

Summary Report
Midwest Region Peer Exchange
Minneapolis, MN
July 18–19, 2019

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Contents

- Summary 1
- Introduction 3
 - Session Format..... 3
- Peer Exchange Notes 5
 - Mission, Strategies & Barriers..... 5
 - FHWA Presentation & Open Discussion on Regulation & Policy 8
 - What can FHWA do for you? 12
- Current Practice Exercise 14
 - Pavement Design Procedures 14
 - Structural Pavement Design Use 14
 - Pavement Design Methodologies 15
 - Traffic Inputs 15
 - Pavement Foundations 15
 - Shoulder Structure 15
 - Rehabilitation..... 15
 - Safety 16
 - Environmental Considerations..... 16
 - Economic Analysis..... 16
 - Addresses Economic Analysis 16
 - Basis for Determining Need for Economic Analysis 16
 - Methodology for Cost-Effective Design 16
 - Alternate Bidding 16
 - LCCA Considerations 17
 - Tools and Documentation..... 17
 - Policy Review & Updates 17
 - Updates to Pavement Policy Manual..... 17
 - Review/Approval of Revisions by FHWA Division Office 17
- Attendee List..... 18

Summary

This report provides a summary of the Midwest Region Peer Exchange on Pavement Design Policy sponsored by the Federal Highway Administration (FHWA). The peer exchange took place in Minneapolis, MN, on July 18–19, 2019. It focused on FHWA pavement design policy as defined by [Title 23 CFR Part 626 Pavement Policy](#) (the “Policy”), Non-Regulatory Supplement NS 23 CFR Part 626 Pavement Design Considerations, and Technical Advisory T5040.39A Use of Alternate Bidding for Pavement Type Selection. Attendees included representatives from State departments of transportation (DOTs) and FHWA Division Offices in Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.

The FHWA presented several items for discussion regarding the current state of the Policy, using focus questions and prompts during moderated exchanges that enabled participants to offer comments and recommendations. Participants discussed current practices for designing new and rehabilitated pavements and for performing economic analysis. They were also provided an opportunity to express organizational needs in terms of research areas, training, guidance, etc. for future consideration by FHWA.

The State DOT participants generally agreed with FHWA’s current mission and goals in terms of the Policy, in that pavements should be designed in a safe, effective, economical, and durable manner. They suggested the following considerations: innovation, efficiency, reliability, education and research, environment, preservation, structural capacity, cost-effectiveness, industry competition, mobility, and quality of life.

During discussion on flexibility in policy, participants said the policy is “too ambiguous.” They suggested changing wording to incorporate more engineering language instead of language for the lawyers. Participants said the non-regulatory supplement would be helpful with minor changes and modernization of some content. Some would like to see the supplement converted to a list format. Participants expressed a desire for it to stay flexible for use as a technical guide for current and future work. This supplement could also be helpful as a guide for incoming administrative leadership, as most presently come in without pavement engineering experience.

The policy should highlight consistency in safety and saving lives. FHWA could test methods used for measuring friction and provide States with a clear understanding of what that friction needs to be to help reduce fatalities. Also, FHWA should promote competition in anything produced for the States. Competition improves the opportunity for innovation and brings a fair and level playing field for all.

The group discussed cost-effectiveness, and the consensus was to remove “life-cycle cost” from the definition, and write a statement about cost within the policy. An agency could use life-cycle cost in some manner but not necessarily use LCCA, ensuring every State has a different cost-effective acceptance process, as long as each State has a defensible process that proves an analysis for that project was conducted.

Support requested from FHWA included more opportunities for training on new and existing pavement design software and better tracking of special “workarounds” while in the AASHTOWare® Pavement ME Design software. More research would be helpful on the subgrade part of the pavement design arena. Additional research and background on hot in-place recycling is needed.

States discussed several barriers to effective pavement design, including funding, which is one of the major issues they deal with daily. The competition for dollars on future projects and sometimes having to share those funds with competing bridge work in this region was discussed. The public perception of funding within the DOTs is that they have enough funds, but in reality, they do not have enough to sustain their systems. In addition, increased reliance on consultants is expensive and some lack the knowledge and expertise needed to be effective. Work zones were identified as a barrier because DOTs are trying to create the safest work zones possible, but they cannot build what they want to due to work zone policies. It was noted that limited lane closures and restrictions on traffic flow impact the quality and life cycle of some projects.

The current and upcoming wave of retiree turnover was also an identified barrier, due to the training and experience needed to continue efficient pavement design. Lack of succession plans, no continuity, and employees moving to other companies as soon as they are trained was discussed as well. One State has developed a “Book of Knowledge” as a means for successfully training new personnel and lessening the loss of workforce knowledge caused by staff turnover and retirements. Innovation can sometimes be a barrier due to high initial cost of introducing new innovations on projects and the lack of new data for pavement design. Communication can be a barrier for States with many districts due to distance and political agendas.

During a discussion on strategies, participants noted safety as a primary concern and suggested friction management and testing was an area where FHWA and its Division Offices could be more proactive. Work zone safety for the public, contractors, and DOT personnel was also a top concern. Effective communication was discussed as key to developing the type of understanding that keeps DOT staff, upper management, and industry on the same page in terms of pavement requirements. Public involvement on larger projects was a discussed strategy to inform the public and provide for their input when choosing a maintenance-of-traffic approach. Strategies for gaining efficiency included alternate bidding to stimulate competition and lower cost as well as using performance based planning processes with pavement designs.

Introduction

[Title 23 CFR Part 626](#) establishes, “Pavements shall be designed to accommodate current and predicted traffic needs in a safe, durable, and cost-effective manner.” Regulations do not specify procedures to follow to meet the requirement. Instead, each State Highway Agency is expected to use a design procedure appropriate for its conditions.

The FHWA hosted a formal listening session in December 2018 to hear industry concerns regarding its pavement design policy and technical guidance. During the listening session, interpretations differed on how cost-effectiveness is considered in pavement design. One interpretation was that an agency must consider performing an LCCA on every pavement design project; another interpretation was that cost-effective does not necessarily mean LCCA as long as cost-effectiveness, or even LCCA, is one consideration in the decision-making process. Other issues mentioned were expected service life of a design, maintenance and rehabilitation, resiliency and sustainability, and relationships with other regulations, such as the asset management rule.

The information from the listening session was used to inform five regional peer exchanges during 2019, in which State DOT and FHWA Division Office representatives were provided the opportunity to discuss and document good practices and barriers to designing cost-effective pavements. FHWA plans to use feedback from the listening session and peer exchanges when it considers the need for future agency action in the pavement design area and to help identify policy changes, program needs, and other initiatives. At the end of the five regional peer exchanges, an executive summary will be developed and used to determine next steps. The FHWA will consider information from the peer exchanges if FHWA decides to pursue actions such as revised regulations, revised/additional technical guidance, proposed research initiatives, website updates, enhanced communication, and implementation activities. The emphasis of the peer exchanges is to identify solutions to the stated challenges that will support agencies in meeting their mission while designing, constructing, and maintaining National Highway System pavements in a cost-effective manner.

Session Format

Peer exchange participants received electronic copies of the following documents in advance of the peer exchange: the Code of Federal Regulations, Title 23, Part 626; the Federal-aid Policy Guide Non-Regulatory Supplement NS 23 CFR Part 626 Pavement Design Considerations, dated April 8, 1999; and Technical Advisory T5040.39A, Use of Alternate Bidding for Pavement Type Selection, dated December 20, 2012. These documents had also been shared with and discussed by industry and FHWA at the industry listening session.

As preparation for the peer exchange, the following five discussion topics were provided in advance to peer exchange participants along with the agenda:

1. What is working with the FHWA pavement design policy and technical guidance? What do you like?
2. What is not working with the FHWA pavement design policy? Where are you having major issues and what challenges do you have?
3. What is needed to address some of the challenges and concerns?

4. Is there anything that, in your organization’s opinion, is missing from the pavement design policy or technical guidance that is needed or needs updating?
5. Is there anything else you would like us to know, or be aware of, or add related to pavement design issues?

Each peer exchange was 1½-days long. The peer exchange format was designed to encourage participants to think outside the box when it comes to pavement design policy and to encourage interaction, dialog, and information exchange with FHWA and each other. The format was based on a “Why-How-What” structure. To start, the “Why” focused on the big picture: Why are we all here? This included the agencies’ high-level missions or goals for their transportation networks, specifically pertaining to pavements. The “How” focused on strategies needed to meet these missions and goals, as well as the barriers participants encounter to doing what is ideal, from a pavement design perspective. The “Why” and “How” helped prime participants for the central purpose of the peer exchange—the “What,” which included discussions on policy, guidelines, research needs, and other tools to achieve their agencies missions and goals.

During the morning session of the first day, following the initial welcome and introductions, the FHWA moderator presented meeting objectives and expectations from participants. The moderator mentioned that “parking lot” pads of paper were placed around the room for participants to note any ideas that needed to be discussed during the peer exchange, such as research needs, technical guidance, education or other issues. Participants were then divided into four groups for the first of three breakout sessions. To enhance dialog and offer a balanced viewpoint, moderators ensured that DOT and FHWA Division Office representatives from the same State were in the same breakout group.

During the first breakout, the groups were tasked with discussing the prompted focus question: “What is the State Department of Transportation’s mission?” An FHWA moderator was present in each group to facilitate the discussion. At the end of the breakout, one member from each group reported out the discussions that occurred within their group to the other peer exchange participants. During the second breakout, each group was tasked with discussing the prompted focus question: “What strategies are needed to meet the goals identified from the first breakout and overcome current barriers to accomplish these strategies?” Again, each of the four breakout groups was facilitated by an FHWA moderator, and one member from each group reported out the discussions that occurred within their group to the other peer exchange participants.

In the afternoon session of the first day, State DOT and FHWA Division Office representatives discussed key points made during the listening session held in December 2018. FHWA explained different tools (statute, guidelines, and future research) and summarized listening session observations. The rest of the afternoon was a moderated open discussion regarding the Policy, including whether the current Policy meets the goals and reflects the strategies discussed previously. Each participant was provided the opportunity to comment on the Policy and on what changes, if any, he or she would recommend be made to any of the Policy documents.

The morning session on Day 2, the final day of the peer exchange, was dedicated to discussing current practices at State DOTs. This took place within the same moderated breakout groups from Day 1, and the current practice information was documented by the FHWA moderators. Finally, each DOT peer exchange participant was provided the opportunity to express his or her agency’s needs in terms of research, guidance, training, etc. and to identify how FHWA could support those needs in the future.

Peer Exchange Notes

Mission, Strategies & Barriers

FHWA Division Office and State DOT representatives noted and discussed their State's mission in terms of pavements and the associated strategies and barriers.

Most States' mission statements aligned with FHWA's policy goals: pavements should be designed in a safe, effective, economical, and durable manner. The following considerations were also suggested: innovation, efficiency, friction management, mobility, reliability, education and research, environment, structural capacity, preservation/pavement life, cost-effectiveness, and quality of life. They noted that industry competition is beneficial overall toward meeting these goals.

Strategies

The following strategies were identified by one or more DOT peer exchange participants:

- Focus on proper design with maintenance.
 - There is a need to foster internal agency understanding as far as the minimum thicknesses they can and should use in order to alleviate the pressure to go thinner than what is needed.
 - Date goals for pavement type selection in pavement design: pavement type selection happens at a specific time prior to the fiscal year, so if a project changes from the assumed type of material on the plan documents, those changes can be addressed.
 - In some States, design is done by the central office for internal and consultant projects. All information on plans and materials is reviewed and approved by the central office.
 - One State's central office performs designs for major projects and has an online Pavement ME Design program for district staff and consultants to use as needed.
- Increase cost-effectiveness.
 - If cost is higher on pavement thickness than what the budget calls, a project may be redesigned such as by reducing project limits or removing elements from the job to get to the appropriate budget.
 - Steps to being more fiscally responsible include using the improved STIP process, resisting the scope change that happens through project development, ensuring the budget is set appropriately at the beginning of the project.
 - One State's Pavement Investment Guide has tools that help define surface treatment fixes when needed, based on the allocation of dollars given to a district. It promotes asset management.
 - Alternate bidding is done to stimulate competition because it increases the number of bidders, which increases competition and lowers cost.
- Focus on safety.
 - Proactive friction management: monitoring crashes (looking for high crash locations, wet weather crashes), looking for new ways to do friction testing.
 - Work zone safety for contractors and DOT staff: developing safety talks and/or lessons learned.
 - Tracking work zone crashes, including feedback from staff in the field on behavior-based safety issues.
 - Project design that shortens construction time; use of value engineering, either pre- or post-award.

- On larger projects, public involvement is incorporated into choosing a maintenance-of-traffic approach. The public has an opportunity to provide input on road closures.
- FHWA can play a supportive role.
 - FHWA guidance on separation of dollars (for example, for Americans with Disabilities Act [ADA] requirements, utilities, etc.) toward a program: If pavement design dollars were separated out, would that help in the overall delivery of pavements?
- Take a proactive approach to education and outreach.
 - A Book of Knowledge can provide a format for gathering staff experience before retirement. Videos, pictures, and descriptions of on-the-job experiences can be used as guidance by others in the future.
 - Consider public involvement in road closure decisions.
 - Use demonstration projects for sharing of ideas and information.

Barriers

- Industry and political pressure.
 - Some States are losing population, and the gas tax has not increased since the early 1990s. Improvements in automotive fuel economy have decreased gas tax revenues. These challenges require more creativity in collecting taxes in the future. One State bases taxes/fees on GPS and odometer readings but may also need to start using tolling, which might not be a favorable solution.
 - DOTs used to be led by a chief engineer in most all States, but now it is usually a commissioner or a governor's appointee. It stopped being a technical person in charge, and that can be both good and bad. However, an appointee or commissioner may not have the same understanding of basic highway department business such as timeline, pavement design, return on investment, and technical issues related to pavement.
- Budget and workforce constraints.
 - Competition for dollars on future projects.
 - Current funding that limits the ability to accomplish some work (even with recent tax increases), and public perspective that the DOTs have adequate funds or the problem was solved when in fact they do not have enough to sustain the system.
 - Stretching funding for project delivery over the number of miles the DOT is responsible for is a huge challenge.
 - Competing needs for funding with bridge work.
 - Innovations often meet roadblocks by those who do not want to implement them due to high initial costs.
 - Losing talent to higher paying consultants. How do we recruit and retain the employees we have?
 - Ownership and expertise issues are happening as State DOTs have fewer employees and onboard more consultants, which translates to lost funds.
 - Consultants are expensive; some have a lack of knowledge and expertise, and they may also lack investment in the mission. They are often there to do the job and leave.
 - Consultants are also having an issue with high turnover, so their workforce knowledge is hard to maintain as well.

- Used to use consultants only during peak seasons, now use consultants on a full-time basis.
- DOTs have no redundancy; should we be cross training more.
- More needs to be done to minimize the loss of workforce knowledge and experience due to turnover and upcoming retirements. There is more on-the-job-training (OJT) going on in the field, but no sound approach to staff training. With OJT, one is also relying on the person doing the training having adequate knowledge to share.
- It takes only a relatively low percentage of untrained staff to disrupt the program at the level of money called for on some projects.
- Lack of succession planning: Once someone is trained, he/she often leaves for another position or job, and there is no continuity with personnel or data. Data needs to be turned into information that can inform decisions.
- Having a limited workforce while using more consultants drives the State DOT employee knowledge base down. If consultants are doing all the work, DOT employees cannot learn from past work or past mistakes because they were not there doing the work.
- Historical data.
 - Innovating is challenging because a lot of pavement management is based on historical data, and historical data is used for performance curves.
 - We have a lot of data but do we know what is good data versus bad data. Are we measuring what is meaningful and important rather than what is just easy to measure?
 - Not all pavement management databases have historical mix design information.
 - Historical data is not always good to include in LCCA because it is what happened and not the right fix at the right time for optimal performance.
 - Cost of Information Technology (IT) for database management is a barrier to using it.
- Inadequate communication.
 - Communication can be a barrier in States with many districts.
 - Political issues within a State can impede communication.
 - Consistency across the districts is a challenge at times.
 - Need to do a better job communicating the value of needed training or materials so upper management will be motivated to make these investments in their people.
 - Need to communicate the value of engineering. Pavement design does not get the attention it deserves.
 - Need to communicate to upper management in terms they understand, i.e. economics and dollars saved.
- Pavement design procedures.
 - Pavement design is getting more complicated and is not traditionally taught in civil engineering classes.
 - Making work zones safest for everyone can be restricted by work zone policies.
 - Work zone issues: Cannot do rigid repairs on rigid pavements in highly urbanized areas because concrete mixes do not set up in time to fix a joint.

- Limits on lane closures and/or limits restricting traffic during work hours impact the quality and life cycle of some projects.
- ADA requirements on all modes of travel, along with limited right-of-way when sharing with bikes and rail, could restrict what can be done in the future.
- Standards for guardrails and cable when doing overlays and going to the AASHTO Manual for Assessing Safety Hardware (MASH) standards: These deal with some consistency issues across the State on how projects are designed.
- Project delivery constraints: the time between when projects are initially investigated and when they are bid and awarded for construction could be several years.
- Construction quality pertaining to life cycles and design goals: Better quality levels are needed in regards to perpetual pavements.
- How does one determine that two designs are equivalent? This is especially important for alternate design alternate bid.
- There is only so much one can do with pavement design to ensure pavement performance. Performance is also dependent on other factors such as construction quality.
- We do not have an understanding of how to account for construction variability in design.

FHWA Presentation & Open Discussion on Regulation & Policy

The following is a summary of participant comments and discussions related to the need for the Policy, and to what States are doing now and the barriers faced.

- General interpretation and overview.
 - Why did talks about changing the Policy come up? Did it have to do with industry?
 - Noted by a show of hands in the group: only half had seen or knew about the Policy before this peer exchange.
 - Most States have a pavement design policy of some sort and do not necessarily use FHWA's.
 - Clarification is needed on the definition of design needs: whether it pertains more to new construction or reconstruction and not necessarily rehabilitation or design. Does it include sub-base and base when one is designing a rehabilitation project?
 - Eliminate the pavement design definition because it does not add anything and only opens a legal Pandora's Box.
 - Not every project considers all factors; it depends on resources available and project size.
 - One State has economized its designs over time; staff uses what needs to be used. Constructability and everything that goes into all of the designs have been refined over time. It is also a good idea for FHWA to have a pavement design policy with a good definition that requires what needs to be done, instead of having industry make up their own and telling DOTs what to do.

- Reword the part about alternative materials to be more general, instead of actually mentioning sub-base, base, and subgrade.
- Add appropriate bridge conditions after the life-cycle cost. Let industry know that this is a general policy statement.
- If FHWA adds more rules to the Policy, it will add more burden to future work along with slowing down innovation.
- The Policy is good but needs to be refined and set as policy around the details that happen at the DOT level. Different States work as needed around their State environments. The engineering happens with people at the DOT level, so let FHWA provide the guidance but allow the engineers to make things happen within those parameters as they do the work.
- Sub-base and base are not well defined. States use different levels of base and sub-base materials and still define that as alternative pavement. Not properly clarifying or having a uniform definition of sub-base and base is very confusing.
- Alternative combinations give the State or the designer the discretion to include a sub-base, base, or surface, or any combination. Also, consider adding “more factors that may be considered” in the definition.
- It is important to have the Policy statement because otherwise, what are they managing? The asset management plan is too high level and a lot of detail would be lost by the time it got to the project level of pavement design.
- If this is going to be law, the less that is put in the policy, the better for the States. Keep it vague enough to let the engineers evaluate the work being done.
- The wording of this policy should include more engineering terms instead of words for the lawyers. The wording is not scientific, not quantifiable. Making it scientific, at least on the engineering side, might produce better results.
- Although it is vague enough to create innovation, it provides opportunity for debate and discussion by industry.
- Ensure the Policy is clear that it covers pavement structure and not just the surface, also add language that life-cycle cost may not always be appropriate to use.
- The CFR is workable but needs to be updated and modernized; keep it vague enough for flexibility but defensible enough for the lawyers.
- The Policy needs to be reviewed and revisited on a regular basis. Peer exchanges are a great way to review policy.
- It is good to have Federal guidance that is flexible, it should not be too prescriptive, and it should allow for the use of design experience gained over the years.
- The Policy aids in leadership buy-in from new administrations.
- Use language that is not open to interpretation as to when and where it should be applied. If it is meant for just pavement design/structure, make sure that is clear.
- Equivalent does not always mean equal. There is always going to be a difference between the two industries. Do not get so prescriptive with either the regulation or the guidance that we point to one area of industry alone.
- Not all states have a policy, so it is good to have a Federal Policy.

- Make the Policy performance based. How does performance-based engineering mix design of concrete and asphalt materials relate to Policy?
- Relate the Policy to Transportation Asset Management Program (TAMP)
- Cost analysis, cost-effectiveness, and competition.
 - Clarification is needed within the LCCA and cost-effectiveness requirements.
 - Is industry considering cost from the whole life cycle of the activity or strictly the initial part of the life cycle?
 - Remove the whole thing as it is covered in the asset management requirements already.
 - In one State, the law requires life-cycle cost on most every project already, so adding or deleting to this policy will not change the way they perform life-cycle cost analyses.
 - “I do think we need to involve industry, because if one industry is unhappy, they are going to write their own law that we might have to follow.” Clarifying the cost-effective manner and life-cycle cost analysis parts of the Policy may help protect the DOTs.
 - How do we get a reasonable user cost?
- Agency impacts.
 - This could be a good tool for the States to use with local agencies or metropolitan planning organizations because if it is federally mandated it must be followed. This provides consistency across those different jurisdictions.
- Miscellaneous specific items within the Policy.
 - Project materials are often decided based on availability. There is no point in looking at alternatives if they are not readily available at the time.
 - One State’s law requires the DOT to compare asphalt to concrete, but that is not what the Policy says right now. It just says compare surface materials—that could mean comparing hot mix versus warm mix.
 - Innovation should be added to the CFR. If FHWA is looking 20 years into the future for this regulation, the agency needs to think about autonomous vehicles, truck platooning, and other upcoming innovations. It is good to leave the door open for future needs with the definition, because in today’s environment, if we do not define things in the CFR, they will be defined for us.

Below is a summary of participant comments and discussion related to the Non-Regulatory Supplement NS 23 CFR Part 626 Pavement Design Considerations. Is there a need for this supplement? Are the States using this, or should it go away?

- General interpretation and overview.
 - Need something that explains the role of FHWA Divisions with Policy and enforcement procedures.
 - We need to first determine the purpose of this document: Is it guidance for FHWA to use in inspecting the States on their designs, or is it for the States to use?
 - Leave Policy more broad. Still include definition or terms, but instead of sub-base, base, and surface, use support layer, structural layer, or functional layer. Then, in the supplement, use somewhat generic terms that have details and intentions behind the

- policy. This would provide uniform support for the long term and ensure performance connecting everything between the technical guidance and the performance measures.
- It is outdated and not needed now.
 - This supplement should not be that long or detailed. Basically it could say what pavement design procedures should take into account, such as traffic, soil, etc. It could easily be two paragraphs, rather than five pages. Make it a list instead of paragraphs.
 - Instead of rewriting the supplement, reference documents that include the information already, such as AASHTO 93 or the Mechanistic-Empirical Pavement Design Guide (MEPDG), and use those as guidance for the Policy.
 - It is mostly a resource for FHWA staff, State personnel do not use it or even know the supplement exists.
 - It is extremely valuable as it can be used as a guide so States can know what FHWA is looking for during their inspections of current work.
 - For incoming personnel, this supplement is a good 3- or 4-page read before they get ready for their “immersion therapy” in the field.
 - Because it is outdated, nobody follows it. Use a list, or eliminate the document altogether.
 - As long as it maintains the considerations and includes nothing that is binding, it should be okay. Make it flexible and allow it to provide some consistency.
- Software program usage, Pavement ME Design, AASHTO 93 or older.
 - Specifications in it should prevent the use of the non-standard software that is currently being used for design.
 - Miscellaneous items and future considerations.
 - There was a discussion on whether or not to have minimum friction requirement. It was mentioned that some time ago many Governors from several states signed a letter against implementing minimum friction requirements.
 - Does FHWA maintain historical documents? It would be helpful to see the change over time and worthwhile to understand how technology has improved and why some of the changes have been made in the past. This would help when trying to articulate what changes in the industry are being addressed with the updates.
 - On the topic of safety, multimodal accessibility and moving goods and people can include bicycles, electric scooters, and other modes of travel today. This brings financial challenges to the roadways. Protecting the safety of other traffic modes should be in the safety portion of this supplement.
 - Some States have environment in their mission statements and are sometimes mandated to use recycled materials in their work, as long as they do not lose sight of how that affects performance. They should be good stewards of spending taxpayer dollars while maintaining performance in a long-term sense.
 - We should have this supplement or some sort of technical guidance that people can go to for information if they do not know the process to do the job. As technical guidance it should be very flexible, but also create consistency with future work.

- Regarding turnover of supervisors and staff, the supplement could serve as a guide to pavement design for them. It might not give them a full view of pavement design, but it can provide a general idea of their division's expectations.
- This would be a great tool for incoming leadership, as it could be a guideline for them when coming into office and wanting to change things without prior experience in pavement engineering.
- It would be a good platform for sharing best practices.
- LCCA and alternate bidding.
 - It would be more defensible if life-cycle cost were in the supplement showing that it is not required for rehabilitation treatments or situations.

What can FHWA do for you?

The following list summarizes discussions related to FHWA's role in helping agency pavement designers, particularly as it relates to research, education, or guidance needs in the pavement design arena.

- Research and guidance.
 - More research and background on the state of practice in hot in-place recycling would be useful.
 - More awareness is needed on better practices for bringing in user cost/impacts is needed, because they are impacting them every time they are on the roadway. It should be considered in the decision on the pavement type.
 - Other considerations/possible research items include motorist safety and the safety of construction workers, and the quality of their products.
 - Help with grooving is needed. How many States require grooving after diamond grinding, the reestablishment of paving or texture? Next generation equipment, use of different aggregates with this equipment, will change the results of the grooving.
 - Concern with continuous improvement: There is a difference between research done in a lab or research center and work done onsite. In-field validation of research results is a huge challenge. A lot of research comes out as "this is the answer" for a specific component, but in the broader context of the pavement system, there are unintended consequences.
 - Premature failure on asphalt pavement involving functional cracking: Pavement that is 1 or 2 years old but has block cracking appropriate for a pavement that is aged at least 10 years. Binder content and spectrometer testing: One district paves an extra 6 inches to each side. This mostly came down to being a binder issue.
 - FHWA should research the subgrade part of pavement design, because the subgrade is the foundation and should be constructed correctly. States use sophisticated software for this and put some values into their designs, but how do they ensure they get that value out in the field? Are there any acceptance tests or criteria for this?
 - More research is needed on the construction quality of pavement, including the subgrade materials. Subgrade does not receive the amount of emphasis it should.
- Training and education.

- More opportunities are needed for training on existing and new software being used for pavements.
- One State has an online program that is beneficial for its staff. They use Pavement ME Design, and the physical-based model is very accurate with local calibrations. They are comfortable that they are putting out a great product with this software. They use LCCA, and the value they see is that it forces industry competition and brings out the best products.
- Training can be an issue with Pavement ME Design. The training is good overall, except when it comes to the special “types of workarounds” for certain projects. It is hard to keep track of these workarounds. They need to be outlined better in future edits of this procedure.
- Provide help with information sharing such as through Peer Exchanges.
- Offer more in-person (not web-based) National Highway Institute (NHI) courses.
- Policy, supportive role, and miscellaneous needs.
 - Which States pay bonuses for smoothness, and what is their International Roughness Index (IRI) threshold? Several States pay bonuses with 25 to 45 inch/mile IRI thresholds.
 - Regarding economic analysis, new regulations or policies may stifle innovation because better ideas may be turned down because of constraints by a policy or regulation. Remember that innovation is just picking up speed and technology is driving it.
 - More information was requested in regard to oversized loads: how States handle a single oversize load and how they assess the damage to their pavement, and how they define a cost to that or a fee. (Load equivalency factors (LEFs) versus equivalent single axle load (ESAL): What would a class nine be in comparison?).
 - Provide flexibility in contract mechanisms to allow for more competition.

Participants were asked to share their best practices. Their responses are listed below.

- One State alternate bids everything out, which is a unique practice within the States; any new pavement construction or reconstruction is done through alternate bidding. Any continuous pavement over 7,500 square yards or non-continuous over 14,000 square yards has a life-cycle adjustment factor added to the low bid. Two asphalt strategies and one concrete strategy are used. The State uses the Office of Management and Budget (OMB) discount rate. To date, it has done between 250 and 300 projects over the past 15 years, with the dollar amount for the pavement projects near 2.5 billion. This process was initiated by the concrete industry for competition purposes.
- One State has used LCCA since the 1960s, and it is still of value there. The State received a grant for a project that could shift the way it specifies sub-grade properties. Through partnering with a geotechnical company to use automated plate load testing and validated integrated compaction methods, they are working to validate and develop sub-grade values for MEPDG.

- One State is working on a study of asphalt modifications. It is developing a lab test that can sense the type of modifiers being used and the impact on the asphalt binder properties and performance.
- In one State, it is required by law to do LCCA. The staff's work is reviewed by concrete industry experts, which allows for guidance when a new governor or commissioner comes in and wants to change the process.
- One State has an online research section that can be accessed if needed.
- One State maintains a relationship with industry groups by including them in meetings and decision-making. The industry partners are not always happy, but everyone has been at the table together trying to work out decisions, and that has been positive.
- For divided new construction and reconstruction, one State universally does subgrade stabilization everywhere, all the time. They do a lot of geotechnical work. They have seen 15 to 20 years of life out of the stabilization.

Participants were asked what is the purpose of performing LCCA. Their responses are listed below.

- One State is working on the preliminary stages of having contractor-specific bid adjustment factors in its policy. Its staff feels there are a lot of bad contractors out there, and they are getting serious about contractor prequalification and performance. If they are doing bid adjustment factors for asphalt versus concrete, why can't they do it for contractor versus contractor? The data says that they can; now they have to present it to the industry and senior appointed elected officials.
- One State is under a new asset management system to put funds toward keeping pavements in better shape. The planning staff is contributing to discussions on life cycles and following what pavement staff is doing so both can be on the same page. This is the third year of this effort, and they are starting to see the impact in the pavement design because of the style of projects they were able to select.
- There is value in the use of LCCA and the competition it brings. One State has two strong industries, so LCCA works for them. Their discount rate is at 5 percent, which is fairly high compared to what other States are using.
- One State recommended sharing LCCA data across States.

Current Practice Exercise

The current practice exercise took place within the same moderated breakout groups from Day 1. FHWA moderators noted current agency practices in terms of pavement design procedures, economic analysis, and policy reviews and updates.

Pavement Design Procedures

Structural Pavement Design Use

In general, States in this region conduct structural design for new, reconstruction, and rehabilitation projects, with some limitations for rehabilitations and structural overlays. The University of Kentucky does forensics, including falling weight deflectometer (FWD), ground-penetrating radar (GPR), and coring to calibrate for the State's rehabilitation and overlays. Some States use hot-mix asphalt (HMA) or Portland

cement concrete, while another uses pulverizing and cold in-place recycling for rehabilitation and overlay programs. One State has no program for HMA, but everything with a 20-year design life or longer requires structural design. One State reported that during mill and fill, resurfacing 10s (under 2 inches) and 20s (2 – 2.5 inches) does not require structural design, but that any time structure is added a structural pavement design is required. Some States only look to verify that no structural issues are present or are situationally dependent when it comes to preservations.

Pavement Design Methodologies

Three of the nine States represented at the peer exchange are using Pavement ME Design for new construction, while two others are using AASHTO 93/Darwin for pavement design. For asphalt and concrete, five of the nine States have performed local calibrations. One State uses Portland Cement Association (PCA) for concrete and Darwin for asphalt work. Two States are working with their local universities to develop and maintain procedures for their designs. One State uses a distilled version of Pavement ME Design called MnPAVE Flex and MnPAVE Rigid.

Traffic Inputs

Most States include traffic volume and classification data in their policy, with some specific variance to practice. Load spectra distribution and annual average daily traffic (AADT) are used for traffic volume while load spectra, percent trucks, and ESALs are used for classifications. Five out of nine States use truck weight data for traffic inputs. For truck weight data, one State uses weigh station data to develop ESAL equations. The majority of the States use weigh-in-motion (WIM) data to project average daily traffic counts. Among the tools used are WIM data used in calibration, ESALs, and automated counters and classifiers developed locally.

Pavement Foundations

Most States have a policy that addresses pavement foundation. Considerations of subgrade, sub-base materials, and drainage systems vary from State to State. For subgrade considerations, some States use soil boring and classification to obtain soil strength, while other States add select materials, geogrid, or some combination of the two. Agencies also vary on thickness for bases and sub-bases. While some specify minimum thicknesses, others did not. However, most States have typical designs or thicknesses for bases and sub-bases. Six out of nine States use a positive drainage system in their design policy that uses longitudinal edge drains. Representatives of the other States said it is a challenge to maintain or not required.

Shoulder Structure

Most States address shoulder structure in their policy, and a majority of those with the same structural capacity as mainline. One State bids alternate—not dependent on mainline type—while others depend on the roadways or situation. Carrying percentage of mainline traffic as well as same materials as mainline pavement was not consistent in this region. Shoulder rumble strips are used by most all States in this region.

Rehabilitation

In general, States address rehabilitation in their pavement design policy. States obtain condition data from historical data, video from an automatic road analyzer (ARAN) van, IRI, and equipment designed in some districts. For coring, boring, and trenching, most States check for HMA stripping, GPR, and verify with cores. Most all States do FWD testing. Engineering and economic analysis of candidate strategies in a

couple of the States are done at the planning level, not the engineering level. Another State's van data is used to give options for rehabilitation, and its central office provides guidance for structural value of layers. Also, economic analysis is performed only if doing an LCCA and comparing concrete to HMA, and sometimes HMA to HMA. One State does not do much FWD testing on concrete, and they are required to do LCCA by law. For one State, overlay usually wins the LCCA, and the overlay decisions usually dictate funds and not the technical decisions.

Safety

States in this region address safety issues, but not in their pavement design policies. Most address requirements for skid resistance regardless of funding source. Some have good friction aggregate based on average daily traffic (ADT) or use aggregates from the approved list and aggregate wear index (AWI). Guidance to minimize disruption and ensure adequate protection of motorists and workers within the work zone may be in work plans or work zone manuals, but not in pavement design policy. Others require use of personal protective equipment (PPE) and restrictions on lane closures.

Environmental Considerations

Most States have some environmental considerations in their policy. Most use recycled materials, diamond grinding slurry, reclaimed asphalt pavement (RAP) and reclaimed asphalt shingles (RAS) in HMA mixtures. WMA is used almost exclusively in one State in this region. A couple of States will not pay additional funds for environmental considerations because funding drives the decisions.

Economic Analysis

Addresses Economic Analysis

All States in this region address economic analysis in their pavement projects. In one State, if a new/major rehabilitation jobs exceeds four lane-miles, then pavement type selection with the LCCA considers flexible versus rigid; all others have an optimized strategy from the pavement management system (PMS).

Basis for Determining Need for Economic Analysis

States typically determine when to use economic analysis based on the size and type of project. Interstate, National Highway System (NHS), or higher ADT types of projects require economic analysis. New construction or reconstruction projects and size of continuous pavement are considerations as well. In one State, LCCAs are done on new construction over 7,500 square yards and on major pavement projects. Another state is required to conduct an LCCA if the cost of pavement in the project is greater than or equal to \$500,000.

Methodology for Cost-Effective Design

Most States use LCCA and historical experiences as methodologies to ensure cost-effective designs. Two States use probabilistic or deterministic models. One State uses WisPAVE 4, which was designed for their State.

Alternate Bidding

In this region, seven out of nine States do alternate bidding. One State does it because it fosters competition between industries. Some States allow for alternate bidding on projects with 10 percent or less difference in cost, while another does them on design-build or alternative pavement contracts. One State does not do alternate bidding except on shoulders.

LCCA Considerations

States include agency cost along with initial and rehabilitation cost in their LCCAs. Maintenance cost is not considered in four of the nine States in this region. Work zone user cost is only considered by two States. The discount rates in this region are determined by OMB, moving average of 20-year Treasury bond or department economist, and are in the range of 3 to 5 percent. Most of the States do not use material price adjustments for concrete or asphalt, inflation rates, or remaining service life in their LCCAs. Those few States that do use material price adjustments determine that by fuel adjustments for both asphalt and concrete, cost estimates are done by the central office and those funds given to the pavement design office for LCCA, or by the department economist.

Tools and Documentation

Most States use Microsoft Excel to help conduct the LCCAs, but one State uses its own standalone application developed in the early 2000s. The LCCA policy is kept in the pavement design manuals for most of the States in this region, and it is reviewed by management and industry.

Policy Review & Updates

Updates to Pavement Policy Manual

States in this region update their policy/manuals when needed, and there is no real timeframe for this.

Review/Approval of Revisions by FHWA Division Office

Most States have their policy reviewed and approved by FHWA Division Offices.

Attendee List

Illinois DOT –

LaDonna Rowden, Bureau Chief, Research

Charles Wienrank, Pavement Design Engineer

Illinois FHWA Division Office – Dennis Bachman, Asset Management/Pavement & Materials Engineer

Indiana DOT –

Kumar Dave, Manager, Pavement Engineering

David Holtz, Pavement Engineering Director

Indiana FHWA Division Office – Thomas Duncan, Pavement & Materials Engineer

Iowa DOT –

Ben Behnami, Transportation Engineer Specialist

Chris Brakke, Pavement Design/Pavement Management Engineer

Iowa FHWA Division Office – Lisa McDaniel, Transportation Engineer

Kentucky Transportation Cabinet – Alan Frazier, Transportation Engineer Specialist

Kentucky FHWA Division Office – Darrin Grenfell, Pavement & Materials Engineer

Michigan DOT –

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Jami Trudelle, Pavement Design Engineer

Michigan FHWA Division Office – Adnan Iftikhar, Pavement & Materials Engineer

Minnesota DOT –

Steven Henrichs, Assistant Pavement Design Engineer

Bruce Tanquist, Pavement Computer Applications Engineer

Curt Turgeon, State Pavement Engineer

Minnesota FHWA Division Office – Kevin Kliethermes, Pavements & Materials Engineer

Missouri DOT – John Donahue, Construction & Materials Liaison Engineer

Missouri FHWA Division Office – Mike McGee, State/National Pavement & Materials Engineer

Ohio DOT – Craig Landefeld, Administrator, Office of Pavement Engineering

Ohio FHWA Division Office – Andy Blalock, Pavement & Materials Engineer

Wisconsin DOT – Peter Kemp, Pavement Unit Supervisor

Moderators:

Gina Ahlstrom, Team Leader – FHWA

Jennifer Albert, Pavement Materials Engineer – FHWA

Heather Dylla, Sustainable Pavement Engineer – FHWA

Shree Rao, Principal Engineer – Applied Research Associates

Tom Yu, Program Manager, Pavement Design – FHWA

Note-Takers:

Jose Chavarria, Instructional Systems Designer – Applied Research Associates

Brandi Tagirs, Administrative Support – Applied Research Associates