Balanced Mix Design
An Overview

Randy West, Ph.D., P.E.
Director, National Center for Asphalt Technology

BMD – a definition

An asphalt mix design that uses practical performance tests on appropriately conditioned specimens to ensure resistance to common distresses and considers mix aging, traffic, climate and location within the pavement structure.

Why change?

Most asphalt technologists are not satisfied with the current long term performance of our pavements. There is a desire to significantly improve the life of asphalt pavements.

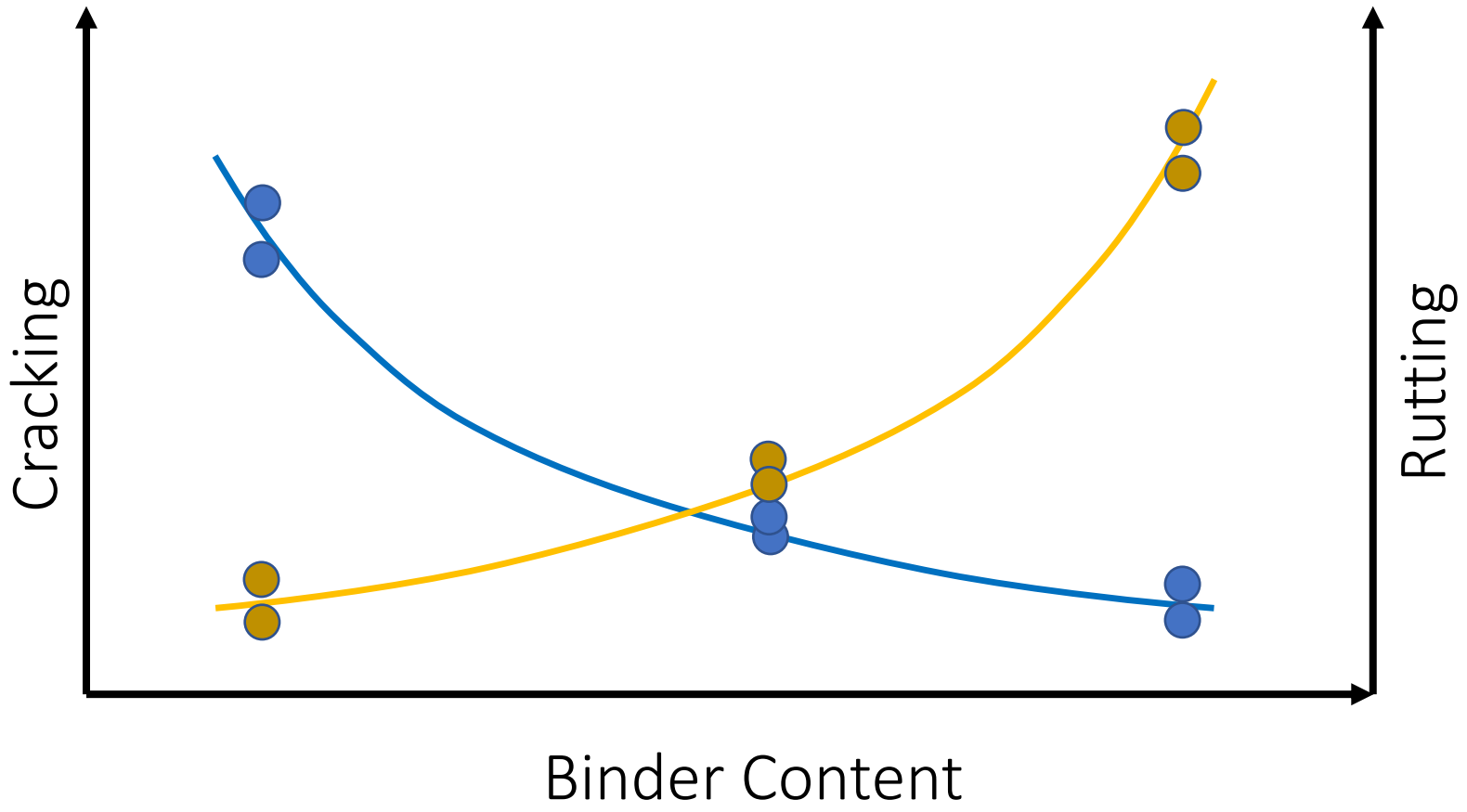
Why change?

- Volumetric properties do not tell us anything about the *quality* of the binder, or about the interactions of different binder components and additives.
- V_{be} is dependent on G_{sb} which is not a reliable property
  - G_{sb} of source materials are subject to change over time, but not often verified.
  - G_{sb} has a low level of precision
  - G_{sb} of RAP aggregate is questionable

With the current volumetric mix design system…

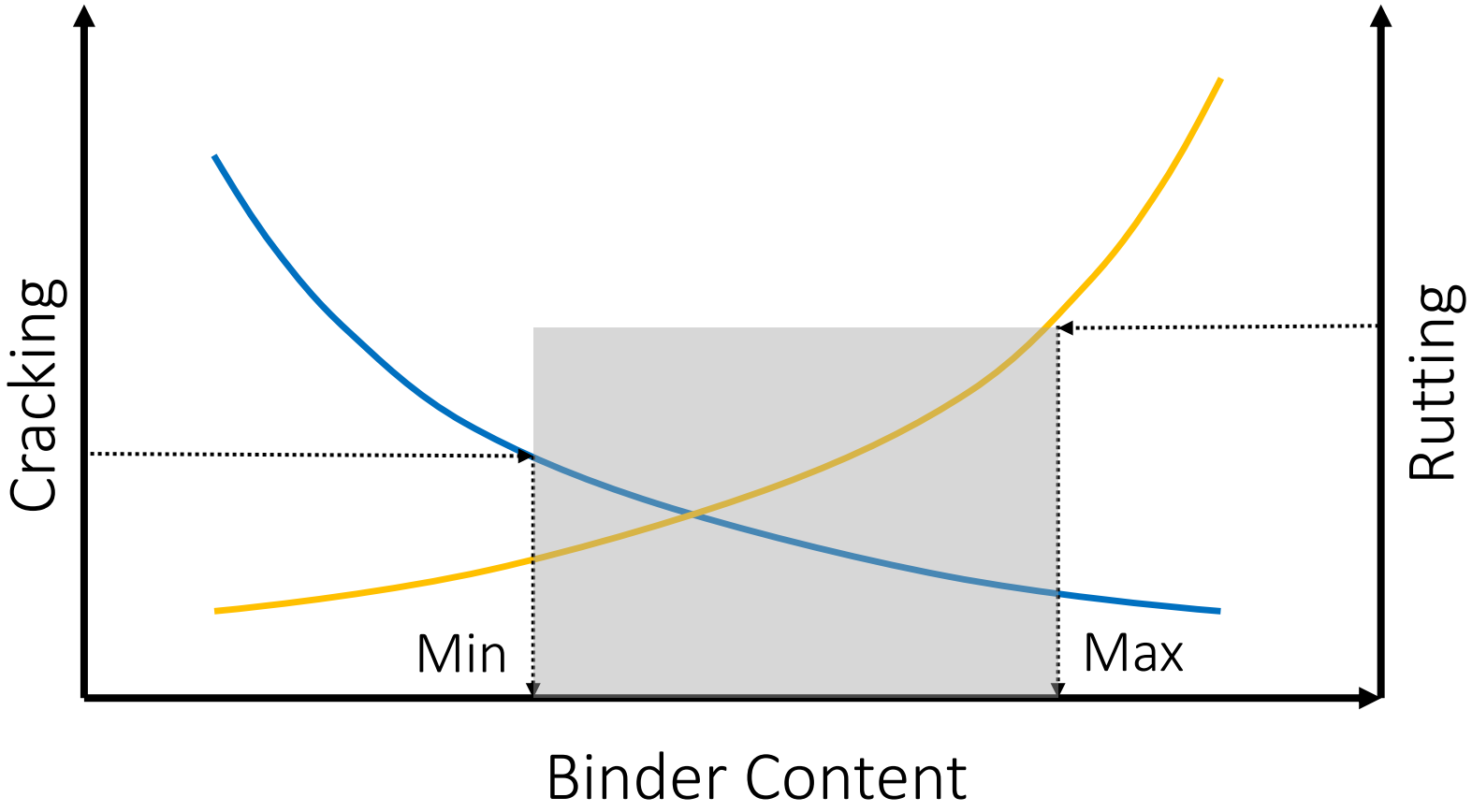
Balanced Mix Design

BMD Optimum Asphalt Content



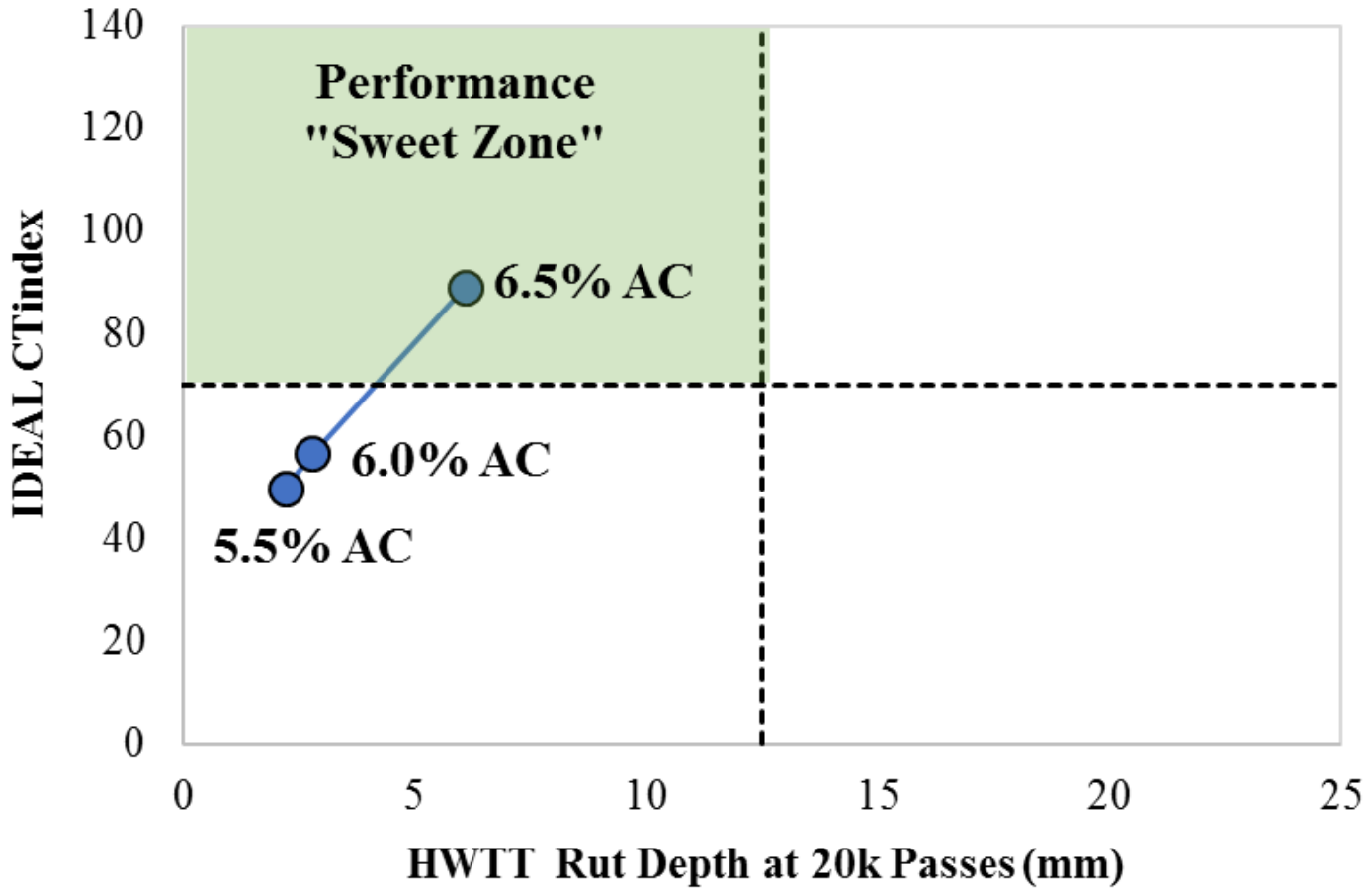
National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

BMD Optimum Asphalt Content



National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

BMD Performance Diagram



National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Numerous options to adjust mixes

Gradation

Asphalt Content

Modifiers

RAP Content

RAS Content

Rejuvenator

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

The BIG questions

1. What performance tests will be used in BMD?
2. How will the performance tests be used? Where will they fit in the mix design process? (The Framework)
3. What criteria should be used in specifications?
4. What aging/conditioning protocols should be used for mixtures in BMD?
5. How will the performance tests be used in Quality Assurance?
6. What should you do to get ready for BMD?

Cracking Group Studies

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Cracking Group Experiments

NCAT Test Track

Top-down cracking

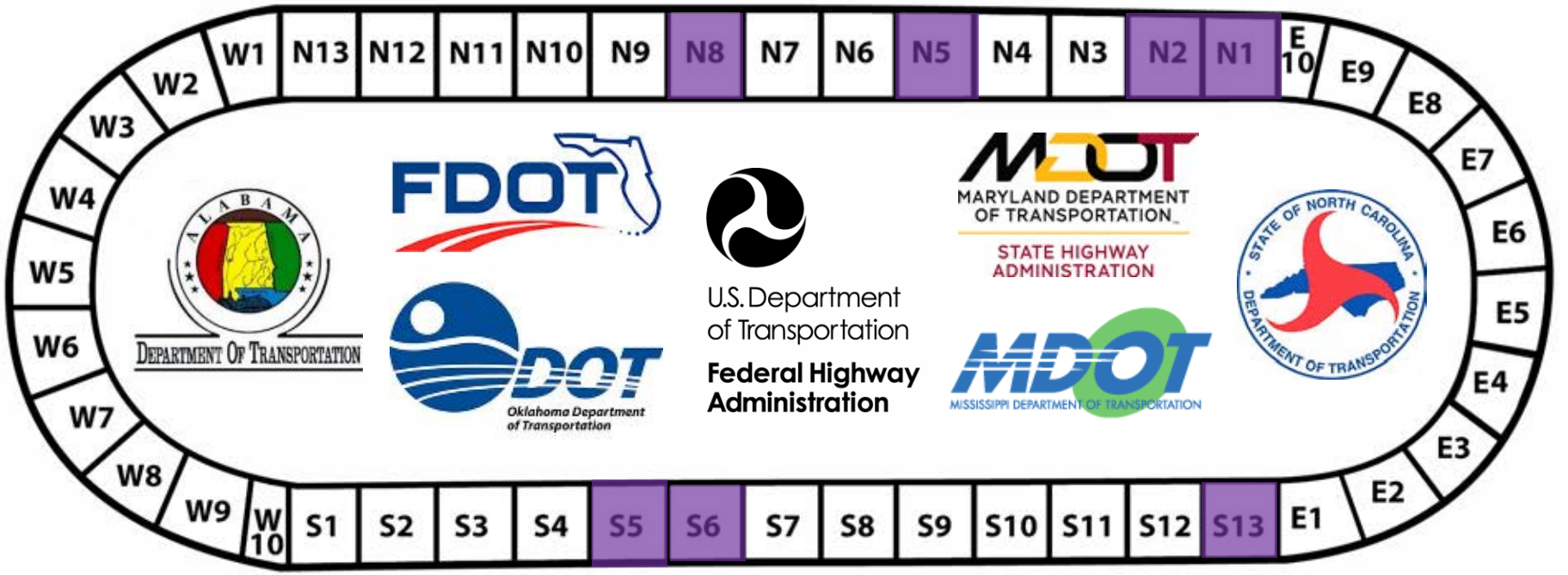
MnROAD

Low-temperature cracking

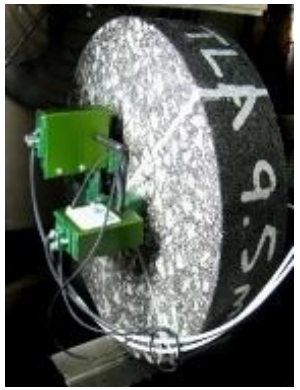
NCAT Test Track

America's asphalt pavement proving ground

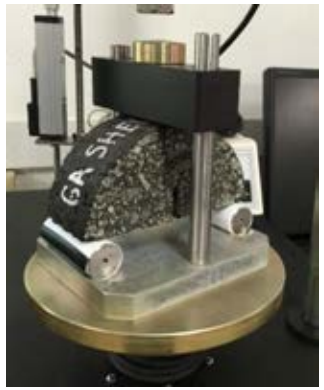
NCAT Cracking Group Sponsors



Selected Top Down Cracking Tests


Energy Ratio


SCB-LA


IFIT


OT-TX


OT-NCAT


IDEAL-CT

All tests have been conducted on:

1. lab prepared mix after short-term aging
2. lab prepared mix after short-term and critical aging
3. plant mix samples that were reheated
4. plan mix samples that were reheated and critically aged

critical aging for Auburn, AL = loose mix oven aging at 135C for 8 hours

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

NCAT CG Field Performance

Section	Description	Cracking (% of lane area		Crit. Aged CT Index
		Start of this Cycle	10/30/19	
N1	20% RAP (Control)	10.3	10.6	8.1
N2	Control w/ High Density	6.9	7.5	5.1
N5	Low AC, Low Density	3.5	9.3	8.6
N8	20% RAP 5% RAS	16.6	34.6	2.4
S5	35% RAP PG 58-28	0	0	16.3
S6	Control w HiMA	0	0	18.7
S13	AZ Rubber Mix	0	0	68.4

MnROAD Cracking Group Test Sections

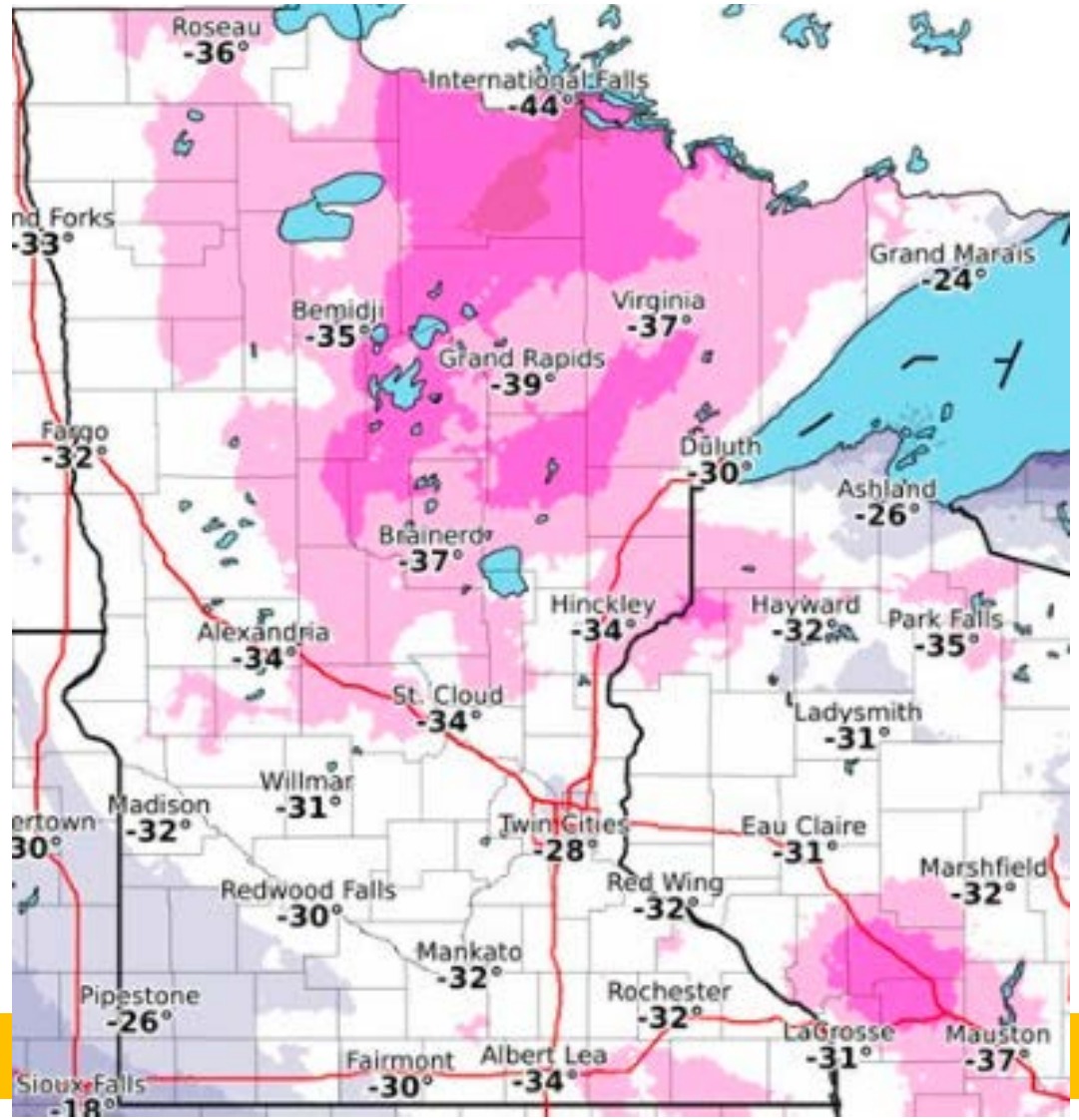
Test sections constructed August 2016

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

MnROAD
Safer, Smarter, Sustainable Pavements Through Innovative Research

MnROAD Cracking Group Sponsors

MnROAD Cracking Group



Low temperatures
January 30, 2019

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

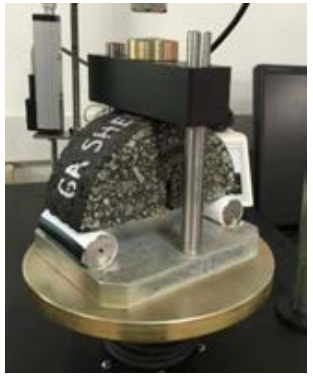
MnROAD
Safer, Smarter, Sustainable Pavements Through Innovative Research

MnROAD Cracking Group
Field Performance through April 2019

Cell	Key Mix Factors	Transverse Cracking (ft.)	Load Related Cracking (% of lane area)
16	Moderate RAP + RAS	58	1.5
17	Low RAP + RAS	70	6.3
18	Moderate RAP	35	3.8
19	Moderate RAP, extra AC	61	0.4
20	High RAP, softer binder	0	0.2
21	Moderate RAP, softer binder	28	1.1
22	Limestone agg. and 9.5 mm NMAS	50	4.4
23	Moderate RAP, Highly mod. binder	43	14.9

MnROAD Cracking Group Tests

Intermediate Temperature Tests



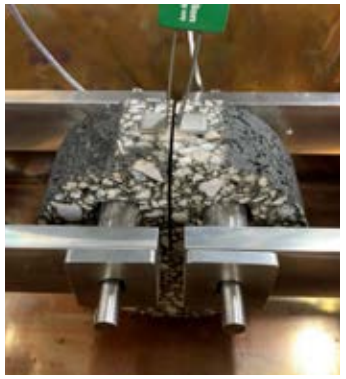
IFIT

Cantabro

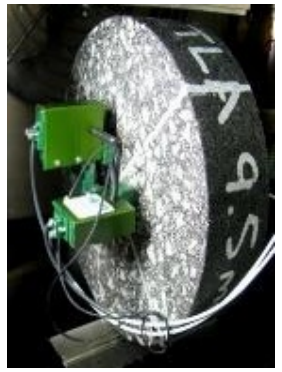
OT-NCAT

IDEAL-CT

Low Temperature Tests



DCT



IDT Creep Compliance & Strength

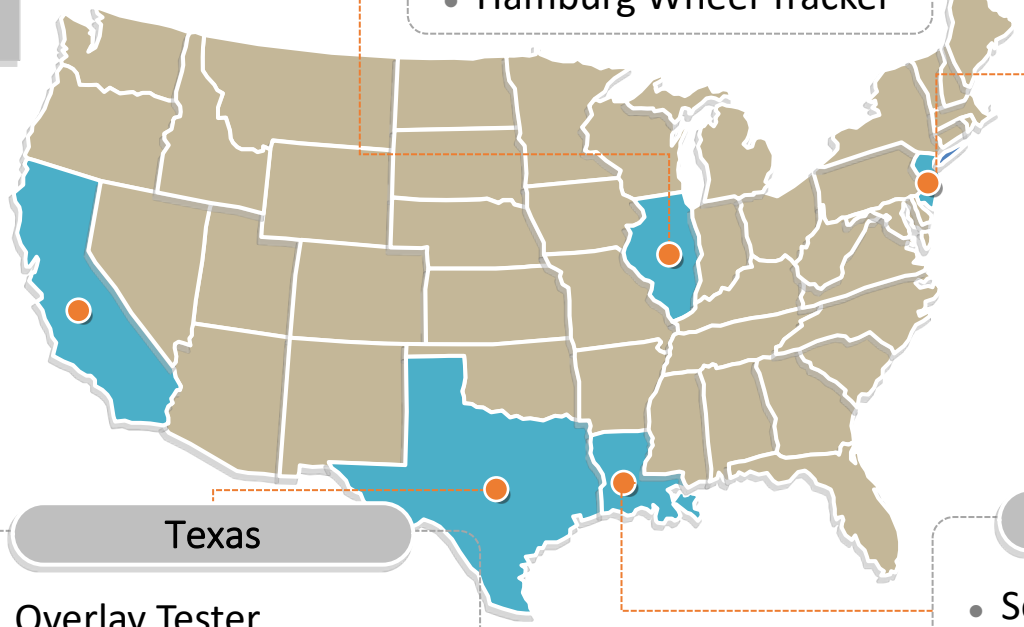
Low Temp. SCB

other tests are being performed by other research organizations

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

MnROAD Safer, Smarter, Sustainable Pavements Through Innovative Research

BMD Implementation Status



Illinois

- Illinois Flexibility Index
- Hamburg Wheel Tracker

New Jersey

- Overlay Test
- Hamburg Wheel Tracker

California

- Bending Beam Fatigue
- Superpave Shear Test

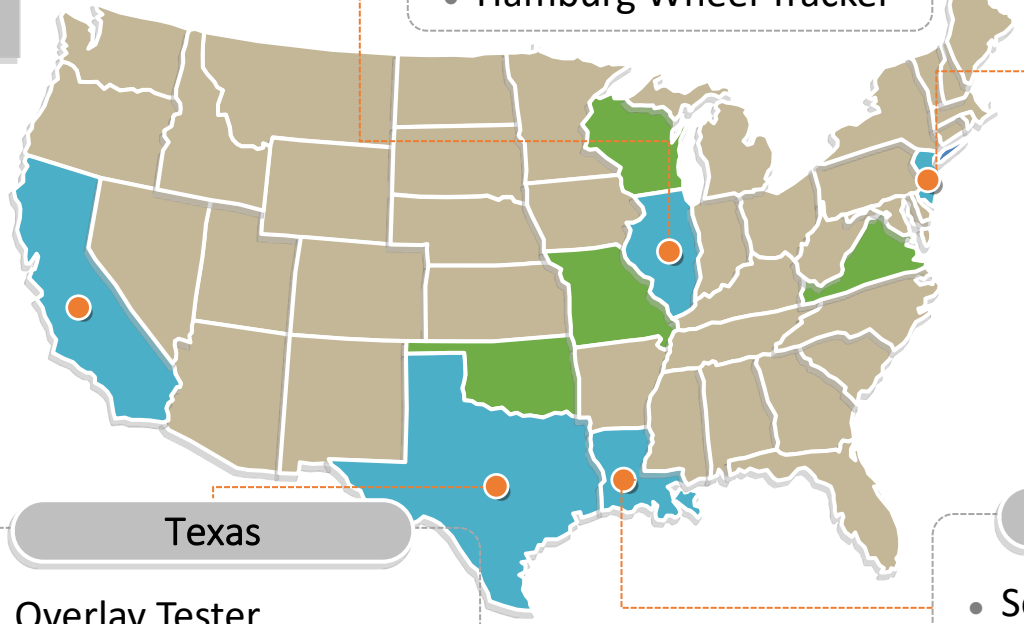
Texas

- Overlay Tester
- Hamburg Wheel Tracker

Louisiana

- Semi-Circular Bend Test
- Hamburg Wheel Tracker

BMD Implementation Status



Illinois
- Illinois Flexibility Index
- Hamburg Wheel Tracker

New Jersey
- Overlay Test
- Hamburg Wheel Tracker

California
- Bending Beam Fatigue
- Superpave Shear Test

Texas
- Overlay Tester
- Hamburg Wheel Tracker

Louisiana
- Semi-Circular Bend Test
- Hamburg Wheel Tracker

Getting all stakeholders to agree on a common BMD Approach will be like….

Work Ahead

- Selection of Tests
- Ruggedness and ILS studies
- Benchmarking current mixes
- Setting criteria
- Training
- Pilot Projects

Become an AAPT Member!

- Belong to a North American-based organization with significant international membership that focuses specifically on asphalt pavements
- Be a member of an association that operates without organizational biases; policies set by and for individual members by an elected Board.
- Have access to a wealth of information and emerging technologies including free webinars
- Be an integral part of a technical community comprised of individuals from all parts of the asphalt industry (material suppliers, researchers, agency owners, consultants, and equipment manufacturers)
- Enjoy the camaraderie of colleagues in the field during annual meetings at attractive venues
- Be a part of lively debates on important technical issues
- Support the next generation of asphalt technologists through a robust student scholarship program

http://asphalttechnology.org/membership.html

95th AAPT Annual Meeting and Technical Sessions

The 2020 Annual Meeting will be held March 22-25, 2020
Westin San Diego Gaslamp Quarter, San Diego, California USA

Our 2020 venue

Westin San Diego Gaslamp Quarter

AAPT
Association of Asphalt Paving Technologists

2020 Annual Meeting

The Annual Business Meeting and Technical Sessions of the Association of Asphalt Paving Technologists (AAPT) will be March 22-25, 2020 in San Diego, California at Westin San Diego Gaslamp Quarter. The annual meeting includes asphalt-related technical sessions comprised of peer-reviewed papers, and invited presentations on specific topics in the AAPT-ISAP International Forum, and Symposium as well as a Student Poster Session.

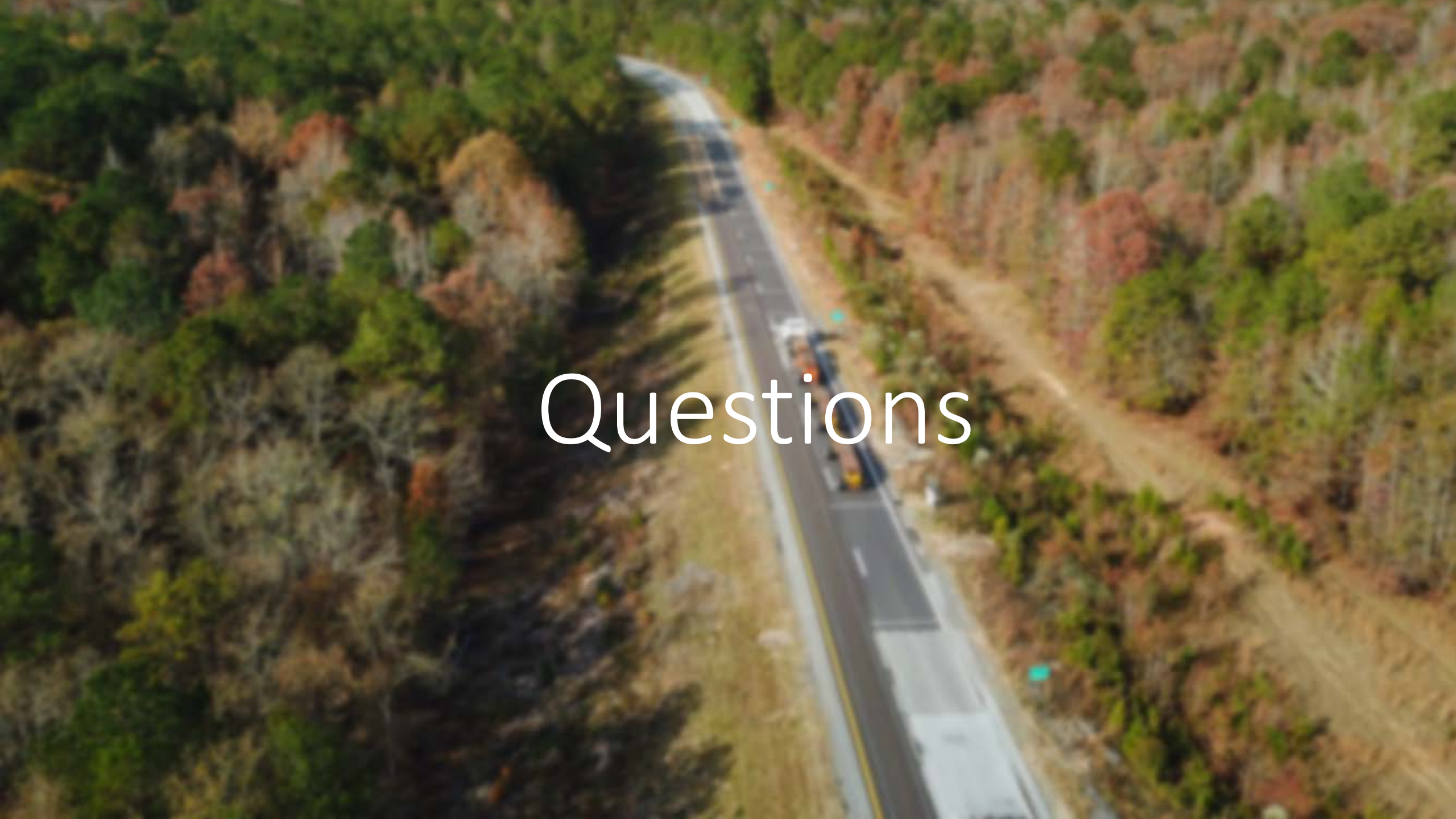
Visit http://asphalttechnology.org/annual-meeting.html for more details as they become available.

Important dates

December 2019 – Annual Meeting registration opens
March 22-25, 2020 - Annual Business Meeting and Technical Sessions

For the latest information please check our web site at: http://www.asphalttechnology.org

AAPT Office:
6776 Lake Drive, Suite 215
Lino Lakes, MN 55014
Phone: 651-293-9188
Email: aapt@asphalttechnology.org


Questions

Thank You

Randy West
randy.west@auburn.edu

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY