

Project No. 20-44(27)

**NCHRP 20-44(27)
FACILITATING BALANCED MIX DESIGN
IMPLEMENTATION**

FINAL CONDUCT OF RESEARCH REPORT

Prepared for
National Cooperative Highway Research Program
Transportation Research Board

of

The National Academies of Sciences, Engineering, and Medicine

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September 2022

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CONTENTS

SUMMARY	1
CHAPTER 1	2
Project Objective and Scope	2
CHAPTER 2	3
Summary of Work Completed.....	3
APPENDIX A	11
Sept. 2022 Proposed Revisions to MP 46-22	11
APPENDIX B	12
Participant Lists for Six Online Workshops.....	12
APPENDIX C	19
National BMD Conference Flyer, BMD Conference Registration List.....	19

S U M M A R Y

In September 2015, the FHWA Expert Task Group on Mixtures and Construction formed a Task Force on Balanced Mix Design (BMD) that defined BMD as “asphalt mix design using performance tests on appropriately conditioned specimens that address multiple modes of distress taking into consideration mix aging, traffic, climate and location within the pavement structure.” BMD infers that mixtures are designed to provide adequate resistance to rutting and cracking using appropriately selected mixture performance tests rather than relying solely on volumetric guidelines.

The National Center for Asphalt Technology (NCAT) completed NCHRP 20-07/Task 406 *Development of a Framework for Balanced Mix Design* in August 2018. The proposed framework allows state Departments of Transportation (DOTs) to select performance tests of their choice for evaluation of mixture rutting resistance, cracking resistance, and moisture damage resistance. The project final report included an analysis of knowledge gaps and recommended research needs that should be addressed in order to continue progress toward the implementation of BMD. The final report also included two proposed provisional standards for BMD that were balloted by AASHTO COMP and subsequently approved as provisional standards in 2019. These standards are MP 46-20 Balanced Mix Design and PP 105 Balanced Design of Asphalt Mixtures.

CHAPTER 1

Project Objective and Scope

The objective of this project was to assist DOTs and contractors in the early stages of BMD implementation by providing up-to-date information on using simple but robust mixture performance tests as part of mix design and quality assurance.

The project included three tasks to facilitate BMD implementation as follows:

- Task 1** Propose updates and refinements to the AASHTO provisional BMD standards based on new information from ongoing research on test methods, aging protocols, and laboratory and/or field studies from which criteria may be established.
- Task 2** Conduct six online BMD workshops to share information with stakeholders in states where efforts to implement BMD are progressing quickly.
- Task 3** Organize and host a national BMD conference to share information and lessons learned from DOTs and contractors that have lead BMD efforts as well as to identify gaps in knowledge yet to be adequately addressed.

CHAPTER 2

Summary of Work Completed

The following sections describe the work completed as fulfillment of the three tasks to facilitate implementation of Balanced Mix Design.

Task 1 – Proposed Updates and Refinements to the AASHTO Provisional BMD Standards

In January 2021, NCAT submitted a redlined version of MP 46-20 with suggested revisions to some of the mixture performance tests and criteria in the specification document. Most of the revisions were accepted by the AASHTO COMP and have been incorporated into MP 46-22. In September 2022, NCAT proposed additional revisions to MP 46-22 based on the most recent information on the use of mixture performance tests and criteria for BMD among state DOTs. These revisions are highlighted with track changes in Appendix A.

Task 2 – Online BMD Workshops

The six online BMD workshops were completed between September and December 2020. Table 1 list the dates, locations and number of participants for the six workshops.

Table 1. Dates and Locations of Online BMD Workshops

Dates	State	DOT Point of Contact	No. of Participants
Sept. 1-3, 2020	Tennessee	Matthew Chandler	29
Sept. 15-17, 2020	Vermont	Aaron Schwartz	39
Oct. 21-23, 2020	Arizona	Jesús Sandoval-Gil	38
Nov. 4-6, 2020	Nebraska	Robert Rea	34
Nov. 17-19, 2020	Oregon	Chris Duman	27
Dec. 7-9, 2020	North Carolina	Todd Whittingham	30

The workshops were conducted as three 2-hour sessions on consecutive days using Zoom. The contents of the workshops were customized for the specific state depending on their selection or preferences for BMD tests, progress toward implementation, and the agency’s mixture QA program. An example agenda is provided in Table 2.

Table 2. Agenda for the Tennessee BMD Workshop

Day 1: September 1, 9 – 11 AM Central Time		
Duration	Topic	Presenter
15 min	The Need for a New Era of Asphalt Mix Design	Randy West
20 min	BMD Approaches and State of Practice	Fan Yin
25 min	Asphalt Mixture Performance Tests	Randy West
20 min	Development and Implementation of a BMD Specification	Fan Yin
20 min	BMD Efforts in Tennessee	Randy & Matt Chandler
20 min	Open Discussions	Randy & Fan

Day 2: September 2, 9 – 11 AM Central Time		
Duration	Topic	Presenter
50 min	IDEAL-CT Cracking Test	Adam Taylor
50 min	Rutting and Moisture Damage Tests	Nathan Moore
20 min	Open Discussions	Adam & Nathan

Day 3: September 3, 9 – 11 AM Central Time		
Duration	Topic	Presenter
30 min	Using Performance Tests During Production	Randy West
15 min	Benchmarking Existing Mix Designs	Fan Yin
15 min	Interlaboratory Evaluations of Performance Tests	Fan Yin
15 min	Using Performance Tests in Quality Assurance	Randy West
10 min	BMD Shadow and Pilot Projects	Randy West
10 min	Training on Mixture Performance Tests	Fan Yin
10 min	BMD Resources	Fan Yin
15 min	Open Discussions	Randy & Fan

A full list of participants for all six workshops is included in Appendix B. Participants were provided links to the presentation materials and other virtual handouts in advance of the sessions and links to the Zoom recordings after the sessions are completed. Participants were also provided Professional Development Hour certificates for the workshop if they requested them.

Overall, participants were appreciative of the information and discussions that will be helpful as they move along the steps toward implementation.

Task 3 – National BMD Conference

The National BMD Conference was held September 2-3, 2021, at the Loews Vanderbilt Hotel in Nashville, TN. The conference was free to all participants and was held live and broadcast via Zoom to virtual attendees. The conference agenda is shown in Figure 1.

Approximately 60 people participated in person and over 100 participated online; the registration list is included in Appendix C. Feedback on the conference was excellent. In particular, many participants especially liked the small discussions during the breakout sessions. Recordings of the conference sessions were emailed to attendees in September.

NATIONAL BALANCED MIX DESIGN IMPLEMENTATION CONFERENCE

NASHVILLE, TN
 SEPTEMBER 2-3, 2021

THURSDAY, SEPTEMBER 2

- 1:30 PM Welcome; Conference Overview.....*Randy West*
- 1:40 PM BMD Case Studies Moderator...*Derek Nener-Plante*
- 1:45 PM Vermont Case Study
 - DOT Perspective.....*Aaron Schwartz*
 - Contractor Perspective.....*Cheng Ling*
- 2:30 PM Virginia Case Study
 - DOT Perspective.....*Stacey Diefenderfer*
 - Contractor Perspective.....*Danny Poole*
- 3:15 PM Break
- 3:30 PM New Jersey Case Study
 - DOT Perspective.....*Stevenson Ganthier*
 - Contractor Perspective.....*Kai Qualben*
- 4:15 PM Case Studies Panel Q&A
- 5:00 PM Adjourn
- 5:30 PM Reception.....*Sponsored by NAPA*

FRIDAY, SEPTEMBER 3

- 8:00 AM BMD Implementation Guide.....*Randy West*
- 8:40 AM Benchmarking Studies
 - Maine.....*Casey Nash*
 - Wisconsin.....*Steve Hefel*
- 9:30 AM Break
- 9:50 AM Breakout Group Instructions.....*Fan Yin*
- 10:00 AM BMD Approaches to Mix Design
- 10:20 AM How to Establish Performance Test Criteria
- 10:40 AM How to Deal with Aging
- 11:00 AM How to use Performance Tests in QA
- 11:20 AM Summaries & Wrap Up.....*Randy West*
- 12:00 PM Adjourn



BMD RESOURCES

Scan this QR code or visit aub.ie/bmd for additional resources related to balanced mix design.



This conference is funded by NCHRP 20-44 (27) Facilitating Balanced Mix Design Implementation and organized by the National Center for Asphalt Technology.

Figure 1. National BMD Conference Agenda

Key takeaways from presentations from the BMD early adopters states and contractors were:

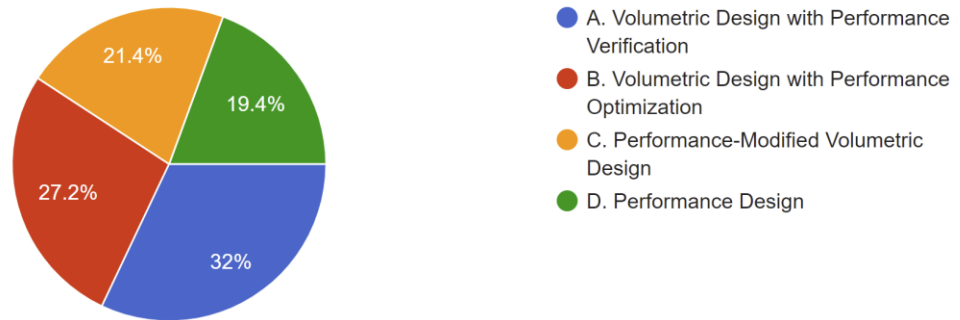
- The Vermont Agency of Transportation (VTrans) is motivated to implement BMD as a means to increase RAP contents and improve resistance of asphalt pavements to a variety of distresses. VTrans initially selected the HWTT and the I-FIT for BMD and began benchmarking plant produced mixtures in 2015. These results were used to support the decision in 2017 to switch to PG 70-28 for most mainline paving. Pilot projects began with Type IVS (9.5 mm surface) using Approach A. TSR was eliminated. Challenges and impediments so far have been issues with HWTT data storage and HWTT turn-around time. VTrans' BMD special provision is on hold while the agency evaluates a variety of related issues including surrogate tests, and aging. Industry experience so far is one contractor that has acquired all necessary BMD equipment. An interesting contractor finding was that binder source made a large difference on FI results but the impact was different depending on the aggregate type. Split sample FI testing indicate differences between agency and contractor lab results. Results also showed that PMLC and LMLC were different, with production results indicating lower stiffness.
- Virginia is motivated to deploy BMD as a pathway to improve the life and durability of asphalt pavement as well provide a means to allow for more sustainable and innovative mix designs. VDOT established an aggressive timeline for implementation beginning in 2018 and an anticipated initial implementation date of 2023. They are primarily using Approach A and using volumetrics for field control, and also have a mix design approach between Approach C and D, but still using traditional volumetric controls during production. Their BMD tests are IDEAL-CT, APA, and Cantabro. They have been building a database of mixtures and used that to set preliminary criteria, but recognize that they lack long-term validation of those criteria. Early shadow projects are being monitored for lab to field correlation. Challenges are dealing differences between unreheated versus reheated mix samples, additional manpower and equipment needs, and training. The contractor experience on pilot projects provided a learning experience. BMD mixes required changes in aggregate materials, increasing asphalt contents, and a recycling agent or a softer binder grade. The pilot projects required a significantly higher demand on QC operations, and raised issues limited ovens capacity and lab space.
- New Jersey DOT began using mix performance tests (Bending Beam Fatigue, Overlay Test and APA) for specialty mixes over 10 years ago based on research by Dr. Tom Bennert at Rutgers University. Key factors in test selection were sensitivity to mix parameters, correlation to field data, testing time, and simplicity of analysis. Mixtures are sampled and tested during production. NJDOT challenges are turn-around time, lab space, and retention of technicians. Positive industry response on opportunity to work outside the box, but obstacles are time to complete tests, additional mix design costs, specialty asphalt binders, slower production, and the need for more training. Keys to success are good communication between agency and industry, benchmarking and being transparent with results.
- Maine DOT is motivated to implement BMD to improve pavement performance and allow for mix design innovations. They have evaluated several rutting and cracking tests. They have a benchmarking database with approximately 1300 HWTT tests, 2000 AMPT tests, 3200 IDEAL-CT tests, 1600 IDEAL-RT tests, and 350 HT-IDT tests. They are moving forward with IDEAL-CT and IDEAL-RT.
- Wisconsin DOT is progressing toward BMD implementation. They funded several studies to examine different BMD tests and aging protocols. They selected the HWTT to assess rutting resistance and the IDEAL-CT for evaluating cracking resistance. They've been building a benchmarking database, drafted a BMD pilot special provision for the primary upper layer, and are planning a study quantify the production variability of HWTT and IDEAL-CT and to validate criteria with field test sections.

Breakout session discussions covered four topics with the following questions and responses collected among live and virtual participants.

1. Which of the BMD approaches do you prefer for mix design approval?
A: Volumetric Design with Performance Verification
B: Volumetric Design with Performance Optimization
C: Performance-Modified Volumetric Design
D: Performance Design

Which of the BMD approaches do you prefer for mix design approval?

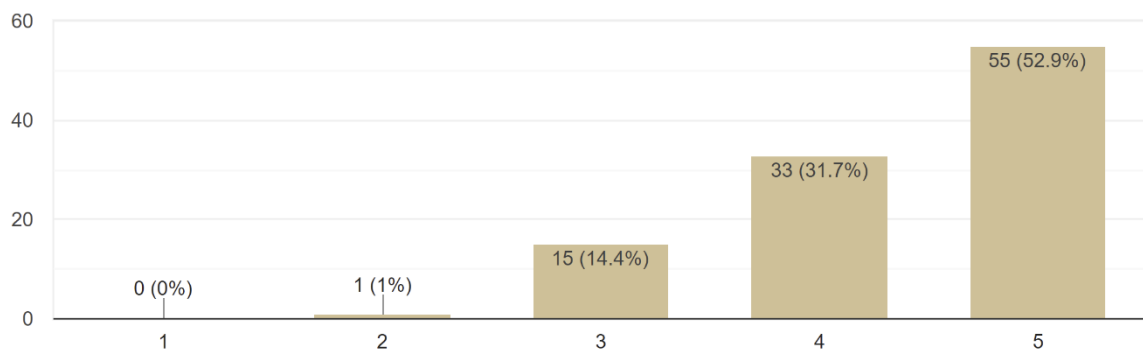
103 responses



2. From your perspective, which sources of data should be used to set BMD criteria? Agree or Disagree on a 1 to 5 scale
 - Benchmarking data
 - PMS data linked with BMD test results
 - Criteria from other states
 - Lab-to-field correlations from experimental test sections.

Benchmarking Data

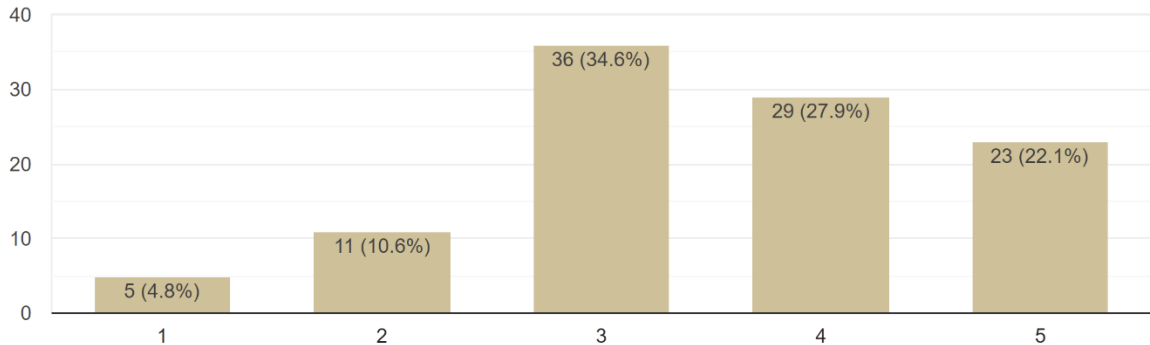
104 responses



PMS data linked with BMD test results



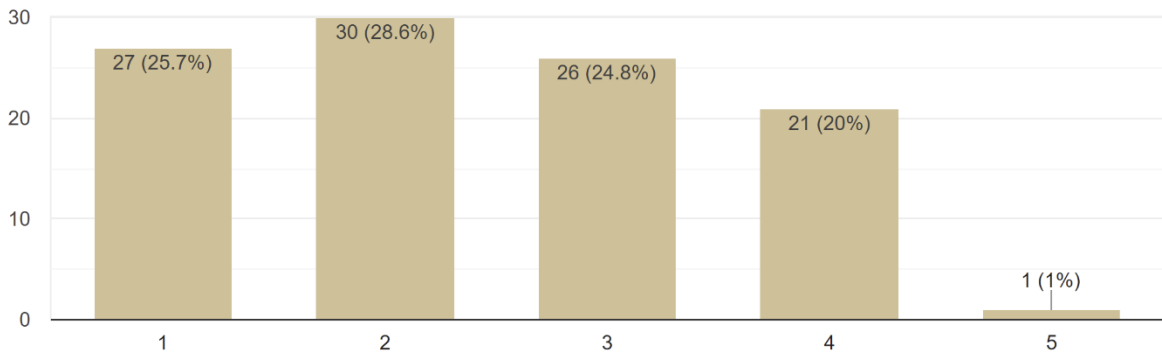
104 responses



Criteria from other states



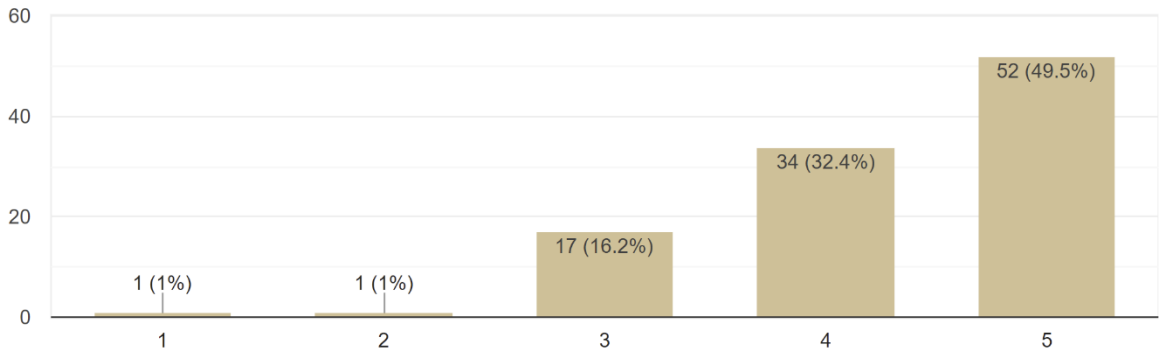
105 responses



Lab-to-field correlations from experimental test sections



105 responses

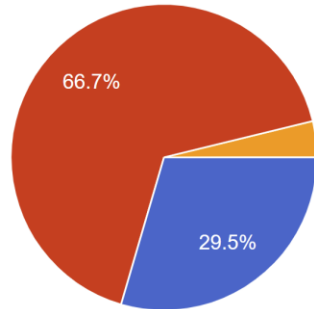


3. Which approach would you prefer for Quality Assurance at the BEGINNING of implementation?

Which approach would you prefer for Quality Assurance at the BEGINNING of implementation?



105 responses



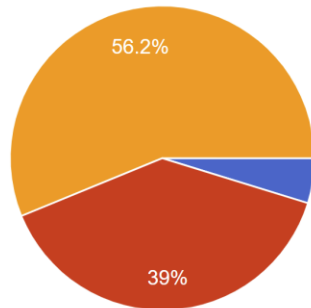
- 1. Do not use BMD tests for QA. Continue to use existing Acceptance Quality Characteristics (AQC)s.
- 2. Verify BMD properties at start up (i.e. initial verification lot), then proceed with traditional AQC)s.
- 3. Replace volumetric properties used as AQC)s with BMD test results on each lot of plant-produced mix.

4. Which approach would you ULTIMATELY prefer for Quality Assurance after several years?

Which approach would you ULTIMATELY prefer for Quality Assurance after several years?



105 responses



- 1. Do not use BMD tests for QA. Continue to use existing Acceptance Quality Characteristics (AQC)s.
- 2. Verify BMD properties at start up (i.e. initial verification lot), then proceed with traditional AQC)s.
- 3. Replace volumetric properties used as AQC)s with BMD test results on each lot of plant-produced mix.

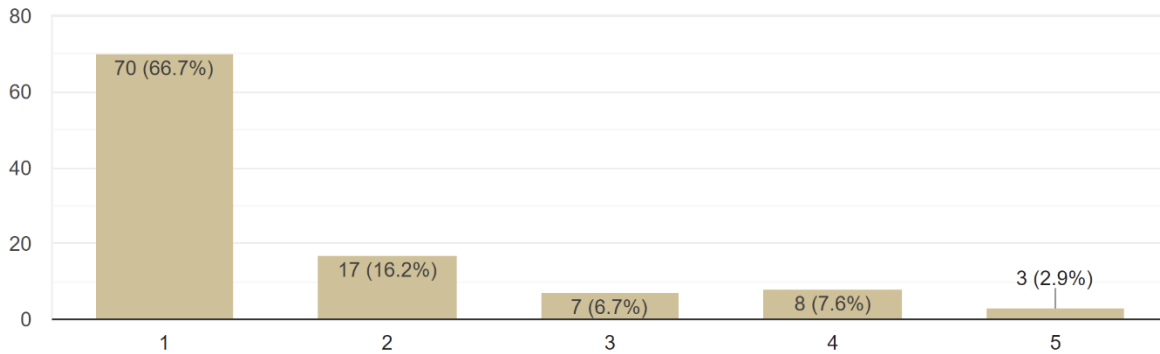
5. Agree or Disagree on a 1 to 5 scale

- Mix aging is NOT a critical issue at this time.
- Mix aging must be included with MIX DESIGN cracking tests for surface mixes.
- Mix aging must somehow be assessed with cracking tests used for Quality Assurance of surface mixes.

Mix aging is NOT a critical issue at this time



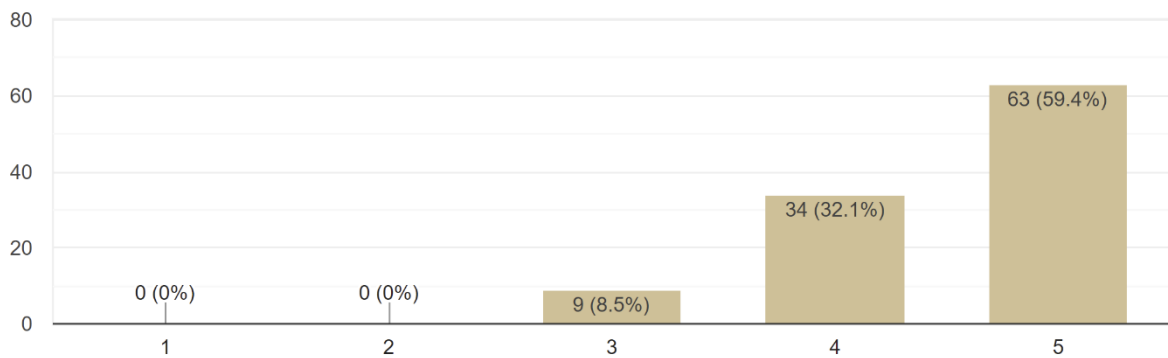
105 responses



Mix aging must be included with MIX DESIGN cracking tests for surface mixes



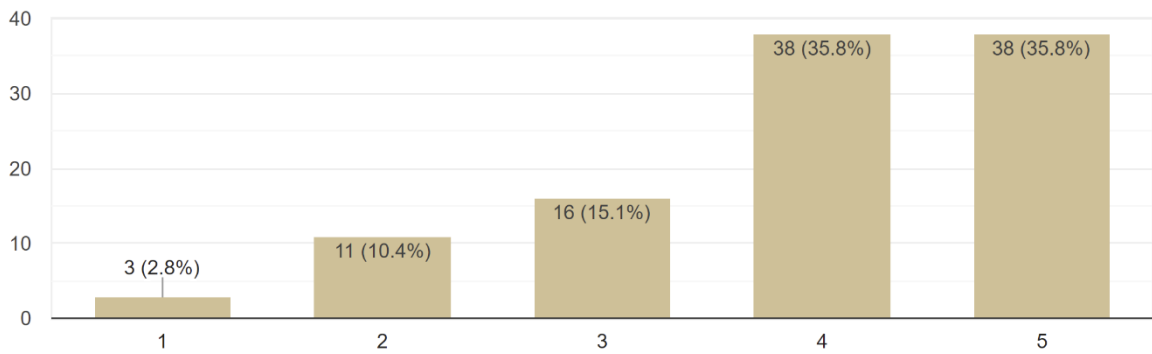
106 responses



Mix aging must somehow be assessed with cracking tests used for Quality Assurance of surface mixes



106 responses



APPENDIX A

Sept. 2022 Proposed Revisions to MP 46-22

(The proposed revisions to MP 46 (2022) have been excluded from the report for AASHTO evaluation)

APPENDIX B

Participant Lists for Six Online Workshops

Table 1. Dates and Locations of Online BMD Workshops

Dates	State	DOT Point of Contact	No. of Participants
Sept. 1-3, 2020	Tennessee	Matthew Chandler	29
Sept. 15-17, 2020	Vermont	Aaron Schwartz	39
Oct. 21-23, 2020	Arizona	Jesús Sandoval-Gil	38
Nov. 4-6, 2020	Nebraska	Robert Rea	34
Nov. 17-19, 2020	Oregon	Chris Duman	27
Dec. 7-9, 2020	North Carolina	Todd Whittingham	30

Tennessee, Sept. 1-3, 2020

Name	Organization	Contact Information
Ted Bryant		
Chad Norton		
Mike Hemsley	Paragon Technical Services	
Austin Bateman	Delta Contracting	
Will Hunt		
Jared Nix	Rogers Group	
Tim Murphy	Vulcan Materials	
Cliff Dye	TN DOT	
Scott Gilliam	TN DOT	
Randall Gilliam	TN DOT	
Tony Renfro	TN DOT	
Kevin Isenberg	TN DOT	
Jason Dryden	TN DOT	
Hossam Bahour	TN DOT	
John Asherbranner	TN DOT	
Mike Doran	TN DOT	
David Royster	TN DOT	
Billy Goins	TN DOT	
Brad Baskette	TN DOT	
Heather Purdy Hall	TN DOT	
Matthew Chandler	TN DOT	
Hong Park	TN DOT	
Tyler Lacy	TN DOT	
Frank Sadler	TN DOT	
Kara Shears	TN DOT	
Lindsey Skaggs	TN DOT	
Frankie Murphy	TN DOT	
Larry Doles	TN DOT	
Matt Jeffers	Ergon	

Vermont, Sept. 15-17, 2020

Name	Organization	Contact Information
Bud Clough		
John Hall		
Tim French		
Jim McNall		
Richard Cook		
Fuller Sand and Gravel		
Matt Geoffroy		
Mike Bailey		
Aaron Roy		
John Cawthern		
Mark Gray		
Mark Peloquin		
Jeffery Greer		
Mark Speshock		
Matt Elliott		
Albert Zander		
Chris Thomas		
Brian Hricay		
Gerald Otis		
Ling Cheng		
Peter Moore		
Ian Anderson		
Nick Van Den Berg		
Aaron Schwartz		
Katrina Collins		
Ryan Darling		
Troy Larson		
Laura Behymer		
Ben Tabor		
Elise Coolbeth		
Kadyn Garcia		
Trent Coletta		
Brandon Kipp		
Matt Bogaczyk		
Andy Elms		
Tim Wilk		
Steven Dombrowski		
Larkin Wellborn		
Matthew Digiovanni		

Arizona, Oct. 21-23, 2020

Name	Organization	Contact Information
Jesús A. Sandoval-Gil	AZ DOT	
Brent Conner	AZ DOT	
Abraham Abdulnour	AZ DOT	
Isaac Conez	AZ DOT	
Jessica Banner	AZ DOT	
Murari M. Pradhan	AZ DOT	
Kelly Baum	AZ DOT	
Dharminder Sharma	AZ DOT	
Joshua Bailey	AZ DOT	
Danny Brock	AZ DOT	
Martin Coronado	AZ DOT	
Aaron R. Robert	AZ DOT	
Nye McCarty	AZ DOT	
Brian Lasham	Granite	
Cristian Velazquez	Granite	
Bruce Victory	FNF Construction, Inc.	
Thomas C. Ludlum	HollyFrontier Asphalt Company	
Brian Frazier	Town of Marana	
Morris Reyna	Town of Marana	
Mark Navarro	Town of Oro Valley	
Rubben K. Lolly	City of Phoenix	
David Orchekowsky	Pima County DOT	
Robert Lane	Pima County DOT	
Xavier de la Garza	Pima County DOT	
Joseph A. Phillips	Terracon	
Miguel Romo	MRM Construction Services, Inc.	
Juan Carlos Villegas	MRM Construction Services, Inc.	
Elizabeth Ortega	MRM Construction Services, Inc.	
David Simon	MRM Construction Services, Inc.	
Carey Oberheim	City of Prescott	
Brad J. Parker	Vulcan	
Matt Manthey	Mesa City Transportation Dept.	
Jeyakaran Thavathurairaja	Integer Consulting LLC.	
Mike Davenport	Solterra Materials	
Sathish Banda	Western Technologies Inc.	
Raphael Tixer	Western Technologies Inc.	
Don Cornelison	Speedie and Associates	
Robert Sowder	AZ DOT	

Nebraska, Nov. 4-6, 2020

Name	Organization	Contact Information
Corey Hilbrands	Omni Engineering	
Gregg Leber	Constructors, Inc.	
Mackenzie Hayden	Constructors, Inc.	
Mike Collins	Knife River Midwest	
Robert Rea	NDOT	
Andy Dearmont	NDOT	
Mick Syslo	NDOT	
Jody Paul	NDOT	
Jacob Reynolds	NDOT	
Mike Reynolds	NDOT	
Jerry Isom	NDOT	
Terry Becker	NDOT	
James Smith	NDOT	
Cal Splattstoesser	NDOT	
Kimberly Kirchner	NDOT	
Brandon Remm	NDOT	
Stacy Burford	NDOT	
Kathy Fread	NDOT	
Michael Eich	NDOT	
Allissa Reinhard	NDOT	
Asad Sahak	NDOT	
Amy Tran	NDOT	
Sean Johnson	NDOT	
Bruce Barrett	NDOT	
Kellie Troxel	NDOT	
Hamzeh Haghshenas	UNL	
Nitish Bastola	UNL	
Nima Aminpour	UNL	
Mahdieh Khedmati	UNL	
Shin-Che Huang	FHWA	
Eric Hunsley	Werner Construction	
Matt Soucie	Werner Construction	
David Mraz	FHWA	
Andrew Heuerman	FHWA	

Oregon, Nov. 17-19, 2020

Name	Organization	Contact Information
Graham Cole	Baker Rock Resources	
Dan Schnurbusch	Knife River Quality Control	
Kevin Jordan	Carlson Testing Inc.	
Michael Miller	RiverBend Materials	
Tyler Lomax	Knife River	
Randy High	Oregon Mainline Paving	
Christopher Duman	Oregon DOT	
Jim Gunter	Oregon DOT	
Tim Earnest	Oregon DOT	
Kelly Warren	Oregon DOT	
Mike Stennett	Oregon DOT	
Larry Ilg	Oregon DOT	
Justin Moderie	Oregon DOT	
Paul Burch	Oregon DOT	
Tom Bosworth	Wildish Sand & Gravel Co.	
Dr. Erdem Coleri	Oregon State University	
Wayne Brown	ODOT	
Paul Mcgrath	ODOT	
Allyson Peterson	ODOT	
Barb Worbington	ODOT	
Scott Young	ODOT	
Andy Clark	ODOT	
David Kirkland	ODOT	
James Brown	ODOT	
James Darnell	ODOT	
Dustin Hass	ODOT	
Travis Evans	High Desert Agg. & Paving	

North Carolina, Dec. 7-9, 2020

Name	Organization	Contact Information
Dr. Y. Richard Kim	North Carolina State University	
Ellis Powell	CAPA	
Todd Wilson	Barnhill Contracting Company	
Marvin Hylton	Thompson-Arthur Paving & Construction	
Richard Wise	Rogers Group Inc.	
Jaehoon Jeong	NC State University	
Bart Roark	Maymead, Inc.	
Todd Whittington	NCDOT	
Matt Hilderbran	NCDOT	
Brian Hunter	NCDOT	
Charles Colgate	NCDOT	
Tony Collins	NCDOT	
Kristin Ewan	NCDOT	
Mehdi Haeri	NCDOT	
Clark Morrison	NCDOT	
Andrew Wargo	NCDOT	
Shihai Zhang	NCDOT	
Josh Holland	NCDOT	
George Boules	NCDOT	
Jim Sawyer	NCDOT	
John Flowers	NCDOT	
Kevin Smith	NCDOT	
Eric Fazekas	NCDOT	
Justin Gill	NCDOT	
Wiley Jones	NCDOT	
Brian Skeens	NCDOT	
Vasyl "Basil" Shymonyak	Carolina Sunrock LLC	
David Branscome	Sharpe Brothers Paving	
Roger Ridenhour Jr.	NJR Group Inc.	
Russel Ross	Fred Smith Company	

APPENDIX C

National BMD Conference Flyer, BMD Conference Registration List



Balanced mix design is opening the door to utilizing innovative materials and technologies to design asphalt pavements while providing agencies with a more reliable way to accept mixtures.

BACK-TO-BACK WITH THE AAPT ANNUAL MEETING

SEPTEMBER 2-3, 2021 | NASHVILLE, TN

Register and reserve your room at the Loews Vanderbilt Hotel at
ncat.us/education/bmd



NO FEE TO ATTEND – REGISTRATION IS REQUIRED

BMD Conference Attendees List

National BMD Implementation Conference

September 2-3, 2021 | Nashville, TN

First	Last	Organization	Thu	Fri
Gina	Ahlstrom	FHWA	✓	✓
Shamma	AL Kaabi	Al Ain City Municipality		
hossam	bahour	TDOT	✓	✓
Ann	Baranov	infraTest USA Inc.	✓	✓
Brad	Baskette	TDOT	✓	✓
Austin	Bateman	Delta Contracting Company, LLC		
Jason	Bausano	Ingevity	✓	✓
Jim	Bibler	Gilson Company Inc		
Erik	Biggers	Martin Marietta	✓	✓
Pablo	Bolzan	Universidad Catvlica Argentina		
Ramon	Bonaquist	Advanced Asphalt Technologies LLC		
Jenna	Bowers	Ingevity	✓	✓
Cory	Bramlett	Stewart Brothers	✓	✓
Jennifer	Breuer	Superior Bowen		
Dale	Brewer	Delta Contracting Company, LLC	✓	✓
Stormy	Brewster	Marathon Petroleum Company	✓	✓
Alicia	Brooks	Luck Stone	✓	✓
Alicia	Brooks	Luck Stone		
Wade	Collins	PTI	✓	✓
John	Collins	Sustainable Pavement Technologies		
Ronald	Corun	Ron Corun Consulting LLC		
John	D'Angelo	D,ÄoAngelo Consulting	✓	✓
Stacey	Diefenderfer	VTRC / VDOT	✓	✓
Jason	Dryden	TDOT	✓	✓
Jon	Epps	Texas A&M Transportation Institute		
Fisseha Nega	Ezezew	Prome Consulting E g.		
David	Farris	Rogers Group Inc	✓	✓
Mike	Fielding	Midsouth Paving		
Steve	Flaherty	necoTech	✓	✓
Jean-Paul	FORT	Colas Inc.	✓	✓
Mawazo	Fortunatus	NCAT		
Stevenson	Ganthier	New Jersey Department of Transportation		
LAWAN	GARBA DAN-ALHAJI	University Technology Mara		
Gregory	Garner	Self	✓	✓

Derek	Gaw	Tennessee DOT		
mohammad	ghodslan			
Billy	Goins	TDOT Materials and Test	✓	✓
Amir	Golalipour	FHWA	✓	✓
Jhony	Habbouche	VTRC	✓	✓
John	Haddock	Purdue University	✓	✓
Elie	Hajj	University of Nevada, Reno		
Adam	Hand	UNR	✓	✓
Steve	Hefel	WisDOT	✓	✓
Jose	Hernandez	Gardner Asphalt Supply	✓	✓
Mohammed	Heyder	Iran university of Science & Technology		
Jason	Hill	Rogers Group	✓	✓
Xiaoyang	Jia	Tennessee DOT		
Wayne	Jones	Asphalt Institute	✓	✓
Joyce	Kamau	Iowa State University		
Amir	Khan	Gardner Asphalt Supply		
Sungho	Kim	VDOT		
Abhilash	Kusam	Trimat Materials Testing		
Matthew	LaChance	Ingevity		
Andrew	LaCroix	NVI Advanced Materials Group		
Cheng	Ling	Pike Industries, Inc.	✓	✓
Paul	Lum	Colas Inc.	✓	✓
Todd	Lynn	Lipscomb University	✓	✓
Cynthia	Lynn	Thunderhead Testing, LLC	✓	✓
Tiana	Lynn	NCAT	✓	✓
Charles	Mills	Asphalt Pavement Association of Michigan	✓	✓
fariborz	mohammadi			
Nathan	Moore	NCAT		
		Advanced Construction Technology Services		
nikesh	Mundayat			
Alex	Murchison	Tennessee Department of Transportation	✓	✓
Hadi	Nabizadeh			
Casey	Nash	Maine Department of Transportation	✓	✓
Tanya	Nash	ATS	✓	✓
Rasool	Nemati	AECOM		
Derek	Nener-Plante	FHWA	✓	✓
Barry	Nunez	Barry L Nunez LLC	✓	✓
Paul	Oel	George Reed Inc		
Mbakisya	Onyango	University of Tennessee at Chattanooga		
Brian	O'Toole	InstroTek, Inc.		

Ankit	Pandey	Indian Institute of Technology Bombay		
Jorge	Paz	OPSS		
Daniel	Poole	Superior Paving Corp	✓	✓
alireza	pourfeiz	babol noshirvani university of technology		
Scott	Quire	Bluegrass Testing Laboratory	✓	✓
Punyaslok	Rath	University of Missouri, Columbia	✓	✓
Courtney	Rice	Owens Corning		
Dan	Ridolfi	LASTRADA Partners	✓	✓
David	Royster	Tennessee Department of Transportation	✓	✓
Adam	Schaefer	Ingevity		
Jim	Scherocman	Consulting Engineer		
Aaron	Schwartz	Vermont Agency of Transportation	✓	✓
Brian	Schwarz	SCHWARZ PAVING CO., INC.		
Brett	Stanton	Asphalt Pavement Association of Michigan	✓	✓
Richard	Steger	Ingevity		
Hassan	Tabatabaee	Cargill	✓	✓
Adam	Taylor	NCAT		
Swathi	Theeds	Asphalt Testing Solutions & Engineering	✓	✓
Ruben	Trillo	George Reed Inc.		
Arthur	Trillo	George Reed Inc.		
Clint	Van Winkle		✓	✓
Christopher	Wagner	USDOT	✓	✓
Travis	Walbeck	NCAT	✓	✓
Andrew	Wargo	NCDOT		
Randy	West	National Center for Asphalt Technology	✓	✓
Brett	Williams	National Asphalt Pavement Association	✓	✓
J. Richard	Willis	National Asphalt Pavement Association	✓	✓
Chris	Winiecki	Walbec Group		
Mark	Woods	Tennessee DOT		
Trey	Wurst	Ingevity	✓	✓
Fan	Yin	NCAT	✓	✓
Will	Gosell	INGEVITY	✓	✓
Bryan	Techt	Ingevity	✓	✓
Tim	Aschabrona	FHWA	✓	✓
Gaylon	Baumgardner	Paragon technical services	✓	✓
Michael	Dunning	NCE	✓	✓
Dave	Allain	ACAF	✓	✓
John				
Keslee	McCardney		✓	