

**64<sup>th</sup> Annual Idaho Asphalt Conference**  
**University of Idaho, Moscow, Idaho**  
**October 23-24, 2024**



**Conference Program**

**Wednesday, October 23, 2024**

8:00 am - Workshop **“Pavement Management and Preservation - A Roadmap to Success”**  
 3:00 pm Presented by AEMA member Scott Dmytrow of Pavement ACES. Separate registration is required  
 4:00 pm **IAC registration opens**  
 5:00 –  
 7:00 pm **Icebreaker in Exhibit Hall – Sponsored by Western States Equipment / Caterpillar**

**Thursday, October 24, 2024**

7:00 am **Registration opens – Continental Breakfast in Exhibit Room**  
 8:00 am **Opening Comments**  
 Dr. Emad Kassem, PE, Associate Professor, University of Idaho  
 8:15 am **Welcome Remarks**  
 Dr. Suzanna Long, PE, Dean of College of Engineering, University of Idaho

<b>Morning Session</b>	<b>Afternoon Session</b>
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<p>Presiding Dave Johnson, PE The Asphalt Institute</p> <p>8:30 am <a href="#"><u>Quality Assurance for Asphalt Mixtures Acceptance</u></a> Dr. Buzz Powell, PE Asphalt Pavement Alliance</p> <p>9:30 am <a href="#"><u>Hot Applied Chip Seal in Urban Environment</u></a> John Arambarri, PE Idaho Transportation Department</p> <p>10:15 am <b>Break</b></p> <p>10:40 am <a href="#"><u>Ride Quality and Smoothness of Pavements</u></a> Dr. Buzz Powell, PE Asphalt Pavement Alliance</p> <p>11:20 am <a href="#"><u>Binder Availability in RAP</u></a> Dr. Grover Allen, PE The Asphalt Institute</p> <p>Noon – 1:45 pm <b>Lunch and Expo</b></p>	<p>Presiding John Arambarri, PE Idaho Transportation Department</p> <p>1:45 pm <a href="#"><u>Performance Tests for Balanced Mix Design</u></a> Dave Johnson, PE The Asphalt Institute</p> <p>2:20 pm <a href="#"><u>Environmental Product Declaration</u></a> Dr. Chait Bhat The Asphalt Institute</p> <p>3:00 pm <b>Break</b></p> <p>3:15 pm <a href="#"><u>Leveraging Artificial Intelligence in Asphalt Pavements: A Look at Hey NAPA</u></a> Brett Williams National Asphalt Pavement Association</p> <p>4:00 pm <a href="#"><u>Aging of Asphalt Mixtures for Balanced Mix Design</u></a> Nathan Moore, PE National Center for Asphalt Technology</p> <p>4:45 pm <b>Adjourn</b></p>
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**Speakers of the 64<sup>th</sup> Idaho Asphalt Conference, Oct. 24, 2024**

From left to right: Nathan Moore, Emad Kassem, Brett Williams, Scott Dmytrow, Dave Johnson, John Arambarri, Grover Allen, and Buzz Powell.

## 64<sup>th</sup> Idaho Asphalt Conference – October 23-24, 2024

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# #BuzzOnAsphalt

## Quality Assurance for Asphalt Mixture Acceptance



Buzz Powell  
10/24/24



1



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## #BuzzOnAsphalt Keys to Pavement Performance

- Mix/materials – meeting specific needs of each layer
- Thickness design – preventing non-surface cracking
- Preservation – safe, durable, renewable surface
  
- Quality materials, designs, construction, inspection.



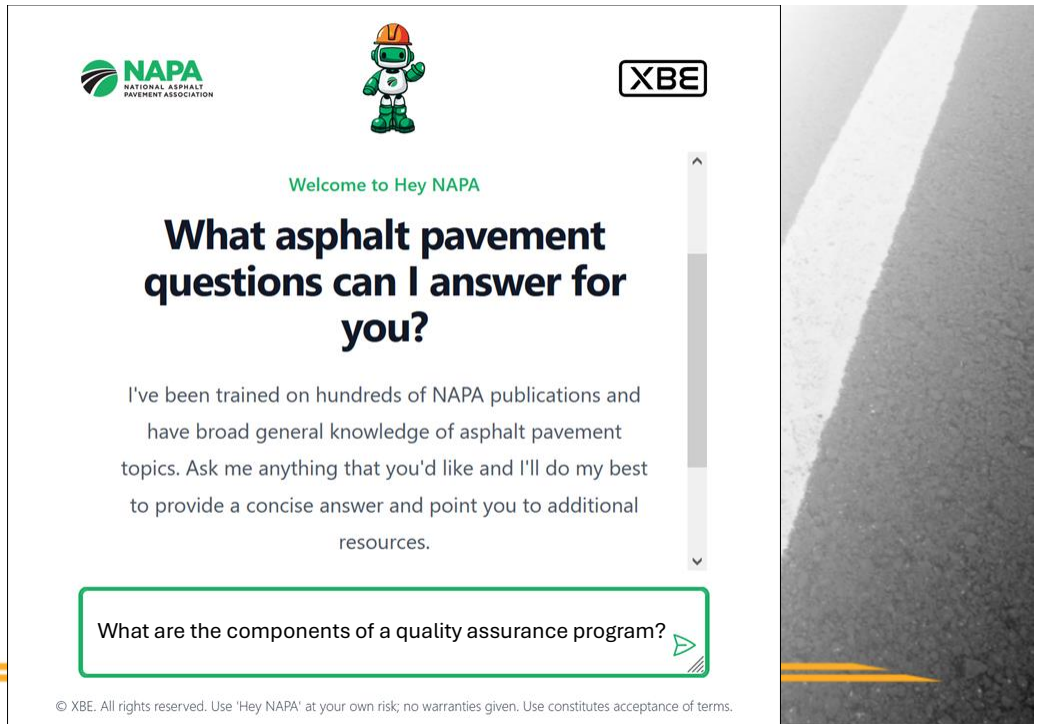
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## Technical Resources

- [www.DriveAsphalt.org](http://www.DriveAsphalt.org) – Asphalt Pavement Alliance
- [www.AsphaltPavement.org](http://www.AsphaltPavement.org) – National Asphalt Pavement Association
- [www.AsphaltInstitute.org](http://www.AsphaltInstitute.org) – Asphalt Institute (MS-22)
- [www.ITD.Idaho.gov](http://www.ITD.Idaho.gov) – Idaho Transportation Department
- [www.ChatGPT.com](http://www.ChatGPT.com) – general information about roads and highways
- [www.HeyNAPA.com](http://www.HeyNAPA.com) – specific information about asphalt pavement.



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**NAPA**  
NATIONAL ASPHALT  
PAVEMENT ASSOCIATION

**XBE**

Welcome to Hey NAPA

## What asphalt pavement questions can I answer for you?

I've been trained on hundreds of NAPA publications and have broad general knowledge of asphalt pavement topics. Ask me anything that you'd like and I'll do my best to provide a concise answer and point you to additional resources.

What are the components of a quality assurance program?

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## HeyNAPA Response

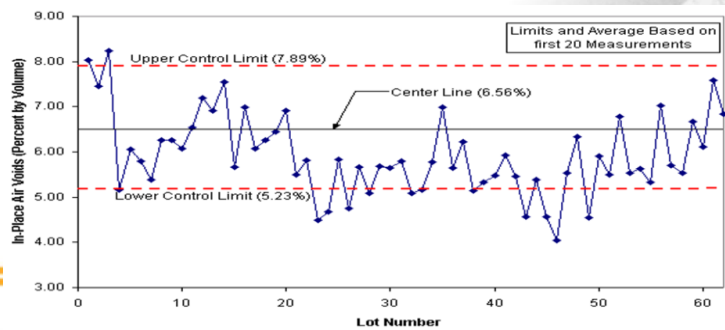
Quality Assurance (QA) refers to the overall set of activities that ensure specified quality standards are met. Components, particularly in the context of asphalt pavements and construction, include the following:

- Contractor quality control (QC)
- Agency quality acceptance
- Independent assurance (IA)
- Dispute resolution
- Laboratory accreditation
- Personnel certification.

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## Contractor Quality Control (QC)

- All operational techniques and activities by the contractor
- Includes best practices and the contract requirements
- Includes sampling, testing, inspection, and corrective actions
- Ensures that the product meets specified quality standards.



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## Agency Quality Acceptance

- Methods and responsibility of the agency
- Quality of the product as specified in the contract requirements
- Includes verification sampling, testing, and inspection
- May rely on results from contractor's QC sampling and testing
- Required statistical validation contractor's test results.



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## Independent Assurance (IA)

- Methods and responsibility of the agency
- Activities designed to provide an unbiased evaluation
- All sampling and testing procedures in the acceptance program
- It includes testing performed on project-produced materials
- Performed by separate personnel using distinct equipment
- Often regional or district personnel in agency laboratory
- Personnel cannot have a conflict of interest in results.



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## Dispute Resolution

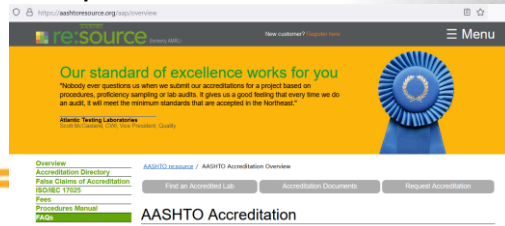
- Procedures for resolving conflicts between agency & industry
- Arising from discrepancies between agency and QC results
- Differences that significantly impact acceptance and payment
- May involve retesting, resampling, or third-party arbitration.



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## Laboratory Accreditation

- Essential to the ability to produce statistically meaningful data
- Labs that meet the standards established by agency programs
- Main/central agency laboratories with AASHTO accreditation (AAP)
- Umbrella program for regional/district laboratories via main/central
- Maintain records of calibration checks and technician proficiency
- Adhere to specific qualification criteria established in formal program.



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## Personnel Certification

- Qualified testing and sampling personnel with agency & industry
- Personnel must be deemed capable under the agency program
- Parameters of programs established by each agency
- Ensure technicians are qualified to perform contract activities
- Representative sampling, meaningful testing, contract enforcement
- Often attached to the laboratory accreditation program.



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# Idaho Quality Assurance (QA) Program

- CFR Part 637 of Title 23 requires a QA program in all states
- Assures conformity of materials & workmanship on NHS projects
- Approved by FHWA and must contain identified CFR elements
- ITD’s program applies to all projects, regardless of funding source:
  - Acceptance Program (Section 200)
  - Independent Assurance Program (Section 300)
  - Project Materials Certification (Section 400)
- Non-ITD laboratories only play one role on a project mix design → QC
- Three levels of quality evaluation are defined (QC, “Qa”, IA).

Dispute Resolution



# Mix Design Requirements

Table 405.02-1 – Superpave Mixture Requirements

Mixture Type	SP 2 (50 gyrations)	SP 3 (75 gyrations)	SP 5 (100 gyrations)
Design ESALs (a) (millions)	< 1	1 < 10	≥ 10
Syratory Compaction Gyration for Nini Gyrations for Ndes Gyration for Nmax	6 50 75	7 75 115	8 100 160
Relative Density, % Gmm @ Nini	≤ 90.5	≤ 89.0	≤ 89.0
Relative Density, % Gmm @ Ndes	96.0	96.0	96.0
Relative Density, % Gmm @ Nmax	≤ 98.0	≤ 98.0	≤ 98.0
Air Voids, % Pa	4.0	4.0	4.0
Dust Proportion Range (b)	0.6 – 1.4	0.6 – 1.4	0.6 – 1.4
Voids Filled with Asphalt (VFA) Range, % 1½"			
1"	64 – 80	64 – 75	64 – 75
¾"	65 – 78	65 – 75	65 – 75
½"	65 – 78	65 – 75	65 – 75
3/8"	65 – 78	65 – 75	65 – 75
#4	65 – 78	73 – 76	73 – 76
	67 – 79	67 – 77	67 – 77
Rut Depth, mm (c)	≤ 10.0 mm	≤ 10.0 mm	≤ 10.0 mm
Stripping, passes (d)	12,500	15,000	15,000
Cracking Test, IDEAL-CTIndex (e)	80 (index value)	80 (index value)	80 (index value)

(a) The anticipated project traffic level expected on the design lane over a 20 year period. Regardless of the actual design life of the roadway, determine the design ESALs for 20 years.  
 (b) For No. 4 nominal maximum size mixtures, the dust proportion is 1.0 to 2.0 for SP 2 mixes and 1.5 to 2.0 for SP 3 and SP 5 mixes. For coarse graded 3/8, 1/2, and 3/4 inch nominal maximum size mixtures, the dust proportion is 0.6 – 1.5. (Fine and coarse graded mixtures are defined in 703.05).  
 (c) Maximum depth after specified number of stripping passes. The Hamburg must have passing test results in the mix design.  
 (d) Minimum number of passes with no stripping inflection point. The Hamburg must have passing test results in the mix design.  
 (e) The Ideal-CT value and the associated data generated will be included in the mix design submittal; the data will only be used for information.



# Contractor Adjustment Limits

Table 405.03-5 – C-JMF Adjustment Limit Table

Parameter	Adjustment
No. 4 (4.75 mm) and greater	± 3% from JMF
No. 8 (2.36 mm)	± 2% from JMF
No. 100 to No. 30 (0.600 mm)	± 2% from JMF
No. 200 (0.075 mm)	± 0.3% from JMF
Asphalt Content	± 0.2% from JMF
G <sub>mm</sub>	± 0.010 from C-JMF <sup>(c)</sup>
G <sub>se</sub>	± 0.010 from C-JMF <sup>(c)</sup>
Individual Cold Feed Percentage for Aggregate	± 10.0% from JMF <sup>(a) (d)</sup>
Cold Feed Percentage for RAP	± 10.0% from JMF <sup>(b) (d)</sup>

- (a) The cold feed percentage of any aggregate may be adjusted up to 10 percentage points from the amount listed on the JMF, however no aggregate listed on the JMF will be eliminated.
- (b) The cold feed percentage for RAP may be reduced up to 10 percentage points from the amount listed on the JMF and must not exceed the percentage of RAP approved in the JMF or for the specific application under any circumstances.
- (c) Based on the initial C-JMF.
- (d) Individual cold feed percentages for aggregate and RAP greater than 5.0% for a single stock pile of the same product must have a new correction factor established in accordance with IR 157.



# Acceptance Test Strip

Table 405.03-4 – Acceptance Test Strip Tolerance

Quality Characteristic	Test Strip Mix Tolerance
VMA, %	703.05 minimum value
Laboratory Air Voids, %	4.0 ± 1.5
Asphalt Binder Content, %	If AAO > 0.3, JMF ± 0.40 If AAO ≤ 0.30, JMF ± 0.40 + AAO
Dust Proportion (DP)	Table 405.02-1 range ± 0.10
VFA, %	Table 405.02-1 range ± 5
No. 4 and larger sieves, %	JMF value ± 6.0 <sup>(a)</sup>
No. 8 to No. 30 sieves, %	JMF value ± 5.0 <sup>(a)</sup>
No. 50 to No. 100 sieves, %	JMF value ± 4.0 <sup>(a)</sup>
No. 200 and smaller sieves, %	JMF value ± 2.0 <sup>(a)</sup>
G <sub>mm</sub>	JMF value at P <sub>2</sub> ± 0.012 <sup>(a)</sup>
G <sub>se</sub>	JMF value ± 0.012 <sup>(a)</sup>
Mainline Density, % Compaction	92.0 – 100.0
Rut Depth, mm <sup>(b)</sup>	10.0 mm maximum <sup>(a)</sup>
Stripping, passes <sup>(c)</sup>	12,500/15,000 <sup>(a)</sup>
Cracking Test, IDEAL-CT <sub>Index</sub>	80 (index value) <sup>(a)</sup>

<sup>(a)</sup> The upper and lower specification limits are never allowed to be outside the control points specified in 703.05.  
<sup>(b)</sup> Maximum depth after 12,500/15,000 passes. For information only.  
<sup>(c)</sup> Minimum number of passes with no stripping inflection point.  
<sup>(d)</sup> For information only.



# Quality Control by Contractor

- Includes all activities required to fulfill the contract requirements
- Construction materials are the contractor’s responsibility
- Performed during the production and/or at the point of delivery
- Test results substantiate the uniformity/compliance of product
- Control/run charts are useful tools in contractor quality control
- Graphs show the average, variation, and change during production
- All Contractor testing to control the quality is considered QC testing.



# Quality Control by Contractor

Idaho Standards

Section 520

Table 1: Example of QC Actions to Implement When Approaching or Exceeding Specification Limits

Test Description	Test Method	QC Action Limits		Situation		Action
		Single Test	4-Point Moving Avg. or Daily Avg.	Single Test	4-Point Moving Avg. or Daily Avg.	
Binder Content, P <sub>s</sub>	FOP for AASHTO T 168 and FOP for AASHTO R 47 and FOP for AASHTO T 308 and FOP for AASHTO T 329	± 0.6	± 0.3	Approaching Limit	Approaching Limit	Discuss with hot mix plant operator, and may suspend construction process
Aggregate Gradation	FOP for AASHTO T 30 (wash method used for all gradation measurements)	NA	C-JMF	4 percent on +#4 2 percent on -#4	Approaching Limit	Increase frequency of tests and prepare for process modification
Air Voids @ N <sub>800g</sub> , P <sub>s</sub>	WAQTC TM 13	± 1.0%	NA	2 tests over ± 1%	NA	Initiate C-JMF Modifications
VMA @ N <sub>800g</sub>	WAQTC TM 13	≤ 1% min	≥ min	3 tests over ± 1%	Approaching Limit	Discuss with the Engineer & Process Modification
Dust Proportion, DP	WAQTC TM 13	NA	≥ min ≤ max	Approaching Limit	Approaching Limit	Modify C-JMF
G <sub>max</sub>	FOP for AASHTO T 168 and FOP for AASHTO R 47 and FOP for AASHTO T 209 (Bowl Method)	C-JMF	C-JMF	Approaching Limit	Approaching Limit	Modify C-JMF or Redesign
G <sub>s</sub>	WAQTC TM 13	C-JMF	C-JMF	Approaching Limit	Approaching Limit	Modify C-JMF or Redesign
Rut Depth, mm	AASHTO T 324	≥ min	NA	Approaching Limit	NA	Discuss with the Engineer & initiate investigation, modification, or redesign
Stripping, passes	AASHTO T 324	≥ min	NA	Approaching Limit	NA	Discuss with the Engineer & initiate investigation, modification, or redesign
Cracking, FI	AASHTO TP 124	≥ min	NA	Approaching Limit	NA	Discuss with the Engineer & initiate investigation, modification, or redesign
Mainline Density	Idaho IR 156, and FOP for AASHTO T 355 or FOP for AASHTO T 343	NA	≥ min	Approaching < 92%	≤ 100% Pay	Notify the Engineer

Note: When 2 consecutive test results fail or if any of the 4-point moving average values fail, production will be suspended and the situation discussed with the Engineer. The process will be corrected before production resumes.





# Production Limits

**Table 405.03-6 – Production Paving Quality Limits**

Mix Quality Characteristic	Limits
<b>SP 2 Mixture</b>	
No. 4 sieve and larger sieves, %	C-JMF value $\pm$ 5.0 <sup>(a)</sup>
No. 8 to No. 30 sieves, %	C-JMF value $\pm$ 4.0 <sup>(a)</sup>
No. 50 to No. 100 sieves, %	C-JMF value $\pm$ 3.0 <sup>(a)</sup>
No. 200 sieve and smaller sieves, %	C-JMF value $\pm$ 1.5 <sup>(a)</sup>
Asphalt Binder Content, %	C-JMF value $\pm$ 0.3
<b>SP 3 and SP 5 Mixtures</b>	
Laboratory Air Voids, % $N_{aspn}$	SP 3: 2.5 – 5.0% SP 5: 2.8 – 5.0%
VMA, % $N_{aspn}$	703.05 minimum value
Dust Proportion	Table 405.02-1 Range
$C_{200}$ <sup>(f)</sup>	C-JMF value $\pm$ 0.012 <sup>(g)</sup>
$G_{mm}$ <sup>(f, g)</sup>	C-JMF value @ $P_c \pm 0.012$ <sup>(g)</sup>
Rut Depth, mm	10.0 maximum <sup>(b, c)</sup>
Stripping, passes	12,500/15,000 <sup>(b, d)</sup>
Cracking Test, IDEAL-CT <sub>Index</sub>	80 (index value) <sup>(b)</sup>
<b>Roadway Quality Characteristic</b>	
Mainline Density, % Compaction	92.0 – 100.0

(a) The upper and lower specification limits are never allowed to be outside the control points specified in 703.05.  
 (b) Hamburg and Ideal-CT are for information only at this time.  
 (c) Maximum depth after 15,000 passes.  
 (d) Minimum number of passes with no stripping inflection point.  
 (e) Gmm tests must be performed only after a 2-hour oven cure time in accordance to the mix design requirements to limit test result variability.  
 (f) Gmm and Gse values are indicators of consistency of the asphalt mix and are tracked using FWL. Gmm and Gse will be monitored for information only and, if the PWL is less than 40, the Engineer and the Contractor will review the data and take appropriate action (e.g., review plant settings, review test results). There will be no deduction for a low PWL based on Gmm or Gse.  
 (g) Based on the initial C-JMF.



# Acceptance Program by Agency

- All factors that determine product quality specified by contract
- Inspection of work in addition to results from sampling and testing
- Certification, acceptance<sub>decision</sub> and verification<sub>QC independent</sub>
- Results used to make acceptance and payment decisions
- Data driven pay at full price, pay at reduced price, or outright reject.



# Independent Assurance by Agency District

- Unbiased and independent evaluation
- All the sampling/testing procedures, personnel, and equipment
- Procedure, personnel, and equipment check
- Not be part of the acceptance decision.



## Idaho Spec

Quality Assurance		400 Surface Courses and Bituminous Pavement		270.30		
BID ITEM MATERIAL	PURPOSE OF TESTING	ITD SPEC. REF. SAMPLED BY	TEST METHOD TESTED BY	REQUIRED REPORT FORM NO.	MINIMUM REQUIRED FREQUENCY	REMARKS, NOTES, OR ADDITIONAL DIRECTIONS
<b>STANDARD SPECIFICATION SECTION: 405 - SUPERPAVE HOT MIX ASPHALT</b>						
Performance Graded Binder	ACCEPTANCE Certification	702.01 702.05	Manufacturer	Manufacturer	ITD-966 OR manufacturer certification Loading Certificate	Initial lot & each new lot to project Each shipment to project See OA Manual Sections 230.10
	VERIFICATION Laboratory Tests	FOP for AASHTO R 66 AASHTO M 320	ITD Project Personnel	ITD Central Materials Lab	ITD-859 ITD-859AW ITD-859AW is the Central Materials Laboratory Report	1 sample (3 quart cans) per shift combined into weekly binder verification unit. Sampled from the line between the storage tank (or the delivery truck) and the mix plant. Purge one gallon from the injection line valve before taking sample No samples required when total quantity is less than 22 Tons See OA Manual Section 230.10
Anti-Strip Additive	ACCEPTANCE Presence of Anti-Stripping Additive	702.04 ITD Project Personnel	Idaho IT 99 ITD Project Personnel	ITD-869	Test at same frequency as sampling of asphalt binder	If anti-strip cannot be detected, add additional anti-strip. The binder will be sampled and tested until a positive result is determined. (green or blue color)
Superpave HMA for Acceptance Test Strip	CONSTRUCTION of Test Strip by Contractor	405.03	Idaho IR 125	ITD-891 (Completed by Contractor)	2 locations per Test Section	Contractor establishes roller pattern.
	ACCEPTANCE (1) (Aggregate Cold Feed Samples) Sand Equivalent	405.02 405.03H 405.03F 703.05	Idaho IR 125 FOP for AASHTO R 90 FOP for AASHTO R 76 FOP for AASHTO T 176 AASHTO Method 2 Mechanical Method 1 Idaho FOP ASTM D4791 Idaho FOP AASHTO T 304	ITD-1048 ITD-772	**3 cold feed increments per test strip.	Random Samples per Idaho IR 125 (1) Combine cold feed increments into a composite sample to determine test strip acceptance.
	Fracture Fat and/or Elongated Particles Fine Aggregate Angularity	Contractor	ITD District Project Personnel			
	INDEPENDENT ASSURANCE	IA Inspector	IA Inspector	ITD-857	Each 15,000 Tons	

\*\*When multiple test strips are required due to failures, the passing aggregate properties determined from the original cold feed sample will be used for subsequent test strips.

405-1



# Idaho Spec

Quality Assurance 400 Surface Courses and Bituminous Pavement 270.30

BID ITEM/MATERIAL	PURPOSE OF TESTING	ITD SPEC. REF.	TEST METHOD	REQUIRED REPORT FORM NO.	MINIMUM REQUIRED FREQUENCY	REMARKS, NOTES, OR ADDITIONAL DIRECTIONS	
		SAMPLED BY	TESTED BY				
405-2 Superpave HMA for Acceptance Test Strip (Cont.)	ACCEPTANCE (2) (Loose Mix Samples)	Idaho IR 125 FOP for AASHTO R 97 * FOP for AASHTO T 196 Method A or AASHTO T 331				Random sample locations per Idaho IR125 *See Note 405.6 (2) Test results for each loose mix sample are averaged for each test section to determine test section acceptance. (3) For calculating VMA use the combined aggregate bulk specific gravity, $G_{sb}$ , determined by the Engineer (4) For SP 3 and SP5 mixes only	
	Air Voids	405.02	FOP for AASHTO T 209 Flow Method		3 per test section.		
	Asphalt Content	405.03-H	AASHTO T 308 FOP for AASHTO T 300 FOP for AASHTO T 309 FOP for AASHTO T 312 AASHTO T 340(4)				Each sample must be at least 100 lb.
	Gratation						
	Voids in Mineral Aggregate (VMA) (3)			ITD-773 ITD-772			
	Voids Filled With Asphalt (VFA)						
	Dust to Binder Ratio (DP)	Contractor	HQ Central Lab/District Lab				
	Moisture Content						
	Rut Depth (4)						
Note: Test Strip mix verification testing will be performed by HQ Central Lab or District Lab. District Labs must be qualified by HQ Central Lab in order to perform Superpave Test Strip testing. Contact Central Materials Laboratory Manager for details: Phone: (208) 334-8453							
	INDEPENDENT ASSURANCE	IA Inspector	IA Inspector	ITD-857	Observation of loose mix testing performed by District Lab every 90 days.		



10/19



# Idaho Spec

Quality Assurance 400 Surface Courses and Bituminous Pavement 270.30

BID ITEM/MATERIAL	PURPOSE OF TESTING	ITD SPEC. REF.	TEST METHOD	REQUIRED REPORT FORM NO.	MINIMUM REQUIRED FREQUENCY	REMARKS, NOTES, OR ADDITIONAL DIRECTIONS
		SAMPLED BY	TESTED BY			
<b>STANDARD SPECIFICATION SECTION: 405 - SUPERPAVE HOT MIX ASPHALT</b>						
Superpave HMA for Acceptance Test Strip (Cont.)	Density (5) GAUGE CORRELATION	405.03-L	Idaho IR 125 FOP for AASHTO T 355 All Method No. 1 (Backscatter mode)			Use same cores that were taken for density acceptance. (5) Each gauge to be used on the project for QC or acceptance testing must be certified on the test strip. Gauge readings for each core must be obtained at each test site prior to coring using each gauge. Each gauge will have a unique correlation factor. Form ITD-820 is completed for each gauge.
		Contractor	Contractor and ITD District Project Personnel	ITD-820	5 per test section	
	ACCEPTANCE(6) Cores Density (Percent Compaction)	405.03-L	Idaho IR 125 FOP for AASHTO R 67 FOP for AASHTO T 196 Method A FOP for AASHTO T 331 ASTM D727		ITD-892 ITD-772	
	INDEPENDENT ASSURANCE	IA Inspector	IA Inspector	ITD-857	Observation of core testing performed by Project Personnel every 90 days	



10/19



# Idaho Spec

Quality Assurance 400 Surface Courses and Bituminous Pavement 270.30

BID ITEM MATERIAL	PURPOSE OF TESTING	ITD SPEC. REF.	TEST METHOD	REQUIRED REPORT FORM NO.	MINIMUM REQUIRED FREQUENCY	REMARKS, NOTES, OR ADDITIONAL DIRECTIONS
		SAMPLED BY	TESTED BY			
405-4 Production Paving SP2	ACCEPTANCE Loose Mix from Roadway Asphalt Content Gradation Moisture G <sub>w</sub>	405.03	FOP for AASHTO R 97* FOP for AASHTO R 47 FOP for AASHTO T 329 FOP for AASHTO T 308 FOP for AASHTO T 30 FOP for AASHTO T 209 Bow Method	ITD-833	Each 750 Tons Each sample must be at least 50 lb	Random sample locations * See page 405-6 G <sub>w</sub> results will be used in density determination below
	INDEPENDENT ASSURANCE Sampling Asphalt Content Gradation Moisture	IA Inspector	IA Inspector	ITD-857	1 observation each project.	
	ACCEPTANCE Density (Percent Compaction)  (Density using correlated density gauge)	405.03	FOP for AASHTO T 365 Alt. Method No. 1 (Backscatter Mode)	ITD-855	Each 750 Tons	Test of random locations  The G <sub>w</sub> for determining the percent compaction will be determined using a rolling, consecutive 2-lot average (i.e., the most recent 2 completed lots) of the Department's G <sub>w</sub> test results. For the first lot of production paving, the test strip G <sub>w</sub> corresponding to the C-3MF is used for determining percent compaction.
	INDEPENDENT ASSURANCE Density (Percent Compaction)	IA Inspector	IA Inspector			



10/19

# Idaho Spec

Quality Assurance 400 Surface Courses and Bituminous Pavement 270.30

BID ITEM MATERIAL	PURPOSE OF TESTING	ITD SPEC. REF.	TEST METHOD	REQUIRED REPORT FORM NO.	MINIMUM REQUIRED FREQUENCY	REMARKS, NOTES, OR ADDITIONAL DIRECTIONS
		SAMPLED BY	TESTED BY			
405-5 Production Paving SP3, SP5	ACCEPTANCE Loose Mix from Roadway Air Voids VMA Moisture	405.03	FOP for AASHTO R 97* FOP for AASHTO R 47 FOP for AASHTO T 329 FOP for AASHTO T 308 FOP for AASHTO T 331 FOP for AASHTO T 209 Bow Method AASHTO T 269 FOP for AASHTO T 312	ITD-833 ITD-777	Each 750 Tons Each sample must be at least 50 lb	Random Sample Locations * See page 405-6
	INDEPENDENT ASSURANCE Sampling Air Voids VMA Moisture	IA Inspector	IA Inspector	ITD-857	1 observation each project.	Observation of the tests that are performed to calculate air voids, VMA, and Moisture
	ACCEPTANCE Density (Percent Compaction)  (Density using correlated density gauge)	405.03	FOP for AASHTO T 365 Alt. Method No. 1 (Backscatter Mode)	ITD-855	Each 750 Tons	Test at random locations  The G <sub>w</sub> for determining the percent compaction will be determined using a rolling, consecutive 2-lot average (i.e., the most recent 2 completed lots) of the Department's acceptance test results. For the first lot of production paving, the test strip G <sub>w</sub> corresponding to the C-3MF is used for determining percent compaction.
	INDEPENDENT ASSURANCE Density (Percent Compaction)	IA Inspector	IA Inspector			
Production Paving Non-structural and Temporary, except on NHS.***	ACCEPTANCE Certification	Manufacturer	Manufacturer	ITD-851	Total Quantity Paid	ITD Project Inspector documents visual inspection.

\*\*\* Temporary paving on the NHS with divided highways will require the same mix design as the mainline paving. Acceptance will be by density, the average percent compaction of 3 random cores must be greater than 90.0%. A random loose mix sample will be obtained to determine the theoretical maximum specific gravity, G<sub>mm</sub>. Sampling will be by the Contractor, testing by the State.



10/19

# Idaho Spec

Quality Assurance		400 Surface Courses and Bituminous Pavement			270.30	
BID ITEM/MATERIAL	PURPOSE OF TESTING	ITD SPEC. REF. SAMPLED BY	TEST METHOD TESTED BY	REQUIRED REPORT FORM NO.	MINIMUM REQUIRED FREQUENCY	REMARKS, NOTES, OR ADDITIONAL DIRECTIONS
400-09 Production Paving when an acceptance test strip is not required, regardless of the class of SuperPave mix and the total quantity is greater than one frequency.  Contractor will sample (Department will witness sampling) and ITD will test for acceptance.	ACCEPTANCE Loose Mix from Roadway	405.03	FOP for AASHTO R 97* FOP for AASHTO R 47 FOP for AASHTO T 328 FOP for AASHTO T 30		Each 750 Tons	* See page 405-6 SP2 Specification Limits apply.
	Asphalt Content Gradation Moisture	ITD Project Personnel	ITD Project Personnel	ITD-833		
	INDEPENDENT ASSURANCE Sampling Asphalt Content Gradation Moisture	IA Inspector	IA Inspector		1 observation each project of more than 2,250 tons.	
	Density (Percent Compaction)	405.03 405.03-L  Contractor	FOP for AASHTO R 67 FOP for AASHTO R 97* FOP for AASHTO T 196 Method A FOP for AASHTO T 331 FOP for AASHTO T 209 (Bowl Method) ASTM D7227	ITD-773 ITD-892  ITD Project Personnel	5 Stratified Random Cores per phase of project	* See page 405-6 Density (percent compaction) acceptance will be determined from the average of the cores.  The average max. specific gravity (G <sub>max</sub> ) from the loose mix samples will be used to determine core density (percent compaction).
Production Paving When an acceptance test strip is not required, regardless of the class of SuperPave mix and the total quantity is less than one frequency.	FOLLOW SECTION 270.04 ACCEPTANCE BY SMALL QUANTITIES Density acceptance will be determined from the average of cores.					
* The plate method is the primary method for obtaining samples from the roadway. For the lifts, less than 0.2', the samples may be obtained from the plant using an attached sampling device or sample from haul units.						



# Future?

# Ensuring Mix Quality

- Legacy volumetrics developed for virgin, neat
- Modern mixes w/ RAP, RAS, polymer, additives, etc.
- Confounding effect of true versus assumed G<sub>sb</sub>
- Legacy volumetric tools for mix optimization, but...
- Need for specification compliance rapid BMD testing
- Quantity and quality of effective binder content!



## Possible Agency Framework

- Eliminate legacy testing not meaningful (e.g.,  $N_{des}$ )
- Implement rapid index testing (i.e.,  $IDEAL_{CT/RT}$ )
- Simultaneous sample preparation (QC vs QC + validation + dispute)
- Critical aging at startup for plant aged-only criteria
- 3 to 4 nonrandomized test increments possible daily
- Basic nonproprietary proportioning in between BMD
- Statistical understanding of outcomes, TSR need.



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## Contractor Compliance

- Need to design mix to exceed specified minimums
- E.g., 50  $IDEAL_{CT}$  min necessitates ~75 design/production
- Excess minimizes risk (e.g., binder load differences)
- BMD sensitive to RAP binder quality (evaluation?)
- Not all recycling agents survive startup critical aging
- Need AC & gradation (PWL) as well as Rice (density)
- TSR/Hamburg because rapid BMD is blind to stripping.



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## One Possible Specification

- Eliminate  $N_{des}$  for QC, use “ $N_{min}$ ” to flag low air voids
- From truck bed to gyratory with no reheating
- Between ~10 and ~40 gyrations for 7% air voids, else  $N_{des}$
- Make test, comparison, dispute pills at same time
- Approximately 3½ hours from sample to results
- $IDEAL_{CT/RT}$  for cracking, rutting with startup plus TSR
- Plant proportions on tickets in between BMD tests.



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## Takeaways

- Ensure performance for taxpayers (agencies)
- Streamline the testing process (workforce)
- Create opportunities for innovation (contractors)
- Idaho specification is functional with legacy volumetrics, but...
- Value from quantity and quality of effective binder content
- Production BMD with minimal volumetrics for innovation
- Safe, sustainable pavement at lowest life cycle cost!



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# Questions?

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📍 PO Box 9029  
Fleming Island, FL 32006

🌐 [DriveAsphalt.org](http://DriveAsphalt.org)







## HOT APPLIED CHIP SEAL

MOBILITY AND INNOVATION IN URBAN ENVIRONMENT



1

## Pavement Preservation

- Cost effective -
  - Maximize Service Interval between paving events
  - Expedient – Minimal Disruptions to Public



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# Welcome to Front Street



2018 Front Street  
Credit: Darin Oswald [doswald@idahostatesman.com](mailto:doswald@idahostatesman.com)



3

# Microsurfacing



Credit: Geneva Rock Products Inc.



4



5



6

# What Failed?



7

# Hot Applied Chip Seal



8

# Specification & Demonstration

- PG 70-28 Binder with anti-strip
  - 325° F
- $\frac{3}{8}$ -inch cover coat
  - P200 below 1.0%
  - Pre-coated aggregate 0.4% to 0.8% PG 70-28



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# Specification & Demonstration

- Test Strip
- Air and Pavement Temperature Restrictions 50° F
- Apply PG 70-28 binder at 325° F
- Cover Coat at 175-225° F
- Roll with pneumatics
- Pre-broom and post broom



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# Specification & Demonstration

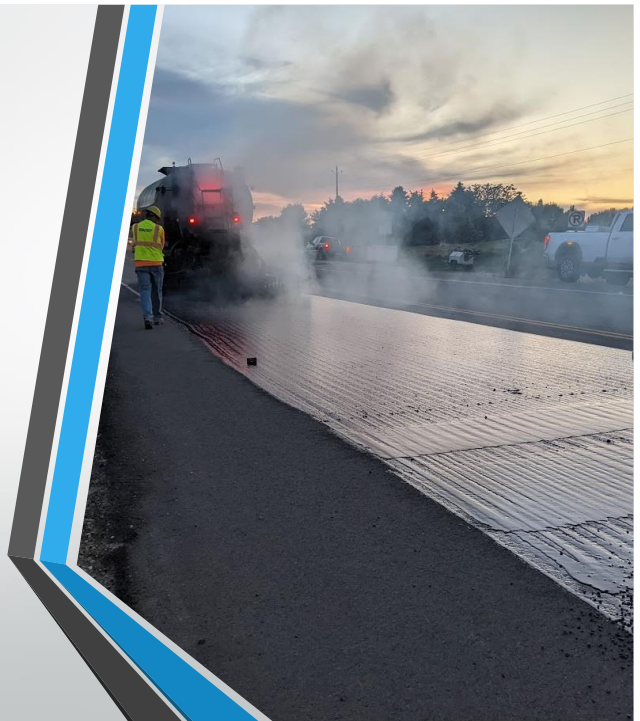
- Hot Applied Asphalt Binder paid \$/ton
- Pre-coated Aggregate paid \$/ton



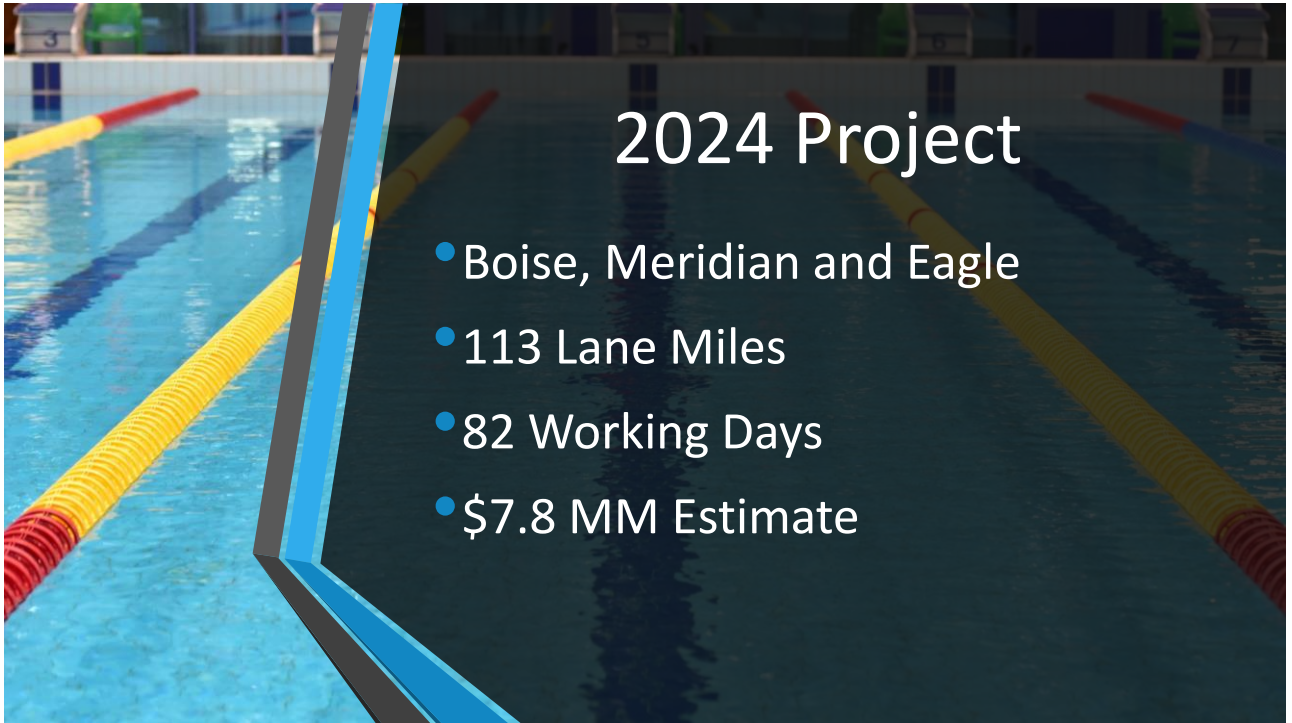
11

## 2023 Demonstration Project

- SH-21 Technology Way to High Bridge
- 6.4 Lane Miles
- PG 64-28 and PG 70-28
- Test Strip
- Material Handling & Performance



12




# 2024 Project


- Boise, Meridian and Eagle
- 113 Lane Miles
- 82 Working Days
- \$7.8 MM Estimate

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# Public Outreach



Credit: Darin Oswald [doswald@idahostatesman.com](mailto:doswald@idahostatesman.com)



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# Public Outreach

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## Anticipated Schedule

Spring	Late Spring	Late Spring/Early Summer	Mid-Summer
Glenwood Street	Chinden Boulevard in Garden City	Front Street Myrtle Street Broadway Avenue	State Street West Chinden Boulevard

## Frequently Asked Questions

**What is chip seal and how is it different than paving?**

Paving is the placement of asphalt that will serve as the thickest part of the roadway. Chip seal, or seal coat, is the placement of a layer of material and gravel on top of asphalt to help prevent cracks or potholes from forming and extend the life of the roadway.

**What is hot chip seal and how is it different than regular chip seal?**

Regular chip seal involves placing lower temperature asphalt on pavement and rolling aggregate (small jagged rocks) into it. Regular chip seals require heat and must be placed during summer daylight hours, and require 24 hours to cure before they can be driven on again.

Hot chip seal is a similar process, but the asphalt is placed at a much higher temperature and the aggregate is pre-coated with hot oil. The higher temperature of the asphalt and the oil coated aggregate allow crews to work at night, and for the surface to cure faster and be ready for motorists within 30 minutes.

**ITD just paved these roads, why are they being paved again?**

The roads are not being paved. ITD is placing chip seal over the summer to preserve the new pavement along these stretches of roadway.

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## ADA COUNTY CHIP SEAL

The Idaho Transportation Department is applying chip seal in Ada County to preserve the new pavement.

Work will begin in May and is expected to be completed by late summer.

**What to expect during construction**


- Work on one roadway at a time.
- Nighttime work Sunday to Friday from 9 p.m. to 6 a.m.
- Access to residences and businesses will remain open.
- At least one lane open in each direction.
- Shifting traffic patterns.
- Flaggers in the roadway.

**Hot Chip Seal**  
Hot chip seal is placed at high temperatures. This allows crews to work at night and cars to return to the roadway quickly. With hot chip seal, the roadway can reopen by morning and minimize impacts to motorists and businesses.

**Chip seal oil is *extremely hot*. To ensure safety, ITD advises individuals to keep distance from the roadway and paving equipment, and follow instructions from flaggers.**

**STAY INFORMED**  
Sign up for construction updates

- ☐ TEXT: ChipSeal to 1-866-483-8422
- 📄 [itdprojects.idaho.gov/pages/adachipseal](http://itdprojects.idaho.gov/pages/adachipseal)
- ✉ (208) 398-0060
- 📧 [Info@AdaChipSeal.org](mailto:Info@AdaChipSeal.org)



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# Segments

- US-20/26 Downtown
  - Front & Myrtle
  - Broadway
  - Chinden Jct SH-16 to Jct I-184
- SH-44
  - Linder to Jct SH-16
  - Glenwood

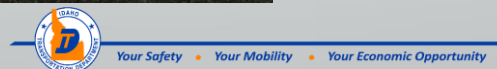
18

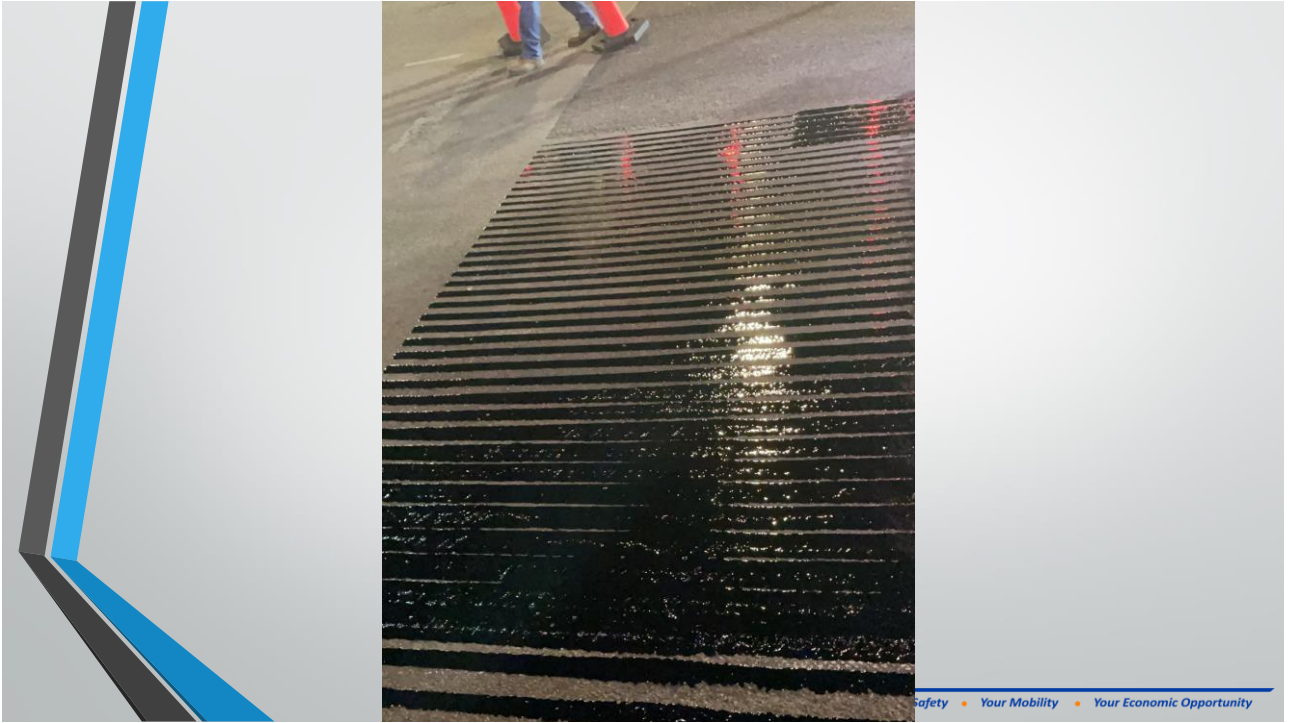
# Test Strip

- PG 76-28 at 0.34 gal/sy
  - 325° F
- Hot Cover Coat at 22 lb/sy
- Dial in Sampling & Testing

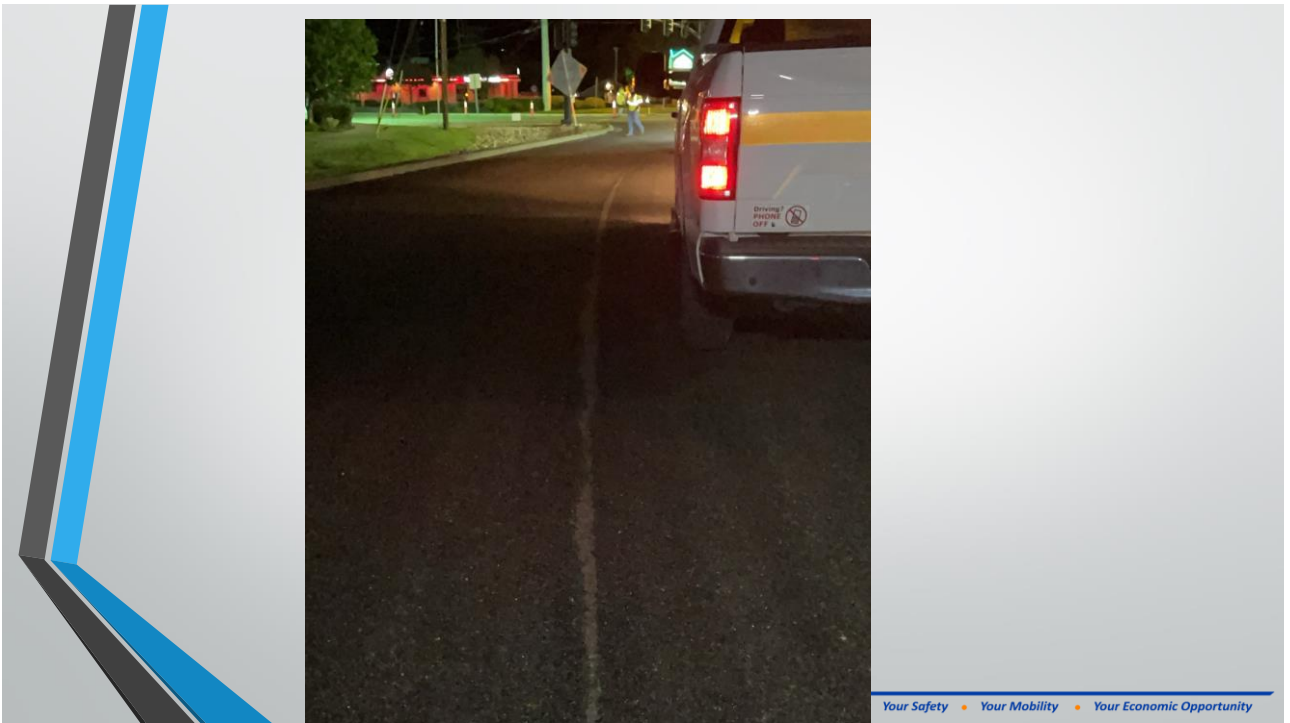


# First Segments





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# First Segments



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23



# First Segments



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# First Segments



25

# First Segments



26



# First Segments



27



# Apply Binder



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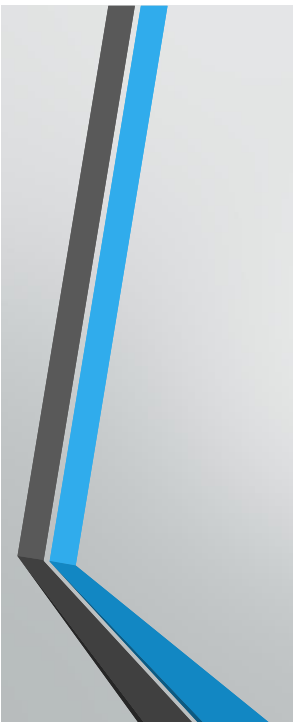


# Apply Chip & Roll




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# Broom



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# Broadway



31



# East Chinden



32





# Intersections



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# Intersections



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# Lessons Learned

- Early preservation
- Brooming
- Intersections



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# Moving Forward (next 12 months)

- Monitor performance
  - Visual
  - Macrotexture
  - Intersections
  - Construction History



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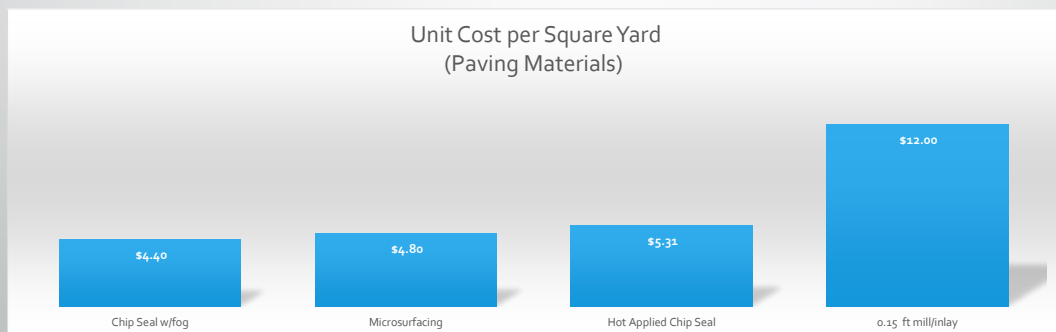
# Moving Forward

- Coordinate with other agencies
  - Oregon Pre-coated Aggregate Asphalt Chip Seal
  - Moscow crumb rubber modification in binder
  - Early summer start



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# Cost Information



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# Cost Information



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# #BuzzOnAsphalt

## Ride Quality and Smoothness of Pavements



Buzz Powell  
10/24/24



1






2

## Technical Resources

- [www.DriveAsphalt.org](http://www.DriveAsphalt.org) – Asphalt Pavement Alliance
- [www.AsphaltPavement.org](http://www.AsphaltPavement.org) – National Asphalt Pavement Association
- [www.AsphaltInstitute.org](http://www.AsphaltInstitute.org) – Asphalt Institute (MS-22)
- [www.ITD.Idaho.gov](http://www.ITD.Idaho.gov) – Idaho Transportation Department
- [www.SmoothPavements.com](http://www.SmoothPavements.com) – The Transtec Group, Inc.
- [www.ChatGPT.com](http://www.ChatGPT.com) – general information about roads and highways
- [www.HeyNAPA.com](http://www.HeyNAPA.com) – vetted information about asphalt pavement.




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Welcome to Hey NAPA

## What asphalt pavement questions can I answer for you?

I've been trained on hundreds of NAPA publications and have broad general knowledge of asphalt pavement topics. Ask me anything that you'd like and I'll do my best to provide a concise answer and point you to additional resources.

Tell me about ride quality and smoothness of pavements. 

© XBE. All rights reserved. Use 'Hey NAPA' at your own risk; no warranties given. Use constitutes acceptance of terms.



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## HeyNAPA Response

Ride quality and pavement smoothness are key factors influencing the comfort and safety of road users. Here's a detailed explanation based on collaborative insights from our expert committee:

- Ride quality vs pavement smoothness
- Importance of ride quality
- Measurement of pavement smoothness
- Impact of pavement roughness
- Factors influencing ride quality
- Benefits of maintaining smooth pavements.



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## Ride Quality versus Pavement Smoothness

- “Ride quality” refers to the level of comfort experienced by vehicle occupants when traveling over a roadway. This is significantly affected by the smoothness or roughness of the pavement surface.
- “Pavement Smoothness” describes the evenness of the road surface. Smoother pavements offer a more comfortable ride and can lead to reduced vehicle operating costs including fuel consumption and maintenance needs.



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## Importance of Ride Quality

- FHWA has pavement smoothness as key performance indicator MAP-21
- Closely tied to the public's perception of roadway conditions
- Surveys show roadway users prioritize smooth pavement
- Smoothness strongly associated with safety and comfort
- Lower vehicle operating costs (higher mpg, lower maintenance).



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## Measurement of Pavement Smoothness

- Present Serviceability Rating (PSR) is the older method
- PSR rated ride quality of roads based on user surveys (0 to 5)
- Bureau of Public Roads “Roughometer” well into the 1980s
- International Roughness Index (IRI) is the current standard
- Quantifies vehicle suspension travel via “gold car” model
- Modeled gold car “runs” along a measured surface profile
- Relative profile elevations measured any number of ways
- Lower IRI is indicate of smoother pavement (i.e., less bounce).



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# www.SmoothPavements.com

**SmoothPavements.com**  
smoothness specifications online

- Smoothness Specs 101**
  - Understanding Specs
  - Development Guidance
  - Glossary
- AASHTO Specifications**
  - What and Why
  - Key Components
  - Summary
- Current Practices**
  - Overview and Summary
  - Smoothness Indices
  - Using ProVAL
- Contact Us**

## What are the AASHTO Specifications?

For years, the pavement profiling industry has had an urgent need for guidance in the development of standard specifications and protocols that will assure owner agencies that test results from inertial profilers are both repeatable and reproducible. In August 2003, the American Association of State Highway and Transportation Officials (AASHTO) adopted Provisional Standards to address these needs, which were further revised as the following full standards:

- M 328** Standard Specification for Inertial Profiler
- R 54** Standard Practice for Accepting Pavement Ride Quality when Measured Using Inertial Profiling Systems
- R 56** Standard Practice for Certification of Inertial Profiling Systems
- R 57** Standard Practice for Operating Inertial Profiling System

**M 328** is an equipment specification to define the required attributes of an inertial profiler system to measure longitudinal pavement profile for construction quality control and acceptance. **R 54** provides guidance for developing specifications when an inertial profiling system is used for measurement and evaluation of ride quality and compliance. **R 56** describes minimum performance requirements for inertial profilers to be used for quality control and quality assurance of surface smoothness when the profile-based smoothness specification is applicable. **R 57** describes the procedures for operating and verifying the calibration of an inertial profiler.

## Key Components

### M 328 Standard Specification for Inertial Profiler

Previously known as MP11, it is an equipment specification that provides a template for profiler procurement language. It describes general hardware requirements such as the number of sensors and sensor performance, triggering capability, and data handling and reporting for an inertial profiler. It describes software requirements, such as IRI and RN calculation, as well as the software that is needed to perform calibration and troubleshooting. The specification also requires some key aspects of performance, such as the valid speed range and the valid roughness range.

Two important aspects of the specification that need review are the waveband and the sampling interval. While these were based on the best available knowledge at the time, these issues are still being researched. For example, it may not be necessary to measure profiles out to such long wavelengths. Furthermore, new footprint and sampling requirements are likely to be needed for coarse-textured pavements. The high-pass filter attenuation and roll off requirements are anticipated to be reviewed and revised. There will also be plenty to learn in this regard from the "Golden Footprint" study currently ongoing.

### R 54 Standard Practice for Accepting Pavement Ride Quality when Measured Using



# Smoothness Standards

Standard Practice for

## Operating Inertial Profiling Systems

AASHTO Designation: R 57-14 (2022)<sup>1</sup> **AASHTO**

Technically Revised: 2014 Reviewed but Not Updated: 2022

Technical Subcommittee: 5a, Pavement Measurement

- SCOPE**
  - This practice describes the procedure for operating and verifying the calibration of an inertial profiling system. This practice is meant to be performed as a quality control/quality assurance (QC/QA) test for use with the appropriate smoothness specifications for paving operations and for network-level data collection. It is not meant to be required as a QA procedure to monitor daily paving operations; however, it is recommended when inertial profiling systems are used for QC testing.
- REFERENCED DOCUMENTS**
  - AASHTO Standards:*
    - M 328, Inertial Profiler
    - R 56, Certification of Inertial Profiling Systems
  - ASTM Standards:*
    - E 867, Standard Terminology Relating to Vehicle-Pavement Systems
    - E 1926, Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements
    - E 2560, Standard Specification for Data Format for Pavement Profile
  - Other Document:*
    - Sayers, M. W. On the Calculation of International Roughness Index from Longitudinal Road Profile. In *Transportation Research Record 1501*, Transportation Research Board, National Research Council, Washington, DC, 1995, pp. 1-12.
- TERMINOLOGY**
  - Definitions:*
    - International Roughness Index (IRI)**—a statistic used to determine the amount of roughness in a measured longitudinal profile. The IRI is computed from a single longitudinal profile using a quarter-car simulation at 50 mph (Sayers 1995). Computer programs to calculate the IRI from a longitudinal profile are referenced in ASTM E1926.
    - longitudinal profile**—the vertical deviations of the pavement surface taken along a line in the direction of travel referenced to a horizontal datum.



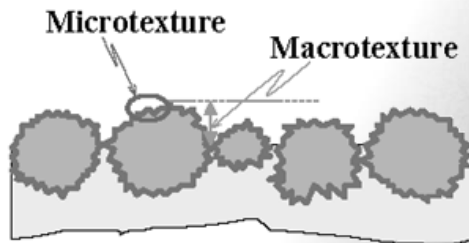
## Measurement Technologies



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## Surface Irregularities

- Microtexture (peak-to-peak) wavelength  $< 0.5$  mm (quarry)
- Macrotexture wavelength from 0.5 mm to 50 mm (plant)
- Roughness wavelength  $> 50$  mm (paver).



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# Idaho Smoothness Specifications

Quality Assurance 400 Surface Courses and Bituminous Pavement 270.30

BID ITEM/MATERIAL	PURPOSE OF TESTING	ITD SPEC. REF.	TEST METHOD	REQUIRED REPORT FORM NO.	MINIMUM REQUIRED FREQUENCY	REMARKS, NOTES, OR ADDITIONAL DIRECTIONS
		SAMPLED BY	TESTED BY			
Surface Smoothness	ACCEPTANCE Profiler	405.03-P Contractor	AASHTO R 57 Contractor	ITD-854 ITD-769	Fully witnessed with report	Contractor furnishes IRI QC test results to Engineer by next calendar day following placement. Acceptance testing to be completed on final lift within 1 week of completion of paving
	VERIFICATION Profiler	405.03-P ITD Project Personnel	ITD Project Personnel			
Pavement Reinforcement Fabric	ACCEPTANCE Certification	718.02 718.08 Manufacturer	Manufacturer	ITD-849 with QC test results attached	Total Quantity Paid	See QA Manual Section 230.09
	VERIFICATION Laboratory Tests	718.03 718.08 ITD Project Personnel	ASTM D4632 ASTM D4533 ASTM D6140 HQ Central Lab	ITD-1044 (Sample Data) ITD-1047 (Lab Report)	1 sample from each manufacturer-identified lot for each type	

405-7



# Idaho Smoothness Specifications

- ≤6.5% grade, ≥1000 foot horizontal curve radii, tangents
- Straightedge only pavement within 50 feet of “other” surfaces
- Exclude speed limits less than 40 mph, interstate ramps, test strips
- Quality control (QC) testing next business day after placement
- Acceptance testing final lift within 1 week of paving<sub>witnessed/verified</sub>
- Can request QC testing for acceptance, elected verification ≤ 10%.



## Idaho Smoothness Specifications

- Beam  $\leq \frac{1}{4}$  inch over 10 feet, either direction, as directed by engineer
- Inertial profiler simultaneously measuring both wheelpaths<sub>MRI</sub>
- Either no high pass/pre filter or at least 200 feet, bump/dip set to “on”
- Resolution 0.01 inches, low pass/other filter(s) set to “off”
- “Calibrate profiler at the beginning of the work, as needed thereafter”
- Smoothness ProVAL assessed in tenth of a mile segments<sub>Excel</sub>



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## Idaho Smoothness Specifications

- Inches per mile of accumulated computed suspension travel
- Schedule I target 60.0-70.0 per tenth, correct above 95.0
- Schedule II target 71.0-80.0 per tenth, correct above 95.0<sub>default</sub>
- Schedule III based on prepaving assessment then improvement
- If prepaving  $< 160.0$ , then all tenths must be  $\leq 80.0$  after paving
- If prepaving  $\geq 160.0$ , then 50% improvement or 100.0 max
- Module for California Profilograph (rolling beam) simulation.



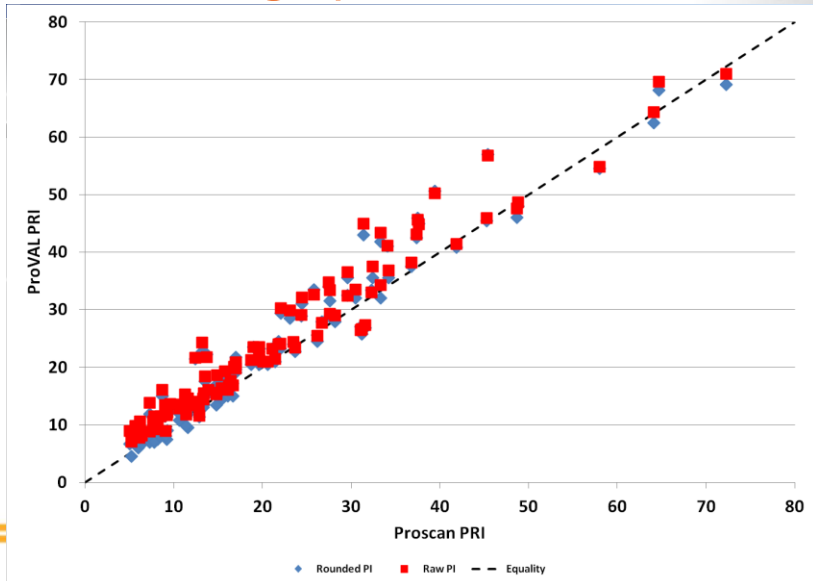
16

# California Profilograph



17

# California Profilograph



18



## Impact of Pavement Roughness

- Rough pavements increase vehicle operating costs for drivers
- More vehicle depreciation, lower mpg, more frequent repairs
- Smoother roads reduce rolling resistance (higher mpg)
- Keeping roads smooth can reduce pavement life cycle cost
- Less bounce → lower dynamic loading → reduced bottom-up cracking
- More bounce → higher dynamic loading → increased bottom-up cracking
- Cheaper to preserve/maintain smooth pavement than rehabilitate rough.



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## Factors Influencing Ride Quality

- Observable patching, joints, other surface conditions (visual)
- Physical experience driving down the road in a vehicle
- Perception of ride quality can vary significantly
- Type of vehicle, speed of travel, position of passengers
- Dramatic impact on suspension travel and seat experience
- Gold car model developed by World Bank to aid development.



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## Benefits of Maintaining Smooth Pavements

- Extends the lifespan of pavement infrastructure
- Reduces environmental impact through better fuel efficiency
- Enhances user satisfaction and safety
- Sets quality standard for new, mill/inlay, and overlay work.



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## Takeaways

- Important to both public perception and life cycle cost
- Industry must win in both the short game and the long game
- Gold car model is objective, repeatable, enforceable
- Idaho smoothness ranges appear to be reasonably achievable
- Laser technology has removed potential macrotexture bias
- Inertial profilers also have the versatility of California Profilograph
- If not in good working order, numbers can run either high or low
- Safe, sustainable pavement at lowest life cycle cost!



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# Questions?

**DR. R. BUZZ POWELL, PE**

APA Technical Director



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✂️ [@BuzzPowell](https://twitter.com/BuzzPowell)

📍 PO Box 9029  
Fleming Island, FL 32006

🌐 [DriveAsphalt.org](http://DriveAsphalt.org)



# Binder Availability in RAP

Idaho Asphalt Conference  
 University of Idaho, Moscow, Idaho  
 October 24, 2024  
 Grover Allen

1

## Why use Recycled Asphalt Materials?

- Valued by Users and Producers
  - Resource-responsible
    - Re-use waste product
    - Offset new (virgin) materials



Guidelines for the use of RAS in Asphalt Pavements.  
 NAPA, 2019.



FL Use of High RAP, Sustainability, Allain 2023

2

# Known Quality Issues with RAP Binder



Multi-source RAP pile (RAP Best Practices. NCAT 2010.)



Heated RAP



Heated Virgin Mix

3

# What is Binder Availability?



0% Available  
"Black Rock"



100% Available

4

## Back to Basics! Mixing Temperatures

**Table 38. Results of coating tests with validation binders.**

Mixer Type		Percentage of Coated Aggregate Particles by ASTM D2489							
		Pugmill				Bucket			
Mixing Temp. °C		120	140	160	180	120	140	160	180
Mixing Temp. °F		248	284	320	356	248	284	320	356
W	90.0 -17.8	17.7	62.2	76.4	86.1	43.9	66.5	81.7	88.6
X	74.2 -27.9	36.7	70.7	80.3	93.3	35.0	26.4	97.4	99.8
Y	73.0 -21.4	73.7	92.9	92.4	91.0	75.3	83.6	98.7	95.2
Z	81.9 -20.1	36.8	79.4	85.3	92.1	27.6	44.5	73.6	98.5

NCHRP Report 648, *Mixing and Compaction Temperatures of Asphalt Binders in Hot-Mix Asphalt (2010)*

5

## Back to Basics! Mixing Temperatures

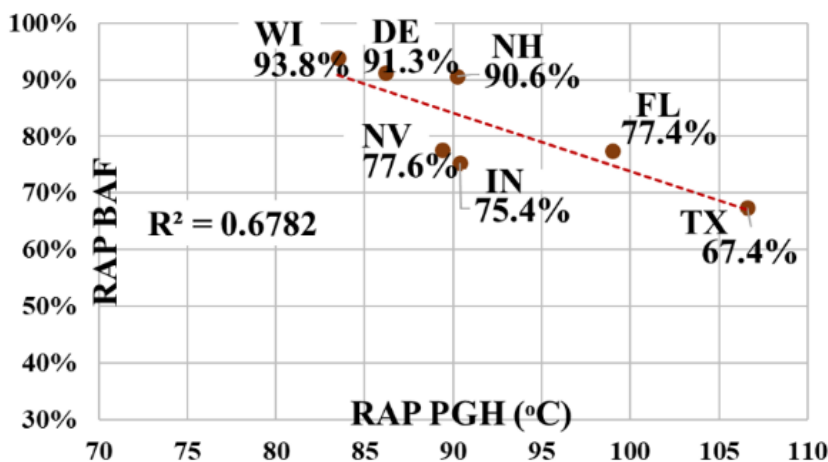
**Table 39. Predicted mixing temperatures for good coating for the validation binders.**

ID	True Grade	Pugmill Mixer			Bucket Mixer		
		<i>a</i>	<i>b</i>	T for 89% Coating	<i>A</i>	<i>b</i>	T for 97% Coating
W	90.0 -17.8	4508.4	0.0609	341	174.784	0.0413	406
X	74.2 -27.9	1614.4	0.0570	331	30484.3	0.0744	365
Y	73.0 -21.4	27.68	0.0373	291	57.00	0.04256	349
Z	81.9 -20.1	6693.6	0.0699	311	9506.3	0.0682	365

NCHRP Report 648, *Mixing and Compaction Temperatures of Asphalt Binders in Hot-Mix Asphalt (2010)*

6

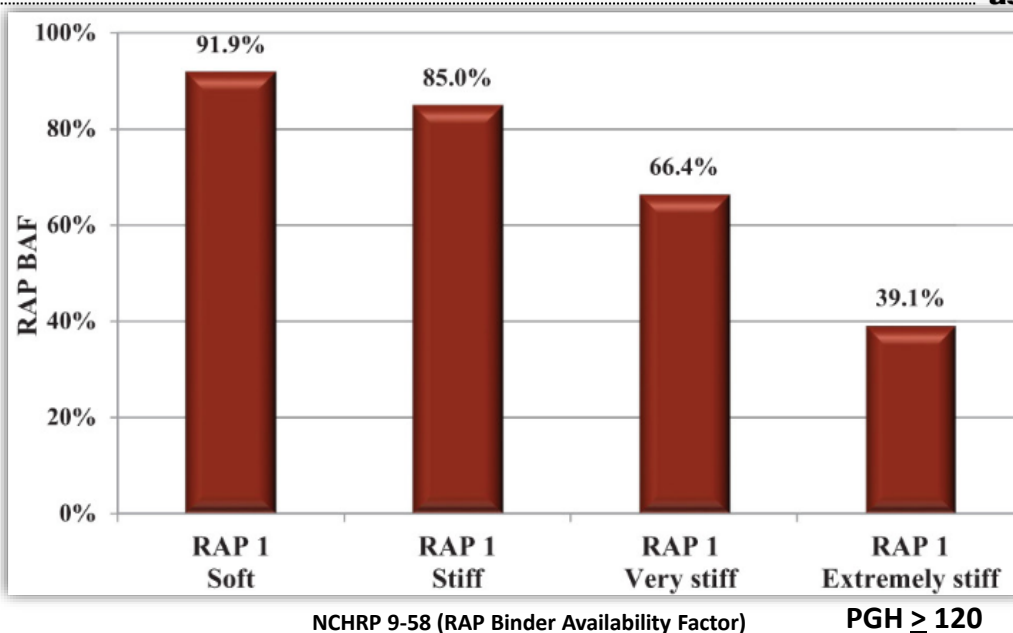
### RAP Binder Availability (NCHRP 9-58)



$RAPBAF = -0.010 \times PGH_{RAP} + 1.771$  for 150°C mixing  
 NCHRP 9-58 (RAP Binder Availability Factor)

7

### RAP Binder Availability (NCHRP 9-58)



NCHRP 9-58 (RAP Binder Availability Factor) **PGH ≥ 120**

8

## RAP Binder Availability (NCHRP 9-68)



Figure 35. Glass Beads before and after Mixing (Sreeram et al., 2018)

$$RBA = \left| \frac{P_{GB} - P_V}{P_{RAP-blend} - P_V} \right| * 100\%$$

9

## How does implementation impact the mix?

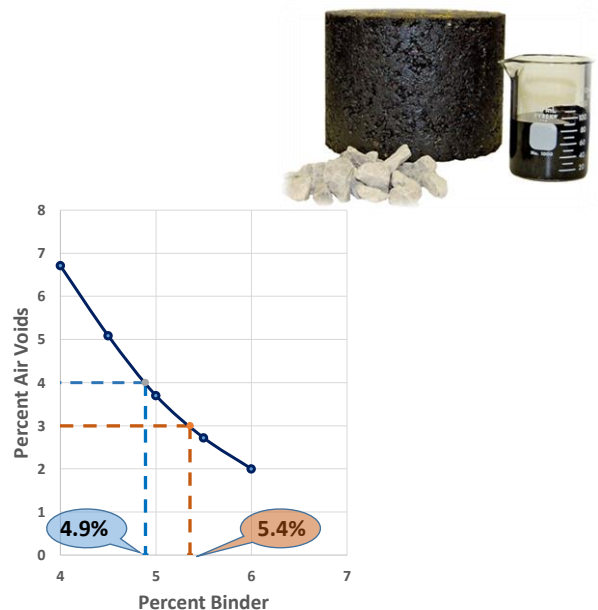
### Increases Binder ( $P_b$ ) !

#### Traditional methods

- Specify lower gyrations levels
- Specify lower air void content
- Raise VMA

#### Newer methods

- Air Void Regression
- BMD
- **Partial RAP Binder Replacement**



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## Estimated Binder Replacement

### Example:

- **6% total binder needed in mix (virgin + RAP binder)**
  - **30% RAP**
  - $P_b$  on RAP = 5%
  - **Assume only 80% RAP binder contribution (20% replacement needed)**

Step 1 – Calc. RAP Binder present in mix  **$5.0 \times .30 = 1.5\%$**

Step 2 – Calc. amount of RAP binder to be replaced

**$1.5\% \times .20 = 0.30\%$**  new virgin binder added to mix

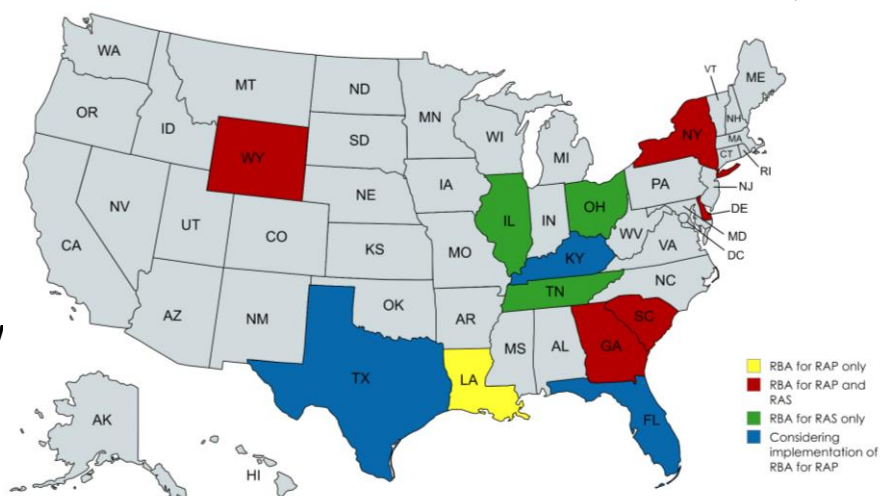
Step 3 – Total binder =  **$6.0\% + 0.30\% = 6.3\%$**

11

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## Partial RAP/RAS Binder Credit: Implementation Status

- **RAP: 5 states**
  - **3 states considering:**  
TX, FL, KY
- **RAS: 8 states**
  - **AASHTO PP78 (RAS Standard Practice):**  
partial binder repl.
  - **27 states do not allow RAS** (NCAT Report 14-06)



Map of state highway agencies allowing only partial credit, or binder availability factors (BAF), for RAP and RAS binders (Epps Martin et al., 2021).

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# RAP Binder Availability (GDOT)



**Georgia addresses pavement performance problems linked to high RAP usage**  
*By Bob Horan, P.E.*



**“Adopting a 60:40 Corrected Optimum Asphalt Content appears to improve roadways.”**



*“The differences between COAC and non-COAC mixes are dramatic.”*

— Will Rogers,  
GAPA Technical Director

**Laboratory heating and blending of 75% virgin aggregate and 25% RAP material**

**9.5mm Type II w/30% RAP held in silo for 15 mins**

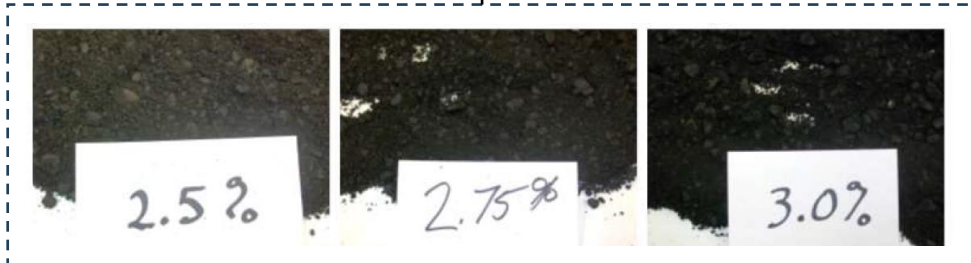
# GDOT Research



**Preheated RAP**



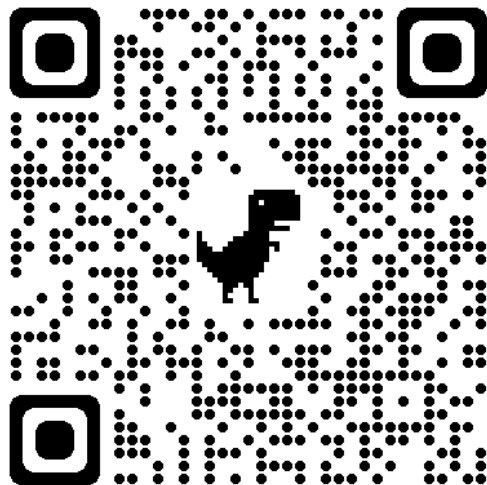
**RAP Aggregate**



**RAP Aggregate + Virgin Binder**



## Georgia (GDOT) addresses pavement performance problems linked to high RAP usage



- AI Magazine Article
  - Bob Horan, AI Senior Regional Engineer
  - Fall, 2020
- Correct Optimum Asphalt Content (COAC)

15

## What Cost/Performance Improvement is Expected?

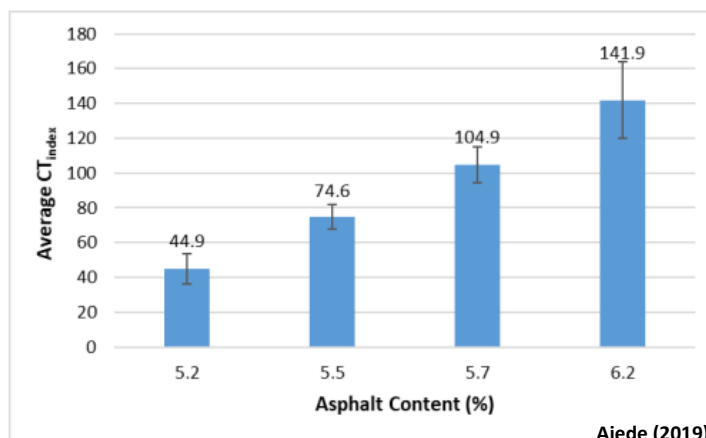
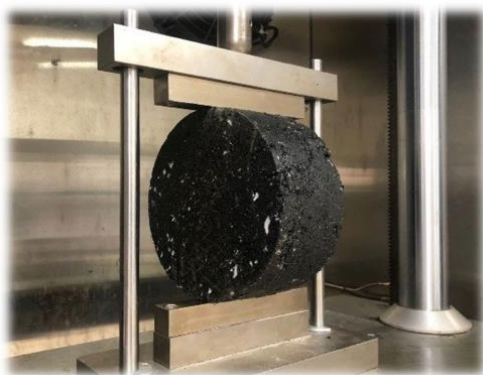


30% RAP Example:

**\$33/ton**

Replace 20% of RAP binder (80% “active binder” credit)

**\$35.50/ton**



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## FDOT expected to adopt RBA limit



- Recommendation is 80:20
- For 20% and 40% RAP, additional 0.23% and 0.45% binder
- Corrected 40% RAP performs more like original 20% RAP
- IDEAL-CT, OT, HWTT, APA, and Cantabro tests measured performance
- Only 2 months additional service life needed to justify additional binder cost



- Create new table with changed RAP percentages for binders.

Table 334-2 Asphalt Binder Grade for Mixes Containing RAP	
Percent RAP	Asphalt Binder Grade
0 - 30	PG 67-22
>30	PG 58-28

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## RAP Binder Availability Industry Sessions (SEAUPG 2023)



SESSION V:	RECLAIMED ASPHALT PAVEMENT (RAP) BINDER AVAILABILITY PART I
1:30 - 2:00 PM	Assessment of High RAP Mixes with Recycling Agents in Virginia -Jhony Habbouche, P.E., Virginia DOT
2:00 - 2:45	Recycled Binder Availability - Impact on Asphalt Mixture Performance -Fan Yin, Ph.D. Assistant Director & Associate Research Professor NCAT



SESSION VI:	RECLAIMED ASPHALT PAVEMENT (RAP) BINDER AVAILABILITY PART II Moderator: Andrew Brooks, C.W. Matthews Contracting
3:30 - 4:00	RAP Containing Ground Tire Rubber (GTR) Modified Asphalt Effective Binder Availability -Serji Amirkhaniyan, Ph.D., The University of Alabama
4:00 - 5:00	Georgia & South Carolina: Contractor & DOT Perspectives (Panel Discussion) -DOT: James Brandon, P.E., Georgia DOT Kimberly Lyons, Ph.D., P.E., South Carolina DOT -Contractor: Tony Felix, Reeves Construction Andrew Brooks, C.W. Matthews Contracting

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## RAP Binder Availability Summary:

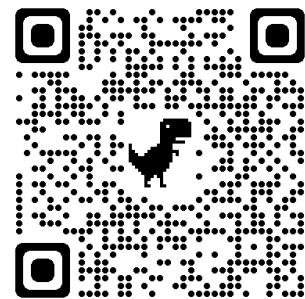


1. RAP binder is not likely “fully” available/effective as a glue
2. As recycled binder stiffness increases, availability decreases
3. National and state-level research being conducted
4. Implementation aims to get the prescribed amount of effective binder
  - Multiple states have already implemented policies requiring 25% or more RAP binder replacement
  - Expect more states to adopt policies (FL, TX, and KY)



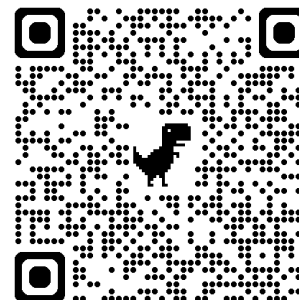
19

## Asphalt Magazine: Spring 2024 Edition



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# Asphalt Magazine: Fall 2024 (Current) Edition



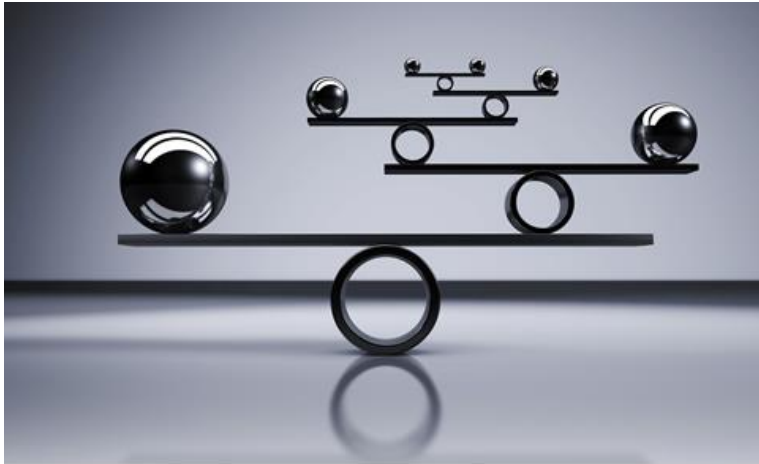
21

## Discussion



22

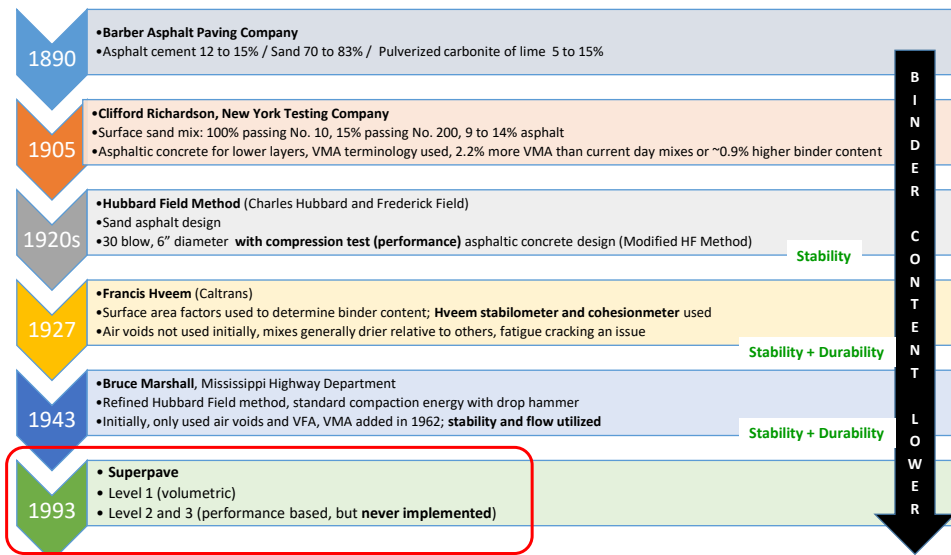
# Performance Tests for Balanced Mix Design



Dave Johnson, P.E.  
Senior Regional Engineer  
Rocky Mountain Region  
Billings Montana

1

## History of Mix Design



<http://asphaltmagazine.com/history-of-asphalt-mix-design-in-north-america-part-2/>

2

## Balance the Mix Design



Strength/  
Stability

Smooth Quiet Ride  
Skid Resistance

Durability

Rut Resistance

Crack  
Resistance

Shoving

Raveling

Flushing  
Resistant

Permeability



**DON'T ATTACK ONE HALF AT THE EXPENSE OF THE OTHER HALF!!**

3

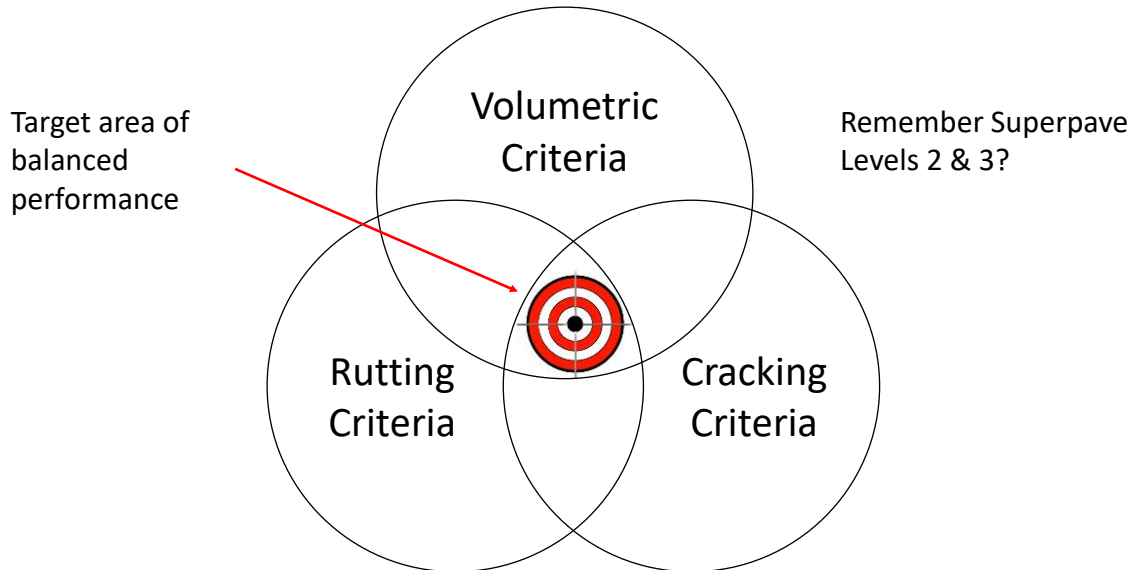
## What Should Have Happened with Superpave...



- Superpave called for **Level 1, 2, and 3** testing based on traffic load
- **Level 1 (Volumetrics + TSR)** was only for up to around 1 million ESALS
- Level 2 and 3 were to be used for higher traffic loads and included rutting and cracking performance test
- Since we saw such good performance (with materials in 1993-2000), **Levels 2 and 3** were soon forgotten

4

## Balanced Mix Design Basic Concept



5

## Balance Mix Design Drivers

- Rutting?
  - **NO**
  - Generally not a widespread distress since Superpave implementation
- Cracking?
  - **YES**
  - Various cracking distresses have increased nationally
- Durability?
  - **YES**
  - Related to cracking, durability concerns have been noted

6

## Balanced Mix Design Goals

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- Ensure pavement performance
  - Rutting
  - Cracking
  - Durability
- Enable innovation
  - Materials
  - Specifications
- Optimize economics

7

## Balance Mix Design Keys

---



- AASHTO PP 105
  - Four approaches
  - Condition specimens
  - Test for differing distress types
  - Consider
    - Aging
    - Traffic
    - Climate
    - Layer within the pavement structure

8



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# **Standard Specification for Balanced Mix Design**

---

**AASHTO Designation: MP 46-24<sup>1</sup>**

Technically Revised: 2024

**Technical Subcommittee: 2d, Proportioning  
of Asphalt–Aggregate Mixtures**

9

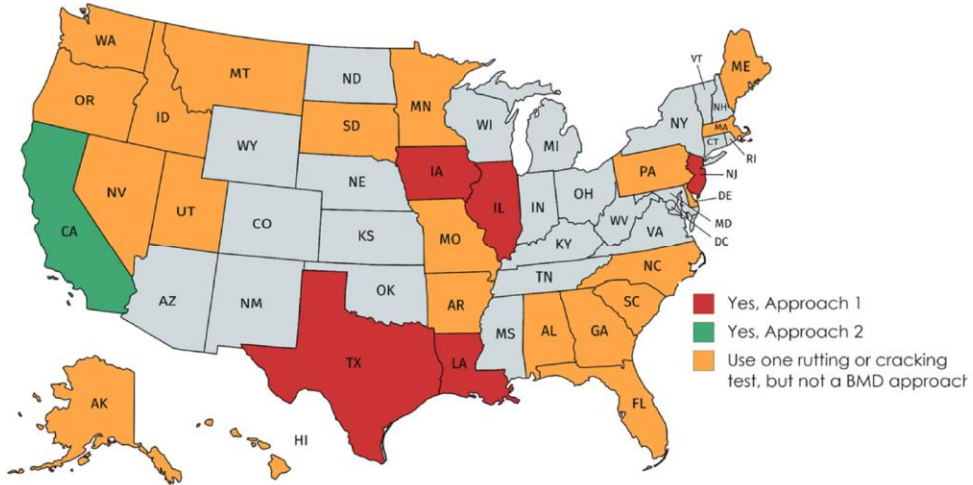
## **Key Features of MP-46**

---

- Background Information
  - Scope
  - Terminology
  - Significance and Use
  - References
- Rutting Tests
- Cracking Tests

10

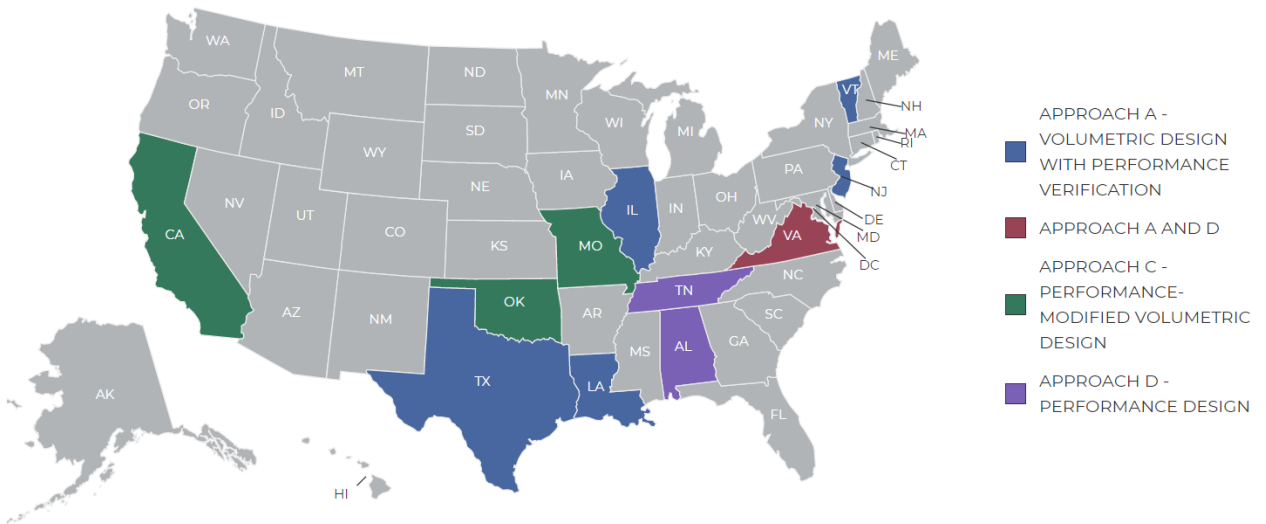
# Performance Asphalt Design Approach in USA (2017)



NCAT's Final Report to the National Cooperative Highway Research Program (NCHRP); Project NCHRP 20-07/Task 406; August 30, 2018

11

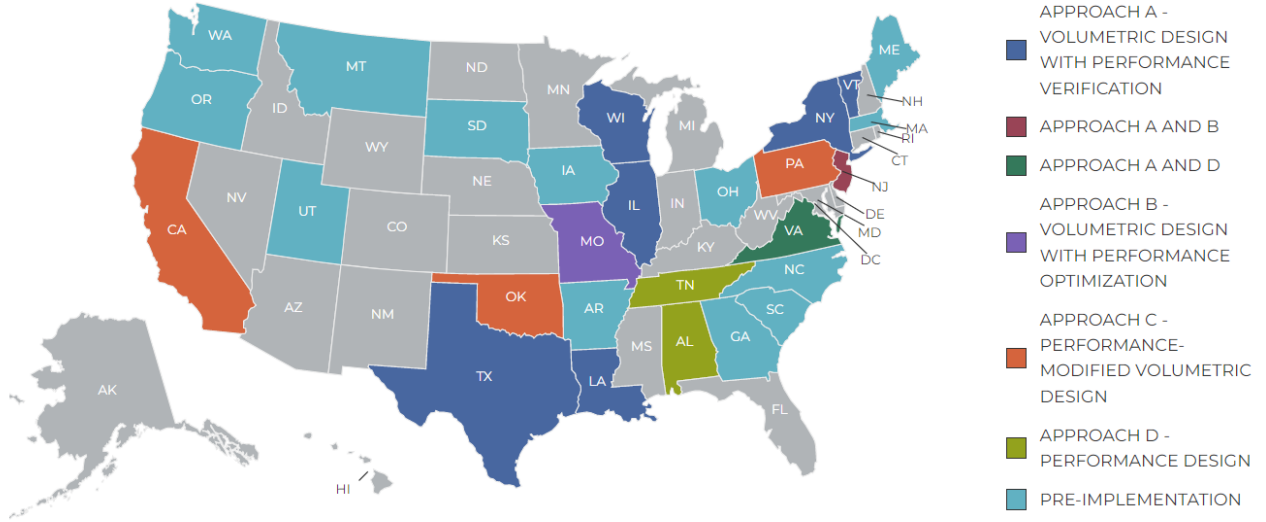
# Balanced Mix Design Approach in USA (August 2021)



<https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide/implementation-efforts>

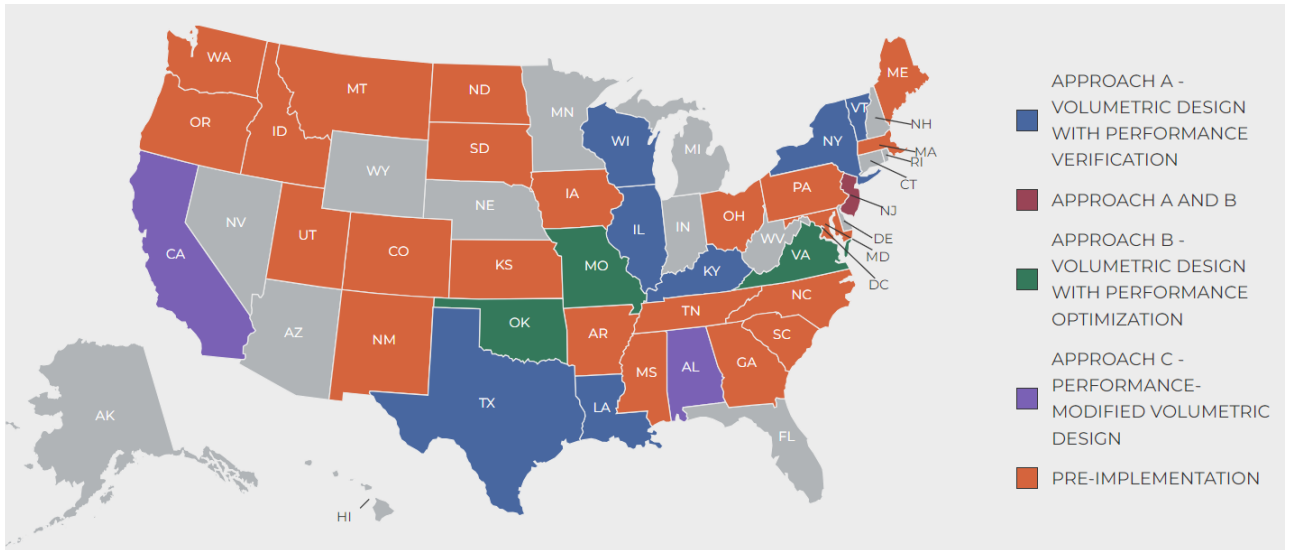
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## Balanced Mix Design Approach in USA (March 2022)



13

## Balanced Mix Design Approach in USA (October 2024)

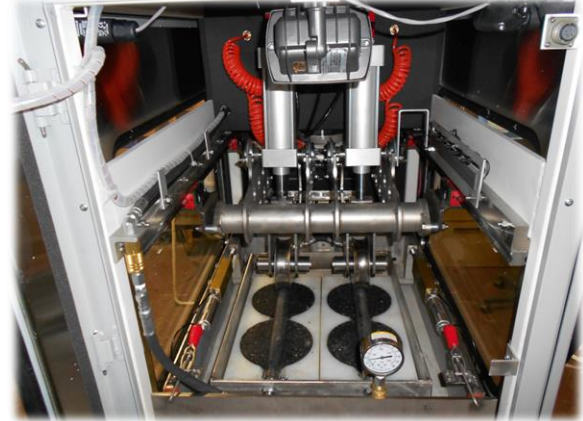


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## AASHTO MP-46 → Rutting Tests

- Asphalt Pavement Analyzer (APA) (AASHTO T-340)
  - Three traffic levels
  - No recommendations on criteria



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## AASHTO MP-46 → Rutting Tests

- Hamburg Wheel-Tracking Test (HWTT) (AASHTO T-324)
  - Three traffic levels
  - No recommendations on criteria
  - Easily the most common choice
    - 40-56°C
    - 10,000-20,000 passes
    - Typically, 10-13 mm maximum rut



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## AASHTO MP-46 → Rutting Tests



- Flow Number Test (AASHTO T-378)
  - Three traffic levels
  - Recommended criteria for both HMA and WMA
- High Temperature Indirect Tensile Test (HT-IDT) (ALDOT-458)
  - Three traffic levels
  - No recommendations on criteria
- Hveem Stability Test (AASHTO T-246)
  - Three traffic levels
  - Recommended criteria

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## AASHTO MP-46 → Rutting Tests



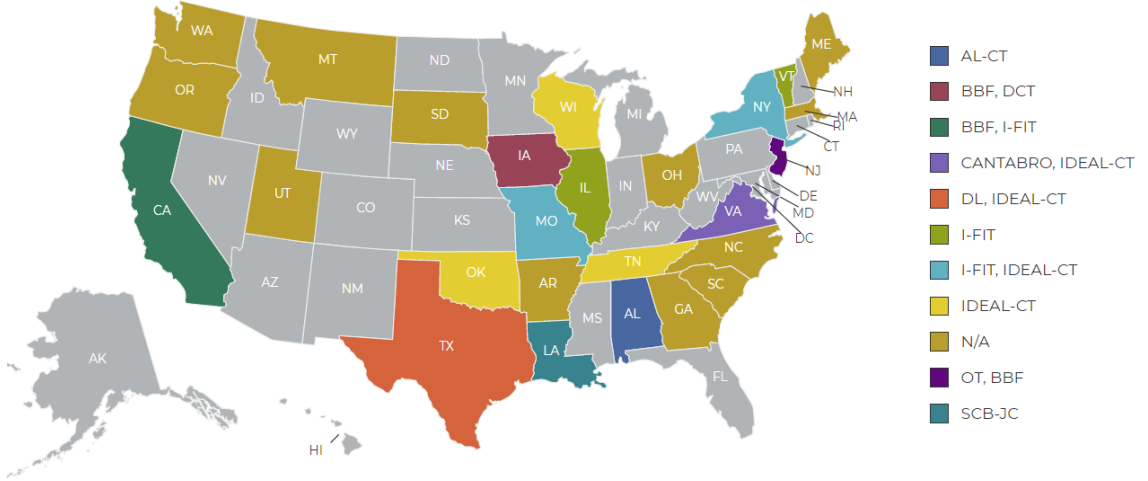
- Superpave Shear Tester (SST) (AASHTO T-320)
  - Three traffic levels
  - Recommended criteria
- Stress Sweep Rutting (SSR) on the AMPT (AASHTO TP-134)
  - Four traffic levels
  - Recommended criteria
- Incremental Repeated-Load Permanent Deformation (iRLPD) (AASHTO TP-116)
  - No traffic level breakdowns
  - No recommendations on criteria

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# Cracking Performance Testing Options (March 2022)



FILTER BY: BMD APPROACH RUTTING TEST **CRACKING TEST**

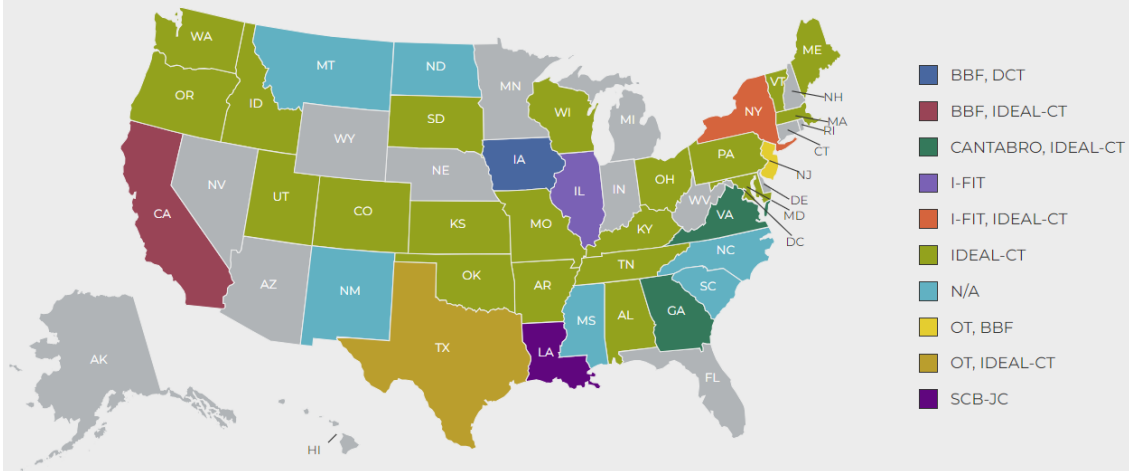


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# Cracking Performance Testing Options (October 2024)



FILTER BY: BMD APPROACH RUTTING TEST **CRACKING TEST**



22

## Cracking Performance Testing Options

- Seven test procedures currently reported
- Two tests most common
  - I-FIT test
  - IDEAL-CT
- Seven states report two cracking tests are required

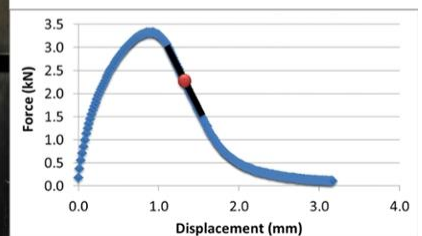
23

## AASHTO MP-46 → Cracking Tests

- Illinois Flexibility Index Test (I-FIT) (AASHTO T-393)
  - Three traffic levels
  - No recommendations
  - Used by three states
    - Illinois
    - California
    - New York



Courtesy of NCAT



24



## AASHTO MP-46 → Cracking Tests

- Indirect Tensile Cracking Test at Intermediate Temperature (IDEAL-CT) (ASTM D8225)
  - Three traffic levels
  - No recommendations on criteria

**Table X1.8**—Summary of IDEAL Cracking Test Criteria Used by State DOTs  
(as of September 30, 2022)

States	Binder/Mixture Types	Min Cracking Tolerance Index ( $CT_{index}$ ) Criteria
Alabama <sup>a</sup>	<1 million ESALs	55 after short-term aging for 2 h at 135°C
	1 to 10 million ESALs	83 after short-term aging for 2 h at 135°C
	10 to 30 million ESALs	110 after short-term aging for 2 h at 135°C
Maryland		80 for plant mixed, lab compacted specimens after reheating
Missouri	Mainline pavement Superpave mix	57 after short-term aging for 2 h at 135°C
	Mainline pavement SMA mix	135 after short-term aging for 2 h at 135°C
Oklahoma	BMD mix	80 after short-term aging for 4 h at 135°C
Virginia	BMD mix, high RAP surface mix	70 after short-term aging for 4 h at 135°C
Wisconsin	Mainline upper layer mix	30 after short-term aging for 4 h at 135°C plus long-term aging of loose mix for 6 h at 135°C

<sup>a</sup> For local roads; provisional specification only. ALDOT-22-PS0165(2).

25

## AASHTO MP-46 → Cracking Tests

- BBR Mixture Bending Test (AASHTO T-419)
- Direct Tension Cyclic Fatigue Test (AASHTO T-400)
- Disc-Shaped Compact Tension (DC(T)) Test (ASTM D7313)
- Flexural Bending Beam Fatigue (BBF) Test (AASHTO T-321)
- Indirect Tensile Creep Compliance and Strength Test (AASHTO T-322)
- Energy Ratio Test – University of Florida
- Overlay Test (Tex-248-F and NJDOT B-10)

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## AASHTO MP-46 → Cracking Tests



- Semi-Circular Bend (SCB) Test at Intermediate Temperature (ASTM D8044)
- Semi-Circular Bend (SCB) Test at Low Temperature (AASHTO T-394)
- Cantabro Abrasion Loss of Asphalt Mixture Specimens (AASHTO T-401)
- Small Specimen Geometry Cyclic Fatigue Test (AASHTO TP-133)
- $N_{flex}$  Factor Test (AASHTO TP-141)

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## AASHTO MP-46 → Moisture Damage Tests



- Hamburg Wheel-Tracking Test (AASHTO T-324)
  - Stripping inflection point
- Tensile Strength Ratio (TSR) (AASHTO T-283)
  - Originally developed by Dr. Bob Lottman at the University of Idaho
- Moisture Induced Stress Tester (ASTM D7870/D7870M)

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# ITD's Choices (Currently)



State	Date Last Reviewed	Agency Website	Contact
Idaho	05/2024	<a href="https://td.idaho.gov/">https://td.idaho.gov/</a>	<a href="mailto:Engineering@asphaltinstitute.org">Engineering@asphaltinstitute.org</a>

### BMD Implementation Summary Table

BMD Approach	Applicable Mixture Type	Rutting Test	Cracking Test	Performance Testing for Production Acceptance
Pre-Implementation	Superpave Mixtures	HWTT	IDEAL-CT	No

### STATE-OF-THE-PRACTICE

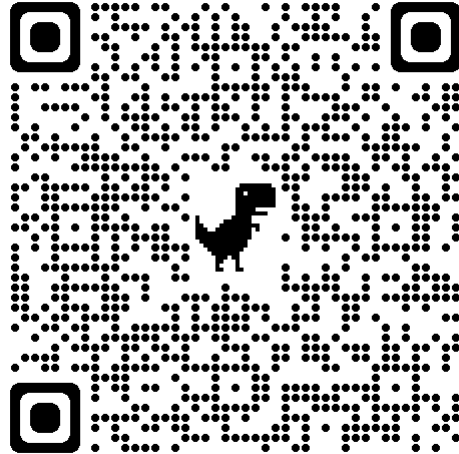
The Idaho Transportation Department (ITD) follows the Superpave method for the volumetric design of asphalt mixtures. The mix design is enhanced by the Hamburg Wheel Tracking Test (HWTT) to evaluate rutting resistance and moisture susceptibility. The volumetric analysis requires 4.0 percent design air voids at 50 gyrations for SP-2 mixes (less than 1 million ESALs), 75 gyrations for SP-3 mixes (1 to 10 million ESALs), and 100 gyrations for SP-5 mixes (over 10 million ESALs). The minimum voids in mineral aggregate (VMA) criteria vary from 11.5 to 16.5 percent depending on the nominal maximum aggregate size. Other volumetric design requirements include relative density ( $\%G_{mm}$ ) at  $N_{des}$ ,  $\%G_{mm}$  at  $N_{max}$ , voids filled with asphalt (VFA), and dust-to-binder (D/B) ratio.

For performance testing, HWTT is conducted in accordance with AASHTO T 324. The test temperature is 50°C. The test is conducted on specimens that are short-term aged for 4 hours at 135°C prior to compaction according to the previous AASHTO R 30. Table 1 presents ITD's HWTT criteria based on two test parameters: 1) rut depth after a specific number of stripping passes and 2) the number of passes with no stripping inflection point (SIP). In addition to HWTT, ITD requires the Indirect Tensile Asphalt Cracking Test (IDEAL-CT) per ASTM D8225 with a preliminary minimum cracking tolerance index ( $CT_{1000}$ ) criterion of 80 for mix design submittal, but the results are for informational purposes only.

Table 1. ITD HWTT Criteria for Mix Design Approval

Mixture Type	SP-2	SP-3	SP-5
Rut Depth after Specified Number of Stripping Passes, mm	≤ 10.0	≤ 10.0	≤ 10.0
Number of Passes with No SIP	≥ 12,500	≥ 15,000	≥ 15,000

Production acceptance of SP-2 mixes is based on asphalt content and gradation. For SP-3 and SP-5 mixes, the acceptance is determined based on air voids, VMA, and D/B ratio while effective specific gravity of the aggregate ( $G_{se}$ ) and theoretical maximum specific gravity of the mix ( $G_{mm}$ ) are tracked for information only. The HWTT and IDEAL-CT results are also required, but they are for informational purposes only.



# ITD's Choices (Currently)



Table 405.02-1 – Superpave Mixture Requirements

Mixture Type	SP 2 (50 gyrations)	SP 3 (75 gyrations)	SP 5 (100 gyrations)
Design ESALs (a) (millions)	< 1	1 < 10	≥ 10
Gyratory Compaction Gyrations for Nini	6	7	8
Gyrations for Ndes	50	75	100
Gyrations for Nmax	75	115	160
Relative Density, % Gmm @ Nini	≤ 90.5	≤ 89.0	≤ 89.0
Relative Density, % Gmm @ Ndes	96.0	96.0	96.0
Relative Density, % Gmm @ Nmax	≤ 98.0	≤ 98.0	≤ 98.0
Air Voids, % Pa	4.0	4.0	4.0
Dust Proportion Range (b)	0.6 – 1.4	0.6 – 1.4	0.6 – 1.4
Voids Filled with Asphalt (VFA) Range, % 1/2"	64 – 80	64 – 75	64 – 75
1"	65 – 78	65 – 75	65 – 75
3/4"	65 – 78	65 – 75	65 – 75
3/8"	65 – 78	65 – 75	65 – 75
#4	65 – 78	73 – 76	73 – 76
	67 – 79	67 – 77	67 – 77
Rut Depth, mm (c)	≤ 10.0 mm	≤ 10.0 mm	≤ 10.0 mm
Stripping, passes (d)	12,500	15,000	15,000
Cracking Test, IDEAL-CT Index (e)	80 (index value)	80 (index value)	80 (index value)

Current ITD Criteria

- (a) The anticipated project traffic level expected on the design lane over a 20 year period. Regardless of the actual design life of the roadway, determine the design ESALs for 20 years.
- (b) For No. 4 nominal maximum size mixtures, the dust proportion is 1.0 to 2.0 for SP 2 mixes and 1.5 to 2.0 for SP 3 and SP 5 mixes. For coarse graded 3/8, 1/2, and 3/4 inch nominal maximum size mixtures, the dust proportion is 0.6 – 1.5. (Fine and coarse graded mixtures are defined in 703.05).
- (c) Maximum depth after specified number of stripping passes. The Hamburg must have passing test results in the mix design.
- (d) Minimum number of passes with no stripping inflection point. The Hamburg must have passing test results in the mix design.
- (e) The Ideal-CT value and the associated data generated will be included in the mix design submittal; the data will only be used for information.

# Where we are going



- Interest in BMD approaches growing significantly
- Multiple combinations of design approaches and testing requirements being seen
- Likely trends that BMD will instigate (Dave’s opinions)
  - Increases in binder contents
    - Mitigates cracking and durability concerns
  - Less reliance on volumetrics
  - Greater reliance on laboratory performance testing during design
  - Innovations
    - Rejuvenators
    - Alternative materials

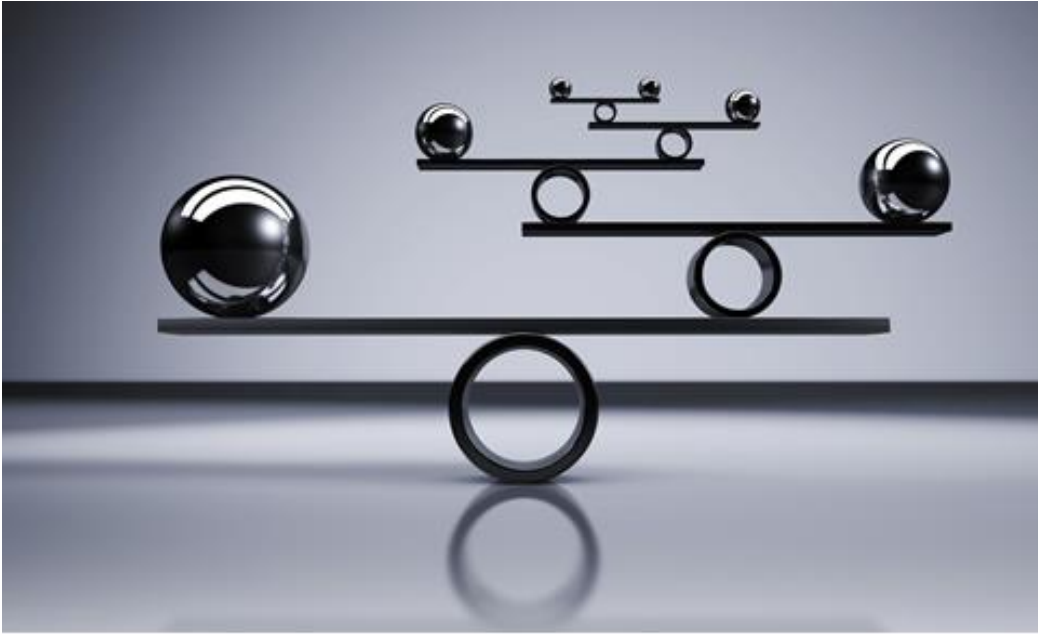
31

# Thank You Asphalt Institute Membership



32

# Questions?



My contact information

# Environmental Product Declaration



Chait Bhat, Ph.D., LCACP  
Sustainability Engineer  
Asphalt Institute  
Lexington, KY

64<sup>th</sup> Annual Idaho Asphalt Conference  
University of Idaho  
Moscow, Idaho  
October 23-24, 2024

1

1

## Overview of the Seminar



- Holistic Sustainability
- Environmental Sustainability - Vision
- Tactical Policies and Industry Initiatives
- Considerations for Path Forward

2

2

1

# Holistic Sustainability

3

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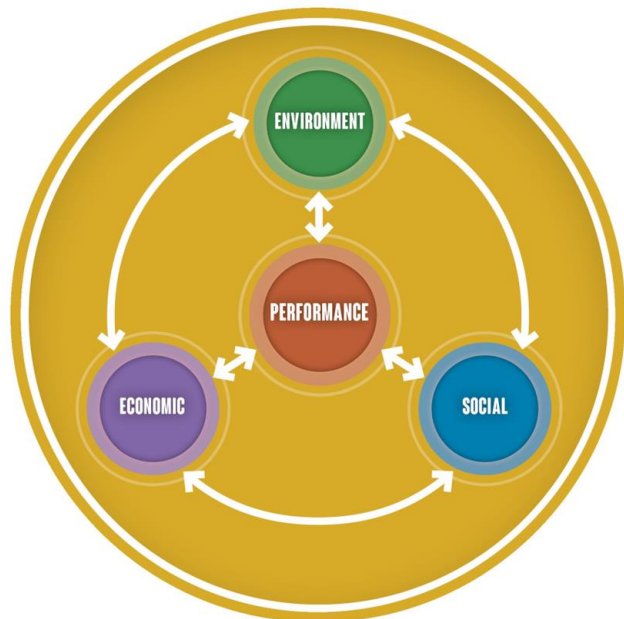
## Definition: FHWA Reference Document (Van Dam et al. 2015)

**Performance:** Achieve the engineering goals for which it was constructed

**Environment:** Preserve and (ideally) restore surrounding ecosystems

**Economy:** Use financial, human, and environmental resources economically

**Social:** Meet basic human needs such as health, safety, equity, employment, comfort, and happiness.



4

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## SUPPLY CHAIN

### UPSTREAM



### ASPHALT BINDER



### DOWNSTREAM



5

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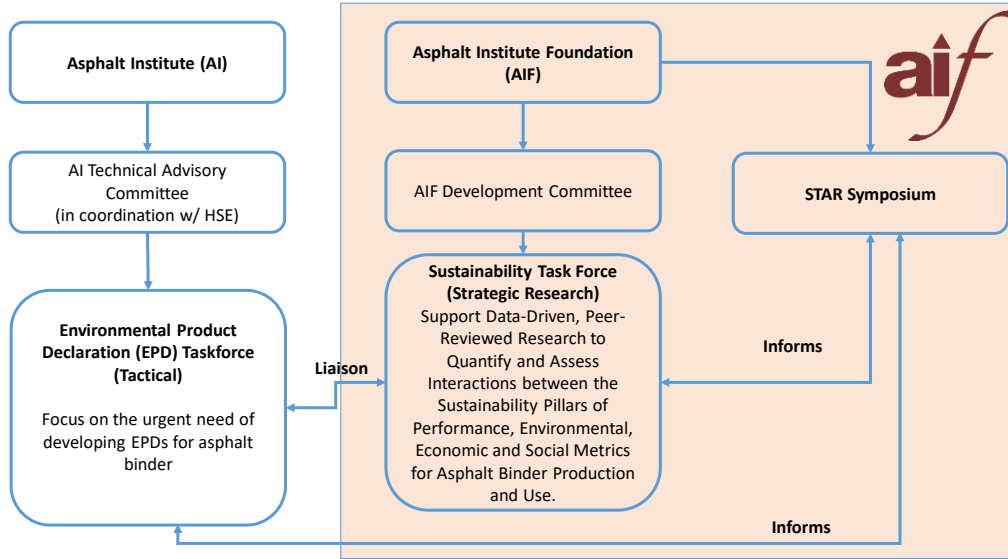
# AI and AIF Sustainability *Vision*

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# Sustainability Vision



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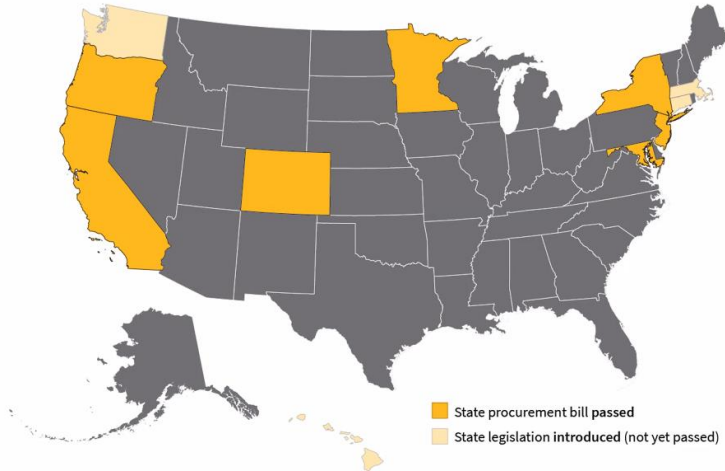
# Tactical Policies: Green Public Procurement

8

8



# Buy Clean Policies at the State Level



Information collected from state legislative websites.

Source: CLF

9

9



# IRA Sections

## Which parts relate to low carbon construction materials?

IRA Section	Agency	Funding	Purpose	Funds obligation deadline
60503	GSA Federal Buildings Fund	\$2.15B	To acquire and install materials/products for use in the construction or alteration of buildings that have substantially lower levels of embodied GHG emissions (as determined by EPA)	9/30/26
60506	DOT FHWA	\$2B	To reimburse or provide incentives (up to 2% of incremental costs) to eligible recipients for the use of construction materials/products that have substantially lower levels of embodied GHG emissions (as determined by EPA)	9/30/26
60116	EPA	\$100M	For administrative costs to develop (with GSA and DOT-FHWA) a program to identify and label construction materials/products that have substantially lower levels of embodied GHG emissions, based on EPDs and determinations by State agencies, as verified by EPA.	9/30/26
60112	EPA	\$250M	Grants and technical assistance to businesses, states, tribes and nonprofit organizations to support the development, enhanced standardization and transparency, and reporting criteria for EPDs for construction materials/products that include measurements of the embodied GHG emissions across all life cycle stages	9/30/31
50161	DOE	\$5.812B	For financial assistance for advanced technology retrofits for US industrial or manufacturing facilities that produce iron, steel, steel mill products, aluminum, cement, concrete, glass, and other energy intensive industrial processes	
	DOE	\$10B	For the 48C tax credit to expand clean technology manufacturing	
30002	HUD	\$837.5M	For direct loans and grants to improve climate resilience of affordable housing, including low- emission building materials/processes	
70006	FEMA		May provide financial assistance for costs associated with low-carbon materials	

Source: EPA

10

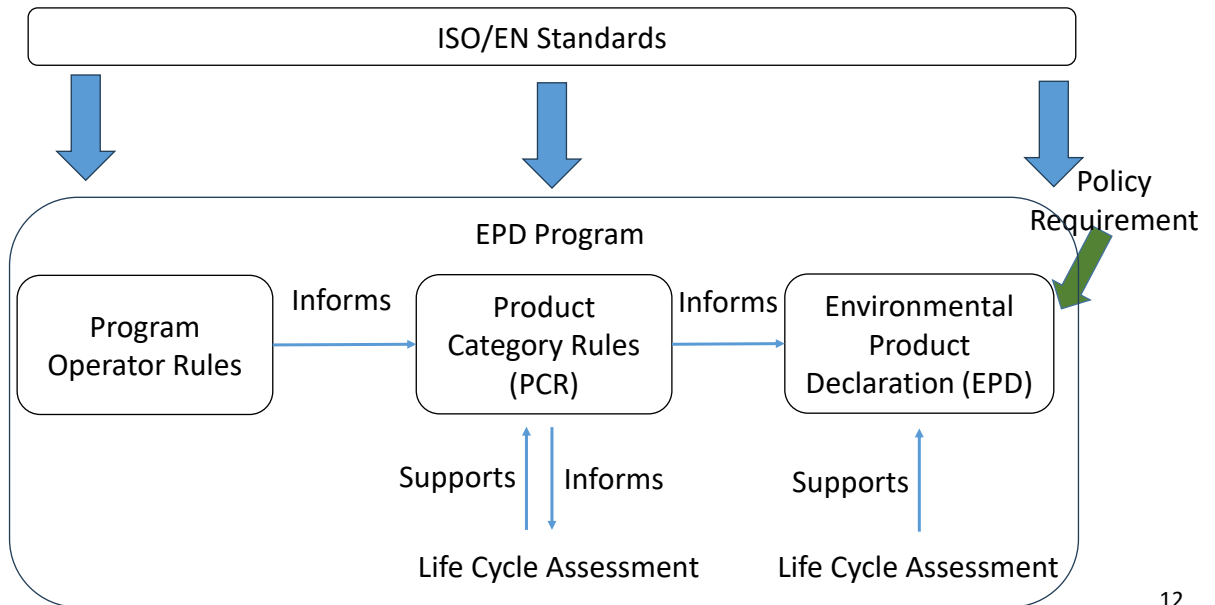
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# Tactical Industry Initiatives

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## EPD Program: An Overview

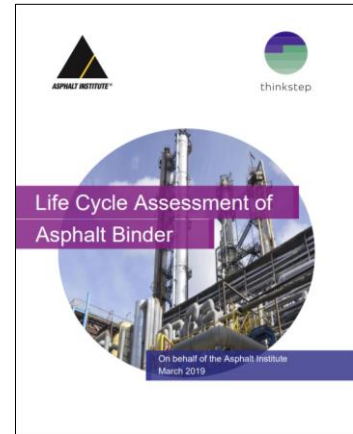


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## EPDs for Asphalt Binder: Reference LCA

- Existing Cradle to Gate Industry Average LCA for Asphalt Binder
  - Published in 2019
  - Started in 2016
  - Contracted with Thinkstep, now Sphera
  - Collected “Foreground” (process) data from 12 refineries and 10 terminals
  - Used Sphera’s “Gabi” for background data
  - Declared Unit: 1 kg of Asphalt Binder
    - Without additives
    - SBS Modified
    - GTR Modified
    - PPA Modified
- Feeds into NAPA’s Mixture EPD Tool



<https://www.asphaltinstitute.org/engineering/sustainability/life-cycle-assessment-of-asphalt-binder/>

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## AI EPD Taskforce: Mid 2022 to April 2023

- AI’s EPD Task Force Seminar (Aug 22 – March 23) - recommended path forward
  - To meet CDOT’s (and others) requirement for EPDs on asphalt by Early 2025
  - **SmartEPD** hired as Program Operator (PO)
    - Oversee PCR development in an unbiased manner
  - **Sphera** hired as LCA consultant
    - Leverage AI’s existing LCA study (published 2019) and methodology
    - Update AI’s existing LCA in accordance with the PCR
    - Develop EPD software tool for asphalt utilizing “LCA Calculator”
      - Refinery template and terminal template

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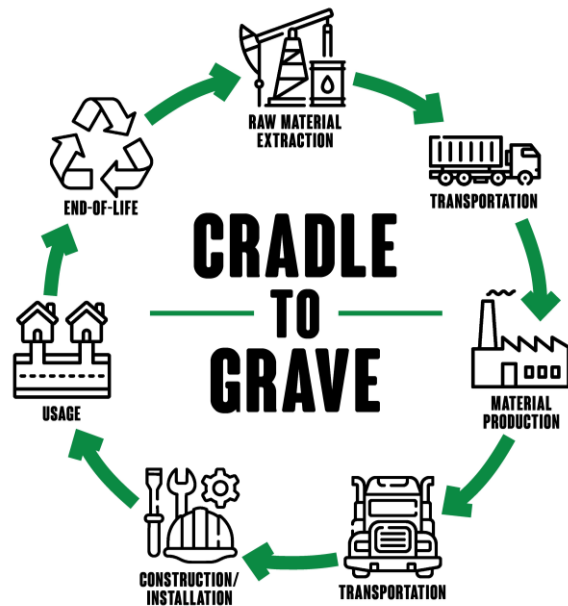
# Considerations for Path Forward

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## Promote Holistic (Entire-Life Cycle Sustainability) Approach

- What's Needed: A systematic analysis of the potential sustainability impacts (Four pillars) of products during their entire life cycle.
- Holistic Sustainability: Not just "Cradle to Gate" but Entire "Life-Cycle"

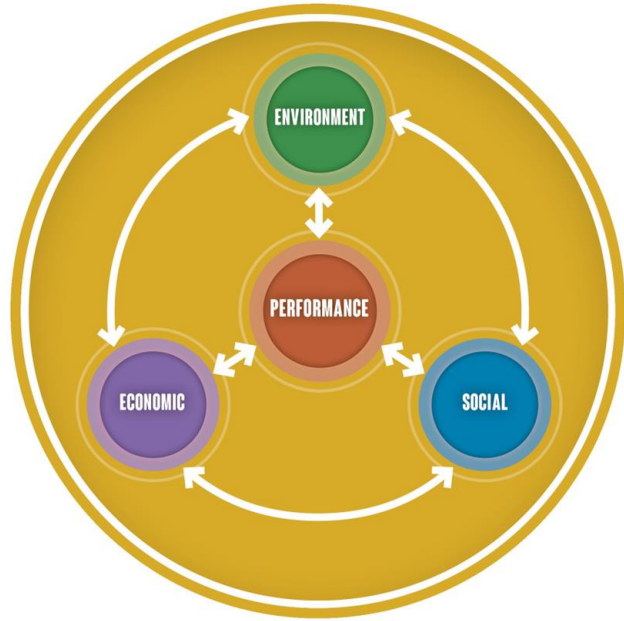


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## Balance – Multi Objective Optimization Problem

- Needed when evaluating projects/ processes between the correlated pillars
- Priorities and “Trade-Offs”
- Priorities need to be established as part of the ultimate goal of a project
  - “You cannot do everything, you must pick priorities”
- Context dependent



17

17

Thank You!

18



# Leveraging Artificial Intelligence in Asphalt Pavements: A Look at Hey NAPA



1



*Our mission:*

To advance the asphalt pavement industry through leadership, stewardship, and member engagement.

*Our vision:*

Sustainable transportation infrastructure that paves the way for thriving communities and commerce.

2

# Idaho NAPA Producer Members

## Gold Club (50+ Years)

- Idaho Materials & Construction A CRH Co.
- Poe Asphalt Paving Inc.

## Members

- Central Paving Co. Inc.
- H-K Contractors Inc., A CRH Co.
- Knife River Corp., Southern Idaho Division



3

## Leveraging AI

- Safety
- Ideation
- Logistics
- Optimization
- Training / Education



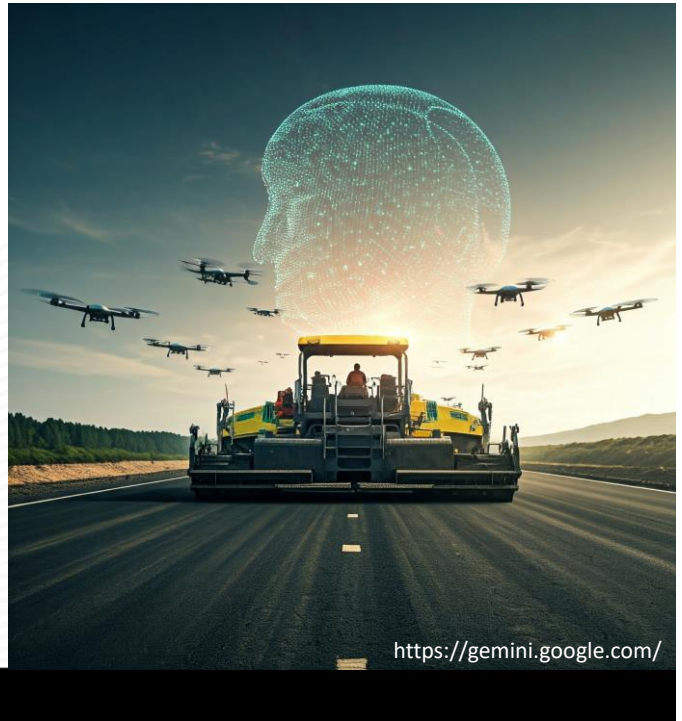
<https://gemini.google.com/>

4



# Leveraging AI

- Communication
- Meetings
- Community
- Other Areas



<https://gemini.google.com/>

5



SCAN ME



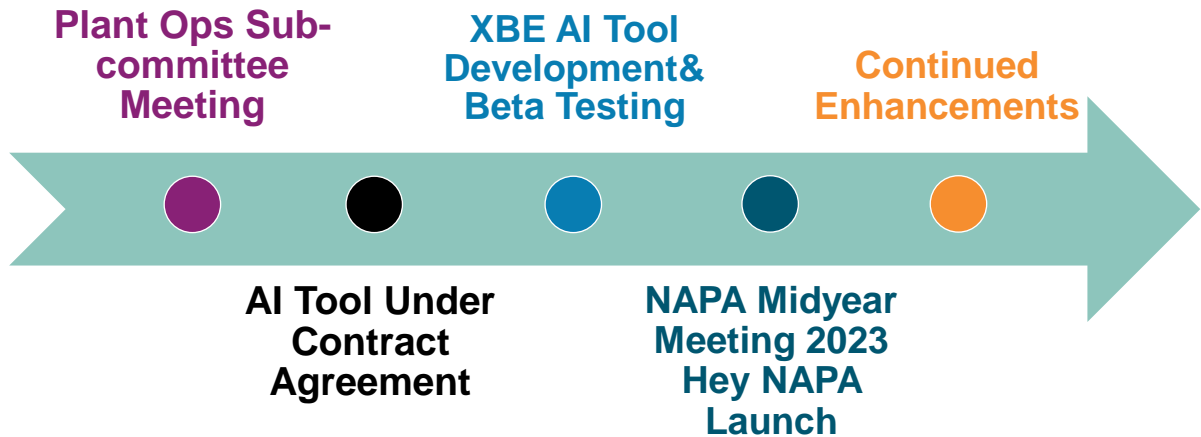
<https://heynapa.com>

Ask any asphalt pavement question.



6

# Project Timeline



7

## Idea – Contract – Development

- **Member Driven**
  - Needs
  - Partnership
- **Functional Considerations**
  - Audience
  - NAPA Store
- **Service Agreement**



8



## Continued Enhancements

- **Enhanced UI**
  - **Collapsible References**
  - **Font/Text, Buttons, etc.**
- **Custom Instructions**
  - **Add context like name, location, & preferences**
- **Image Support**
  - **Prompt or question pictures**

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## Some Key Features

- **References First**
  - **Single-click access to all PDF's (Full document and exact pages)**
- **Static Chat URL's**
  - **Ease of sharing/citing**
- **Contextual Awareness/Multilingual**
  - **Conversational**

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# Hey NAPA



**2,100**  
Users



**29,000**  
Pages



**15,000+**  
Chats



## Prompt Engineering



- **Clarity and Specificity**
- **Ambiguity leads to imprecision**
- **Desired Output / Format**
- **Streamlining communication**
- **Iteration and Experimentation**
- **Phrasing and Structure**
- **Be Creative**

### 6 EFFECTIVE PROMPTING TECHNIQUES TAILORED TO HEY NAPA & THE ASPHALT PAVEMENT INDUSTRY

#### 1 Contextual Clarity (Explicit Instructions)

- Imagine you're placing asphalt on a project. Just as you'd specify the layer thickness and compaction requirements, be explicit in your prompts to Hey NAPA.
- Instead of asking, "How do I improve pavement durability?" try, "What are recommended compaction levels for interstate asphalt pavement surface layers that serve high-traffic volumes in the cold-west region of the United States?"
- By providing context and clear instructions, Hey NAPA can better understand your query and offer more precise answers.

#### 2 Role Definition

- Think of Hey NAPA as your seasoned asphalt expert. When you approach an industry expert on-site, you wouldn't say, "Tell me everything about asphalt." Instead, you'd ask specific questions related to your role.
- For instance, if you're a quality control engineer, prompt Hey NAPA with, "As a quality control engineer, can you share with me what material properties can be monitored to help ensure quality asphalt mix production beyond the compliance requirements of the owner agency?"
- Defining your role ensures Hey NAPA tailors its responses to your expertise level.

#### 3 Formatting Request

- Just as you'd request asphalt mixture test results in a specific format (say, in specific units or reported to a set level of significant figures), ask Hey NAPA for information in a structured manner.
- Instead of a vague query like, "Tell me about asphalt binder," try, "Provide a list of 4 commonly used Performance Graded (PG) asphalt binders and include a concise comparison of these products."
- Specific formats lead to more focused, relevant answers.

#### 4 Content Limitation

- Just as a paving project can limit the length and/or time window of a lane closure to minimize the disruption to traffic, consider content limitations for Hey NAPA.
- Specify guardrails to avoid overly complex or irrelevant answers.
- For instance, you might prompt, "Concisely compare Steel Wheel Rollers and Pneumatic Tire Rollers in the compaction of asphalt pavements, focus on the impact each roller type has on the final pavement density and surface texture."
- By setting these limitations, you ensure relevant and actionable responses.

#### 5 Practical Examples

- Asphalt professionals thrive on real-world scenarios. Hey NAPA appreciates practical examples too!
- Instead of a theoretical question like, "What's the impact of air voids on asphalt performance?" try, "We are measuring excess in-place air voids on a pavement resurfacing project, can you explain how this could affect rutting resistance in the asphalt pavement surface layer?"
- Real-world examples resonate better and enhance understanding.

#### 6 Conversation Flow (Follow-up Questions)

- Real-world project discussions often involve back-and-forth dialogues. Hey NAPA can handle it!
- After receiving an answer, follow up: "Interesting! Can you elaborate on...?"
- Conversations allow you to dig deeper and explore nuances.

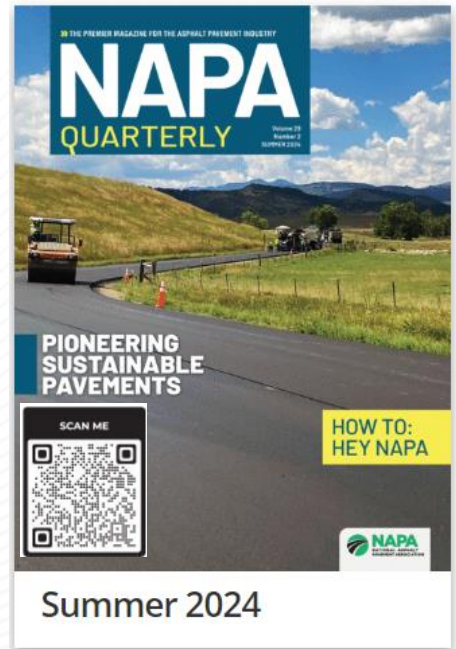


For more details and to learn more about Hey NAPA, visit [AsphaltPavement.org/HeyNAPA](https://AsphaltPavement.org/HeyNAPA).



## Additional Resources

- **Unlocking Co-Intelligence Article**
- <https://www.asphaltpavement.org/heynapa>
  - **FAQ's**



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## Top Keywords – Hey NAPA Use

- **Asphalt Production:** The process of producing asphalt mixtures.
- **Hot Mix Asphalt:** Traditional asphalt mixture produced at high temperatures.
- **Balanced Mix Design:** A method of designing asphalt mixtures that considers both performance and cost.
- **Best Practices:** Could refer to recommended methods in various asphalt-related processes.
- **Hey NAPA:** Direct references to the chatbot or possibly the National Asphalt Pavement Association.
- **Asphalt Binder:** The sticky, black, and highly viscous liquid or semi-solid form of petroleum used in asphalt.

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## Popular Topics – Hey NAPA Use

- **Industry Operations and Training:** asphalt, industry, training, production, paving, reduction, plant, development, process, curriculum
- **Mix Design and Materials:** asphalt, mix, explanation, paving, plant, pavement, design, warm, concrete
- **Technical Aspects and Standards:** napa, asphalt, air voids, explanation, ideal values
- **Best Practices and Specific Techniques:** best practices, explanation, sma, tack coat, meaning, mix, rap
- **Pavement Performance and Research:** pavement, definition, understanding, impact, research, hma, rap, vma, performance

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Welcome to Hey NAPA

## What asphalt pavement questions can I answer for you?

Hey NAPA, I'm working on a presentation titled "Leveraging Artificial Intelligence in Asphalt Pavements: A Look at Hey NAPA." Could you provide an overview of the most effective ways users in the asphalt industry can harness your capabilities? Specifically, I'm looking for real-world use cases or examples where you've enhanced processes such as data analysis, technical support, or training. I'd also appreciate tips on how to illustrate these methods visually for an audience who may not be familiar with AI tools.

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## Leveraging Hey NAPA

1. Access to Industry Knowledge
2. Troubleshooting and Problem Solving
3. Training & Skill Development
4. Continuous Improvement
5. Regulatory and Compliance Support

19



Do you have access to regulatory requirements so that you are able to verify compliance?

Hey NAPA, as an AI assistant, doesn't have direct access to regulatory databases or the ability to verify compliance with regulatory requirements. However, I can provide on where to find relevant regulatory information and suggest best practices based on industry standards. For specific compliance verification, it's recommended to consult local regulatory bodies or utilize specialized software that can integrate regulatory requirements into your operational processes.

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Please explain how "Hey NAPA can be used to quickly verify compliance requirements"

### Referenced Documents (6)

Answers are supported by relevant documents. Click on here to explore them.



To clarify, Hey NAPA itself does not have the capability to directly verify compliance requirements in the way that specialized compliance software or regulatory databases might. However, Hey NAPA can assist users in the asphalt industry to quickly find information and resources that are pertinent to understanding and meeting compliance requirements. Here's how:

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### 1. Guidance on Regulatory Resources:

- a) Ex: Inquiry on silica exposure → OSHA standards & NAPA publications

### 2. Best Practices and Compliance Strategies:

- a) Ex: Tips on documenting process or maintain records of environmental compliance

### 3. Access to NAPA Publications:

- a) Ex. Link to access/download applicable report

### 4. Connecting with Experts:

- a) Ex. Point user to NAPA VP, Environment, Health, & Safety

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Welcome to Hey NAPA



I took this picture while visiting a plant site. Can you tell me what you see?



23



Certainly! The image likely shows an asphalt plant with a conveyor. The conveyor belt appears to be moving Reclaimed Asphalt Pavement (RAP) to the mixing drum. Additionally, large vertical structures in the image are likely silos for storing raw materials like aggregates or asphalt binder. The setup is part of the asphalt production process, where materials mixed and prepared for paving projects.

Do you see opportunities to possibly improve energy efficiency?

24



## Referenced Documents (13)

Answers are supported by relevant documents. Click on here to explore them.

- [Teaming Up to Save Energy](#)
  - [Teaming Up to Save Energy - Page 1](#) **86%**
  - [Teaming Up to Save Energy - Page 12](#) **84%**
  - [Teaming Up to Save Energy - Page 30](#) **83%**
  - [Teaming Up to Save Energy - Page 26](#) **83%**

25



Certainly! In an asphalt plant setting, numerous opportunities can be explored to improve energy efficiency. Here are several strategies based on best practices in the industry:

1. **Regular Equipment Maintenance:** Ensure all equipment, including conveyors, mixers, and burners, are well-maintained to prevent energy loss due to wear and tear or misalignment.
2. **Variable Frequency Drives (VFDs):** Install VFDs on motors to adjust speed based on demand, which can lead to significant energy savings, especially in conveyors and fans.

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3. **Insulation:** Insulate hot oil lines, storage tanks, and other heat-related equipment to reduce heat loss and maintain optimal temperatures with less energy.
4. **Lighting Efficiency:** Upgrade to LED lighting and install motion sensors or timers to ensure lights are only on when necessary.
5. **Compressed Air System Optimization:** Identify and repair leaks in the compressed air system, and ensure the system is properly sized and maintained to avoid unnecessary energy consumption.
6. **Optimizing Burner Efficiency:** Regularly tune the burners to ensure efficient fuel use and to reduce excess emissions.

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7. **Heat Recovery Systems:** Implement heat recovery systems where possible, such as using waste heat from the exhaust to preheat aggregates or other materials.
8. **Operational Procedures:** Train staff on energy-efficient operational practices, such as shutting down equipment when not in use and optimizing production schedules to reduce idle times.
9. **Alternative Fuels:** Consider the use of alternative fuels that might offer energy savings or reduced emissions, ensuring compliance with local regulations.
10. **Energy Monitoring and Audits:** Continuously monitor energy use and conduct regular energy audits to identify inefficiencies and areas for improvement.

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11. **Automation and Controls:** Implement advanced control systems to optimize plant operations, including temperature control and material flow, based on real-time data.

By focusing on these areas, an asphalt plant can significantly enhance its energy efficiency, leading to cost savings and a reduced environmental impact.

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## Pave It Black

- **Season 8 Episode 3**
  - **Luke Kotz, Manatts, Inc.**
  - **People, process, then technology: Unlocking operational efficiencies with AI**
- <https://www.asphaltpavement.org/podcast>

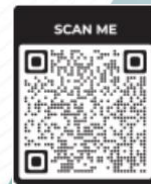


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» YOUR PERSONALIZED INDUSTRY NEWS ROUNDUP

# NAPA NEWSBRIEF

- Emailed Industry News Roundup
- Powered by Artificial Intelligence
- Free to sign up, manage all NAPA Subscriptions in one place



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# Questions?

**Brett Williams**

[bwilliams@asphaltpavement.org](mailto:bwilliams@asphaltpavement.org)

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# Aging of Asphalt Mixtures for Balanced Mix Design



Nathan Moore  
October 24, 2024



1

## Background

- Cracking is the primary mode of distress in asphalt pavements
- Many state DOTs are interested in balanced mix design (BMD) to abate cracking issues while maintaining good rutting performance
- Mixture conditioning/aging is critical for performance testing
  - Rutting tests: short-term aging
  - Cracking tests: long-term aging
- AASHTO R 30
  - Short-term aging: 2 hours at  $T_c$  for volumetric mix design; 4 hours at  $135^{\circ}\text{C}$  for performance testing (**under revision by AASHTO COMP**)
  - Long-term aging: 5 days at  $85^{\circ}\text{C}$  on compacted specimens (**Needs work...**)

2


2

# Asphalt Mixture Aging


- Crucial in evaluating cracking resistance of surface mixes
  - Top-down cracking, thermal cracking
- Cracking does not occur right after construction; instead, it starts to develop after several years in service
- Asphalt binders do not age at the same rate
  - Binder source (chemical composition)
  - Binder grade
  - Recycled asphalt binders
  - Asphalt additives (polymer, warm mix asphalt, liquid anti-strip, etc.)

3

3



**Final Report  
Available Below**



4



**Validation of Loose Mix Aging  
Procedures for Cracking  
Resistance Evaluation in  
Balanced Mix Design**

Fan Yin, Principal Investigator  
National Center for Asphalt Technology  
Auburn University

NOVEMBER 2023

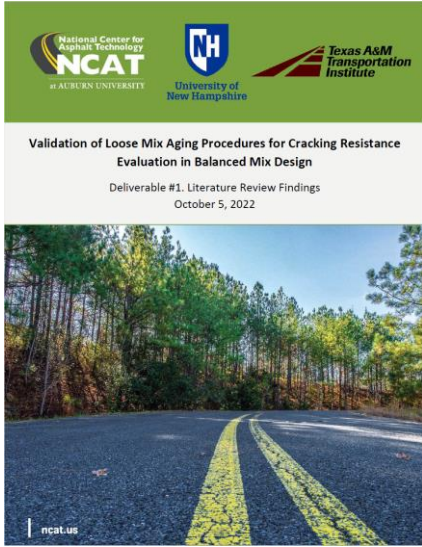
Final Report NRRA202308



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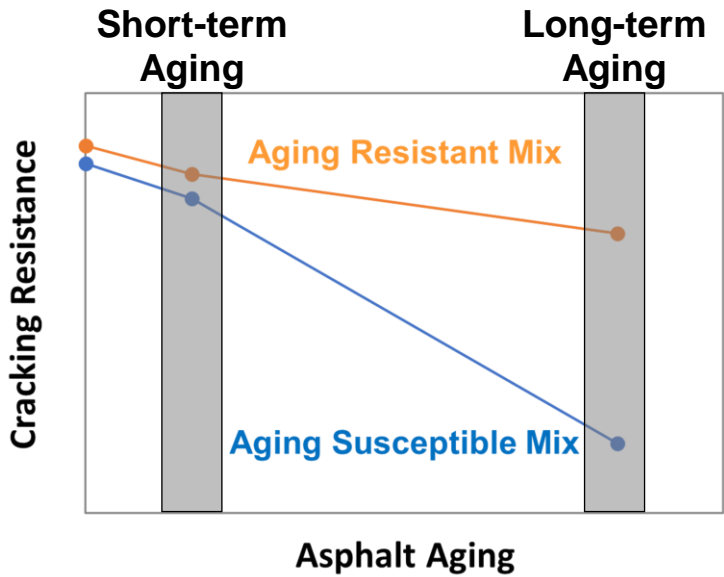
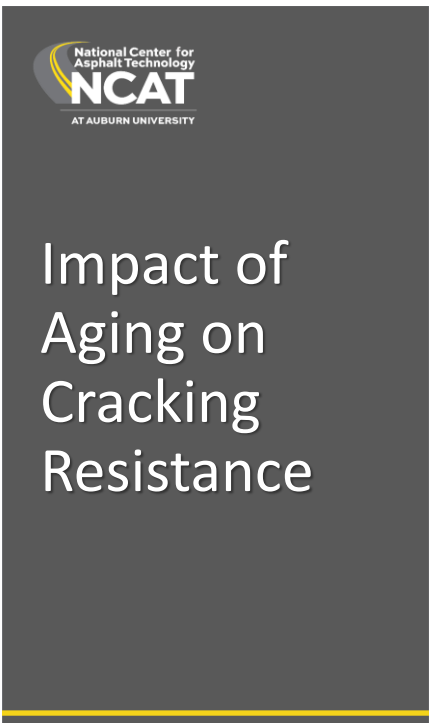
# Research Gap Analysis



1. Lab-to-field aging correlation
2. Applicability to asphalt mixtures containing additives
3. Performance tests and parameters suitable for assessing loose mix aging
4. Implementation into BMD

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# Existing Long-term Aging Methods

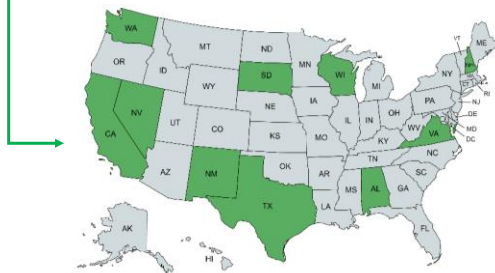
- AASHTO R 30: 5 days at 85°C on compacted specimens
  - Not severe enough
- Loose mix aging vs. compacted specimen aging
  - Accelerated aging
  - Not susceptible to aging gradient and specimen distortion issues
- Selected loose mix aging methods
  - Field aging maps at 95°C (NCHRP 09-54)
  - 6 to 8 hours at 135°C (NCAT, UW-Madison)
  - 20 hours at 100 to 125°C (TTI)
- How to incorporate loose mix aging into BMD cracking evaluation?

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## 1. Lab-to-field Aging Correlation

Loose Mix Aging Procedure	# Mixtures with Lab-to-field Aging Data	# Field Projects with Lab-to-field Aging Data
Aging at 85°C	4	1
Aging at 95°C	Over 35	10
Aging at 100-125°C	None	None
Aging at 135°C	12	5



NCHRP 9-54: a series of aging maps

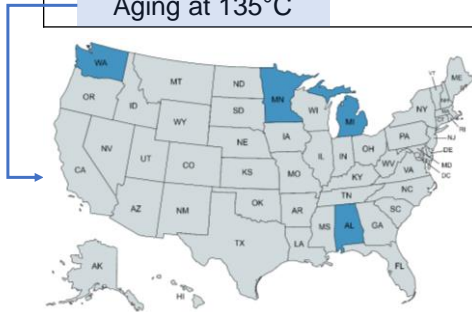
- Pavement location
- Field aging time
- Pavement depth

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# 1. Lab-to-field Aging Correlation

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Aging at 135°C	12	5



NCAT: 8 hours at 135°C = 5 to 6 years of surface field aging (top 1 inch) on the NCAT Test Track

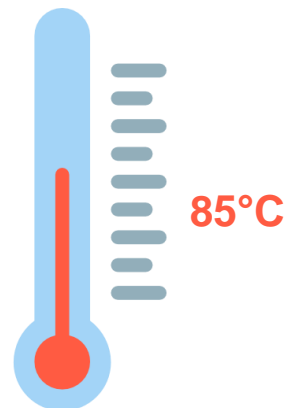
**“Critical Aging”**

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## Loose Mix Aging for 5 Days at 85°C

- Developed in NCHRP 09-52A at TTI
- Expected to simulate 114,000 cumulative degree days (CDD) of field aging for surface mixtures
  - 7 to 10 years in warmer climates
  - 12 to 14 years in cooler climates

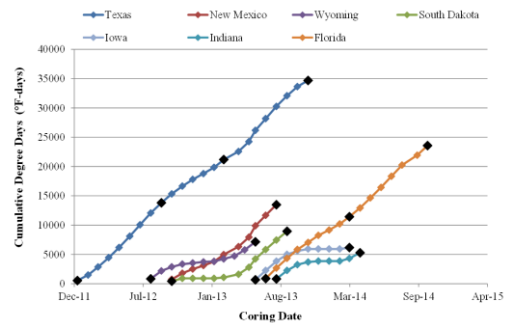
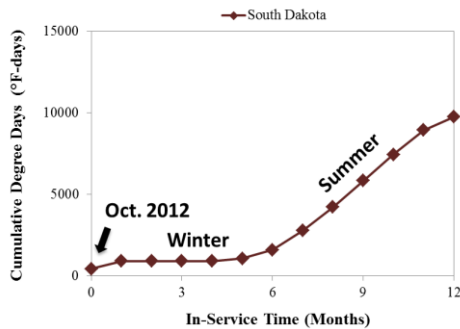


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# What is CDD?

- Defined as sum of the daily high temperature above freezing for all the days from time of construction to the time of core sampling
- A simple climate index to “normalize” the field aging of projects with different construction seasons and geographic locations

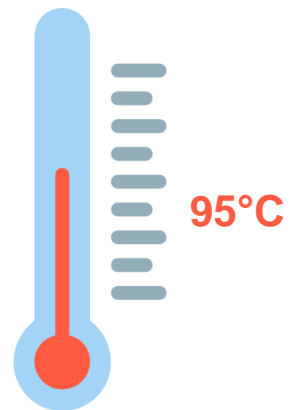


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# Loose Mix Aging at 95°C

- Developed in NCHRP 09-54 at NCSU
- A series of aging maps for field correlation
  - Pavement location
  - Field aging time
  - Pavement depth
- Aging time varies from 0.1 to 32 days
- Validated with 30 mixtures
  - Further validation needed for RAP mixtures

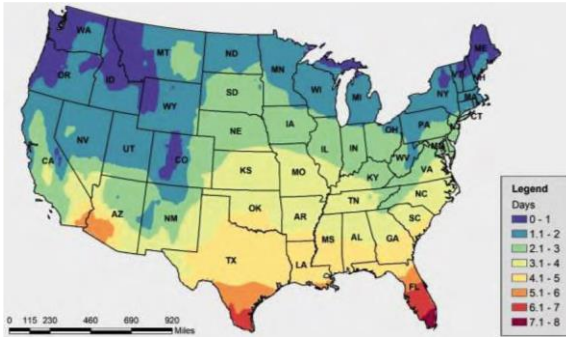


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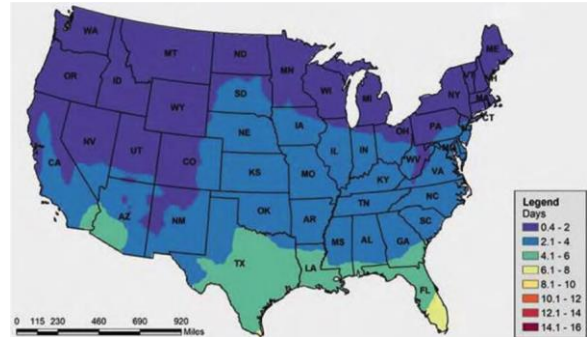
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# NCHRP 09-54 95°C Loose Mix Aging Maps

**4 Years of Field Aging  
6 mm below Pavement Surface**



**8 Years of Field Aging  
30 mm below Pavement Surface**



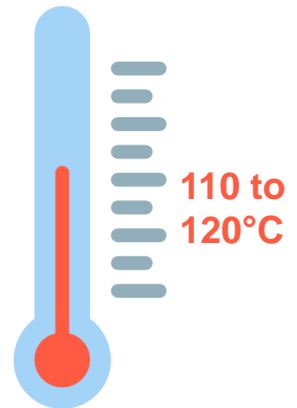
(Kim et al., 2021)

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## Loose Mix Aging for 20 Hours at 110-120°C

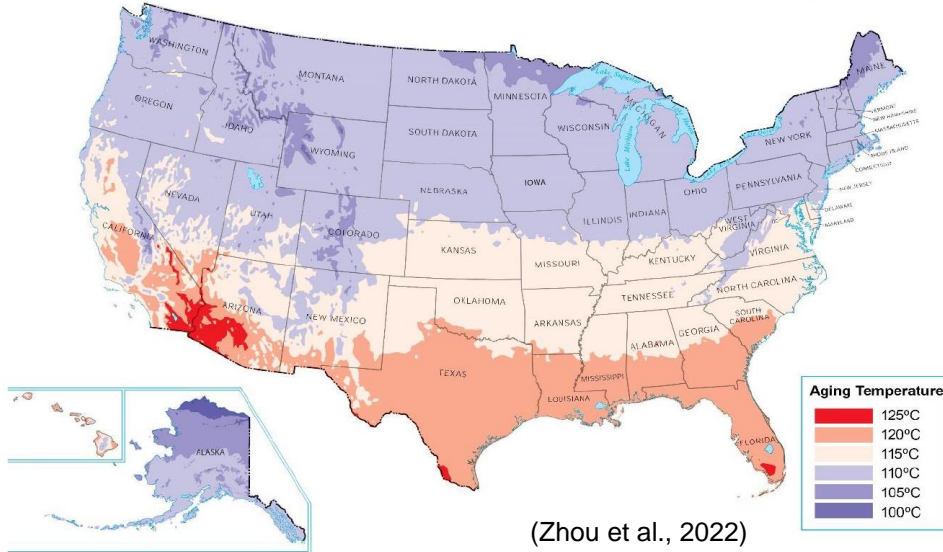
- Developed in at TTI
- Equivalent to 6-day, 95°C loose mix aging in terms of impact on mixture cracking resistance (measured in IDEAL-CT, I-FIT, and OT)
- Expected to simulate 12 years of field aging at 50 mm below pavement surface
- Correlation developed based on IDEAL-CT results (7 mixtures)
- No field validation yet
- Focused on simplicity and efficiency



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## 20-hour Loose Mix Aging Map

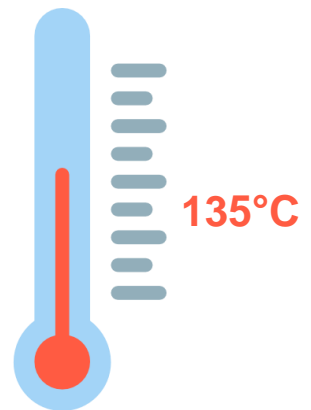


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## Loose Mix Aging at 135°C

- First evaluated at UIUC (and then at AI, MTE, NCAT, UNH, UW-Madison, etc.)
- Aging time varies from 6 to 24 hours
- Lab-to-field aging correlation
  - MTE: 24-hour, 135°C > 6 years of surface aging in Minnesota (3 mixtures from MnROAD)
  - NCAT: 8-hour, 135°C ≈ 5 to 6 years of surface aging in Alabama (4 mixtures from Test Track)
- Limitations
  - Change in oxidation mechanism (for certain binders)
  - Thermal degradation of SBS in HiMA binder



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## 2. Applicability to Mixtures containing Additives

- Use of asphalt additives
  - Historical efforts focus on improving pavement performance
  - Increasing interest in using additives for sustainability benefits



- Potential impacts on asphalt aging susceptibility
- Thus, crucial to consider aging when evaluating the cracking resistance of mixtures containing additives

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## 3. Performance Test to Assess Loose Mix Aging

What lab tests should we use?

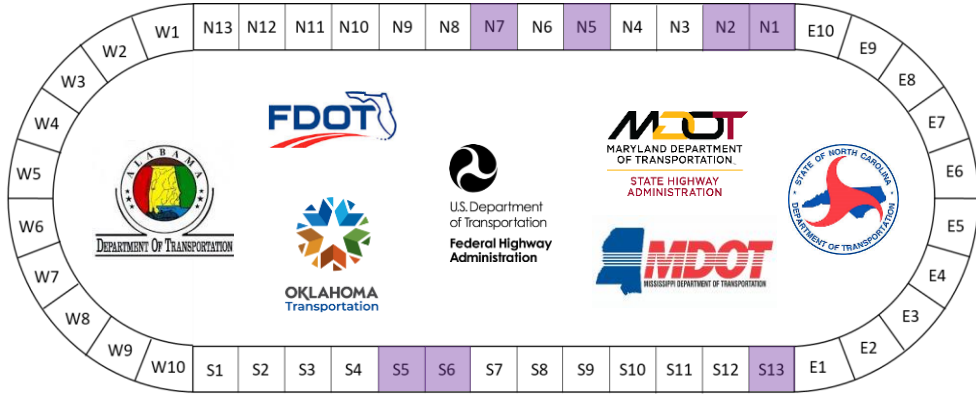
What criteria should we set?

What aging condition should we use?



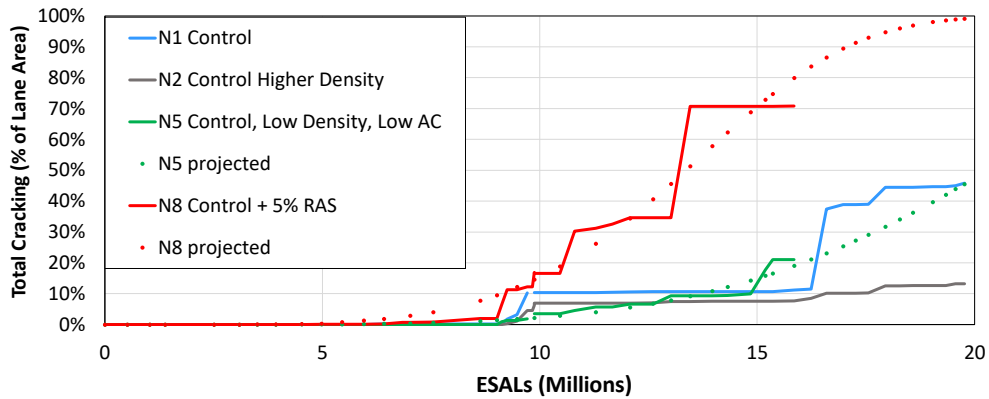
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# 2015-2021 NCAT Cracking Group Experiment



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# Progression of Cracking



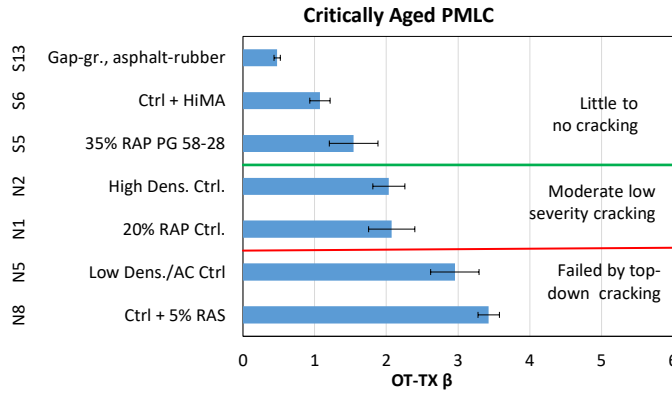
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# Texas Overlay Test (Tex-248-F)



OT-TX



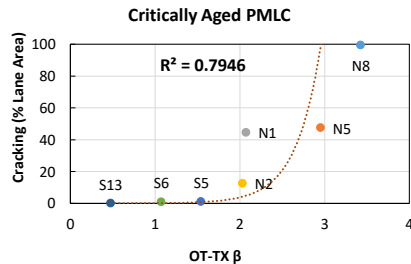
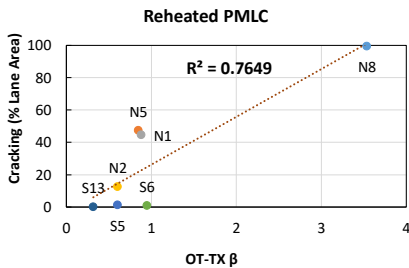
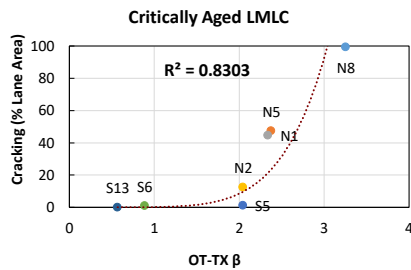
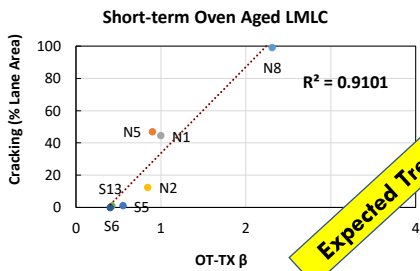
Sorted from best to worst field cracking performance

lower  $\beta$  = better cracking resistance



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## Correlations of Texas Overlay Test Results to Cracking on the Test Track

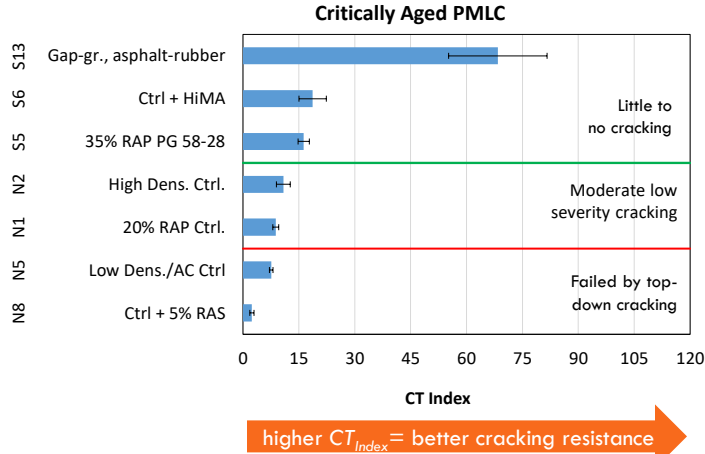


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# IDEAL-CT Test (ASTM D8225-19)

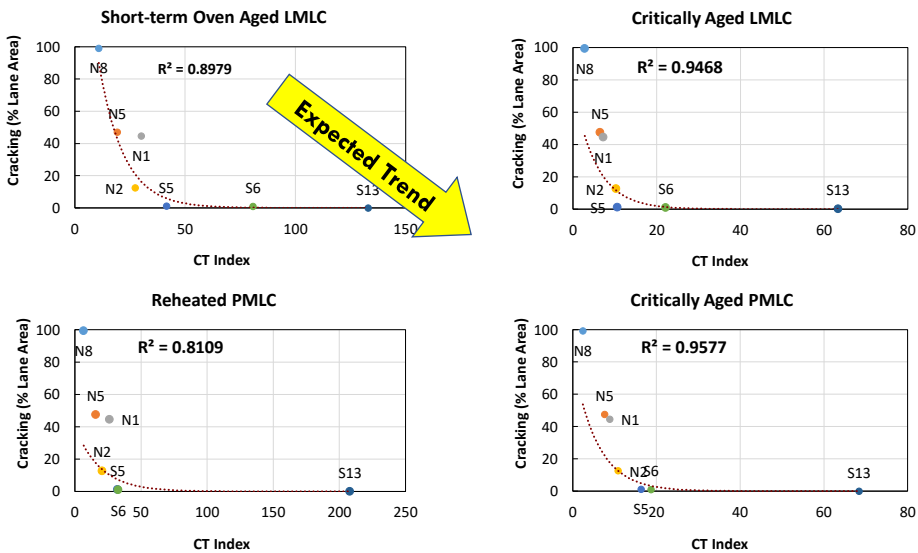


IDEAL-CT



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## Correlations of IDEAL-CT Results to Cracking on the Test Track



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## Cracking Group Experiment Takeaways

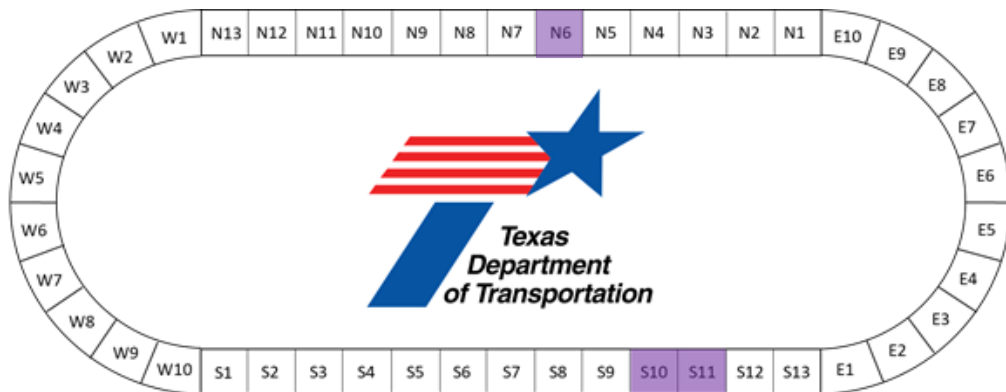
- IDEAL-CT and Overlay Test best discrimination between mixes' lab results and field performance
  - Are we trying to predict or screen out mixes?
- NCAT set preliminary lab thresholds as a result of this work
- Aging had expected effects on mixes
- Mixes maintained their relative ranks well in both aging conditions

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## Current NCAT Test Track Example

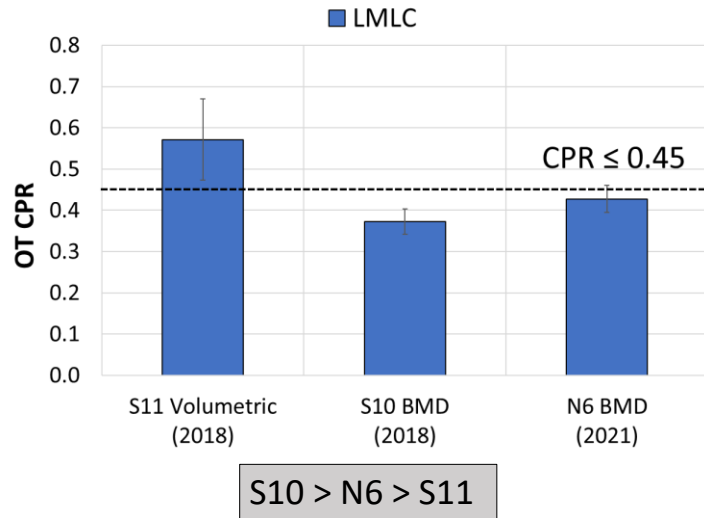


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# Design Performance Test Results

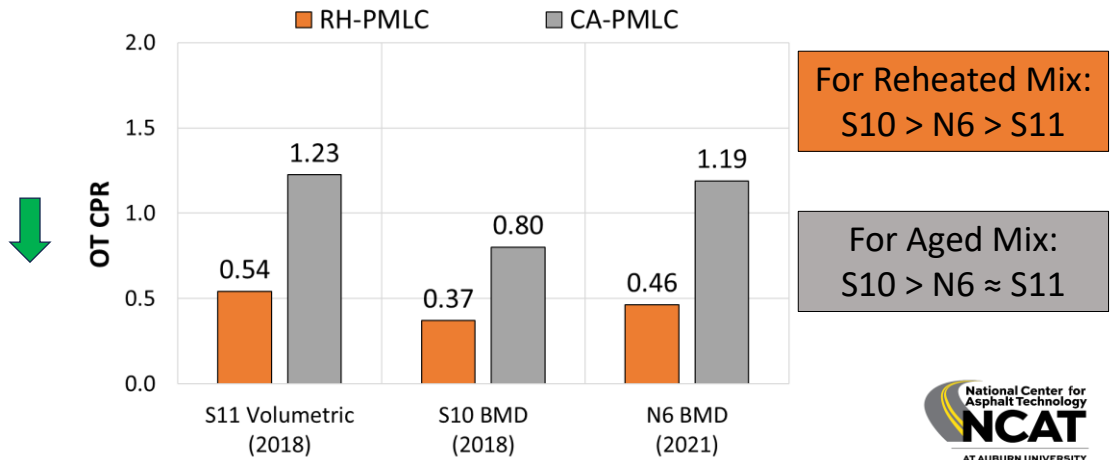
↓ Better cracking resistance



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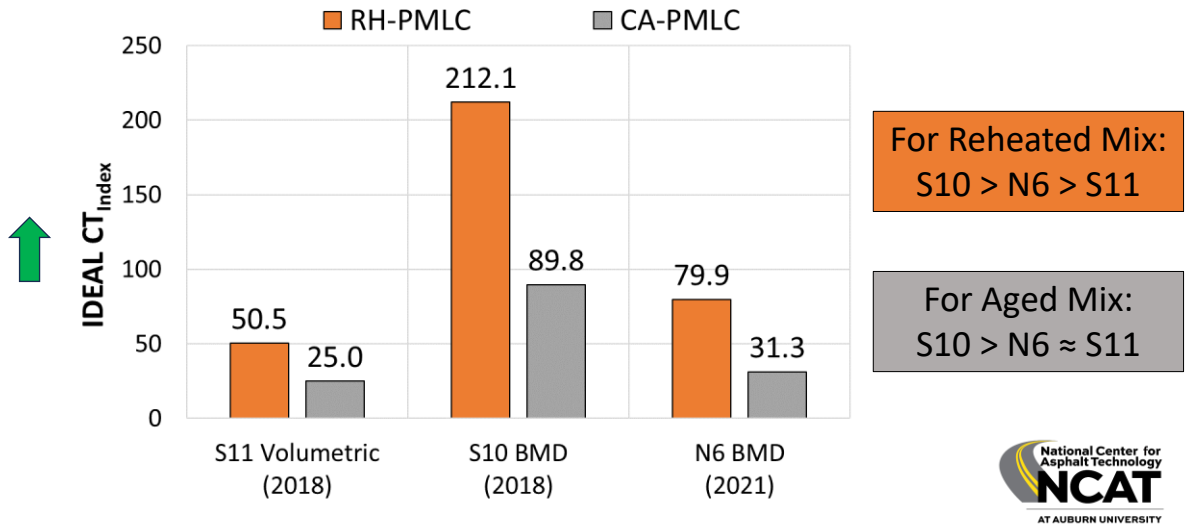
# Production OT Results

Critical aging: 8 hours at 135°C (loose mix)



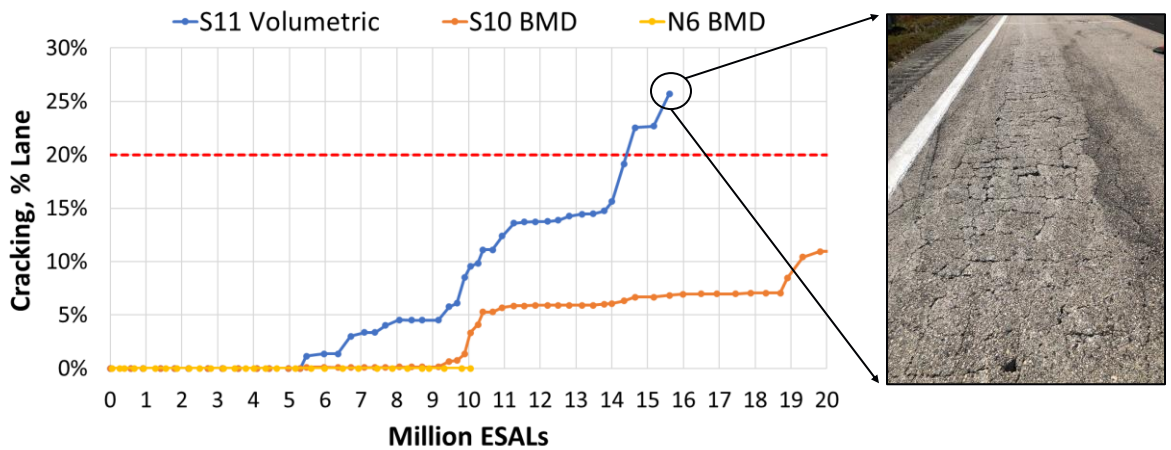
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# Production IDEAL-CT Results



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# Field Cracking



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# 4. Implementation into BMD

Loose Mix Aging Procedure	Advantages	Disadvantages
Aging at 85°C	Similar to AASHTO R 30	1) Long duration 2) Very limited field validation
Aging at 95°C	Robust field validation	Long duration
Aging at 100-125°C	1) Short duration 2) Lab operations-friendly	1) Potential chemistry change 2) No field validation
Aging at 135°C	Short duration	1) Potential chemistry change 2) Very limited field validation

## Time vs. Temperature

### Tradeoff between accuracy and practicality

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# 4. Implementation into BMD

- How accurate is accurate enough?
- It depends...is BMD intended to
  - Predict pavement performance?
  - Screen poor-performing mixes from design and production?
- Asphalt Institute article



**LAB CORNER**

**Having it all?**

It mostly comes down to the usual suspects - time and temperature.

Source	Temperature	Duration
AASHTO R 30 (2003)	85°C (185°F)	16 hours
ASTM D 2922 (2003)	100°C (212°F)	16 hours
ASTM D 2922 (2003)	125°C (257°F)	16 hours
ASTM D 2922 (2003)	135°C (275°F)	16 hours

**Model 3: Loose Mix Long-Term Conditioning Options for Asphalt Mixtures**

Asphalt Institute article content...

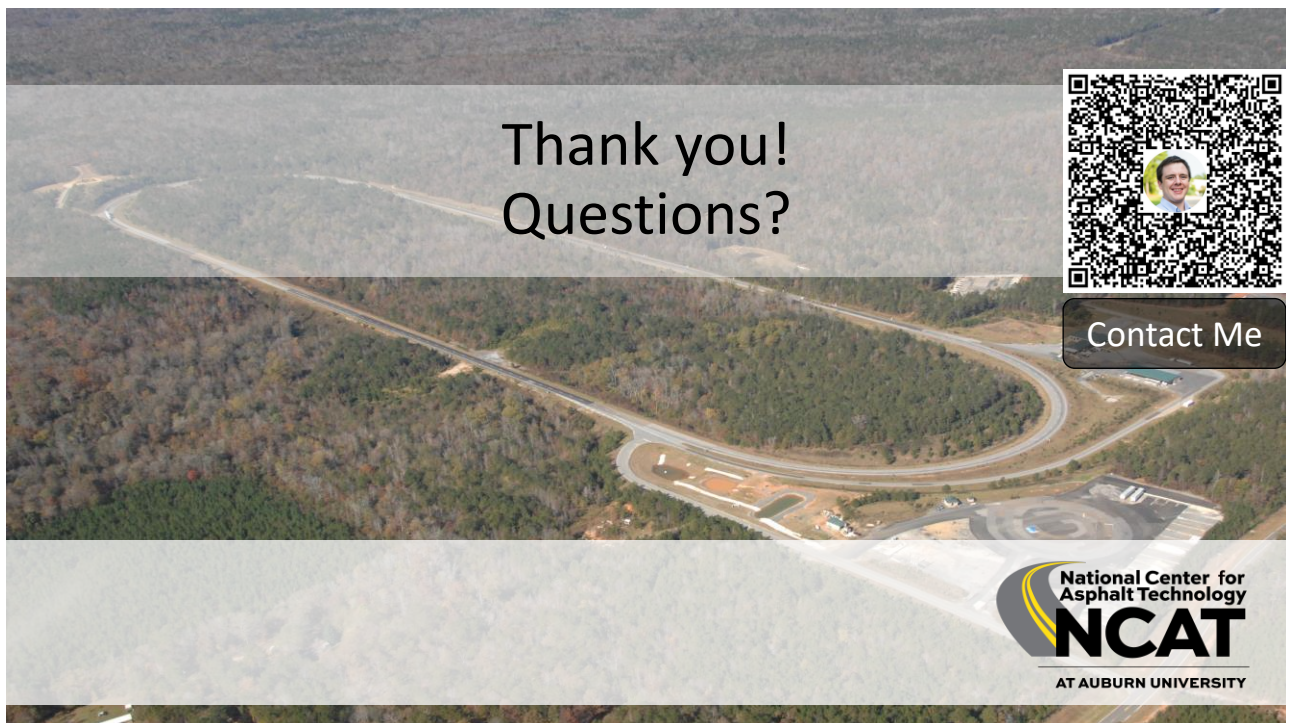
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# There's more to come!


- Proposed new AASHTO standard practice on long-term aging
  - R30 on short-term aging only
  - Method A: compacted specimen aging for 5 days at 85°C (LA)
  - Method B: loose mix aging for 5 days at 85°C
  - Method C: loose mix aging at 95°C
  - Method D: loose mix aging for 20 hours at 100 to 125°C (possibly OH)
  - Method E: loose mix aging for 6 or 8 hours at 135°C (WI)

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Thank you!  
Questions?



Contact Me

National Center for  
Asphalt Technology  
**NCAT**  
AT AUBURN UNIVERSITY

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