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September 17, 2024

Asphalt Mix Design of the Future

National Center for Asphalt Technology

NCAT

AT AUBURN UNIVERSITY

Randy C. West

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Association of Asphalt Paving Technologists

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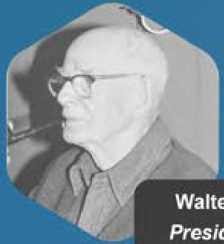

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Balanced Mix Design

Cracking Resistance

"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."

Rutting and Moisture Damage Resistance

AASHTO Standards for BMD (Frameworks)

- TP 105 Standard Practice for Balanced Design of Asphalt Mixtures
  - Four approaches to BMD
  - Agencies chose mix performance tests and mix conditioning procedures
- MP 46 Standard Specification for Balanced Mix Design
  - Agencies set criteria for test results
- R 121 Long-Term Laboratory Conditioning of Asphalt Mixtures
  - Five options for long-term mix conditioning

The Tenants of Balanced Mix Philosophy

- The Goal is to design, produce, and place an **economical**, *resource-responsible*, **long-life** asphalt pavement.
- PMS data tells us what modes of distress are prevalent in asphalt pavements. We can effectively assess mix resistance to those various distresses with laboratory performance tests.
- There can be a juxtaposition between designing mix resistance to two or more distresses, necessitating a balanced approach.
- The best way to simultaneously encourage innovation and achieve economy is to allow the contractor freedom to choose the materials needed to meet the mix performance criteria.

Approaches to Balanced Mix Design, PP 105

Approach A	• Volumetric Design with Performance Verification
Approach B	• Volumetric Design with Performance Optimization
Approach C	• Performance-Modified Volumetric Design
Approach D	• Performance Design

Standard Practice for Balanced Design of Asphalt Mixtures AASHTO PP 105

A
V+

Volumetric Design

+

Performance Test Criteria

B
V. Opt. P_b

Initial Volumetrics

Perf. Tests @ Vol. Opt. Binder ± 0.6%

C
Perf-Mod V

Volumetric Design

Perf. Criteria

Adjust components

Perf. Criteria

D
Perf Design

Performance Criteria

No Volumetric Requirements

For more information, check out this special report

https://aub.ie/BMDapproaches

» Balanced Mix Design, Special Report 228

NAPA NATIONAL ASPHALT PAVEMENT ASSOCIATION

GUIDANCE ON PROGRESSING THROUGH
BMD APPROACHES

Randy West and Fan Yin

INTRODUCTION

Balanced Mix Design (BMD) continues to be one of the most talked about topics in the asphalt pavement industry. As the State Departments of Transportation (DOTs) work toward BMD implementation, one of the important early decisions is how to approach BMD for mix design approval. This guide presents the pros and cons of different approaches in AASHTO PP 105 to implement the new BMD performance tests that DOTs should consider in this decision. Other relevant guide documents for implementing BMD specifications and conducting field validation of performance test criteria can be found on the National Asphalt Pavement Association (NAPA's) Balanced Mix Design Resource Guide website.

WHY CHANGE?

The motives for any change are typically rooted in dissatisfaction with the status quo. Feedback from BMD Peer Exchanges in 2023 (Bittner et al., 2023a; Bittner et al., 2023b; Bittner et al., 2023c) indicates that the most common reasons why state DOTs want to implement BMD include:

- Improving the service lives of asphalt pavements
- Eliminating premature failures of some asphalt pavements
- Reducing the carbon footprint of asphalt pavements
- Optimizing asphalt mixtures for specific applications

Most stakeholders realize that it is not possible to accomplish the above goals by continuing to use existing specifications, mix design practices, and construction methods. Although tweaks to existing Superpave specifications and methods, such as with Superpave 5, regressed air voids, and the corrected optimum asphalt content (COAC) concept, can provide some performance improvements, they do not fix the underlying limitations of a volumetric mix design system.

There are two recognized deficiencies of mix design systems based on volumetric properties: (1) the reliability and accuracy of VMA are challenging because of the difficulties in accurately determining the bulk specific gravity (G_{sb}) of aggregates, and (2) there is no way to determine the interaction effects of virgin binders, recycled binders, and other additives such as recycling agents. These issues are further discussed below.

Concerns regarding VMA

The two primary volumetric properties used in asphalt mix design and QA specifications are air voids (*Va*) and voids in the mineral aggregate (VMA). Air voids represent the volume of void space within a compacted specimen at a specific compactive effort, which has been related to rutting resistance (Brown and Cross, 1992). VMA is defined as the volume of the intergranular void space between the aggregate particles of a compacted asphalt mixture that includes the air voids and the effective binder content. A minimum VMA is important to ensure a mixture contains an adequate volume of effective asphalt. Although many asphalt technologists know that the minimum VMA criteria were established by Norman McLeod in the late 1950s, some are surprised to know that he provided no mix performance data to support the criteria (Kandhal et al., 1998). Numerous other researchers have also discussed the weakness of VMA as a mix design criterion (Coree & Hislop, 2000).

Balanced Mix Design

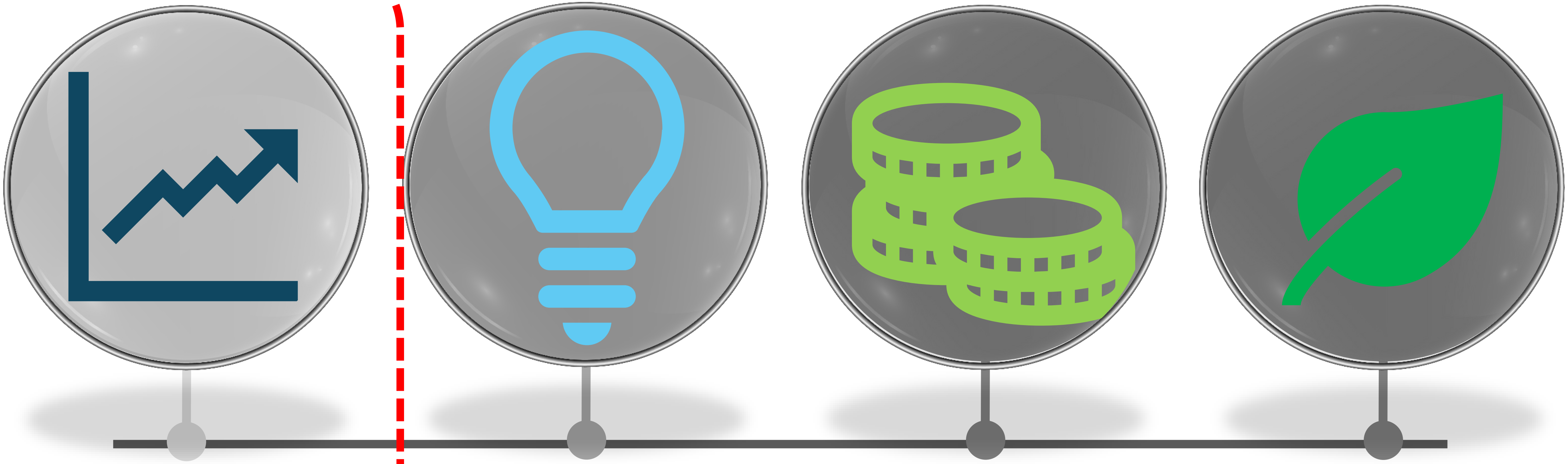
Cracking Resistance

"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."

Rutting and Moisture Damage Resistance


2nd grade
Why?

Anticipated Benefits of BMD



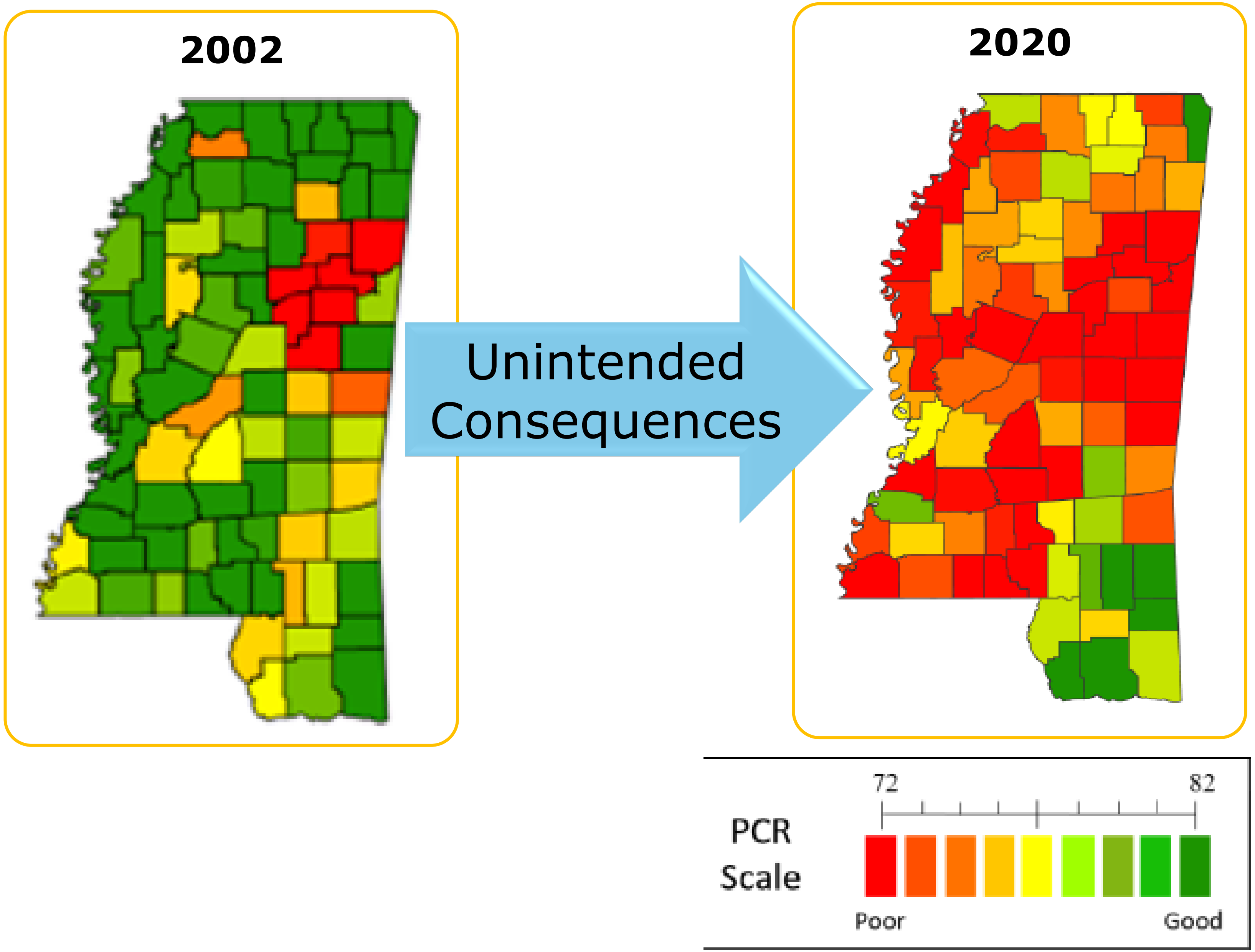
Improve Performance

Enable Innovation

Optimize Cost

Sustainable

Volumetric-only mix design is not fully capable of dealing with present-day mixes



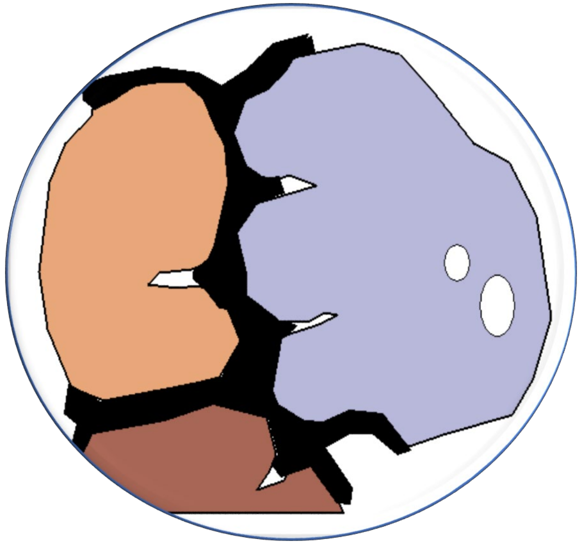
Pavement Condition Rating

Superpave to BMD: Why Change?

DOTs and industry acknowledge that Superpave (Superior Performing Pavements) has not lived up to its promise.

Superpave: what are the limitations?

- The key mix properties in Superpave are air voids (V_a) and volume of effective binder (V_{be})



- Volumetric properties do not tell us anything about the **quality** of the binder or about the interactions of different binder components and additives

Superpave: What are the limitations?

The volume of effective binder (V_{be}) is dependent on the aggregate bulk specific gravity (G_{sb}), which is not a reliable property

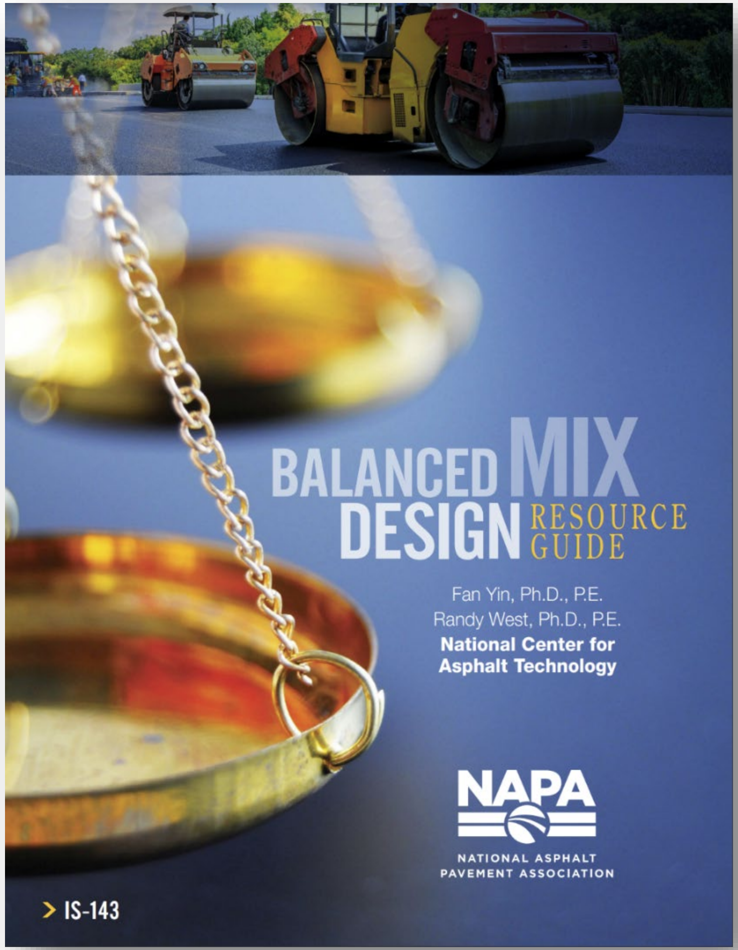
- G_{sb} is subject to change over time but not often verified
- G_{sb} has a low level of precision
- G_{sb} of RAP aggregate is questionable

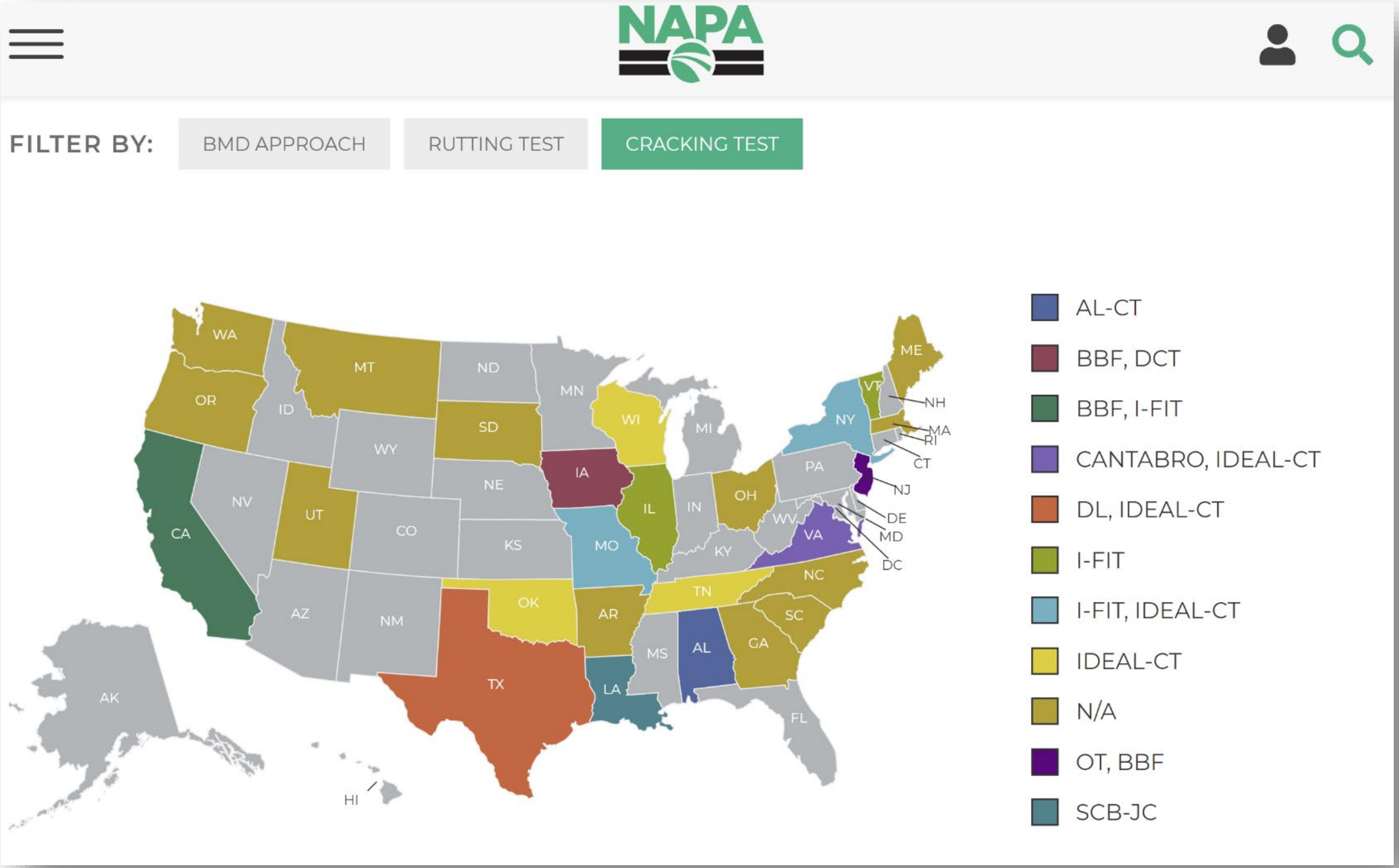
AASHTO / ASTM	Acceptable Range of Two Results (d2s) Bulk specific gravity (SSD)	
Precision	Coarse T85/C127	Fine T84/C128
Single-operator	0.020	0.027
Multi-laboratory	0.032	0.056

Example Effect of G_{sb} Impact on VMA

Given	P_b = 5.2%	P_b = 5.2%
	G_{mm} = 2.531	G_{mm} = 2.531
	G_{mb} = 2.431	G_{mb} = 2.431
	G_{sb} = 2.640	G_{sb} = 2.670
Calculated	Air Voids = 4.0%	Air Voids = 4.0%
	VMA = 12.7%	VMA = 13.7%
	VFA = 69%	VFA = 71%


Quantity
Quality
BMD

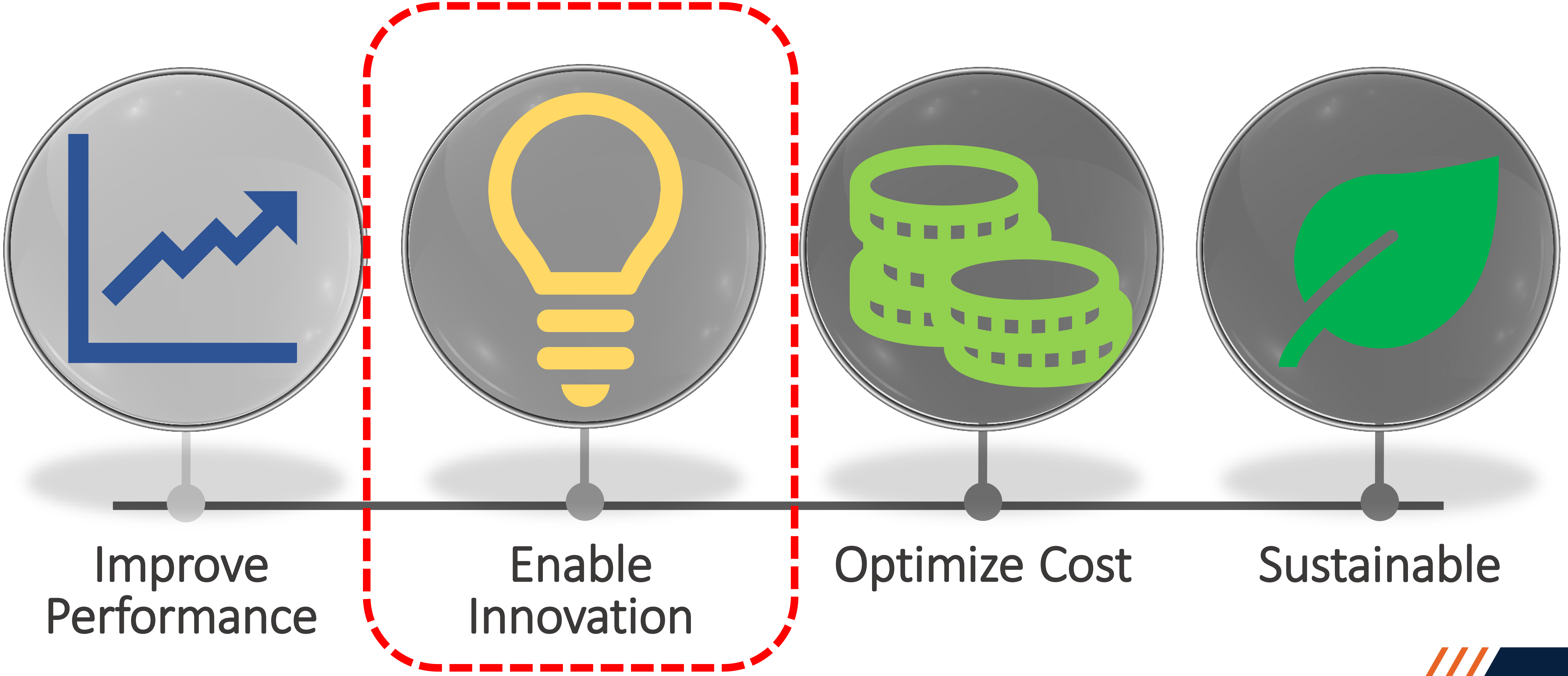




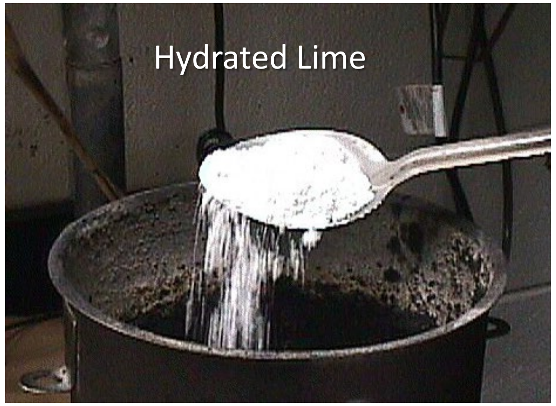
BMD Resources

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

Anticipated Benefits of BMD



With a volumetric mix design approach…



With a volumetric mix design approach…

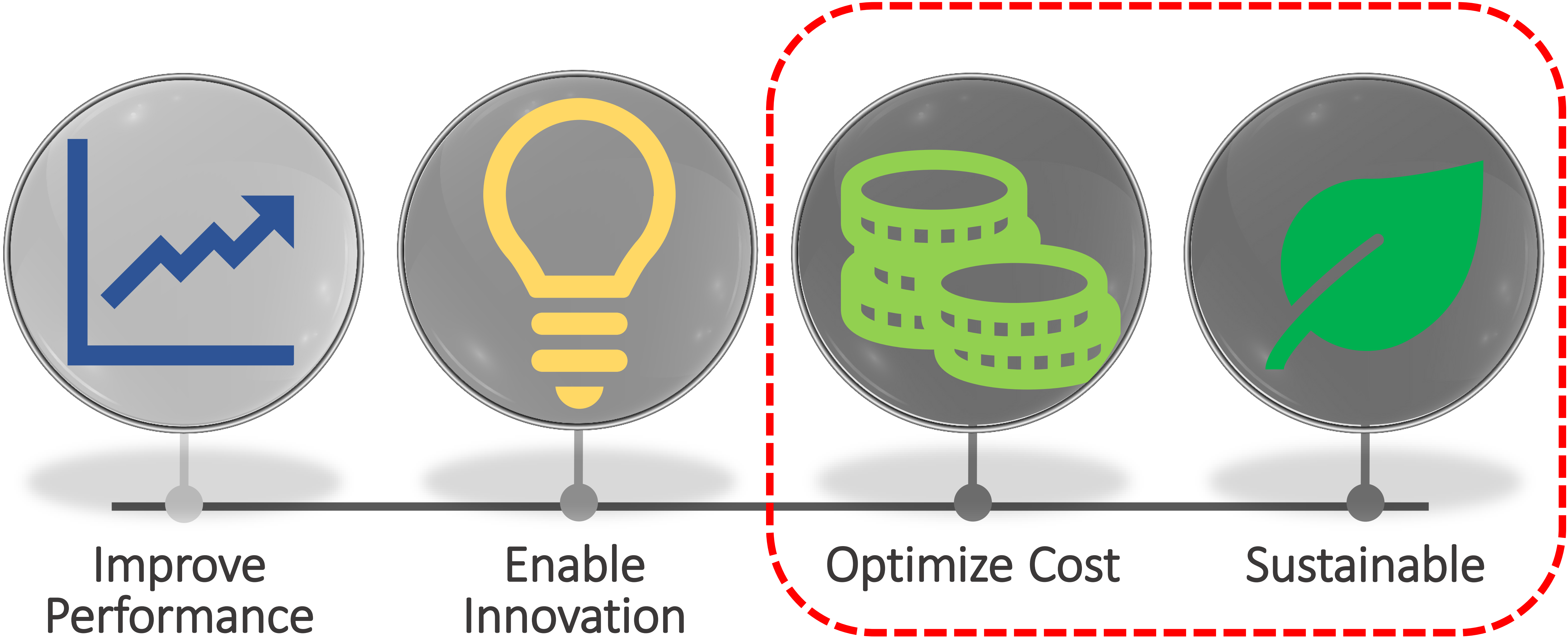
Graphene

Recycled Plastics


BALANCED APPROACH
SAND
SAND
ROCK
ROCK
RAP
SAP
EPD
RSJAT
GTR
RAP
ROUND
GROUND
SBS
RRPEL
LIQUDAL
SPECE
WMT
SBBAL
LIQUD
WMT
SBS
SOY
RAS
TPH

Are you a Chef or a Cook?

Anticipated Benefits of BMD



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Engineering, Environmental, & Economic Benefits of BMD, Case Studies from the NCAT Test Track

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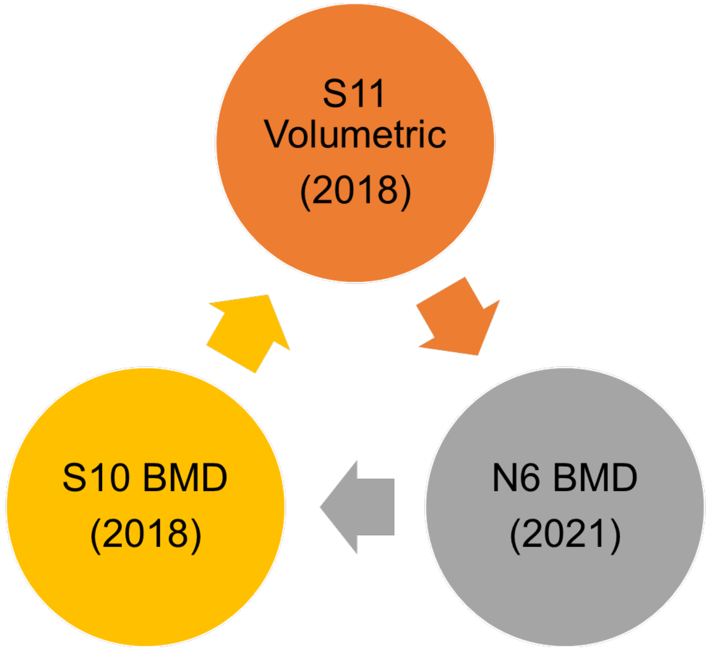
- 1.7-mile Test Track
- 46 Test Sections, 200 ft. each
- 5 trucks each pulling 3 heavily loaded trailers make 400 laps/day
- Test sections are evaluated continuously over 3-year cycles
- 2024 begins our 9^{th} cycle

TxDOT BMD Experiment at the NCAT Test Track

- Field performance comparison of asphalt mixes designed with volumetric vs. BMD approaches
  - 2.5 in. mill-and-inlay
  - Underlying pavement 15-20% lane area cracking



TxDOT BMD Experiment Mix Designs

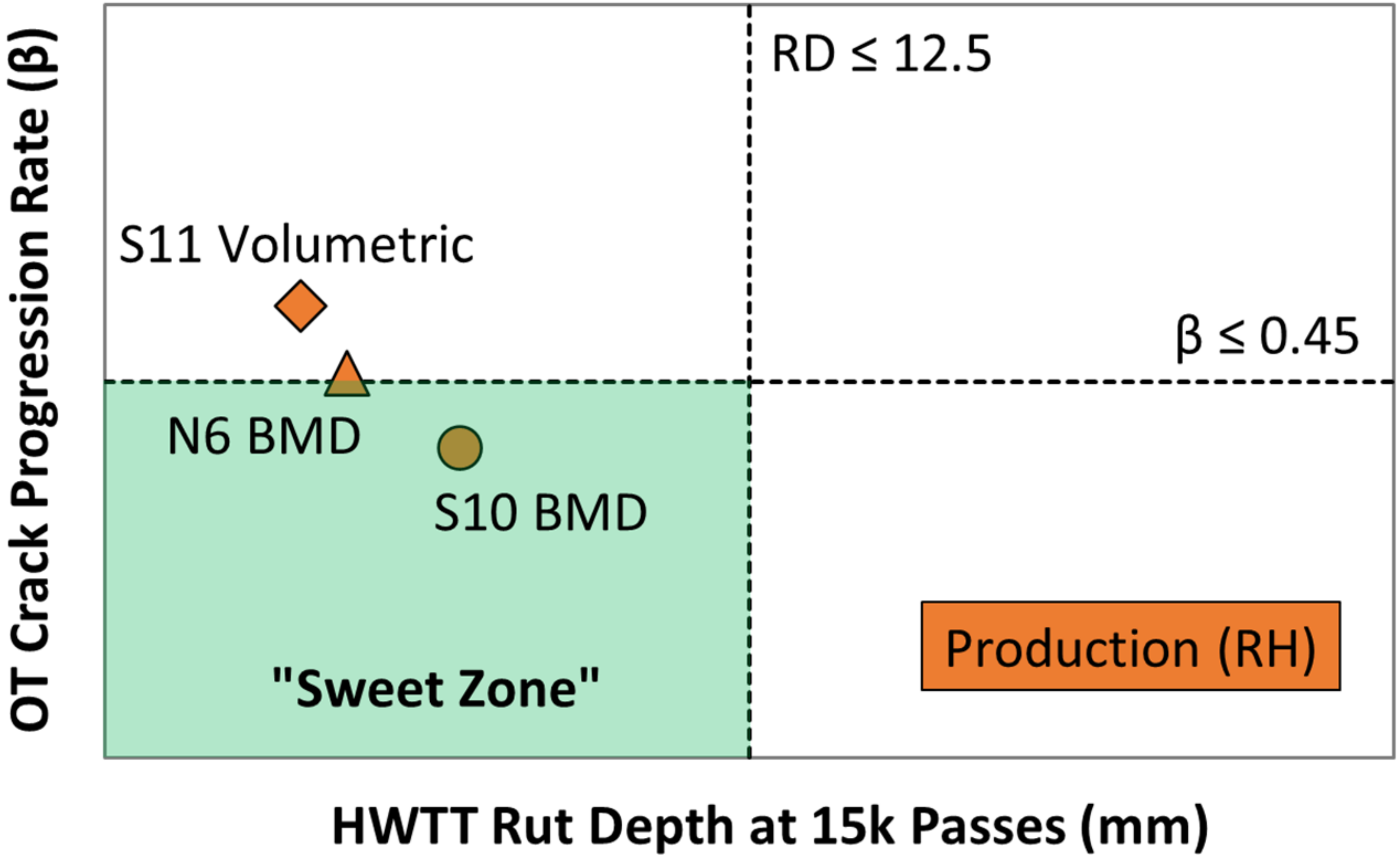
- TxDOT 12.5mm SP-C surface mix – “volumetric”
- PG 70-22 SBS binder in all three test sections
- BMD approach A: Volumetric Design with Performance Verification

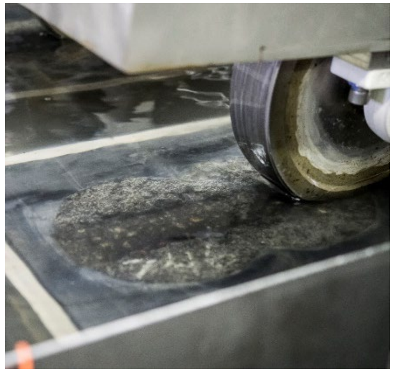
Mix Design	S11 Volumetric (2018)	S10 BMD (2018)	N6 BMD (2021)
Total Binder Content	4.7	5.5	5.3
RAP Binder Replacement	20	20	19
Air Voids (50 Gyrations)	4.0	4.0	4.0
VMA*	15.0	16.6	16.4
V_{be}*	11.0	12.6	12.4
VFA*	73	76	76

* based on Gse

BMD Performance Diagram (OT vs. HWTT)

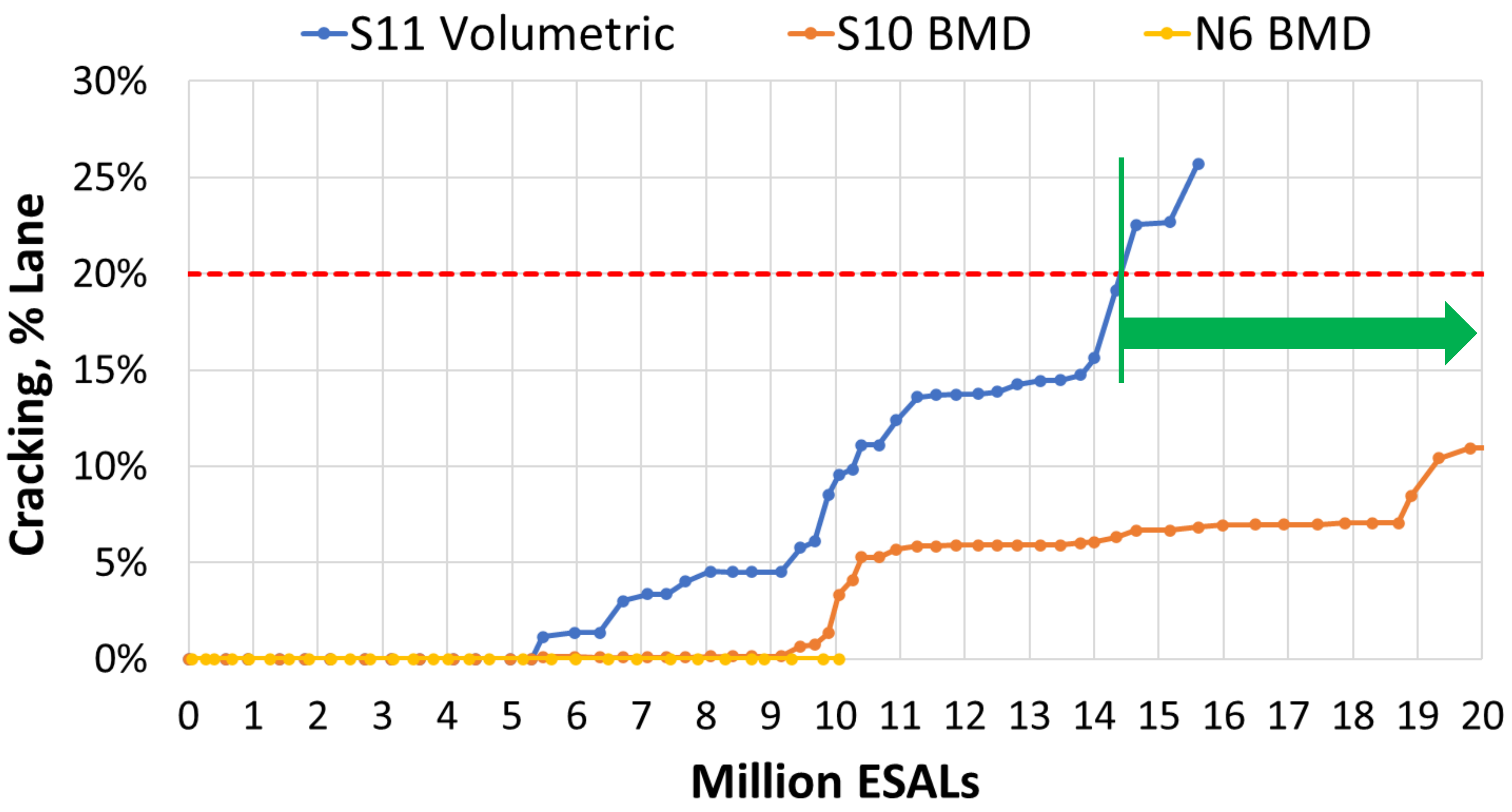
Overlay Test





Hamburg WT

TxDOT BMD Field Cracking Results



BMD overlay life extension > 5.5 MESALs (>1.3 times longer)

Cracking performance: S10 > S11

LCCA for Texas mix comparison

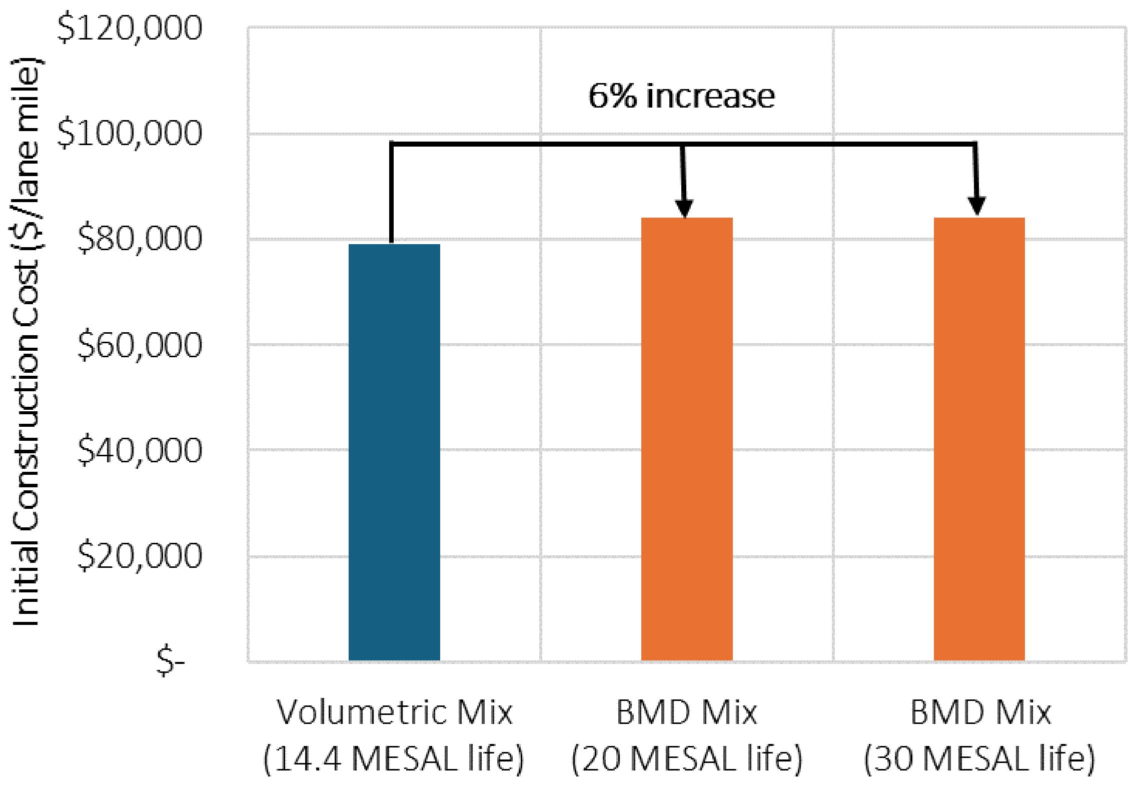
- TxDOT Life Cycle Cost Analysis Policy
  - 40-year Analysis Period
  - Discount rate: 3.72%
  - 12-year performance period for volumetric mix
  - Volumetric mix cost: $80/ton per TxDOT bid price database
  - BMD mix cost: $84.8/ton = $80/ton + 0.64% more virgin PG 70-22 binder × $750/ton

M&R Schedule for LCCA and LCA, TxDOT Ex.

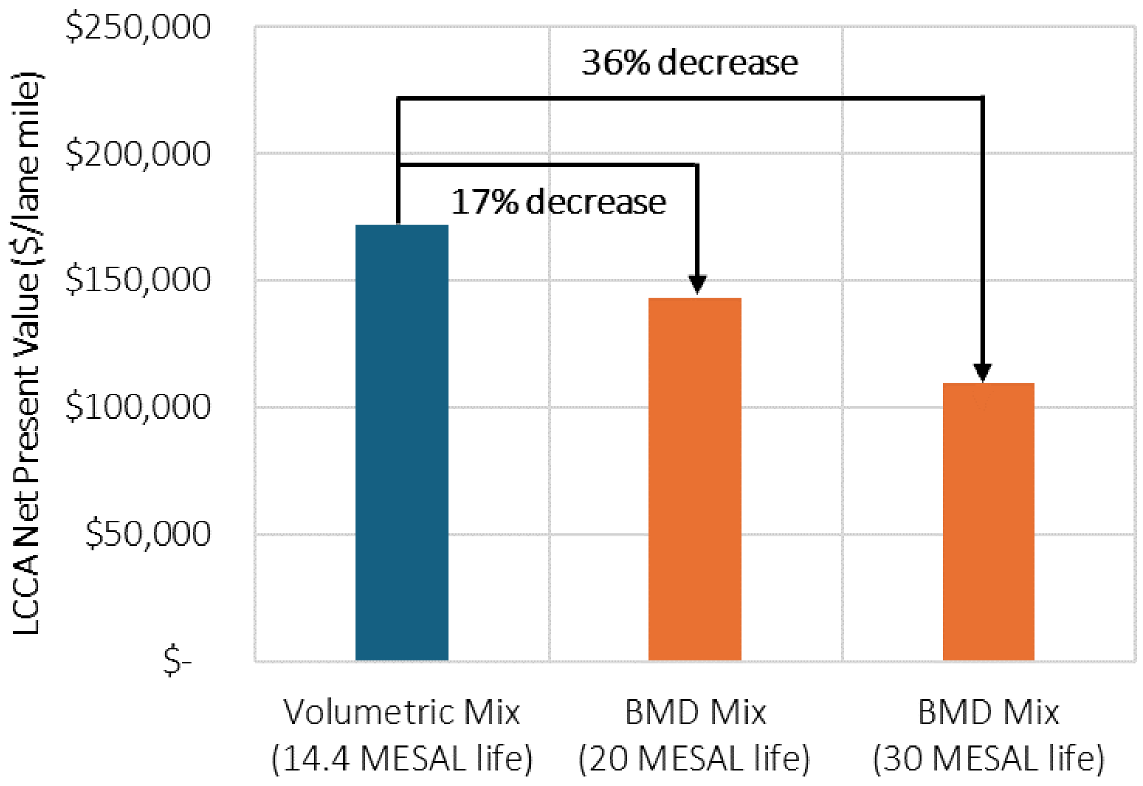
Year	Volumetric Mix (14.4 MESAL Life)	BMD Mix (20 MESAL Life)	BMD Mix (30 MESAL Life)
0	Initial construction	Initial construction	Initial construction
12	2.5” mill & fill		
16.6		2.5” mill & fill	
24	2.5” mill & fill		
25			2.5” mill & fill
33.2		2.5” mill & fill	
36	2.5” mill & fill		
40	End of analysis period	End of analysis period	End of analysis period
Remaining Life (yrs.)	8.0	9.8	10.0

Life Cycle Cost Analysis Results

Initial Construction Cost Comparison

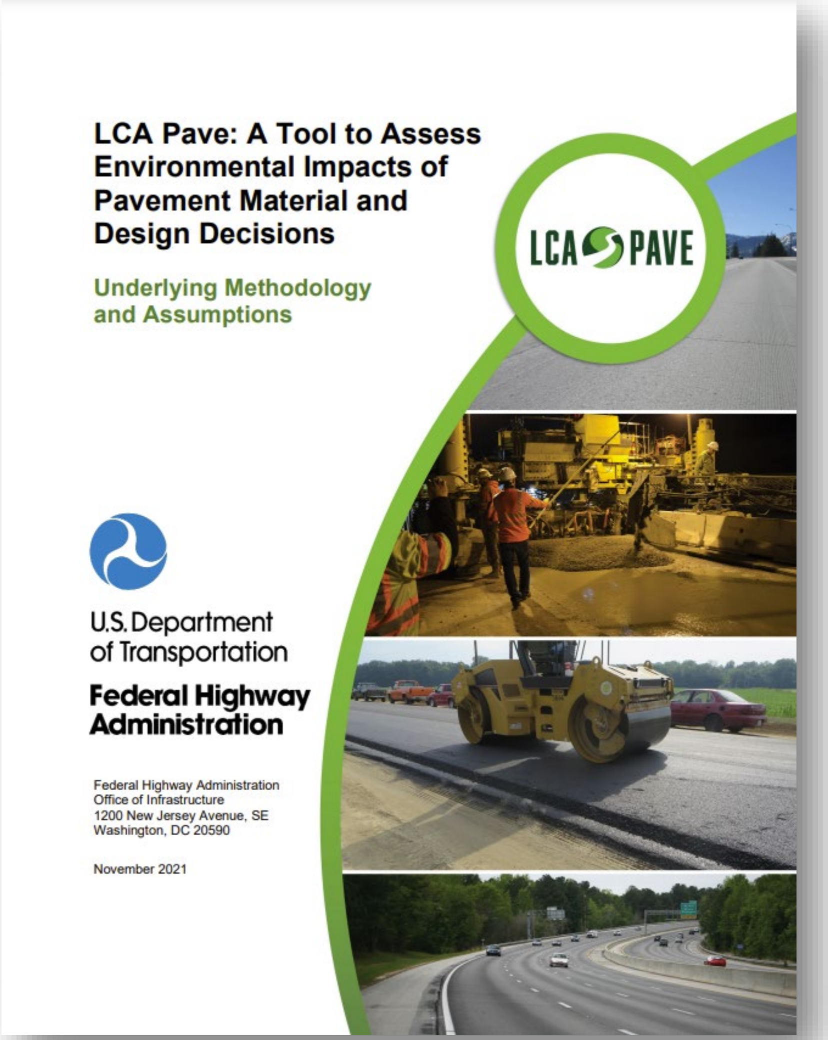


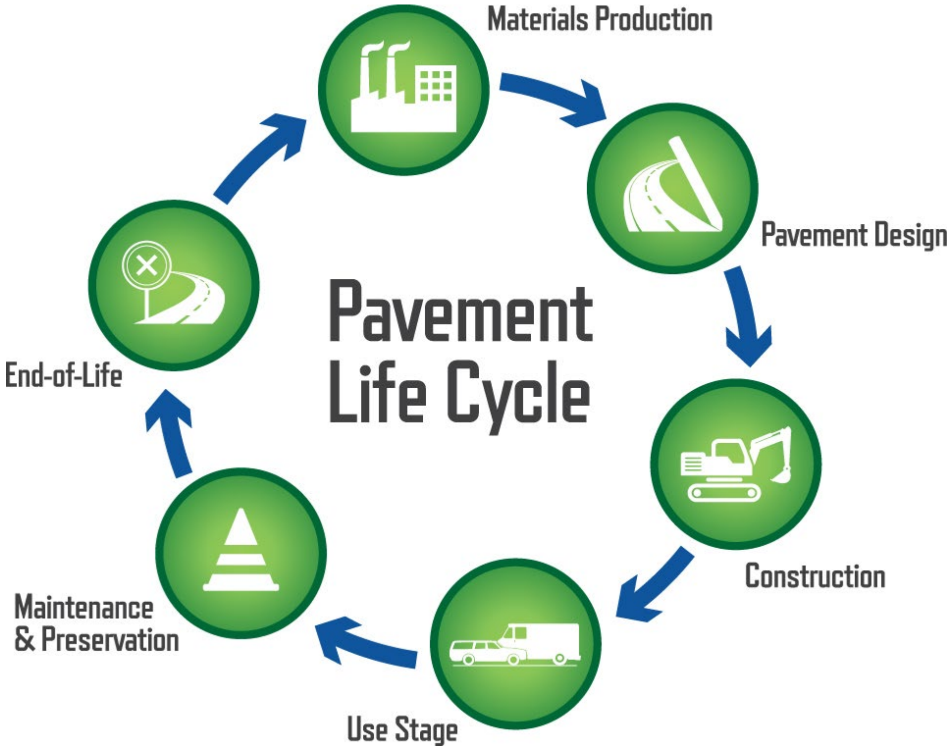
LCCA Net Present Value Comparison



Functional Unit – One Lane mile

Life Cycle Assessment



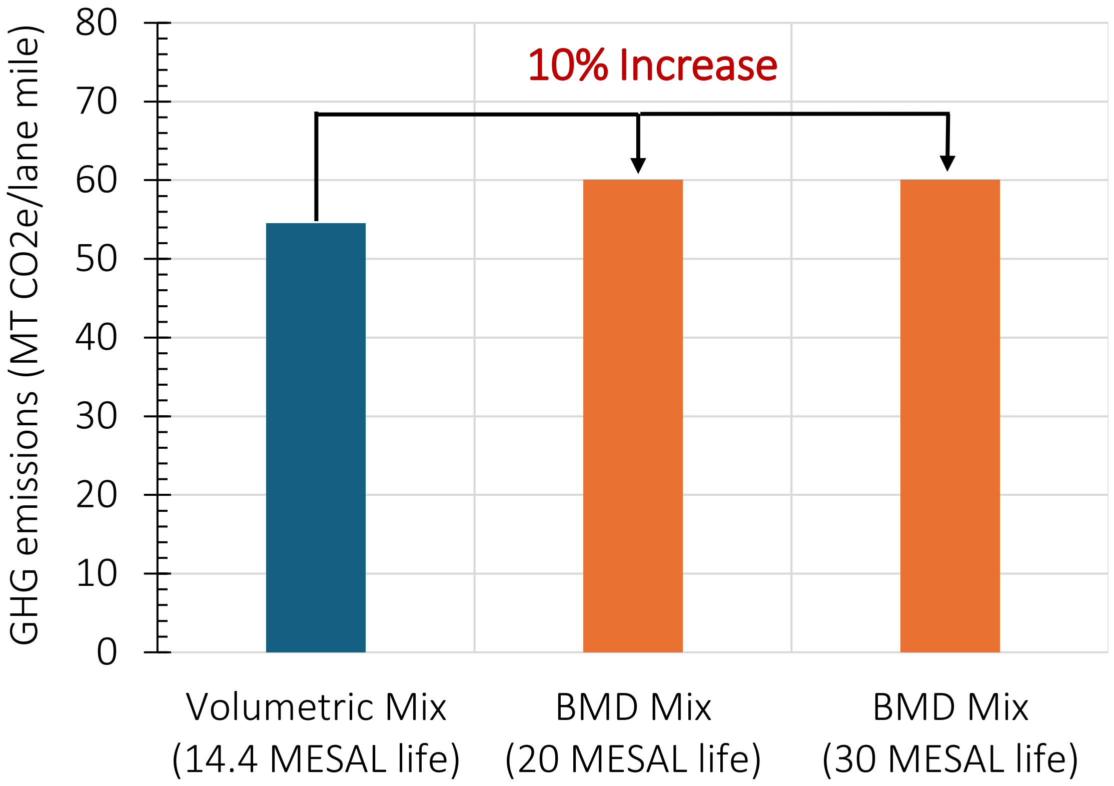


- LCA Pave
- Same Analysis Period and Performance Periods as LCCA
  - Use Stage is not included

Life Cycle Assessment Results

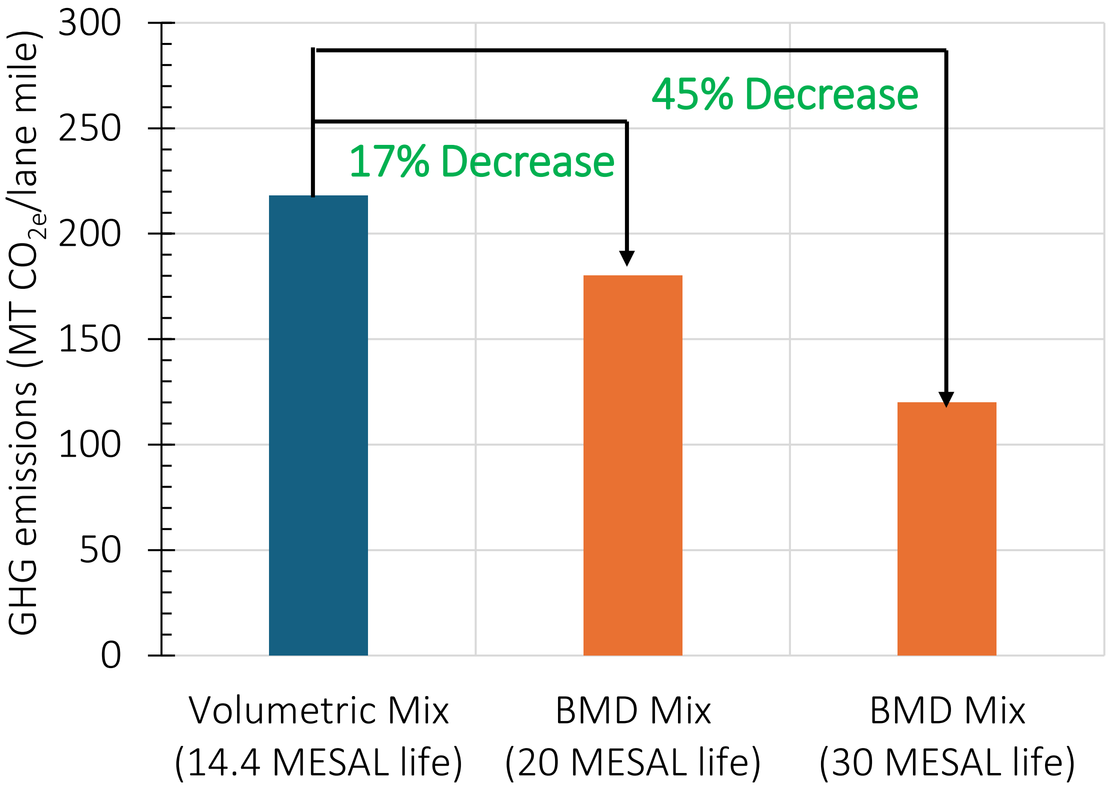
Initial Construction

(Cradle-to-Constructed)



Full Life Cycle

(Cradle-to-Grave)



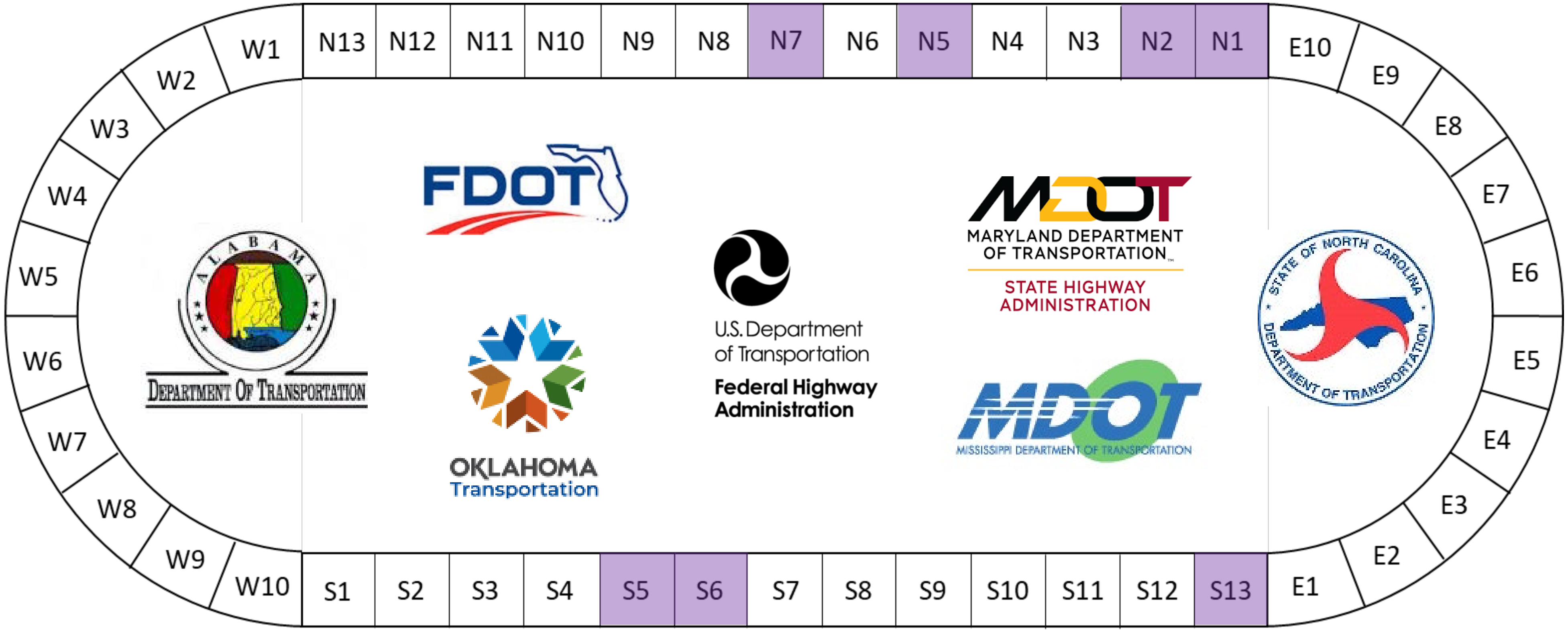
Functional Unit – One Lane mile

MT = Metric ton

Example #2

- 2015-2021 NCAT Cracking Group Experiment
- Correlation of BMD Cracking Tests to Field Performance

2015-2021 NCAT Cracking Group Experiment



NCAT Cracking Group Experiment – QC Results

Section	Description	NMAS	Eff. Binder Content (%)	Air Voids (%)	VMA (%)	As-Const. Density (%G_{mm})	Recovered Binder Cont. Grade
N1	20% RAP (Control)	9.5 mm	4.7	3.8	14.7	93.6	88.6 -16.6
S5	35% RAP, PG 67-28	9.5 mm	5.1	3.2	15.1	92.2	82.8 -23.0
S6	Control w HiMA	9.5 mm	5.0	3.1	14.7	91.8	101.4 -21.5

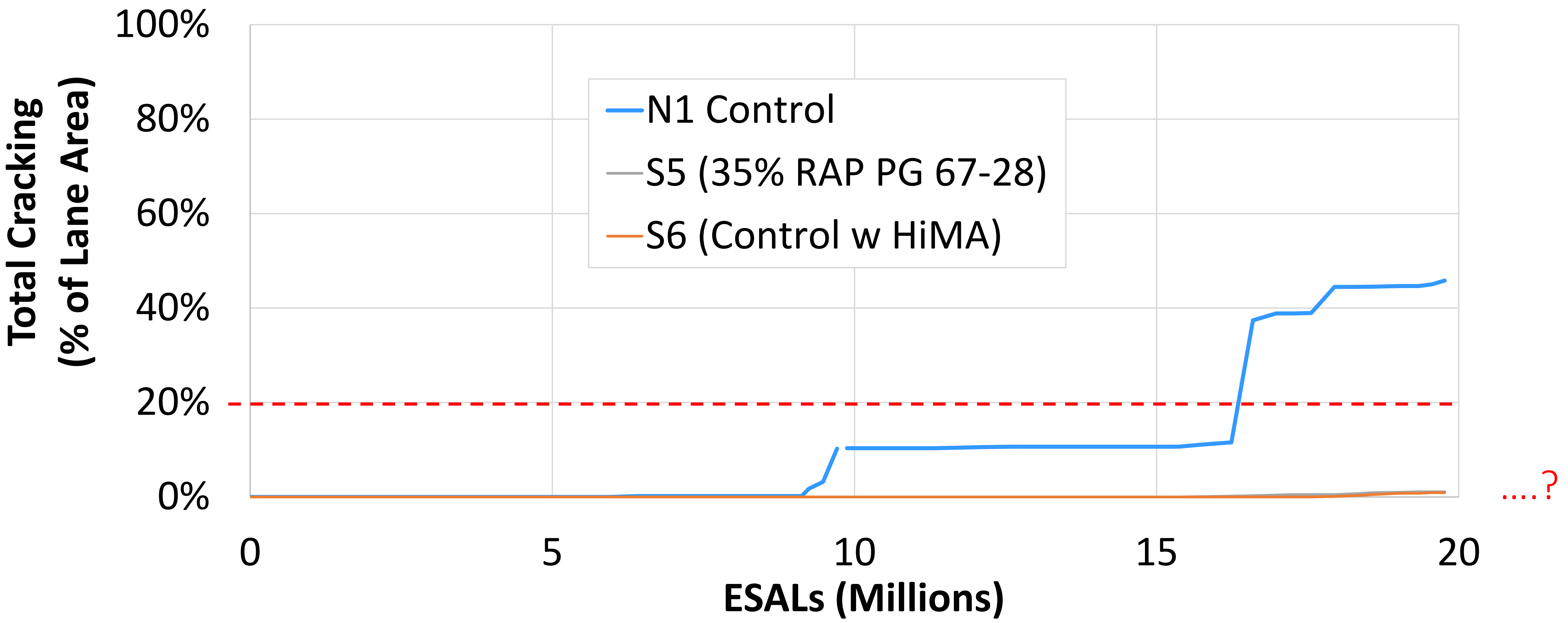
Cracking Group Test Section Layer Thicknesses

Surface (Experimental) Layer	**1.5”**	6”
HiMA mix Intermediate Layer	2.25”	
HiMA mix Base Layer	2.25”	
Granular base	6”	
Stiff track subgrade	infinite	

Cracking Group Experiment:
BMD Cracking Test Results & Field Performance

		Critically Aged Test Results					% Lane Area Cracking
Section	Description	CT_{index}	Flexibility Index	OT-β	NCAT-OT β	S_{app}	Feb. 2021 20 MESALs
N1	20% RAP (Control)	8.8	0.6	2.08	0.50	18.6	44.5
S5	35% RAP PG 67-28	16.3	1.8	1.54	0.33	45.3	1.1
S6	Control w HiMA	18.7	3.8	1.07	0.27	48.0	0.9

Cracking Group Field Performance



LCCA for Cracking Group mix comparison

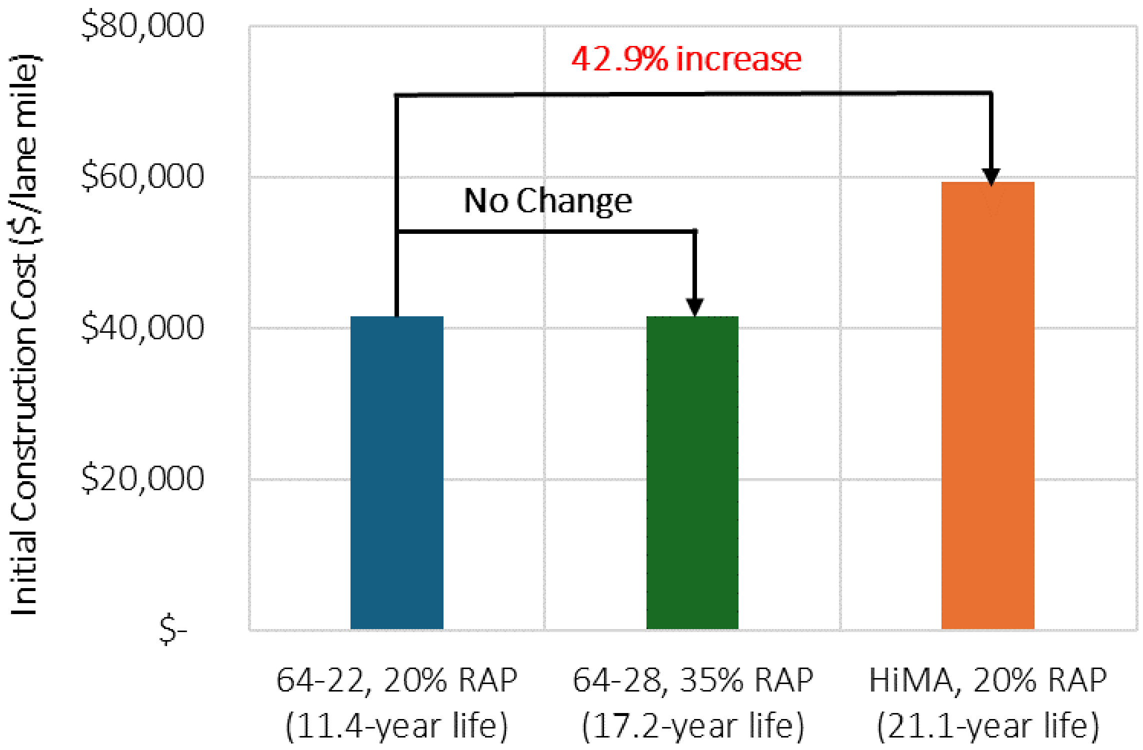
- NCAT LCCA recommendations for ALDOT
  - 40-year Analysis Period
  - Discount rate: 4.0%
  - Performance Periods
    - Control mix: 1 yr. on TT = 3.5 yrs on I-85 = 11.4 years
    - 35% RAP mix = ratio of NCAT-OT β = 1.51 = 17.2 years
    - HiMA mix = ratio of NCAT-OT β = 1.85 = 21.1 years
  - Mix Costs
    - Volumetric mix: $70/ton per ALDOT bid price database
    - 35% RAP mix: $70/ton (PMA binder & RAP savings wash)
    - HiMA mix: $100/ton (estimate)

Cracking Group Assumed LCCA & LCA M&R Schedule

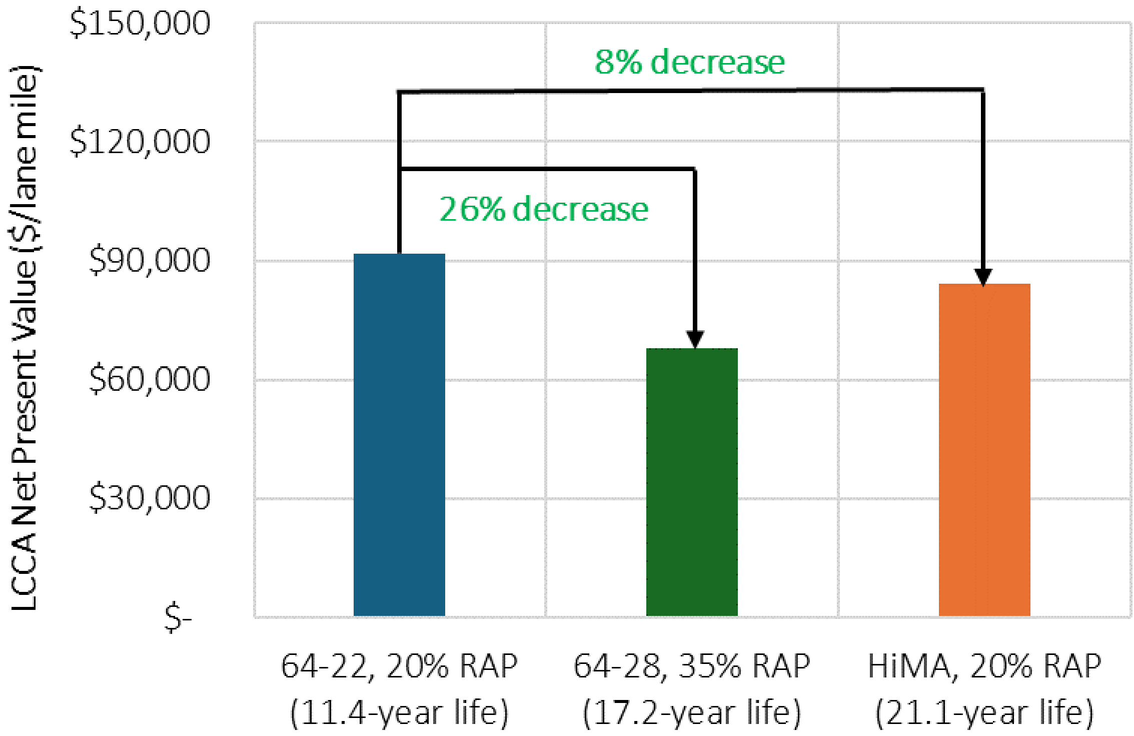
Year	64-22 w/ 20% RAP (11.4 Year Life)	64-28 w/ 35% RAP (17.2 Year Life)	HiMA w/ 20% RAP (21.1 Year Life)
0	Initial construction	Initial construction	Initial construction
11.4	1.5" mill & fill		
17.2		1.5" mill & fill	
21.1			1.5" mill & fill
22.8	1.5" mill & fill		
34.2	1.5" mill & fill		
34.4		1.5" mill & fill	
40	End of analysis period	End of analysis period	End of analysis period
Remaining Life (yrs)	5.6	11.6	2.2

Life Cycle Cost Analysis Results

Initial Construction Cost Comparison

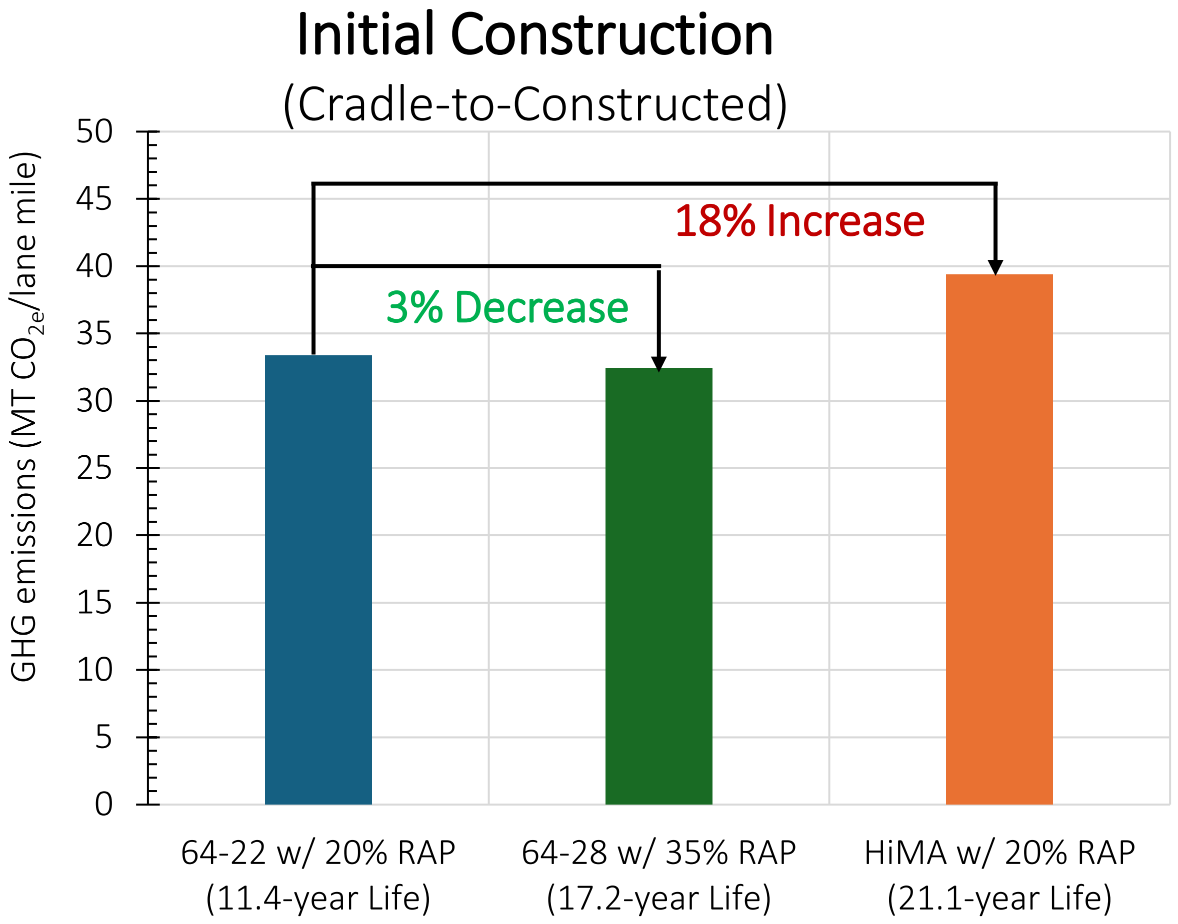


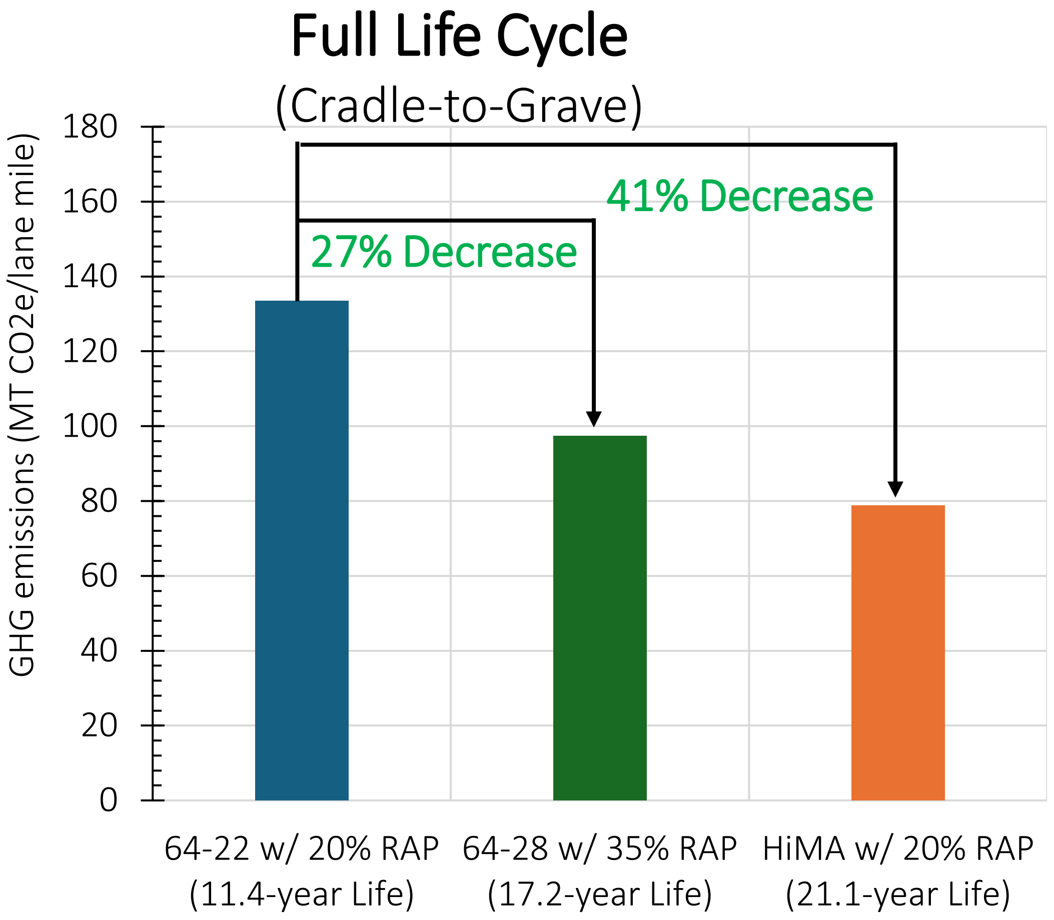
LCCA Net Present Value Comparison



Functional Unit – One Lane mile

Life Cycle Assessment Results





Functional Unit – One Lane mile

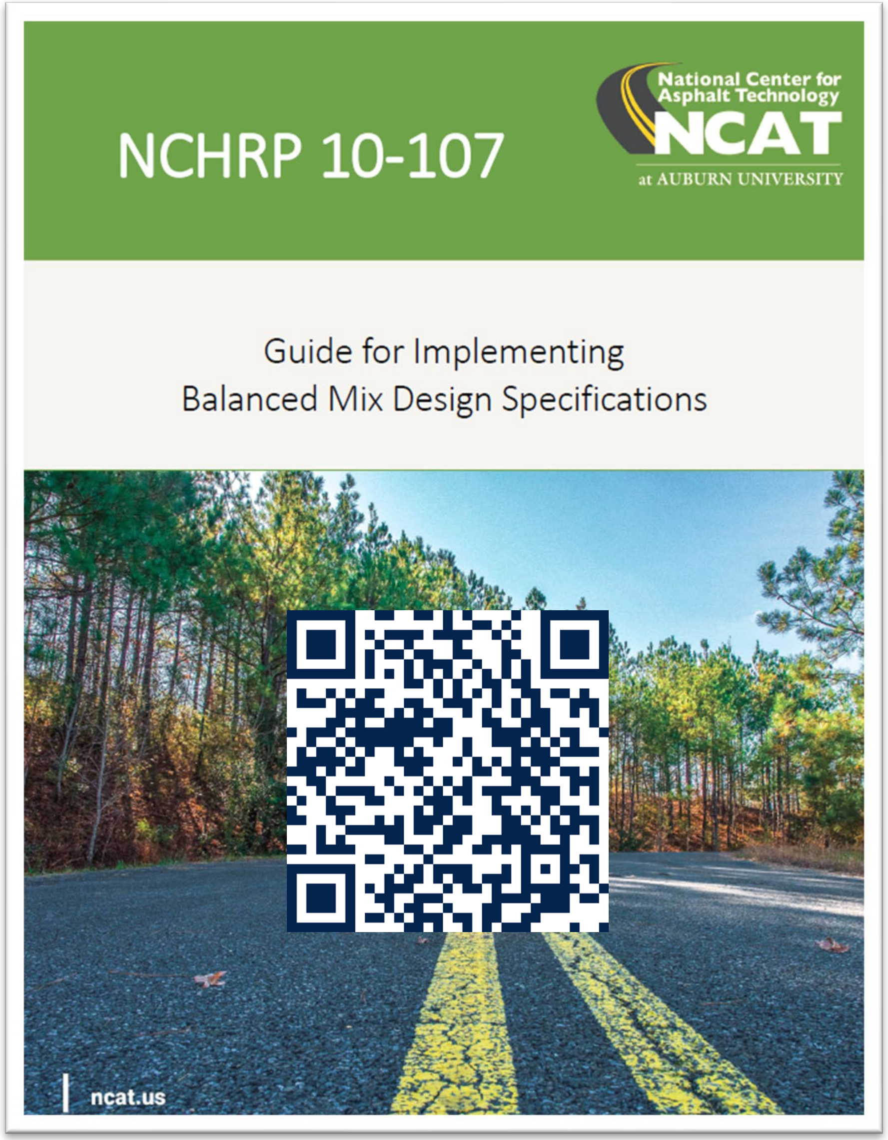
Summary

- Our first expectation for BMD should be better field performance and longer pavement lives. The Test Track is giving us a glimpse of that.
- Initial cost of BMD mixes will likely be higher, especially for Approaches A and B.
- LCCA and LCA benefits should show economic and environmental benefits of BMD.

Impacts of BMD

Factors	Superpave	Approach A	Approach B	Approach C	Approach D
Cost BMD	Baseline	↑	↑	↑	↑
Time BMD	Baseline	↑	↑	↑	*Slight* ↑
Cost of Mix	Baseline	↑	↑	Neutral	*Slight* ↓
Innovation	None	None	None	↑	*Yes!*
Local Materials	Limits	Negative Impact	Neutral	↑	↑
Recycled Matls.	Unable to Characterize	Negative Impact	Neutral	↑	↑
EPD (GWP)	Baseline	↑ GWP	↑ GWP	↓	↓


CORP'S



Contains 8 chapters corresponding to the 8 major tasks on the path to BMD implementation

Task		Sub Task	Description	Expected Start (Month)	Duration (Months)
1	Motivations and Benefits of Performance Specifications			-4	4
2	Overall Planning	2.1	Identification of Champions	1	1
		2.2	Establishing a Stakeholders Partnership	2	1
		2.3	Doing Your Homework	2	2
		2.4	Establishing Goals	3	2
		2.5	Mapping the Tasks	3	3
		2.6	Identifying Available External Technical Information and Support (periodically)	2	--
		2.7	Developing an Implementation Timeline	3	3
3	Selecting Performance Tests	3.1	Identifying Primary Modes of Distress.	6	1
		3.2	Identifying and Assessing Performance Test Appropriateness.	7	3
		3.3	Validating the Performance Tests	10	60
4	Performance Testing Equipment: Acquiring, Managing Resources, Training, and Evaluating	4.1	Acquiring Equipment	10	1 - 18
		4.2	Managing Resources	27	2
		4.3	Conducting Initial Training	28	2
		4.4	Evaluating Performance Tests	28	6
		4.5	Conducting Inter-Laboratory Studies	34	6
5	Establishing Baseline Data	5.1	Reviewing Historical Data & Information Management System	33	1
		5.2	Conducting Benchmarking Studies	34	12
		5.3	Conducting Shadow Projects	34	15
		5.4	Analyzing Production Data	38	12
		5.5	Determining How to Adjust Asphalt Mixtures Containing Local Materials	34	15
6	Specifications and Program Development	6.1	Sampling and Testing Plans	46	6
		6.2	Pay Adjustment Factors (If Part of the Goals)	49	3
		6.3	Developing Pilot Specifications and Policies	46	6
		6.4	Conducting Pilot Projects	52	18
		6.5	Final Analysis and Specification Revisions	67	6
7	Training, Certifications, and Accreditations	7.1	Developing and/or Updating Training and Certification Programs	73	6
		7.2	Establishing or Updating Laboratory Accreditation Program Requirements	34	3
8	Initial Implementation			80	--

Motivations and Benefits of BMD

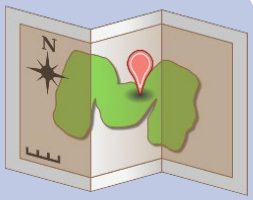
Chapter 1. Motivations and Benefits of BMD and Performance Specifications

1.1 What are Performance Specifications?

1.2 Why Change?

1.3 Benefits of Using Balanced Mix Design

1.4 The Steps in the Process of Implementing Performance Specifications



Plan the Process

Chapter 2. Overall Planning

2.1 Identify Champions
2.2 Establish a Stakeholders Partnership
2.3 Identify Issues, Resources and Lit. Review
2.4 Establish Goals
2.5 Map the Tasks
2.6 Identify External Information & Support
2.7 Develop Implementation Timeline

Select Performance Tests

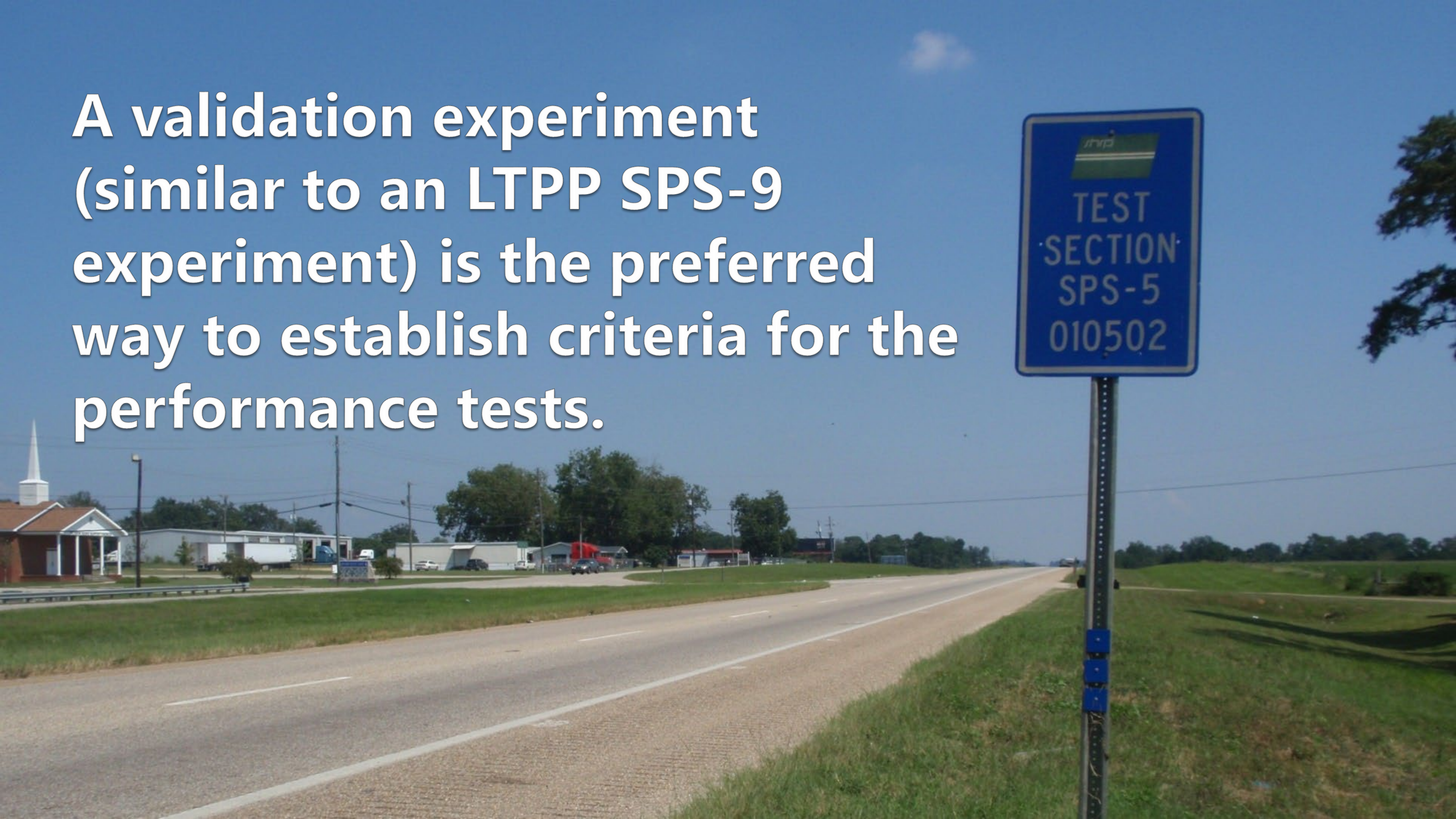
Chapter 3. Selecting the Performance Tests

3.1 Identify Primary Modes & Causes of Distress

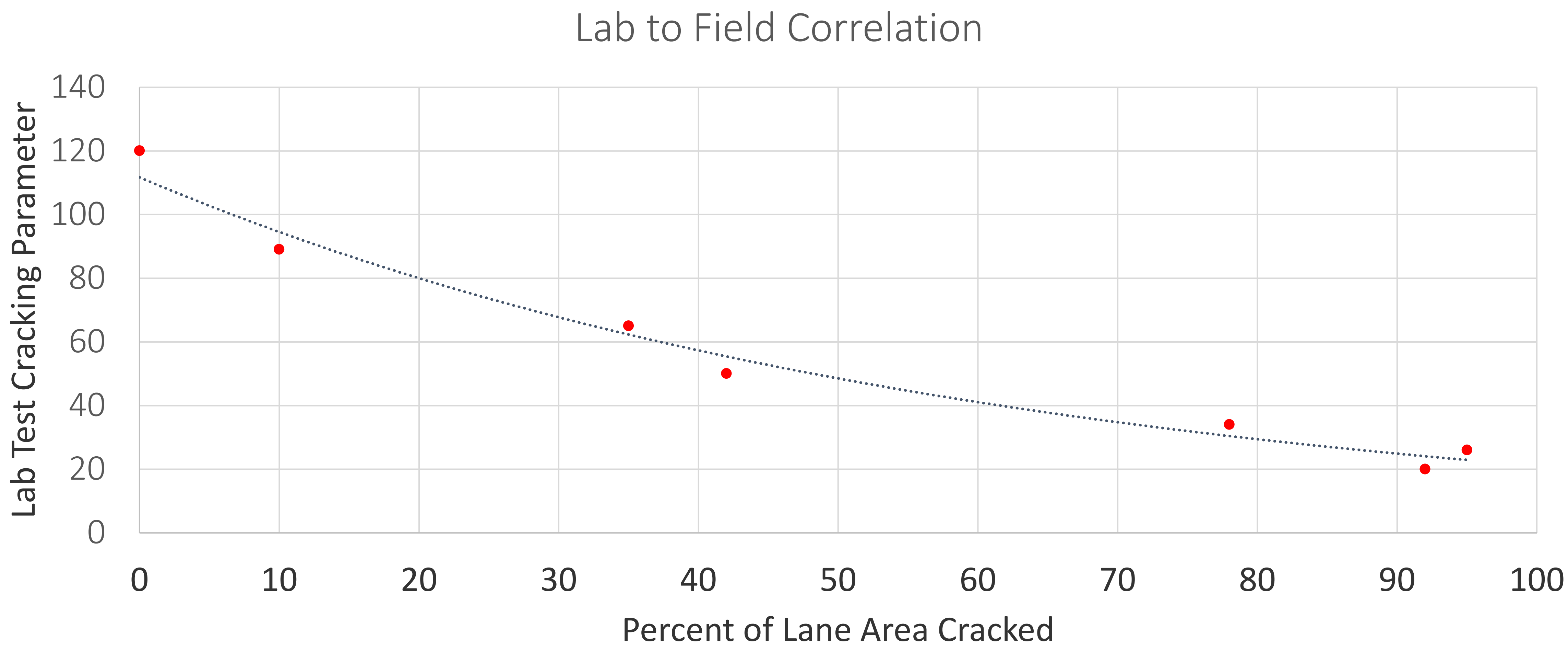
3.2 Identify / Assess Performance Tests Appropriateness

3.3 Validate the Performance Tests

A validation experiment (similar to an LTPP SPS-9 experiment) is the preferred way to establish criteria for the performance tests.



BMD Relationship Confirmation



Chapter 4. Performance Testing Equipment: Acquiring, Managing Resources, Training & Evaluation

4.1 Acquiring Equipment

4.2 Managing Resources

4.3 Conducting Initial Training

4.4 Refining Procedures

4.5 Conducting Interlaboratory Studies

Chapter 5. Establishing Baseline Data

5.1 Reviewing Existing Lab Results & Pavement Management System Data

5.2 Conducting Benchmarking Studies

5.3 Conducting Shadow Projects

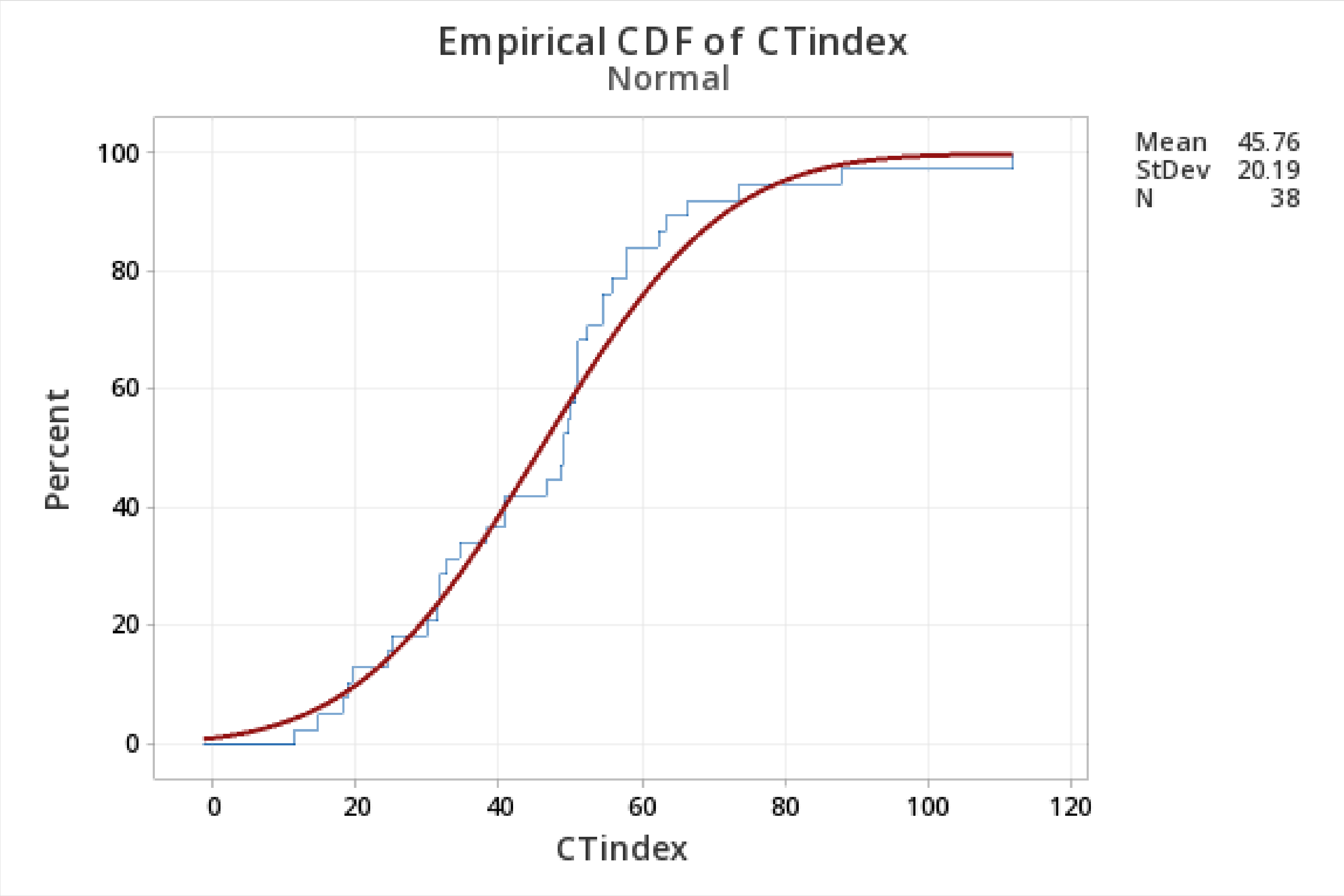
5.4 Analyzing Production Data

5.5 Determining How to Adjust Mixtures Containing Local Materials

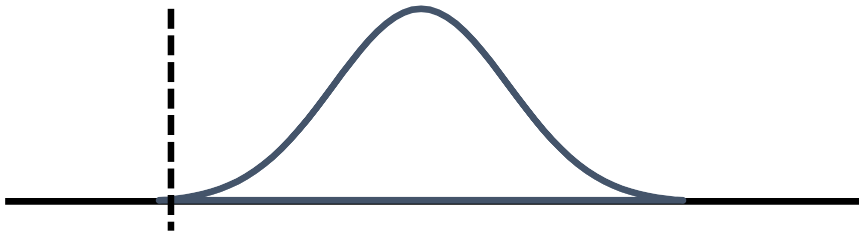
Benchmarking

- A database of test results of currently used mixtures
  - Lab produced mixtures → mix design criteria
  - Plant produced mixtures → acceptance criteria
- Analysis
  – Distribution of results for each mix classification
  – Impact of mix factors that impact BMD test results

Analysis of Benchmarking Data



- A Shadow Project is a project on which additional tests are conducted at a frequency similar to existing AQCs.
- The mixture is produced and accepted based in existing AQCs.
- The goals of Shadow Projects are to:
  1. Gather information on typical production variability
  2. Add to the benchmarking database
  3. Familiarize DOT and contractor personnel with the selected tests



Chapter 6. Specifications and Program Development

6.1 Sampling and Testing Plans

6.2 Developing Pilot Specs and Policies

6.3 Conducting Pilot Projects

6.4 Final Analysis and Spec Revisions

- Pilot Projects – projects on which the mixture is produced and accepted based on new AQCs
- Projects are let as Pilot Projects so that contractors can account for uncertainty in their bids
- Goals of Pilot Projects
    1. Expand the number of stakeholders involved in BMD projects
    2. Evaluate the preliminary specification and QA program under actual project conditions

Conduct Training & Certifications

Chapter 7. Training, Qualifications and Accreditations

7.1 Developing &/or Updating Training and Certification Programs

7.2 Establishing or Updating Lab Accreditation Program Requirements

7.3 Establishing a Proficiency Sample Program

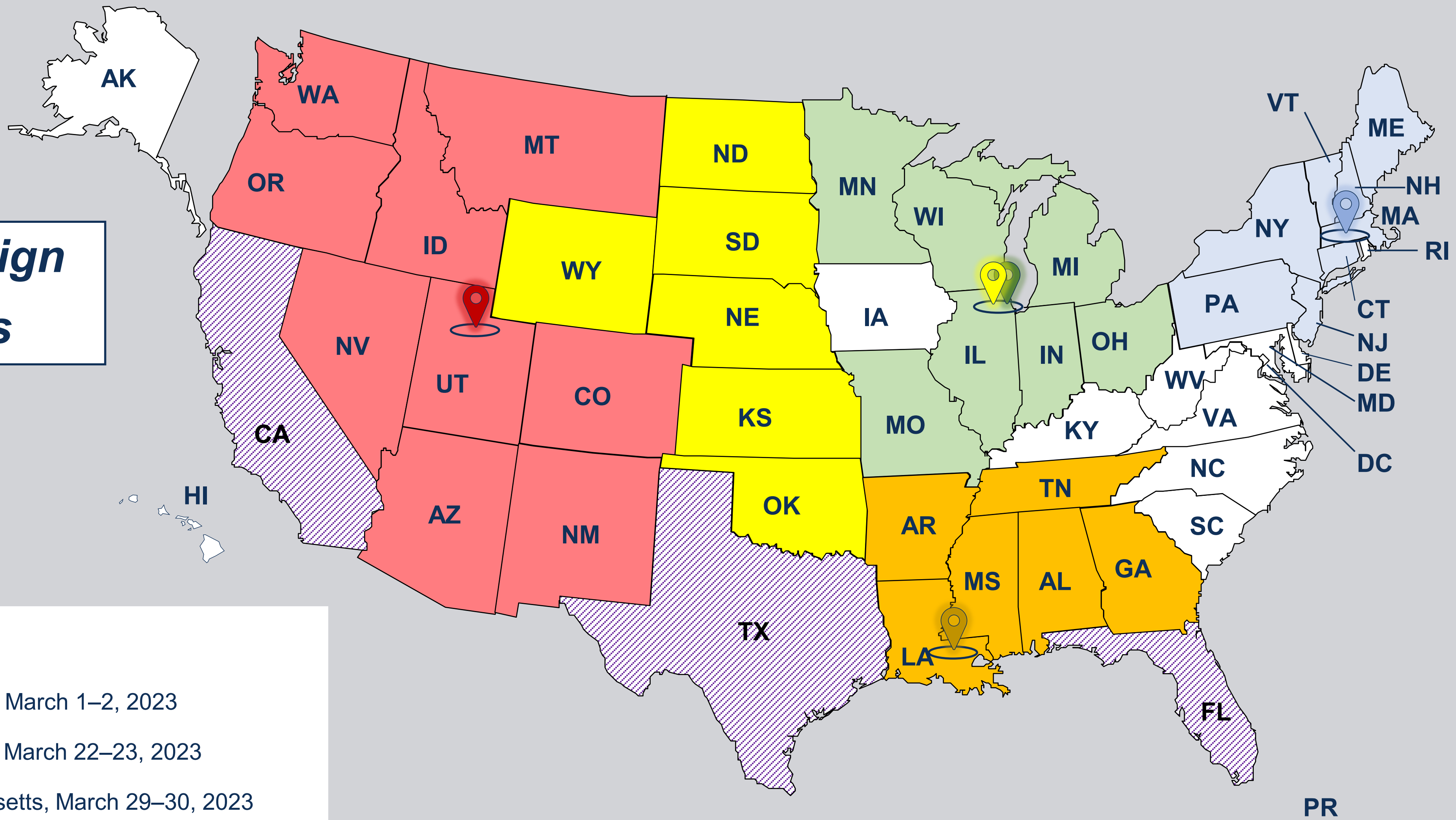
Initial Implement-ation

Chapter 8. Initial Implementation

- Lessons learned from Pilot Projects
- Make sure all stakeholders are informed
- Feedback loop to allow the program to continue to evolve.


ATMOSOCIC REENTRY ISSUES
NASA
ATMOSTOR REENTRY ISSUES
DEFLECTOR INSEGIEE
DEFLECTERY INTEGITY
COMMUNICATION
LIFE SPUNT SYSTEM
LIFE SUPPEIT SYSTEMS
BLACKOUT TIME
LIFE SOMT TIME
OXCYGEN AND CO2S
345
BLACKOUT TAME
EXYGEN & CO22
LEVELS
LACKOUT
BLACKUCATION
ISUES
BLACKOUT TYME
GAPS
OXYGEN
LEVELS
36 35 55
345
LIFE SUPPE
NASA

Balanced Mix Design Peer Exchanges



Meeting Location
- Southeast Peer Exchange, Louisiana, March 1–2, 2023
- North Central Peer Exchange, Illinois, March 22–23, 2023
- Northeast Peer Exchange, Massachusetts, March 29–30, 2023
- Rocky Mountain West Peer Exchange, Utah, November 28–30, 2023
- Midwest Peer Exchange, Illinois, December 13–14, 2023
- Mega-States Peer Exchange

Critical Challenges for BMD

Its more than just technical items!

Management Challenges

Technical Challenges

Management Challenges

- Change Management.
- Cost-Benefit Analysis
- Specifications & Risk Management.
- Resource Allocation.
- Implementation Planning.
- Stakeholders Engagement.

- Integration with Existing Practices.
- Education, Training, & Skill Development.
- Information Sharing & Collaboration Among Peers

Technical Challenges

- BMD Tests Validation
- Testing Procedures & Protocols
- Variabilities
- Database Setup, Collection, Analysis, & Management.
- Pathway for Use in Field Quality Assurance (QA).
- Volumetrics Historical Usage

Be Mindful that…

- Not all states are experiencing every challenge listed.
- All raised challenges are listed, even if only mentioned by few states.

Two present statuses for the challenges:

1. The path forward has been identified and implemented.
2. Ongoing efforts are in progress to address and find solutions.

Be Mindful that…

Similar challenges are heard from contractors.

- Implementation requires resources.
- Resistance to change.
- BMD tests may not be able to fully replace current acceptance testing.
- Variability in BMD tests results.
- Etc.

Source: NAPA

Improving Imperfect Tests

- IDEAL-CT, for example
  - Quick and low cost, but…
  - Sensitive to preparation techniques
    - Increases variability of results
  - The effect of specimen air voids is counterintuitive
    - eliminates using cores for analysis
    - creates issues when in-place density target ≠ 93.0% of G_{mm}

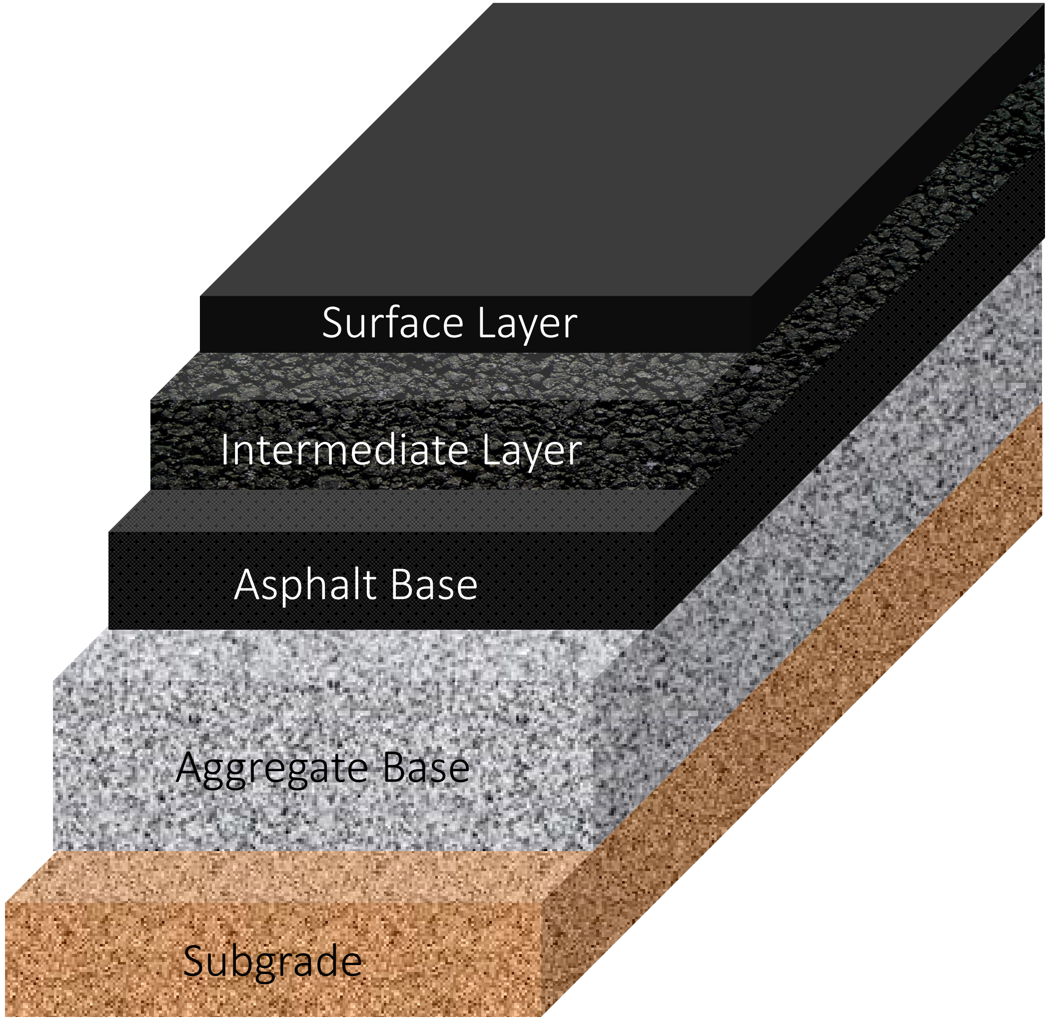
Understanding differences between results of lab-prepared and plant-produced mixtures

- What are the causes of differences between lab-produced and plant-produced mixtures?
  - Does short-term lab conditioning = plant mix produced at WMA temps., with & without silo storage + haul time?
  - What is the impact of mix reheating?

Asphalt Mixture Aging

- lab accelerated aging methods
  - simulation of how many years?
  - time, temp., press.
  - practicality for mix design and QA
  - potential for automation
- aging susceptible binders and additives
- aging resistant additives

BMD Criteria for Different Applications



- Criteria for different asphalt layers
- Criteria for different loading conditions
  - traffic categories
  - intersections
  - airports
  - parking lots

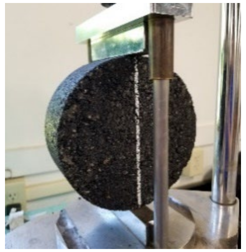
Using BMD Tests in Quality Assurance

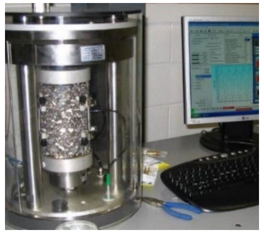
Acceptance Quality Characteristics (AQCs) should be:

ACCURATE
QUICK
REASONABLE
MEASURABLE
REPEATABLE
INDEPENDENT
FEW
RAPID
LOGICAL
QUANTIFIABLE
SIMPLE
FAST
PERFORMANCE RELATED
FUNDAMENTAL
LOW VARIABILITY
NOT SUBJECTIVE
LOW COST
ACTIONABLE
RELIABLE
AUTOMATED
STATISTICALLY VALID

Connecting Mix Design & QA Properties to Pavement Design

Materials Characterization

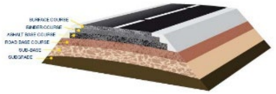




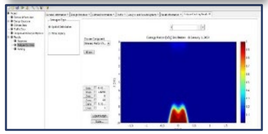
Pavement Analysis

AASHTOWare Pavement ME Design

AASHTO



FlexPAVE™



Predicted Performance

Can we connect BMD indices to engineering properties used for pavement design and analysis?

Strategies Toward Net-Zero

- Design and build longer life pavements
- Maximize the use of local materials
- Increase recycled materials contents
- Reduce mix temperatures
- Develop...
  - Alternative, bio-based binders
  - Aging-resistant additives
  - Carbon-negative additives
  - Low rolling resistant mixtures and pavements

The Road Forward
A Vision for Net Zero Carbon Emissions for the Asphalt Pavement Industry


The Road Forward
A Vision for Net Zero Carbon Emissions for the Asphalt Pavement Industry
80
Gen Z is more concerned about climate change than most of us are


WHY?


Thank You
National Center for Asphalt Technology
NCAT
AT AUBURN UNIVERSITY

Asphalt Mix Design of the Future

- Future methods for evaluating innovative materials
- State-of-the-art balanced mix design (BMD) for optimizing asphalt mixtures
- Cost, sustainability, and performance goals of owner agencies
- Gaps in current BMD initiatives
- Implementation roadmap for industry and agencies
- Follow-up panel discussion on November 21 at Arizona Pavements & Materials Conference
- Visitor parking available at Fulton Center parking

Presented by:

Randy West, Ph.D., P.E.

Director and Research Professor
National Center for Asphalt Technology
Auburn University

September 17, 2024 | 9:00-11:00 AM MST

Devil's Oasis, 2nd Floor, Paul C. Helmick Center Building , Arizona State University. 660 S. College Ave. Commons, Tempe, AZ 85281