Joint Technical Committee on Pavements
Meeting
Bloomington, MN
May 10 - 11, 2016

The AASHTO Joint Technical Committee on Pavements (JTCP) met on May 10 - 11, 2015 in Bloomington, MN. The meeting was chaired by Judy Corley-Lay and assisted by John Donahue, the JTCoP vice-chair. The agenda for the meeting is included as Attachment 1 and the attendees present at the meeting are included in Attachment 2.

Introduction

Judy Corley-Lay (NC) opened the meeting and welcomed all of the attendees to the annual meeting of Joint Technical Committee on Pavements (JTCOP). She thanked Curt Turgeon for hosting this year’s meeting in Bloomington, MN. Self introductions were made by all participants. Judy welcomed our new member from AL, Lyndi Blackburn. Judy announced that this will be her last meeting with the JTCOP as she will be retiring this year. JTCOP is very meaningful as our pavements are the highest dollar value asset of agencies. She is confident work will continue and the Committee will do good things. Her recommendation to AASHTO is that the Chair of technical committee be kept as a technical lead from a State agency. The next chairperson for the JTCOP will likely to come from the committee. Let Judy know if you are interested and she may be contacting committee members as well.

Judy went through the agenda, which has been in the same standard format for several meetings now. We will have three technical presentations followed by some updates by NCHRP and industries. This meeting is a mix of asphalt and concrete topics. In the afternoon, John will start the discussion on research needs and State updates. John put together the TRB RNS and will talk about revisions and enhancements to the statements. We will need to prioritize our needs quickly after this meeting.

Technical Presentation 1: A Model for Incorporating Slab/Underlying Layer Interaction into the MEPDG Concrete Pavement Analysis Procedures (Lev Khazanovich)

Dr. Lev Khazanovich, professor at University of Minnesota, presented an update on NCHRP 1-51 (Attachment 3).

This project was to develop a new model for slab based interaction to account for base layers. The pavement base contributes to structural design, impacting the k-value. In AASHTO 93 the k-value is bumped when accounting for the base. In MEPDG there is a minor effect on the k-value. The full bond of base to pavement will enhance long life pavements based on modeling. The goal was to develop a model for partial bond. The models had to be fully compatible with AASTRO-ME so they can be implemented into the software. The early work focused on characterizing friction and found that that friction does not equal bond interaction.
The model was developed for an intermediate state (“partial friction”). Intermediate friction can vary over time and season. It was intended to match AASHTO M-E models for fully bonded (high friction) and full slip (no friction) states. The models had to be validated and in general there was insufficient documentation for the models. The work in this project reverse engineered and corrected the model. The use of variable friction in the model led to the need to characterize friction. The LTTP FWD and friction analysis of all SPS-2 and GPS-3 sections was used. Found that asphalt-treated bases experienced lower cracking than other bases. Cement treated bases experience higher cracking than other bases. Also found that on average a loss of friction age of 0 years provided the best fit for JPCP constructed over CTB or LCB. Built-in curl and distress calculations were evaluated. AASHTO M-E models were recalibrated, with a slightly better fit.

LTTP profilometer data was considered. Found a built-in curl parameter using LTTP profilometer. Slab profile was difficult to infer. When 1-47A proposal was written built-in curl and top-down cracking were not included as parameters. It is still not understood, but is being used as a calibration parameter. After 20 years of research there are still no guidelines to estimate these parameters. The project concluded that an estimate cannot be done. It is proposed that two parameters are used due to the constant changing of the conditions during paving. The model is not perfect but it is an improvement of what is currently in the M-E models.

In summary, after a full review of LTTP and experimental data it was found that slab base interaction cannot be described by a single parameter. A revised cracking model was developed and will be proposed as a revision to AASHTO M-E models. Nomographs have been replaced by poorly documented black box programs. AASHTO is headed to a dead-end if performance models cannot be independently reproduced.

Questions and Discussion

- Amir – the draft report was received and there are some questions by the panel. Another draft is due before it is final. The second draft is due before the end of the month. It will take 3 months for a revised version, so we can expect the completion of the project by the end of August. Amir would like feedback from this committee.

- Tom Yu raised a concern about higher stresses from cement or lean concrete bases. What is important in the field is performance. We need to minimize risk during design rather than by assumptions made during design. There may be a better fit for the data but during design we don’t know what we will get into during construction. Lev- the model considers this by considering partial bond.

- Chris- what was this calibrated against, how many projects? Lev-calibrated with the same database and pavement M-E runs as AASHTO M-E.

- John- how is built-in curing calculated? Lev-it is a result of the calibration.

- Judy-it makes sense that in 2016 we find more complete models as compared to the 2000 models. When the initial research contract was started the direction was to use off the shelf models. There was a genuine effort to have good models. There were some compromises made to get the run time down so the software could be used in a production setting. Some of those decisions had long-term consequences. There is now an effort to look at bringing in new models and this type of work is expected to continue for the next 20 years. The next step is to look at final report when Amir makes it available. The Committee should review the report and should be polled to see if it is ready for implementation. Step 1 is getting the new model ready and then Step 2 is to provide the recommendation to the ME Task Force and have them consider implementation issues and
feasibility. Judy thanked Lev for making sure what he did was compatible with current M-E. That is biggest hurdle with new models.

- Vicki- AASHTO gives researcher copy of software so that they can look at any implementation issues. This is a big step forward in allowing implementation of new research. Curt is chair of technical panel for this project.
- Jeff- How does this model affect the thickness of concrete pavement? Judy- The goal of pavement M-E is to make it so that the design prediction is as close to possible as the actual prediction of the design period and conditions you are working under, rather make performance predictions as accurate as possible. Amir “this is an analysis procedure not a thickness design procedure”. Chris- It is critical that discussions are held such that agencies and their consultants designing pavements the same way. Guidance needs to be developed so that pavements are designed consistently.
- Judy- compatibility is a good topic for M-E Design Work Group. Could come up with guidance on bond/no bond defaults and the impacts of choices. Amir- essentially we need to find a way to estimate bond over time. Judy- This is an important issue and we need to poll the Committee in the fall to determine if we move forward with recommended changes. Please keep this as an important action item for the Committee. Amir- This is a good project because it deals with concrete pavement and most research deals with asphalt pavement. We need to consider what is needed for concrete pavements.

Technical Presentation 2: MnDOT data and more data from asphalt pavement construction; Pavement Management Buried Treasure or Sinks the Ship (Curt Turgeon)

Curt Turgeon, Minnesota State Pavement Engineer, began by providing some history on materials and quality data in Minnesota (Attachment 4). In the late 1980s MN went to a quality management plan. Materials left the plant and the agency was very knowledgeable about the materials. Now we sample very little in comparison for what is placed.

We are collecting a lot of data on construction projects. Spot densities using nuclear density, requiring GPS locations for cores. We need to look at reorganizing data for simpler upload and organization. We look at so much data (for example we now have paver mounted thermal profiling), but the question is if it really gives us the information we need. We can look at real time non uniformities beyond delta-T. Inconsistencies can be seen during construction and segregation can be found in as-built about a year after construction. Want to explore Semi-Variogram Transverse data and how it would work in an actual contract. Looking at whether a deduct will be added into specifications when there are paver stops. When comparing Intelligent Compaction data vs. cores, should every scenario be put into a specification? These are all contract administration issues that are being discussed.

Another big question is what should be done with all of the data for pavement Management. Would you want all the data in your State? Do you want to know all real-time data to later determine how construction affected performance? Minnesota developed a Pavement Smoothness Report Card and send to their Resident District Engineers. A vast majority of new paving is lower than 60, which is very good. The report card is able to give a real data and analysis picture on smoothness. The data can be sorted by contractor or project type. The State will continue to discuss how to look at QC data and how to put into a specification.

Questions and Discussion
- John-Even if data is not used in a specification, it is useful for forensic analysis purposes.
• Curt- The issues is how to store all the data. Minnesota needs to determine where the importance needs to be placed and to apply deducts accordingly.
• Audrey- Need to remember that for the contractor there is a cost for equipment and the Agency should look at appropriate incentives and disincentives.
• Curt- the Agency is looking at ultimately moving to performance.
• Judy- need to consider the cost of data retention; server size an issue within the state; we need to be selective about data we want and what data we will use. We need to know what type of decisions will be made based on data we have. Cost is a huge factor for data storage and collection. If we put this info into our pavement management system, how does someone make sense of the data 20 years from now?
• Audrey – We have heard that Agency CEO’s want to know about the data needs of their pavement engineers and designers and going forward data and proper use of data is a big concern for State agencies.
• Lyndi- believes there is a need for some of the data storage; the agency needs are defined by looking at forensics and pavement performance, which is in-depth for interstate routes.
• WA and CA are seeing the inside lanes going two cycles and outside going one cycle.

FHWA Update (Gina Ahlstrom)

Gina provided the Committee a handout (Attachment 5). The Pavement and Materials Team Leaders in FHWA Headquarters, Research, and the Resource Center have been working over the past six months to develop a strategic plan aligning goals and strategies across the agency. The handout shows what has risen to the tops as priorities that we will be focusing on going forward. Chris Wagner added that MEPDG users group pooled fund will be coming soon and we are hoping to start regional meetings this year.

Asphalt Industry Update (Audrey Copeland)

Audrey Copeland, Vice President of Engineering, Research, and Technology for NAPA provided an update on the asphalt pavement industry activities (Attachment 6).

The Asphalt Pavement Alliance (APA) is a partnership between NAPA, the State Asphalt Paving Associations (SAPA), and the Asphalt Institute (AI). Recently there was a leadership change with Amy Miller as the new National Director. The APA will determine needs at a state level and bring experts together to address a state or regional issue. Regional councils will be piloted with the first in the Northcentral region, led by Dan Staebell. Dan will be headquartered in Iowa but will travel to states in the region. The council is a “field resource team of experts”. Please let NAPA know how this group can be useful to you.

Audrey provided a handout with NAPA’s Research Project Summary. There are a number of projects on pavement design, porous pavement design, PaveXpress design guidance. PaveXpress provides a simple pavement design based on AASHTO 93 and 98 to fill the gap between Darwin and ME implementation. Pave Xpress. Training is available and a number of new features are planned.

There are a number of NCAT publications available for advancements in flexible pavement design. The goal is to try to avoid over-designing pavements and answering the question- what is maximum thickness for a pavement? There will be a report published in the next couple of months that looks at local calibration of flexible pavements.
There are case studies from contractors in LA and IN looking at the speed of construction and provide the keys to rapid construction. NAPA has a number of resources on recycled materials (RAP and RAS).

There is an industry-wide initiative to focus on pavement performance. FHWA identified challenges related to use of RAS and other variables impacting performance. A performance testing/cracking test is needed. A new partnership with NCAT and MN Road was formed to look at a cracking test as the missing link to field verification and performance. Lack of funding, possibly dry mixes, and construction practices were identified as issues impacting performance and durability. The FHWA Asphalt ETG is tackling “balanced mix design” (performance based). A white paper will be developed based on a survey.

Questions and Discussion

- Leif- how is the mix design balanced?
- Audrey- the balance is between the rutting and cracking performance tests. We are looking at being more quantitative with performance tests.
- John Donahue asked which cracking tests are rising to the top for implementation? Audrey- Semi Circular Bend Tests (SCB) and other tests are being considered and narrowed down. Audrey will send John details on more promising tests.

Concrete Industry Update (Leif Wathne)

Leif Wathne, Executive Vice President for ACPA provided an update on the concrete pavement industry activities (Attachment 7).

Recently the 125th anniversary of the oldest concrete street in America was celebrated in Bellefontaine, OH. Contractor membership in ACPA is at an all-time high. We are coming out of recession and agencies have been deferring their major capital improvement projects for more preservation and resurfacing projects. Concrete overlays consist of 16% of total SY placed. Overlays remain a major focus moving forward. Trust fund is structurally deficient, agencies are severely constrained, but the FAST Act is keeping us stable. ACPA’s position is that the Remaining Service Interval (RSI) should be embraced as a measure. Wikipave was launched last year and ACPA is transitioning all technical resources so they are free. ACPA is active in implementation of Pavement ME. ACPA still supports StreetPave, which is for streets and local roads. Bonded Concrete Over Asphalt (BCOA) ME design tool for concrete overlays will be rolled into ASHTO ME in next update.

ACPA is working coordinating with FHWA to implement concrete overlays, concrete mixture improvements/Performance Engineered Mixtures for durability and long life, and sustainability with a focus on benchmarking recycled concrete aggregate (RCA) and Life Cycle Assessment. There is a potential collaborative effort with FHWA Turner Fairbank on thin concrete overlays using Roller Compacted Concrete (RCC) and the Accelerated Load Facility (ALF).

ACPA has a series of task forces including: Asset Management, design, jointing, Maintenance of Traffic (MOT), RCC, and smoothness.
As ACPA is looking toward the future, they are referring back to a 1997 Blueprint Effort that considered input from FHWA, states, industries. Would like to create a blueprint for the next generation of concrete pavement research and technology, considering the backdrop of pavement performance.

**NCHRP Update (Amir Hanna)**

Amir Hanna, NCHRP Senior Program Officer, provided an update on the current and upcoming NCHRP related activities ([Attachment 8a and 8b](#)). Amir provided a presentation including background on NCHRP. The Technical Committee has to submit through their Parent Committee, which is the Subcommittee on Design. NCHRP is working on the FY 18 program now. There will be a solicitation July 1, 2016 with end date of October 14, 2016 for problem statements. The anticipated projects for FY 2016 and FY 2017 are:

- 10-98 Protocols for Network Macro-Texture
- 1-58 Process for Evaluating the Impacts of Implements of Husbandry on Pavements
- 9-62 Quality Assurance and Specifications for In-Place Recycled Pavements Constructed Using Asphalt-Based Recycling Agents

Projects nearing completion by end of this year:

- 1-51 A Model for Incorporating Slab/Underlying Layer Interaction into the MEPDG Concrete Pavement Analysis Procedures
- 1-50 Quantifying the Influence of Geosynthetics on Pavement Performance
- 1-52 Calibrated, Mechanistic-Based Models for Top-Down Cracking of Hot-Mix Asphalt Layers
- 10-93 Measuring, Characterizing, and Reporting Pavement Roughness of Low-Speed and Urban Roads
- 1-53 Proposed Enhancements to Pavement ME Design: Improved Consideration of the Influence of Subgrade and Unbound Layers on Pavement Performance
- 1-57 Standard Definitions for Comparable Pavement Cracking Data
- 14-33 Pavement Performance Measures that Consider the Contributions of Preservation Treatments

One note, the geosynthetics project is inconclusive for concrete, but some there will be recommendations for asphalt.

**AASHTOWare Pavement ME Design Update (Vicki Schofield)**

Vicki Schofield, AASHTO Project Manager, provided an update on the AASHTOWare Pavement ME Design software ([Attachment 9](#)). The following is a summary of this presentation.

Information and resources are available at [www.aashtoware.org/Pavement](http://www.aashtoware.org/Pavement) and [www.me-design.com](http://www.me-design.com). These are both underutilized websites and many question can be answered by visiting these sites. The software notes about each release can be found on the sites. There is also access to FHWA DRIP and XML Validator. There are 42 licensing agencies including Puerto Rico and the District of Columbia. FHWA and Maricopa County, AZ are associate members. In addition, 4 Canadian provinces are licensing. Between
2015 and 2016 there has been an increase in many license types. Planned for FY 2016 are the following enhancements:

1. APIs for ICM and JULEA
2. MAP-ME
   - reviewed almost 200,000 lines of code
   - cleaned up code
   - refactored
   - alpha tested changes
4. Mapped of English and SI Units in the Existing Code
5. Vertical Slice for Web Based Application
6. Prioritization of Analysis Executables for APIs
7. Long Term Training on ME Design Principles
8. Thin Bonded Concrete Overlay Model
   - Development of Traffic Module
   - Development of Existing HMA Layer Damage Modulus Module
   - Development of NN Structural Model Module
   - Development of New Fatigue Damage Models
9. Reflection Cracking Implementation

There are a number of planned enhancements for FY 2017. For example the MEPDG Guide and Pavement ME software can't be separated, so they will be integrated and married together. The Manual will be available in the software. Need to work with NCHRP to review relevant published research related to Pavement ME. The licenses fees will increase in FY 2017 (fiscal year starts July 1, 2016) and looking to develop a web version. The Task Force decided in to increase fees recently, which are needed to enhance and maintain the software. There is a royalty agreement between AASHTO and ARA because ARA manages the international licenses.

The solicitation will be sent out for new members of the ME Task Force and Judy's position as Chair of the Committee. The members will be increased to prevent a tie (currently 6 members).

Discussions are underway to move from a desktop client to a web-based software approach. A solicitation was sent to establish a Technical Review Team composed of experts from AASHTO member agencies to review minimally viable product. Additional activities are noted in PowerPoint attachment.

There was some discussion about how corrects are done on the code. Vicki and Judy clarified that a review done on code and ARA has to correct errors. Lev noted that he has corrections. Anyone can submit issues to the AASHTO ME Pavement Design Task Force and they will be discussed at the next semi-annual meeting. Judy asked Lev to submit his list of issues to her and she would get it reviewed and considered.
Finally, AASHTO proposed new structure and the JTCOP will likely not become its own subcommittee. This committee has a very hard time getting our RNS through the subcommittees and we have gotten very little research approved as a result. This matter will be discussed further within AASHTO.

**Technical Presentation 3: SHRP 2 Research on Identifying Delamination in Flexible Pavement Layers (Mike Heitzman)**

Mike Heitzman Assistant Director and Senior Researcher at the National Center for Asphalt Technology (NCAT) made a presentation SHRP2 Renewal Project R06D Advanced Methods to Identify Asphalt Pavement Delamination ([Attachment 10](#)). Mike provided a brief background on SHRP2. There are four focus areas and most of the pavement projects originated from the Renewal area. There are 63 products and over 350 implementation projects, most of which are in the renewal area. Implementation consists of training, workshops, peer exchanges, demos, and showcases.

Within the Implementation Assistance Program there are three areas- proof of concept, lead adopter incentive, and user incentive. There are various requirements for each area. One of the projects addresses the issue of delamination, debonding or stripping. The goal is to identify the extent and severity of delamination. Non-Destructive Testing (NDT) needs to be comprehensive and rapid for evaluation and detection. In addition it needs to operate at a reasonable travel speed and cover a full-lane width. NCAT built test sections to evaluate a GPR antenna array with frequency sweep with 3D radar and an Impact Echo and seismic analysis of surface waves SAWS rolling wheel scanning system (by Olson Engineering) as two potential solutions (see PowerPoint for more details).

GPR has 40 antennas with multiple frequencies. The advantage is a 3D database that and can identify stripping. It will not identify de-bonding of two layers unless water is between two layers (water infiltration). The equipment is useful to identify areas where there is a potential problem for further analysis.

IE/SASW is handheld device which is modified for attachment to a trailer. The device is used at walking speed, to be used behind traffic control. A user could first use GPR to identify areas and then use the “golf cart” to mark specific areas. You can print areas for analysis as you are walking down the street.

The benefits to each method can be found in the PowerPoint presentation. In the future, product demand will drive software development to make data analysis more efficient and effective. We need real time display detail and automated signal identification in distressed areas.

A R06E showcase will be held at NCAT in August/September. 13 states applied to attend the showcase. All agencies that submitted applications for Round 7 are encouraged to attend the showcase.

**Questions and Discussion**

- The costs seem to be prohibitive for some.
- 13 agencies applied. MN has 3D radar system that the highway agency used to have and they are one of the applicants.
- John- surprising that after all this time there isn’t better software to interpret data.
- Mike- software seems to be improved from where we were.
• John- more DOT’s may be on board if more people could do the analysis. There is more emphasis on safety; there is a safety concern on our most heavily used roadways when we have to have a lane drop to take a core. There is a fundamental issue for rehabilitation when having to decide whether to mill the surface or not. We need to do an evaluation before milling to prevent mistakes if you run into delamination.

State approaches to Network Level Life Cycle Costs Analysis Required in MAP 21 Transportation Asset Management Plans (All)

• Every year as part of agenda, Judy selects a topic that seems to be something of interest overall to the States or on some new requirement. Would like to share how States approaching various topics. We started with Performance Measures, HPM new requirements for pavements. Now a TAMP is required by all States as a result of MAP-21.
• Typically we have done Life Cycle Cost Analysis (LCCA) at the project level but now it needs to be extended to the network level. In NC, the first draft needs to be done by Judy prior to her retirement. MN has posted on the web as one of 4 plans done in coordination with FHWA. LA has a plan but want to reevaluate it once final rule comes out. MO has one as well. The plans posted on-line are very different.
• Curt- For pavements in MN the typical strategy is to delay the need for reconstruction by applying a combination of surface treatments, crack sealing, and mill and overlays, depending on condition of pavement and available budget. The worst-first thinking for pavement reconstruction is to let a pavement deteriorate to poor condition without preservation. The desired approach is to perform a LCCA over a 50 year analysis period. Created a typical life cycle management strategy for flexible pavements using age range and treatment. In order to accurately document typical DOT strategy, they had to push out to a 70 year analysis period. The analysis definitely shows that worst first approach is more expensive. Also have a desired life cycle management strategy for flexible pavements.
• Judy- NC has not been doing worst-first or the “do nothing alternative” (minimal patching). They will be surveying the maintenance crews to get a better feel for what is being done.
• John- MO looked at their data and considered the worst-first approach, building a framework to report information, and assumed that they would be at a level that would be much less than required to match federal funds. Conducted a pavement summary of lane miles, percent good condition, and percent state travel based on route type. Found that low volume roads are in the worst condition, however this accounts for only 2% of state travel. Have a fairly large system due to low volume roads. The question is what is a typical pavement treatment assumptions, cost per mile, and average service life of treatments. They also went through a similar exercise for bridges considering bridges in critical condition. Have the ability to show that by District if available funding meets the needs.
• Rich- CO is referencing the optimization process for pavements. Dayton software will be used for optimization. The agency determined a decision tree based on condition and use their pavement management system to optimize fixes. Information is provided to an internal group, which will then vote and finally distribute funds.
Jeff- in WA preservation and maintenance activities were used to identify the pavement treatments, added life, and typical cost. Need to do maintenance first before reconstruction will be considered. There is a process for prioritizing pavement projects. A ranking factor for pavement type is calculated for each project within Categories 1-8. The highest priority goes to lowest $/lane mile-truck. Jeff reported that flexible pavements are the lowest cost per LMY-truck. Combined factors take into consideration the best buys of long-term performance in addition to effects of truck volumes. Concrete pavements are managed in two categories- preservation and reconstruction, with the highest priority is given to rehabilitation over reconstruction.

Research Needs from Related TRB Committees (John Donahue)

John Donahue reviewed the nine research needs statements (RNS) that he received from related TRB Committees and what he collected from a review of the TRB website. Our goal is to provide a list of our ranking of RNS and forward them to the appropriate AASHTO Subcommittee. We will briefly go over the RNS today and then discuss them in more detail tomorrow.

1. “Methodology to Determine Requirements and Specifications for Pavement Condition Data” (AFD 20) - There is an overarching need to address MAP 21 requirements and possibly unique state data collection requirements.
2. “Evaluation of Network-Level Pavement Structural Condition Using Continuous Deflection Testing Data” (AFD 20) - This is to develop standardize data collection procedures for rolling wheel deflection data or procedures on a national basis.
3. “Calibration and Verification of Pavement Surface Images” (AFD 20) - Identify methods to calibrate image data collection systems an automated image distress survey systems and develop a protocol.
4. “Highway Network Alternatives to Determining High Stress Pavement Safety Hotspot” (AFD 90) - Identify surface characteristics with wet-dry characteristics; identify areas with safety concerns.
5. “Develop and Validation of Advanced Macrotexture Descriptors”- Decided to table this proposal for now; Proposed AASHTO specification will handle a lot of this as well as RNS #4 above.
6. “Developing Data Needs for Pavement Management Decision Making for Local Agencies to Meet National Performance Measures”- The data collection needs of local agencies are different than state needs.
7. “Valuating Pavement Assets”- This is to evaluate pavement assets; what is depreciation cost of assets.
9. “Development of a National Test Section Tracking Database” (AFD 40) - This would be a way to track pavement test sections throughout the county.

Additional RNS carried over from last year are:

11. Performance Evaluation and Life Cycle Cost Analysis of Bonded Concrete Overlays on Asphalt or Composite Pavements and Development of Recommended Maintenance and Rehabilitation Procedures”

There are some other needs that are out there, but they are not formalized. We need to get them on the list for consideration.

**State DOT Key Issues and Issues for States Implementing ME-Design**

**Washington- Jeff Uhlmeyer**
- Having design-build issues and pavement design. State provides the pavement section and there is a question as to what happens when there is a design build job. Recently some contract teams are coming back and questioning the state design. Missouri has the same issues. State then tends to be in a defensive situation and accept ideas engineer doesn’t agree with. The State has to justify all decisions now. Design-bid build projects set precedence. North Carolina provides pavement sections- both asphalt and concrete, with no negotiation. Colorado provides sections, either one asphalt or one concrete, but not both. A contactor proposal will review alternates and either accept or approve.
- As a result of MAP-21 technical teams are established and educating the MPOs, which is appreciated. They have an asset management technical team as well.

**Kentucky- Paul Looney**
- There are new ME Design and design-build issues as well.
- Pavement staff is challenged by updating their design catalog; not on a production level. Need to analyze pavement management data to evaluate distress thresholds. Struggle with correlation of automation and thresholds. Have an Excel based design catalog, and would like it to be updated. A draft input guide has been developed and shared with industry. Asphalt industry has been aggressive and wants to look at the software.
- Doing a lot with GPR. Using it for dowel bar alignment and the industry has not been supportive. The goal is to be equitable and consistent between industries.

**Colorado- Rich Zamora**
- Focusing on system preservation with the current revenue stream. There is a need to have a local aspect or toll to generate revenue. There is a potential ballot for a tax increase.
- For Road “X” there is an effort to get operational improvements, like ramp metering. Have a road to vehicle connected pilot project.
- Data is very important and a Chief Data Operator will be hired to assist with these needs.
- LCCA is under scrutiny by industry who is questioning all inputs. Industry is pushing for alternate bids on all jobs.
- ME-Design is implemented.
- There is a lack of industry unity with how to use geogrids and agency needs to look at the issues.
Louisiana- Jeff Lambert
- Have a new governor and the State has a $2 billion shortfall for this year and next year.
- There is an interest in SHRP2 R23 (Pavement Renewal Solutions) and they are trying to come up with a project.
- Roller Compacted Concrete (RCC) research at loading facility. Anticipating fracking industry and oil prices staying high. Fracking has slowed in LA.
- Implementing Pavement ME- final report for local calibration received. Working on plugging in adjustments.

Missouri- John Donahue
- Due to funding, there is still a struggling with meeting needs. There are a number of critical bridges and this will be an emphasis area for the State, at least for a couple fiscal years.
- M-E Design- Will begin a 2nd round of local calibration for pavements. The 1st round of local calibration was done in 2008. The 2nd round will focus on overlay models because there are more reliable models today for evaluation.
- Looking at thin overlays and reclaimed materials. A lot of RAP was used over the past several years and also use a lot of RAS, as well. Having a problem with high percentage of shingles, especially thermal cracking. Specifications are being developed to ensure final blend is giving required properties.
- Will have a demo with Intelligent Compaction (IC) and infrared technology. A showcase with FHWA will be held June 1.
- Have done some projects with bonded concrete overlays over the past few years. Did a survey of use and the first project in the state was 17 years ago. Used a geotextile interlayer and the concrete was placed under traffic. All projects are doing well with low panel failure rates. There are some areas with failures, such as in bridge approach areas or an area with an unusual construction joint. All mainline pavements are in good condition. Won a national ACPA award for an 8” unbonded overlay on I-35, however within 4-5 years had a lot of cracking and some failures. Issue was it was designed as a widened slab with little edge support, no dowels, and 1” asphalt interlayer. Found that there was stripping of the interlayer. Restoration project done with cross-stitching, full-depth patching, and diamond grinding. Finally made quarter panels to reduce the stresses.

Kansas- Greg Schieber
- Since 2011 State has been transferring large sums of money from state highway fund to the general fund. This year projects will be delayed due to lack of funds.
- For the past 3-4 years using alternate bid on major reconstruction projects. There has been a lot of arguing over adjustment factors.
- For concrete- SHRP2 renewal project for precast pavements. Will consider for high traffic areas. There is a struggle with local aggregate issues. Participating in a pooled fund to fingerprint aggregates which could potentially be used to reject stockpiles. Goal is to have a pass-fail test for freeze-thaw.
- Asphalt- RAP and RAS looking at quite a bit. Looking at higher density and lower air voids along with FHWA project. Trial phase.
**Minnesota- Curt Turgeon**

- Participating in a pooled fund with NCAT.
- Looking at preventative maintenance options.
- Participating in the National Road Research Alliance with MnRoad. Looking at implementation, pilot studies, and peer exchanges with other states. Still looking for state and industry participation so please consider.
- Looking at a pooled fund to make sense of data issues brought up earlier in this meeting.
- Asphalt- Looking at dropping gyrations.
- Concrete- Implementing the BCOA design process. Building more concrete overlays and we need to consider how they will perform. Currently three are programed for construction.

**Alabama- Lyndi Blackburn**

- State has funding issues and there is no increase anticipated and also going through reorganization. There are a lot of projects on the street but having problems with what is being constructed in the field.
- Due to funding issues, need to get back into pavement preservation. Many years ago preservation was done frequently. There is now a lack of knowledge, such as how long are surface treatments going to last? Research needs to answer these questions. Has found that water and moisture is number one enemy with preservation treatments.
- ME-Design- Seems we are the last to implement. Right now there are no intentions for implementation. We are working on recalibrating the structural coefficient and changed pavement thickness by 18%.
- Asphalt- We are putting 5% shingles into mixes and are having problem with dry mixes. We are getting help from the asphalt industry. Need to find a way to make them work in mixes because shingles are not going to go away. The need for a cracking test is imperative.
- We are working on our TAMP. Meetings are being held with other program areas in the agency.
- Regarding alternatives designs and alternate pavement types with alternate designs- The interaction of the pavement with the base layer is important. We need a strong impermeable base that is flexible. There are pavements with the correct designs and we should not have alternatives. Both types will not work for all situations. It is difficult to get two parties to agree to alternate designs since there are completely different design approaches.
- LCCA for pavement and material selection – when incorporating user costs, you may not get best materials for costs.

**North Carolina- Judith Corley-Lay**

- The State currently has a budget surplus. The focus was on bridges four years ago, which resulted in a decline in pavement condition. The focus on bridges lasted two years. It is difficult to deal with structurally deficient bridges, but letting pavement condition decline is not cost effective.
- The big project in our State is the major reconstruction of the interstate inner loop around Raleigh. The project is political and has impact concerns, but it is going very well. Notifying the public has made a huge difference.
Discussion and Prioritization of Research Needs Statements (All)

The discussion on the RNS from Day 1 continued. A summary of the discussion is included for each RNS.

- Voting members should prioritize their top 3 RNS and then John will compile.
- Amir - The literature review is important and need to consider if it cover previous work and the nature of work and project. Does the RNS cover a big part of nation, reasonable resources, and is there a reasonable amount of time to address the issue.
- Ben Worel - RNS #9 is to develop a national test section tracking database. Purpose is to keep track of test sections across the nation. Can we learn from national calibrations? Include SHRP2 test sections. TX did work with flexible tracking database. How do we track these test sections? We need to make sure the database is not too complex. Chris - What research is needed? This is a database activity and could be very difficult. Katherine - FHWA is developing a pavement database for this type of work and projects can be added. CO - concerns with how complicated this activity would be. Leif - seems a perfect fit for FHWA. Judy - there may be issues with ownership and maintenance. Paul - Problem with what data is available and who has the data. John - database needs to be more than site location and contact person. Leif - could be similar to ACPA’s explorer map with all locations and limited details, such as what was the experiment designed to do. Lyndi - the concern is who owns the database and maintains it, which is a big effort. Amir - intent appears to be a library, which Ben confirmed. Amir - You need to specify what information is needed and the purpose of the database. It is reasonable to assume NCHRP is a good place to start the database, but the question remains on who would provide maintenance and updates. CO - keep the RNS in the pool for consideration and then prioritize.
- John - RNS #5 (Develop and Validate Advanced Macrotexture Descriptors) is to improve skid descriptor characteristics. We have the sand patch test (ASTM), which measures the diameter of a circle. The greater the diameter, the lower the texture. It is a crude test, but it is understandable. But the question is how do the results relate to skid resistance? A literature search for what equipment is out there is needed. John has been deposed for wet weather accidents, and would feel better if there was something more defensible. KS - what is difference with this and NCHRP 10-98? The 10-98 project is just starting. Amir - there is a potential for John to join panel but the panel has been in place for some time.
- John - RNS #6 (Developing Data Needs for Local Agencies to meet National Performance Measures). John recognizes that LPAs don’t have to require the level of data as states do, but what data should they be collecting. Looking for some guidance for LPA’s, to support national requirements. This is not a direct value to states, but could potentially help fill a need that states will have. Chris - seems as though the RNS is ahead of curve (guidance). Judy - There is a lot of frustration with the requirements and the compliance dates. FHWA should be responsible for LPA guidance because this is a critical need. NCHRP 10-93 addresses data measurements for lower volume local roads.
- John - RNS #7 (Valuating Pavement Assets) is not a true RNS. It appears to be an accounting tool for DOTs. What are depreciation rates for infrastructure components? This may be important to a DOT CFO or at the executive level. Curt - challenging to try to explain to non-engineers about non-
valuing investments. Judy- this is a critical piece for developing a financial plan for infrastructure. There is no guidance on how to develop depreciation rate and value. There are two approaches and guidance is not that good. Lyndi- will it be one number or a regional number? Judy- it may be several numbers. The bottom line is whether we are funding at an appropriate level to address depreciation rate. Judy- Asked if this should this be a synthesis. Amir agreed it would be a good synthesis topic, with the question being how are states valuating their assets?

- John- RNS #1 (Methodology to Determine Requirements and Specifications for Pavement Condition Data) may be too generic and broad. This is not focused on one area that you could address in a 2-year study. It is not addressing any one thing and lacks focus.
- John RNS #3 (Calibration and Verification of Pavement Surface Images) links to MAP-21. It appears that crack measurement will be a data collection requirement. The needs statement addresses that potential requirement. This is a direct focused item and will have great value in future. Judy- this is a high interest for NC. We are trusting images from our vendor, but we are not able to maintain contracts with a single vendor indefinitely. We need guidance and standards so that more than one vendor can be trusted. This would allow us to intermix with different technologies so a DOT doesn’t have to stay with just one vendor. Judy rates this RNS high. It does need to be re-worked to address the needs. This RNS is a result of Andy Mergenmeier’s pooled fund, which is supported by the 20 states in pooled fund. Chris will have Andy revise the RNS to address Judy’s comments. The pooled fund project has needs greater than available funding so this work would fill that gap.
- John- RNS #2 (Evaluation of Network-Level Pavement Structural Condition Using Continuous Deflection Testing Data) This project would come up with means to develop testing protocols for available equipment. Would look at one facet of data collection with achievable outcomes. FWD data collection comes back to a problem with traffic control. Amir- what is continuous collection? There are a couple technologies now that are being evaluated to address continuous collection. Lyndi- this RNS is building off the pooled fund study that is underway. Amir- could this be a potential synthesis? No, because there is not that much equipment to synthesis. This work is a little advanced because states can’t collect data unless they hire someone to do it. John- this would address the future of data collection. FWD will slowly become a thing of the past due to traffic and safety concerns and because it is a slower way of collecting data. Greg- would contract out the work but State would not purchase equipment. Ben- This is just an indication of structural strength and not the same thing as FWD.
- John- RNS # 8 (Impact of Flooding on Performance of Concrete Pavements) There is a loss of support on concrete pavements due to a flood. Katherine- FHWA has an ongoing research project on flooded pavements, which is not specific to one pavement type. University of New Hampshire is doing the work. A decision tree will be developed on how to assess pavements after a flood. The project will finish early next year. We should wait to see what comes out of FHWA research, but there is not much interest in building a pavement section to flood and fail.

John then revisited two older RNS:

- John- RNS # 10 (Validation of the Drainage Component of the Enhanced Integrated Climatic Model) - This issue will linger until it is addressed. The basic problem is the surface infiltration layer
boundary is modeled empirically. We don’t have a thorough mechanistic model to make it more reliable. We need validation of current models, and then if they don’t work, a new model needs to be built. Lyndi- those are two different projects. Judy- using traditional approach for NCHRP problem statements, we need to look at what models are available and then look at an improved moisture infiltration model. There may be something better out there since what was first put into ME-Design. Would like to move toward a more mechanistic model. Committee believes this is an important need. Amir- need to look at it systematically. Chris- when you look at all the needs of ME-Design, this is low on the list. The current version does a pretty good job with climatic model.

- **John- RNS #12 (Including the Effects of Shrink/Swell and Frost Heave in Mechanistic-Empirical Pavement Design) -** This RNS deals with the effects of Shrink Swell in ME Design Guide. ARA’s recommendation was that this was too much for them to handle as an enhancement. They recommended that this work be done as a coordinated national research effort. The AASHTO Subcommittee on Materials felt this was a regional need. Shrinkage/Swell of expansive soils and frost heave is a concern for southern and northern regions. The RNS is general and widespread and includes more than just a drainage component statement. Chris- Shrink swell is currently not a component of the models. John- still a high priority and would be good to have a unified model. Amir- this RNS was submitted a few years ago and it should be a pooled fund due to the regional nature. Judy- the issue covers too big of a region. Many states don’t want to host a pooled fund because of the administrative challenges. The State has to have all the contributions before the first contract can be issued. Some states have the ability to do pooled funds, but they are doing so many it is becoming a burden. RAC and SCOR need to be aware that this issue with pooled funds.

- **John- RNS # 11 (Performance and LCCA for Bonded Concrete Overlays (BCO)) -** John and Tom Burnham put this together. Currently a comprehensive analysis of bonded overlays has not been done. This RNS would look at a comprehensive study. Amir- LCCA is in problem statement, but it is not described; why is it included? John suggested that LCCA/cost is taken out of the RNS. Judy- does it add something to look at LCCA? If the purpose is just to collect service life data, then the state can do the LCCA. The BCOA pooled fund work comes up with a model that does not exceed cracking limits, etc. John- we need more recommended practice for how to address maintenance. Structural fibers are routinely used for concrete overlays. John will clarify the LCCA part in the RNS.

### Implementing Plans for Research Needs Statements (All)

- Ratings need to be done before the Subcommittee on Design next month. Would be great if we got endorsement from Subcommittee on Materials and Subcommittee on Design, but if we do not have them by that time then we can still submit our statements on-line. We need to build support for our statements by talking to the right people. Members need to get grass-roots support for our top votes.

- Calibration and verification for ME-Design is more critical. AL, KS, NC- focus on assisting states to allow different vendors for data collection, consistency of results, data protocols, and potentially looking at an AASHTO standard. Historically vendors promote themselves and will not fall in line with a national standard unless it is driven by agencies.
• For the project evaluating of network level continuous deflection data (RNS #2), suggested to eliminate Task 6. John will send out the RNS after the meeting and ask Committee members to recommended changes.
• It was agreed to table RNS #8 (flooded pavements) until the FWHA research project is completed.
• Climatic model- Leave for members to rank.
• The Swell and Frost Heave project will be sent out to be ranked. John will send it to the ME Design User Group and see if anyone would be interested in taking it on as pooled fund, letting them know this is a need. Previously it was rejected because it was thought it should be a pooled fund. Christ to work with John to get contact list for the User Group.
• The database project will be sent out to be ranked by the Committee members.
• We may have a new RNS based to look at estimating the change in bond of the subbase and concrete over time to provide guidance on the consideration of bond or no bond over time. We should wait until the report from Lev’s project is complete and then the Committee will reevaluate the need for a new RNS.

Next Meeting

Thank you to Curt for hosting this year’s meeting!

Jeff Uhlmeyer will host our 2017 meeting in Seattle, Washington. Thank you Jeff!

John Donahue will host our 2018 meeting in Missouri.

In a normal year the JTCOP meets in mid-April before Mother’s Day. This allows us to miss the graduation time of year and it is after the big AASHTO meeting. It seems to work well for all members.

Action Items

• Revisions to the RNS need to be done within two weeks. Then members vote and rank the statements. The Subcommittee on Design meets June 19, which gives us 2 weeks to review and vote. Please vote even if you don’t have a priority.

Adjourn

In closing Judy thanked everyone on the committee. It was a pleasure to work with everyone over the years and she thanked everyone for all the time and effort they put into the committee.

The meeting was adjourned at approximately 11:15.
NCHRP 1-51 “Slab-base Interaction” Methodology and Results

Prof. Lev Khazanovich
Base Contribution

- AASHTO-93, PCA design procedures
  - Bumping k-value
Time to LOF and distress prediction

Site ID 582 near Stockton, CA

COTE = 5.5
ΔT = -10F

Transversely Cracked Slabs (%) vs. Age (mo)

- Unbonded
- Bonded
The objective of this research is to develop a mechanistic-empirical model (and associated computational software) for considering the interaction between the concrete slab and underlying layer and its effect on pavement performance. The model shall be appropriate for use with the MEPDG procedures for concrete pavement analysis and design.

- Early work focused on characterizing friction
  - Important: “friction” ≠ “interaction”
- Developed a product that can be implemented immediately (short-term) and long-term
- Make product fully compatible with AASHTO M-E
Model development

- Developed model for intermediate state ("partial friction") between full bond and full slip
  - Used neural networks for stress calculations used in AASHTO M-E
  - Intermediate friction can vary over time and season
  - Intended to match AASHTO M-E models for fully bonded (high friction) and full slip (no friction)
Model development
1. Matching 1-51 model with AASHTO M-E model for full bond and full slip cases
2. Characterizing friction parameter given available data
3. Evaluating if the “partial friction” model is sufficient
AASHTO M-E models

- Generally insufficient documentation for models
  - Fatigue cracking model is not reported correctly in software
  - Non-linear temperature stress correction is not documented
  - Temperature linearization procedure is not documented

- Implemented more rigorous temperature linearization
- Novel non-linear temperature stress correction

\[
PC = \log \left(\sum_{i} \frac{C_i}{\text{Total temperature gradient}} \right)
\]

- Pavement ME and MEPDG Manual of Practice

Khazanovich 1994

0.4371

1

Missing term uncovered by 1-51 from original 1-37A
• Use of variable friction in model led to need to characterize friction
  – Developed edge backcalculation procedure to determine variable friction parameter using LTPP FWD data

• LTPP FWD and friction analysis of all SPS-2 and GPS-3 sections
  – Used data from 4,572 individual test sites corresponding to 289,816 FWD tests
  – Did not yield satisfactory model parameters to characterize friction
LTPP SPS-2 performance reviews

• 1-51 review of all SPS-2 section follows on Jiang and Darter (2005)
  – Review through LTPP Standard Data Release 28.0
• Asphalt-treated bases outperformed other base types in every regard
• Cement-treated bases experienced higher cracking than other base types
Selected Loss of Friction Age for ADOT JPCP/CTB Projects

RESULTS: On average, a loss of friction age of 0 years provided the best fit for JPCP’s constructed over CTB or LCB.
Built-in curl and distress prediction

Site ID 582 near Stockton, CA

ΔT = -10°F is upper bound

COTE = 5.5
Loss of Friction = 0

AASHTO JTCOP, May 10, 2016
Built-in curl and distress prediction

\[ \Delta T = -10^\circ F \text{ is lower bound} \]
Evaluating AASHTO calibrations

- AASHTO cracking calibration uses 984 observations from 133 SPS-2 and GPS-3 sections
- 15 sections have non-default built-in curl

<table>
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<th>BUILT-IN</th>
<th>BASE</th>
<th>PROJECT</th>
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What if default values for AASHTO calibration?
Recalibrated current AASHTO M-E

- **JPCP transverse cracking**

\[ CR = \frac{C_1}{C_2 + C_3 \cdot FD^{C_4}} \]

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<td>3.24</td>
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<tr>
<td>( C_4 )</td>
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</table>

- **JPCP joint faulting**

\[
\Delta T = \sum_{i=1}^{m} \Delta Fault_i = C_{34} \cdot DE_i \cdot (FAULTMAX_{i-1} - Fault_{i-1})^2
\]

\[
FAULTMAX_i = FAULTMAX_0 + C_7 \cdot C_{56} \cdot \sum_{j=1}^{m} DE_i
\]

\[
FAULTMAX_0 = C_{12} \cdot C_{56} \cdot \delta_{crit} \cdot \log \left( \frac{P_{200} \cdot \text{WetDays}}{P_i} \right)^{C_6}
\]

\[
C_{56} = \log(1 + C_5 \cdot 5^{\text{KProj}})C_6
\]

\[
C_{12} = C_1 + C_2 \sqrt{FR}
\]

\[
C_{34} = C_3 + C_4 \sqrt{FR}
\]

*\( \Delta T \) by base reserved for cracking calibration

- **CRCP punchouts**

\[ PO = \frac{C_3}{1 + C_4 \cdot FD^{C_5}} \]

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<td>( C_5 )</td>
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</table>

*FAULTMAX_0 = FAULTMAX 
*\( C_7 \) = \log(1 + C_5 \cdot 5^{\text{KProj}})C_6
*\( C_{12} = C_1 + C_2 \sqrt{FR}
*\( C_{34} = C_3 + C_4 \sqrt{FR}

*\( \Delta T \) by base reserved for cracking calibration
LTPP profilometer data

• Find built-in curl parameter using LTPP profilometer
  – Develop empirical mode decomposition (EMD) tool to assess slab profile from profilometer data
  – Quantify slab curl by LTPP section by applying tool to LTPP database
• Slab profile difficult to infer, either inconclusive or contradictory
• After difficulty assessing built-in curl, turned focus to AASHTO calibrations, which modified built-in curl
Brief history of built-in curl

• 1-37A proposal did not include built-in curl parameter OR top-down cracking
• Still not understood, but being used as a calibration parameter (See above)
• No guidelines to estimate this parameter after 20 years of research
Project treatment of built-in curl

- Project conclusion is that estimation cannot be done
  - How to characterize it in one parameter? Especially with a stabilized base…
  - As DELT becomes more negative, BU goes down and TD goes up
  - As DELT becomes more positive, BU goes up and TD goes down

- As first step, use two values for the parameter

\[ \Delta T = \Delta T_{input} \pm A \left( 1 - \text{Exp}(B \frac{E_{PCC} h_{PCC}}{E_{PCC} h_{PCC} + E_{base} h_{base}}) \right) \]
1-51 Cracking Model Calibration

- **GRAN**
  - \( y = 0.9987x \)
  - \( R^2 = 0.9346 \)

- **CTB, Adj**
  - \( y = 0.8987x \)
  - \( R^2 = 0.8701 \)

- **PSAB**
  - \( y = 1.0729x \)
  - \( R^2 = 0.2817 \)
Research products

- Full review of LTPP and experimental data found that slab-base interaction cannot be described by a single parameter
- Short-term objective to incorporate slab-base interaction into current AASHTO M-E accomplished through revised calibrations
- Long-term objective to implementation-ready models accounting for slab-base interaction accomplished through modified AASHTO M-E models
Research products for AASHTO-ME

- **Short-term:** Use MEPDG/Pavement ME as-is
  - Re-calibrate models to aggregate base first, then modify calibration by base type
  - Built-in curl was used as a part of the calibration rather than loss of friction
  - This is more important for local than national calibration

- **Long-term:** re-developed cracking model
  - Accounts for slab-base interaction
  - Rigorous temp linearization process
  - Different, more rigorous way of accounting for high non-linear temp stresses
  - Reconsidered built-in curl concept
A future for AASHTO M-E models...

- Nomographs have been replaced with poorly documented, "black box" programs
- AASHTO M-E heading to a dead end if its performance models cannot be independently reproduced
ON THE BRINK OF DATA OVERLOAD?

Curt Turgeon
May 10th, 2016
AASHTO Joint Technical Committee on Pavements
Early 1980s ASPHALT PLANT

SMOKE

BA-1

85-100

PEN

AC

MnDOT INSPECTOR TEST SHACK
1980s Switch to QM

- Previous
  - Two Pay Items
  - Inspector Called Shots
  - Spot checks for AC
  - Gradations
  - One lab at CO
  - Samples were run in to verify mixes????

- Quality Management
  - AASHTO test procedures
  - Off shelf test equipment
  - Field Labs – contractor
  - Cert. Techs
  - District Labs
  - One Pay item
  - Contractor Mix Design
SOME STUFF HAPPENS WITH FEEDING THE PAVER, PAVER PLACES MAT, ROLLERS ROLL, MAT GETS COOL, 24 HOURS LATER WE TAKE SOME CORES

ALL WE KNOW IS WHAT WE SEE IN THE MAT, IF WE HAVE SOMEONE AVAILABLE.
› SOME STUFF HAPPENS WITH FEEDING THE PAVER, PAVER PLACES MAT, ROLLERS ROLL, MAT GETS COOL, 24 HOURS LATER WE TAKE SOME CORES

› ALL WE KNOW IS WHAT WE SEE IN THE MAT, IF WE HAVE SOMEONE AVAILABLE.
Elephant = 6 tons

Hedgehog < 1 pound

For every 100 elephants of mix, we sample and test two hedgehogs (cores)

THAT’S IT?
CONSTRUCTION PROJECT DATA SETS

- CONTRACTOR MIX TESTS – AASHTOware?
- AGENCY MIX TESTS – AASHTOware?
- SPOT DENSITY TESTS
- PAVER MOUNTED THERMAL PROFILING
- INTELLIGENT COMPACTION
- GPR FOR DENSITY AND/OR THICKNESS
- AS CONSTRUCTED IRI
SPOT DENSITY TESTS

- CONTRACTOR – GUAGES USED AS QC CONCURRENT TO PRODUCTION
- CONTRACTOR – CORE DATA
- AGENCY – CORE DATA TO VERIFY CONTRACTOR CORE DATA
- REQUIRING GPS COORDINATES FOR CORE LOCATIONS
- REORGANIZING DATA FOR SIMPLER UPLOAD TO DATABASE
Paver Mounted Thermal Profiling

Photo Courtesy of Moba Corporation
DELTA-T BASED SPECIFICATION

![Graph showing the percentage of sublots for End Dump, Pickup Machine, and Material Transfer Device, with categories Low and Moderate.](image)
NON UNIFORMITIES BEYOND DELTA–T
Not what we want!
Semi-Variogram

US75_08_06_2 Station 2850
AT 50, Sill 83, Range 8

- Data
- Power Fit
- Range
- > 350 °F
- 325-350
- 300-325
- 275-300
- 250-275
- 225-250
- 200-225
- < 200 °F
- Excluded
Semi–Variogram

US75_08_08_1 Station 6750
ΔT 36.4, Sill 51, Range 5.4

- Data
- Power Fit
- Range
- > 350 °F
- 325-350
- 300-325
- 275-300
- 250-275
- 225-250
- 200-225
- < 200 °F
- Excluded

Lag Distance (ft)

Semi-Variogram (°F²)
Semi – Variogram Transverse

Transverse SV TH34  L1  WB  7.7-6.5  Lot028
ΔT = 26, Lot Variance = 29, SNS = 18.0

Diagram showing semi-variogram with temperature gradient and lag distance in feet.
Delete Paver Stops is in Current Spec
PAVER STOPS

- Stop excluding?
- Deduct for each?
- Let smoothness spec deal with it?
- Incorporate ProVal into Veta..future
What would YOU want in Pavement Mgmt Database?

- Full color profiles
- Delta–T Data
- Semi–Variogram 2D
- Semi–Variogram 1D
- Paver Stop number or time?
Intelligent Compaction – Rolling Patterns

Before

After
Less Compaction by Breakdown Roller & Cooler Compaction Temp.

May 8, 2015
Density Deduction = ($9,405.25)

Breakdown (Tmean = 235°F)

Intermediate (Tmean = 185°F)

Finishing (Tmean = 125°F)
IC Data vs. Cores
ROLLING DENSITY METER- GPR
RDM JOINT ANALYSIS

- S8 -1.0 ft EB
- S8 -1.0 ft EB (unconfined)
- S8 1.0 ft WB (confined)
- S8 1.0 ft WB (confined)
- Core Location

Relative Permittivity, $\varepsilon$

distance, ft

0  20  40  60  80  100  120
RDM MAT AND JOINT ANALYSIS
What would YOU want in Pavement Mgmt Database?
PAVEMENT SMOOTHNESS REPORT CARD

2015 HMA Smoothness Histograms

Credit Tom Nordstrom
PAVEMENT SMOOTHNESS REPORT CARD

2015 HMA Smoothness Box Plots

- **HMA-A**
  - Good: 20.3
  - Fair: 30.1
  - Poor: 41.3
  - Median: 34.7

- **HMA-B**
  - Good: 16.2
  - Fair: 25.1
  - Poor: 38.0
  - Median: 31.5

- **HMA-C**
  - Good: 23.8
  - Fair: 35.6
  - Poor: 47.8
  - Median: 41.2

Credit Tom Nordstrom
# REPORT CARD SORTED BY CONTRACTOR

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<thead>
<tr>
<th>Contractor</th>
<th>HMA-A</th>
<th>HMA-B</th>
<th>HMA-C</th>
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<td></td>
<td>Miles of Pavement</td>
<td>Mean Smoothness (in/mi)</td>
<td>Miles of Pavement</td>
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<tr>
<td>Mathy</td>
<td>0.0</td>
<td>NA</td>
<td>49.2</td>
</tr>
<tr>
<td>NNN</td>
<td>0.7</td>
<td>68.5</td>
<td>20.9</td>
</tr>
<tr>
<td>AAA</td>
<td>0.0</td>
<td>NA</td>
<td>52.9</td>
</tr>
<tr>
<td>BBB</td>
<td>0.0</td>
<td>NA</td>
<td>24.6</td>
</tr>
<tr>
<td>CCC</td>
<td>0.0</td>
<td>NA</td>
<td>34.9</td>
</tr>
<tr>
<td>DDD</td>
<td>8.8</td>
<td>36.7</td>
<td>24.1</td>
</tr>
<tr>
<td>EEE</td>
<td>0.0</td>
<td>NA</td>
<td>7.7</td>
</tr>
<tr>
<td>FFF</td>
<td>36.1</td>
<td>36.6</td>
<td>52.4</td>
</tr>
<tr>
<td>GGG</td>
<td>0.0</td>
<td>NA</td>
<td>4.4</td>
</tr>
<tr>
<td>HHH</td>
<td>0.0</td>
<td>NA</td>
<td>12.2</td>
</tr>
<tr>
<td>III</td>
<td>0.0</td>
<td>NA</td>
<td>8.6</td>
</tr>
<tr>
<td>JJJ</td>
<td>0.0</td>
<td>NA</td>
<td>0.0</td>
</tr>
<tr>
<td>KKK</td>
<td>15.9</td>
<td>45.6</td>
<td>0.0</td>
</tr>
<tr>
<td>LLL</td>
<td>4.2</td>
<td>34.4</td>
<td>0.0</td>
</tr>
<tr>
<td>MMM</td>
<td>41.0</td>
<td>32.3</td>
<td>0.0</td>
</tr>
<tr>
<td>All Contractors</td>
<td>106.6</td>
<td>36.4</td>
<td>291.8</td>
</tr>
</tbody>
</table>
Figure 6-2: Life-Cycle Cost Analysis Modeling Strategies

<table>
<thead>
<tr>
<th>ASSET</th>
<th>TYPICAL STRATEGY</th>
<th>WORST-FIRST STRATEGY</th>
<th>DESIRED STRATEGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavements</td>
<td>- Delay need for reconstruction by applying a combination of surface treatments,</td>
<td>- Reconstruct a pavement as it deteriorates to Poor condition without routine preservation activities.</td>
<td>- Apply a major rehabilitation/reconstruction activity at year 50, once the pavement has gone through a few preservation cycles and minor rehabilitation events.</td>
</tr>
</tbody>
</table>
Figure 6-5: Summary of Life-Cycle Cost Analysis Results (Pavements)

- Typical
- Desired
- Worst-First

Life-Cycle Cost (in today’s dollars, excludes initial investment):
- Typical: $410, Desired: $390, Worst-First: $980

Life-Cycle Cost as a percent of initial investment (excludes initial investment):
- Typical: 142%, Desired: 111%, Worst-First: 287%
### Figure 6-3: “Typical” Life-Cycle Management Strategy for Flexible Pavements (Mill and Overlay Strategy)

<table>
<thead>
<tr>
<th>Typical Pavement Age* (yrs)</th>
<th>Pavement Age Range** (yrs)</th>
<th>Treatment</th>
<th>Typical Condition When Applied</th>
<th>Typical Cost ($/In-mi)***</th>
<th>Cost Range ($/In-mi)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Initial Construction</td>
<td>-</td>
<td>$657,500*</td>
<td>$210,000 - $2,000,000</td>
</tr>
<tr>
<td>8</td>
<td>6-10</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$8,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>12</td>
<td>10-14</td>
<td>Surface Treatment</td>
<td>Good</td>
<td>$15,000</td>
<td>$10,000 - $30,000</td>
</tr>
<tr>
<td>20</td>
<td>18-22</td>
<td>Mill &amp; Overlay (1st Overlay)</td>
<td>Fair</td>
<td>$155,000*</td>
<td>$145,000 - $175,000</td>
</tr>
<tr>
<td>24</td>
<td>21-25</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$6,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>26</td>
<td>25-29</td>
<td>Surface Treatment</td>
<td>Fair</td>
<td>$15,000</td>
<td>$10,000 - $30,000</td>
</tr>
<tr>
<td>35</td>
<td>33-35</td>
<td>Mill &amp; Overlay (2nd Overlay)</td>
<td>Fair</td>
<td>$155,000</td>
<td>$145,000 - $175,000</td>
</tr>
<tr>
<td>39</td>
<td>36-40</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$8,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>41</td>
<td>39-43</td>
<td>Surface Treatment</td>
<td>Fair</td>
<td>$15,000</td>
<td>$10,000 - $30,000</td>
</tr>
<tr>
<td>47</td>
<td>45-49</td>
<td>Mill &amp; Overlay (3rd Overlay)</td>
<td>Poor</td>
<td>$155,000</td>
<td>$145,000 - $175,000</td>
</tr>
<tr>
<td>51</td>
<td>49-53</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$8,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>53</td>
<td>51-55</td>
<td>Surface Treatment</td>
<td>Fair</td>
<td>$15,000</td>
<td>$10,000 - $30,000</td>
</tr>
<tr>
<td>57</td>
<td>55-59</td>
<td>Mill &amp; Overlay (4th Overlay)</td>
<td>Poor</td>
<td>$155,000</td>
<td>$145,000 - $175,000</td>
</tr>
<tr>
<td>61</td>
<td>59-63</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$8,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>63</td>
<td>61-65</td>
<td>Surface Treatment</td>
<td>Fair</td>
<td>$15,000</td>
<td>$10,000 - $30,000</td>
</tr>
<tr>
<td>65</td>
<td>63-67</td>
<td>Mill &amp; Overlay (5th Overlay)</td>
<td>Poor</td>
<td>$155,000</td>
<td>$145,000 - $175,000</td>
</tr>
<tr>
<td>68</td>
<td>66-70</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$8,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>70</td>
<td>68-72</td>
<td>Reconstruction</td>
<td>Fair</td>
<td>$657,500*</td>
<td>$210,000 - $2,000,000</td>
</tr>
</tbody>
</table>

Notes:
### Figure 6-4: "Desired" Life-Cycle Management Strategy for Flexible Pavements (FDR strategy)

<table>
<thead>
<tr>
<th>Typical Pavement Age* (yrs)</th>
<th>Pavement Age Range** (yrs)</th>
<th>Treatment</th>
<th>Typical Condition When Applied</th>
<th>Typical Cost ($/ln-mi)***</th>
<th>Cost Range ($/ln-mi)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Initial Construction</td>
<td>-</td>
<td>$657,500£</td>
<td>$210,000 - $2,000,000</td>
</tr>
<tr>
<td>8</td>
<td>6-10</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$6,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>12</td>
<td>10-14</td>
<td>Surface Treatment</td>
<td>Good</td>
<td>$15,000</td>
<td>$10,000 - $30,000</td>
</tr>
<tr>
<td>20</td>
<td>18-22</td>
<td>Mill &amp; Overlay (1st Overlay)</td>
<td>Fair</td>
<td>$155,000</td>
<td>$145,000 - $175,000</td>
</tr>
<tr>
<td>23</td>
<td>21-25</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$6,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>27</td>
<td>25-30</td>
<td>Surface Treatment</td>
<td>Fair</td>
<td>$15,000</td>
<td>$10,000 - $30,000</td>
</tr>
<tr>
<td>35</td>
<td>33-35</td>
<td>Mill &amp; Overlay (2nd Overlay)</td>
<td>Fair</td>
<td>$155,000</td>
<td>$145,000 - $175,000</td>
</tr>
<tr>
<td>38</td>
<td>36-40</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$6,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>43</td>
<td>41-45</td>
<td>Surface Treatment</td>
<td>Fair</td>
<td>$15,000</td>
<td>$10,000 - $30,000</td>
</tr>
<tr>
<td>50</td>
<td>47-53</td>
<td>FDR/Reconstruction</td>
<td>-</td>
<td>$657,500£</td>
<td>$210,000 - $2,000,000</td>
</tr>
<tr>
<td>58</td>
<td>56-60</td>
<td>Crack Treatment</td>
<td>Good</td>
<td>$6,000</td>
<td>$3,000 - $10,000</td>
</tr>
<tr>
<td>62</td>
<td>60-64</td>
<td>Surface Treatment</td>
<td>Good</td>
<td>$15,000</td>
<td>$10,000 - $30,000</td>
</tr>
<tr>
<td>70</td>
<td>66-72</td>
<td>Mill &amp; Overlay (1st Overlay after FDR/Reconstruction)</td>
<td>Fair</td>
<td>$155,000</td>
<td>$145,000 - $175,000</td>
</tr>
</tbody>
</table>

**Notes:**
FHWA’s Pavements and Materials Program Area Strategic Plan

FHWA’s Offices of Infrastructure (HQ), Infrastructure R&D (Research), and Technical Services (Resource Center) are working together to develop a coordinated strategic plan for pavements and materials. We anticipate an increased emphasis on performance metrics, pavement condition, performance-related approaches to increasing durability, and quality assurance. These areas are high priority due to an increased focus on long term quality and effective use of Federal-aid funds, of which the MAP-21 rule making is a component. FHWA will use these goals and objectives to guide coordinated projects and programs across Offices.

The Pavements and Materials Strategic Plan goal areas and objectives are:

1. **Pavement Performance**- Obtain and preserve pavement performance and condition data for a safe and durable highway system.

2. **Pavement Materials and Structural Design**- (1) Optimize materials selection, analysis, and mixture design for the required pavement performance (2) Optimize structural design of pavements for the desired performance based on the specific loading, environment, and functional requirements.

3. **Sustainable Pavements**- (1) Increase the effective use of reclaimed, recycled materials and industrial by products in pavements; Adopt sustainable technologies and practices throughout the entire pavement life cycle, from materials extraction through end of life. (2) Assess the environmental impacts in the design, construction and use phase of pavements.

4. **Pavement Construction**- Adopt techniques and practices to construct quality pavements in a safe, expedited, efficient, and sustainable manner.

5. **Materials Quality Assurance**- Ensure State’s materials, practices and capabilities meet regulations and promote durable pavements.

6. **Technical Capacity**- Strengthen collaboration, coordination and technical development opportunities for FHWA Pavement and Materials staff and our transportation partners.
ASPHALT INDUSTRY UPDATE
Audrey Copeland
AASHTO JTCOP
Bloomington, MN
May 10th, 2016
Let’s Discuss...

- Asphalt Pavement Alliance
- Pavement Design Guidance
- New Resources
- Pavement Performance
The APA is a partnership of the Asphalt Institute, National Asphalt Pavement Association, and the State Asphalt Pavement Associations.

National Director
Amy Miller, PE

• Bridges National and State Efforts
• Providing Resources
• Connecting With Experts
• Communicates Local Needs

National Deployment
Bring together SAPAs, Asphalt Producers, AI Regional Engineers, & Others to develop solutions to meet local & regional needs.
Pilot: Northcentral RMC
SAPAs & Projects Partners

- pavia systems
- trisIGHT
- ASU Arizona State University
- NCAT Auburn University
- Federal Highway Administration
- Texas A&M Transportation Institute

Kevin Hall

Chuck Schwartz
PAVEMENT DESIGN GUIDANCE

• PaveXpress
• Optimized Flexible Pavement Design
  • ASCE Flexible Pavement Design Course
• MEPDG Implementation
PAVEMENT DESIGN
Simplified

Web-Based Pavement Design Tool

Designing the right pavement for the job just got easier thanks to PaveXpress, a free web-based pavement design tool for roadway and parking lot pavements.

Projects created in PaveXpress can be printed, shared, and saved, and design options can easily be evaluated in a side-by-side comparison. As a browser-based tool, PaveXpress is always up to date and can be accessed from any computer or mobile device, regardless of screen size or operating system.

PaveXpressDesign.com
PaveXpress Knowledge Transfer

1,725 people reached
PaveXpress

Over 9,000 Users!
Future of **PaveXpress**

- Simplified mechanistic design for asphalt pavements
- Pavement cost estimating module
- Porous pavement design tool
- Suggestions?
Speed of Construction

Case studies from contractors in LA and IN.

Keys to rapid construction:
1. Isolating work zone from traffic
2. Using in-place material as much as possible
3. Lane closures to improve productivity
4. Contractor control over work zone
5. Innovative approaches for moving traffic in and around work zones.

http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/161405-1.pdf
Pavement Performance

- Industry-wide initiative with focus on long-term performance & competitiveness over pavement life-cycle
  - States implementing changes related to volumetrics, establishing minimum AC contents, and construction best practices
  - FHWA identified challenges related to use of RAS and other variables impacting performance
  - Performance testing – cracking test needed
MnDOT’s MnROAD Research Facility Partnership
with National Center for Asphalt Technology (NCAT)

Alabama Lead State – MnDOT is a subcontractor to Auburn (NCAT)

The Minnesota Department of Transportation’s Road Research Facility (MnROAD) has partnered with the National Center for Asphalt Technologies (NCAT) Partnership to advance pavement engineering focusing on two important national issues that impact each agency. Two research efforts were started in the fall of 2015 which include:

- Development of a National Pavement Preservation research effort to determine the life extending benefit curves of a number of different pavement preservation techniques constructed in both Alabama and Minnesota.
- Development and implementation of asphalt performance tests to predict cracking for common distress found in North America. Both MnROAD and NCAT will develop test sections to support this effort in 2015 and 2016.

Sharing resources and expertise will improve coordination of experiments and expand evaluation of pavement performance in both northern and southern climates, providing cost-effective solutions that can be implemented nationwide. Currently a total of 17 states are sponsoring these projects; there are seven committed northern states including Colorado, Illinois, Michigan, Maryland, Minnesota, New York, and Wisconsin. The Foundation for Pavement Preservation and the National Center for Pavement Preservation are also active members.
## The Issues
- Long-term funding and lack of proper funding for preservation and maintenance
- Possible dry mixtures with low asphalt content
- Construction practices, lack of inspection, and need for training.

## The Strategy
- Pavement Performance Task Group
- Issues and Industry Strategies
- Partnerships
- Recommendations for Ensuring Durability

## The Focus
- Refocused Engineering Committee
- Focus on Durability in Partnership with FHWA & SAPAs
- Rethinking Asphalt Mixture Design & Simplifying Specifications
  - TRB Workshop
  - NAPA Workshop
  - FHWA Task Group
Information Exchanges

  • Workshop
  • Circular
• NAPA’s Annual Meeting – February 2016
  • Educational Session
• AAPT Annual Meeting – March 2016
  • Symposium Session

• FHWA Asphalt Mixture Expert Task Group
  • Balanced Mix Design Task Group – Shane Buchanan, Chair
State of Balanced Mix Design Practice - Example

Are performance tests used in your current mix design specifications?

- 21 state DOTs reported that they do
- 6 states DOTs reported that they do not

![Bar chart showing 20 Yes and 5 No responses](chart.png)

![Map of the United States showing states with red indicating states where performance tests are not used](map.png)
State of Balanced Mix Design Practice - Example

If yes, are the same performance tests used to evaluate mix during production?

- **12** state DOTs reported that they **do** use the same performance tests to evaluate mix during production.
- **10** states reported that they **do not** use the same performance tests to evaluate mix during production.
- **5** states reported that they **do and do not** use the same performance tests to evaluate mix during production. They only use it if specific issues arise but not every time.
BMD Task Group Work Items

• Current State of Practice & Task Force Accomplishments

• Identify gaps & prepare RNSs

• Draft AASHTO Standard

• Information clearinghouse

Next Steps – Proposed Work Item

2. Identify issues and deficiencies in current knowledgebase and prepare future Research Needs Statement(s) (RNS)
   - BMD implementation considerations
     - Repeatability / Reproducibility of performance tests
     - Use of test for acceptance/payment
     - Testing time
     - Test simplicity and sensitivity
     - Lab/field correlation
   - Integration of balanced mix design approaches with structural pavement design
   - Consideration items
     - Climate
     - Pavement structure
     - Traffic

The National Academies of Science, Engineering, and Medicine
What is our future?

A performance-based system based on engineered solutions for the pavement industry; to eventually replace the recipe or method based specification system.
Any Questions?
92nd AAPT Annual Meeting and Technical Sessions

The 2017 Annual Meeting will be held March 19-22, 2017
The Island Hotel, Newport Beach, California USA

2017 Call for Papers

The Association of Asphalt Paving Technologists is actively soliciting paper offers for its 2017 Annual Meeting and Technical Sessions. Papers reporting on studies concerning any aspect of asphalt paving technology or related fields are considered. These can include research, design, construction and maintenance issues dealing with all types of asphalt binders, asphalt mixtures, and pavement applications – including innovative ideas and improvements to current practice. Papers will be considered for presentation at the Annual Meeting which is attended by specialists from academia, research organizations, material producers, contractors, national and state authorities, and consultants from around the world. Papers offered for the 2017 Annual Meeting must be submitted through the AAPT website.

Important dates

May 1, 2016 web site open for paper submission
August 15, 2016 - deadline for submitting papers
November 4, 2016 - notification of paper acceptance
December 2016 - registration open
March 19 to 22, 2017 - annual meeting and technical sessions

For current information please check our web site at: http://www.asphalttechnology.org
Concrete Pavement Industry Update

- Where are we?
  - Industry and Market
  - Highway Bill
- What are we doing?
  - Technology
  - FHWA Implementation
  - Advocating for funding
- Where are we going?
Bellefontaine PCCP 125th Anniversary
Where are we?

- Industry transitioning
  - Clawing out of recession…
  - Cement industry changes – dynamic time

- Contractor membership – near all-time high
- Cautious optimism…
Many public road agencies have been deferring major capital improvement projects in favor of:
- Projects w/ shorter timeframes.
- Preservation and resurfacing projects.

2015 concrete paving volumes:
- 51 Million SY nationwide.
- Concrete overlays 16% of SY.

Aviation – holding steady
Source: Calculated from Square Yard paving items. Data from states reported in ACPA’s Publication “Pavement Market Quarterly” and data received from ACPA chapters/state paving associations.

As of: November 2015
What is Framing Where We Are...?

- Recent Federal funding “stability”… FAST Act
  - Agencies still severely constrained – flat funding, state revenues vary??

- Trust Fund is Structurally Deficient!

- MAP-21 performance measures
  - Still unfolding
  - ACPA posture—RSI should be embraced as measure.
Concrete Pavement Industry Update

WHAT ARE WE DOING?
What are we doing? Technical Resources

- Technical Resources
  - Wikipave launched
  - Resource Center – 1,400 pubs
  - New ACPA Specifications

WikiPave.org
What are we doing? Technical Resources

- Technical Resources
  - App Library - growing
  - Explorers – Overlays, RCC, Historical
  - Pavement Design
    - Pavement ME Design
    - StreetPave
    - BCOA -ME

University of Pittsburgh
What are we doing? FHWA Implementation

- AID-PT implementation
- Concrete overlays – resurfacing alternative
- Mixture improvement/PEM – durability and long life
- Sustainability – RCA benchmark, life cycle focus (LCA), etc…
- Research – RCC TCP OL?
What are we doing? Task Forces

- Asset Management
- Design
- Jointing
- Maintenance of Traffic
- RCC
- Smoothness
Concrete Pavement Industry Update

WHERE ARE WE GOING?
Where are we going?

- 1997 Blueprint Effort…
- Looking to create the blueprint for next generation of concrete pavement research and technology
  - Long lasting, reliable, cost effective
  - PEM, Optimization, Sustainability
  - Asset management context
  - Preservation, resurfacing, rehabilitation environment
  - Leveraging competition
- DOTs, FHWA, Academia and Industry
Strength through Partnerships

- Surface smoothness
- Tire/Road Noise
- Pavement Preservation

- DOT support
- National Resource

- State support/policies
- Contractor lead

- Durable, efficient, cost-effective solutions
- Implement effective strategies
- Federal legislation/policy
- Define industry standards
National Cooperative Highway Research Program (NCHRP)
Research for Improved Pavement Design and Construction
AASHTO Joint Technical Committee on Pavements
May 10-11, 2016
Minneapolis, Minnesota
NCHRP- National Cooperative Highway Research Program

• Part of the Transportation Research Board (TRB)

• Part of The National Academies of Sciences, Engineering, and Medicine

• Private, non-profit institution

• Independent, non-partisan, objective
NCHRP- National Cooperative Highway Research Program

• An AASHTO program sponsored by state DOTs
• Started in 1962
• Covers all aspects of highways: 8 fields of research (Administration, Planning, Design, Materials and Construction, Soils and Geology, Maintenance, Traffic, and Special Projects) and 25 Subject areas (pavements, concrete materials; bituminous materials; general materials; specifications, procedures, and practices; etc.)
• Considers problem statements only from AASHTO member departments (individually or through AASHTO committees) and FHWA
• Annual funding ~ $40 million/year
NCHRP: Goal-Oriented Research

• Responds to state DOT needs: DOTs and AASHTO committees propose research topics; SCOR selects projects.
• Ensures applicability of the results: state DOTs and other sectors of the highway industry participate in monitoring the research.
• Results are published by NCHRP (reports, digests, synthesis, CD-ROMs, and Web documents) or by AASHTO (guides/manuals, specifications, and test methods), and often adopted by state DOTs and other organizations.
NCHRP FY 2017 - Summary

- 16 Continuation (special) projects ($12.775 million)
- 37 New projects ($18,000 million):

  Total 53 projects ($30.775 million) in about 20 problem areas (bridges, maintenance, materials, pavements, traffic, security, safety, etc.)
NCHRP Special Projects

- 20-05 Synthesis Program
- 20-06 Legal Studies
- 20-07 AASHTO Highways Committee
- 20-24 Administration of State DOTs (for CEOs)
- 20-30 NCHRP-IDEA
- 20-44 Accelerating the Application of NCHRP Research Results
- 20-65 AASHTO Public Transportation Committee
- 20-68 US Domestic Scan Program
- 25-25 AASHTO Environment Committee
## NCHRP FY 2017 Program

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<td>Continuations</td>
<td>16 ($12,775)</td>
<td>16 ($12,775)</td>
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<tr>
<td>New Projects</td>
<td>101 ($43,600)</td>
<td>37 ($18,000)</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>117 ($56,375)</strong></td>
<td><strong>53 ($30,775)</strong></td>
</tr>
<tr>
<td>FY 2016</td>
<td>122 ($50,968)</td>
<td>60 ($30,340)</td>
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</table>
# NCHRP FY 2017 New Projects

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<th>Submitted</th>
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</thead>
<tbody>
<tr>
<td>Member Dept.</td>
<td>49</td>
<td>12</td>
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<tr>
<td>AASHTO Com.</td>
<td>50</td>
<td>24</td>
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<tr>
<td>FHWA</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>101</td>
<td>37</td>
</tr>
</tbody>
</table>
NCHRP FY 2017 Program

- March 17-18, 2016: FY 2016 projects selected
- April 20, 2016: Program announcement
- April 20, 2016: Solicit panel nominees
- National Academies acceptance
- Panel formation
- July-December 2016: 1st and 2nd panel meetings (develop RFPs and select agencies)
- February 2017?: FY 2017 authorization
- February-March 2017: Contracting
NCHRP FY 2018 Program

- July 1, 2016: Solicitation of FY 2018 problem statements
- Oct. 14, 2016: End date for problem statements
- Nov. 18, 2016: Respond to submitters
- December 2, 2016: End date for submitter comment
- January 2, 2017: Mail candidates to SCOR/RAC
- February 20, 2017: SCOR/RAC ballots due
- March 7, 2017: Ballot summary report to SCOR
- March 2?-2?, 2017: SCOR meeting/project selection
NCHRP Projects - Anticipated

- NCHRP Project 10-98: *Protocols for Network Macro-Texture*
- NCHRP Project 1-58: *Process for Evaluating the Impacts of Implements of Husbandry on Pavements*
- NCHRP Project 9-62: *Quality Assurance and Specifications for In-Place Recycled Pavements Constructed Using Asphalt-Based Recycling Agents*
NCHRP Projects – In Progress

Nearing completion:

• NCHRP Project 1-51: *A Model for Incorporating Slab/Underlying Layer Interaction into the MEPDG Concrete Pavement Analysis Procedures*
• NCHRP Project 1-50: *Quantifying the Influence of Geosynthetics on Pavement Performance*
• NCHRP Project 1-52: *Calibrated, Mechanistic-Based Models for Top-Down Cracking of Hot-Mix Asphalt Layers*
• NCHRP Project 10-93: *Measuring, Characterizing, and Reporting Pavement Roughness of Low-Speed and Urban Roads*
NCHRP Projects – In Progress

• NCHRP Project 1-53: Proposed Enhancements to Pavement ME Design: Improved Consideration of the Influence of Subgrade and Unbound Layers on Pavement Performance

• NCHRP Project 01-57: Standard Definitions for Comparable Pavement Cracking Data

• NCHRP Project 14-33: Pavement Performance Measures that Consider the Contributions of Preservation Treatments
More Information

NCHRP: Advancing transportation and meeting states’ needs for half a century

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• Contact: Amir N. Hanna
  ahanna@nas.edu
  202/334-1432
I. Pavement Materials

1. Completed

Project 1-28: Laboratory Determination of Resilient Modulus for Flexible Pavement Design (available as NCHRP Web Document 14)

Project 1-28A: Harmonized Test Methods for Laboratory Determination of Resilient Modulus for Flexible Pavement Design (summarized in NCHRP Research Results Digest 285)

Project 4-18: Design and Evaluation of Large Stone Mixtures (published as NCHRP Report 386)

Project 4-19: Aggregate Tests Related to Asphalt Concrete Performance in Pavements (published as NCHRP Report 405)

Project 4-19(2): Aggregate Tests for Hot-Mix Asphalt Mixtures Used in Pavements (published as NCHRP Report 557)

Project 4-20: Aggregate Tests Related to Performance of Portland Cement Concrete (Phase I)


Project 4-20B: Aggregate Tests Related to Performance of Portland Cement Concrete Pavements: Plan for Further Evaluation

Project 4-20C: Aggregate Tests Related to Performance of Portland Cement Concrete Pavements (summarized in NCHRP Research Results Digest 281)

Project 4-21: Appropriate Use of Waste and Recycled Materials in the Transportation Industry (an informational database is available on the CD-ROM CRP-CD-5)

Project 4-23: Aggregate Tests Related to Performance of Unbound Pavement Layers (published as NCHRP Report 453)

Project 4-30: Test Methods for Characterizing Aggregate Shape, Texture, and Angularity (Phase I)

Project 4-30A: Test Methods for Characterizing Aggregate Shape, Texture, and Angularity (published as NCHRP Report 555)

Project 4-31: Tests of Recycled Aggregates for Use in Unbound Pavement Layers (published as NCHRP Report 598)

Project 4-34: Application of LADAR in the Shape Analysis of Aggregates Characteristics (published as NCHRP Report 724)

Project 4-35: Improved Test Methods for Specific Gravity and Absorption of Coarse and Fine Aggregate (will be published as NCHRP Report 805)

Project 4-36: Characterization of Cementitiously Stabilized Layers for Use in Pavement Design and Analysis (published as NCHRP report 789)

Project 9-7: Field Procedures and Equipment to Implement SHRP Asphalt Specifications (published as NCHRP Report 409 and available on the CD-ROM CRP-CD-1)

Project 9-9: Refinement of Superpave Gyratory Compaction Procedure (summarized in NCHRP Research Results Digest 237 and available on the CD-ROM CRP-CD-1)

Project 9-9(1): Verification of Gyrations Levels in the Ndesign Table (published as an NCHRP Report 573; literature survey and information on initial tests are available as NCHRP Web Document 34)

Project 9-10: Superpave Protocols for Modified Asphalt Binders (published as NCHRP Report 459)

Project 9-12: Incorporation of Reclaimed Asphalt Pavement in the Superpave System (summarized in NCHRP Research Results Digest 253; Technician’s manual published as NCHRP Report 452; available as NCHRP Web Document 30 and on the CD-ROM CRP-CD-8)


Project 9-14: Investigation of the Restricted Zone in the Superpave Aggregate Gradation Specification (published as NCHRP Report 464)

Project 9-16: Relationship Between Superpave Mix Gyratory Compaction Properties and Pavement Deformation in Service (published as NCHRP Report 478)

Project 9-17: Accelerated Laboratory Rutting Tests: Asphalt Pavement Analyzer (published as NCHRP Report 508)


Project 9-29: Simple Performance Tester for Superpave Mix Design (the work have been published as NCHRP Reports 513, 530, 614, 629, and 702)


Project 9-34: Improved Conditioning Procedures for Predicting the Moisture Susceptibility of HMA Pavements (published as NCHRP Report 589)

Project 9-35: Aggregate Properties and the Performance of Superpave-Designed Hot Mix Asphalt (published as NCHRP Report 539)

Project 9-36: Improved Procedure for Laboratory Aging of Asphalt Binders in Pavements (published as NCHRP Report 709)

Project 9-37: Using Surface Energy Measurements to Select Materials for Asphalt Pavements (summarized in NCHRP Research Results Digest 316)

Project 9-38: Endurance Limit of Hot Mix Asphalt Mixtures to Prevent Fatigue Cracking in Flexible Pavements (published as NCHRP Report 646)

Project 9-43: Mix Design Practices for Warm Mix Asphalt (published as NCHRP Report 691)

Project 9-44: Developing a Plan for Validating Endurance Limit for HMA Pavements (available as NCHRP Web-Only Document 134)

Project 9-44A: Validating an Endurance Limit for HMA Pavements: Laboratory Experiment and Algorithm Development (published as NCHRP Report 762)

Project 9-45: Test Methods and Specification Criteria for Mineral Filler Used in HMA (summarized in NCHRP Research Results Digest 357)


Project 9-47: Engineering Properties, Emissions, and Field Performance of Warm Mix Asphalt Technologies - Phase I (Phase II work was performed under NCHRP Project 9-47A)


Project 9-48: Field versus Laboratory Volumetrics and Mechanical Properties (will be publishes as NCHRP Report 818)

Project 9-49: Performance of WMA Technologies: Stage I--Moisture Susceptibility (published as NCHRP Report 763)

Project 9-52: Short-Term Laboratory Conditioning of Asphalt Mixtures (published as NCHRP Report 815)
Project 9-53: Properties of Foamed Asphalt for Warm Mix Asphalt Applications (published as NCHRP Report 807)
Project 18-4A: Durability of "Early-Opening-To-Traffic" Portland Cement Concrete for Pavement Rehabilitation (Phase I)
Project 18-4B: Guidelines for "Early-Opening-To-Traffic" Portland Cement Concrete for Pavement Rehabilitation (published as NCHRP Report 540)
Project 18-5: Relationship of Portland Cement Characteristics to Concrete Durability (summarized in NCHRP Research Results Digest 270)
Project 18-9A: Guidelines for Reducing Premature Deterioration in Hydraulic Cement Concrete Pavements: Background and Research Plan
Project 18-10: Procedures for Evaluating Air-Entraining Admixtures for Highway Concrete (published as NCHRP Report 578)
Project 18-11: Improved Specifications and Test Protocols for Processing Additions in Cement Manufacturing (published as NCHRP Report 607)

2. In Progress

Project 1-55: Performance-Based Mix Design of Porous Friction Courses
Project 9-49A: Performance of WMA Technologies: Stage II—Long-Term Field Performance
Project 9-50: Performance-Related Specification for Asphalt Binders Used in Preservation Surface Treatments
Project 9-51: Material Properties of Cold In-Place Recycled and Full-Depth Reclamation Asphalt Concrete for Pavement Design
Project 9-54: Long-Term Aging of Asphalt Mixture for Performance Testing and Prediction
Project 9-55: Recycled Asphalt Shingles in Asphalt Mixtures with Warm Mix Asphalt Technologies
Project 9-59: Relating Asphalt Binder Fatigue Properties to Asphalt Mixture Fatigue Performance
Project 18-17: Entrained Air Void System for Durable Highway Concrete

3. Anticipated/Pending

Project 9-60: Addressing Impacts of Changes in Asphalt Binder Formulation and Manufacture on Pavement Performance through Changes in Asphalt Binder Specifications
Project 9-61: Short and Long-term Aging Methods to Accurately Reflect Binder Aging in Different Asphalt Applications

II. Pavement Design, Construction, and Rehabilitation

1. Completed

Project 1-29: Improved Surface Drainage of Pavements (available as NCHRP Web Document 16)
Project 1-31: Smoothness Specifications for Pavements (available as NCHRP Web Document 1)
Project 1-32: Systems for Design of Highway Pavements (summarized in NCHRP Research Results Digest 227 and CD-ROM)
Project 1-34: Performance of Subsurface Pavement Drainage (selected portions of the reports on Project 1-34 and 1-34B summarized in NCHRP Research Results Digest 268)
Project 1-34A: Contributions of Pavement Structural Section Layers to Rutting of Flexible Pavements (published as NCHRP Report 468)
Project 1-34B: Effectiveness of Subsurface Drainage for HMA and PCC Pavements (selected portions of the reports on Project 1-34 and 1-34B summarized in NCHRP Research Results Digest 268)
Project 1-34C: Effects of Subsurface Drainage on Performance of Asphalt and Concrete Pavements (published as NCHRP Report 499)

Project 1-34D: Effects of Subsurface Drainage on Performance of Asphalt and Concrete Pavements: Further Evaluation and Analysis of LTPP SPS-1 and SPS-2 Field Sections (published as NCHRP Report 583)

Project 1-36: Determination of Pavement Damage from Super-Single and Single-Out Dual Tires: Phase I


Project 1-38: Guide on Pavement Rehabilitation Strategies (available as NCHRP Web Document 35)

Project 1-39: Traffic Data Collection, Analysis, and Forecasting for Mechanistic Pavement Design (report on equipment for collecting traffic load data published as NCHRP Report 509; final report published as NCHRP Report 538)

Project 1-40: Facilitating the Implementation of the 2002 Guide for the Design of New and Reconstructed Pavement Structures (conducted as 1-40A through 1-40D; completed work summarized in NCHRP Research Results Digest 307)


Project 1-40D(01): Technical Assistance to NCHRP and NCHRP Project 1-40A: Versions 0.9 and 1.0 of the M-E Pavement Design Software

Project 1-40D(02): Technical Assistance to NCHRP and NCHRP Project 1-40A: Versions 0.9 and 1.0 of the M-E Pavement Design Software (summarized in NCHRP Research Results Digest 308)

Project 1-41: Models for Predicting Reflection Cracking of Hot-Mix Asphalt Overlays (published as NCHRP Report 669)

Project 1-42: Top-Down Fatigue Cracking of Hot-Mix Asphalt Layers – Phase I

Project 1-42A: Models for Predicting Top-Down Cracking of Hot-Mix Asphalt Layers (available as NCHRP Web Document 162)

Project 1-43: Guide for Pavement Friction (summarized in NCHRP Research Results Digest 321; published by AASHTO as Guide for Pavement Friction, Publication Code: GPVF-1)

Project 1-44: Measuring Tire-Pavement Noise at the Source (published as NCHRP Report 630)


Project 1-47: Sensitivity Evaluation of MEPDG Performance Prediction (summarized in NCHRP Research Results Digest 372)

Project 1-48: Consideration of Preservation in Pavement Design and Analysis Procedures (published as NCHRP Report 810)

Project 9-19: Superpave Support and Performance Model Management (published as NCHRP Reports 465, 547, and 580; and available on CRP CD-10 and CRP-CD-46)

Project 9-20: Performance-Related Specifications for Hot-Mix Asphalt Construction (published as NCHRP Report 455)

Project 9-23: Environmental Effects in Pavement Mix and Structural Design Systems (published as NCHRP Report 602 and summarized in NCHRP Research Results Digest 324)

Project 9-26: Precision Statement for AASHTO Laboratory Test Methods (completed work is available as NCHRP Web Documents 54, 66, and 71)

Project 9-27: Relationships of HMA In-Place Air Voids, Lift Thickness, and Permeability (published as NCHRP Report 531)

Project 9-30: Experimental Plan for Calibration and Validation of Hot-Mix Asphalt Performance Models for Mix and Structural Design (summarized in Research Results Digests 283 and 284)
Project 9-30A: Calibration of Rutting Models for HMA Structural and Mix Design (published as NCHRP Report 719)
Project 9-40: Optimization of Tack Coat for HMA Placement (published as NCHRP Report 712)
Project 9-41: Performance and Maintenance of Permeable Friction Courses (published as NCHRP Report 640)
Project 10-41: Evaluation of Unbonded Portland Cement Concrete Overlays (published as NCHRP Report 415)
Project 10-47: Standards for Longitudinal Pavement Profile Measurement (published as NCHRP Report 434 and summarized in NCHRP Research Results Digest 244)
Project 10-50A: A Process for Selecting Strategies for Rehabilitation of Rigid Pavements (available as NCHRP Web Document 45 and summarized in an NCHRP Research Results 272)
Project 10-66: Predicting In-Service Performance of Flexible Pavements from Accelerated Pavement Testing – Phase I
Project 10-67: Texturing of Concrete Pavements (published as NCHRP Report 634)
Project 10-69: Guidelines for Dowel Alignment in Concrete Pavements (published as NCHRP Report 637)
Project 14-14: Guide for Optimal Timing of Pavement Preventive Maintenance Treatment Applications (published as NCHRP Report 523)
Project 20-07, Task 288: National Calibration of MEPDG Rigid Pavement Models Based on Corrected CTE Values
Project 20-7, Task 327: Developing Recalibrated Concrete Pavement Performance Models for the Mechanistic Empirical Pavement Design Guide (provided to AASHTO)
Project 20-36: Long-Life Concrete Pavements: A Scanning Tour of Canada, Germany, Austria, Belgium, The Netherlands, and the United Kingdom (available from FHWA)

2. In Progress

Project 1-50: Quantifying the Influence of Geosynthetics on Pavement Performance
Project 1-51: A Model for Incorporating Slab/Underlying Layer Interaction into the MEPDG Concrete Pavement Analysis Procedures
Project 1-52: A Mechanistic-Empirical Model for Top-Down Cracking of Asphalt Pavement Layers
Project 1-53: Proposed Enhancements to Pavement ME Design: Improved Consideration of the Influence of Subgrade and Unbound Layers on Pavement Performance
Project 1-54: Guidelines for Limiting Damage to Flexible and Composite Pavements Due to the Presence of Water

3. Anticipated/Pending

Project 1-58: Process for Evaluating the Impacts of Implements of Husbandry on Pavements
Project 9-62: Quality Assurance and Specifications for In-Place Recycled Pavements Constructed Using Asphalt-Based Recycling Agents

III. Pavement Management and Evaluation

1. Completed

Project 1-33: Methodology to Improve Pavement-Investment Decisions (summarized in NCHRP Research Results Digest 246)
Project 1-35A: Guide for Pavement Management (published by AASHTO)


Project 9-11: Segregation in Hot-Mix Asphalt Pavements (published as NCHRP Report 441)


Project 9-22: Beta Testing and Validation of HMA PRS (published as NCHRP Report 704)

Project 10-44: Nondestructive Testing to Determine Insitu Material Properties of Pavement Layers (Phase I)

Project 10-44A: Determination of Insitu Material Properties of Asphalt Concrete Pavement Layers (summarized in NCHRP Research Results Digest 271)

Project 10-48: Assessing Pavement Damage Using Deflection Data (summarized in NCHRP Research Results Digest 254)

Project 10-75: Guide for Pavement-Type Selection (published as NCHRP Report 703)

Project 10-76: Evaluating Pavement Strategies and Barriers for Noise Mitigation (published as NCHRP Report 738)

Project 10-79: Guidelines for Pavement-Related Pay Adjustment Factors (summarized in NCHRP Research Results Digest 371)

Project 10-82: Performance-Related Specifications for Pavement Preservation Treatments (Phase I)

Project 10-93: Measuring, Characterizing, and Reporting Pavement Roughness of Low-Speed and Urban Roads

Project 14-33: Pavement Performance Measures that Consider the Contributions of Preservation Treatments

2. Anticipated/Pending

Project 10-98: Protocols for Network-Level Macrotexture Measurement

IV. LTPP-Specific Projects

Project 20-50(2): LTPP Data Analysis: Relative Performance of Jointed Plain Concrete Pavements with Sealed and Unsealed Joints (available as NCHRP Web Document 32)

Project 20-50 (3&4): LTPP Data Analysis: Effectiveness of Maintenance and Rehabilitation Options (available as NCHRP Web Document 47)


Project 20-50 (7 & 12); LTPP Data Analysis: Daily and Seasonal Variations in Insitu Material Properties (available as NCHRP Web document 60)

Project 20-50 (8 & 13): LTPP Data Analysis: Factors Affecting Pavement Smoothness (available as NCHRP Web Document 40; also summarized in NCHRP Research Results Digest 264)

Project 20-50 (9): Feasibility of Using FWD Deflection Data to Characterize Pavement Construction Quality (available as NCHRP Web Document 52)
Project 20-50(14): LTPP Data Analysis: Significance of "As-Constructed" AC Air Voids to Pavement Performance (summarized in NCHRP Research Results Digest 269)

IV. Synthesis of Information Related to Highway Problems

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Project 10-76: Evaluating Pavement Strategies and Barriers for Noise Mitigation (published as NCHRP Report 738)
Project 10-79: Guidelines for Pavement-Related Pay Adjustment Factors (summarized in NCHRP Research Results Digest 371)
Project 10-82: Performance-Related Specifications for Pavement Preservation Treatments (Phase I)
Project 10-82A: Performance-Related Specifications for Pavement Preservation Treatments
Project 14-31: Development of a Pavement Maintenance Database System (will be published as NCHRP Report 820)

2. In Progress

Project 1-57: Defining Comparable Pavement Cracking Data
Project 10-82A: Performance-Related Specifications for Pavement Preservation Treatments
Project 10-93: Measuring, Characterizing, and Reporting Pavement Roughness of Low-Speed and Urban Roads
Project 14-33: Pavement Performance Measures that Consider the Contributions of Preservation Treatments

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Topic 38-06: Pre-Overlay Treatment of existing Pavements (NCHRP Synthesis 388)
Topic 38-09: Estimating Stiffness of Subgrade and Unbound Materials for Pavement Design (NCHRP Synthesis 382)
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Topic 40-13: Recycling and Reclamation of Asphalt Pavements Using In-Place Methods (NCHRP Synthesis 421)
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Topic 43-03: Practices for Unbound Aggregate Pavement Layers (NCHRP Synthesis 445)
Topic 44-07: Thin Asphalt Concrete Overlays ((NCHRP Synthesis 464)
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Topic 47-08: Pavement Management Systems: Putting Data to Work (in progress)
AASHTOWare

Pavement

For state-of-the-art pavement design

AASHTOware Pavement ME Design is the next generation of pavement design software, which builds upon the National Cooperative Highway Research Program mechanistic-empirical pavement design guide.

State-of-the-art procedures incorporated in the software reflect eight years of research and development involving both AASHTO members and the National Cooperative Highway Research Program (NCHRP). The research and development process and resulting software beautifully illustrate the power and effectiveness of the cooperative development practice behind all AASHTOWare products. Continuous improvement of pavement process continues under NCHRP, the Federal Highway Administration and state agencies.

Pavement ME Design represents a quantum leap forward from previous processes. Engineers can now precisely predict pavement performance because the software incorporates material mechanics, climate data, axle-load spectra and other advances.

For technical support, contact the Pavement ME Design Help Desk toll free at 1-877-500-3465 or email pavementmedesign@ara.com
AASHTOWare Pavement ME Design

***Version 2.2 now available for download! Get the newest release notes here.***

AASHTOWare Pavement ME Design is the next generation of AASHTOWare® pavement design software, which builds upon the mechanistic-empirical pavement design guide, and expands and improves the features in the accompanying prototype computational software. ME Design supports AASHTO’s Mechanistic-Empirical Pavement Design Guide, Interim Edition: A Manual of Practice. ME Design is a production-ready software tool to support the day-to-day pavement design functions of public and private pavement engineers.

For additional information contact:
Vicki Schofield, Project Manager, AASHTO
444 N. Capitol St., NW, Suite 249
Washington DC 20001
Fax: (202) 265-5459
E-mail: vschofield@aashto.org

To contact the ME Design Help Desk:
The ME Design Support Team
Phone 1-877-590-3496
Monday through Friday
8:00am – 5:00pm CST
E-mail: pavementmedesign@ara.com
AASHTOWare Pavement ME Design provides the user features to save/search/load data from a database. To get started, users must install a database first. Two empty database files are available for the user to download and install, one is for SQL and another is for Oracle.

- MSSQL database
- Oracle database

More information is available through the following links:

- Instructions for DBA
- Instructions for using the database
A simple web application designed to make it easy to create ME Design project files (DGPX) seeded with geospatially referenced information relevant to the analysis and design of your pavement.
Mantis Bug Reporting System

You have to create a Mantis account from the link below. When your account is created you will be sent a verification e-mail from "Mantis" which will allow you to set your password for your new account. Once your account is verified, you will be added to the ME Design project and you will be able to submit bug reports using the Mantis web site.

To submit a bug report, log into your account on the Mantis Web Site and select the "Report issue" option from the main menu. You will be sent status updates by e-mail for your issue. If you wish to change this, you can select the "My Account" option from the main menu. The Account Preferences allow you to choose which e-mail notifications you receive.

> Mantis Bug Reporting System
AASHTOWare Pavement ME Design Licensee Map – United States

County/City
FHWA
Maricopa County
AZ

licensing - 42
not licensing - 12

Puerto Rico
AASHTOWare Pavement ME Design Licensee Map – Canada
## Additional License Types

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Cost Educational</td>
<td>57</td>
<td>69</td>
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<tr>
<td>Private Sector</td>
<td>69</td>
<td>73</td>
</tr>
<tr>
<td>Universities</td>
<td>26</td>
<td>24</td>
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<tr>
<td>Local Agencies</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>30-Day Evaluation</td>
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<td>5</td>
</tr>
<tr>
<td>International</td>
<td>17</td>
<td>15</td>
</tr>
</tbody>
</table>

2015 - Spain, Brazil, Bolivia, Sweden, India, Guatemala, Saudi Arabia, Indonesia, UK, China, Hong Kong, Qatar, United Arab Emirates, Canada, Portugal, Venezuela, Norway

2016 –Brazil, Chile, China, Hong Kong, Columbia(2), Guatemala, India, Latvia, Norway, Portugal, Sweden, UK (2), United Arab Emirates.
ENHANCEMENTS FOR FY2016

1. APIs for ICM and JULEA
2. MAP-ME
   reviewed almost 200,000 lines of code
   cleaned up code
   refactored
   alpha tested changes
4. Mapped of English and SI Units in the Existing Code
5. Vertical Slice for Web Based Application
6. Prioritization of Analysis Executables for APIs
7. Long Term Training on ME Design Principles
8. Thin Bonded Concrete Overlay Model
   Development of Traffic Module
   Development of Existing HMA Layer Damage Modulus Module
   Development of NN Structural Model Module
   Development of New Fatigue Damage Models
9. Reflection Cracking Implementation
Planned Enhancements FOR FY2017

1. Integrate the Manual of Practice (MOP) into the Pavement ME Design Software
2. Prepare Materials for Webinar to Explain Revisions and Updates to Software
3. Develop Recalibration Plan for Flexible and Semi-Rigid Pavements: Both New and Rehabilitated Pavements
4. Develop APIs for Selected Executables
5. Prepare Deflection Analysis Protocols and Backcalculation Tools for Use with the Pavement ME Software
6. Full Integration of Specialized Truck Traffic Loadings into Traffic Mix
7. Report Reviews on Published and On-Going Research Relevant to Pavement ME Design
8. Update Legacy Software GUI Terminology - Address the inconsistency with terminology in the MEPDG Manual of Practice, the software, and Help screens.
Fees will increase by 10%:

- Single user: $5,500
- Site License – up to 9 concurrent users: $22,000
- Site License – up to 14 concurrent users: $33,000
- Site License – up to 20 concurrent users: $44,000

Service Units (about 65 hours): $13,200

- ARA manages international licenses
AASHTOWare Pavement ME Design Product Task Force

Judy Corley-Lay, Chair - North Carolina DOT
Bill Barstis - Mississippi DOT
John Donahue - Missouri DOT
Jay Goldbaum - Colorado DOT
Marta Juhasz - Alberta Transportation
Mehdi Parvini - California DOT

Liaisons:
Tom Yu, FHWA
Felix Doucet, Ministère des Transports du Québec - TAC
Jack Dartman, Montana DOT - TAA
Shane Marshall, Utah DOT - SCOJD
Other Activities

• The Pavement ME Design Task Force and ARA have been discussing, researching, developing and outlining an approach to move from a desktop client to a web-based software product. This effort has progressed in a step by step approach.

• At the Task Force’s request, ARA completed a thorough line-by-line code review, technical audit and SI mapping of the current code.

• The Task Force has approved a proposal for a research project under the AASHTOWare Program Development Pool to develop a minimally viable product that incorporates web technology into single analysis type, new JPCP, from the desktop application of Pavement ME Design.

• Currently establishing a Technical Review Team comprised of experts from the AASHTO member agencies. The minimally viable product will be developed via the Agile methodology.
For Additional Information:

Vicki Schofield
AASHTO Project Manager
vschofield@aashto.org
(202) 624-3640
SHRP2 Renewal Project R06D
Advanced Methods to Identify Asphalt Pavement Delamination

Michael Heitzman
National Center for Asphalt Technology

May 2016
SHRP2 Focus Areas

**Safety**: fostering safer driving through analysis of driver, roadway, and vehicle factors in crashes, near crashes, and ordinary driving

**Reliability**: reducing congestion and creating more predictable travel times through better operations

**Capacity**: planning and designing a highway system that offers minimum disruption and meets the environmental and economic needs of the community

**Renewal**: rapid maintenance and repair of the deteriorating infrastructure using already-available resources, innovations, and technologies
SHRP2 at a Glance

- **SHRP2 Solutions** – 63 products
- **Solution Development** – processes, software, testing procedures, and specifications
- **Field Testing** – refined in the field
- **Implementation** – 350 transportation projects; adopt as standard practice
- **SHRP2 Education Connection** – connecting next-generation professionals with next-generation innovations

350 SHRP2 projects nationwide
SHRP2 Implementation: Moving Us Forward

$122 million
FUNDING ASSISTANCE

63
SHRP2 SOLUTIONS

350
PROJECTS IMPLEMENTED

DOT: 52 Recipients
MPO/LOCAL: 29 Recipients
UNIVERSITY: 10 Recipients
FEDERAL/TRIBAL: 7 Recipients

RENEWAL: 179
CAPACITY: 95
RELIABILITY: 65
SAFETY: 11
SHRP2 Implementation: Moving Us Forward

- **145,831** Participants Engaged
- **5,713** Outreach Activities
- **6,155** Hours of Technical Assistance

- Training: 5,474 hours
- Workshops: 152 hours
- Peer Exchanges: 40 hours
- Demos: 29 hours
- Showcases: 18 hours
## SHRP2 Implementation Assistance Program

<table>
<thead>
<tr>
<th>Proof of Concept Pilot</th>
<th>Lead Adopter Incentive</th>
<th>User Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>To evaluate product readiness.</td>
<td>To help offset costs associated with product implementation and risk mitigation.</td>
<td>To support implementation activities, such as conducting internal assessments, changing processes, and organizing peer exchanges.</td>
</tr>
</tbody>
</table>

### PROOF OF CONCEPT REQUIREMENTS:

- Participate in a Technology Showcase/Demo
- Prepare work plan activities
- Work with FHWA/AASHTO/SME
- Availability of equipment (owned or lease)
- Execute work plan and provide updates
- Participate in peer exchanges
Advanced Methods to Identify Pavement Delamination (R06D)

CHALLENGE:
• Several pavement distresses can be attributed to delamination.
• Primarily caused by debonding & stripping.
• Identifying the extent and severity of delamination is difficult.
• Coring is a destructive method providing limited value as part of a pavement evaluation.
• NDT methods are needed for comprehensive, rapid evaluation and detection.

RESEARCH GOAL:
Identify and develop NDT technology that can:
• Detect & quantify delamination in HMA
• Operate at reasonable traveling speed
• Cover full-lane width
## R06D Test Sections at NCAT Test Track

<table>
<thead>
<tr>
<th>Top 2-inch lift</th>
<th>Full bond</th>
<th>Full bond</th>
<th>Full bond</th>
<th>Partial No bond</th>
<th>No bond</th>
<th>partial stripping</th>
<th>Full bond</th>
<th>Full bond</th>
<th>Full bond</th>
<th>Full bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom 3-inch lift</td>
<td>no bond</td>
<td>Full bond</td>
<td>Full bond</td>
<td>Full bond</td>
<td>Full bond</td>
<td>Full bond</td>
<td>partial Stripping</td>
<td>Full bond</td>
<td>partial No bond</td>
<td>No bond</td>
</tr>
<tr>
<td>Existing surface</td>
<td>PCC</td>
<td>PCC</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
</tr>
</tbody>
</table>
Solutions

• Ground-penetrating radar (GPR) antenna array with frequency sweep

• 3-D Radar

• Impact echo (IE) and seismic analysis of surface waves (SASW) rolling wheel scanning system

• Olson Engineering
GPR - Ground Penetrating Radar
GPR - Ground Penetrating Radar
GPR at NCAT Test Track
GPR Depth Slice

Water infiltration

Stripped areas
Project Length Analysis – Single Pass
IE/SASW – Mechanical Surface Waves
IE/SASW – Mechanical Surface Waves
IE / SASW at NCAT Test Track

<table>
<thead>
<tr>
<th>Section 1</th>
<th>Section 2</th>
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</thead>
<tbody>
<tr>
<td>No bond</td>
<td>Full bond</td>
</tr>
<tr>
<td>5-inch depth</td>
<td>control</td>
</tr>
</tbody>
</table>

IE report

SASW report
Real-time IE Output During Test

Delamination at 5 inches
Sound 12-inch pavement
### SASW Project Report Concept

<table>
<thead>
<tr>
<th>LANE SECTION</th>
<th>DEPTH = &lt; 0.25 ft</th>
<th>DEPTH = 0.25 to 0.50 ft</th>
<th>DEPTH = 0.50 to 0.75 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MP) (direction)</td>
<td>VELOCITY &gt;4500 fps</td>
<td>4000 to 4500</td>
<td>&lt; 4000</td>
</tr>
<tr>
<td>35.1 EB</td>
<td>90</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>35.2 EB</td>
<td>92</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>35.3 EB</td>
<td>90</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>35.4 EB</td>
<td>92</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>35.5 EB</td>
<td>91</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>35.6 EB</td>
<td>90</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>
Benefits

- GPR with frequency sweep antenna array
  - Can identify variations in the pavement, isolate the depth of discontinuity, and provide a relative degree of severity.
  - Operates at reasonable speed and full-lane width in a single pass.
  - Multi-functional NDT (pavement, bridge decks, embankment,…)

- IE/SASW scanner
  - Can identify variations in the pavement; width depends on system configuration and the depth of discontinuity.
  - Multi-functional NDT tool (pavement and bridge deck delamination)
  - Excellent forensic tool for project level analysis
The Future

Product demand will drive software development to make data analysis more efficient and effective.

- Real-time display detail
- Automated signal identification in distressed areas
Coming Soon: R06D Technology Showcase
A product showcase will be held later this year to demonstrate R06D tools.

- Held at National Center for Asphalt Technology (NCAT) Test Track at Auburn University in Auburn, AL
- To be announced August – September
- All agencies that submit an application to participate in Round 7 of the Implementation Assistance Program on R06D will be encouraged to participate in the showcase.
Showcase at NCAT Pavement Test Track
Auburn, AL 2016

Surface cracking in Section 4

Section 1 begins here
For More Information on R06D

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