

# Final Summary

## Industry Listening Session

Washington, DC

December 14, 2018 – 8:30 AM to 12 NOON



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## Attendees

### Discussion Participants (provided input)

**Advanced Concrete Pavement Consultancy LLC (ACPC)**

Shiraz Tayabji, President, ACPC

**American Concrete Pavement Association (ACPA)**

Jim Mack, Chairman of the Board, ACPA

Leif Wathne, Executive Vice President, ACPA

**American Council of Engineering Companies (ACEC)**

Matt Reiffer, Director of Transportation Programs, ACEC

**Interlocking Concrete Pavement Institute (ICPI)**

David Smith, Technical Director, ICPI

**National Asphalt Pavement Association (NAPA)**

Audrey Copeland, Chief Operating Officer, NAPA

Richard Willis, Senior Director of Pavement Engineering & Innovation, NAPA

**National Ready Mixed Concrete Association (NRMCA)**

Brian Killingsworth, Executive Vice President for Local Paving, NRMCA

**National Stone, Sand, and Gravel Association (NSSGA)**

Travis Chewning, Vice President of Engineering & Operational Support, Luck Stone Corp.

Emily Coyner, Senior Director, Environmental Policy & Regulatory Affairs, NSSGA

### Other Attendees (did not provide input)

**American Association of State Highway and Transportation Officials**

Vicki Schofield, AASHTOWare Project Manager

**Federal Aviation Administration**

Benjamin Mahaffay, Airport Pavement R&D Section

**Federal Highway Administration**

Brian Fouch, Heather Dylla, Janet Myers, Tom Yu, Jeff Withee, Gina Ahlstrom, LaToya Johnson, Chris Wagner, Tom Everett, Derrell Turner, and Nadarajah (Siva) Sivanesarwan.

**Applied Research Associates, Inc.**

Moderator: Bill Vavrik

Note Takers: Bruce Grabbe, Brandi Tagirs

This listening session summary was prepared by the note takers Brandi Tagirs and Bruce Grabbe, and technical editor Letha Cozart. It was reviewed by moderator Bill Vavrik and project manager Shree Rao. This summary of the meeting does not necessarily represent FHWA views. Participant comments are a detailed summary rather than a direct word-for-word transcription. Some elements (such as repetitions, etc.) were removed while keeping with the spirit of the comment.

## Executive Summary

This document provides a summary of the listening session with industry held December 14, 2018, at Federal Highway Administration (FHWA) headquarters in Washington, DC. The session focused on FHWA Pavement Design Policy as defined by Title 23 CFR part 626; Pavement Design Considerations Non-Regulatory Supplement NS 23 CFR part 626; and Technical Advisory T5040.39A, *Use of Alternate Bidding for Pavement Type Selection*. The listening session was attended by 10 discussion participants representing 7 industry associations and consultants who provided input to the FHWA. One additional individual provided input to the FHWA via email communications. Also in attendance at the session were individuals who did not provide any input, but participated only in a listening, moderating, or note-taking role. These included several Federal agency personnel, Federal agency consultants that included the moderator and two note-takers, and one representative from American Association of State Highway and Transportation Officials (AASHTO).

A first draft of this summary document was prepared by the consultant and sent to the FHWA and all the discussion participants for comments and feedback. Comments received from discussion participants and the FHWA are incorporated in this final summary document.

FHWA posed five topics of interest for discussion regarding the current state of the Pavement Design Policy (“the Policy”), and a number of common themes emerged from both the listening session and the written comments submitted by participants following the event, including flexibility and communication. Several participants indicated that the Policy, non-regulatory supplement (NRS), and technical advisory (TA) are well written and offer State Departments of Transportation (State DOTs) flexibility and guidance. Safety, durability, and cost effectiveness were noted as important considerations in pavement design.

Some of the challenges and concerns with the Policy that were discussed include achieving consistency between the CFR, the TA, and the NRS; ensuring references are updated with the latest information; improving the guidance on selecting rehabilitation strategies; and achieving greater uniformity in communication and interpretation by the State DOTs and the FHWA Division Offices.

Specific suggestions for updates to the Policy were offered. Among the additions proposed were expanding the Policy definition to include pavement service life and end of life, and including environmental consideration as part of the definition. More than one participant suggested flexibility for State DOTs could be further increased by changing current language that prevents preservation actions from being employed if they add structural capacity. Participants communicated a desire to include life cycle assessment (LCA) in drafting policy for pavement design type decisions, but differed somewhat in regard to whether the current timing is right for such an inclusion.

Regarding communication, participants generally agreed that the FHWA does a good job of shepherding collaboration between State DOTs on research, innovation, and technology implementation. In terms of the Policy, they suggested it would be beneficial to build in regular review periods so that new knowledge and innovations can be incorporated.

A general discussion and wrap-up included mentions of the need to consider future transportation innovations that will affect pavement policy over the next 20 years, as well as what matters now to the traveling public, from safety and work zones to pavement smoothness.

The FHWA plans to use the information from the December 2018 Industry Listening Session when it considers whether future agency action is needed in the pavement design area, and to inform five planned regional peer exchanges during 2019, designed to identify both good practices and potential barriers related to designing cost-effective pavements.

## Considerations for Pavement Design Guidance: Summary by Topic

### Flexibility

There was general concurrence that the Policy gives State DOTs flexibility to develop design procedures that are appropriate for their conditions while still providing an outline of the process and key factors to address. Some participants also liked that the NRS ties design to economic analysis, and specifically to life-cycle cost analysis (LCCA).

### Collaboration

Participants noted that boosting State DOT-to-DOT interactions through peer exchanges, etc., is important along with putting research into practice.

### Innovation

Participants noted, without any dissent, that the Policy can help boost innovation and create collaborative environments through incentives for competition, that FHWA field trials are helpful in moving products from research to practice, and that there should be encouragement of research on pavement design and mixtures.

Further guidance in the contracting process, where the low-bid environment does not always encourage innovation, could be helpful.

### Life Cycle Cost Analysis (LCCA)

Some participants liked that the Policy relates pavement design to both engineering and economic considerations and allows for consideration of safety, durability, and cost effectiveness together with the design. In particular, the ability to include cost effectiveness through LCCA was noted as important. One participant suggested including calculation of user costs due to pavement vehicle interaction in the NRS, while another suggested including costs due to user delays during maintenance, rehabilitation, and reconstruction.

Some participants indicated, and no one dissented that more guidance could be added to the LCCA guidelines to include the latest information and best practices.

There was not agreement as to whether the Policy or regulation is consistent in encouraging consideration of a broad range of materials.

### Alternate Bidding and LCCA Bid Adjustment

There was not agreement as to whether the current language on commodity price adjustment clauses/LCCA bid adjustments and material quantities was appropriate, with participants citing different research/studies as the basis for their positions.

### Sustainability

There was not consensus regarding increased emphasis on recycled materials and reuse of materials, with some pointing out that recyclability does not automatically equal sustainability and, just as with LCCA, the numbers should be run to determine the best alternative.

Some participants indicated that the Policy/regulation definition should be kept high level. There was no agreement regarding whether some sort of environmental consideration should be included. Sustainability and resiliency should be taken into account but left open/kept general. While some stated that this was necessary and a good idea, others stated that the science was not ready and there were too many missing pieces. There was disagreement on whether FHWA should help State DOTs get there versus putting it in a regulation or rule.

#### Life Cycle Assessment (LCA)

Participants were very supportive of LCA, but were not in agreement as to whether it is ready to be included in the Policy and TA at this time. LCA could be considered as an addition to the NRS.

#### Expected Service Life

Some participants noted and no one dissented that the Policy should include indication of the designated design period, in terms of what service life is expected and it should be tied to performance expectation either in the definition or the NRS, and that the addition of service life to the Policy should also consider end of life. If measured in years, should allow for changes in level of traffic.

However, some disagreed over whether it should be a mandate or whether there should be incentives.

#### Asset Management, Preservation, Structural Capacity

Some participants indicated that the inclusion of asset management principles is a positive, but also that there are existing issues with the way the process is currently implemented (e.g., encourages a “worst first” type of strategy, overly focuses on preservation, and makes certain preservation choices not available for use because they also add structural capacity).

#### Rehabilitation

Some participants agreed there should be recognition that design consideration should reflect just the rehabilitation of the upper layer to be able to use the existing foundation when appropriate.

There was broad agreement that foundation is a very important consideration during design and that State DOTs could use more guidance in the NRS on pavement structure, tied to the different ways to account for end of life.

One participant suggested defining “major rehabilitation” in terms of “at least one major rehabilitation cycle.”

#### Pavement Design Methods

Participants noted, without anyone dissenting, that local calibration of the pavement needs to be done. One participant suggested that guidance needs to say “Use whatever is best out there” to encourage a holistic, life cycle thinking approach.

#### AASHTOWare Pavement ME Design

It was broadly agreed that significant updating in this area of the NRS is needed. Update to the new name and include guidance to encourage local calibration for equivalent designs.

There was an overall concurrence without any dissents that this is the most scientifically robust design software available but that other methodologies can and should be used. Modeling issues and calibration efforts may make some State DOTs reluctant to accept all or part of Pavement ME, so an interim solution is needed. An area where FHWA can provide more guidance is in design equivalence.

### Road User Consistency

Some agreement that design objectives and rehabilitation expectations should be consistent from State DOT to State DOT, because the Interstate Highway System crosses all States and users expect uniform performance.

General concurrence, without any objections, that surface texture/smoothness is important to users and should be considered, but improving performance needs to be looked at holistically as part of asset management and against other needs, such as increasing capacity and other factors that matter to the driving public.

### Safety

General agreement that pavement design considerations on safety use a good approach. Suggestion was that it may need higher priority, based on current FHWA priorities.

### Automated Vehicles

Overall, participants indicated that designing pavements for automated vehicles currently does not need to be in the Policy. Participants did note that there is a need to prepare for the impacts of automated vehicles on pavement design along with other future changes such as roadway uses which are expanding from just being a surface to carry traffic loads to include other functions such as —storm water capture, energy storage, charging electric vehicles, or a communications backbone.

### Policy Review Process

There was broad agreement that in general there should be more frequent reviews of the Policy to better keep up with industry changes and allow new knowledge and innovations to be incorporated. It was suggested AASHTO be involved in reviews.

### Interpretation / Communication

There were different interpretations by participants as to whether the intent of the Policy is as a regulation or mandate versus guidance. There was broad agreement without any dissent that it is important to clarify and communicate what is a regulation or mandate and what is guidance, and ensure regulations/mandates are consistently interpreted and guidance clarified and utilized by the FHWA Division Offices and the State DOTs.



## Introduction

[Title 23 CFR part 626](#) establishes the following pavement design policy for Federal-aid highway projects: “Pavements shall be designed to accommodate current and predicted traffic needs in a safe, durable, and cost-effective manner.” The regulations do not specify procedures to be followed to meet this requirement. Instead, each State DOT is expected to use a design procedure that is appropriate for its conditions.

FHWA hosted a formal listening session in December 2018 to hear industry views regarding the Policy and technical guidance. The listening session was attended by 10 discussion participants representing 7 industry associations and consultants who provided input to the FHWA. One additional individual provided input to the FHWA via email communications. Other attendees included Federal agency personnel, Federal agency consultants, and AASHTO personnel.

The information from the listening session will be used to inform five planned regional peer exchanges during 2019, in which State DOT representatives will discuss and document both good practices and barriers related to designing cost-effective pavements. The FHWA plans to use the information from this listening session when it considers whether future agency action is needed in the pavement design area.

## Focus Areas

The focus of the listening session discussions was primarily on 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.

The following five topics of interest were provided to industry participants by FHWA:

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?

## Session Format

The listening session was divided into three rounds. In the first round, speakers provided prepared statements addressing the five topics of interest. In the second round, speakers had the opportunity to clarify positions or add to their previous statements after hearing what was said in round one. The third round allowed for interactivity, as a more general discussion took place among participants with moderated questions based on the topics from rounds one and two that had garnered the most interest or concerns.

The FHWA, Federal Aviation Administration (FAA), and American Association of State Highway and Transportation Officials (AASHTO) representatives in attendance participated by listening only and did

not provide comments or ask questions. Note takers were present to collect participant feedback and discussion points.

### Opening Remarks

Brian Fouch, Director of FHWA's Office of Preconstruction, Construction and Pavements, provided the opening remarks for the session. He introduced FHWA's newly published fiscal year 2019-2022 Strategic Plan, which focuses on four areas: safety, infrastructure, innovation, and accountability. He noted that safety had never been a core objective in FHWA's Strategic Plan before—it had always been a subset of other objectives—but under the new administration, safety is a core objective and a number one priority. He encouraged the session attendees to, during the day's discussions, continue focusing on ways that FHWA can improve safety on the Nation's highways, as well as on ways to increase infrastructure efficiencies, employ innovation, and ensure accountability to the public.

## Round One Speakers

During Round One, attendees were invited to address the five topics of interest and provide comments on the policy. Five speakers, representing five different pavement industry associations, were called on in random order to present their comments.

### National Ready Mixed Concrete Association (NRMCA)

*The following is a summary of comments by Brian Killingsworth, NRMCA Executive Vice President for Local Paving.*

*23 CFR part 626:* The simplicity of the policy allows for flexibility in establishing design procedures that are appropriate for different conditions. The policy allows for consideration of safety, durability, and cost effectiveness together with the design. In particular, the ability to include cost effectiveness through life cycle cost analysis (LCCA) is important.

*Pavement Design Considerations NRS:* The non-regulatory supplement allows for and encourages the use of scientifically based procedures during the design process. The ability to include materials, traffic, climate, maintenance, and life cycle costs, etc., is important in tying the design to cost effectiveness.

*Technical Advisory T5040.39A:* The policy is well written and there is good guidance, particularly in the areas of equivalent designs and how to use the discount rate and bid adjustment. The technical advisory is a positive step in combining all those things together, and it gives a clear and concise methodology. It is encouraging that the guidance does direct States under the policy to perform activities that result in real net savings, which is another part of design cost effectiveness.

### Interlocking Concrete Pavement Institute (ICPI)

*The following is a summary of comments by David Smith, ICPI Technical Director, and of written comments provided to FHWA by ICPI (see Appendix B).*

*23 CFR part 626:* On the definitions of pavement designs, we would like to see a life cycle assessment (LCA) added. Expanding the definition would frame the LCA into the policy in terms of examining environmental impacts as a means of finding additional cost savings.

*Pavement Design Considerations NRS:* We appreciate the NRS recognizing AASHTO pavement design methods. We adapted AASHTO design for flexible pavements for the design of interlocking concrete pavements. This has been formalized into an American Society of Civil Engineers (ASCE) standard (ASCE/ANSI 58-16 Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways). There is also an opportunity to mention LCA in terms of potentially reducing life cycle costs in the NRS in Section 4, Engineering Economic Analysis. Consider inserting LCA here framed as another economic analysis tool via environmental impact analysis. Section 5, Rehabilitation Pavement Design, could reference the great online tools available from the FHWA Sustainable Pavements Group that support pavement evaluation.

In Section 1b, Pavement Design Factors, specifically sub-section 3, Shoulder Structure, part C encourages using similar structures on the shoulder in addition to travel lanes. This is cost effective, but it could preclude the use of permeable pavements. Permeable pavements on shoulders may be more cost effective than traditional pavement particularly in highly urbanized areas that present few alternatives for storm water management. Benefits and design guidelines are provided in the National Cooperative

Highway Research Program (NCHRP) Project 25-25/82 report for the AASHTO Standing Committee on the Environment called *Permeable Shoulders with Stone Reservoirs*. Language in part C explaining that there may be exceptions where States may consider other materials for shoulder pavements that support project LCCA, LCA, and storm water permit requirements would help keep the policy flexible for users.

*Technical Advisory T5040.39A*: In the alternative bidding pavement type section, consider adding language on alternate bidding based on pay items that include LCA for the manufacturing and construction phases. The thrust here is to combine LCA with LCCA to find the more cost effective and performance-effective selection. This positions the State Highway Agencies to not necessarily have to accept the lowest bid price based on initial costs alone, but instead select the best performing option from economic and environmental analyses.

Note: Specific suggestions for items to update, add, and/or clarify are identified in written comments submitted by ICPI (see Appendix B).

#### National Stone, Sand, and Gravel Association (NSSGA)

*The following is a summary of comments by Travis Chewing, Vice President of Engineering & Operational Support for Luck Stone Corporation, who represented NSSGA at the listening session.*

*Mr. Chewing began by stating that, as part of the stone industry, NSSGA supports a lot of those represented at this session and also plays an active role in road construction. He said he is personally not quite as familiar with the details of the policy, so his comments would be more general.*

*23 CFR part 626*: In terms of what is good and working, the intent and purpose of the policy guidelines are to ensure pavement structures are durable, cost effective, stand the test of time, and put taxpayer dollars to best use.

*Pavement Design Considerations NRS*: From an industry perspective, NSSGA recognizes that FHWA supports the use of AASHTO's Mechanistic-Empirical Pavement Design Guide (MEPDG) and Pavement ME, but the concern continues to be whether the model appropriately represents the strength characteristics of the unbound aggregate layer in the structure. The results significantly understate the value the structural contribution of the aggregate base layer has in terms of the model's recommendations. We have worked hard as an industry in the past few years to share those thoughts with FHWA as well as the State associations. Currently, NCHRP study 01-53 is trying to address these issues. Moving forward, NSSGA's concern is with how those results will be incorporated into the model and how the results will be communicated to various State agencies. The more that can be done to promote communication and facilitate sharing of best practices is a benefit. A new policy can help promote that.

The current policy provides a framework that is flexible; however, we believe it is important for FHWA to continue to explore innovation in pavement design and continue seeking concepts that are high performing, sustainable, resilient, and cost effective. The aggregate industry's processes result in products with by-products and co-products, and while some factors in the current pavement design trend toward use of the fine products or of clean sub-products, there may be opportunity for a more sustainable utilization of the co-generated products in the pavement designs through alternatives.

One example is inverted pavement design or sandwich pavement design, which leverages the strength characteristics of what are sometimes by-product or waste stream products from the production process. We would like to see more research on alternative pavement designs, such as inverted pavement, which incorporate the stronger and cost effective properties of stone. There is evidence that this is a good alternative for the industry.

The current guidelines do a great job of making sure that the products we use in public transportation are well researched. We would like to see more interest in the research side in order to continue to look into innovative solutions.

#### National Asphalt Pavement Association (NAPA)

*The following is a summary of comments by Audrey Copeland, NAPA Chief Operating Officer, as well as written comments provided by NAPA (see Appendix B).*

*After introducing her colleague Richard Willis, NAPA's Senior Director for Pavement Innovation and Engineering, she began her comments to the group by noting that NAPA works in partnership with the 39 State Asphalt Pavement Associations and has received input on the pavements policy from them as well.*

*23 CFR part 626: The current policy and accompanying guidance strike a balance that facilitates sound pavement type decisions on the engineering analysis side that are cost effective without unnecessary burdens on State Highway Agencies and State DOTs. FHWA's current LCCA policy, for example, gives States the flexibility to evaluate the current and future needs of their transportation network and to determine the most cost-effective way to ensure they maintain a high-performance system.*

*Pavement Design Considerations NRS: NAPA sees no major issues with the pavement design policy or the supplemental information for the Pavement Design Considerations. We support FHWA's efforts to address and update the engineering economic analysis/LCCA guidance included in the NRS. This policy encourages the use of recycled materials while balancing engineering and economics. It is in line with FHWA's focus on sustainability and LCA. We would urge FHWA to put the consideration for recycled materials and reuse of materials more front and center, where feasible.*

NAPA fully supports the consideration for safety in the NRS. While safety is currently listed in the NRS, FHWA should consider making it more of a main focus.

*Technical Advisory T5040.39A: Technical Advisory for Alternate Bidding: Some State Asphalt Pavement Associations are reporting that their State DOTs or their FHWA Divisions are interpreting the TA as a mandate. NAPA suggests FHWA should post a disclaimer on all TAs, stating that TAs are purely advisory in nature. The FHWA Contract Administration Core Curriculum Manual contains an example of this type of disclaimer.*

NAPA's main areas of concern are with the sections on commodity price adjustments (Section 7b), equivalent designs using DARWin-ME (Section 6a), LCCA bid adjustments (Section 7a), and material quantities (Section 7d).

Commodity price adjustments—NAPA asserts that these are desirable for alternate bidding projects in order to maintain equivalent levels of material cost risk, increase competition, and encourage more aggressive bidding from various size small contractors, because it helps them be able to manage their

bids. NAPA would like FHWA to reconsider that part of the TA to maintain that, overall, it results in a lessening of the disparity of risk and competing alternatives.

Equivalent designs using DARWin-ME—NAPA suggests FHWA update the TA to the new name (AASHTOWare Pavement ME) and include guidance to encourage local calibration for equivalent designs. It is very important on the flexible pavements side, in order to get accurate results, that local calibration is performed. While FHWA also recognizes the importance of local calibration, NAPA suggested this could be more prominent.

LCCA bid adjustment—The current TA states “bid adjustments should be used,” and NAPA suggests that the language be softened to “...may be used.” Consideration should be given to whether historical data shows a significant cost difference in maintenance and rehabilitation and salvage values of alternatives, considering the same level of service. The desire is to get the same level of service over the life of the pavements and be able to compare the two.

Material quantities—NAPA recommends deleting this section, as there is no basis for the statement that “Using materials pay items that are based on weight or mass may result in cost overruns.”

Additional suggested updates to the TA include the following:

- Provide additional guidance on end-of-life considerations for pavements. In most cases, asphalt pavements are never removed completely, and thus have significant salvage value that should be reflected in the LCCA.
- Define “major rehabilitation.” The State Asphalt Pavement Associations have expressed concern over the vagueness of what could be defined as “at least one major rehabilitation cycle.”
- Consider including calculation of user costs, which are included in the United States Code’s definition of LCCA. Tools have been developed to calculate these costs and are readily available.

*Closing Comments:* Considering the TA guidance directly impacts cost estimates, LCCA determination, and bidding approaches, NAPA suggests the TA be reviewed with input from experts with practical experience in fiscal management. NAPA also recommends that the TA and any guidance FHWA publishes on these policies be reviewed by AASHTO.

NAPA is aware that LCA is a method that can be used to calculate the environmental impacts of processes and/or materials and actively supports the continued development of LCA science for asphalt pavements. The FHWA Sustainable Pavements Technical Working Group is working to promote and advance the use of sustainable pavements. This program has developed a reference guide that offers agencies a catalogue of choices for making more sustainable decisions during pavement design, production, construction, use, and maintenance. In addition, the program has developed a framework for conducting LCAs for pavements. However there are still gaps within the science. Further time is needed to continue to advance the knowledge to the point where it is implementable.

While LCA is currently being conducted on pavement materials, there are still unreliable data for many paving mixture components in the United States. Therefore while many components of LCA may be ready, until a more complete picture of the true environmental impacts can be given, LCA should be used “for information only” and not for pavement type selection.

NAPA encourages FHWA to first and foremost consider the positive impact of a well-maintained pavement on vehicle and greenhouse gas emissions and focus efforts on funding and maintaining a good condition highway network. This priority is already addressed in FHWA's effort to establish National Performance Measures for preserving, maintaining, and improving the Interstate and National Highway System (NHS).

Note: Additional information and publication references are available in the written comments submitted by NAPA (see Appendix B).

#### American Concrete Pavement Association

*The following is a summary of comments by Leif Wathne, ACPA Executive Vice President, and of written comments provided by ACPA following the session (see Appendix B).*

*23 CFR part 626:* We think the policy as written is clear and gives States flexibility to develop design procedures that are appropriate for their conditions while still providing an outline of the process and stating what key factors need to be addressed. We like that the policy recognizes there are alternative combinations of materials that can provide the needed load carrying capacity (there is no one "right" pavement design for any application), and that there are multiple pavement design options that will work for almost all applications. We like that the policy specifically ties design together with safety, durability, and cost effectiveness and recognizes that cost effectiveness of pavement is defined using life cycle costs.

When taken together, the policy's tone and tenor essentially relate pavement design to both engineering and economic considerations, and we believe it directs States to ensure competition, an important element of stewardship.

Regarding what is not working with the pavement policy, we do not believe it is being clearly and uniformly interpreted, communicated, and enforced by the FHWA Division Offices. Too many pavement decisions are being made on initial cost only, something our industry believes is inconsistent with the existing policy. The policy needs strengthening by requiring State DOTs to demonstrate they have complied with its provisions, including ensuring they have given detailed consideration to both the engineering and economics of the alternative pavement designs being considered.

The most cost effective engineering solution for a project at any given time will depend on prevailing economic conditions. Since economic conditions are constantly changing, the only way to establish which method is most cost effective is to run an LCCA.

It is important to note that ensuring DOTs run an LCCA does not constitute a mandate on which materials or design to use. The final choice is still a State decision. Requiring an LCCA per the policy is about ensuring that good business practices are used to verify Federal dollars are invested wisely. Including factors such as materials and life cycle costs is consistent with the current FHWA Pavement Type Selection Policy Statement (1981 FR Vol 46 No 195).

*Pavement Design Considerations NRS:* We like that the NRS encourages the development of mechanistic pavement design procedures and provides guidance on some aspects related to overall good pavement engineering practice. However, some significant updating is needed, as already pointed out by some of the previous speakers. The revision should include removing all references to AASHTO 93, to be replaced with AASHTOWare Pavement ME. The adoption of Pavement ME as a best practice for design of new

and rehabilitated conventional concrete and asphalt pavements needs to be strongly encouraged when using Federal funds. For non-conventional pavements, such as interlocking concrete pavers, States should be encouraged to use the most up-to-date process, which for concrete pavers is a modified AASHTO 93 procedure.

We like that the NRS provides guidance on some aspects related to overall good pavement engineering practice, such as widened lanes. Also, similar to the 23 CFR part 626 policy, we like that the NRS ties design to economic analysis, and specifically to LCCA. Finally, we like that it states project-specific analysis should be evaluated considering the needs of the entire system, essentially recognizing the importance of asset management.

We recognize that some States have and/or are developing mechanistic-based programs of their own, and we support their use. We also recognize that modeling issues and calibration efforts may make some States reluctant to accept all or part of Pavement ME. As such, in the interim we suggest FHWA inform States that, when necessary, they can use different mechanistic design processes for concrete and asphalt, including the use of Pavement ME for one pavement type (concrete) and not for another (asphalt). The concrete industry believes that Pavement ME is ready for full implementation with national calibration and encourages FHWA to recommend its adoption even if the asphalt side is not.

Regarding the NRS policy on LCCA, we believe the wording is incompatible with the intent of the pavement policy where 23 CFR part 626 says “Pavement **shall** be designed...and cost effective manner” while the NRS says “...pavements **should** include an engineering and economic evaluation...” We believe it should be rectified to say that LCCA **shall** be used.

Similar to the design guidance, the LCCA guidelines should be updated to include the latest information and best practices to meet the requirements of the 2013 General Accounting Office (GAO) LCCA Report.

*Technical Advisory T5040.39A:* We think the TA is very well written and the overall guidance on equivalent designs, discount rate, LCCA bid adjustments, consideration of uncertainty, commodity price adjustments, material quantities, etc., should be the basis for all pavement type selection at the project level. It is good, sound guidance that can and does direct States to activities that result in real net savings. An example is given in ACPA’s written remarks (see Appendix B).

We believe that the guidance on requiring equivalent designs and directing States to use real discount rates that are consistent with current OMB circular A-94, Appendix C are good and should be continued. Also, we believe the guidance on using LCCA bid adjustments to account for future maintenance and rehabilitation costs to determine the lowest responsive bidder is warranted and ensures the best use of Federal dollars.

The “consideration of uncertainty” is an important principle that needs to be built on in order to produce more robust solutions. Likewise, directing States to account for items such as commodity price adjustment, quality price adjustments, and material quantities should continue. Any item that impacts the initial construction costs and changes what is bid by a contractor and what is paid by the agency needs to be accounted for to ensure the comparison of alternatives is truly representative of what each pavement design will ultimately cost the agency.

While we believe that overall the TA is well done, we do see States not following its guidance and implementing poor practices. Too many are developing alternate processes or ignoring portions of the



TA, such as not including LCCA bid adjustments, which in turn are biasing the alternative pavement type bidding (AD/AB) process. We would like to see FHWA more clearly communicate that requirement in the TA and ensure that States consider all the requirements when using Federal dollars on AD/AB projects.

*Closing Comments:* In summary, the current policy is clear, it just needs to be more uniformly communicated and interpreted by the Division Offices. The TA on alternate bidding is also very good guidance, and we think it has netted some real savings on the Federal-aid Program, but the non-regulatory guidance contains some significantly outdated items.

Overall, we believe there needs to be greater consistency between the three documents to encourage and ensure good stewardship of highway pavement expenditures (e.g., the policy is a “shall” document and others should follow its precedence).

Note: Specific items to update, add, and/or clarify are identified in written comments submitted by ACPA (see Appendix B).

This concluded Round One.

## Round Two Speakers

For Round Two, speakers were again drawn in random order, with 15 minutes allotted to each to make additional comments or ask questions. There were six speakers in this round.

### American Concrete Pavement Association

*The following is a summary of comments by Jim Mack, ACPA Chairman of the Board.*

*23 CFR part 626:* One of the items discussed earlier that we like is the addition of LCA to the process, and looking at that, sustainability is going to become much more of an issue in the future. To date, the process may not be as readily available as LCCA, but it is close. We think we need to start thinking about those activities.

We would also like to express that recyclability does not automatically equal sustainability, just as with LCCA, the numbers need to be run to determine the best alternative. We agree that when a product needs replacing, and it can be recycled, it is a positive versus disposal. However, in some cases, a more sustainable solution may be to use a product or material that, due to long-term performance characteristics, does not need such frequent replacement (with the associated energy and environmental impacts).

*Pavement Design Considerations NRS:* We would like to see more guidance added to the LCCA guidelines. For example, in the 2013 GAO report, there was general agreement that the way that States are doing their LCCAs is reasonable. We, as an industry, agree with that also. What is not being done well are the cost estimating practices, so we think there should be additional guidance on how to take best cost estimating practices into account.

We believe that cost estimates should be part of the design process, as well. We design pavements for future traffic, so we need to continue to make sure we account for future costs in our pavements. That could possibly mean making LCCA more a part of the design process. Bringing the two processes together can improve competition between industries, which we think provides good long-term benefits to the taxpayer.

Another thing that came out of the guidelines in the GAO report was how to present LCCA results correctly. There is going to be a range associated with the results, so we need to provide better guidance so that the LCCAs are more robust, looking at different probabilities and solutions and at the whole process itself, because otherwise anybody can manipulate a cost analysis to come up with the answer they want.

One of the things we think should be added to the LCCA process is real price changes. Other industries take it into account. How to take it into account could be a State decision, but it needs to be defined at the Federal level. User costs due to Pavement Vehicle Interaction (PVI) should be added as well.

In the Economic Analysis section, in addition to the language on variability of inputs, language should be added directing agencies to account for Price Adjustment Clauses (indexing) and Material Quantity Specifications. These items will impact how contractors bid and what is actually paid for during initial construction and needs to be accounted for to have an accurate comparison between competing alternatives.

Regarding the discussion on mandates and how they are interpreted, ACPA does not interpret anything in the practices and the policy, the NRS, or the TA as mandate. What is seen is good guidance giving States the right to make their own decisions. It does not dictate how to do the engineering, but it says you need to use good engineering processes. Good engineering processes for pavement design are paramount to spending Federal dollars wisely.

We believe a positive aspect of the NRS is the recognition that asset management principles are included. However, we believe the current rules will not produce the desired results because the measures do not capture the structural components of the pavement system. We think that is a good process that should be built on. However, we also recognize existing issues with the asset management program. The intent of the process is good; however, the way the process is currently being implemented is forcing States to use a “worst first” type of strategy, and there is sometimes a hyper-focus on preservation. We suggest a mix of strategies, because preservation is good but it may not always be the best solution.

We should remove rules that artificially constrain the class of activities that pavement funds can be spent on simply because they do not fit within an arbitrary definition. Specifically, preservation treatments are defined as activities that do not increase the structural capacity of a system. This means some activities are excluded when they could be the most cost-effective solution but are not eligible because they add structure to the pavement. Restrictive uses of money need to be discontinued so that the State DOTs can determine the best use of available funds.

*Technical Advisory T5040.39A:* One contentious issue within the AD/AB and LCCA processes is the use of Price Adjustment Clauses. We firmly believe the guidance in the TA is good guidance and strongly encourage its continued use. It is difficult to administer equal treatment to various alternate materials, and the use of commodity price adjustments will result in different levels of material cost risk being included in the bid for alternate pavement types.

Having said that, we also want to point out that recent research from Georgia found that there was “no evidence indicating that offering price adjustment clauses leads to more bidders or less dispersion of submitted bid.” Based on these results, we question why FHWA and states would continue to expend precious resources on a program that does not reduce risk or offer any benefits, and recommend that they be discontinued.

#### Interlocking Concrete Pavement Institute

*The following is a summary of comments by David Smith, Technical Director, ICPI, and of written comments provided to FHWA by ICPI (see Appendix B).*

In adding LCA to the Policy and TA, the issue is incentivizing State Highway Agencies to use it. LCA’s benefits should be framed in terms of economic analysis. A few State highway agencies have started using LCA as a means to identify where waste is, a concept that came out of private industry beginning in the 80s and 90s. Because waste equals money being wasted, the incentive then for doing LCA is identifying waste pollution. The object is to make these externalities controllable and, more importantly, assign a cost for that control so that spending the time to control it can be rationalized through shifting the impacts to the bottom line.

Emerging tools, including one being developed by FHWA, will be available to help compare cost savings from different strategies. The available databases are becoming more refined. We believe the time is right to put this type of language into FHWA policy. ICPI would like to see LCA as part of the incentive for Federal highway funds at some point, based on the economic benefits that come from it.

#### Advanced Concrete Pavement Consultancy LLC

*The following is a summary of comments by Shiraz Tayabji, President, ACPC.*

*23 CFR part 626:* The policy is well written; however, it lacks an indication of the designated design period, in terms of what service life is expected. If possible to address this, the policy could read, for example, “the pavement shall be designed to be durable over a designated period of time and to accommodate current and predicted traffic needs in a safe, sustainable, and cost effective manner.” Another gap is in regard to pavement rehabilitation. There should be some recognition that the design consideration should reflect just the rehabilitation of the upper layer, in order to be able to use the existing foundation (slightly reworked to accommodate grade changes and so forth) when appropriate.

The design objectives and rehabilitation expectations should tie-in with the performance policy document being developed by Peter Stephanos [FHWA Office of Stewardship, Oversight, and Management]. Some States are designing for 20, 25, or 30 years. Advanced Concrete Pavement Consultancy’s (ACPC) recommendation is to do 40 years or more in terms of design analysis, for both concrete and asphalt. This should be consistent from State to State, because the Interstate Highway System crosses all States and users expect uniform performance. Any State where roads are always under construction is also not good for the users.

With the new design policy, there should be a review mandated after 5, 10, or another certain number of years to better keep up with industry changes in design, construction, and so forth.

Note: Specific items to update, add, and/or clarify are identified in written comments submitted by ACPC (see Appendix A).

#### National Asphalt Pavement Association

*The following is a summary of comments by Audrey Copeland, Chief Operating Officer, NAPA, as well as written comments provided by NAPA (see Appendix B).*

Through interactions with their different State associations and with the DOTs, NAPA has opportunities to listen to the Chief Engineers, and what they routinely hear from them is, “If you can show me value, I’m interested. If you can stretch my pavement dollars, we’re interested in that.” There is currently a focus on pavement preservation in terms of dollars spent, but also a high concern for work zone safety. Consideration during this policy update process should also be placed on work zone safety, as well as time spent in work zones.

It would be beneficial for FHWA to work with AASHTO as they develop all aspects of their pavement policy and work with the AASHTO members, because they are the ones dealing with this on a daily basis in the field.

Recycling and reuse is the original sustainable activity. NAPA has determined, in partnership with FHWA, that there are savings of over \$2 billion per year to our country from the recycling and reuse of

pavement. FHWA has been a leader in this, in the recycling and reuse of materials in highway applications, and we support that and encourage you to promote that in the policy.

In terms of price adjustment clauses, what we have found through our research, is that the use of commodity price adjustments does result in more equivalent levels of material cost risk, which in turn results in more equal treatment among alternate materials. Without these price adjustments in the alternate bid environment, alternatives utilizing a commodity that is fixed price have a substantial bidding advantage over alternatives using a volatile commodity, and therefore a difference in risk. FHWA can help level the playing field by giving States the option to include that consideration.

In the material quantities section mentioned in Round One, what is the basis there for stating that using material pay items that are based on weight or mass may result in cost overruns? Alternate bid awards are based on the total project cost, not pavement items. So whether it is bid by weight or mass or area should not matter. Consideration should be given to deleting that statement.

Local calibration of equivalent designs using MEPDG: in addition to the local calibration of equivalent designs mentioned in Round One, there should be some consideration for other design methods. Several States, including Illinois, Texas, and California, have developed their own mechanistic pavement design methods, and those should be able to be recognized. There are also other design methods available, such as PAVExpress, which do account for AASHTO 93/98, which a majority of States are still using, and also account for mechanistic design principles, which have been recognized by States such as Washington and West Virginia.

The LCCA bid adjustment should not be used, especially in conditions of market volatility where prices may be changing rapidly through escalation or de-escalation. This is where there is no reasonable means of estimating what future prices may be. In terms of having material-specific rates, discount rates, etc., it has been shown repeatedly to not be good economic policy. We believe the TA already addresses this uncertainty by recommending a probabilistic LCCA. So what we would encourage, is investing additional time and effort into achieving a more accurate LCCA method, and then also eventually getting to the probabilistic LCCA.

Real cost should go along with the probabilistic LCCA. We believe that conducting the LCCA should validate the historical performance and cost data, but not be used as an adjustment factor on a bidder's price. If FHWA does decide to use this LCCA bid adjustment, then the commodity price adjustment should be allowed. The current TA puts some contractors at a disadvantage.

We at NAPA are very supportive of LCA. NAPA developed its own Environmental Product Declaration program for members to quantify their environmental impact. We do have some concerns that this is still an evolving process and may not yet be suitable to be included in policy. We want to move forward with it, but it may be a little early because we are still attempting to accurately quantify those environmental impacts, especially for production and construction, as well as the numerous materials and additives used in our industry. There is also a concern that, if we push hard on the LCA side, something else may be sacrificed in the process. Considering the focus on safety and on time in the work zone, achieving a balance is important.

We agree that service life would be a good addition to the design policy and would add that it should also consider the end of life. Choices that need to be made at the end of life of a pavement will depend

on the choices made at the beginning. I agree with Shiraz regarding focusing on the surface and leaving the foundation in place, so we are getting long-life pavement and considering that in terms of service life. But again, along with longer service life, we need to consider what decisions will be made at end of life for that pavement to restore it back to the desired surface.

Regarding work zones, I think States could use help with them on multiple levels. A big issue for contractors is keeping their workers safe; we are actually seeing an increase in work zone fatalities. If there is guidance or incentives that could be given to States in terms of work zones, it would be worth looking into. It may not necessarily belong in the policy, but it may be good to consider moving forward because getting work zones to move as quickly as possible may not be the safest choice for workers.

We agree with the comments made regarding certain preservation choices not being available for use because they add structural capacity. That definitely needs to be changed.

An additional comment in closing, on FHWA's current website, it can be difficult to locate the prevailing policy (from 1999) and how it falls into place. An updated website or repository for disseminating active policy and guidance is recommended.

#### National Stone, Sand, and Gravel Association

*The following is a summary of comments by Travis Chewning, Vice President of Engineering & Operational Support for Luck Stone Corporation, who represented NSSGA at the listening session.*

I am really encouraged by some of the strategic objectives that are out there for FHWA, specifically around safety and innovation. Safety and innovation go hand in hand. This is a collaborative area in which effort can be made to ensure everyone gets home safely. I respect FHWA's responsibility to promote innovation in this highly regulated, high-risk environment. In terms of reducing risk, experimentation and research are needed. Promoting experimentation in the right environment can better inform research.

I appreciate the comments on improved information sharing. Bringing that back to the strategic platform of innovation, if you share information and really empower people with research and policy and guidance and best practices, it facilitates new thinking and new ideas.

Regarding the comments on AASHTOWare Pavement ME Design, the more we rely on sophisticated design tools like these to inform pavement design, the more it is really important to understand the research and the underlying models to ensure that it is producing objective and accurate design recommendations. With good research and good education on how to use them and on the pros and the cons, I think this a very solid tool.

On alternative designs at the local level, I agree that looking at alternatives is an important way to promote innovation. Also, it is important for the public to see there is continued accountability and promotion of quality and performance in all we do.

As the world evolves and we are thinking more about sustainability and LCAs, we have got to continue to adapt but also look at it in a really well informed, balanced way.

#### National Ready Mixed Concrete Association

*The following is a summary of comments by Brian Killingsworth, NRMCA Executive Vice President for Local Paving.*

I would also encourage reviews like this of the policy to happen more often. Having the opportunity to review allows new knowledge and innovations to be incorporated.

The policy and guidance should encourage competition. Competition fosters innovation that saves taxpayer dollars, which we can then extend to other parts of the system.

Life-cycle thinking involves both cost analysis and environmental analysis. Recycling and reuse is an extremely important part of the sustainable equation, but it has to be holistic. FHWA has taken a giant step in the Sustainable Pavements Technical Working Group. A lot of good information has come from that very good report and very good methodology. It is not ready for prime time, but we are very close. So I think life-cycle thinking can be adopted and referenced in the policy based on the work done by FHWA with the inclusion of industry.

It is important to ensure the policy is consistently interpreted and utilized by the FHWA Division Offices and the States. At the State level, decisions generally are being made based on an initial cost only. Our industry, the concrete industry, believes that a life cycle approach really is most important.

We absolutely agree that right now, AASHTO Pavement ME is the most scientifically robust design software available. I also completely agree that other methodology should be utilized or can be utilized. An area where FHWA can provide more guidance is in the idea of design equivalence. When we get to life-cycle thinking, in terms of equivalent design, that part of it, I think for those who are doing the boots-on-the-ground work, can be confusing. Some guidance there would be very important so that we are getting equivalent designs to compare when we get to the life cycle aspect of it. Then, as was mentioned, the rehabilitation concerns, the asset management mentality, is another part that should be addressed in the policy and the guidance.

In terms of rehabilitation/structural capacity, I appreciate the point that was made that we are looking typically at the surface, and that is what we are rehabilitating. Particularly when we get into situations in which the pavement has been utilized significantly more than what it was originally intended for, we need to have rehabilitation activities that address the ability to add structural capacity for when we are going to have to get into the base and do full-depth reclamation, etc.

This concluded Round Two.

## Round Three General Discussion

Prior to the start of general discussion in Round Three, Bill Vavrik introduced AASHTOWare project manager Vicki Schofield. She stated AASHTO recognizes the importance of calibration within the tool, and she announced that a new Pavement ME Design tool will be launched tentatively in July 2019 with local calibration embedded within the software.

Questions posed by moderator Bill Vavrik in Round Three were developed based on comments presented during Rounds One and Two and were intended to help facilitate further discussion of the most-talked-about items.

To begin the discussion, he referred to 23 CFR part 626, pointing out that some referred to it as policy while others called it a regulation. To clarify this point, he stated 23 CFR part 626 is listed in the Code of Federal Regulations, making it a regulation as well as a policy. He then opened Round Three with the following question:

*Bill Vavrik: If you read this regulation as a requirement, specifically, factors that are to be considered include: materials, traffic, climate, maintenance, drainage, and life cycle costs—if this were to be a checklist or requirement that FHWA had for the States, what are your thoughts on that?*

Leif Wathne: Our industry's perspective of the policy is clear. We believe the intent is as a regulation, a checklist that stipulates "pavement shall be designed in this manner." Pavement design is defined in the previous paragraph, indicating life cycle costs are a requirement in pavement design. FHWA has not been good at communicating that or been consistent.

ACPA's written comments stated that many States are not complying with the Federal pavement policy, which they believe requires States to consider alternative combinations of materials as well as life cycle cost, and that FHWA is not enforcing these Federal requirements appropriately. The ACPA estimates this costs taxpayers roughly \$5 billion each year, according to industry and MIT estimates, and urges FHWA to take a firm posture in helping insulate the Federal-aid program from local influence and politics.

*Bill Vavrik: Is the list comprehensive enough? Too comprehensive? If this was a checklist of things that needed to be carried out, are all the right things on there? Is there anything missing or anything that should be taken off?*

Jim Mack: In terms of establishing the load carrying capacity, those items—materials, traffic, climate, maintenance, and drainage—are all things we need to be looking at. I think we are all pointing out that some sort of environmental consideration needs to be part of that definition. For example, we have project-level activity where we do engineering and economic considerations, but we don't have anything in there that talks about environmental considerations. It's an iterative process. We can include cost and environmental considerations while we're designing so that we can optimize our cross-section for those as well as traffic. For the definition, that is something I see as a gap.

David Smith: A comment on your comment: add at the end an environmental LCA and leave it open. Understanding that LCA involves looking at a many phases: manufacture, construction, use-phase, end life. I think you can put it in the policy and address it in the NRS as manufacture and construction with a view toward developing use-phase and end of life assessment tools. Just keep it open.



Jim Mack: I agree the sustainability aspect should be included. Something else that is becoming top of mind for a lot of groups is resiliency—recoverability from disasters. We need to take that into account as we design. That should be included also.

Shiraz: I want to re-emphasize what I stated before. In the definition of end of life for life cycle cost, always designate a period of time.

Audrey Copeland: I want add to the end of life considerations. I agree that sustainability should be a consideration of the environment, but it needs to be kept very general. Everyone is saying, “We’re close, but we’re not there yet,” so we just need to be very mindful of helping States get there versus going ahead and putting it in a regulation or rule. There are other aspects to consider in terms of environmental impacts. There are other agencies that deal with that on a project basis as well. There needs to be some consideration given there. I think drainage probably addresses it, but foundation is a very important consideration during pavement design. Maybe it’s better to call that out specifically.

Travis Chewning: I would like to address the comments just made around foundation. I think that’s important in pavement design. If it’s not built on a good foundation then it’s not good. It’s going to have a very hard time standing the test of time.

Jim Mack: I like where we are going with that, and we should maybe even broaden it further. States are asking, “How about structure?” “What about layers?” “How do I put my layers together?” It’s the materials that go into it, the structure itself, somewhere that needs to be included in the policy. It needs to go into the non-regulatory. I think that is where a lot of the agencies are lost. “How do I develop a rehab schedule that is realistic in design?” There are a lot of other ways to account for end of life. It’s going to be different for each, and we need to be able to tie those together. But that gets back to the supplement.

*Bill Vavrik: Yes, that’s why this question starts in the regulation, because more of the later questions will apply to the guidance.*

Leif Wathne: That’s a good point. I think the policy or the regulation should be very high level. If you’re going to use Federal dollars under the Federal-aid program, you must consider these things. How you do it is more technical, and States should be afforded the flexibility to do that. However, they cannot reflexively pick one material. We see that as inconsistency with policy because it relates to stewardship. FHWA has a vested interest there and should be consistent in overall guidance.

Audrey Copeland: I would maintain that FHWA is doing that now. I could go through a list of ways FHWA encourages that. Yes, it’s challenging to do in this country with 50 States and Division Offices, but the framework that FHWA has set up allows for and encourages that.

*Bill Vavrik: The first question was focused on that regulation. Frankly, that part is a little harder to change. Now we will have more of an open discussion. Question two: What is pavement life or design life? And how should or shouldn’t that be part of the guidance?*

Shiraz Tayabji: I think there needs to be uniform design in pavement for the States and Federal-aid for States with primary highway systems. Short-term life being used in States is hard to answer, but there are short-term budgetary units. I think we must officially establish recommendations. Where it’s guidance or recommendation for what, officially, the expectations are in terms of how long new

pavement or rehabilitated pavement are expected to last. It comes down to how much can we afford to disrupt traffic for a given period of time.

Brian Killingsworth: Traditionally we think of that in terms of what that initial design life is. That's what we typically design for; we look at service life, and that's what we utilize in our LCCA. Then we know we have a true surface life. Because we don't have enough money to fix what we have, it is therefore in place much longer than intended. The bridge industry has accepted this fact. They realize most bridges are lasting longer than they anticipated. It's not so unusual to see in design guidance—you're designing for a 100-year surface. This is based off the facts of seeing bridges last this long.

*Bill Vavrik: I'm sure there are people in this room who would argue that we have pavement lasting that long.*

Brian Killingsworth: I think we do need to provide some guidance on that. Whether it's part of the definition or in the non-regulatory. I think we should make the expectations clear. I don't know how we do that yet, because suddenly you are setting a mandate that says "you must do it to the expectation."

Leif Wathne: It's a good question. One way to restate it is, if policy says, "If you apply a Federal dollar on a pavement segment, you will not apply another Federal dollar on that pavement segment for 30 years," for example. Let the State decide. It could be innovative. You force industry to come up with solutions that meet that expectation. That could be one way to do it. If you make a Federal investment, you want to make sure it lasts a long time. We would rather have industry compete and innovate to solve that problem.

Shiraz Tayabji: It has to tie in to performance expectations. What are the expectations for pavements to remain in solid condition? When you're talking about service life, it should maintain the performance criteria as stated in this guideline for a period of time without additional repairs and protection. Something like that can be incorporated.

Richard Willis: From a pavement design standpoint, I think we do ourselves a disfavor by talking about pavement life in terms of years instead of in traffic. Because we design for the level of traffic that we're putting on the roads. The policy even states, "To accommodate current predicted traffic needs in a safe, durable, and cost-effective manner." If we start saying you can't put another Federal dollar down for 30 years, but Walmart puts a distribution center next to that road, you then meet that traffic need in 5 years instead of 20 years. If it lasted 15 years, then we get 10 extra years of life that we were not expecting. When we start talking about this in terms of years, we need to understand that there are some things we may be hamstringing the industry on, or the States on, because of that choice of language.

Jim Mack: This may tie in with what Shiraz said, and I agree with Richard. Maybe we need to stop thinking about design as an issue of rehabilitation. We have to answer, "What are we going to do with this system for the next 50 years?" "What are my next steps?" "What is the next step after a preservation treatment?" We need to account for this in the asset management process and the allocation process. I have the same amount of money: I can get a lot of pavements or I can get few pavements. What's the long term application of that system and how will we maintain that system?

*Bill Vavrik: This comes down to a number of comments from folks, “roads don’t go away.” We rarely pick them up and put them down again. This being a foundational piece of a 20-year period, based on the AASHTO process. Everyone uses this method. How long do these roads stay in place?*

Jim Mack: Forty years, at least.

*Bill Vavrik: As we get better with new tools, we’re actually able to predict that a lot closer. How does that impact what we are talking about today? How does that impact the guidelines or policy?*

Leif Wathne: Some States have adjusted; I think Wisconsin has a 40-year life design, at least on concrete. States don’t want 20-year pavements. I think the constraint of 20 years came from the Federal-aid program or the interest program being a 20-year program. Pavements were designed to last until the end of the program, and States would handle maintenance. The investment was only to construct it, and maybe the 20-year period is an artificial constraint carried on through history. People want more from their pavement. It’s a great question.

Jim Mack: If you want to design for 20 years and fix it, that’s fine. Account for future impact in your evaluation period. Think in the long term.

*Bill Vavrik: Building off that, talking about future traffic and future traffic needs. We will probably include automated vehicles. How should the guidelines or policy address that?*

Audrey Copeland: We’ve been looking into this at NAPA. What I’ve found through my own research is what’s important to us now will be important to us in the future. Good road condition; roads that are smooth and well-marked. Eventually we will move away from pavement markings, but that’s still a long way away. What’s important to us now will be important for automated vehicles in the future. Two things to think about: there should be encouragement for research in terms of pavement designs and pavement mixtures. Next, the National Highway Transportation Safety Administration is looking at this in terms of human-interaction road signs to robotic interaction. At this point, I don’t think it belongs in policy because FHWA is figuring out where they belong in this structure.

Brian Killingsworth: You’ve also got to consider the roadway could be used as an energy source. You see it in Europe; they’re generating energy with the use of roadways.

Audrey Copeland: I think that’s a really good point. What other uses besides just being a surface can pavements provide?

Vicki Schofield: I think, relative to automated vehicles, there may be a point in time where the road itself may be communicating with the vehicle. It may not be that the vehicle has wheels on pavement, they could be above the surface, but it still needs to communicate with the surface because that’s the track. That could be 20 to 30 years down the road, but there has been a lot of progress made with automated vehicles.

Leif Wathne: We held a session last year with people from various agencies, including TRB, FHWA, and industry, and we asked, “What is the future of transportation?” “What are roadways?” “What is concrete’s role within that?” That session and the work that followed taught us change is coming. We’re looking at another 70 million people in the United States by 2040 to 2045. That’s the current populations of Texas, Florida, and New York combined. That growth is going to increase the amount of freight that will probably be connected on an autonomous network.

The second thing is pavement, in urban areas in particular, real estate is going to be expensive, and therefore we cannot afford to allow pavements to only serve one purpose. Whether it's storm water capture, energy storage, charging electric vehicles, or a communications backbone. It has to be adaptable, and how will the policy capture that? I think it's probably premature. That's a very difficult challenge, but we should be thinking about those things. It's eye-opening to listen to all these people from different industries and sectors talk about this. It's important and we need to prepare for it.

*Bill Vavrik: My next question is based off a comment about consistency from State to State for the user. What does that mean in terms of what we're doing here today? What does that consistency mean regarding the regulation's policy guidance?*

Shiraz Tayabji: This ties into the pavement performance policy. The user wants to have uniform standards across States, at least for a Federal highway system. They define the different pavement types down to roughness and smoothness requirements. As long as the smoothness requirements are met, most users are happy with it. One thing we have not discussed is noise; we are looking for smoothness and safe texture. I think we should include surface texture in the policy discussion.

Brian Killingsworth: There is an impact to that. Take into account asset management. We look at a particular serviceability factor, one which Shiraz rightly pointed out is typically smoothness. When you cross a State line, you hope to at least hit some minimum level of smoothness. That also drives the way we maintain our roadways. We're not looking at it holistically. We try to fix the worst roads first. That could cause some issue with how you spend money, and not having resources to add capacity when you need it.

Audrey Copeland: Building off the smoothness topic, we've done surveys and in-depth interviews of drivers, and it does come down to smoothness. This is more of a question for FHWA, which they will not answer today, but it is something to consider. You also have pavement performance rulemaking where we're determining conditions of the highway and later set bars for State DOTs. Those smoothness requirements, the IRI requirements, are loose and States are admitting in public they are setting loose targets. On one hand, I understand. On the other hand, what can be done to improve performance? It's something for FHWA to think through as stewards of Federal money and while looking at this policy.

Jim Mack: Building on that, I agree smoothness is important. Is that the only thing that matters to the driving public? We need to think about traffic disruptions, noise, and effects on fuel efficiency. What are the sustainable aspects of this? Right now, we are focused on one thing. Expand on that. We need to think beyond just what my everyday standard usage is.

Leif Wathne: I'll just add, smoothness is important, but I think from a stewardship perspective, FHWA's role is certainly to encourage and enable States to maintain that smoothness, but in a fiscally responsible way. We address this with asset management. We need to find ways to ensure we get it to the lowest cost to the user. That's where I see opportunities for improvement.

*Bill Vavrik: Within what we're doing in pavement regulations, policies or guidelines, what's the best way to address innovation?*

Leif Wathne: I think that FHWA can do a better job of getting States to embrace the concept of competition in alternative combinations of base and surface materials. I think innovation comes out of competition, from which we can all benefit. A policy like the pavement design policy can underscore the

importance in stewardship of having States actually consider those alternative combinations. That will help with innovation. It will move all of us forward and provide the solutions at a lower unit cost to the public.

Audrey Copeland: I agree with innovation. That's how products and pavement types distinguish themselves, through function, design, quality, production, speed of construction, and innovation. What we found to be successful is partnerships, working with the Federal government as well with the State Highway Agencies. Whatever FHWA can do to foster that collaborative environment is very helpful. We're working with FHWA on pilot sections in different States to simply increase density and improve performance. It's something very simple, but it's hopefully going to result in changes in construction processes for different States that are going to improve. I suggest concentrating on that field—getting out there and doing the experimental projects and trials. Research is very important, and FHWA has an entire arm dedicated to research, but getting in the field I think is key.

Matt Reiffer: I think the more we can do to promote collaboration, the better. I think providing an environment where there is incentive for competition that drives innovation but also, from a research standpoint, some ways to have a balanced view. Not to be overly influenced by one perspective or another, which I think FHWA tries to do a really good job at. I think finding ways to allow States to be more experimental, it takes money to do that. If FHWA could fund some of that in a modest and very thoughtful way—anything we could do to help with the initiative.

*Bill Vavrik: I've heard collaboration come out as a theme. Are there models of collaboration and working together that you've seen work well?*

Jim Mack: I think this is good. When I first came to the industry about 30 years ago, there was a lot more State-to-State interaction. That interaction has shrunk tremendously. Having State-to-State interactions is important. Let's have that State-to-State interaction. Going back to peer exchanges would be extremely helpful in allowing different States to do that.

Leif Wathne: I'll add to Audrey's comment—In terms of FHWA, I think they've done a good job shepherding some of that collaboration. We kind of heard it repeated in several of the comments here. Not just on the research side, but implementation. If you spend 1 million dollars on researching something, you're probably going to spend 2, 3 or 5 million dollars to actually implement it. That's where a lot of the heavy lift comes in. FHWA plays a unique role in that regard. For the reason they can help be an agent for change. They can help take on some of the risk, even the pilot projects, for example. I think they do a really good job with the accelerated implementation program, specifically around this concept of trying to push innovation, and research done at Turner-Fairbank and other places and putting it into practice. I think that's a good model.

Audrey Copeland: I think something that's probably missing from this discussion is the contracting process. We're in a low-bid environment, which in some cases does not always encourage innovation. I think it would be worthwhile for FHWA to also consider thinking about providing guidance for the contracting and bidding process.

One of the examples in our industry is intelligent compaction. For asphalt, it's obviously a very useful technology, and contractors using it have found it very useful. A few years ago, it was considered very innovative. But the problem is that with funding for certain projects, there's no incentive to invest. It's a

capital investment at the end of the day, and there's no incentive to invest in that. What can we do, in terms of either the contracting process or in providing additional funding, that would help incentivize using these innovative technologies on projects? My overall comment is there is lots of discussion about the contracting process. There are States that have value engineering who can suggest something that will improve the project engineering or the cost, but it's not widespread.

*Bill Vavrik: What will it take for a pavement design method to be accepted within the guidance?*

Shiraz Tayabji: I think you need to reword the question, how can we consider different design procedures as equivalent?

Jim Mack: I like that question. What I think is important is local calibration of the pavement. We agree it needs to be done. On the concrete side it's less important. There have been a number of studies to show that the national calibrations are good but in certain States we can't implement concrete until we implement asphalt. We would like guidance to say, "Use whatever is best out there. You don't need to have them the same."

The equivalency can be accounted for in realistic performance projections, "What will this have to perform like?" "What's your realistic rehabilitation strategy for that, and what's the cost?" I can come up with an equivalent section based on cost by doing a very robust LCCA. If I can take into account the risk and commodity price adjustment, I can come up with the most cost-effective option. Here is the least risky and what's going to provide best value. It needs to be a very holistic lifecycle thinking approach.

Audrey Copeland: I would just add, what do you expect of pavement? What you're designing to and if you're confident in the different methods under this policy, they're allowed.

*Bill Vavrik: Last question and we can open the floor for closing comments. What is the best way to address safety in the pavement guidance? How should that safety come into play?*

Vicki Schofield: AASHTOWare also has a safety analyst software product that takes crash data and analyzes it based on road segments. I know their performance requirements at the Federal level are a part of MAP-21. We need to start looking at some of those and how they apply to pavement. Let's look at other factors for crashes.

Audrey Copeland: If you look at pavement design considerations on safety, they encourage the pavement to be skid resistant. It also addresses updating the pavement, in terms of the work zones, minimizing disruptions for safety. They are suggesting a periodic analysis of wet weather crashes on all standard surfacing types, a systematic process to identify, analyze, and correct hazardous skid locations. If a State is following that, I imagine they might have an idea of the effect via pavement. I think, based on reading this one more time, overall I'm happy with the approach. I think it addresses the work zone safety and the pavement safety itself. It just might need to be a higher priority. Especially if it's become such a high priority with FWHA.

This concluded Round Three.

## Appendix A: Comments Arranged by Topic

### 23 CFR part 626

#### What Works

*Travis Chewning/NSSGA:* In terms of what is good and working, the intent and purpose of the policy guidelines are to ensure pavement structures are durable, cost effective, stand the test of time, and put taxpayer dollars to best use.

*Leif Wathne/ACPA:* When taken together, the policy's tone and tenor essentially relate pavement design to both engineering and economic considerations, and we believe it directs States to ensure competition, an important element of stewardship.

*Audrey Copeland/NAPA:* The current policy and accompanying guidance strike a balance that facilitates sound pavement type decisions on the engineering analysis side that are cost effective without unnecessary burdens on State Highway Agencies and State DOTs.

#### Flexibility

*Leif Wathne/ACPA:* We think the policy as written is clear and gives States flexibility to develop design procedures that are appropriate for their conditions while still providing an outline of the process and stating what key factors need to be addressed. We like that the policy recognizes there are alternative combinations of materials that can provide the needed load carrying capacity (there is no one "right" pavement design for any application), and that there are multiple pavement design options that will work for almost all applications.

#### Life Cycle Cost Analysis (LCCA)

*Brian Killingsworth/NRMCA:* The simplicity of the policy allows for flexibility in establishing design procedures that are appropriate for different conditions. The policy allows for consideration of safety, durability, and cost effectiveness together with the design. In particular, the ability to include cost effectiveness through LCCA is important.

*Audrey Copeland/NAPA:* FHWA's current LCCA policy gives States the flexibility to evaluate the current and future needs of their transportation network and to determine the most cost-effective way to ensure they maintain a high-performance system.

*Leif Wathne/ACPA:* We like that the policy specifically ties design together with safety, durability, and cost effectiveness and recognizes that cost effectiveness of pavement is defined using life cycle costs.

It is important to note that ensuring DOTs run an LCCA does not constitute a mandate on which materials or design to use. The final choice is still a State decision. Requiring an LCCA per the policy is about ensuring that good business practices are used to verify Federal dollars are invested wisely. Including factors such as materials and life cycle costs is consistent with the current FHWA Pavement Type Selection Policy Statement (1981 FR Vol 46 No 195).

## What Could Be Improved Life Cycle Assessment

*David Smith, ICPI:* On the definitions of pavement designs, we would like to see an LCA added. Expanding the definition would frame the LCA into the policy in terms of examining environmental impacts as a means of finding additional cost savings.

*Audrey Copeland/NAPA:* NAPA is aware that LCA is a method that can be used to calculate the environmental impacts of processes and/or materials and actively supports the continued development of LCA science for asphalt pavements. The FHWA Sustainable Pavements Technical Working Group is working to promote and advance the use of sustainable pavements. This program has developed a reference guide that offers agencies a catalogue of choices for making more sustainable decisions during pavement design, production, construction, use, and maintenance. In addition, the program has developed a framework for conducting LCAs for pavements. However there are still gaps within the science. Further time is needed to continue to advance the knowledge to the point where it is implementable.

While LCA is currently being conducted on pavement materials, there are still unreliable data for many paving mixture components in the United States. Therefore while many components of LCA may be ready, until a more complete picture of the true environmental impacts can be given, LCA should be used “for information only” and not for pavement type selection.

We at NAPA are very supportive of LCA. NAPA developed its own Environmental Product Declaration program for members to quantify their environmental impact. We do have some concerns that this is still an evolving process and may not yet be suitable to be included in policy. We want to move forward with it, but it may be a little early because we are still attempting to accurately quantify those environmental impacts, especially for production and construction, as well as the numerous materials and additives used in our industry. There is also a concern that, if we push hard on the LCA side, something else may be sacrificed in the process. Considering the focus on safety and on time in the work zone, achieving a balance is important.

NAPA encourages FHWA to first and foremost consider the positive impact of a well-maintained pavement on vehicle and greenhouse gas emissions and focus efforts on funding and maintaining a good condition highway network. This priority is already addressed in FHWA’s effort to establish National Performance Measures for preserving, maintaining, and improving the Interstate and National Highway System (NHS).

*David Smith/ICPI:* In adding LCA to the Policy and TA, the issue is incentivizing State Highway Agencies to use it. LCA’s benefits should be framed in terms of economic analysis. A few State highway agencies have started using LCA as a means to identify where waste is, a concept that came out of private industry beginning in the 80s and 90s. Because waste equals money being wasted, the incentive then for doing LCA is identifying waste pollution. The object is to make these externalities controllable and, more importantly, assign a cost for that control so that spending the time to control it can be rationalized through shifting the impacts to the bottom line.

Emerging tools, including one being developed by FHWA, will be available to help compare cost savings from different strategies. The available databases are becoming more refined. We believe the time is



right to put this type of language into FHWA policy. ICPI would like to see LCA as part of the incentive for Federal highway funds at some point, based on the economic benefits that come from it.

*Travis Chewning/NSSGA:* As the world evolves and we are thinking more about sustainability and LCAs, we have got to continue to adapt but also look at it in a really well informed, balanced way.

### Expected Service Life, Rehabilitation

*Shiraz Tayabji/ACPC:* The policy is well written; however, it lacks an indication of the designated design period, in terms of what service life is expected. If possible to address this, the policy could read, for example, “the pavement shall be designed to be durable over a designated period of time and to accommodate current and predicted traffic needs in a safe, sustainable, and cost effective manner.”

Another gap is in regard to pavement rehabilitation. There should be some recognition that the design consideration should reflect just the rehabilitation of the upper layer, in order to be able to use the existing foundation (slightly reworked to accommodate grade changes and so forth) when appropriate.

The design objectives and rehabilitation expectations should tie-in with the performance policy document being developed by Peter Stephanos [FHWA Office of Stewardship, Oversight, and Management]. Some States are designing for 20, 25, or 30 years. Advanced Concrete Pavement Consultancy’s (ACPC) recommendation is to do 40 years or more in terms of design analysis, for both concrete and asphalt. This should be consistent from State to State, because the Interstate Highway System crosses all States and users expect uniform performance. Any State where roads are always under construction is also not good for the users.

Note: Specific items to update, add, and/or clarify are identified in written comments submitted by ACPC (see Appendix B).

*Audrey Copeland/NAPA:* We agree that service life would be a good addition to the design policy and would add that it should also consider the end of life. Choices that need to be made at the end of life of a pavement will depend on the choices made at the beginning. I agree with Shiraz regarding focusing on the surface and leaving the foundation in place, so we are getting long-life pavement and considering that in terms of service life. But again, along with longer service life, we need to consider what decisions will be made at end of life for that pavement to restore it back to the desired surface.

### Review Process

*Shiraz Tayabji/ACPC:* With the new design policy, there should be a review mandated after 5, 10, or another certain number of years to better keep up with industry changes in design, construction, and so forth.

*Audrey Copeland/NAPA:* It would be beneficial for FHWA to work with AASHTO as they develop all aspects of their pavement policy and work with the AASHTO members, because they are the ones dealing with this on a daily basis in the field.

*Brian Killingsworth/NRMCA:* I would also encourage reviews like this of the policy to happen more often. Having the opportunity to review allows new knowledge and innovations to be incorporated.

## Interpretation: Mandate vs. Guidance

*Leif Wathne/ACPA:* Overall, we believe there needs to be greater consistency between the three documents to encourage and ensure good stewardship of highway pavement expenditures (e.g., the policy is a “shall” document and other others should follow its precedence).

Our industry’s perspective of the policy is clear: We believe the intent is as a regulation, a checklist that stipulates “pavement shall be designed in this manner.” Pavement design is defined in the previous paragraph, indicating life cycle costs are a requirement in pavement design. FHWA has not been good at communicating that or been consistent.

*Jim Mack/ACPA:* Regarding the discussion on mandates and how they are interpreted, ACPA does not interpret anything in the practices and the policy, the NRS, or the TA as mandate. What is seen is good guidance giving States the right to make their own decisions. It does not dictate how to do the engineering, but it says you need to use good engineering processes. Good engineering processes for pavement design are paramount to spending Federal dollars wisely.

*Brian Killingsworth/NRMCA:* It is important to ensure the policy is consistently interpreted and utilized by the FHWA Division Offices and the States. At the State level, decisions generally are being made based on an initial cost only. Our industry, the concrete industry, believes that a life cycle approach really is most important.

## Pavement Design Considerations NRS

### What Works

*Brian Killingsworth/NRMCA:* The non-regulatory supplement allows for and encourages the use of scientifically based procedures during the design process. The ability to include materials, traffic, climate, maintenance, and life cycle costs, etc., is important in tying the design to cost effectiveness.

*David Smith, ICPI:* We appreciate the NRS recognizing AASHTO pavement design methods. We adapted AASHTO design for flexible pavements for the design of interlocking concrete pavement. This has been formalized into an American Society of Civil Engineers (ASCE) standard (ASCE/ANSI 58-16 Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways).

*Audrey Copeland/NAPA:* NAPA sees no major issues with the pavement design policy or the supplemental information for the Pavement Design Considerations. We support FHWA’s efforts to address and update the engineering economic analysis/LCCA guidance included in the NRS. This policy encourages the use of recycled materials while balancing engineering and economics. It is in line with FHWA’s focus on sustainability and life cycle assessment.

*Leif Wathne/ACPA:* We like that the NRS provides guidance on some aspects related to overall good pavement engineering practice, such as widened lanes. Also, similar to the 23 CFR part 626 policy, we like that the NRS ties design to economic analysis, and specifically to LCCA. Finally, we like that it states project-specific analysis should be evaluated considering the needs of the entire system, essentially recognizing the importance of asset management.

## What Could Be Improved Updates

*Leif Wathne/ACPA:* The non-regulatory guidance contains some significantly outdated items. Specific items to update, add, and/or clarify are identified in written comments submitted by ACPA (see Appendix B).

### Life Cycle Assessment

*David Smith, ICPI:* There is an opportunity to mention LCA in terms of potentially reducing life cycle costs in the NRS in Section 4, Engineering Economic Analysis. Consider inserting LCA here framed as another economic analysis tool via environmental impact analysis. Section 5, Rehabilitation Pavement Design, could reference the great online tools available from the FHWA Sustainable Pavements Group that support pavement evaluation.

### Life Cycle Cost Analysis

*David Smith, ICPI:* Regarding the NRS policy on LCCA, we believe the wording is incompatible with the intent of the pavement policy where 23 CFR part 626 says “Pavement **shall** be designed...and cost effective manner” while the NRS says “...pavements **should** include an engineering and economic evaluation...” We believe it should be rectified to say that LCCA **shall** be used.

Similar to the design guidance, the LCCA guidelines should be updated to include the latest information and best practices to meet the requirements of the 2013 General Accounting Office (GAO) LCCA Report.

*Jim Mack/ACPA:* We would like to see more guidance added to the LCCA guidelines. For example, in the 2013 GAO report, there was general agreement that the way that States are doing their LCCAs is reasonable. We, as an industry, agree with that also. What is not being done well are the cost estimating practices, so we think there should be additional guidance on how to take best cost estimating practices into account.

We believe that cost estimates should be part of the design process, as well. We design pavements for future traffic, so we need to continue to make sure we account for future costs in our pavements. That could possibly mean making LCCA more a part of the design process. Bringing the two processes together can improve competition between industries, which we think provides good long-term benefits to the taxpayer.

Another thing that came out of the guidelines in the GAO report was how to present LCCA results correctly. There is going to be a range associated with the results, so we need to provide better guidance so that the LCCAs are more robust, looking at different probabilities and solutions and at the whole process itself, because otherwise anybody can manipulate a cost analysis to come up with the answer they want.

One of the things we think should be added to the LCCA process is real price changes. Other industries take it into account. How to take it into account could be a State decision, but it needs to be defined at the Federal level.

## Pavement Design Factors: Shoulder Structure

*David Smith, ICPI:* In Section 1b, Pavement Design Factors, specifically sub-section 3, Shoulder Structure, part C encourages using similar structures on the shoulder in addition to travel lanes. This is cost effective, but it could preclude the use of permeable pavements. Permeable pavements on shoulders may be more cost effective than traditional pavement particularly in highly urbanized areas that present few alternatives for storm water management. Benefits and design guidelines are provided in the National Cooperative Highway Research Program (NCHRP) Project 25-25/82 report for the AASHTO Standing Committee on the Environment called *Permeable Shoulders with Stone Reservoirs*. Language in part C explaining that there may be exceptions where States may consider other materials for shoulder pavements that support project LCCA, LCA, and storm water permit requirements would help keep the policy flexible for users.

## Innovation, Sustainability, and Resiliency

*Travis Chewing/NSSGA:* The current policy provides a framework that is flexible; however, we believe it is important for FHWA to continue to explore innovation in pavement design and continue seeking concepts that are high performing, sustainable, resilient, and cost effective. The aggregate industry's processes result in products with by-products and co-products, and while some factors in the current pavement design trend toward use of the fine products or of clean sub-products, there may be opportunity for a more sustainable utilization of the co-generated products in the pavement designs through alternatives.

One example is inverted pavement design or sandwich pavement design, which leverages the strength characteristics of what are sometimes by-product or waste stream products from the production process. We would like to see more research on alternative pavement designs, such as inverted pavement, which incorporate the stronger and cost effective properties of stone. There is evidence that this is a good alternative for the industry.

*Audrey Copeland/NAPA:* We would urge FHWA to put the consideration for recycled materials and reuse of materials more front and center, where feasible.

Recycling and reuse is the original sustainable activity. NAPA has determined, in partnership with FHWA, that there are savings of over \$2 billion per year to our country from the recycling and reuse of pavement. FHWA has been a leader in this, in the recycling and reuse of materials in highway applications, and we support that and encourage you to promote that in the policy.

*Jim Mack/ACPA:* One of the items discussed earlier that we like is the addition of LCA to the process, and looking at that, sustainability is going to become much more of an issue in the future. To date, the process may not be as readily available as LCCA, but it is close. We think we need to start thinking about those activities.

We would also like to express that recyclability does not automatically equal sustainability, just as with LCCA, the numbers need to be run to determine the best alternative. We agree that when a product needs replacing, and it can be recycled, it is a positive versus disposal. However, in some cases, a more sustainable solution may be to use a product or material that, due to long-term performance characteristics, does not need such frequent replacement (with the associated energy and environmental impacts).

*Brian Killingsworth/NRMCA:* The policy and guidance should encourage competition. Competition fosters innovation that saves taxpayer dollars, which we can then extend to other parts of the system.

Life-cycle thinking involves both cost analysis and environmental analysis. Recycling and reuse is an extremely important part of the sustainable equation, but it has to be holistic. FHWA has taken a giant step in the Sustainable Pavements Technical Working Group. A lot of good information has come from that very good report and very good methodology. It is not ready for prime time, but we are very close. So I think life-cycle thinking can be adopted and referenced in the policy based on the work done by FHWA with the inclusion of industry.

### **Asset Management, Preservation, Structural Capacity**

*Jim Mack/ACPA:* We believe a positive aspect of the NRS is the recognition that asset management principles are included. However, we believe the current rules will not produce the desired results because the measures do not capture the structural components of the pavement system. We think that is a good process that should be built on. However, we also recognize existing issues with the asset management program. The intent of the process is good; however, the way the process is currently being implemented is forcing States to use a “worst first” type of strategy, and there is sometimes a hyper-focus on preservation. We suggest a mix of strategies, because preservation is good but it may not always be the best solution.

We should remove rules that artificially constrain the class of activities that pavement funds can be spent on simply because they do not fit within an arbitrary definition. Specifically, preservation treatments are defined as activities that do not increase the structural capacity of a system. This means some activities are excluded when they could be the most cost-effective solution but are not eligible because they add structure to the pavement. Restrictive uses of money need to be discontinued so that the State DOTs can determine the best use of available funds.

*Audrey Copeland/NAPA:* We agree with the comments made regarding certain preservation choices not being available for use because they add structural capacity. That definitely needs to be changed.

*Brian Killingsworth/NRMCA:* In terms of rehabilitation/structural capacity, I appreciate the point that was made that we are looking typically at the surface, and that is what we are rehabilitating. Particularly when we get into situations in which the pavement has been utilized significantly more than what it was originally intended for, we need to have rehabilitation activities that address the ability to add structural capacity for when we are going to have to get into the base and do full-depth reclamation, etc.

The rehabilitation concerns, the asset management mentality, is another part that should be addressed in the policy and the guidance.

### **Safety**

*Audrey Copeland/NAPA:* NAPA fully supports the consideration for safety in the NRS. While safety is currently listed in the NRS, FHWA should consider making it more of a main focus.

The State associations NAPA works with have a high concern for work zone safety. Consideration during this policy update process should also be placed on work zone safety, as well as time spent in work zones.

Regarding work zones, I think States could use help with them on multiple levels. A big issue for contractors is keeping their workers safe; we are actually seeing an increase in work zone fatalities. If there is guidance or incentives that could be given to States in terms of work zones, it would be worth looking into. It may not necessarily belong in the policy, but it may be good to consider moving forward because getting work zones to move as quickly as possible may not be the safest choice for workers.

*Travis Chewning/NSSGA:* I am really encouraged by some of the strategic objectives that are out there for FHWA, specifically around safety and innovation. Safety and innovation go hand in hand. This is a collaborative area in which effort can be made to ensure everyone gets home safely.

## Research

*Travis Chewning/NSSGA:* The current guidelines do a great job of making sure that the products we use in public transportation are well researched. We would like to see more interest in the research side in order to continue to look into innovative solutions.

I respect FHWA's responsibility to promote innovation in this highly regulated, high-risk environment. In terms of reducing risk, experimentation and research are needed. Promoting experimentation in the right environment can better inform research.

## Mechanistic-Empirical Pavement Design Guide (MEPDG)

### *Strength of base and calibration*

*Travis Chewning/NSSGA:* From an industry perspective, NSSGA recognizes that FHWA considers the use of AASHTO's MEPDG and Pavement ME critical to improving the highway system, but the concern continues to be whether the model appropriately represents the strength characteristics of the unbound aggregate layer in the structure. The results significantly understate the value the structural contribution of the aggregate base layer has in terms of the model's recommendations. We have worked hard as an industry in the past few years to share those thoughts with FHWA as well as the State associations. Currently, NCHRP study 01-53 is trying to address these issues. Moving forward, NSSGA's concern is with how those results will be incorporated into the model and how the results will be communicated to various State agencies. The more that can be done to promote communication and facilitate sharing of best practices is a benefit. A new policy can help promote that.

*Audrey Copeland/NAPA:* Local calibration of equivalent designs using MEPDG: in addition to the local calibration of equivalent designs mentioned in Round One, there should be some consideration for other design methods. Several States, including Illinois, Texas, and California, have developed their own mechanistic pavement design methods, and those should be able to be recognized. There are also other design methods available, such as PAVExpress, which do account for AASHTO 93/98, which a majority of States are still using, and also account for mechanistic design principles, which have been recognized by States such as Washington and West Virginia.

## AASHTO Pavement ME

*Leif Wathne/ACPA:* We like that the NRS encourages the development of mechanistic pavement design procedures and provides guidance on some aspects related to overall good pavement engineering practice. However, some significant updating is needed, as already pointed out by some of the previous speakers. The revision should include removing all references to AASHTO 93, to be replaced with AASHTOWare Pavement ME. The adoption of Pavement ME as a best practice for design of new and rehabilitated conventional concrete and asphalt pavements needs to be strongly encouraged when using Federal funds. For non-conventional pavements, such as interlocking concrete pavers, States should be encouraged to use the most up-to-date process, which for concrete pavers is a modified AASHTO 93 procedure.

We recognize that some States have and/or are developing mechanistic-based programs of their own, and we support their use. We also recognize that modeling issues and calibration efforts may make some States reluctant to accept all or part of Pavement ME. As such, in the interim we suggest FHWA inform States that, when necessary, they can use different mechanistic design processes for concrete and asphalt, including the use of Pavement ME for one pavement type (concrete) and not for another (asphalt). The concrete industry believes that Pavement ME is ready for full implementation with national calibration and encourages FHWA to recommend its adoption even if the asphalt side is not.

*Travis Chewing/NSSGA:* Regarding the comments on AASHTOWare Pavement ME Design, the more we rely on sophisticated design tools like these to inform pavement design, the more it is really important to understand the research and the underlying models to ensure that it is producing objective and accurate design recommendations. With good research and good education on how to use them and on the pros and the cons, I think this a very solid tool.

On alternative designs at the local level, I agree that looking at alternatives is an important way to promote innovation. Also, it is important for the public to see there is continued accountability and promotion of quality and performance in all we do.

*Brian Killingsworth/NRMCA:* We absolutely agree that right now, AASHTO Pavement ME is the most scientifically robust design software available. I also completely agree that other methodology should be utilized or can be utilized. An area where FHWA can provide more guidance is in the idea of design equivalence. When we get to life cycle thinking, in terms of equivalent design, that part of it, I think for those who are doing the boots-on-the-ground work, can be confusing. Some guidance there would be very important so that we are getting equivalent designs to compare when we get to the life cycle aspect of it.

## Communication

*Leith Wathne/ACPA:* Regarding what is not working with the pavement policy, we do not believe it is being clearly and uniformly interpreted, communicated, and enforced by the FHWA Division Offices. Too many pavement decisions are being made on initial cost only, something our industry believes is inconsistent with the existing policy. The policy needs strengthening by requiring State DOTs to demonstrate they have complied with its provisions, including ensuring they have given detailed consideration to both the engineering and economics of the alternative pavement designs being considered.

ACPA's written comments stated that many States are not complying with the Federal pavement policy, which they believe requires States to consider alternative combinations of materials as well as life cycle cost, and that FHWA is not enforcing these Federal requirements appropriately. The ACPA estimates this costs taxpayers roughly \$5 billion each year, according to industry and MIT estimates, and urges FHWA to take a firm posture in helping insulate the Federal-aid program from local influence and politics.

*Audrey Copeland/NAPA:* On FHWA's current website, it can be difficult to locate the prevailing policy (from 1999) and how it falls into place. An updated website or repository for disseminating active policy and guidance is recommended.

*Travis Chewning/NSSGA:* I appreciate the comments on improved information sharing. Bringing that back to the strategic platform of innovation, if you share information and really empower people with research and policy and guidance and best practices, it facilitates new thinking and new ideas.

## Technical Advisory T5040.39A

### What Works

#### Discount Rate and Bid Adjustment

*Brian Killingsworth/NRMCA:* The policy is well written and there is good guidance, particularly in the areas of equivalent designs and how to use the discount rate and bid adjustment. The technical advisory is a positive step in combining all those things together, and it gives a clear and concise methodology. It is encouraging that the guidance does direct States under the policy to perform activities that result in real net savings, which is another part of design cost effectiveness.

*Leif Wathne/ACPA:* We think the TA is very well written and the overall guidance on equivalent designs, discount rate, LCCA bid adjustments, consideration of uncertainty, commodity price adjustments, material quantities, etc., should be the basis for all pavement type selection at the project level. It is good, sound guidance that can and does direct States to activities that result in real net savings. An example is given in ACPA's written remarks (see Appendix B).

We believe that the guidance on requiring equivalent designs and directing States to use real discount rates that are consistent with current OMB circular A-94, Appendix C are good and should be continued. Also, we believe the guidance on using LCCA bid adjustments to account for future maintenance and rehabilitation costs to determine the lowest responsive bidder is warranted and ensures the best use of Federal dollars. The TA on alternate bidding is also very good guidance, and we think it has netted some real savings on the Federal-aid Program.

### What Could Be Improved

#### Use of Alternate Bidding

*David Smith, ICPI:* In the alternative bidding pavement type section, consider adding language on alternate bidding based on pay items that include LCA for the manufacturing and construction phases. The thrust here is to combine LCA with LCCA to find the more cost effective and performance-effective selection. This positions the State Highway Agencies to not necessarily have to accept the lowest bid price based on initial costs alone, but instead select the best performing option from economic and environmental analyses.



Note: Specific suggestions for items to update, add, and/or clarify are identified in written comments submitted by ICPI (see Appendix B).

## Communication

*Audrey Copeland/NAPA:* Some State Asphalt Pavement Associations are reporting that their State DOTs or their FHWA Divisions are interpreting the TA as a mandate. NAPA suggests FHWA should post a disclaimer on all TAs, stating that TAs are purely advisory in nature. The FHWA Contract Administration Core Curriculum Manual contains an example of this type of disclaimer.

*Leif Wathne/ACPA:* While we believe that overall the TA is well done, we do see States not following its guidance and implementing poor practices. Too many are developing alternate processes or ignoring portions of the TA, such as not including LCCA bid adjustments, which in turn are biasing the alternative pavement type bidding (AD/AB) process. We would like to see FHWA more clearly communicate that requirement in the TA and ensure that States consider all the requirements when using Federal dollars on AD/AB projects.

In summary, the current policy is clear, it just needs to be more uniformly communicated and interpreted by the Division Offices.

## Equivalent Designs Using DARWin-ME

*Audrey Copeland/NAPA:* NAPA suggests FHWA update the TA (Section 6a) to the new name (AASHTOWare Pavement ME) and include guidance to encourage local calibration for equivalent designs. It is very important on the flexible pavements side, in order to get accurate results, that local calibration is performed. While FHWA also recognizes the importance of local calibration, NAPA suggested this could be more prominent.

## Commodity Price Adjustments and Material Quantities

*Audrey Copeland/NAPA:* NAPA asserts that commodity price adjustments are desirable for alternate bidding projects in order to maintain equivalent levels of material cost risk, increase competition, and encourage more aggressive bidding from various size small contractors, because it helps them be able to manage their bids. NAPA would like FHWA to reconsider that part of the TA (Section 7b) to maintain that, overall, it results in a lessening of the disparity of risk and competing alternatives.

In terms of price adjustment clauses, what we have found through our research, is that the use of commodity price adjustments does result in more equivalent levels of material cost risk, which in turn results in more equal treatment among alternate materials. Without these price adjustments in the alternate bid environment, alternatives utilizing a commodity that is fixed price have a substantial bidding advantage over alternatives using a volatile commodity, and therefore a difference in risk. FHWA can help level the playing field by giving States the option to include that consideration.

NAPA recommends deleting the section on material quantities (Section 7d), as there is no basis for the statement that “Using materials pay items that are based on weight or mass may result in cost overruns.” Alternate bid awards are based on the total project cost, not pavement items. So whether it is bid by weight or mass or area should not matter. Consideration should be given to deleting that statement.

*Leif Wathne/ACPA:* The “consideration of uncertainty” is an important principle that needs to be built on in order to produce more robust solutions. Likewise, directing States to account for items such as commodity price adjustment, quality price adjustments, and material quantities should continue. Any item that impacts the initial construction costs and changes what is bid by a contractor and what is paid by the agency needs to be accounted for to ensure the comparison of alternatives is truly representative of what each pavement design will ultimately cost the agency.

*Jim Mack/ACPA:* One contentious issue within the AD/AB and LCCA processes is the use of Price Adjustment Clauses. We firmly believe the guidance in the TA is good guidance and strongly encourage its continued use. It is difficult to administer equal treatment to various alternate materials, and the use of commodity price adjustments will result in different levels of material cost risk being included in the bid for alternate pavement types.

Having said that, we also want to point out that recent research from Georgia found that there was “no evidence indicating that offering price adjustment clauses leads to more bidders or less dispersion of submitted bid.” Based on these results, we question why FHWA and states would continue to expend precious resources on a program that does not reduce risk or offer any benefits, and recommend that they be discontinued.

In the Economic Analysis section, in addition to the language on variability of inputs, language should be added directing agencies to account for Price Adjustment Clauses (indexing) and Material Quantity Specifications. These items will impact how contractors bid and what is actually paid for during initial construction and needs to be accounted for to have an accurate comparison between competing alternatives.

## Life Cycle Cost Analysis

### *Bid Adjustments*

*Audrey Copeland/NAPA:* The current TA (Section 7a) states “bid adjustments should be used,” and NAPA suggests that the language be softened to “...may be used.” Consideration should be given to whether historical data shows a significant cost difference in maintenance and rehabilitation and salvage values of alternatives, considering the same level of service. The desire is to get the same level of service over the life of the pavements and be able to compare the two.

The LCCA bid adjustment should not be used, especially in conditions of market volatility where prices may be changing rapidly through escalation or de-escalation. This is where there is no reasonable means of estimating what future prices may be. In terms of having material-specific rates, discount rates, etc., it has been shown repeatedly to not be good economic policy. We believe the TA already addresses this uncertainty by recommending a probabilistic LCCA. So what we would encourage, is investing additional time and effort into achieving a more accurate LCCA method, and then also eventually getting to the probabilistic LCCA.

Real cost should go along with the probabilistic LCCA. We believe that conducting the LCCA should validate the historical performance and cost data, but not be used as an adjustment factor on a bidder’s price. If FHWA does decide to use this LCCA bid adjustment, then the commodity price adjustment should be allowed. The current TA puts some contractors at a disadvantage.

### *End-of-Life Considerations*

*Audrey Copeland/NAPA:* Provide additional guidance on end-of-life considerations for pavements. In most cases, asphalt pavements are never removed completely, and thus have significant salvage value that should be reflected in the LCCA.

### *Calculation of User Costs*

*Audrey Copeland/NAPA:* Consider including calculation of user delay costs, which are included in the United States Code's definition of LCCA. Tools have been developed to calculate these costs and are readily available.

*Jim Mack/ACPA:* User costs due to Pavement Vehicle Interaction (PVI) should be added as well.

### **Major Rehabilitation**

*Audrey Copeland/NAPA:* Define "major rehabilitation." The State Asphalt Pavement Associations have expressed concern over the vagueness of what could be defined as "at least one major rehabilitation cycle."

### **Review Process**

*Audrey Copeland/NAPA:* Considering the TA guidance directly impacts cost estimates, LCCA determination, and bidding approaches, NAPA suggests the TA be reviewed with input from experts with practical experience in fiscal management. NAPA also recommends that the TA and any guidance FHWA publishes on these policies be reviewed by AASHTO.

### **What Must be Considered in Pavement Design?**

*Jim Mack/ACPA:* In terms of establishing the load carrying capacity, those items—materials, traffic, climate, maintenance, and drainage—are all things we need to be looking at. I think we are all pointing out that some sort of environmental consideration needs to be part of that definition. For example, we have project-level activity where we do engineering and economic considerations, but we don't have anything in there that talks about environmental considerations. It's an iterative process. We can include cost and environmental considerations while we're designing so that we can optimize our cross-section for those as well as traffic. For the definition, that is something I see as a gap.

*David Smith/ICPI:* A comment on your comment: add at the end an environmental LCA and leave it open. Understanding that LCA involves looking at a many phases: manufacture, construction, use-phase, end life. I think you can put it in the policy and address it in the NRS as manufacture and construction with a view toward developing use-phase and end of life assessment tools. Just keep it open.

*Jim Mack/ACPA:* I agree the sustainability aspect should be included. Something else that is becoming top of mind for a lot of groups is resiliency—recoverability from disasters. We need to take that into account as we design. That should be included also.

*Shiraz Tayabji/ACPC:* I want to re-emphasize what I stated before. In the definition of end of life for life cycle cost, always designate a period of time.

*Audrey Copeland/NAPA:* I want add to the end of life considerations. I agree that sustainability should be a consideration of the environment, but it needs to be kept very general. Everyone is saying, "We're

close, but we're not there yet," so we just need to be very mindful of helping States get there versus going ahead and putting it in a regulation or rule. There are other aspects to consider in terms of environmental impacts. There are other agencies that deal with that on a project basis as well. There needs to be some consideration given there. I think drainage probably addresses it, but foundation is a very important consideration during pavement design. Maybe it's better to call that out specifically.

*Travis Chewing/NSSGA:* I would like to address the comments just made around foundation. I think that's important in pavement design. If it's not built on a good foundation then it's not good. It's going to have a very hard time standing the test of time.

*Jim Mack/ACPA:* I like where we are going with that, and we should maybe even broaden it further. States are asking, "How about structure?" "What about layers?" "How do I put my layers together?" It's the materials that go into it, the structure itself, somewhere that needs to be included in the policy. It needs to go into the non-regulatory. I think that is where a lot of the agencies are lost. "How do I develop a rehab schedule that is realistic in design?" There are a lot of other ways to account for end of life. It's going to be different for each, and we need to be able to tie those together. But that gets back to the supplement.

*Leif Wathne/ACPA:* I think the policy or the regulation should be very high level. If you're going to use Federal dollars under the Federal-aid program, you must consider these things. How you do it is more technical, and States should be afforded the flexibility to do that. However, they cannot reflexively pick one material. We see that as inconsistency with policy because it relates to stewardship. FHWA has a vested interest there and should be consistent in overall guidance.

*Audrey Copeland/NAPA:* I would maintain that FHWA is doing that now. I could go through a list of ways FHWA encourages that. Yes, it's challenging to do in this country with 50 States and Division Offices, but the framework that FHWA has set up allows for and encourages that.

## **Pavement Life/Design Life: What Should be Part of the Guidance?**

### **Technical Guidance, LCA/Environmental Parameters**

*Shiraz Tayabji/ACPC:* I think there needs to be uniform design in pavement for the States and Federal-aid for States with primary highway systems. Short-term life being used in States is hard to answer, but there are short-term budgetary units. I think we must officially establish recommendations. Where it is guidance or recommendation for what, officially, the expectations are in terms of how long new pavement or rehabilitated pavement are expected to last. It comes down to how much can we afford to disrupt traffic for a given period of time.

*Brian Killingsworth/NRMCA:* Traditionally we think of that in terms of what that initial design life is. That's what we typically design for; we look at service life, and that is what we utilize in our LCCA. Then we know we have a true surface life. Because we don't have enough money to fix what we have, it is therefore in place much longer than intended. The bridge industry has accepted this fact. They realize most bridges are lasting longer than they anticipated. It's not so unusual to see in design guidance—you're designing for a 100-year surface. This is based off the facts of seeing bridges last this long.

I think we do need to provide some guidance on that. Whether it is part of the definition or in the non-regulatory. I think we should make the expectations clear. I don't know how we do that yet, because suddenly you are setting a mandate that says "you must do it to the expectation."

*Leif Wathne/ACPA:* It is a good question. One way to restate it is, if policy says, “If you apply a Federal dollar on a pavement segment, you will not apply another Federal dollar on that pavement segment for 30 years,” for example. Let the State decide. It could be innovative. You force industry to come up with solutions that meet that expectation. That could be one way to do it. If you make a Federal investment, you want to make sure it lasts a long time. We would rather have industry compete and innovate to solve that problem.

*Shiraz Tayabji/ACPC:* It has to tie in to performance expectations. What are the expectations for pavements to remain in solid condition? When you’re talking about service life, it should maintain the performance criteria as stated in this guideline for a period of time without additional repairs and protection. Something like that can be incorporated.

*Richard Willis/NAPA:* From a pavement design standpoint, I think we do ourselves a disfavor by talking about pavement life in terms of years instead of in traffic. Because we design for the level of traffic that we’re putting on the roads. The policy even states, “To accommodate current predicted traffic needs in a safe, durable, and cost-effective manner.” If we start saying you can’t put another Federal dollar down for 30 years, but Walmart puts a distribution center next to that road, you then meet that traffic need in 5 years instead of 20 years. If it lasted 15 years, then we get 10 extra years of life that we were not expecting. When we start talking about this in terms of years, we need to understand that there are some things we may be hamstringing the industry on, or the States on, because of that choice of language.

*Jim Mack/ACPA:* This may tie in with what Shiraz said, and I agree with Richard. Maybe we need to stop thinking about design as an issue of rehabilitation. We have to answer, “What are we going to do with this system for the next 50 years?” “What are my next steps?” “What is the next step after a preservation treatment?” We need to account for this in the asset management process and the allocation process. I have the same amount of money: I can get a lot of pavements or I can get few pavements. What’s the long term application of that system and how will we maintain that system?

*Bill Vavrik:* *How long do these roads stay in place? As we get better with new tools, we’re actually able to predict that a lot closer. How does that impact what we are talking about today? How does that impact the guidelines or policy?*

*Leif Wathne/ACPA:* Some States have adjusted; I think Wisconsin has a 40-year life design, at least on concrete. States don’t want 20-year pavements. I think the constraint of 20 years came from the Federal-aid program or the interest program being a 20-year program. Pavements were designed to last until the end of the program, and States would handle maintenance. The investment was only to construct it, and maybe the 20-year period is an artificial constraint carried on through history. People want more from their pavement. It’s a great question.

*Jim Mack/ACPA:* If you want to design for 20 years and fix it, that’s fine. Account for future impact in your evaluation period. Think in the long term.

## **Automated Vehicles**

*Bill Vavrik:* *Building off that, talking about future traffic and future traffic needs. We will probably include automated vehicles. How should the guidelines or policy address that?*

*Audrey Copeland/NAPA:* We've been looking into this at NAPA. What I've found through my own research is what's important to us now will be important to us in the future. Good road condition; roads that are smooth and well-marked. Eventually we will move away from pavement markings, but that's still a long way away. What's important to us now will be important for automated vehicles in the future. Two things to think about: there should be encouragement for research in terms of pavement designs and pavement mixtures. Next, the National Highway Transportation Safety Administration is looking at this in terms of human-interaction road signs to robotic interaction. At this point, I don't think it belongs in policy because FHWA is figuring out where they belong in this structure.

*Brian Killingsworth/NRMCA:* You've also got to consider the roadway could be used as an energy source. You see it in Europe; they're generating energy with the use of roadways.

*Audrey Copeland/NAPA:* I think that's a really good point. What other uses besides just being a surface can pavements provide?

*Vicki Schofield/AASHTO:* I think, relative to automated vehicles, there may be a point in time where the road itself may be communicating with the vehicle. It may not be that the vehicle has wheels on pavement, they could be above the surface, but it still needs to communicate with the surface because that's the track. That could be 20 to 30 years down the road, but there has been a lot of progress made with automated vehicles.

*Leif Wathne/ACPA:* We held a session last year with people from various agencies, including TRB, FHWA, and industry, and we asked, "What is the future of transportation?" "What are roadways?" "What is concrete's role within that?" That session and the work that followed taught us change is coming. We're looking at another 70 million people in the United States by 2040 to 2045. That's the current populations of Texas, Florida, and New York combined. That growth is going to increase the amount of freight that will probably be connected on an autonomous network.

The second thing is pavement, in urban areas in particular, real estate is going to be expensive, and therefore we cannot afford to allow pavements to only serve one purpose. Whether it's storm water capture, energy storage, charging electric vehicles, or a communications backbone. It has to be adaptable, and how will the policy capture that? I think it's probably premature. That's a very difficult challenge, but we should be thinking about those things. It's eye-opening to listen to all these people from different industries and sectors talk about this. It's important and we need to prepare for it.

## Road User Consistency

*Bill Vavrik:* Consistency from State to State for the use--What does that mean in terms of what we're doing here today? What does that consistency mean regarding the regulation's policy guidance?

*Shiraz Tayabji/ACPC:* This ties into the pavement performance policy. The user wants to have uniform standards across States, at least for a Federal highway system. They define the different pavement types down to roughness and smoothness requirements. As long as the smoothness requirements are met, most users are happy with it. One thing we have not discussed is noise; we are looking for smoothness and safe texture. I think we should include surface texture in the policy discussion.

*Brian Killingsworth/NRMCA:* There is an impact to that. Take into account asset management. We look at a particular serviceability factor, one which Shiraz rightly pointed out is typically smoothness. When

you cross a State line, you hope to at least hit some minimum level of smoothness. That also drives the way we maintain our roadways. We're not looking at it holistically. We try to fix the worst roads first. That could cause some issue with how you spend money, and not having resources to add capacity when you need it.

*Audrey Copeland/NAPA:* Building off the smoothness topic, we've done surveys and in-depth interviews of drivers, and it does come down to smoothness. This is more of a question for FHWA, which they will not answer today, but it is something to consider. You also have pavement performance rulemaking where we're determining conditions of the highway and later set bars for State DOTs. Those smoothness requirements, the IRI requirements, are loose and States are admitting in public they are setting loose targets. On one hand, I understand. On the other hand, what can be done to improve performance? It's something for FHWA to think through as stewards of Federal money and while looking at this policy.

*Jim Mack/ACPA:* Building on that, I agree smoothness is important. Is that the only thing that matters to the driving public? We need to think about traffic disruptions, noise, and effects on fuel efficiency. What are the sustainable aspects of this? Right now, we are focused on one thing. Expand on that. We need to think beyond just what my everyday standard usage is.

*Leif Wathne/ACPA:* I'll just add, smoothness is important, but I think from a stewardship perspective, FHWA's role is certainly to encourage and enable States to maintain that smoothness, but in a fiscally responsible way. We address this with asset management. We need to find ways to ensure we get it to the lowest cost to the user. That's where I see opportunities for improvement.

## Innovation

*Bill Vavrik:* Within what we're doing in pavement regulations, policies or guidelines, what's the best way to address innovation?

*Leif Wathne/ACPA:* I think that FHWA can do a better job of getting States to embrace the concept of competition in alternative combinations of base and surface materials. I think innovation comes out of competition, from which we can all benefit. A policy like the pavement design policy can underscore the importance in stewardship of having States actually consider those alternative combinations. That will help with innovation. It will move all of us forward and provide the solutions at a lower unit cost to the public.

*Audrey Copeland/NAPA:* I agree with innovation. That's how products and pavement types distinguish themselves, through function, design, quality, production, speed of construction, and innovation. What we found to be successful is partnerships, working with the Federal government as well with the State Highway Agencies. Whatever FHWA can do to foster that collaborative environment is very helpful. We're working with FHWA on pilot sections in different States to simply increase density and improve performance. It's something very simple, but it's hopefully going to result in changes in construction processes for different States that are going to improve. I suggest concentrating on that field—getting out there and doing the experimental projects and trials. Research is very important, and FHWA has an entire arm dedicated to research, but getting in the field I think is key.

*Matt Reiffer/ACEC:* I think the more we can do to promote collaboration, the better. I think providing an environment where there is incentive for competition that drives innovation but also, from a research standpoint, some ways to have a balanced view. Not to be overly influenced by one perspective or

another, which I think FHWA tries to do a really good job at. I think finding ways to allow States to be more experimental, it takes money to do that. If FHWA could fund some of that in a modest and very thoughtful way—anything we could do to help with the initiative.

## Collaboration

*Bill Vavrik: I've heard collaboration come out as a theme. Are there models of collaboration and working together that you've seen work well?*

*Jim Mack/ACPA:* I think this is good. When I first came to the industry about 30 years ago, there was a lot more State-to-State interaction. That interaction has shrunk tremendously. Having State-to-State interactions is important. Let's have that State-to-State interaction. Going back to peer exchanges would be extremely helpful in allowing different States to do that.

*Leif Wathne/ACPA:* I'll add to Audrey's comment—In terms of FHWA, I think they've done a good job shepherding some of that collaboration. We kind of heard it repeated in several of the comments here. Not just on the research side, but implementation. If you spend 1 million dollars on researching something, you're probably going to spend 2, 3 or 5 million dollars to actually implement it. That's where a lot of the heavy lift comes in. FHWA plays a unique role in that regard. For the reason they can help be an agent for change. They can help take on some of the risk, even the pilot projects, for example. I think they do a really good job with the accelerated implementation program, specifically around this concept of trying to push innovation, and research done at Turner-Fairbank and other places and putting it into practice. I think that's a good model.

*Audrey Copeland/NAPA:* I think something that's probably missing from this discussion is the contracting process. We're in a low-bid environment, which in some cases does not always encourage innovation. I think it would be worthwhile for FHWA to also consider thinking about providing guidance for the contracting and bidding process.

One of the examples in our industry is intelligent compaction. For asphalt, it's obviously a very useful technology, and contractors using it have found it very useful. A few years ago, it was considered very innovative. But the problem is that with funding for certain projects, there's no incentive to invest. It's a capital investment at the end of the day, and there's no incentive to invest in that. What can we do, in terms of either the contracting process or in providing additional funding, that would help incentivize using these innovative technologies on projects? My overall comment is there is lots of discussion about the contracting process. There are States that have value engineering who can suggest something that will improve the project engineering or the cost, but it's not widespread.

## Pavement Design Methods

*Bill Vavrik: What will it take for a pavement design method to be accepted within the guidance?*

*Shiraz Tayabji/ACPC:* I think you need to reword the question, how can we consider different design procedures as equivalent?

*Jim Mack/ACPA:* I like that question. What I think is important is local calibration of the pavement. We agree it needs to be done. On the concrete side it's less important. There have been a number of studies to show that the national calibrations are good but in certain States we can't implement concrete until



we implement asphalt. We would like guidance to say, “Use whatever is best out there. You don’t need to have them the same.”

The equivalency can be accounted for in realistic performance projections, “What will this have to perform like?” “What’s your realistic rehabilitation strategy for that, and what’s the cost?” I can come up with an equivalent section based on cost by doing a very robust LCCA. If I can take into account the risk and commodity price adjustment, I can come up with the most cost-effective option. Here is the least risky and what’s going to provide best value. It needs to be a very holistic lifecycle thinking approach.

*Audrey Copeland/NAPA:* I would just add, what do you expect of pavement? What you’re designing to and if you’re confident in the different methods under this policy, they’re allowed.

## Safety

*Bill Vavrik:* What is the best way to address safety in the pavement guidance? How should that safety come into play?

*Vicki Schofield/AASHTO:* AASHTOWare also has a safety analyst software product that takes crash data and analyzes it based on road segments. I know their performance requirements at the Federal level are a part of MAP-21. We need to start looking at some of those and how they apply to pavement. Let’s look at other factors for crashes.

*Audrey Copeland/NAPA:* If you look at pavement design considerations on safety, they encourage the pavement to be skid resistant. It also addresses updating the pavement, in terms of the work zones, minimizing disruptions for safety. They are suggesting a periodic analysis of wet weather crashes on all standard surfacing types, a systematic process to identify, analyze, and correct hazardous skid locations. If a State is following that, I imagine they might have an idea of the effect via pavement. I think, based on reading this one more time, overall I’m happy with the approach. I think it addresses the work zone safety and the pavement safety itself. It just might need to be a higher priority. Especially if it’s become such a high priority with FHWA.

## Appendix B: Pavement Design Policy Written Comments

### Advanced Concrete Pavement Consultancy

#### **§626.2 Definitions**

Pavement design means a project level activity where detailed engineering and economic considerations are given to alternative combinations of subbase, base, and surface materials which will provide adequate load carrying capacity. Factors which are considered include: Materials, traffic, climate and maintenance, drainage, and life-cycle costs.

#### **Suggested changes:**

ADD at end of first sentence: ...over a designated period of time (or something that brings in service life expectations)

#### **§626.3 Policy**

Pavement shall be designed to accommodate current and predicted traffic needs in a safe, durable, and cost effective manner.

#### **Suggested changes:**

Pavement shall be designed to be durable over a designated period of time and accommodate current and predicted traffic needs in a safe, sustainable, and cost effective manner.





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December 21, 2018

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Re: Pavement Design Policy Written Comments

The concrete pavement industry appreciates the opportunity to provide verbal comments during the December 14, 2018 listening session on FHWA's pavement design policy and guidance. The comments below are offered in addition to those verbal comments.

We have framed our responses both around the topics of interest outlined in the original invite, as well as from discussions during the listening session. While the listening session was primarily related to Pavement Design Policy and Guidance and we do believe there are updates needed to these pavement policy and guidance documents, (especially to the *Non-Regulatory Supplement*, 23 CFR Part 626 (NRS)), we also believe that FHWA needs to update other guidance documents that are related to the broader pavement type selection process (including FHWA's *Interim Technical Bulletin: Life Cycle Cost Analysis in Pavement Design* FHWA-SA-98-079, and the *RealCost* LCCA program).

Fundamentally, we believe that current federal pavement policy (as expressed in the *Pavement Type Selection; Policy Statement*, and *Pavement Policy*) **requires** states to consider alternative combinations of materials, as well as life cycle cost. Unfortunately, many states don't comply with this policy and FHWA is not enforcing these federal requirements appropriately. This lack of action upon FHWA's part is arguably costing taxpayers money – roughly \$5 billion each and every year, according to industry and MIT estimates. By rectifying these stewardship oversights, U.S. departments of transportation could complete more than 10% additional infrastructure work at no additional cost to the taxpayer.

We caution against FHWA weakening their policy and guidance in the pavement design and type-selection areas. FHWA serves a critically important stewardship role in the federal aid program, not the least of which involves ensuring that the public receives full value for their highway dollar. There is a long history behind the idea of providing an additional and independent level of oversight, especially when the sums are so vast (upwards of \$44B

annually). It makes good financial sense to ensure that some of the key programmatic and stewardship decision-making is once-removed from where the moneys are actually spent. We urge FHWA to take a firm stand and posture in favor of good governance and stewardship, and help insulate the process from local influence and politics. This is in fact one of the primary roles FHWA division offices should play in the context of federal stewardship of federal highway dollars.

Our written comments to your topics of interest are provided below:

**1. What is working with the aforementioned Pavement Design Policy and technical guidance? What do you like?**

**Title 23 CFR 626 Policy Discussion –**

*As noted in 626.2, Pavement design means a **project level activity** where detailed engineering and **economic considerations** are given to **alternative combinations** of subbase, base, and **surface materials** which will provide adequate load carrying capacity.*

***Factors which are considered** include: Materials, traffic, climate, maintenance, drainage, and **life-cycle costs**.*

- a. Overall, we think the Policy as written is clear and gives the states the flexibility to develop design procedures that are appropriate for their conditions; while still providing an outline of the process and stating what the key factors are that need to be addressed.
- b. We like that the policy recognizes there are alternate combinations of materials that can provide the needed load carrying capacity of the pavement (e.g. there is no one “right” pavement design for any application) and that there are multiple pavement design options that will work for almost all applications.
- c. We like that the policy specifically ties “design” together with safety, durability and cost effectiveness and recognizes that cost effectiveness of the pavement is defined using life cycle costs, as per the 626.2 Definition.
- d. When taken together, we like the policy’s tone and tenor, essentially relating pavement design to BOTH engineering and economic considerations and believe that it directs states to ensure one of the important elements of stewardship - competition.

**Pavement Design Considerations Non-Regulatory Supplement NS 23 CFR Part 626**

- a. We like that the Non-Regulatory Supplement (NRS) encourages the development of mechanistic pavement design procedures, such as Pavement ME, and believe it (Pavement-ME) should be firmly positioned as a best practice for the design of new and rehabilitated conventional concrete and asphalt pavements. For non-conventional pavements, such as interlocking concrete pavers, the states should be encouraged to use the most up to date process, which for concrete pavers is a modified AASHTO 93 procedure.
- b. We like that the NRS provides guidance on some aspects related to overall good pavement engineering practice, such as widened lanes.

- c. Similar to the 23 CFR 626 Policy, we like that the NRS ties the “design” together with the “Economic Analysis” and specifically to Life Cycle Costs Analysis (LCCA).
- d. Finally, we like that it states project specific analysis should be evaluated considering the needs of the entire system, which is essentially recognition of the importance of Asset Management (see additional discussion in response to Question 5).

**Technical Advisory T 5040.39A Use of Alternate Bidding for Pavement Type Selection**

- a. Overall, we think the TA is very well written and that the overall guidance on equivalent designs, discount rate, LCCA bid adjustments, consideration of uncertainty, commodity price adjustments, material quantities, etc. (items in paragraphs 6 and 7) should be the basis for **all** pavement type selection at the project level.
- b. We believe that the guidance on requiring equivalent designs and directing states to use real discount rates that are consistent with current OMB circular A-94, Appendix C are good and should be continued.
- c. We also believe the guidance on using LCCA Bid adjustments to account for future maintenance and rehabilitation costs to determine the lowest responsive bidder is warranted and ensures the best use of Federal dollars.
- d. We believe that the “Consideration of uncertainty” is an important principle that needs to be built on in order to produce more “robust” solutions.
- e. Likewise, we believe that directing states to account for items such as commodity price adjustment, quality price adjustments and material quantities must continue. Any item that impacts the initial construction costs and changes what is bid by a contractor and what is paid by the agency needs to be accounted for to ensure the comparison of alternatives is truly representative of what each pavement design will ultimately **cost** the agency (not what is bid to the agency for a particular design).

It is important to note that such guidance can and does result in net real savings. One such recent example is Beckley Widening project in WV (WV Turnpike Project – Bid August 22nd, 2018). This was a rebid of a project where the original bid had only 1 bidder with a cost of \$111.9M. On the rebid using ADAB, there were 5 bidders and while the same contractor won, his winning bid was \$6M lower (even though the project scope had grown).

**2. What is not working with the aforementioned Pavement Design Policy? Where are you having major issues and what challenges do you have?**

**Title 23 CFR 626 Policy Discussion –**

- a. We do not believe that the *Pavement Policy* is being clearly and uniformly interpreted; communicated; and enforced by the FHWA division offices. Too many pavement decisions are being made on initial cost only – something our industry believes is inconsistent with existing policy. We believe that FHWA needs to assert its stewardship authority given by the policy and require states to demonstrate that they have complied with the provisions of the policy, including ensuring that state

DOTs have given detailed considerations to both the engineering and economics of the alternate pavement designs being considered.

- b. For any given project, there will be many different engineering solutions (combinations of subbase, base and surface materials) that are viable. However, the most cost-effective solution at any given time will be dependent on the prevailing economic conditions at that time; and since economic conditions are constantly changing, the only way to determine the most “cost effective manner” is to actually run an LCCA.
- c. It is important to note that ensuring that DOTs evaluate alternate structures, materials and cost effectiveness using LCCA does not constitute a mandate on which materials or design to use. The final pavement design and which material to use is still a state decision. Having said that, requiring an LCCA per the policy is about ensuring that good “business” practices are used to verify that all federal dollars are invested wisely. LCCA is simply a process that evaluates the total “cost of ownership” of different alternatives and should be fundamental to any Pavement Type Selection process. That is, just as FHWA would not accept a Pavement Type Selection process that used a design procedure that did not account for future traffic, FHWA should also not accept a Pavement Type Selection process that does not look at the total cost of ownership (i.e. future costs) to determine the most cost-effective solution for any given project.
- d. Finally, it is important to recognize that this viewpoint of including factors such as materials and life cycle costs is consistent with the current FHWA *Pavement Type Selection Policy Statement* (1981 FR Vol 46 No 195) which states:

*The policy is designed to provide the public with acceptable service at a minimal annual or life cycle cost while permitting maximum flexibility. The policy encourages the consideration of alternate designs and strategies in the type selection process. As used in this policy, pavement type includes both new and rehabilitated pavements including their components of overlays, shoulders, bases, and subbases. The FHWA policy can be addressed under the following four key issues:*

1. *Pavement type selection should be based upon an engineering evaluation considering the factors contained in the 1960 AASHTO publication entitled "An Informational Guide on Project Procedures."*
2. *Pavement type determinations should include an economic analysis based on life cycle costs of the pavement type. Estimates of life cycle costs should become more accurate as pavement management procedures begin providing historical cost, serviceability, and performance data. States without this data are encouraged to obtain it.*
3. *An independent engineering and economic analysis and final pavement type determination should be performed or updated a short time prior to advertising on each pavement type being considered.*
4. *Where the analysis reflects that two or more initial designs and their forecasted performance are determined to be comparable (or equivalent),*

*then alternate bids may be permitted if requested by the contracting agency. The Division Administrator shall review the analysis and concur in the finding or equivalency prior to PS&B approval. Price adjustment clauses where utilized would also have to be treated on an equal basis. This policy is written with the intention of taking advantage of fluctuating material prices while not compromising good design and pavement management practices.*

#### **Pavement Design Considerations Non-Regulatory Supplement NS 23 CFR Part 626**

- a. We think that the NRS is outdated and should be completely rewritten, including the removal of references to AASHTO 93 and replaced with reference to AASHTOWare Pavement ME.
- b. With regard to design guidance, we firmly believe that the FHWA and NRS should strongly encourage the adoption of Pavement ME as best practice for all federal aid pavement projects and that the NRS should discourage the use of non-mechanistic procedures such, as AASHTO 72 and 93 for the design of new and rehabilitated conventional concrete and asphalt pavements. The AASHTOWARE Pavement ME design is the most scientifically rigorous and robust design procedure that not only defines the details of the pavement structure (subbase, base, and surface materials), but it also provides estimates of the pavement's performance, which can and should be used in developing "pavement specific" rehabilitation schedules for the LCCA on a given project.

Having said that, we recognize that some states have and/or are developing mechanistic based programs of their own and we support their use. We also recognize that modeling issues and calibration efforts may make some states reluctant to accept all or part of Pavement ME. As such, in the interim we would like FHWA to inform states that when necessary, they can use different mechanistic design processes for concrete and asphalt, including the use Pavement ME for one pavement type (concrete) and not for other (asphalt).

*Note: The concrete industry believes that Pavement ME is ready for full implementation with national calibration and encourages FHWA to recommend its adoption even if the asphalt side is not.*

- c. Regarding NRS policy on LCCA, we believe the wording is incompatible with the actual intent of the FHWA *Pavement Policy*. The *Pavement Policy* (23 CFR 626) says "Pavement **shall** be designed ... and cost-effective manner" while the NRS says "...pavements **should** include an engineering and economic evaluation..." We believe this to be inconsistent and should be rectified to say that LCCA **shall** be used.
- d. Similar to the design guidance, we also believe that the LCCA guidelines need to be updated to include the latest information and best practices; and should at a



minimum be updated to meet the requirements of the 2013 GAO LCCA Report<sup>1</sup>, including the full incorporation of the GAO Cost Guide's best practices.<sup>2</sup>

### **Technical Advisory T 5040.39A Use of Alternate Bidding for Pavement Type Selection**

As mentioned earlier, while we believe that overall the TA is well done, we do see states not following its guidance and implementing poor practices. Too many states are developing alternate process or ignoring portions of the TA, such as not including LCCA bid adjustments, which in turn are biasing the ADAB process. We would like to see FHWA more clearly communicate that requirement in the TA and ensure that states in fact DO consider all the requirements when using federal dollars on ADAB projects.

- 3. What is needed to address some of these 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?**

*Note: We are answering these questions together to add clarity and avoid redundancies. Also, the ideas expressed here are just a few of the issues. The concrete industry has ideas about how FHWA can improve their guidance and policy as it relates to pavement design, pavement selection, asset management and stewardship and we would like to provide additional guidance and input as these policy documents are updated. We are anxious to share this with FHWA in any and all appropriate forums.*

Overall, we believe there needs to be greater consistency between the three documents to encourage and ensure good stewardship of highway pavement expenditures (e.g. the Policy is a "shall" document and other others should follow its precedence.)

#### **Title 23 CFR 626 Policy Discussion –**

- a. While we believe that the Pavement Policy (23 CFR 626) is written clearly, we believe that the policy needs to be strengthened to require states to demonstrate that they have complied with the provisions of the policy – such as ensuring that they in fact have given detailed engineering **and** economic considerations to alternative combinations of subbase, base and surface materials, including factors such as materials and life cycle costs. This is also consistent with current *Pavement Type Selection: Policy Statement* (1981 FR Vol 46 No 195).
- b. Likewise, we think adding language around "sustainability" and "resiliency" would strengthen the policy and would recognize some our new realities that did not exist when originally written. Having said this, it is also important that the language remains a high-level framework with specific details covered in the NRS and TA documents.

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<sup>1</sup> Federal-Aid Highways: Improved Guidance Could Enhance States' Use of Life-Cycle Cost Analysis in Pavement Selection, GAO Report GAO-13-544, Washington, D.C., 2013

<sup>2</sup> GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs. GAO-09-3SP, Washington, D.C.: March 2009

**Pavement Design Considerations Non-Regulatory Supplement NS 23 CFR Part 626  
Technical Advisory T 5040.39A Use of Alternate Bidding for Pavement Type Selection**

As both the NRS and TA documents are intended provide more detailed guidance on design, LCCA and other issues associated with pavement type selection, many of our comments on what needs added and updating apply for both. Having said that, we also believe that of the two, the NRS is the most outdated (needs the most work and should be completely rewritten), and therefore any discrepancies between the NRS and the Alternate Bidding TA document should defer to the Alternate Bidding TA as it has the most up to date information and higher relevance.

Some of the specific items to be updated or added to the NRS include:

- a. Update information on traffic to move away from ESALs
- b. Update Foundations and Drainage references. Include a description of how the base requirements for asphalt and concrete pavements differ. For example, a 600 mm (23.6-inch) base is not required for a concrete pavement due to how it distributes loads to underlying layers differently than asphalt pavement. Likewise, the reference that drainage is particularly important to concrete pavements needs to be removed. Research<sup>3,4,5</sup> shows that for doweled concrete pavements, which is what most state DOTs would be building, drainage has little impact on faulting and other non-material performance issues.
- c. Update the recommended widening of the shoulder to 12 inches for Concrete Pavements. The recommended widening of the shoulder by 0.5 m (~20-inches) is too wide for concrete pavements and can cause longitudinal cracking.
- d. Strengthen the language in the NRS to ensure that good stewardship and competition is used. Our reading of the current pavement type selection policy plainly requires states to consider alternative combinations of materials (i.e. JPCP, CRCP, HMA, Warm-mix etc.), but states are not held to this federal requirement. We would like to see FHWA more clearly communicate that requirement in the NRS and ensure that states in fact DO consider all the viable pavement alternatives when using federal dollars (including possibly withholding federal dollars from states that do not have policies and practices that encourage industry competition).
- e. In the Economic Analysis section, in addition to the language on variability of inputs add language directing agencies to account for Price Adjustment Clauses (Indexing) and Material Quantity Specifications. These items will impact how contractors bid and what is actually paid for during initial construction and needs to be accounted for to have an accurate comparison between competing alternatives.

Some of the specific items to update and add to the TA include:

- a. While we believe that Works Zone User costs are important and need to be evaluated, better guidance Work Zone Traffic management can be provided,

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<sup>3</sup> NCHRP 1-34: Subsurface Drainage for Pavements

<sup>4</sup> NCHRP Report 583: Effects of Subsurface Drainage on Pavement Performance: Analysis of the SPS-1 and SPS-2 Field Sections

<sup>5</sup> Incremental Cost & Performance Benefits of Various Features of Concrete Pavement (FHWA Report FHWA-HRT-04-044, April 2004)

including early opening requirements for concrete and other such things to keep analysts from developing unrealistic scenarios.

- b. It is also important to recognize that many different Work Zone Traffic management scenarios could be performed in the future when the pavement requires rehabilitation and that the alternative selected will impact the results. As such, we recommend that greater emphasis on the uncertainty of Future WZ Users Costs be included.

Some of the specific items to update, add and/or clarify for **both** the NRS and TA include:

The *Engineering Economic Analysis* sections direct agencies to FHWA's *Interim Technical Bulletin: Life Cycle Cost Analysis in Pavement Design* (FHWA-SA-98-079, September 1998) and FHWA's *Demonstration Project 115: Probabilistic Life Cycle Cost Analysis in Pavement Design* for detailed LCCA guidance. While these references are good for keeping consistency, these sources are also need updating to incorporate newer information and sources; including the recommendations from *2013 GAO LCCA Report* and incorporation of the *GAO Cost Guide's Best Practices*. This update should include updating guidelines to provide improved guidance on cost estimating including on how to account for:

- a. Real Price changes and materials cost escalation – real price change does exist, and the LCCA process needs to account for it. To account for real price changes in a LCCA requires two items:
  - i. LCCA process must be able to account for “real price changes” when it does exist. The current FHWA / DOT guidelines for pavement LCCAs do not, even though most other non-pavement applications of LCCA do.
  - ii. There needs to be a process to predict future “real price” changes. MIT has developed “real price forecasting models” that are ready to be implemented<sup>6,7</sup> but others could also be developed. For example, the U.S. Energy Information Administration predicts three scenarios for oil prices (1- high oil price scenario, 2- reference price scenario and 3- low price scenario) for 20+ years into the future that could be used as basis for a real price forecasting model.
- b. Bid Quantities – Need to account for project size and Economies of Scale in developing cost estimates. See footnote<sup>8</sup>.
- c. Incidental Cost – There are two issues with incidental costs such as traffic control, Engineering and Inspection (E&I), mobilization, etc. The first deals with initial construction and basing non-paving (incidental) costs on a percentage of pavement costs, which can overestimate these costs for the higher cost alternative. For example, adding a 20% E&I cost on a \$12M alternate vs \$10M alternate will add an

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<sup>6</sup> Swei, O., Gregory, J., and Kirchain, R. Probabilistic Approach for Long-Run Price Projections: Case Study of Concrete and Asphalt. *Journal of Construction Engineering and Management*. 2016.

<sup>7</sup> Mack, J., Swei, O., Akbarian, M., Gregory, J., and Kirchain, R. A Review of Pavement Economic Studies at the MIT Concrete Sustainability Hub. Presented at the 13th International Symposium on Concrete Pavements, Berlin, Germany, 2018.

<sup>8</sup> M. Akbarian, O. Swei, and J. Gregory, Probabilistic Characterization of Life-Cycle Agency and User Costs: Case Study of Minnesota, *Transportation Research Record: Journal of the Transportation Research Board*, No. 2639, 2017, pp. 93–101. 2017

- additional \$400k to the first alternate for essentially the same activities. Such costs should be developed and applied consistently to all alternatives as they will be approximately the same. Note this could be avoided if initial construction incidental costs were just left out of the analysis, but not all agencies leave it out. The second issue deals with rehabilitation incidental costs and leaving them out. While initial construction incidental costs can be left out as they are about the same value and occur at the same time, rehabilitation incidental costs cannot be left out and must be included because they occur in different years; in different quantities; and in the number of times that they occur. Therefore, due to the time value of money, their values will be different.
- d. Rehabilitation Selection - provide improved guidance on selecting multiple rehabilitation strategies that consider uncertainty and variability, including recognizing that more than one sequence of activities are possible, and agencies should use multiple rehabilitation scenarios that could be performed (rather than the standard, policy-set, rehabilitation schedule applied to all pavements of a given type currently used by most DOTs). There are many different rehabilitation scenarios that could be performed when the pavement requires rehabilitation, and which one is selected will impact the results. This can be done using probability analysis and decision tree analysis.<sup>9</sup>
  - e. User Costs – in addition to the WZ user costs modifications, we believe that user costs due to Pavement Vehicle Interaction (PVI) need to be added. This should include the PVI from IRI, PVI due to structure and PVI due to textures (that is, any PVI that can be calculated in an LCA needs to be included). Recent research looking into PVI user costs in MN has shown that they can be higher than WZ user costs.<sup>10</sup>
  - f. Risk Analysis - Update guidelines to show practitioners how to properly consider risks (ranges of inputs and outputs) so the results are more “robust,” which can minimize the LCCA being manipulated to get a particular “desired” answer.
  - g. Develop and Provide guidance on including LCA results in the process. One potential way is to convert CO<sup>2</sup> into dollars using the cost of carbon.
  - h. Probabilistic Analysis - We believe that the discussion on using Probability Analysis and the FHWA RealCost LCCA program<sup>11</sup> is good and should be continued. However, we also believe that the cost probability should be built around the pavement unit costs rather than the total project costs (i.e. initial costs, Rehab 1 costs, etc.) as done currently. DOT’s have more and better information around individual bid items and they can build better cost probability models around the unit costs than they can around the total costs for a given, unique project.

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<sup>9</sup> *Developing Robust Rehabilitation Scenario Profiles for Life Cycle Cost Analysis*, J.W. Mack, J. Gregory, PhD, R.E. Kirchain, PhD; Proceedings of the 11th International Conference on Concrete Pavements, San Antonio, TX, Aug 28-Sept 1, 2016

<sup>10</sup> Probabilistic Characterization of Life-Cycle Agency and User Costs Case Study of Minnesota, M. Akbarian, O. Swei, R. Kirchain, & J. Gregory, *Transportation Research Record: Journal of the Transportation Research Board*, No. 2639, 2017, pp. 93–101. <http://dx.doi.org/10.3141/2639-12>

<sup>11</sup> FHWA Realcost 2.5: <https://www.fhwa.dot.gov/infrastructure/asstmgmt/lccasoft.cfm>

- i. We believe that FHWA should recommend as good practice to incorporate LCCA cost estimating into the design process so that LCCA's are more representative of the specific pavements being evaluated (i.e. use an iterative process).
- j. We believe guidance is needed on how to use Equivalent Uniform Annual Cost (EUAC). Some states have elected to EUAC instead of Net Present Value in their LCCA's in the belief that it allows for comparison of alternatives with different lives (e.g. a preservation activity vs a reconstruction activity). This is not correct. With EUAC, the basic assumption is that a whatever is being evaluated will be indefinitely repeated. That is, the Agency will always use a 2-inch AC overlay that last 10 years or a 10-inch concrete pavement that last 35 years. Neither case is likely. The next AC rehab may need to be 3-inches AC overlay and the concrete pavement will not be replaced at the 1st rehab - it will be diamond ground, or overlaid. As such, to compare alternates of different lives, the agency still needs to map out the entire life cycle of the alternatives over a substantially long analysis period to the point when the activities are again repeated.

**5. Is there anything else you would like us to know, be aware of, or add related to pavement design issues?**

As we noted in our response to Question 1. above, we believe a positive aspect of the NRS is the recognition that asset management principals are included (e.g. "project specific analysis should be evaluated in light of the needs of the entire system").

Having said that, we believe that the current rules will not produce the desired results because the measures do not capture the structural components of the pavement system.

- a. There is need for better measures that capture the structural components of the pavement system. The current condition performance indicators are "delayed" indicators that do not help program activities and instead promote "band aid approaches." We believe that new measures that are "forward looking" need to be developed and implemented. These forward-looking measures need to tell "how long" a pavement will remain in a certain condition; how it may change over time; and how a particular activity will impact those characteristics.
- b. A similar view was expressed by Kirk Steudle (Michigan DOT) at the most recent AASHTO Council on Highways and Streets meeting in Atlanta, Georgia, where he stated that the current Asset Management and Performance Measures rules were inadvertently forcing states into a "worst first" strategy – in direct contradiction to both stated congressional intent, and good asset management practice. ACPA supports revisiting the Pavement Condition and Asset Management rules to address these significant shortcomings, and commits to (again) submit comments and suggestions to help improve the rules in order to address their stated intent.
- c. We need to remove unsubstantiated "rules" that artificially constrain the class of activities that pavement funds can be spent on simply because they don't fit with a arbitrary definition. Specifically, preservation treatments are defined as activities that do not increase the structural capacity of a system. This means activities such

- as Full Depth Reclamation with Cement and Concrete Overlays are excluded when they could be the most cost-effective solution (often winning on initial costs); but are not eligible because they add structure to the pavement. Restrictive uses of money need to be discontinued so that the state DOTs can determine the best use of available funds, be it preservation or complete reconstruction whatever the funding source.
- d. We think it is in FHWA's (and taxpayers) best interest to make it clear to agencies that best practice in stewardship requires a focus not only on project considerations, but also programmatic considerations. Often, states look at the impact of ADAB or LCCA as it relates to a project and miss the broader programmatic implications. Stewardship of taxpayer dollars should involve a program of projects – not just a single project. Part of the spirit of FHWA pavement type selection policy speaks to this issue exactly. E.g. not selecting concrete for projects because they may have higher initial costs, can have the unintended consequence of dismantling an entire industry and therefore inflating costs of the remaining and dominant industry as there is no competing alternative. FHWA should dedicate resources to train states in stewardship best practices.

**Other issues raised during the listening sessions that we feel compelled to provide comments on:**

- a. One contentious issue within the ADAB and LCCA processes is the use of Price Adjustment Clauses. We firmly believe the guidance in the TA is good guidance and strongly encourage its continued use. It is difficult to administer equal treatment to various alternate materials, and the use of commodity price adjustments will result in different levels of material cost risk being included in the bid for alternate pavement types.
- b. Having said that, we also want to point out that recent research from Georgia<sup>12</sup> found that there was “no evidence indicating that offering PACs leads to more bidders or less dispersion of submitted bid.” Based on these results, we question why FHWA and states would continue to expend precious resources on a program that does not reduce risk or offer any benefits, and recommend that they be discontinued.
- c. It was stated that there is no proof that accounting for “material specific inflation” (aka Real Price Changes, changes in relative prices, and constant dollar changes – all of which mean the difference between a specific material or product's inflation rate and the general rate of inflation) does not improve results. This is not correct. MIT research<sup>13</sup> has shown accounting for real price changes is more accurate than current practice of assuming no price change. Furthermore, it also needs to be

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<sup>12</sup> Effects of Price-Adjustment Clauses on Number of Bidders and Dispersion of Bid Prices in Highway Construction, M. Ilbeigi, and D. Castro-Lacouture, Georgia Institute of Technology, ASCE Journal of Management in Engineering, published online on March 3, 2017

<sup>13</sup> Research Summary: Material Price Projections for Pavement Life Cycle Cost Analysis, <http://cshub.mit.edu/news/research-summary-material-price-projections-pavement-life-cycle-cost-analysis>. Also see the other MIT results on this subject at <http://cshub.mit.edu/pavements/lcca>

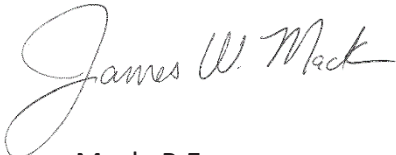
noted that the assumption that prices will remain the same is still a prediction of the future that we know it is not realistic. Finally, if the process for real price change did not improve results, it would not be recommended, endorsed and used by many Governmental Agencies including:

- The Office of Management & Budget (OMB) Circular A-94, section 7
  - GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs
  - Economic Analysis Primer, FHWA Publication Number FHWA-IF-03-032, August 2003 (pp. 10-11)
  - ASTM standard E 917 “Standard Practice for Measuring Life-Cycle Costs of Buildings and Building Systems.”
  - Life-Cycle Costing Manual for the Federal Energy Management Program, Department of Commerce,
- d. During the meeting, it was implied that recycling a material automatically makes it a more “sustainable material.” We disagree. We do agree that when a product needs replacing, and it can be recycled, it is a good and positive thing rather than disposing of the material. However, a more sustainable solution may be to have a product / material that does not need recycled because it has long-term performance characteristics, and does not need replacing. Thus, to avoid issues with “green washing”, we believe FHWA should focus on using Life Cycle Assessment rather than solely promoting recycling as a sustainable practice. The truth is that we have no way of knowing whether a particular recycling practice is sustainable unless we perform a LCA and compare with other alternatives. Envision a pavement material that needs to be replaced every few months, but it almost entirely recycled. Is use of such a material sustainable simply because it is recycled? Arguable not, since there are materials available that do not need such frequent replacement (with the associated energy and environmental impacts or necessitates).
- e. Also raised during the meeting was the position that Price Adjustment Clauses (PACs) ensured a competitive market while real price changes did not improve LCCA results. The fact is, both of these describe the same underlying issue – the volatility of price changes (one short term and the other long term). In this context, the key point to recognize is that the use of PACs in the bidding process to account for price movement and not accounting for real price changes / material specific inflation in the LCCA are inconsistent philosophies that distorts the marketplace. The fact is both do exist, and the evaluation process must be able to account for these fluctuations.
- f. Another issue raised during the listening session related to how material quantities are handled in the ADAB Technical Advisory (T5040.39). As noted in the guidance, asphalt and concrete pavements are specified using different methods for materials quantities. We firmly agree that using materials pay items that are based on weight or mass may result in cost overruns compared to an agency’s quantity estimates whereas using a materials pay item based on area is less likely to result in a materials overrun. We also agree that incurring material overruns will result in a higher cost to the agency than was anticipated and will likely invalidate the

economic analysis that is the foundation for the LCCA analysis. Further, we firmly believe that agencies should establish a process to monitor the actual agency costs of the completed pavement system and compare these costs to the estimated costs to the agency at time of award, to ensure that a systematic bias does not exist due to contract administration procedures. For alternate bidding scenarios, to avoid an unequal sharing of risk that would compromise the integrity of the bidding process, agencies should use the same type of method for materials quantities (i.e. specifying by area) for all alternates considered.

The concrete pavement industry genuinely appreciates the opportunity to provide input during this process. Please don't hesitate to reach out if you have questions or would like to discuss any of these items in more detail.

Sincere regards,



James Mack, P.E.  
2019 ACPA Chairman of the Board



Leif G. Wathne, P.E.  
Executive Vice President

C: Gerald Voigt, P.E.



## Fugro USA Land, Inc.

1. What is working with the aforementioned Pavement Design Policy and technical guidance?  
What do you like?  
The policy identifies most of the key parameters that affect the pavement design decision.
2. What is not working with the aforementioned Pavement Design Policy? Where are you having major issues and what challenges do you have?
  - a. There is no guidance on expansive soil treatment even though it impacts the performance significantly. Guidance on treatments on expansive soils is needed.
  - b. It is understood that it is challenging to accurately estimate user delay cost, but user delay cost is an essential part of LCCA and should be encouraged in LCCA by FHWA.
3. What is needed to address some of these challenges and concerns?  
Study and research are needed to better estimate user delay cost.
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?  
No guidance on expansive soil mitigation. Guidance on treatments on expansive soils is needed.
5. Is there anything else you would like us to know, be aware of, or add related to pavement design issues?  
No comment at this point.



December 19, 2018



**icpi**

Interlocking Concrete  
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Dear Heather:

Thank you for hosting the December 14<sup>th</sup> Industry Listening Session on FHWA's Pavement Design Policy and Guidance. ICPI members and I appreciated the opportunity to comment on FHWA pavement policy. Comments along the lines provided last week follow, specifically on the three documents referenced herein with recommendations for your consideration. We are seeing increased use of interlocking concrete pavements in federal-aid highway projects in urban areas. Hence, our participation in this session.

An initial step could include updating the *Code of Federal Regulations*, Title 23 by adding the following text (**bold font**):

**§626.2 Definitions.**

Pavement design means a project level activity where detailed engineering and economic considerations are given to alternative combinations of subbase, base, and surface materials which will provide adequate load carrying capacity. Factors which are considered include: Materials, traffic, climate, maintenance, drainage, and life-cycle costs, **and environmental life cycle assessment.**

This addition frames LCA into the policy with the intent of examining environmental impacts as another means towards reducing costs. If current policy emphasizes cost reduction that might emerge from LCA and life-cycle cost analysis, then this obviates mentioning the politically charged notion of carbon emissions or global warming. More importantly, this addition places LCA on the radar of state highway agencies and municipalities that adopt state policies, technical guidance and construction specifications. Inclusion of life cycle analysis phases can be left to the discretion of state agencies based on available data from industry or other sources.

We appreciate *Federal-aid Policy Guide Non-Regulatory Supplement NS 23 CFR* (aka Pavement Design Considerations) dated April 8, 1999 recognizing AASHTO pavement design methods. Interlocking concrete pavement (ICP) has been used in some projects funded with federal highway funds. We encourage designers to use ASCE/ANSI 58-16 Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways because this national standard applies AASHTO flexible pavement design methodology to ICP. The application of AASHTO pavement design was originally proposed in a 1990 ASCE *Journal of Transportation Engineering* paper entitled, "Structural Design of Concrete Block Pavements" by Gonzalo Rada, John Miller, Matthew Witczak and me.

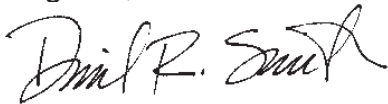
There is an opportunity to mention LCA and its impacts on potentially reducing life cycle costs. This section could be inserted in 4. *Engineering Economic Analysis*. Please consider inserting LCA here and framing it as another economic analysis tool via environmental impact analysis. This section can specifically mention FHWA tools and reports that support LCA from the FHWA Sustainable Pavements Program. Similar text mentioning FHWA tools to evaluate pavement rehabilitation should be noted in 5. *Rehabilitation Pavement Design*.

Section 1b *Pavement Design Factors*, specifically subsection 3. *Shoulder Structure*, part c encourages using similar pavement structures on the shoulder as in the travel lanes. While a cost-effective approach, it could preclude the use of permeable pavements. In some cases, permeable pavements on shoulders may be *more* cost-effective than traditional pavement, particularly on highways in high-density urban settings that present few options for managing stormwater. Benefits and design guidelines are provided in the 2013 NCHRP Project 25-25/Task 82 *Permeable Shoulders with Stone Reservoirs* developed at the request of the AASHTO Committee on the Environment and Sustainability. This report included a decision support tool to assist designers in determining site suitability for permeable pavements in road shoulders and elsewhere. Please consider modifying part c to include the following: "There may be exceptions where SHA's may consider other materials for shoulder pavements that support project LCCA, LCA, and stormwater permit requirements." This would allow consideration of permeable pavements.

Finally, general comments follow on the *Technical Advisory on Use of Alternative Bidding for Pavement Type Selection* dated December 20, 2012. While editing this Advisory is beyond my expertise, my sense is this document could include alternate bidding based on pay items that include LCA for the manufacturing and construction phases. This can be more useful than LCCA alone. Again, the thrust should be using LCA with LCCA to find the most cost-effective and performance-effective selection. This supports state agencies *not* being forced to accept the lowest bid price based on initial costs only, and instead provides justification for selecting the best performing option from economic and environmental analyses.

Thank you for your time and consideration.

Regards,

A handwritten signature in black ink that reads "David R. Smith". The signature is written in a cursive, flowing style.

David R. Smith  
Technical Director





December 28, 2018

U.S. Department of Transportation  
East Building, Room E73-469  
1200 New Jersey Avenue SE  
Washington, DC 20590

Re: Pavement Design Policy Written Comments

Dear Dr. Dylla:

The National Asphalt Pavement Association (NAPA) appreciates the opportunity to provide comments on the Federal Highway Administration (FHWA) Pavement Design Policy as defined by Title 23 CFR 626, Pavement Design Considerations Non-Regulatory Supplement NS 23 CFR Part, 626 and Technical Advisory T 5040.39A Use of Alternate Bidding for Pavement Type Selection. NAPA, with more than 1,100 member companies, is the only trade association that represents exclusively the interests of the asphalt producer/contractor at the national level before Congress, government agencies, and other trade and business organizations. NAPA's membership also includes companies and individuals who support the asphalt pavement industry, such as engineering consultants, construction equipment manufacturers and material suppliers. NAPA also partners with the State Asphalt Pavement Associations (SAPAs), which work directly with state highway agencies (SHAs).

In its request for comments, FHWA posed five questions regarding the current state of its design policy. NAPA will address four of these questions individually throughout these written comments.

*Question 1. What is working with the aforementioned Pavement Design Policy and technical guidance? What do you like?*

**NAPA believes FHWA's current policy and accompanying guidance strikes a balance that facilitates sound pavement type decisions (engineering analysis) that are cost-effective (economic analysis) without unnecessary burdens on SHAs and state departments of transportation (DOTs).** The federal-aid highway program is a federally assisted state program which NAPA fully supports. NAPA, as a policy, does not support pavement type or material mandates, thus we support FHWA's policy which allows and supports decision making by the SHAs with guidance from FHWA.

**NAPA supports FHWA's role in providing guidance to SHAs and supports FHWA policies that do not impose unnecessary regulations or mandates.** Each SHA faces

unique local design considerations that must be considered in pavement type decisions. SHAs need the flexibility to evaluate the current and future needs of their transportation network and to determine the most cost-effective way to ensure they maintain a high-performance system. For example, FHWA's current LCCA policy gives states the flexibility to develop LCCA methodologies that follow current best practices for sound economic analyses that suit their local needs. FHWA's current policy regarding LCCA states, "The FHWA fully supports and promotes sound economic analyses of highway investment alternatives that consider relevant costs and benefits over the full life of the facility... Alternative forms of LCCA are acceptable if they are consistent with principles of good practice."<sup>1</sup>

In addition, the United States Code tasks the Secretary of Transportation with developing recommendations for states to conduct LCCA based on principles contained in Section 2 of Executive Order No. 12893<sup>2</sup> and in consultation with the American Association of State Highway Transportation Officials (AASHTO); however, the code also states, "the Secretary shall not require a State to conduct a LCCA for any project as a result of the recommendations under this subsection."<sup>3</sup> Therefore, FHWA can and should suggest best practices for LCCA; however, it cannot mandate the methods a state uses to conduct an LCCA or alternative economic analysis. In addition to supporting FHWA's current Pavement Design Policy as defined by Title 23 CFR 626, **NAPA continues to support FHWA's efforts to address and update engineering economic analysis/LCCA guidance, which is included in the Pavement Design Considerations non-regulatory supplement.**

**The Pavement Design Considerations non-regulatory supplement also specifies that the engineering evaluation should include consideration of the use of recycled materials and/or pavement recycling techniques, where feasible.<sup>4</sup> NAPA supports this policy and its encouraged use.** This policy encourages the use of recycled materials, but not to the point of ignoring the engineering suitability and the economic benefits that may or may not be achieved with their use. This type of policy, which balances engineering and economics, has allowed the asphalt industry to make asphalt pavement the most recycled material, at a rate of 99%, in the United States, which lowers material and production costs and prevents additional construction waste from entering landfills. The asphalt industry not only recycles asphalt pavements, but it has also developed methods for incorporated small percentages of recycled tire rubber and reclaimed asphalt roofing shingles, among other waste and industrial byproducts, into asphalt mixtures. In fact, a

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<sup>1</sup> FHWA. 1996. Life-Cycle Cost Analysis. *Federal Registrar*, Vol. 61, No. 182 (61 FR 49187).

<sup>2</sup> Clinton, W.J. 1994. Executive Order 12893: Principles for Federal Infrastructure Investments. *Federal Register*, Vol. 59, No. 20. (59 FR 4233).

<sup>3</sup> 23 USC 106(f)(1). 2015. Title 23 United States Code, Chapter 1 Federal-Aid Highways, Section 106, Project Approval and Oversight.

<sup>4</sup> FHWA. 2002. *FHWA Recycled Materials Policy*.

<https://www.fhwa.dot.gov/legsregs/directives/policy/recmatpolicy.htm>

joint FHWA and NAPA asphalt pavement recycling survey has determined that reuse of asphalt material in pavements results in savings of \$2 billion dollars every year.

NAPA also fully supports the consideration for safety included in the Pavement Design Considerations non-regulatory supplement, especially that “[P]lans and specifications for pavement rehabilitation, reconstruction, and maintenance projects should include items to minimize disruption and ensure adequate protection of motorists and workers within the construction work zone”.

*Question 2. What is not working with the aforementioned Pavement Design Policy? Where are you having major issues and what challenges do you have?*

**NAPA’s primary concerns related to FHWA’s Pavement Design Policy stem from the interpretation of and information in the Technical Advisory, Use of Alternate Bidding for Pavement Type Selection (T. 5040.39).** In discussing the Pavement Design Policy with NAPA partners, several SAPAs report SHAs and/or FHWA Division Offices (DOs) interpreting the TA as a mandate. FHWA should emphasize that the TA is purely advisory in nature. The following language from the FHWA Contract Administration Core Curriculum Manual (FHWA-NHI-134077, page 7) should be added as a disclaimer for all TAs:

*Technical Advisories (TAs) contain permanent or long-term technical information that is purely advisory. They are not to be used to impose requirements or issue policy since FHWA Order 1321.1C terminated TAs as a category of directive. TAs are directed to the STAs, GSHRs, and local public agencies, as well as FHWA, as a means of describing “state of the art” or “state of the practice” for common items that support the FAHP.<sup>5</sup>*

In addition to concerns regarding SHAs interpreting the TA as a mandate, NAPA has also received significant concerns regarding commodity price adjustments (Section 7b), equivalent designs using DARWIN-ME (Section 6a), LCCA Bid Adjustments (Section 7a), and Material Quantities (Section 7d). Each of these topics will be briefly addressed below.

#### *Commodity Price Adjustments*

**NAPA asserts that the use of Commodity Price Adjustments for materials are desirable for alternative bidding projects in order to maintain equivalent levels of material cost risk, increase competition, and encourage more aggressive bidding from contractors of various sizes (e.g., small businesses).** A recent National Cooperative Highway Research Program (NCHRP) Project evaluated the perception and use of price indexing for transportation construction. In a survey of DOTs, almost 96 percent of the 46 DOTs surveyed believed the DOT itself benefited from the use of price-adjustment clauses. When contractors were surveyed, 82 percent believed the DOT

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<sup>5</sup> FHWA. 2014. *FHWA Contract Administration Core Curriculum Manual* (FHWA-NHI-134077). <https://www.fhwa.dot.gov/programadmin/contracts/cacc.pdf>



received a moderate to large benefit from the use of commodity price adjustments. However, when price-adjustment clauses are absent, 40 percent of contractors surveyed said they would be less likely to bid on procurement and 90 percent said they would build a price contingency into the bid.

A 2011 report from the University of Oklahoma evaluated the impact of commodity price adjustments on contractor bidding and survival. This report concluded that, “The indexation of selected input prices has induced more aggressive bidding especially from small firms, further confirming the stylized notion that they are generally faced with more adverse liquidity constraints, and have more to gain when investment risks are reduced.”<sup>6</sup>

FHWA’s TA on *Development and Use of Price Adjustment Contract Provisions*<sup>7</sup> states “For single season contracts price adjustment provisions should apply to all price-volatile materials and supplies which significantly affect the unit costs of major items. For example, fuel costs would probably have a significant effect on major items of a grade and drain project, but not on a traffic signal installation project.” It follows by saying, “For multiple season contracts, all price-volatile materials and supplies expected to be used should be subject to price adjustments.” Project alternatives using volatile commodities constrained by price adjustment provisions experience limited risk, limited bid inflation, and are therefore afforded near equal treatment (i.e., similar competitiveness) to alternatives utilizing a non-volatile (fixed price) commodity. In such cases, although the alternate-bid environment includes a commodity price adjustment for only the volatile commodity, it results in a more equitable treatment of the competing alternatives than when no price adjustment for any commodity is included. As such, it is reasonable for alternate-bid construction contracts to include commodity price adjustments provided the price adjustment inclusion results in a lessening of the disparity in risk among the competing alternatives.

In an alternate-bid environment, without commodity price adjustments alternatives utilizing a commodity with a fixed price have a substantial bidding advantage over alternatives using a volatile commodity because there is little to no risk associated with the future cost of a fixed price material. Conversely, alternatives that require the use of material derived from a volatile commodity (such as crude oil) experience substantial risk which may require contingencies and, as such, a bidding disadvantage.

As shown, research and past FHWA guidance indicate that the use of commodity price adjustments results in more equivalent levels of material cost risk which, in turn, results in more equal treatment among alternate materials. State DOTs have seen the benefit of such

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<sup>6</sup> Zhou, X., G. Kosmopoulou, and C. Lamarche. 2011. *On the Distributional Impact of Price Adjustment Policies: Bidding Patterns and Survival in the Market*. The University of Oklahoma.

<sup>7</sup> FHWA. 1980. *Development and Use of Price Adjustment Contract Provisions* (T 5080.3). <https://www.fhwa.dot.gov/programadmin/contracts/ta50803.cfm>

practices and, as of year-end 2018, 39 states publish and use price-adjustment indexes for asphalt binder and other construction materials, including diesel, cement, and steel.<sup>8</sup>

*Equivalent Designs using Darwin-ME (Section 6a)*

**NAPA recommends FHWA update the TA to use the new name AASHTOWare Pavement ME™ and include guidance to perform local calibration for the proper use of the program for equivalent designs.** The TA guides agencies to AASHTOWare Pavement ME™ as an approach for developing equivalent designs for alternate pavements used in alternate bidding. The models used in Pavement ME™, particularly for flexible pavements, are still evolving. Numerous NCHRP projects are currently underway, and the national models without calibration are not appropriate for a local design. Furthermore, most agencies have not calibrated and fully implemented the Pavement ME™ design approach, and some agencies may not have the data necessary to populate inputs into Pavement ME™. In FHWA's report *Local Calibration of the MEPDG Using Pavement Management System*<sup>9</sup>, the authors state: "Before the MEPDG can be fully implemented, it has to be calibrated using actual pavement design input and response data to ensure its validity and accuracy." Until proper calibration and validation are complete, and there is confidence in the design outcomes of Pavement ME™ supported by agencies' experience, the use of Pavement ME™ to develop equivalent designs may not be valid. AASHTO even realizes the need for local calibration. AASHTO recently announced that the next version of AASHTOWare Pavement ME™ Design will include a local calibration tool to aid states in completing this task. It should also be noted that PavementME is not necessary to have design alternatives that are considered equal, as indicated in the TA. The designs need to be able to carry the loads over the design life considering factors as outlined in the FHWA's current pavement design policy and associated definition.

In addition to the AASHTOWare product, FHWA should also acknowledge that numerous other states, including California, Minnesota, Texas, and Illinois, are using locally developed mechanistic-empirical design procedures and have built design systems grounded on local materials and performance. These design methodologies are equally valid for pavement design as AASHTOWare Pavement ME™ and should be recognized/allowed in all FHWA pavement design policy and guidance.

**NAPA agrees with FHWA that developing equivalent designs are difficult.** FHWA should also note that equivalent designs using two different types of design (empirical vs. ME) is even more problematic due to the differences in traffic inputs and fatigue characterization. For example, using the 1993 AASHTO Design Guide, a pavement will continually get thicker with additional traffic, but this does not consider the fatigue capacity of the asphalt materials. In addition, comparing equivalent single axle loads (ESALs) to load spectra in ME can be difficult to reconcile. Research has shown that

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<sup>8</sup> NAPA collects for internal purposes published information about material price adjustments from state DOT websites, SAPAs, and other public sources..

<sup>9</sup> FHWA. 2010. *Local Calibration of the MEPDG Using Pavement Management Systems* (HIF-11-026). <https://www.fhwa.dot.gov/pavement/management/pubs/hif11026/hif11026.pdf>

applying a limiting strain approach can help determine appropriate minimum and maximum design thicknesses for long-life asphalt pavements. Therefore, if ME and 1993 AASHTO Design are to be considered equivalent, a maximum thickness criterion should be established based on research to ensure pavements are not overdesigned in comparison to an ME design.<sup>10</sup>

#### *LCCA Bid Adjustment (Section 7a)*

**NAPA disagrees that an LCCA bid adjustment should be used for all alternative bid projects and recommends that an LCCA bid adjustment may be used.** Consideration on this matter should be given to whether historical data shows a significant cost difference in maintenance and rehabilitation and salvage value of alternatives kept at the same level of service over their performance life.

An LCCA bid adjustment should not be used, especially in conditions of market volatility where prices may be changing rapidly through escalation or de-escalation, if there is no reasonable means of estimating what future prices might be. The TA already addresses uncertainty by recommending a probabilistic LCCA and the use of RealCost software based on real price and performance data. Conducting an LCCA should validate historical performance and cost data but should not be used as an adjustment factor on bidders' prices. If an LCCA bid adjustment is used, commodity price adjustments should be allowed.

Another area of concern is related to the language of "same level of service." In many states, two pavement types may not be held to the same standard. For example, when considering the smoothness of a pavement, some states will hold asphalt smoothness to a different standard than concrete pavements immediately post-construction and when initiating pavement rehabilitation work. The same level of service should be expected from all pavement types during the entire course of the pavement's life.

#### *Material Quantities (Section 7d)*

**NAPA recommends deleting this section.** FHWA has not provided any basis for stating that "Using materials pay items that are based on weight or mass may result in cost overruns." Alternative bid awards are based on the total project costs and not pavement items. It should not matter whether the bid is done by weight or mass or area. The cost of the project should be the same no matter how the bidding is completed.

*Question 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?*

**NAPA encourages FHWA to provide additional guidance on end-of-life considerations for pavements.** In most cases, asphalt pavements are never removed completely and, thus, still have significant salvage value that should be reflected in the life-cycle cost analysis. Guidance on calculating the salvage value of pavements has been given in research

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<sup>10</sup> Tran, N.H., M.M. Robbins, D.H. Timm, J.R. Willis, and C. Rodezno. 2015. *Refined Limiting Strain Criteria and Approximate Ranges of Maximum Thicknesses for Designing Long-Life Asphalt Pavements* (NCAT Report 15-05R). National Center for Asphalt Technology at Auburn University.

conducted by the National Center for Asphalt Technology in its review of LCCA procedures for the Alabama DOT.<sup>11</sup>

The TA should also define “major rehabilitation.” SAPAs have expressed concern over the vagueness of what could be defined as “at least one major rehabilitation cycle.” FHWA originally stated a major rehabilitation “consists of structural enhancements that both extend the service life of an existing pavement and/or improve its load-carrying capacity” in its *Memorandum on Pavement Preservation Definitions*<sup>12</sup>. However, this has since been superseded by *Guidance on Highway Preservation and Maintenance*,<sup>13</sup> which does not include a definition of major rehabilitation.

Additionally, the TA should consider including the calculation of user costs, which are included in the United States Code’s definition of Life-Cycle Cost Analysis: “a process for evaluating the total economic worth of a usable project segment by analyzing initial costs and discounted future costs, such as maintenance, user costs, reconstruction, rehabilitation, restoring, and resurfacing costs, over the life of the project segment.”<sup>14</sup> User delay costs during construction, maintenance, and rehabilitation are real costs incurred by the taxpayers. Tools have been developed that reasonably calculate these costs, and using such readily available tools should be encouraged, when possible.

**Considering the TA guidance directly impacts cost estimates, LCCA determination, and bidding approaches, NAPA requests that the TA be reviewed with input from experts with practical experience in fiscal management. NAPA also recommends that the TA and any guidance FHWA publishes on these policies be reviewed by AASHTO.**

*Question 5. Is there anything else you would like us to know, be aware of, or add related to pavement design issues?*

NAPA is aware that life cycle assessment (LCA) is a method that can be used to calculate the environmental impacts of processes and/or materials and we are active and support the continued development of LCA science for asphalt pavements. Over the past eight years, the FHWA Sustainable Pavements Technical Working Group has worked to promote and advance the use of sustainable pavements. This program has developed a reference guide<sup>15</sup> that offers agencies a catalogue of choices for making more sustainable decisions during pavement

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<sup>11</sup> West, R.C., N.H. Tran, M. Musselman, J. Skolnik, and M. Brooks. 2013. *A Review of the Alabama Department of Transportation’s Policies and Procedures for Life-Cycle Cost Analysis for Pavement Type Selection* (NCAT Report 13-06). National Center for Asphalt Technology at Auburn University.

<sup>12</sup> FHWA. 2005. *Memorandum: Pavement Preservation Definitions*.  
<https://www.fhwa.dot.gov/pavement/preservation/091205.cfm>

<sup>13</sup> FHWA. 2016. *Memorandum: Guidance on Highway Preservation and Maintenance*.  
<https://www.fhwa.dot.gov/preservation/memos/160225.cfm>

<sup>14</sup> 23 USC 106(f)(2). 2015. Title 23 United States Code, Chapter 1 Federal-Aid Highways, Section 106, Project Approval and Oversight.

<sup>15</sup> Van Dam, T., J. Harvey, S. Muench, K. Smith, M. Snyder, I. Al-Qadi, H. Ozer, J. Meijer, P. Ram, J. Roesler, and A. Kendall. 2015. *Toward Sustainable Pavements: A Reference Document* (FHWA-HIF-15-002).

design, production, construction, use, and maintenance. In addition, the program has developed a framework for conducting LCAs for pavements.<sup>16</sup> While both documents have aided in advancing the science of sustainable pavements, the documents also point to the complexity of LCA and gaps within the science. This group, as well as industry and academia, needs further time to continue to advance the knowledge to the point where it may one day be implementable.

While LCA is currently being conducted on pavement materials, there are still unreliable data for many paving mixture components in the United States. The current Product Category Rule (PCR) for Asphalt Mixtures outlines current data gaps that could be environmentally relevant for asphalt mixtures, including liquid anti-strips, recycling agents, warm-mix chemical additives, ground tire rubber and the energy used for recycling rubber, and polymers added to asphalt binders.<sup>17</sup> Similarly, the PCR for concrete materials suggests that sometimes upstream data do not exist and “thus results may be incomplete.”<sup>18</sup> The PCR for concrete materials also suggests filling data gaps for admixtures with European data, which may not be representative of the products and practices within the United States.<sup>20</sup>

There are challenges moving beyond the materials acquisition and production phases of LCA. Agencies are unable to capture how a contractor will construct the project (e.g., quantity and quality of equipment), which will ultimately impact the LCA results. As it currently stands, LCA for pavements is not complete enough to be used in drafting policy for pavement design/type decisions. While many components of LCA may be ready, until a more complete picture of the true environmental impacts can be given, LCA should be used “for information only” and not for pavement type selection. If FHWA does plan on reviewing its pavement design policy every 5 to 10 years, NAPA encourages FHWA to revisit this science at each appointed review to determine when the science is ready for implementation; however, FHWA should not make LCA policy until the science is ready and all pavement types can be judged from a transparent and equivalent methodology.

**NAPA encourages FHWA to first and foremost consider the positive impact of a well-maintained pavement on vehicle and GHG emissions and focus efforts on funding and maintaining a good condition highway network.** This priority is already addressed in FHWA’s effort to establish National Performance Measures for preserving, maintaining, and improving the Interstate and National Highway System (NHS); however, this performance measure should be well-established before adding emissions as a performance measure.

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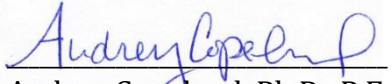
<sup>16</sup> Harvey, J., J. Meijer, H. Ozer, I. Al-Qadi, A. Saboori, and A. Kendall. 2016. *Pavement Life-Cycle Assessment Framework* (FHWA HIF-16-014).

<sup>17</sup> National Asphalt Pavement Association. 2017. *Product Category Rule for Asphalt Mixtures*.

<sup>18</sup> Carbon Leadership Forum. 2018. *Technical Committee Proposal for Version 2 of the Product Category Rules for ISO 14025 Type III Environmental Produce Declarations: Concrete*.

NAPA greatly appreciates the opportunity to provide comments on the Pavement Design Policy. If you have any questions or need more information regarding our comments, please contact us. We look forward to working with you.

Sincerely,



Audrey Copeland, Ph.D., P.E.

Chief Operating Officer



J. Richard Willis, Ph.D.

Sr. Director of Pavement Engineering & Innovation

cc: Craig Parker, 2018 Chairman of NAPA  
Mike Acott, President of NAPA