2024

Mid-Atlantic Peer Exchange on Balanced Mix Design (BMD)

Outcomes Summary

Washington, D.C.

November 14–15, 2024

PUBLICATION No. FHWA-HIF-25-008

U.S. Department of Transportation

Federal Highway Administration

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. FHWA-HIF-25-008	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Mid-Atlantic Peer Exchange on Balanced Mix Design (BMD): Outcomes Summary		5. Report Date January 2025 6. Performing Organization Code
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9. Performing Organization Name and Address Department of Civil and Environmental Engineering University of Nevada 1664 North Virginia Street Reno, NV 89557		10. Work Unit No. 11. Contract or Grant No. 693JJ32350026
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Highway Administration Office of Preconstruction, Construction and Pavements 1200 New Jersey Avenue, SE Washington, DC 20590		13. Type of Report and Period 14. Sponsoring Agency Code FHWA-HICP-40
15. Supplementary Notes FHWA Agreement Officer's Representative: Timothy B. Aschenbrener, PE.		

16. Abstract

Seven States from the Mid-Atlantic U.S. and the District of Columbia (the District) gathered for a peer exchange and discussion on implementation activities to support Balanced Mix Design (BMD). The peer exchange was sponsored by the Federal Highway Administration (FHWA). The seven States and the District met to assess the state-of-practice for the technology, tools, and techniques in designing, verifying, and accepting asphalt mixtures for different layers within the flexible pavement structure, as well as for overlays of different pavements following BMD emerging practices. The peer exchange was held in Washington, D.C. This summary report focuses on agency motivations for considering BMD, implementation challenges, key takeaways, and emerging themes.

17. Key Words Balanced mix design, pavement performance, mechanical tests, distress, implementation		18. Distribution Statement No restrictions.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 35	22. Price N/A

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
APA	Asphalt Pavement Analyzer
ARAN	Automatic Road Analyzer
BMD	balanced mix design
DDOT	District Department of Transportation
DOT	Department of Transportation
FHWA	Federal Highway Administration
FWD	falling weight deflectometer
GPR	ground penetrating radar
HWTT	Hamburg Wheel Tracking Test
IDOT	Iowa DOT
KYTC	Kentucky Transportation Cabinet
LTOA	long-term oven aging
MDOT	Maryland DOT
NCAT	National Center for Asphalt Technology
NCDOT	North Carolina DOT
NMAS	nominal maximum aggregate size
OBC	optimum binder content
PG	performance grade
PMS	pavement management system
QA	quality assurance
QAP	quality assurance program
RAP	reclaimed asphalt pavement
RAS	reclaimed asphalt shingles
SCDOT	South Carolina DOT
STOA	short-term oven aging
TSR	tensile strength ratio
U.S.	United States
VDOT	Virginia DOT
WVDOT	West Virginia DOT

INTRODUCTION AND PURPOSE

On November 14–15, 2024, seven States from the Mid-Atlantic United States (U.S.) and the District of Columbia gathered in Washington, D.C., for a peer exchange on implementation activities to support Balanced Mix Design (BMD). The peer exchange was sponsored by the Federal Highway Administration (FHWA). The seven States and the District met to assess the state-of-practice for the technology, tools, and techniques in designing, verifying, and accepting asphalt mixtures for different layers within the flexible pavement structure, as well as for overlays of different pavements following BMD emerging practices. This summary report focuses on State agency motivations for advancing BMD into practice, implementation challenges, key takeaways, and emerging themes. It should be noted that use of the specifications referenced in this document is not a Federal requirement unless otherwise noted.

PEER EXCHANGE GENERAL OVERVIEW

BMD focuses on designing asphalt mixtures to meet performance requirements rather than just volumetric requirements. Association of State Highway and Transportation Officials (AASHTO) PP 105-24 Standard Practice for Balanced Design of Asphalt Mixtures[1] describes four approaches for BMD, summarized as follows:

- ***Approach A — Volumetric Design with BMD Verification*** consists of using existing volumetric mix design along with additional mechanical tests and criteria.

- ***Approach B — Volumetric Design with BMD Optimization*** consists of using existing volumetric mix design to determine a preliminary optimum binder content (OBC) but allows moderate changes in asphalt binder content to meet mechanical test criteria. This approach is slightly more flexible than Approach A.

- ***Approach C — BMD-Modified Volumetric Mix Design*** allows some of the volumetric properties to be relaxed or eliminated as long as the mechanical test criteria are satisfied. The mechanical test results are used to adjust either the preliminary asphalt binder content or mixture component properties and proportions. This approach is more flexible than Approach A and Approach B.

- ***Approach D — BMD Design Only*** does not use volumetric properties and relies solely on the mechanical test results to establish and adjust mixture components and proportions. This is considered the most flexible approach.

[1]AASHTO PP 105 Standard Practice for Balanced Design of Asphalt Mixtures. American Association of State Highway and Transportation Officials, Washington, D.C., 2020. Use of this AASHTO specification is not a Federal requirement.

Participants

States represented at the BMD peer exchange included (Figure 1):

- District Department of Transportation (DDOT)
- Iowa Department of Transportation (IDOT)
- Kentucky Transportation Cabinet (KYTC)
- Maryland DOT (MDOT)
- North Carolina DOT (NCDOT)
- South Carolina DOT (SCDOT)
- Virginia DOT (VDOT)
- West Virginia DOT (WVDOT) (participated virtually)

Agenda

Day 1 of the meeting focused on each State's existing efforts on BMD, while Day 2 focused on future efforts planned on BMD. The following items were included in the agenda:

- BMD status.
- BMD goals, scope, and approaches.
- Benchmarking studies.
- Validation efforts.
- Challenges and lessons learned.
- Next steps toward implementing BMD within each Agency and needs for moving forward.

Questionnaire

Three weeks before the peer exchange, the attendees from the participating States and the District were asked to complete a short questionnaire pertaining to their BMD practices. Their responses are summarized in Appendix A.

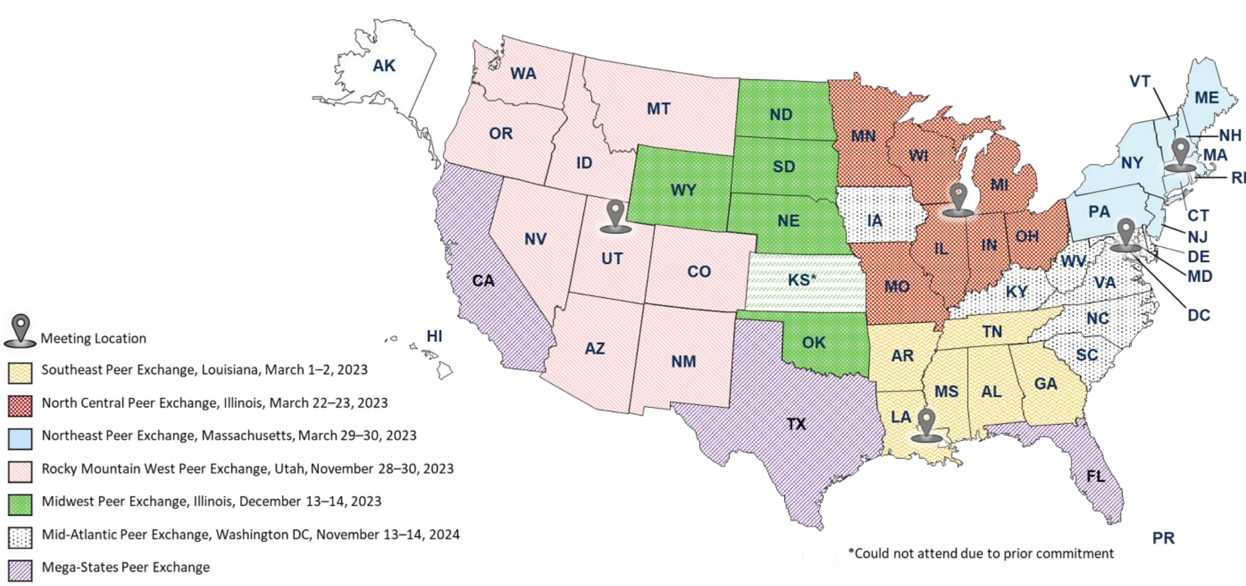

Figure 1. U.S. Map showing participating States in the Mid-Atlantic BMD Peer Exchange.

Motivations for Considering Moves to BMD Approaches

In the U.S., the Superpave[2,3,4] volumetric mix design is primarily used for asphalt mix design. Since its implementation in the late 1990's and early 2000's, State DOTs have identified performance challenges related to the Superpave, including cracking, raveling, and moisture damage[5], which have become the primary distresses controlling the service lives of asphalt pavements. A common motivation for changing from Superpave to BMD is that the traditional volumetric-based mix design procedure may not provide optimum performance for asphalt mixtures and lacks opportunities for innovation.

Reflective cracking, top-down cracking, thermal or block cracking, and moisture damage were reported as a major concern for the participating States and the District as they considered BMD approaches.[5] One State also reported the reduced surface friction characteristic for existing asphalt mixtures as an additional reason for considering BMD. A key benefit cited by multiple States was the potential to see longer-lasting and better-performing pavements by eliminating "dry mix" issues while reducing costs due to less frequent maintenance and rehabilitation activities. Furthermore, some States noted that they would like to simplify the mix design process through BMD implementation.

Some States discussed how BMD mechanical tests would provide contractors the opportunity to use higher percentages of reclaimed asphalt pavement (RAP) and other recycled or locally available materials while retaining pavement performance within the coming years. A State participant noted that their agency has been exploring BMD for high RAP (over 30 percent) asphalt mixtures. The early performance of these existing pavements has been promising. States also discussed the cost-saving benefits of using recycled materials such as RAP and reclaimed asphalt shingles (RAS). Further identified motives for moving to BMD approaches included increasing pavement performance in harsh or extreme winters.

SUMMARY OF CRITICAL CHALLENGES IDENTIFIED BY STATE PARTICIPANTS IN IMPLEMENTING BMD

State participants discussed how BMD mechanical tests assess the resistance of asphalt mixtures to common distresses and enable mix designers to better utilize resources responsibly. This use of recycled or other innovative materials can help the States achieve longer life spans for pavements. The goal is to utilize BMD for the optimization of RAP usage without jeopardizing long-term performance of asphalt mixtures.

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[2]Superpave system was developed under the Strategic Highway Research Program (SHRP), which was a 5-year, $150 million applied research program authorized by the Surface Transportation and Uniform Relocation Act of 1987. $50 million of the SHRP effort was dedicated to Superpave.

[3]AASHTO M 323 Standard Specification for Superpave Volumetric Mix Design. American Association of State Highway and Transportation Officials, Washington, D.C., 2024. Use of this AASHTO specification is not a Federal requirement.

[4]AASHTO R 35 Standard Practice for Superpave Volumetric Design for Asphalt Mixtures. American Association of State Highway and Transportation Officials, Washington, D.C., 2024. Use of this AASHTO practice is not a Federal requirement.

[5]Distress Identification Manual for the Long-Term Pavement Performance Program (Fifth Revised Edition). FHWA-HRT-13-092, FHWA, U.S. Department of Transportation.

However, State participants identified several specific challenges and themes that are summarized as follows. Overall challenges included communicating the benefits of BMD; adequate resources; testing needs and sources of variabilities; initial database setup; new materials and additives; BMD validation framework; historical usage of volumetric properties; and pathway for quality assurance (QA).

- **Communicating BMD Value, Telling the Story, and Identifying the "Why?"** State participants identified that industry and officials within State agencies often need to be convinced of the need for a change in practice. Furthermore, they noted the importance to identify and "document" the need for BMD and the primary goal, determine the scope, develop a plan for phased implementation, and determine how BMD can address the agency priorities.
    - *Process.* Communicating the importance of BMD to industry and agency leadership can be critical for further adoption. Messaging may include that BMD gives contractors flexibility in the mix design and materials selection. States noted the need to identify and document the "why" and the "goal" of their BMD approach. Several anticipated benefits were noted by most of the participants, including improved asphalt pavement performance, better ability to use recycled and local materials, reduced pavement cracking potential, and more sustainable and cost-effective asphalt mixtures.
    - *Gaps and Issues Identified by the State Participants.*
        - Having difficulties in hiring and attracting personnel in general, and in providing necessary certifications and training for technicians involved in BMD mechanical testing.
        - Having the necessary commitment and involvement from the industry toward the implementation of BMD.

- **Adequate Resources, Staffing, and Training.** State participants noted the difficulty of implementing new practices without the necessary staff and budget. Several States noted that they only had limited staff resources and highlighted the importance of meeting the timing requirements for testing within the short construction seasons. State participants also emphasized the necessity of retaining staff with expertise and availability to perform the BMD tests. Identified needs to address this issue included:
    - *Process.*
        - Provide training, education, and new qualifications for staff as needed.
        - Consider formal training workshops on new procedures.
    - *Gaps and Issues*
        - Increase training and staffing to support the implementation of BMD.
        - Get contractors on board with purchasing BMD test equipment for their laboratories.
        - Improve cooperation and collaboration between field and office staff, particularly for the acquisition of additional materials samples.
        - Address challenges such as staff wage rates, rotation, hiring, and retention.

- **Testing Needs and Sources of Variabilities.** Several testing needs and variabilities in materials and test procedures were identified by the State participants that could impact the implementation of BMD.

- *Sample handling and conditioning protocols*. States reported inconsistency or a lack of documented protocols on how to handle asphalt mixtures and compacted specimens due to logistic issues and practices, among others. State participants realized that greater care and more detailed procedures would be needed for mechanical tests than volumetric properties, as the former is significantly more sensitive to sample handling and conditioning.
- *Aging Protocols*. Aging protocols for BMD tests vary from one State agency to another and were raised as a key issue within variabilities.
  - There is a need for an asphalt mixture aging procedure that can be implemented during production and QA.
  - Several States noted that asphalt mixture aging is still a significant factor to consider with BMD tests, especially given the ongoing challenges during production with long and variable transportation time between job sites and laboratories. The handling and conditioning methods still need to be defined and implemented.
  - The aging effect on BMD test results may be more critical for asphalt mixtures with RAP and additives.
  - Questions were raised during the discussion regarding the influence of short-term oven aging (STOA) versus long-term oven aging (LTOA) on BMD test results and asphalt mixture performance. Similar concerns were raised about lag time (i.e., how long after mixing can the specimens be compacted) and dwell time (i.e., how long after compaction can the specimens still be tested and get representative results).
- *Asphalt binder sources.* Several State participants noted that they allow asphalt contractors to change the source of asphalt binder from mix design to production or during production as long as the binder grade remains unchanged and meets the project Performance Grade (PG) requirement. However, they recognized that although volumetric properties are generally not sensitive to the changes in asphalt binder source, BMD test results can be. For example, two asphalt binders from different suppliers may impact the BMD cracking test results even when both binders meet the PG specified for the project. The State participants shared that there is a lack of guidance on how to detect and handle the change in asphalt binder sources in a BMD environment.
- P*roduction versus mix design.*
  - Variability during production at the asphalt mixture plant remains an issue for BMD testing.
  - Laboratory test results from mix design often differ from the test results on plant-produced material.
  - Information is needed on how to determine the optimum lot size for BMD testing while taking into consideration the variability in test results.

- *Moisture Damage*. Moisture damage ranges in severity from raveling to stripping of asphalt mixtures. Participating States shared that they are generally satisfied with their current testing and process to identify if a mixture is moisture susceptible. However, it was recognized during the discussion that a couple of State participants use the Hamburg Wheel Tracking Test (HWTT) (AASHTO T 324), while the others use the tensile strength ratio (TSR) (AASHTO T 283) or a modified version of TSR to evaluate the moisture damage of asphalt mixtures at the mix design stage. Some States use HWTT only for rutting tests or are in the process of purchasing or implementing HWTT. The States noted that implementation of any of the moisture damage tests as part of BMD during production and acceptance involves additional resources and staffing.

- **Initial Database Setup.** State participants generally noted that there are several data fields that could be useful for reporting and analysis at the completion of testing. While they agreed that these fields should be captured in a common database within each State, the specific fields and the structure of the database varied across the States.
    - *Template and format*. State participants noted that additional guidelines, including templates and formatting needs, may be useful for initial database setup.
    - *Laboratory produced versus plant produced data*. Additional data fields should include the source of the samples and other related information (e.g., handling protocols, aging conditions, and storage time).
    - *Data Collection*. States suggest expanding data collecting to include additional raw and field data (pre-, during-, and post-construction of BMD mixtures). This stems from the understanding that data currently seen as irrelevant may be useful and valuable in the future.
    - *Challenges.* Several States have only started benchmarking in the past few years, while a couple more have not started benchmarking. Database setup and implementation varied widely across State participants. An additional challenge raised by several State participants was the effective management of the database and the ability to tie BMD test results to field performance due to distinct variations in traffic, climate, pavement structure, age, and underlying conditions.

- **New Materials and Additives**. State participants expressed interest in implementing BMD to responsibly increase the use of RAP and RAS while ensuring satisfactory pavement performance. Similarly, they also noted that BMD provided a platform to better evaluate new additives, including recycling agents, plastics, fibers, etc., compared to the existing volumetric system. Nevertheless, the State participants shared that guidance on how to effectively incorporate the evaluation of new materials and additives into BMD is still lacking.

- **Identifying a BMD Validation Framework.** Validation of mechanical tests is needed to make sure that test results have a strong relationship to field performance, thus supporting the development of specification criteria for mix design approval and possibly production acceptance. The first step of the validation process is to review and assess the applicability of past studies relating test results to field performance. State participants reported different BMD validation approaches, including using the National center for Asphalt Technology (NCAT) Test Track, accelerated loading facility, shadow projects, and pavement management system (PMS). The following is a summary of the State participants efforts:
    - DDOT’s validation effort is in the planning stages, with a focus on ensuring laboratory resources are available and enhancing coordination with the infrastructure management team. While there is a need for improved alignment between the laboratory team and the asset management section, this presents an opportunity for strengthening internal collaboration. DDOT aims to build on the

successful efforts of neighboring States like Maryland and Virginia, streamlining the process. By addressing internal logistical and personnel considerations, DDOT is poised to move forward efficiently, potentially accelerating the timeline by leveraging proven methods from nearby States.

- IDOT has over a decade of experience with the HWTT, yet some failures still occur during IDOT's mix design verification. Contractors often depend on consultants for verification due to limited in-house capabilities. Thus, proper sample preparation and consistency among different laboratories is needed to reduce the likelihood of having failing asphalt mixtures. Benchmarking tests are currently being conducted to evaluate the field performance of high-performance overlays.
- KYTC validation effort started in 2019 and consists of monitoring the performance of asphalt mixtures under live traffic conditions. After five years of in-service evaluation, the focus is on deriving insights from the performance of these mixtures. Since 2022, a mix design requirement for BMD has been implemented, but full insights from field performance of these mixtures will take a few more years. Additionally, KYTC has an NCAT test section focusing on studying friction characteristics. Although Kentucky's climate differs from that of the test track in Alabama, valuable lessons can still be learned. The validation process is dynamic, with continuous adjustments made based on feedback from field performance.
- MDOT's validation involved benchmarking asphalt mixtures with different nominal maximum aggregate size (NMAS) and RAP levels, starting with 20 asphalt mixtures and later adding 70 more. This process led to the selection of a CT index criterion at the 90th percentile of the collected data. PMS data was then used to assess field performance, categorizing cracking into three levels (less than 5%, 5 to 10%, and more than 10%). Asphalt mixtures with more than 10% field cracking exhibited a CT index value that failed to meet the benchmark-established test criteria, confirming the reliability of the employed approach. Initially, a CT index of 95 was set, but after adding more mixtures, it was adjusted to a CT index of 80 without long-term aging. Cracking data was collected from the Automatic Road Analyzer (ARAN), which captures various types of cracking. It's also important to note that the number of mixtures in PMS was fewer than those used in benchmarking.
- NCDOT's validation effort focuses on collecting promising field performance data, particularly regarding cracking, to support BMD through an experimental project. If the data shows minimal cracking, it could validate BMD's role in the success of the new mix. While NCDOT has confidence in BMD, it will need to develop an acceptance program. NCDOT plans to address validation through research and leverage data from regions already using BMD mixtures.
- SCDOT has just started working on validating its mix designs by collecting shadow test results, aiming to gather five years of data. SCDOT plans to replicate successful validation efforts from States like Virginia, Iowa, and Kentucky. SCDOT has used the Asphalt Pavement Analyzer (APA) for years, but past validation efforts are not well documented. SCDOT is now looking to these

leading States for guidance on replicating their successful processes and ensuring fair validation for its own mix designs.

- VDOT's validation effort includes a combination of field performance monitoring and laboratory testing. VDOT has utilized accelerated pavement testing to evaluate the long-term performance of asphalt mixtures, with data being compared against the benchmark data that was used initially to establish the BMD test criteria. Field assessments are conducted using pavement management systems (PMS), with VDOT's team conducting coring, windshield surveys, and structural evaluations through tools like falling weight deflectometer (FWD) and ground penetrating radar (GPR). This allows VDOT to assess the performance of past mix designs and refine future mix design requirements. VDOT also engaged in a collaborative research project with academia, where asphalt mixtures were tested in the laboratory and their measured properties were used to predict pavement performance in terms of cracking and rutting. These efforts align with VDOT's goal to re-evaluate and possibly revise mix design thresholds, taking into account performance in the field and model predictions. In addition, VDOT is reviewing asphalt mixtures with varying RAP contents, focusing on adjusting thresholds to ensure performance improvements without requiring significant redesigns by contractors. VDOT aims to strike a balance between improving mixture performance and ensuring the changes are practical for industry implementation.
    - The Cantabro test (Virginia Test Methods, VTM–144: *Cantabro Abrasion Loss of Asphalt Mixture Specimen*) is used as a screening tool for assessing the durability of asphalt mixtures during production, typically conducted every 2,000 tons. The test provides a quick evaluation of the asphalt mixture's durability, serving as an early warning indicator. If the Cantabro test fails, it signals that the contractor should immediately investigate the issue, as it may point to a significant problem. While VDOT has observed that failing Cantabro results often correlate with a low or failing CT index value, they have not yet conducted a statistical analysis to confirm if this relationship is significant.

State participants also raised several questions that require additional consideration.

- *Getting Started*. Although many States are making efforts with validation, few States had a documented plan for BMD Test Validation at this point. Further identified challenges included having a plan for monitoring and documenting pavement performance, including the assignment of responsibilities.
- *Testing Procedures and Protocols.* Few State participants had established BMD testing procedures and protocols. Some questioned the intent of asphalt mixture aging in regions with colder climates. Further identified challenges in testing included resources for equipment maintenance and reference specimens for verification and calibration.
- *Barriers.* Several barriers were observed, including limited internal resources within agencies, competing responsibilities, and constraints on available funding. Furthermore, broader industry acceptance remains a notable challenge.

- **Volumetric Properties Historical Usage**. During the discussion, State participants expressed interest in implementing BMD and recognized its potential benefits. However, they emphasized the need to gain contractor and industry buy-in before relaxing traditional volumetric requirements in mix designs. Several State participants noted that relying heavily on volumetric properties has revealed shortcomings, particularly in failing to capture changes in asphalt mixture components and proportions. They observed that shifting towards asphalt mixture performance testing would give contractors the ability to have greater access to more resources and responsible use of materials. To support successful implementation of BMD, States indicated they would benefit from additional assistance in the following areas:
    - Relaxing volumetric properties, including which criteria, how much, and the role they play in quality control and acceptance. States' questions to address:
        - Are BMD mechanical tests enough to control consistency without volumetric properties? What other parameters can be used to control consistency?
        - Will industry and agency leadership confidently believe in using mechanical mixture performance tests in lieu of volumetric properties, given current testing technology and practices?
    - Identified States gaps and next steps.
        - Messaging takes time.
        - Stakeholder engagement.
        - Correlation of BMD test results to field pavement performance.
        - Focus on benchmarking procedures.

- **Pathway for Quality Assurance (QA) including Field Acceptance and Quality Control.** State participants expressed a clear desire to move forward to using BMD principles in mix design. However, they also identified several challenges to acceptance that are further explored below:
    - *Gaps and Issues Identified by State Participants:*
        - *Cost versus Perforamnce:* State participants noted that asphalt mixtures are generally designed for the lowest cost under low-bid contracts and not necessarily for performance. A key question remains: how can contractors use BMD to produce cost-effective asphalt mixtures meeting BMD test criteria while still being competitive?
        - *Roles and Responsibilities in Sampling and Testing:* States raised questions about roles and responsibilities in the BMD process. Specifically, who should be sampling asphalt mixtures for acceptance, preparing samples and specimens, ensuring sample security, and conducting mechanical tests?
        - *Industry Concerns with BMD Acceptance:* State participants highlighted ongoing concerns regarding the acceptance side of BMD. They noted that addressing these concerns is critical for successful implementation.
        - *Quality Assurance Program (QAP):* There was a shared recognition of the need to review and strengthen existing QAPs before incorporating new elements, such as BMD mechanical testing. Some States reported challenges with the contractor's tests used in acceptance decisions, underscoring the importance of a more robust QAP framework to ensure consistency and reliability in these decisions.
        - *Additional Considerations:* States also discussed the importance of

interlaboratory studies and the potential for restructuring pay for asphalt mixtures. For example, one State noted that paying separately for asphalt binders made it easier to increase asphalt binder content, thereby ensuring acceptable mixture durability and resistance to cracking.

- **Regional Collaboration Opportunities.** State participants discussed and expressed interest in regional collaboration to support the implementation of BMD. At a minimum, they suggested exchanging databases and sharing insights regarding challenges faced and strategies to overcome them.
- **Other Challenges Identified by State Participants:**
  - State participants emphasized the importance of understanding the impact of long-term oven aging, as well as lag and dwell time, on mixture performance.
  - A key concern was the lack of a clear implementation plan for BMD. Participants noted the need for defined milestones, improved messaging and motivation strategies, and a better understanding of complementary efforts needed for successful implementation.
  - Continued stakeholder engagement was identified as critical. Participants highlighted the need for ongoing conversation with the industry and coordination with contractors to explore what changes and improvements can be achieved.
  - Participants raised questions about which asphalt mixture factors should be prioritized in BMD test sections, especially considering logistical and practical limitations.
  - Concerns were expressed about the limitations of implementing BMD without broader acceptance from industry.
  - The lack of proficiency sample program for BMD tests led participants to rely on local or regional interlaboratory studies (i.e., round-robin) to ensure proper test results are being produced. This can be further challenging in regions where only a few laboratories are equipped to perform BMD testing.
  - Verifying moisture damage during production, particularly when TSR is specified, was identified as a challenge. Contractors typically verify TSR for the first lot of production, as it is difficult to perform this test frequently during continuous production.

SUMMARY OF TAKEAWAYS

(Refer to Appendix A–Survey Responses for Additional Information on Current State Practices)
Participants were asked to identify their primary lessons and outcomes from participating in the peer exchange. This section provides existing efforts, future roadmaps, and State-level lessons learned from the peer exchange to highlight items that various State DOTs found valuable and important for their future implementation efforts.

Overall Key Takeaways

- Start by developing a plan for the implementation of BMD to avoid missteps and minimize mistakes that could have been avoided in the first place.
- The need for research and collaboration on lag and dwell times and their impact on BMD test results.

- Identify staffing needs to implement BMD, particularly when there are many competing quality improvement priorities within an agency. Current staffing resources and additional workload for implementing BMD should be considered.
- Document and identify the agency's "why" and relative benefit of BMD. This can be important for the development of BMD goals and scope and when there are competing priorities.
- Leverage existing funding sources, including FHWA's pooled fund resource.
- Where possible, provide staff training on BMD approaches and implementation methods.
- Identify ways to partner with industry during implementation to ensure buy-in.
- Leverage existing experiences and resources from peer agencies.
- Seek opportunities for regional collaboration to accelerate the implementation of BMD. This includes sharing experiences, creating and providing access to a shared database, unifying handling, reheating, conditioning and aging procedures, etc.
- Recognize that implementation of BMD will take time and might face setbacks during the process. One State participant noted that, while the path to BMD implementation is a big lift, the potential benefits are similarly immense.

Action Items Recommended by the State Participants

District of Columbia:

- Significant progress in BMD has been made in VA and MD, providing valuable insights. Stay connected with MDOT and VDOT regarding their BMD implementation progress and efforts.
- Study and learn from the work conducted by neighboring States to inform internal practices and strategies.
- Explore more training and education opportunities on BMD
- Evaluate and restructure the State DOT teams to create an entity dedicated to following up on BMD tasks. Leverage new team members by integrating them into the asphalt team to enhance testing capacity.
- Meet with stakeholders to ensure alignment and collaboration on BMD initiatives.

Iowa:

- Ensure all stakeholder members are well-informed about BMD through targeted training and workshops. Encourage and support the State bituminous engineer's participation in BMD training courses.
- Reconvene with State DOT personnel to review the purpose and benefits of BMD, ensuring alignment of expectations and goals.
- Identify a champion within the State DOT to lead the BMD efforts and leverage existing knowledge to tie BMD results with PMS data effectively.
- Assess the need for a comprehensive data library to facilitate and support BMD implementation efforts.

Kentucky:

- Increase visibility by documenting and sharing existing BMD implementation efforts to engage stakeholders and foster collaboration.
- Strengthen communication between technicians, managers, and industry stakeholders for better alignment.
- Update the existing BMD implementation plan (developed in 2018 and last updated in 2020) to establish benchmarks and milestones for formal progress.
- Continue BMD benchmarking and data analysis.
- Investigate BMD production data of existing projects.
- Discuss BMD validation efforts with neighboring States.

Maryland:

- Formalize the BMD implementation process by establishing a committee or a working group comprising industry and agency representatives.
- Prioritize activities by properly documenting processes, specifications, and activities to identify and address the current gaps.
- Develop an implementation plan using milestones from the eight tasks for BMD implementation.
- Develop a BMD benchmarking database and seek recommendations for template format and metadata.
- Document ongoing BMD validation efforts.

North Carolina:

- Stay proactive with the BMD implementation process. Emphasize a forward-looking strategy to ensure continued advancement and alignment with broader agency goals in order to secure stakeholder buy-in.
- Develop a formal roadmap to proactively outline research direction and progress.
- Discuss the successful use of RAS with the Illinois Tollway.

South Carolina:

- Schedule BMD stakeholder meetings for State DOT staff and asphalt contractors and provide clearer explanations of the BMD concept to increase understanding and buy-in
- Encourage State DOT and industry personnel to attend BMD training courses and ensure a comprehensive understanding of BMD.
- Engage State DOT upper management for BMD implementation support.

Virginia:

- Update existing BMD implementation documents (e.g. implementation plan, sampling guidance, sample preparation protocols).
- Update and crossmatch BMD and PMS databases.
- Investigate the impacts of lag and dwell time on BMD test results. At a minimum, update laboratory practices to include reporting of lag and dwell times alongside test results.
- Continue to monitor the performance of existing BMD test sections.
- Refine processes and details to improve overall implementation.

APPENDICES

Appendix A: Questionnaire Responses

Prior to the FHWA peer exchange meeting, attendees were asked to complete a short survey pertaining to their agency's BMD practices. The intent of the survey was to stimulate thoughts in preparation for the meeting and to generate information to help guide the meeting discussions. Responses were received from five agencies and are summarized below.

District of Columbia

Task	Sub Task	Description	Status
1. Motivations and Benefits of Performance Specifications	**n/a**		In Progress
2. Overall Planning	2.1	Identification of Champions	Ongoing
	2.2	Establishing a Stakeholders Partnership	In Progress
	2.3	Doing Your Homework	In Progress
	2.4	Establishing Goals	In Progress
	2.5	Mapping the Tasks	Not Started
	2.6	Identifying Available External Technical Information and Support (periodically)	Not Started
	2.7	Developing an Implementation Timeline	Not Started
3. Selecting Performance Tests	3.1	Identifying Primary Modes of Distress	Ongoing
	3.2	Identifying and Assessing Performance Test Appropriateness.	In Progress
	3.3	Validating the Performance Tests	Not Started
4. Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating	4.1	Acquiring Equipment	In Progress
	4.2	Managing Resources	In Progress
	4.3	Conducting Initial Training	Not Started
	4.4	Evaluating Performance Tests	Not Started
	4.5	Conducting Inter-Laboratory Studies	Not Started
5. Establishing Baseline Data	5.1	Reviewing Historical Data & Information Management System	Not Started
	5.2	Conducting Benchmarking Studies	Not Started
	5.3	Conducting Shadow Projects	Not Started
	5.4	Analyzing Production Data	In Progress
	5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials	Ongoing
6. Specifications and Program Development	6.1	Sampling and Testing Plans	In Progress
	6.2	Pay Adjustment Factors (If Part of the Goals)	Not Started
	6.3	Developing Pilot Specifications and Policies	In Progress
	6.4	Conducting Pilot Projects	Not Started
	6.5	Final Analysis and Specification Revisions	Not Started
7. Training, Certifications, and Accreditations	7.1	Developing and/or Updating Training and Certification Programs	Ongoing
	7.2	Establishing or Updating Laboratory Accreditation Program Requirements	Ongoing
8. Initial Implementation	n/a		Not Started

1. What does your state consider to be the primary benefits of BMD?
Since DDOT's infrastructure is considerably old, the majority of the failures are emanating from the lower lifts of subgrade which are 3 to 4 feet deep. So DDOT mills and replaces 2" of surface on an "as needed" bases. Politics also determines if and when a roadway is resurfaced. Underground piping (when they fracture) plays a major roll also. Carbon reduction will offset any benefits that BMD may provide.
2. What hurdles and/or gaps need to be addressed for mix design approval implementation?
The BMD benefits vs. the mandated carbon reduction requirements.
3. Do you currently use or plan to use performance tests for acceptance in the future? If no, skip to question 6.
No, DDOT does not currently use performance tests for acceptance at the present time. Our future mix design changes so far appear to be controlled directly by changing mix components that would reduce carbon emissions. At present, our lab is in the process of obtaining new equipment to perform long term performance testing. The BMD method and carbon reduction determination are the new equipment’s main objectives.
4. What hurdles and/or gaps need to be addressed for plant mix verification?
Not Applicable since DDOT has not implemented (not started) using the BMD method yet.
5. What hurdles and/or gaps need to be addressed for mixture acceptance implementation?
Not Applicable since DDOT has not implemented (not started) using the BMD method yet.
6. What challenges have you overcome in the path to implementation?
Obtaining equipment for BMD testing.
7. What are your expectations for the lead states peer-exchange? What do you hope to learn?
No idea

Iowa

Task	Sub Task	Description	Status
1. Motivations and Benefits of Performance Specifications	**n/a**		
2. Overall Planning	2.1	Identification of Champions	Complete
	2.2	Establishing a Stakeholders Partnership	Ongoing
	2.3	Doing Your Homework	Ongoing
	2.4	Establishing Goals	Ongoing
	2.5	Mapping the Tasks	Ongoing
	2.6	Identifying Available External Technical Information and Support (periodically)	Ongoing
	2.7	Developing an Implementation Timeline	Ongoing
3. Selecting Performance Tests	3.1	Identifying Primary Modes of Distress	Complete
	3.2	Identifying and Assessing Performance Test Appropriateness.	Ongoing
	3.3	Validating the Performance Tests	Ongoing
4. Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating	4.1	Acquiring Equipment	Complete
	4.2	Managing Resources	Ongoing
	4.3	Conducting Initial Training	Ongoing
	4.4	Evaluating Performance Tests	Ongoing
	4.5	Conducting Inter-Laboratory Studies	Ongoing
5. Establishing Baseline Data	5.1	Reviewing Historical Data & Information Management System	Ongoing
	5.2	Conducting Benchmarking Studies	Ongoing
	5.3	Conducting Shadow Projects	In Progress
	5.4	Analyzing Production Data	Ongoing
	5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials	Not Started
6. Specifications and Program Development	6.1	Sampling and Testing Plans	Ongoing
	6.2	Pay Adjustment Factors (If Part of the Goals)	Not Started
	6.3	Developing Pilot Specifications and Policies	In Progress
	6.4	Conducting Pilot Projects	Not Started
	6.5	Final Analysis and Specification Revisions	Ongoing
7. Training, Certifications, and Accreditations	7.1	Developing and/or Updating Training and Certification Programs	Ongoing
	7.2	Establishing or Updating Laboratory Accreditation Program Requirements	Ongoing
8. Initial Implementation	n/a		In Progress

1. What does your state consider to be the primary benefits of BMD?
The BMD framework provides the contractor the opportunity to benefit from additives-at-the-plant. Iowa has a framework that addresses the failure mode the agency is most concerned about for that mix. For example, for a high-rap mix, the concern is cracking so the mixture is testing only for cracking resistance. Rutting has not generally been an issue under the current design framework.
2. What hurdles and/or gaps need to be addressed for mix design approval implementation?
Validation between contractor and agency test values. Dispute resolution process. Integration with PWL. We need to know that BMD will incorporate durability. How to handle field adjustments.
3. Do you currently use or plan to use performance tests for acceptance in the future? If no, skip to question 6.
Possibly, we use performance tests for acceptance in the Hamburg for certain mixtures requiring anti-stripping agent. DCT would be used for high RAP mixtures.
4. What hurdles and/or gaps need to be addressed for plant mix verification?
Agency testing bandwidth, demonstrating to contractors that plant mix verification will be a fair, reliable evaluation process. Ensuring agency and contractor results match, especially for cracking tests.
5. What hurdles and/or gaps need to be addressed for mixture acceptance implementation?
Agency testing bandwidth, Continuing to show evidence of correlations between performance testing and field performance.
6. What challenges have you overcome in the path to implementation?
We have implemented performance testing benchmark as part of the mixture design process in several situations. Contractors are used to these tests being required in certain situations. Hamburg is implemented and DCT is required for High Rap (greater than 30% binder replacement).
7. What are your expectations for the lead states peer-exchange? What do you hope to learn?
What hurdles they faced during implementation and how they worked with industry to build consensus on the best was to address the challenges and write the specifications.

Kentucky

Task	Sub Task	Description	Status
1. Motivations and Benefits of Performance Specifications	**n/a**		Ongoing
2. Overall Planning	2.1	Identification of Champions	Complete
	2.2	Establishing a Stakeholders Partnership	Complete
	2.3	Doing Your Homework	Ongoing
	2.4	Establishing Goals	Ongoing
	2.5	Mapping the Tasks	Ongoing
	2.6	Identifying Available External Technical Information and Support (periodically)	Ongoing
	2.7	Developing an Implementation Timeline	Ongoing
3. Selecting Performance Tests	3.1	Identifying Primary Modes of Distress	Complete
	3.2	Identifying and Assessing Performance Test Appropriateness.	Complete
	3.3	Validating the Performance Tests	Ongoing
4. Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating	4.1	Acquiring Equipment	Complete
	4.2	Managing Resources	Ongoing
	4.3	Conducting Initial Training	Complete
	4.4	Evaluating Performance Tests	Ongoing
	4.5	Conducting Inter-Laboratory Studies	Ongoing
5. Establishing Baseline Data	5.1	Reviewing Historical Data & Information Management System	Ongoing
	5.2	Conducting Benchmarking Studies	Ongoing
	5.3	Conducting Shadow Projects	Ongoing
	5.4	Analyzing Production Data	Ongoing
	5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials	Ongoing
6. Specifications and Program Development	6.1	Sampling and Testing Plans	Ongoing
	6.2	Pay Adjustment Factors (If Part of the Goals)	Ongoing
	6.3	Developing Pilot Specifications and Policies	Ongoing
	6.4	Conducting Pilot Projects	Ongoing
	6.5	Final Analysis and Specification Revisions	Ongoing
7. Training, Certifications, and Accreditations	7.1	Developing and/or Updating Training and Certification Programs	Ongoing
	7.2	Establishing or Updating Laboratory Accreditation Program Requirements	Ongoing
8. Initial Implementation	n/a		Complete

1. What does your state consider to be the primary benefits of BMD?
Data-driven, proactive solutions to pavement problems. Ease of specification adjustments once confidence is established in performance metrics. Innovation and possible cost-effective paving solutions.
2. What hurdles and/or gaps need to be addressed for mix design approval implementation?
Currently implemented, but hurdles include: Agency/Industry buy-in, Honesty with processes, confidence in metric levels.
3. Do you currently use or plan to use performance tests for acceptance in the future? If no, skip to question 6.
Yes, that's the goal but many many hurdles.
4. What hurdles and/or gaps need to be addressed for plant mix verification?
Differences between lab mix/plant mix beyond control, industry buy in regarding transparency, agency buy in regarding QC/QA thoroughness, appropriate plant mix performance metrics.
5. What hurdles and/or gaps need to be addressed for mixture acceptance implementation?
Confidence in metrics and their ability to translate to pavement performance.
6. What challenges have you overcome in the path to implementation?
Test selection, mixture benchmarking in lab and plant (5+ years of data on thousands of contracts), test procedure decisions, mix design requirement specification is now live for all surface mixtures in Kentucky.
7. What are your expectations for the lead states peer-exchange? What do you hope to learn?
What hurdles they faced during implementation and how they worked with industry to build consensus on the best was to address the challenges and write the specifications.

Maryland

Task	Sub Task	Description	Status
9. Motivations and Benefits of Performance Specifications	**n/a**		
10. Overall Planning	2.1	Identification of Champions	Complete
	2.2	Establishing a Stakeholders Partnership	Complete
	2.3	Doing Your Homework	In Progress
	2.4	Establishing Goals	In Progress
	2.5	Mapping the Tasks	In Progress
	2.6	Identifying Available External Technical Information and Support (periodically)	In Progress
	2.7	Developing an Implementation Timeline	Ongoing
11. Selecting Performance Tests	3.1	Identifying Primary Modes of Distress	Complete
	3.2	Identifying and Assessing Performance Test Appropriateness.	Complete
	3.3	Validating the Performance Tests	Complete
12. Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating	4.1	Acquiring Equipment	Ongoing
	4.2	Managing Resources	Complete
	4.3	Conducting Initial Training	Ongoing
	4.4	Evaluating Performance Tests	Complete
	4.5	Conducting Inter-Laboratory Studies	Ongoing
13. Establishing Baseline Data	5.1	Reviewing Historical Data & Information Management System	Ongoing
	5.2	Conducting Benchmarking Studies	Ongoing
	5.3	Conducting Shadow Projects	In Progress
	5.4	Analyzing Production Data	In Progress
	5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials	Ongoing
14. Specifications and Program Development	6.1	Sampling and Testing Plans	In Progress
	6.2	Pay Adjustment Factors (If Part of the Goals)	Not Started
	6.3	Developing Pilot Specifications and Policies	Complete
	6.4	Conducting Pilot Projects	Ongoing
	6.5	Final Analysis and Specification Revisions	In Progress
15. Training, Certifications, and Accreditations	7.1	Developing and/or Updating Training and Certification Programs	Not Started
	7.2	Establishing or Updating Laboratory Accreditation Program Requirements	Not Started
16. Initial Implementation	n/a		Ongoing

1. What does your state consider to be the primary benefits of BMD?
The primary benefit is to extend the durability of pavements by using the recycled materials more responsibly than what we are using now.
2. What hurdles and/or gaps need to be addressed for mix design approval implementation?
The current threshold set up at 20% COV between QC and QA when we test QC samples in our lab to approve mix design. This seems to be helpful, however we need to offer hands on training to the QC technicians and then only they can understand the process right and should be able to produce the mix within that 20% COV tolerance.
3. Do you currently use or plan to use performance tests for acceptance in the future? If no, skip to question 6.
Not in near future
4. What hurdles and/or gaps need to be addressed for plant mix verification?
5. What hurdles and/or gaps need to be addressed for mixture acceptance implementation?
6. What challenges have you overcome in the path to implementation?
We had to do several round robin tests between different labs to gain confidence in our own testing. We realized that the results are sensitive to the test temperature and air voids. Some producers are not convinced that their mix with a long history is failing to meet current BMD criteria, and some are not willing to lower sublot size to get more samples for testing.
7. What are your expectations for the lead states peer-exchange? What do you hope to learn?
We want to know if the team can offer assistance in developing training material to offer to the local asphalt industry and make it as standardized certification course for technicians to prepare and test BMD samples at both QC and QA labs.

North Carolina

Task	Sub Task	Description	Status
17. Motivations and Benefits of Performance Specifications	**n/a**		
18. Overall Planning	2.1	Identification of Champions	Not Started
	2.2	Establishing a Stakeholders Partnership	In Progress
	2.3	Doing Your Homework	In Progress
	2.4	Establishing Goals	In Progress
	2.5	Mapping the Tasks	Not Started
	2.6	Identifying Available External Technical Information and Support (periodically)	Ongoing
	2.7	Developing an Implementation Timeline	Not Started
19. Selecting Performance Tests	3.1	Identifying Primary Modes of Distress	In Progress
	3.2	Identifying and Assessing Performance Test Appropriateness.	In Progress
	3.3	Validating the Performance Tests	Ongoing
20. Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating	4.1	Acquiring Equipment	In Progress
	4.2	Managing Resources	In Progress
	4.3	Conducting Initial Training	In Progress
	4.4	Evaluating Performance Tests	In Progress
	4.5	Conducting Inter-Laboratory Studies	Not Started
21. Establishing Baseline Data	5.1	Reviewing Historical Data & Information Management System	In Progress
	5.2	Conducting Benchmarking Studies	Not Started
	5.3	Conducting Shadow Projects	Not Started
	5.4	Analyzing Production Data	Not Started
	5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials	Not Started
22. Specifications and Program Development	6.1	Sampling and Testing Plans	Not Started
	6.2	Pay Adjustment Factors (If Part of the Goals)	Not Started
	6.3	Developing Pilot Specifications and Policies	In Progress
	6.4	Conducting Pilot Projects	Not Started
	6.5	Final Analysis and Specification Revisions	Not Started
23. Training, Certifications, and Accreditations	7.1	Developing and/or Updating Training and Certification Programs	In Progress
	7.2	Establishing or Updating Laboratory Accreditation Program Requirements	In Progress
24. Initial Implementation	n/a		Not Started

1. What does your state consider to be the primary benefits of BMD?
Making dry mixes better and identifying cracking potential at the mix design stage
2. What hurdles and/or gaps need to be addressed for mix design approval implementation?
Overcoming industry resistance in our state
3. Do you currently use or plan to use performance tests for acceptance in the future? If no, skip to question 6.
We currently use APA jr. testing and hope to utilize Ideal-CT and RT in the future
4. What hurdles and/or gaps need to be addressed for plant mix verification?
Overcoming contractors fears of incurred/increase costs
5. What hurdles and/or gaps need to be addressed for mixture acceptance implementation?
Establishing an agreed upon CT/RT index for would be considered as failing
6. What challenges have you overcome in the path to implementation?
Contractor buy-in
7. What are your expectations for the lead states peer-exchange? What do you hope to learn?
How to address contractor objections/concerns and resistance to change.

South Carolina

Task	Sub Task	Description	Status
25. Motivations and Benefits of Performance Specifications	**n/a**		
26. Overall Planning	2.1	Identification of Champions	Ongoing
	2.2	Establishing a Stakeholders Partnership	Ongoing
	2.3	Doing Your Homework	Ongoing
	2.4	Establishing Goals	Ongoing
	2.5	Mapping the Tasks	Ongoing
	2.6	Identifying Available External Technical Information and Support (periodically)	Ongoing
	2.7	Developing an Implementation Timeline	Ongoing
27. Selecting Performance Tests	3.1	Identifying Primary Modes of Distress	Ongoing
	3.2	Identifying and Assessing Performance Test Appropriateness.	Ongoing
	3.3	Validating the Performance Tests	Ongoing
28. Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating	4.1	Acquiring Equipment	Complete
	4.2	Managing Resources	Ongoing
	4.3	Conducting Initial Training	Complete
	4.4	Evaluating Performance Tests	Ongoing
	4.5	Conducting Inter-Laboratory Studies	Ongoing
29. Establishing Baseline Data	5.1	Reviewing Historical Data & Information Management System	Ongoing
	5.2	Conducting Benchmarking Studies	Ongoing
	5.3	Conducting Shadow Projects	Ongoing
	5.4	Analyzing Production Data	Ongoing
	5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials	Ongoing
30. Specifications and Program Development	6.1	Sampling and Testing Plans	Not Started
	6.2	Pay Adjustment Factors (If Part of the Goals)	Not Started
	6.3	Developing Pilot Specifications and Policies	Not Started
	6.4	Conducting Pilot Projects	Not Started
	6.5	Final Analysis and Specification Revisions	Not Started
31. Training, Certifications, and Accreditations	7.1	Developing and/or Updating Training and Certification Programs	Not Started
	7.2	Establishing or Updating Laboratory Accreditation Program Requirements	Not Started
32. Initial Implementation	n/a		Not Started

1. What does your state consider to be the primary benefits of BMD?
Adding an additional test to the mix design requirement that can show how that mix design will perform in the field.
2. What hurdles and/or gaps need to be addressed for mix design approval implementation?
SCDOT needs to continue to benchmark our current mix designs using Ideal CT. Our current data shows that most of our mix designs are breaking on average lower than what we would like to see based on other states' minimum requirement.
3. Do you currently use or plan to use performance tests for acceptance in the future? If no, skip to question 6.
No
4. What hurdles and/or gaps need to be addressed for plant mix verification?
5. What hurdles and/or gaps need to be addressed for mixture acceptance implementation?
6. What challenges have you overcome in the path to implementation?
We need to continue to collect/ benchmark our current mix designs so that we can select the right minimums for design.
7. What are your expectations for the lead states peer-exchange? What do you hope to learn?
I hope to learn what other states are doing to benchmark data and how they are using this data to select the right limits.

Virginia

Task	Sub Task	Description	Status
33. Motivations and Benefits of Performance Specifications	**n/a**		Complete
34. Overall Planning	2.1	Identification of Champions	Complete
	2.2	Establishing a Stakeholders Partnership	Complete
	2.3	Doing Your Homework	Complete
	2.4	Establishing Goals	Complete
	2.5	Mapping the Tasks	Complete
	2.6	Identifying Available External Technical Information and Support (periodically)	Ongoing
	2.7	Developing an Implementation Timeline	Ongoing
35. Selecting Performance Tests	3.1	Identifying Primary Modes of Distress	Complete
	3.2	Identifying and Assessing Performance Test Appropriateness.	Ongoing
	3.3	Validating the Performance Tests	Ongoing
36. Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating	4.1	Acquiring Equipment	Complete
	4.2	Managing Resources	Complete
	4.3	Conducting Initial Training	Complete
	4.4	Evaluating Performance Tests	Ongoing
	4.5	Conducting Inter-Laboratory Studies	In Progress
37. Establishing Baseline Data	5.1	Reviewing Historical Data & Information Management System	Ongoing
	5.2	Conducting Benchmarking Studies	Ongoing
	5.3	Conducting Shadow Projects	Ongoing
	5.4	Analyzing Production Data	Ongoing
	5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials	Ongoing
38. Specifications and Program Development	6.1	Sampling and Testing Plans	Ongoing
	6.2	Pay Adjustment Factors (If Part of the Goals)	Not Started
	6.3	Developing Pilot Specifications and Policies	Ongoing
	6.4	Conducting Pilot Projects	Ongoing
	6.5	Final Analysis and Specification Revisions	Ongoing
39. Training, Certifications, and Accreditations	7.1	Developing and/or Updating Training and Certification Programs	Ongoing
	7.2	Establishing or Updating Laboratory Accreditation Program Requirements	Ongoing
40. Initial Implementation	n/a		Complete

1. What does your state consider to be the primary benefits of BMD?
Primary - potential for increasing mixture durability and lifespan Secondary - ability to address the use of additive/new technologies/different materials that volumetric design did not address Not in initial benefits, but more important now given political and societal interest - opportunities for increasing sustainability
2. What hurdles and/or gaps need to be addressed for mix design approval implementation?
These are more gaps than hurdles, as we already have a mix design approval process in use for 9.5mm & 12.5mm non-PMB surface mixes. Differences in source materials from design to production - particularly binder and RAP, but also changes in aggregate properties Differences between lab-mixed design material and plant-produced production material
3. Do you currently use or plan to use performance tests for acceptance in the future? If no, skip to question 6.
Yes - currently use Cantabro mass loss, CTindex, APA rut depth, and TSR as go/no-go tests. Anticipate eventual use of testing in acceptance.
4. What hurdles and/or gaps need to be addressed for plant mix verification?
Reheat/non-reheat material differences Lag/dwell time influence
5. What hurdles and/or gaps need to be addressed for mixture acceptance implementation?
Test time, test variability (including factors leading to that variability) Determination of what characteristics/properties should be used for pay Approach to acceptance - strict pass/fail or variable penalty
6. What challenges have you overcome in the path to implementation?
Initial resistance to concept; test selection to be scientifically appropriate yet practical; training; improvement of test variability through training and experience; transferring research results into viable specifications; addressing mix changes and impacts on test results; lack of links between materials information and pavement performance and structure information; need for making decisions before information is available, while overall picture has not come into focus; assessing risk and cost/benefit of moving forward with various aspects of implementation;
7. What are your expectations for the lead states peer-exchange? What do you hope to learn?
I am looking forward to seeing how other states are approaching implementation. Where exactly are the other states - outside of discussion at these meetings, information is nearly always somewhat outdated. Why are they taking their approach? Are there better ways to address various aspects and challenges? What approaches/issues seem to be universally applicable versus what aspects need to be more localized? What unusual or particular challenges have others addressed and can those solutions be applied in our efforts?

West Virginia

Task	Sub Task	Description	Status
41. Motivations and Benefits of Performance Specifications	**n/a**		Ongoing
42. Overall Planning	2.1	Identification of Champions	Ongoing
	2.2	Establishing a Stakeholders Partnership	Ongoing
	2.3	Doing Your Homework	Ongoing
	2.4	Establishing Goals	Ongoing
	2.5	Mapping the Tasks	Ongoing
	2.6	Identifying Available External Technical Information and Support (periodically)	Ongoing
	2.7	Developing an Implementation Timeline	Ongoing
43. Selecting Performance Tests	3.1	Identifying Primary Modes of Distress	Complete
	3.2	Identifying and Assessing Performance Test Appropriateness.	Ongoing
	3.3	Validating the Performance Tests	Ongoing
44. Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating	4.1	Acquiring Equipment	Ongoing
	4.2	Managing Resources	Ongoing
	4.3	Conducting Initial Training	Not Started
	4.4	Evaluating Performance Tests	Ongoing
	4.5	Conducting Inter-Laboratory Studies	Ongoing
45. Establishing Baseline Data	5.1	Reviewing Historical Data & Information Management System	In Progress
	5.2	Conducting Benchmarking Studies	Ongoing
	5.3	Conducting Shadow Projects	Not Started
	5.4	Analyzing Production Data	Ongoing
	5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials	Ongoing
46. Specifications and Program Development	6.1	Sampling and Testing Plans	Not Started
	6.2	Pay Adjustment Factors (If Part of the Goals)	Not Started
	6.3	Developing Pilot Specifications and Policies	Not Started
	6.4	Conducting Pilot Projects	Not Started
	6.5	Final Analysis and Specification Revisions	Not Started
47. Training, Certifications, and Accreditations	7.1	Developing and/or Updating Training and Certification Programs	Not Started
	7.2	Establishing or Updating Laboratory Accreditation Program Requirements	Not Started
48. Initial Implementation	n/a		Not Started

1. What does your state consider to be the primary benefits of BMD?
Primary benefits to us include longer-lasting pavements, fewer distresses, and the ability to increase recycling without sacrificing quality.
2. What hurdles and/or gaps need to be addressed for mix design approval implementation?
Many hurdles currently exist and most are based in funding. We are a poor state and maintain a very large network (37,000 Miles) with very few dollars. Once necessary equipment is secured it will make a large impact on our ability to move forward efficiently.
3. Do you currently use or plan to use performance tests for acceptance in the future? If no, skip to question 6.
Not initially. We have discussed moving to this but the current variability of certain performance tests creates concern for us. Risk costs money and that's something we don't have an abundance of.
4. What hurdles and/or gaps need to be addressed for plant mix verification?
5. What hurdles and/or gaps need to be addressed for mixture acceptance implementation?
6. What challenges have you overcome in the path to implementation?
Not many at this point, but we have secured equipment for crack testing. I'm sure that doesn't sound like a big deal to some. Fortunately, we have a great relationship with industry here in WV and they have been helpful with performing initial testing.
7. What are your expectations for the lead states peer-exchange? What do you hope to learn?
We are in the preliminary stages so my hope is to learn what to avoid from the experience of others.