a joint initiative including PennDOT, FHWA, Mascaro Construction, and the University of Pittsburgh. There are two primary objectives (i.e., phases) to the Smart Pavement Project as identified in this report. Of these two objectives, research documented herein helps fulfill the second goal: to establish Mechanistic-Empirical Pavement Design Guide (M-E PDG) for New and Rehabilitated Concrete Pavements inputs for a pavement constructed in Pennsylvania. The data from embedded sensors, surface profile measurements, truck loading, and falling weight deflectometer (FWD) measurements taken on a section of roadway along SR 22 in Murrysville, Pennsylvania were used to characterize a pavement’s seasonal temperature and moisture conditions, describe response to loads, and validate finite element models developed to evaluate the accuracy of the M-E PDG calculations. Pavement thickness determined by M-E PDG methods were compared to typical PennDOT design methods.

Among the conclusions of this report, it is recommended that the finite element model developed herein be used to evaluate stresses and verify M-E PDG accuracy, and to continue collecting data for this section for another few years before performing a dowel bar retrofit of unrestrained slabs. This research work is an example of CP Road Map Track 2: Performance Based Design Guide for New and Rehabilitated Concrete Pavements.

For more information, click here.

**Evaluation of Concrete Pavement Cracking Rehabilitation**

The PennDOT Technical Report *Evaluation of Concrete Pavement Cracking Rehabilitation* by Dave Serra and J. Alberto Medina was published in August, 2009. The report documents field research evaluating the performance of alternative rehabilitation methods for cracked concrete pavements. Dowel bar retrofit (DBR), full-depth patching, steel mesh paving, hot-mix asphalt (HMA) overlays, and combinations thereof were used as rehabilitation methods along a deteriorated section of I-80 in Valley Township, Montour County. The purpose of this research effort was to identify the best alternative for rehabilitation of concrete pavements in PennDOT District 3. The report concludes that DBR is a viable, faster alternative when cracking is of low severity, whereas full-depth patching is the preferred alternative when cracking is of high severity; steel mesh slows the progression of reflective cracking provided existed pavement is structurally sound; and HMA overlays improve long-term performance of DBR. This research work identifies and implements practical rehabilitation methods and identifies which method is a faster alternative. Therefore, this work is an example of CP Road Map Track 2 and Track 7.

For more information, click here.

**Technology Evaluation on Characterization of Air Void System in Concrete**

The PennDOT Technical Report *Technology Evaluation on Characterization of the Air Void System in Concrete* by Maria Lopez de Murphy, Cliff Lissenden, and Chao Xiao was completed on September 17, 2009. Sponsored by PennDOT, the research work was performed at the Thomas D. Larson Pennsylvania Transportation Institute, Pennsylvania State University. The goal of this research work was to identify
devices capable of measuring air void systems in concrete and to investigate their ability to analyzing air void system parameters (e.g., size, spacing factor, surface characteristics) in both fresh and hardened concrete. The need for such research is to be able to improve quality control in order to maximize long-term durability. The report includes a comprehensive literature review, discussion of the formation of the air void system during cement hydration and how it relates to durability, testing procedures with results, and conclusions that identify ultrasound and thermography as technologies having the most potential for evaluating concrete air void systems. This work evaluates testing methods for the assessing materials, and therefore, is an example of CP Road Map Track 1: Performance-Based Concrete Pavement Mix Design System.

For more information, click here.

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- Sabrina Shields-Cook, National Concrete Pavement Technology Center, Editor
Updates from the States: Washington (November 2010)

Updates from the States: Washington
The Washington Department of Transportation (WSDOT) often partners with others through various programs in order to accomplish their concrete pavement related research needs. WSDOT partners with universities, other states' departments of transportation, and national centers through programs and organizations such as the Transportation Pooled Fund (TPF), Washington State Transportation Center (TRAC), Transportation Northwest (TransNow), and State Pavement Technology Consortium (SPTC).

TRAC is a partnership between WSDOT, the University of Washington, and Washington State University. TransNow is a Regional University Transportation Center led by the University of Washington. Universities from Idaho, Alaska, and Oregon are also a part of TransNow. SPTC pools the resources and efforts of California, Minnesota, Texas, and Washington DOT's for pavement research in an effort to improve design, construction, and maintenance methods and procedures.

To learn more about each of these programs, follow the links below.

- TPF: http://www.pooledfund.org/
- TRAC: http://depts.washington.edu/trac/
- TransNow: http://www.transnow.org/

The sections below identify research that is scheduled to begin in the near future, is currently ongoing (including TPF activities), and was recently completed. The research involves WSDOT and its partners. How each of the research activities align with the CP Road Map is identified.

Future Research
WSDOT is planning work to evaluate long-term pavement performance and noise characteristics of next-generation concrete surfaces. With research work planned to potentially extend through 2015, evaluations will focus on resistance to studded tire wear, durability, friction resistance, and splash/spray characteristics over time.

The University of Washington plans to begin work in 2011 on a project titled *Determining Changes in Greenhouse Gas Emissions from Circa 1990 to Present due to Changes in Pavement Technology* can be categorized under CP Road Map Track 13: Concrete Pavement Sustainability.

Current Research
Following is a list of WSDOT research projects, categorized according to CP Road Map track.

- Track 1: Performance-Based Concrete Pavement Mix Design System
  - Concrete Performance Using Low Degradation Aggregate

- Track 2: Performance Based Design Guide for New and Rehabilitated Concrete Pavements

For more information on these or other ongoing research projects, click here.
Transportation Pooled Fund (TPF) Studies
WSDOT is involved in several TPF projects. A list of various concrete related TPF projects WSDOT is involved with and how the TPF projects are categorized according to the CP Road Map Track follows.

- Track 4: Optimized Surface Characteristics for Safe, Quiet, and Smooth Concrete Pavements
  - TPF-5(135) Tire/Pavement Noise Research Consortium

- Track 12: Advanced Concrete Materials
  - TPF-5(098) Self-Consolidating Concrete: Applications for Slip-Form Pavement

Recently Completed Research

- Track 1: Performance-Based Concrete Pavement Mix Design System
  - Evaluation of Portland Cement Concrete Pavement with High Slag Content Cement

- Track 12: Advanced Concrete Pavement Materials
  - Use of Recycled Concrete Aggregate in PCCP: Literature Search (this work can also be categorized under Track 13)
  - Effect of Chloride-based Deicers on Reinforced Concrete Structures
  - Evaluating and Optimizing Recycled Concrete Fines in PCC Mixtures Containing Supplementary Cementitious Materials (this is also an example of work that can be categorized under Tracks 1 and 13)

- Track 13:
  - Greenroads – A Sustainability Performance Metric for Roadway Design and Construction
  - Sustainable Roadway Design and Construction: An Online Course

For more information on other completed projects, click here.

Highlights
The following highlights describe some of the recently completed research projects by providing additional details and direct links for more information.

Greenroads
Stephen Muench and Jeralee Anderson recently completed a report titled Greenroads – A Sustainability Performance Metric for Roadway Design and Construction. The research was done through the SPTC and TransNow. This report discusses how Greenroads can be a tool for quantifying sustainability in roadway design and construction. The Greenroads approach presented in the report awards sustainability credits (i.e., points) for a variety of design and construction practices. The University of Washington research on sustainability and the development of the Greenroads rating system has been ongoing for a number of years. This report provides a summary of what Greenroads is; however, since its publication, additional research continues, with the goal of improving the Greenroads approach to quantifying sustainability. The Greenroads website provides the best outlet for the most up-to-date information on this topic. This work is an example of work categorized under CP Road Map Track 13: Concrete Pavement Sustainability.

Click here to download the report.

To access the Greenroads website, click here.

Sustainable Roadway Design and Construction
Steve Muench, Shane Brown, and Jeralee Anderson recently completed a report, Sustainable Roadway Design and Construction: An Online Course, for TransNow. This report outlines an eleven-week online course that educates participants on four main topics: 1) the concept of sustainability, 2) systems for evaluating sustainability, 3) sustainable materials, methods, and practices, and 4) an introduction to life cycle analysis (LCA). This course is the first of its kind and will be available to University of Washington students in Spring 2011. This work is an example of work categorized under CP Road Map Track 13: Concrete Pavement Sustainability.
To read this report in detail, click here.

To find out more information about the online course contact the University of Washington.

**Evaluation of Portland Cement Concrete Pavement with High Slag Content Cement**
In June 2009, Keith Anderson, Jeff Uhlmeyer, Kurt Williams, Mark Russell, and Jim Weston completed the report titled *Evaluation of Portland Cement Concrete Pavement with High Slag Content Cement*. The report presents a comparison study of two roadway sections one built with 25 percent slag cement and the other with 30 percent slag cement. Construction methods and test results are documented, as well as initial measurements for wear, ride, and friction. These measurements will be gathered regularly over the next few years and reported on accordingly. The purpose of this study is to evaluate the performance of pavements with higher slag cement content that are subjected to studded tires. This study is an example of work that can be categorized under CP Road Map Track 1: Performance-Based Concrete Pavement Mix Design System.

Click here to download the report.

**Use of Recycled Concrete Aggregate**
Aggregate used in concrete pavements constructed in Washington is of such good quality that the DOT is very interested in reusing the material. Therefore, in June of 2009, Keith Anderson, Jeff Uhlmeyer, and Mark Russell completed a report for WSDOT that documents recommendations for the use of recycled concrete aggregate in DOT projects. The recommendations presented in the report, *Use of Recycled Concrete Aggregate in PCCP: Literature Search*, were developed based on an extensive literature search. This research is an example of work categorized under CP Road Map Track 12: Advanced Concrete Pavement Materials and Track 13: Concrete Pavement Sustainability.

Click here to download the report.

**Effect of Chloride-Based Deicers on Reinforced Concrete Structures**
In July 2010, the Western Transportation Institute completed a report that documents a literature review that explores the effect of chloride-based deicers on steel reinforcement in concrete pavements, and laboratory tests performed for the purpose of evaluating corrosion inhibitors in concrete pavements. The report, *Effect of Chloride-Based Deicers on Reinforced Concrete Structures*, identifies differences between the effects of magnesium and sodium chlorides. It is also suggested in this report that corrosion inhibitors delay the initial onset of corrosion of steel in concrete; however, after corrosion begins, the inhibitor does little to prevent the corrosion process. This research is an example of work that can be categorized under CP Road Map Track 12: Advanced Concrete Pavement Materials.

Click here to download the report.

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CP Road Map
Project Team Conference Call
June 1, 2010
Meeting Minutes

Attendees: Tom Cackler, Sabrina Shields-Cook, Peter Taylor, Rob Rasmussen, Dale Harrington, Melisse Leopold (taking minutes)

- Rob will send Dale a list of tasks that are remaining on TOPR 3 and a breakdown of the May monthly budget so they can determine a budget for the extension of TOPR 3.

- Sabrina Shields-Cook will send Dale a paragraph on the communications to be used in TOPR 4 scope.

- Tom Cackler will prepare the TOPR 3 extension request.

- Dale will talk with Rob Rasmussen and Sabrina Garber on the PennDOT and Wisconsin DOT conference calls and go over what needs to be accomplished.

- The group discussed how to proceed with the project booklets that are prepared for states research projects. It was suggested developing a booklet with all the states projects and post it on the CP Road Map website.
  - It was also suggested that the CP Tech Center send an email to states asking them to furnish six or so key projects that will be used in the booklet.
  - The e-news will feature on state per month and could include a link for additional information on other states’ research projects.

- Tom Cackler will contact Peter Kopac to confirm if Ahmad Ardani is taking over immediately or if there will be an interim person until Ahmad is up to speed on the CP Road Map project.

- The May addition of the e-news is going out today (June 1, 2010). The monthly e-news and MAP Briefs will go out the third week of each month, i.e. June 18th, July 16th. Sabrina will need the content for the e-news and MAP Briefs a week before the distribution, i.e. June 11th, July 9th.

- The AASHTO Committee meeting is scheduled for July 26 – 29, 2010 in Kansas City. Dale and Rob Rasmussen will discuss who will attend to present for the Center on the CP Road Map.

- It was discussed that the Highway for Life solicitation is a good way to get information out to states. Could send to the NC2 contacts or state contact to provide resources to states. Tom Cackler will think about this process and discuss further with Sabrina and Dale.
• Rob Rasmussen had suggested buying flash drives which sell for $15.00 a piece and handing them out when the Center travels and presents at different events. The drives could hold CP Road Map publications, IMCP and/or Preservation modules and could have the CP Road Map and/or Center’s website printed on the side of the flash drive.

• Rob sent an email to Tom about their business systems and if the Center needs information they can use it. Tom will discuss this further with Dale and get back to Rob.

Integrated Solutions

• Dale stated he didn’t like the flowchart format as it could get too complicated and he preferred to use a table. They could develop a simple flowchart in adjacent 8 ½” x 11” pages. Dale will look at his notes and discuss this further with Tom and Rob.
Attendees: Tom Cackler, Peter Taylor, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Rob sent Dale Transee's remaining tasks for TOPR 3. Dale sent an email to Tom on the remaining budget breakdown for the remaining TOPR 3 tasks. It looks like the budget will allow the extension to October 12, 2010.

- Dale will give Tom a paragraph on communications for TOPR 4.

- Due to Sabrina Shields-Cook being out this week the deadline for the e-news and MAP Briefs will be pushed a week.

- Rob and Sabrina Garber will do the next MAP Brief on Durability of Concrete Pavement Texture. Rob will need to contact the Belgium author and look at the substance to see what needs to be done. The MAP Brief will need to be sent to the CP Tech Center for final layout by the middle of next week. CP Tech Center pubs staff will do the final layout.

- AASHTO Committee meeting scheduled for July 26 – 29, 2010 in Kansas City. Peter and Tom will be gone that week. Dale is in Illinois the first two days of that week. Rob is available that week however he suggested looking at the agenda. Good opportunity for advertising for the Center and the CP Road Map. If they have an open forum Rob could give a short speech and hand out the brochure. AASHTO Committee meets twice a year and Rob will see when their next meeting after the July meeting will be held.

- It was discussed that the Highway for Life solicitation is a good way to get information out to states. Could send to the NC2 contacts or state contact to provide resources to states. Tom Cackler has not had an opportunity to focus on this and will look at it closer in the next couple of days.

- Sabrina was going to check on the ability of the Nevada firm to put data on flash drives. John Cunningham is going to send Tom the name of the vendors that ICPA uses for flash drives. Tom stated the CP Tech Center would look into the pricing for the flash drives.

- Peter stated flash drives may be provided at the sustainability conference this year. This is becoming more popular.

- Tom and Dale will talk about the business systems today and they will get back to Rob on some ideas following their meeting.

Meeting adjourned at 11:00a.m.
Attendees: Tom Cackler, Peter Taylor, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Dale sent Sabrina Garber and email with a few comments on the e-news link. Dale had comments on the North Dakota as he wasn’t sure what was the joint concept.

- Report North Dakota did a field trial and felt that unsealed joints would not be something they would consider. Identify what was going and how it linked to the track. She will change the wording and delete the word “innovative”.

- Dale asked Sabrina to explain the research work by the University of Michigan,

- Sabrina stated there is a paper that will be presented at the sustainability conference using ETG for an option to overlay. Paper will state why it is a sustainable option. Wanted to highlight the link to the University of Michigan which highlights the work they are doing.

- Peter is not sold on the ETG technology that University of Michigan. Sabrina wanted to highlight the research that is going on with Professor Lee and provide the link to their website.

- Rob stated it may not be a success but at least want to show that it is being researched.

- Tom stated he agreed with Rob and it is okay to showcase the research that people are promoting.

- Sabrina stated it is called, Engineered Cementitious Composite. She will add a sentence that states it is also know as bendable concrete or self healing concrete.

- Rob stated he is cool to it as a one to one replacement. It may be interesting for a high profile or approach slab.

- Tom okay to through ideas out there.

- Dale on the Michigan highlights – concrete pavements with material related distresses. A report done in 2000 or 2001 is this an edition to that? Was done by Tom Van Dam. Sabrina there are several reports done by TVD, it did not identify it as an continuation of the previous work but he does make reference to the previous work that has been done. Dale – tom showed a summary table of material related stresses and what caused them. Is this an update of that table? Sabrina – does not appear that it is.

- Sabrina sent report to Professor Lee, DeGraff, Tom Van Dam and John Statton. She received comments and incorporated them in to the final version.
- Durability tech brief will be done by Wednesday. Sabrina, Rob, Rich Sewhanney (Transtec) are working on the tech brief along with the primary author. They are putting final touches on the tech brief and will probably be about 6 pages with some figures.

- Tom stated the extension for TOPR #3 has been submitted to FHWA and is in process. Have not received the TOPR 4 rfp still waiting.

- Dale may let Sabrina Shields-Cook write the paragraph on communications for TOPR 4

- Dan R. will be at the ACPA mid-year meeting as he is on the strategic board and Tom Cackler will be attending for the Center.

- Tom asked Rob do you want to try and connect with John Roberts after this call. Tom will try to call John and let Rob know if they are going to have a call.

- Rob has talked to Steve (California contact) on the Two-Lift project in California. He will call him later this week to check on the status and let them know we are there to help. What to provide a support role and let them know we are here to help move it forward.

- Dale we are going to the AASHTO Mississippi Valley and will have a booth. Tom stated they will be holding a tech date on July 8th. Talked last week on topics to develop a display and have people talk about. Will probably contact Rob on some of the topics to get assistance from Rob or Sabrina for some of the information.

- Sabrina sent Dale a new link for the Integrated Solutions draft review. Meeting on June 21st with the committee. Dale stated we are trying to get a mockup of the Integrated Solutions draft out today. Rob the further along in the week it will be further updated. Rob intended to send additional sheets to the report towards the end of the week. Dale asked to send it to the committee by Thursday and Rob agreed. Dale asked if the 21st was a discussion on the draft. Rob stated they would be sent additional sheets it would not be the final draft. Rob went through the schedule with Dale.

- Tom asked Rob one of the e-news if we could draft for Suneele an update on the Implementation associated with eh European scan. A lot has been done and Suneele was a co-chair and if we could show some success it could be a positive impact. Rob suggested it could be an e-news with some kind of highlight on other technologies that connect to the scan. Rob suggested doing it for the July issue and Tom stated that would be great. Tom stated he would contact Suneele and let him know they are preparing this and Rob will contact him to get some information from him.

- Tom stated a week from tomorrow (June 22nd) is the Ex Com call for the road map. Need to discuss the agenda so we can get it out.

- Dale has some information on the agenda that they had discussed last week. Sabrina Garber sent some notes about three weeks ago with a bulleted list. Dale will look up the list and conference call Rob, Peter, and Tom and they will finalize the agenda.
Items for the CP Road Map Ex Com conference call:

Tom – there is a lot of research that we are trying to support the road map and transfer that knowledge. Try to highlight what is going on in the tracks.
Dale – not much changes on the track meetings.
Tom – we can tell them that and state we have been working on
Rob - the massive outreach program up and going. Send out the e-news link prior to the meeting. Dale – and we can review it with them during the meeting.

1. Communications progress on TOPR 3
   ▪ e-news
   ▪ MAP Briefs

2. Discuss some details on TOPR 4
   ▪ Refresh the CP Road Map booklet, add a new cover and add or adjust some tracks
   ▪ Mark Snyder may have some interest in leading a new track team. Don’t want to over commit on the proposal. Tom will review the email sent to Peter Kopac and they can go through it.

3. Business details
   ▪ Put together a plan for approval of FHWA on behalf of the pool fund group. Ask FHWA for input on areas within the business track that we should be focusing on in TOPR 4. What areas are most important in the business track that we should be trying to address in TOPR 4? Tom – send info out to them ahead of time and then have it on a web presentation to discuss on the conference call.

4. Talk on track priorities
   ▪ Dale – did we talk about the track priorities before? Rob need to talk about overlays and pavement preservation. Need to get FHWA’s opinion on what we should address in TOPR 4 for track priorities. Dale – do we talk about the track priorities prior to getting FHWA input? Ask FHWA if they agree with the priorities or should be change them. Should we ask for their validation of existing track priorities? Tom – maybe there isn’t much to talk about. Dale – each track has identified their priorities and should we give them suggested updates and do they agree with the priorities? Tom just recap the tracks and what they are doing and review the priorities. Tom stated in TOPR 4 we will focus on update the existing track leadership teams and priorities for the lead tracks not for all the tracks. Dale will draft the agenda and send it to Tom for his review. Denise will send the final agenda to the Executive Committee. Tom stated we should ask the Executive Committee what the priorities are to be developed under the business track and send it to them before the meeting.

Meeting adjourned at 11:34a.m.
CP Road Map
Project Team Conference Call
June 21, 2010
Meeting Minutes

Attendees: Tom Cackler, Peter Taylor, Sabrina Shields-Cook, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Tom talked to Suneel about doing an article on the scan in July or August. He likes the idea and was very positive. Ted had suggested they do something in the Focus magazine but they weren't sure how to get the info together. If we do an e-news they would use the info for the Focus magazine. May want to get a couple of quotes Suneel suggested contacting Raymond Brew (Belgium) may contact him for comment. Tom said we would send Suneel a draft for the e-news article.

- Rob is this different than the e-news or something different with more paragraph content? Tom said we need some detail on the geotextile, foundation. Rob the 6 technologies were:
  - Two lift concrete paving (Kansas project)
  - Pavement design catalogue – Resources would be Mike Ayers, Gary Crawford
  - High quality pavement foundations - will contact Dave Fowler, David White
  - Improved Mix Designs – Peter Taylor – has a program now they are running; he will send Rob a presentation and article. Tom suggested the design and control article. Peter stated to contact Michelle Wilson. Tom suggested referencing the MCO project and testing guide. Peter also suggested contacting Dan DeGraaf on contractor experiences.
  - Geotextile – ETG activities will be highlighted and the new website. Oklahoma I40 project, and Jim Duit project he is currently working on. Tom – visit with Jim Duit on a cost perspective and the savings from using geotextile. Rob stated the Concretenetop.com site has the geotextile website.
  - Noise reduced in concrete pavement surfaces – European testing that has been done.

- Rob asked what we should do in making it a special edition e-news? Tom agreed to calling it a special edition. Give some background, quotes, Suneel and progress on the STIP. Sabrina Shields-Cook – the format is flexible with e-news would be good as a lead in article.

- Rob stated the scan cross cuts a lot of the CP Road Map tracks. Rob suggested doing the article in August to give time to get international participation. If we get the information and outline done in time could do July.

- Dale suggested briefing the ExCom on the plan for the scan article on the conference call tomorrow. Rob will send the outline to Tom by 2pm today so he has the information for the ExCom call tomorrow.
- Tom – distribution list; how is it coming together? Sabrina Shields-Cook took the info from Rob and combined it with Center’s list and sent it to 99 people at a time. Sabrina stated there were around 2,000 names between the two lists. Over 100 names were return as undeliverable. Texas DOT changed their domain. Sabrina will send Rob the list of names that were undeliverable and he will help with identifying new addresses. TRB and ACPA picked up and reported on the notice. Sabrina stated to send her other newsletters or email updates or print publications that she can contact. Sabrina will contact Better Roads.

- Tom had a call from Better Roads and in the August issue they want to do an update on the CP Road Map. Tom will give him a call. Dale stated on the last article he and Marsha Brink developed the information for the article that they used. Sabrina will contact Tom Keenen with Better Roads to see what information he wants and offer the Center will develop the article. Dale suggested developing an outline. Dale suggested briefing the ExCom on this also.

- Dale will cover the PennDOT research visit with the ExCom conference call and Sabrina will cover some of the agenda items also. Rob will not be on the ExCom conference call tomorrow as they have a previous commitment.

Meeting adjourned at 10:42a.m.
CP Road Map
Project Team Conference Call
June 28, 2010
Meeting Minutes

Attendees: Tom Cackler, Sabrina Shields-Cook, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Sabrina Shields-Cook and Dale will meet today to talk about the MAP brief topics. Sabrina stated the next e-news will go out this week and then July 19 (tentatively partial depth repair as a tech bulletin) and mid August (2nd week) for the long life pavement scan topic. Rob & Sabrina Garber are pulling together information for the scan MAP Brief.

- Dale stated we are going through the administrative process for TOPR 4 and told Rob to keep track of his time as he is aware Transtec funds will be running out.

- Tom stated Peter Taylor has initiated contact with Terry Arnold at Turner Fairbank about the opportunity to work with Ahmad on an exchange for the Road Map to get their support. Tom stated they are trying to initiate some sort of exchange to get alignment on what Turner Fairbanks is doing. Rob stated they would be available to help prepare to meet with them. Tom stated maybe we could feature Turner Fairbanks in an e-news. Sabrina suggested doing a Turner Fairbank (on their work) after the August issue. Rob stated they have worked with Rick Mineger at Turner Fairbanks and he could solicit him to see what his thoughts are on news worthy information. Tom felt it would be fine for Rob to contact Rick.

- Tom stated he and Sabrina Shields-Cook have an interview tomorrow with Better Roads Magazine on an updated article on the CP Road Map. If you think of things that would be helpful for the article send it to Tom. They will be show casing accomplishments and current technologies and the future direction of the Road Map with emphasis on rehabilitation and preservation. Tom is working on an outline and he will send it to Rob & Dale for their review and input. The article needs to go out this week with a brief review time for CP Tech Center. Need to be ready for a review and quick turnaround.

- Dale stated he will send Rob the minutes on the CP Road Map Executive Committee conference call.

- Dale mentioned on the Executive Committee conference call it was brought up that the innovative equipment is still on the top twelve MAP briefs. We need to keep that in mind for a future MAP brief.

- Dale stated that ACPA is putting out a webinar on tie bars. Dale is going to contact ACPA to see if they have a tech brief on tie bars. He stated it would be a good idea to focus on industry’s work for a MAP Brief. Rob stated on a recent Texas project the tie bar issue came up. Rob has looked into it a lot. Transtec did the design work on a project and they looked at the tie bar work. In addition to ARA’s work Transtec looked at Moon Won’s research work at Texas Tech on tie bars.
• Dale asked Rob about his report on the Texas concrete overlay bonded for CRCP project. Rob stated the field review was done in April of 2009. The Open house was in May 2010 which Rob attended. Rob stated he is now updating the report as an addendum to the original field report. They are waiting for information from Moon Won and Texas DOT. Rob stated until there is a proven benefit on this process he didn’t feel we should do a tech brief on the subject and the group agreed.

• Dale and Tom will have a discussion later with Rob on the Business Systems track for the CP Road Map.

• Tom stated the CP Tech Center will have an exhibit on the CP Road Map at the Mississippi Valley Conference being held in Des Moines.

• Dale asked about the scan implementation that is going to be featured in the August e-news. Rob stated that Peter sent the article to him and Rob is going to contact Michelle to follow-up.

Meeting adjourned at 11:05 a.m.
CP Road Map
Project Team Conference Call
July 12, 2010
Meeting Minutes

Attendees: Tom Cackler, Sabrina Shields-Cook, Peter Taylor, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Tom Cackler asked about the Better Roads article status. Sabrina Shields-Cook stated she sent their comments to the author but has not heard anything else. It should be in the August edition.

- Tom stated that Rob Rodden wanted to link to the ACPA overlay database. Everyone felt it would be a good thing to do. Peter Taylor stated the database was a bit temperamental, he got into it but Tom had difficulty. Tom stated they would put the link on the CP Tech Center website.

- Tom stated that late last week they became aware a tech brief had already been developed by Larry Sutter on the deicer scaling project in South Dakota however it has not been circulated a lot. Sabrina Shields-Cook felt it could be modified a little bit with a couple hours work to turn it into a MAP Brief. Peter will forward it to Dale. Peter stated Larry sent it to him and Larry would like to be acknowledged as a writer. Sabrina stated the deicer scaling MAP Brief is on the schedule for September however, it could be done for July and save the two lift for the special issue in August. It was agreed to do the Deicer in July, Two Lift in August and Foundations in September.

- Tom stated we need to reply to the TOPR 4 in two weeks. Tom will review. It is very close to what the Center proposed.

- Dale asked where are we on the TOPR 3 extension and additional money for Transtec? Dale stated he and Sharon met regarding the funds he could move to Transtec and funds the Center has for Transtec. Tom stated that TOPR 3 was approved last week. Sharon stated the funds for Transtec have been approved and she will send the request for additional funding and time for S&A today or tomorrow. As soon as S&A receives the extension for time and funds from ISU Dale will authorize the funds for the subs including Transtec.

- Dale asked if the Two Lift MAP Brief has been drafted. Sabrina Shields-Cook stated it has and she sent it this morning for Dale to review.

- Rob is going to develop a cost estimate for the two lift. Tom stated the he received a cost estimate for the two lift from Andy (?). The change order cost 25% more per square yard although they had better quality aggregate for the upper lift. Tom will send the information to Rob.

- Rob asked if Suneeel was leaning towards the Missouri two lift project? Tom had a conference call with Missouri ACPA and DOT. They are very interested in doing an open house tentatively in late September 2010. Tom will look at dates. The California opportunity may be later. Gina sent an email to Tom stating Highways for Life is accepting applications again and closes August 31, 2010. Rob stated Steve Halo would
probably approve funds through Highways for Life for the Caltrans two lift project. Rob will talk to Steve to see if he will support this project.

- Dale asked about the mix design EB401 PCA document and asked if Rob had talked to Michelle about it yet. Rob stated he will talk to her this week.

CP Road Map discussion ended at 10:50 a.m.

- Integrated Solutions Rob has used the budget for this project. Rob stated he will pay out of pocket for the work that remains. Rob is glad to be a part of the project and he doesn’t anticipate a lot of extra work to be done. Tom stated and it was agreed to see what the committee has to say today and see what the next steps will be.
CP Road Map
Project Team Conference Call
July 19, 2010
Meeting Minutes

Attendees: Tom Cackler, Peter Taylor, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Dale Harrington asked about the Better Roads article. Tom stated that Sabrina stated Tom from Better Roads thanked them for the feedback and it would be in the magazine.

- The following MAP Briefs are scheduled: Deicer Scaling in July, Two Lift in August and Foundations in September.

- Dale asked about the spreadsheet sent for the concrete pavement research project on mix track. Peter sent a spreadsheet database of research for the mix track. Dale wondered if they could do it for the other tracks. Peter is going to talk to Sabrina about putting it on the website. Peter will send it to Tom and Sabrina.

- Sabrina Garber has a similar table that is specific for each state and their projects and what track they fall under. As they continue to talk to states she continues to update the database. Sabrina will send it to Dale.

- Dale – the call with PennDOT – Sabrina will add them to the list with their research.

- Thursday is a visit with Minnesota who will be coming to CP Tech Center.

- Dale -- any information on our current website database that needs updating? Rob – needs a thorough review. Particularly surface characteristics may need updating. A thorough review of all tracks may need to be done under TOPR 4. Dale – Peter T and other track leaders have a need to know what is going on for their track. Dale will talk to Sabrina SC to confirm if the website database for the track research is still up and accessible. Peter stated all the track leaders should be using the format from the website to update their tracks for research. Dale stated we need to make sure the track leaders are keeping the track databases updated. Dale stated we need to get the updated information out to the other track leaders. Tom stated this is information that could be on the website for others to obtain. Sabrina Garber will look at Peter’s database to make sure she is using the same format. Sabrina Garber stated the link for the database on the website is not currently active. Peter and Rob felt the database for research topics probably isn’t something outside researchers would be looking for. Tom stated if we have one person do the updating for all tracks that would assume that one person has the knowledge for all the tracks. It may make more sense to depend on the track leaders to keep their tracks updated with research projects. Tom stated this would need to be reflected in the TOPR 4 budget. Dale stated we need to do this uniformly and do it correctly. Tom stated you run the risk of putting research on the website and if you leave someone out they may become offended. Dale stated it is a database of our internal use for tracking what is going on. Tom felt we need to have an access code to reach the database by staff only.
Dale asked Sabrina Garber to work on a spreadsheet that lists all the major research that is going on and categorized by the CP Road Map tracks if she has the time and it may have to wait for TOPR #4.

- Dale – ACPA Overlay database – does Tom want it listed as a link to the CP Tech center website? Tom stated it would be good and we are putting it into the e-news. Sabrina will put it in the next edition.

- The Larry Sutter MAP brief on deicer scaling will be done this month.

- The extension has been received and Melisse will send a contract amendment to Rob.

- Rob had a conversation with Steve Halo on two-lift. Possibility of doing Highway for Life application in California. California has cooled off quite a bit however Rob will still keep in contact with them.

- Tom stated Missouri two-lift conference will happen on September 28, 2010 and he is developing a draft agenda. Tom would like to get an announcement out by the end of this week. Tom stated it will be similar as in Kansas. First night a reception and dinner and some background presentations. Rob – background on two-lift paving and the European practice. John K on pervious pavements. Next morning a project specific presentation. Missouri talk about the project description and objectives and their test results. Need to do a session on environmental benefits. Talk about construction considerations, do a site tour and then a question and answer. This is a site with the working going on during the site visit. They are working on getting the materials and starting their lab work. Will be a two lift project with a Titanium dioxide shoulder. Might be a project that could help with getting California interested. Dale asked Sabrina to consider this project for the e-news.

- Dale stated that he received a request from Minnesota to submit a proposal for $10,000 to $25,000 to determine if cracking is detrimental to their pavements. Dale will meet with Tom this afternoon. Dale and Tom will call Matt Zeller.

Call adjourned at 11:23a.m.
Attendees: Tom Cackler, Sabrina Garber, Sabrina Shields-Cook, Dale Harrington, Melisse Leopold (taking minutes)

- Dale stated that FHWA had sent their comments on the Deicer MAP Brief. Sabrina Shields-Cook suggested sending the July e-news since it is ready and the MAP Brief will need some work after receiving the comments. Sabrina will send the e-news today (August 9, 2010). The Deicer MAP Brief will be sent out in September.

- Dale mentioned it has been taking at least three weeks for review of the MAP Briefs.

- Sabrina Shields-Cook stated the Two Lift MAP Brief will be done for August and is ready for review. Sabrina will put the photos into the Word file and send it out for review.

- Sabrina Garber stated they did not receive anything on the Deicer MAP Brief. Sabrina Shields-Cook will send both MAP Briefs (Deicer and Two Lift) to Rob Rasmussen and Sabrina Garber.

- Dale stated the MAP Briefs need to be reviewed thoroughly by Dale and Sabrina Shields-Cook prior to sending them to Ahmad Ardani (FHWA) for his review.

- Sabrina Garber will contact Suneel to get his comments on the Two Lift and the Scan.

- Sabrina Shields-Cook stated the database is not on the website and has not been kept up. There is an Access database which is the background content running the website. Sabrina Shields-Cook is aware the website is out of date and needs to be updated. She stated they have a new employee that will help with updating the website.

- Peter sent his Excel spreadsheet to Sabrina Garber and she is working to fill out her information.

- Sabrina Shields-Cook stated all the Mix Track research is on the website. Sabrina Garber will send her updates to Sabrina Shields-Cook and she will get it put on the website.

- Dale stated that ACPA has given the CP Tech Center permission to link to their Overlay database. Sabrina Shields-Cook will develop the link today on CP Road Map website.

- Tom will check to see if the announcement was sent out on the Missouri Two-Lift conference that is scheduled for September 28, 2010.

- Dale mentioned that he had been contacted by Todd LaTorella (Missouri/Kansas ACPA) to participate at a Concrete Overlay Open House. Dale will talk with Tom to see how to proceed.
• Dale stated he needs to email the CP Road Map track leaders to ask when their next track leadership meetings will be held.

• Sabrina Garber stated the state contacts are coming along. Sabrina stated the next state highlight would be Pennsylvania.

• Dale stated they had a meeting with Minnesota DOT at the CP Tech Center. Dale will look for his notes and let Tom know if he finds them. Dale will send the notes to Sabrina Garber. Dale stated it would be a good state for the next contact and Sabrina stated she would follow up with Minnesota once she received the notes.

Meeting adjourned at 10:55a.m. CDT
CP Road Map
Project Team Conference Call
August 16, 2010
Meeting Minutes

Attendees: Tom Cackler, Peter Taylor, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Dale discussed the MAP Briefs and the call he received from Ahmad Ardani. Ahmad stated that TOPR #4 was technically approved. Ahmad also stated how concerned he is about the MAP Briefs and felt they were done in poor quality. He was so concerned he went to Cheryl Richter on the poor quality. He said they photos were wrong and not in order. Ahmad stated he wanted experts to review the MAP Briefs. Dale stated that the authors are the individuals reviewing the MAP Briefs as the expert. Dale told Ahmad that from now on Ahmad will be sent a final MAP Brief document. The following guidelines were suggested by Dale for future handling of the MAP briefs:
  - The tech brief writer needs to have the MAP brief completed and sent to me at least a month before the month it is to be published.
  - I will decide who needs to review it with me.
  - The MAP brief needs to be as good we can make it and it should be considered final when it goes to Ahmad.
  - Initially it needs to be sent to me in Word format so I can comment on it. This would also be true for Ahmad when he receives the final copy.

- Rob stated we should talk to Ahmad and see if there are other things we should be doing. Dale stated we should sent him an excellent finished MAP Brief first prior to talking to him again on the issue.

- Dale felt the e-news was getting out too late. Dale stated he felt it was everyone’s responsibility.

- Sabrina Garber stated the links for the August edition are not yet ready as she was waiting to hear from Suneel. He did call this morning and gave her some guidance on how to introduce and add the links. She will work on the introduction and then send it to the project team for review and then to Suneel for his review prior to publishing.

- Dale stated the e-news and MAP Briefs should be sent in Word so that FHWA can comment on them easier. Dale will send the MAP Briefs to Ahmad when ready.

- Dale – August 9th minutes – Dale and Sabrina Shields-Cook will finalize the listing of the MAP Briefs and which months they will come out and send it to Ahmad for approval. Once Ahmad has approved the listing it will be followed and not changed to avoid confusion.

- Dale stated the Missouri Two-Lift conference is scheduled for September 28, 2010. Denise Wagner will be sending out an announcement today. Tom stated agenda, travel, hotel information has been sent out. The conference is being held near St. Louis,
Missouri. They will demonstrate two lift paving and some pervious shoulder. Brent Troutman will talk on materials and Paul Core on construction considerations (is the Contractor). The lead is Tom Cackler. Rob Rasmussen will be presenting. Tom is in the process of filling in speakers for the program. Tom has a conference call today with John Kevern on pervious. Jesse Jones DOT will give a project update. Bill Stone will talk on the environmental monitoring. Dale stated we should include this in the e-news for this month. Sabrina Garber will include the information from the flyer.

- Dale stated the Sustainability conference is coming up on September 15-17 in Sacramento. Peter stated there are about 165 registered and they have room for more so they will send out another announcement. Dale stated we could include a short notice in the e-news that is going out today. The group agreed to include a notice and a link to the website in the e-news today and the next e-news also.

- Sabrina Garber is following the format for the database that Peter Taylor sent to her which is the same as what Rob had originally began. She is working on the details as she gets the information.

- Dale will talk to Sabrina Shields-Cook on the website updates. A new employee has been hired and he will help with the website updates. Sabrina Garber will talk to Sabrina Shields-Cook on getting the information on the website.

- Dale stated the ACPA overlay database is very well done.

- Tom Cackler located his notes from the Minnesota DOT meeting and Dale has some notes too that they will put together and send to Sabrina Garber.

- Rob is going to talk to Dan Dawood and Gary Crawford about the Design track status.

- Dale will ask Sabrina Shields-Cook to send Rob and Sabrina Garber what she has on the Two Lift MAP Brief. They have not seen the Deicer or the Two Lift MAP Briefs yet.

Meeting adjourned at 11:06 a.m.
CP Road Map
Project Team Conference Call
August 23, 2010
Meeting Minutes

Attendees: Tom Cackler, Sharon Prochnow, Sabrina Shields-Cook, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Sabrina Shields-Cook stated she should have the Two Lift MAP Brief to Ahmad either today or tomorrow for his review. She stated that Larry Sutter had a couple of comments on the Deicer MAP Brief. The August MAP Brief will be the Two Lift and the September MAP Brief will be on Intelligent Compaction. The Deicer will be saved for a later date, maybe in the winter months.

- Dale will summarize the potential topics and he and Tom will meet to layout the topics and schedule for the next 12 months. Once that is accomplished they will call Ahmad to discuss the schedule with him.

- Sabrina Garber stated she is working on the August E-News. Dale will send Sabrina his comments on the draft.

- Tom stated the Missouri Two Lift program is framed out and everyone is aware of their part. The announcement has been sent out. There is room for additional attendees so they will send another announcement out this week.
CP Road Map
Project Team Conference Call
August 30, 2010
Meeting Minutes

Attendees: Tom Cackler, Sharon Prochnow, Sabrina Shields-Cook, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melissa Leopold (taking minutes)

- Deicing Map Brief comments have been received from Larry Sutter. It will be put on hold for now and maybe used in the winter months.

- Intelligent Compaction MAP Brief will be developed for September. Sabrina Shields-Cook stated the August e-news and MAP Brief are going out now and in September they will need to prepare for the September, October, and November MAP Briefs.

- Dale stated the Integrated Solutions is currently being prepared by Rob and Sabrina Garber. We could use this information in a November MAP Brief.

- Rob stated the Recycled Concrete Aggregate proposed with FHWA could be used in a MAP Brief topic. Will have a lot more information after the first task has been completed on this project, probably after the first of the year although could be in December. Tom stated it is in contracts and the technical review has been done.

- Sabrina Shields-Cook stated the Map Brief is described as promising new technology to advance concrete paving practices.

- Dale stated we could do some pavement preservation topics for future MAP Briefs.

- Rob stated the tech brief, “What Make’s A Quieter Concrete Pavement” is included in the surface characteristics work. Dale asked if there are any tech briefs under the surface characteristics program that could be used as a MAP Brief. Rob thought it would be a good idea to use the information from the three tech briefs that they will prepare. Could prepare one in January.

- RCC could be used as a tech brief. Sabrina Garber will send Sabrina Shields-Cook the Integrated Solutions tech brief information.

- It was agreed that the following will be the schedule for the MAP Briefs:
  - Intelligent Compaction - September
  - Stringless Paving - October
  - RCC - November
  - Deicer - December
  - Surface Characteristics - January
  - Recycling Concrete Pavements - February

- Dale and Tom will schedule a conference call with Ahmad and Cheryl Ritcher either for the end of this week or the beginning of next week to talk about the CP Road Map. Tom stated they could talk to them about the Executive Committee agenda at that time too.
• Dale stated we need to get the following topics scheduled sometime for a MAP Brief: Smart Pavements, Pavement Preservation, Pervious Concrete and Sustainability.

• The MAP Brief for sustainability could tie in with the recycled concrete topic.

• It was agreed that the Two Lift MAP Brief will be categorized under the sustainability track.

• Dale stated the technical summaries that we have done in the past could be used in future for MAP Briefs. Materials and compatibility, development of concrete mixes, topics from the IMCP Manual could be used in the future for MAP Briefs. Tom stated as long as we keep the information new and current the topics would be good to use.

• Missouri Two Lift program is all coming together. Tom has the speakers finalized. The agenda needs to be finalized. Not sure exactly where they will be paving and the contractor and sponsor are working out the details.

• Sabrina Garber stated she is working on the September e-news. Should have it to Sabrina Shields-Cook the week of September 6th for her review.

• Sabrina Shields-Cook stated she did not have any issues on the Intelligent Compaction MAP Brief – she will send the schedule to the group.

• Dale stated we need to get going on some of the contacts with our universities and DOTs. Dale will look at the list this week to see what to plan next and in the future; who to contact.

• Tom stated the next CP Road MAP Executive Committee will be held on October 15th in Kansas City. Dale asked why we are having a face to face meeting and Tom stated the Committee asked for a face to face meeting. He stated they need to talk to the States at the meeting on extending the pool fund as it expires next year. It is helpful to review the accomplishments and future direction with the face to face committee meeting. Tom and Dale will prepare a draft agenda today and then send it to Rob for review. Tom and Dale will then discuss it with Ahmad and Cheryl.

Meeting adjourned at 11:21 a.m.
CP Road Map  
Project Team Conference Call  
September 7, 2010  
Meeting Minutes

Attendees: Tom Cackler, Peter Taylor, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- August e-news everything is ready to go except for okay from Ahmad in regards to the latest issue. Not going to pursue the CO2 issue with Ahmad.

- Integrated Solutions (map brief in November) Dale stated it took Wayne Adaska two weeks to get his comments in on Integrated Solutions. He submitted them today. May need a conference call with Wayne to go through his comments. Rob stated Sabrina has made the changes from the previous comments submitted. Rob and Sabrina will look at Wayne’s comments and see if they are just editorial. If there is a need for a conference call Rob will let Dale know. Wayne will be at the sustainable conference and if needed Rob and Dale will meet with him there. Dale will call Wayne to see when he can meet.

- Recycled Concrete Aggregate proposal could be used in a MAP Brief topic. Rob stated it could take awhile before they get a response on the proposal.

- The August e-new is ready to go out after they receive the okay from Ahmad on the Two Lift MAP Brief. Dale will contact Ahmad today to see if he has any comments.

- Ahmad will be at the Sustainable conference; Tom and Dale will try to meet with him on the CP Road Map.

- Dale and Tom are meeting today to go over an outline on the October meeting.

- September MAP Brief will be Intelligent Compaction. Dale will send Sabrina Garber the notes on the Minnesota meeting held at the CP Tech Center.

Meeting adjourned at 10:43a.m.
CP Road Map
Project Team Conference Call
September 20, 2010
Meeting Minutes

Attendees: Tom Cackler, Peter Taylor, Sabrina Shields-Cook, Sharon Prochnow, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Rob stated he talked to Jeff Roesler about the web-based and upgrades for the Overlay Design Guide. The work could be done in two phases or run in parallel. Spreadsheet up in a web-based version including fibers, and is functional in terms of web-programming $25,000 - $30,000 for a two to three month effort. Phase II - Jeff Roesler estimate work to calculate a small database of different state level inputs (for all 50 states) - additional $35,000 to $40,000. Will be based off of Randy Riley's ACPA spreadsheet. Rob feels they can do the work in parallel and make it so everyone can benefit from the efforts. It was felt that this work is needed and that ACPA can use it to revise StreetPave. Dale and Tom will talk with Randy Riley on the approach and get back to Rob.

- Sabrina sent out the e-news last week. Sabrina will send it out to the ACPA Chapter Executives also.

- Work has begun on the RCC tech brief which Sabrina should be able to get done in a couple of days. Dale will check to see what track to put it under and let Sabrina know.

- Transtec is out of budget for the CP Road Map. Sharon stated that TOPR 4 has been awarded but not for the entire amount. Sharon will look at the budget and Dale will look at his budget for TOPR 3 and may move some funds to Transtec. Transtec will continue to work on the project. Sharon will send an email on the TOPR 4 award. S&A will amend Transtec's contract to include TOPR 4 budget and time.

- Here is the current listing for the MAP Briefs:
  - September -- RCC
  - October -- Intelligent Compaction
  - November -- Stringless paving
  - December -- Deicer
  - January -- Surface Characteristics
  - February -- Recycled Aggregates

- Tom asked what the key messages are we need to talk to the Executive Committee about. He felt we need to talk to them about extending the Pool fund. Need to talk about what has been accomplished and what the continued benefits are and have an upbeat meeting. Ahmad spoke to Dale said the CP Road Map needs to produce something. Ahmad felt we should put out some research and Dale stated this is not our charge that we are to pull people together to collaborate on research. Peter Taylor will be meeting next week with Ahmad and his colleagues about what the Center is doing on the CP Road Map. Dale felt we should have a simple handout for the committee on the track priorities. The information can be obtained from the framework and the e-news on tracks. The group agreed. Tom stated the agenda will show case the national momentum on
track research and focus on technology transfer, tech briefs, TOPR 4 and where we are going in the future. Dale suggested including a copy of the MAP Briefs that have been developed. Sabrina will show the positive feedback she has received from the e-news that has been sent out.

- It was discussed that October 19, 2010 will not work for several for the Executive Committee meeting. Tom will contact Ahmad and talk to him about the October 19th date to see what he thinks.

- Rob asked about the link for national training to the CP Road Map. He stated next week they may want to talk about ISCP.

Meeting adjourned at 11:35 a.m.
CP Road Map
Project Team Conference Call
October 4, 2010
Meeting Minutes

Attendees: Tom Cackler, Peter Taylor, Sabrina Shields-Cook, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melissa Leopold (taking minutes)

- Rob has not received the TOPR 4 contract and Melissa will work on getting it to them sometime this week.
- Dale is working on the stringless paving tech brief.
- Sabrina Garber is working on e-news research.
- Tom reviewed the CP Road Map Exec Com meeting draft agenda.
- Rob R is not available on October 27th for the Exec Com meeting. Rob is not available in October. Sabrina Garber may attend and provide an overview of the tasks that have been completed on the tracks or Transtec will prepare the materials to be reviewed if they cannot attend.
- Last conference call with the CP Road Map Exec Committee was June 22, 2010.
- Rob stated to talk about what has been renewed about the CP Road Map and how we are moving forward now. Talk about the branding of the CP Road Map and the e-news and communication plan.
- Sabrina Garber will let Tom Cackler know if she can attend the Ex Com meeting in person.
- Dale will hold a conference call with Rob on Tuesday at 8:30 a.m. to discuss the meeting agenda.
- The CP Road Map items need to be finished by October 22, 2010 for the ExCom meeting.

Meeting adjourned at 10:54 a.m.
CP Road Map
Project Team Conference Call
October 25, 2010
Meeting Minutes

Attendees: Tom Cackler, Peter Taylor, Sabrina Shields-Cook, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- Dale stated the e-news regarding Pennsylvania was sent to PennDOT for their review. Sabrina Garber stated she spoke to PennDOT and they received the e-news and were reviewing it. She will follow up with them to see if they have any comments. Sabrina Garber is hoping to have it finished by Wednesday of this week.

- Dale stated that he will have the stringless paving tech brief figure corrected and send it to Sabrina Shields-Cook (Figure 4 on second page). Jim Cable sent Dale comments and Dale will talk to Jim about his comment on Figure 4. Dale will send Matt Morrison from Leica the tech brief for his review also. It should be ready to send to Ahmad on Wednesday for his review.

- Dale stated the only research that has been done on stringless paving are the two that the CP Tech Center has done.

- Dale stated he, Melisse and Rob, Sabrina Garber were in the process of putting together the research in progress for the TOPR 3 project. Stopped working on it when the CP Road Map ExCom meeting was moved. Sabrina Garber would like to start working on it again later this week or next week. Dale and Melisse will talk on Wednesday to see where Luke Snyder is on putting together the presentation. Once the research in progress is put together Sabrina Shields-Cook will figure out how to get it on the website. We will talk about where we are in preparing for the CP Road Map ExCom meeting on the next team conference call.

- Intelligent Compaction will probably fall behind. Sabrina Shields-Cook stated the October issue is behind also. The deicer one is done and it could be moved up. George Chang (Transtec) is very involved with the intelligent compaction research and Sabrina Garber can see what he has on other states and send it to Sabrina Shields-Cook. Sabrina Shields-Cook will continue to work on the Intelligent Compaction and review the deicer MAP Brief. Deicer will come out first and then the Durability of textures.

- Durability of textures of concrete pavements tech brief is done and the Noise 101 tech brief has been completed. Durability of textures was sent to Ahmad and he did not think it was a good tech brief topic as it was too technical and did not have a wide enough audience. Dale stated he may take two or three tech briefs and develop a MAP Brief. Sabrina Shields-Cook stated we should make sure it describes a promising new technology and is not to broad or theoretical. Dale felt we could develop a MAP Brief for on the durability of concrete pavements. Dale will talk with Rob and Sabrina Garber and they will talk about it further. Dale asked what they thought about developing a MAP Brief on full depth reclamation. Tom stated if you could focus on some project and case studies and approach it that way it could work.
- PennDOT was the only state that we have held a call with. We will not have time to get the next state conference call held in order to highlight it in the next e-news. Prior to holding the calls with the states we just randomly picked a state to highlight. Minnesota has already been done. It was felt it would be good to contact Missouri to hold a conference call with them. Dale stated he would like to contact a state in the west to hold a call with them. Tom suggested Washington state and Dale could contact Jeff Uhlmeyer.

- Sabrina Shields-Cook will meet with Tom and Peter to discuss the pubs schedule.

Meeting adjourned at 11:15 a.m.
CP Road Map
Project Team Conference Call
November 1, 2010
Meeting Minutes

Attendees: Sabrina Shields-Cook, Sabrina Garber, Rob Rasmussen, Dale Harrington, Melisse Leopold (taking minutes)

- National CP Tech Center is in Chicago on November 16th. Same thing needs to be presented at this meeting that would be presented at the CP Road Map Executive Committee meeting. Need to get the research in progress done for the meeting. Dale & Melisse will prepare slides for framework and track meetings.

- Sabrina SC is finishing the Stringless paving and will send to Dale to review prior to sending to Ahmad.

- Dale looked over the Pennsylvania information and thought it looked good. Sabrina Garber heard from Lydia and Michael and they liked the e-news highlight. Michael was going to send it to others at PennDOT. Dale felt it should go out today to Sabrina SC today if they don't hear back from PennDOT since Lydia felt it looked good.

- Sabrina SC is dealing with other items at InTrans and has not had a lot of time to devote to CP Tech Center tasks. Dale stated that Intelligent Compaction will fall behind as they had discussed before and should be moved down the list for now.

- Dale felt the Noise and Quieter Pavement tech brief is excellent and felt a combination of what makes a quieter pavement combined with the language of noise would make a good MAP brief. Rob and Sabrina felt it would be too long to combine both into one. Rob felt that combining noise specifications, better practices and how to pick the right texture would make a good MAP brief. Rob stated they could do a MAP Brief on the European testing that was done recently. Dale suggested teaching them the noise of quieter pavements. Developing quieter pavement would include the principals that were found and develop a MAP Brief. Sabrina has worked on the Deicer MAP Brief and felt it could be done for November. She received comments from Larry Sutter and worked on the photos. Sabrina Garber suggested preparing latest ASR protocols. Dale stated the topics have already been approved by FHWA. However he could try to get FHWA approval for the ASR topic however the topics where approved by CP Road MAP ExCom. Sabrina suggested something on smart cure or intelligent construction which FHWA is very big on right now. It was decided that Rob and Sabrina Garber will draft something on Smart Cure as a MAP Brief.

- Sabrina SC stated she is almost done with the Intelligent Compaction MAP Brief.

- Dale asked if Sabrina and Rob were prepared to do the research in progress and Rob stated they can prepare it. He will talk to Dale later this week.

- Rob does not need to go to Chicago for the CP Tech Center meeting. Dale will send the CP Tech Center agenda to the team and asked them to look at the agenda to see if there are tasks for them to do.
CP Road Map  
Project Team Conference Call  
November 8, 2010  
9:30a.m. Conference Call  
Meeting Minutes

Attendees: Tom Cackler, Peter Taylor, Sharon Prochnow, Rob Rasmussen, Dale Harrington, Melisse Leopold (taking minutes)

- TOPR submitted as $199,366.00 FHWA reduced it to $185,412.00. When additional funds are available the will okay up to the $199,366.00. ISU is working on a new subcontract for the entire amount for TOPR 4 to Snyder & Associates.

- Rob and Dale reviewed Transtec’s budget for TOPR 4. Transtec wants to make sure they cover what the Center needs for TOPR 4 objectives. Some things were identified during the development of TOPR 4 that there are not funds available to complete the reorganization task. There is some money for the CP Road Map that is not yet obligated. Send Sharon a budget of what funds are needed to cover Transtec’s costs up until November 1st and she will increase the subcontract for TOPR 3 as they have some budget left to cover. Transtec will get their October invoice to Snyder & Associates and then Dale will let Sharon know what is needed.

- Dale would like Sabrina Garber to work on the tech briefs and e-news, doing the research and the content for the e-news. Also she will work on one MAP Brief and the PowerPoint for the ExCom meeting. Sabrina was going to serve as the secretary at the Track Leadership meetings. Rob will adjust Transtec hours to work on these items.

- During the conference call with Ahmad he stated he wanted a MAP Brief every month and we agreed to do it. Sharon stated we are committed to doing them every month and may not be able to get additional money. Dale stated we may be able to do one every other month and drop the reorganization of the CP Road Map or the number of tracks leadership meetings that Rob and Dale are running. Dale stated we now have some historical information to back up the budget request. Tom is concerned that we are committed to doing the e-news/MAP Briefs every month however Dale stated we actually are doing the MAP briefs every six weeks.

- On TOPR 3 the Center has $12,000 left, need to do the final report. This could be used towards TOPR 4. Need to write the request so we are clear that it is for work that was not previously identified.

- A lot of time is spent on the state highlights for the e-news. Most of the Transtec budget for TOPR 4 will be spent on the e-news/MAP Brief task and the remaining budget will be used for the ExCom meeting prep and track leadership meetings.

- The priorities are the e-news and the MAP Briefs, the track meetings, the leadership meetings, then track reorganization.
• Dale suggested talking to Ahmad and telling him about the feedback we have received from the different states on the e-news/MAP Briefs and tell him how well it is being received. We need to also let the ExCom know how well it is doing also.

• Dale will review the scope for Transtec for TOPR 4 and suggested that we not modify the budget. Rob will send Dale an updated version.

• Following are the priorities for Dale:
  o Work out a subcontract with Transtec, stay within the budget but revise the scope.
  o Prepare enough information where we are going for the November 15th CP Tech Center Executive Committee meeting as it pertains to the CP Road Map
  o Prepare the report for TOPR 3

Sabrina Garber joined the conference call:

• Dale asked Sabrina Garber to put together the CP Road Map accomplishments that we have done for the CP Tech Center Executive Committee meeting.

• Melisse will send Rob and Sabrina the CP Tech Center ExCom agenda.

• Sabrina Garber sent the e-news to Sabrina SC and it should be ready to be sent out. Dale received Sam Tyson and Ahmad’s comments on the stringless paving MAP Brief and sent them to Sabrina SC.

• The next MAP Brief will be the deicer and Sabrina SC sent it to Dale and he will review the draft and get the comments back to her. Ahmad had previously felt there were some things missing and Sabrina SC spoke to Larry Sutter and revised the brief.

• Sabrina Garber will develop the Smart Cure MAP Brief for December.

• Rob is working on developing a listing of the various comments that we received on the Overlay Design project. Dale stated they were going to send the comments to the ETG, which Leif is a part of, and get their input and then the conference call is being held on November 17th before we have the call with FHWA, ACPA, and the CP Tech Center which includes Rob Rasmussen. Then hold the call with FHWA, ACPA, and the CP Tech Center and Dale will suggest November 20th for the call.

• Need to be careful with the budget for the Overlay Design Guide. We can ask to extend the effort to include new analysis that can be added to the Overlay Design Guide.

• Need to get more information from Leif on the New York unbonded distress study. Dale did not feel it should be presented to the ETG for design and feels we need a lot more information and that it was not a design issue. Tom agreed with getting more information and felt it should not be taken to the ETG. Dale felt it should go to the overlay committee if needed.
• Integrated Solutions Manual status is Sabrina has looked at Dale’s comments and has received Wayne’s comments. Sabrina and Dale will have a call on November 11th with Wayne to discuss all the comments and then she will make changes as agreed to on the call. It will then be sent to publications.

• ACPA annual meeting – Tom will go for the Chapter meeting on Tuesday. On Friday is the strategic board and Jerry asked Tom to work on a presentation regarding the relationship between ACPA and the Center and also give an update on the Center.

• Recycled Aggregate development plan is being directed by Peter Taylor. Sabrina Garber sent an email to take a look at the library to see if there is something that is not in there that should be included. She will send information on the survey and get comments.

• On the Manual of Practice the chapters will be reviewed with the committee chapter by chapter. Peter will send an email to the authors to get the chapters submitted for review. Would like to get the chapters reviewed prior to December 25, 2010.

Meeting adjourned at 11:10 a.m. CST
CP Road Map
Project Team Conference Call
November 22, 2010
Meeting Minutes

Attendees: Sabrina Shields-Cook, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melisse Leopold (taking minutes)

- The Deicer MAP Brief should be near completion and Dale has sent her his comments.
- Sabrina Garber will work on the Smart Cure MAP Brief for December.
- Sabrina Garber will contact Washington State this week and should receive some information after the holidays. She will contact Jeff Ullmeyer and a few others.
- Rob mentioned if we send a MAP Brief out in late December it may not get read due to the holiday backlog. Suggested combining the two for a Holiday issue.
- Sabrina Garber has collected links and some information on the state highlights for the E-news. She should have a draft written by Wednesday of this week although it will not have been reviewed by Washington state.
- Rob Rasmussen will be presenting at the ACPA Conference in December.
- Dale suggested having a MAP Brief as a handout for the ACPA meeting. Dale will check with Tom or Sharon to make sure there is a live link in the meeting room so they can get on the website.
- Sabrina Shields-Cook stated the Deicer MAP Brief is ready. She is waiting for Larry Sutter's okay to print it. Would like to Ahmad's comments by next week if possible. Would like to wait until Larry's okay prior to sending it to FHWA. Sabrina SC will send it to Dale for review after Peter has seen it. Sabrina Shields-Cook will ask Peter Taylor to review it and address some of the questions.
- Dale probably won't attend the ACPA meeting in December. Tom may need additional support from Rob. Rob confirmed that he would be available to help out at the meeting.
Attendees: Sabrina Shields-Cook, Rob Rasmussen, Sabrina Garber, Dale Harrington, Melissa Leopold (taking minutes)

- Integrated Solutions cross section coming from John Kevern on pervious and Dale will send it to Sabrina Garber.

- Deicer MAP Brief – As soon as Figures 5 & 6 are redone it will be sent to Ahmad to review. Tom is going to remind Larry Sutter to review and approve the MAP Brief for printing.

- Sabrina Garber – November issue of e-news she is waiting to hear back from Jeff Uhlmeyer. She will follow-up with Jeff. He is looking over the list of projects that will be highlighted and approve the list of individuals to contact at the Washington DOT.

- Sabrina Garber will start working on the Smart Cure MAP Brief for the December issue. She felt she could develop it within a week.

- CP Road Map Pool fund states – there are six states. We are highlighting those states in the e-news. Rob will look up the list of states to see if there are any remaining to be highlighted. Iowa is one that has not been highlighted. Dale will call Ahmad to let him know we are highlighting the Pool Fund states as they are putting funds into the project and that we will be highlighting Iowa (the chairperson for the Pool Fund states).

- Pennsylvania, Iowa, Mississippi, New York, Virginia, Michigan, are the Pool Fund states. Iowa, Mississippi and Virginia need to be highlighted within the next three months. Virginia (Dec/Jan) will be the next state to highlight and then Mississippi (Jan/Feb) followed by Iowa (Feb/Mar) for the e-news highlights.

- Rob is speaking on the SHARP 2 work at the ACPA annual meeting. He will be available to help Tom with his meetings at ACPA. Tom has the CP Road Map update presentation for the ACPA meeting. Dale will call Tom to suggest having the Stringless Paving MAP Brief as a handout. Rob stated at the CP Tech ExCom meeting it received a lot of compliments. Sabrina Shields-Cook will have them printed and sent to Tom at the ACPA meeting.

- Dale and Melissa will prepare the TOPR 3 report. Sabrina Garber sent Dale some information for the report. The CP Road Map ExCom meeting is scheduled for January 11, 2011 in Chicago with the location to be decided (near the airport).

- Dale and Melissa are working on the presentation for the CP Road Map ExCom meeting. Sabrina Garber sent Dale a table of national research that is ongoing (some could be done). The information will be put in the presentation.

- For the CP Road Map project we do not do research however we are tasked with coordinating research.
- A table showing the track leadership meetings was in the presentation for the CP Tech ExCom meeting. Most track leadership meetings occurred late last year or early this year. We do not have the budget to do seven tracks. How can we hold meaningful meetings? Dale will talk with Rob to see what tracks we could hold meetings with so we can let them know at the executive meeting.

- Other subjects for the MAP Briefs are Smart Cure (December), Intelligent Compaction (January), Recycled Aggregates (February). Should probably do the Recycled Aggregates after March with the project is to be complete.

- The MAP Brief topics will be put on the agenda for the Executive Committee to discuss to get new topics.
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For example, Column 1 might contain categories or identifiers, while Column 2 provides corresponding details or values. The rows could be organized by date, project status, or another relevant criterion.

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