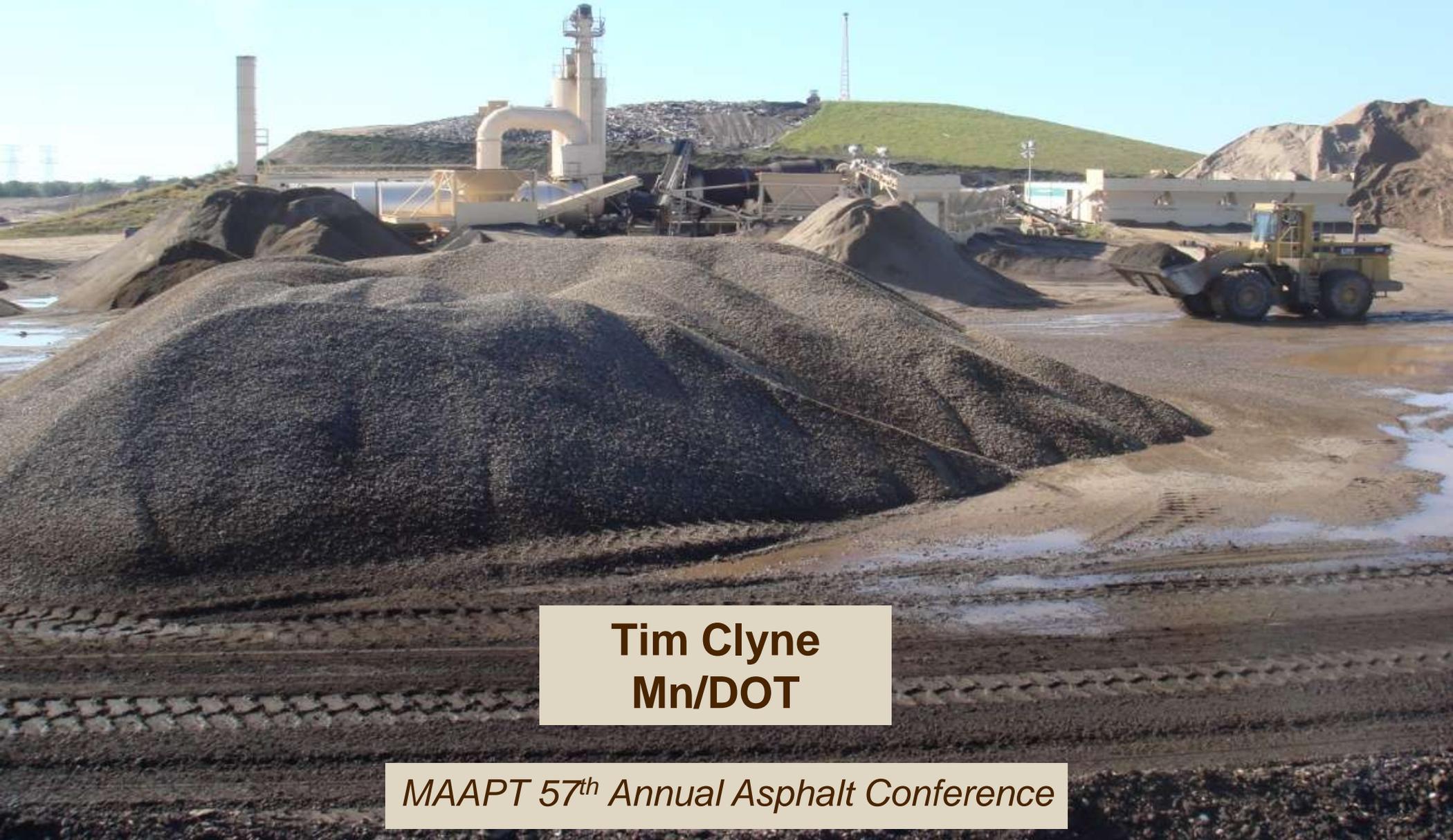


WMA Performance at MnROAD



Tim Clyne
Mn/DOT

MAAPT 57th Annual Asphalt Conference

What is Warm Mix Asphalt (WMA)?

Technology that allows the reduction of mixing temperature by 20 to 100 F

★ 50 F typical

Acts as a lubricator, not viscosity reducer

★ Reduces surface tension of asphalt binder

★ Allows binder to flow and coat aggregates

Potential Benefits of WMA

Environmental

- ★ Lower greenhouse gas emissions (~30-90%)
- ★ Lower fuel consumption (~30%)

Operational

- ★ Lower plant wear
- ★ Better compaction
- ★ More comfortable working conditions

Performance

- ★ Can use RAP and/or shingles with WMA
- ★ Reduced binder aging
- ★ Eliminates bumps in overlays

Technology Overview**

WAM-Foam  

Rediset WMX 

Low Emission Asphalt  

Aspha-Min 

AquaFoam 

Advera 

Ultrafoam GX 

Sasobit 

Terex 

REVIX 

Accu-Shear 

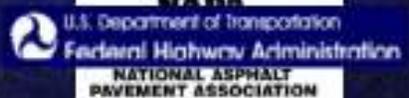
Evotherm 

Aquablack 

Cecabase RT 

Double Barrel Green 

Thiopave  

 NATIONAL ASPHALT PAVEMENT ASSOCIATION

**FHWA does not endorse any particular proprietary product or technology.

2008 MnROAD Construction

Warm Mix Asphalt						Control
15	16	17	18	19	23	24
3" WM	5" WM 58-34	5" WM 58-34	5" WM 58-34	5" WM 58-34	5" WM 58-34	3" 58-34
11.1" 64-22 1993 HMA	12" 100% recycle PCC	12" 50% RePCC 50% Class 5	12" 100% RAP	12" CI-5	12" Mesabi Ballast	4" Cl6sp
Clay	12" Cl3sp	12" Cl3sp	12" Cl3sp	12" Cl3sp	12" Cl3sp	Sand
58-34 Surface Binder	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	7" Select Gran	100' Fog Seal 2008
	Clay	Clay	Clay	Clay	Clay	100' Chip Seals 2009 2010 2011 2012

Mix Design Requirements

Wear and Non-Wear

12.5 mm NMAS

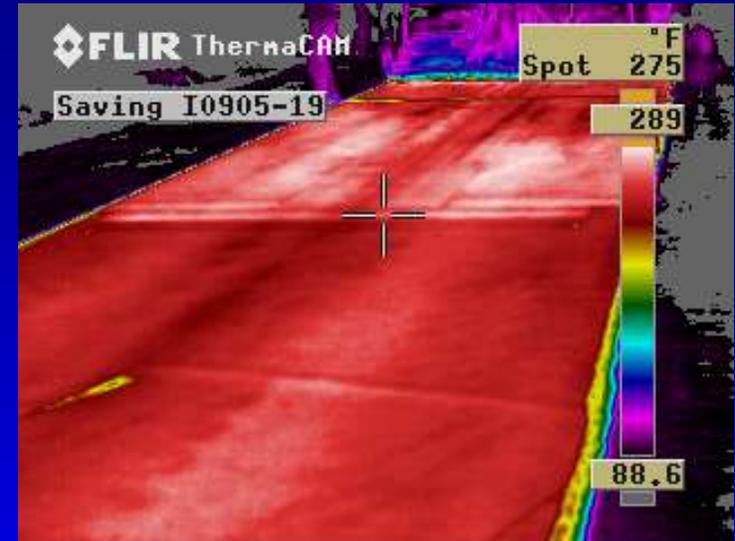
Traffic Level 4

PG 58-34

20% RAP from MnROAD

No requirements for WMA technology

★ **Hardrives chose REVIX (Evotherm 3G)**



Next several slides courtesy of Chris Miller, Hardrives

WMA Laydown

Business as usual – only cooler
Positive comments from the crew
Rolling Pattern Challenges



Laydown Temp (224 F)



Density Results

Non-Wear

- ★ All cores > 93.0%
- ★ Low air voids

Wear

- ★ Cores averaged 92%



WMA vs HMA



WMA vs. HMA



WMA vs. HMA



Lessons Learned

More lab work needed at mix design to determine compaction temperature range

Definite energy savings

Appears as though fumes/emissions were less

Equal density appears to be achievable with equal or less effort



Laboratory Test Results

Sampling and Testing

Samples Collected

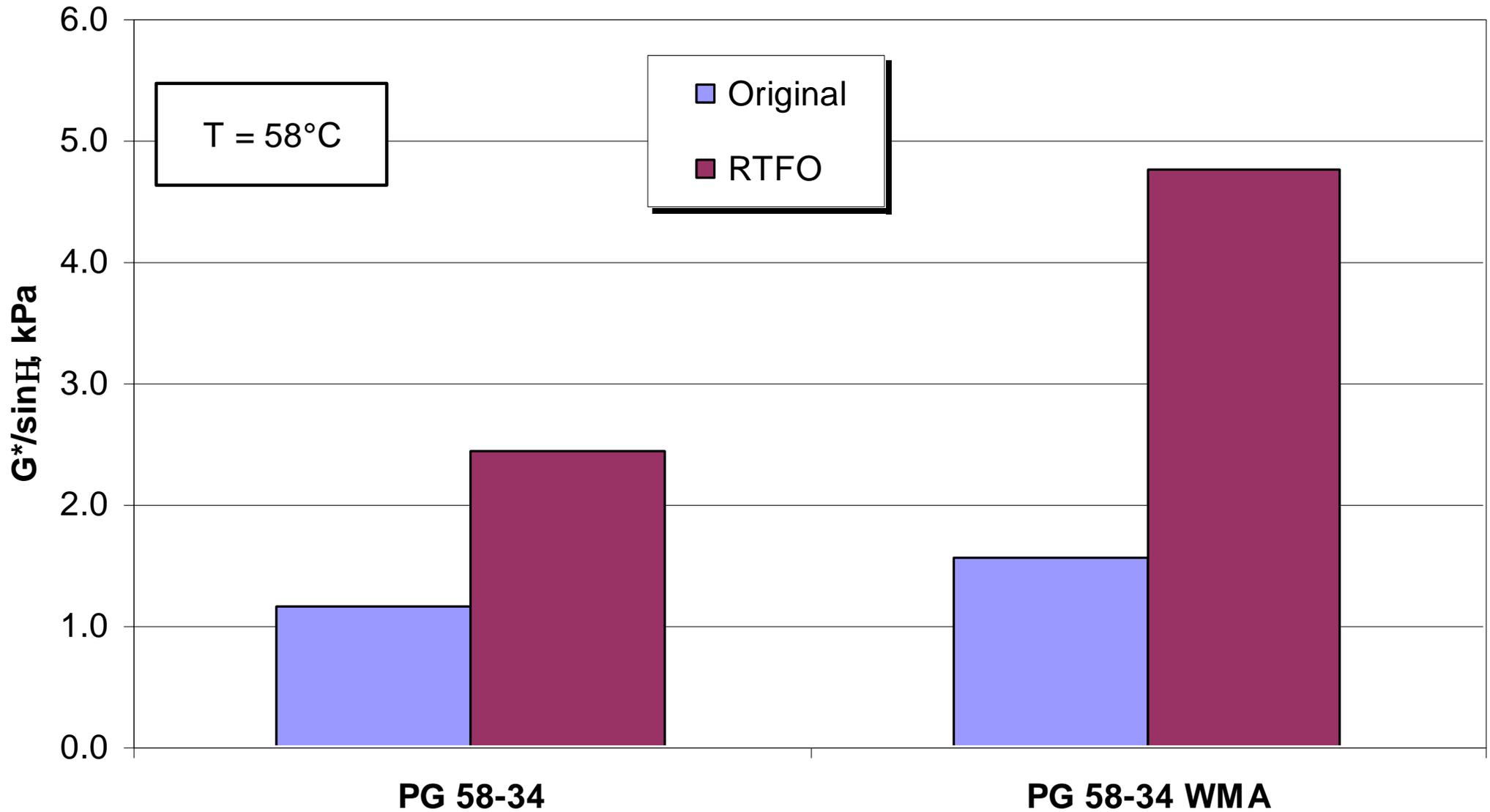
- Asphalt Binder
- Asphalt Mixture

Testing Partners

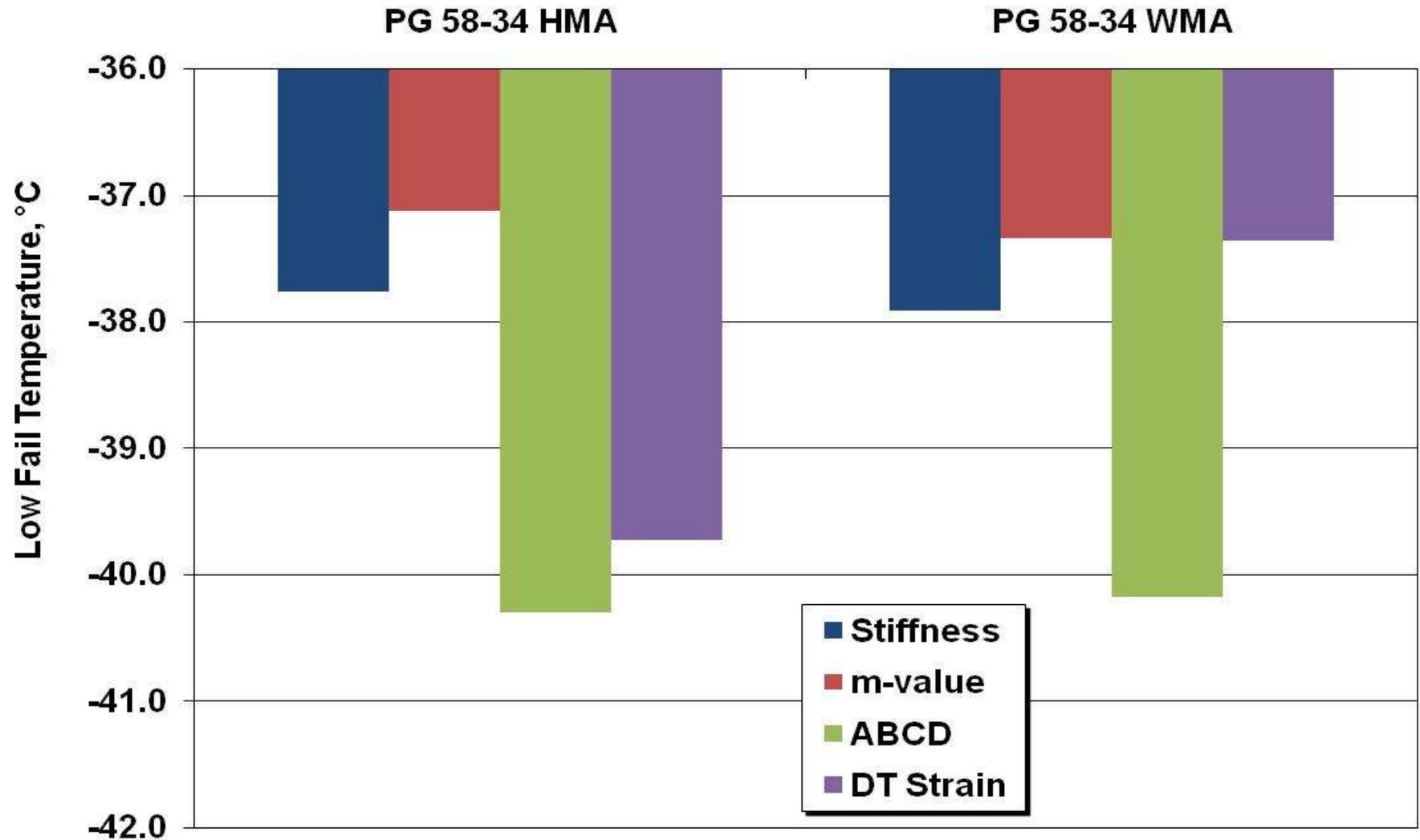
- NCAT
- FHWA
- Texas Transportation Institute
- Ohio University
- University of Minnesota
- Mn/DOT



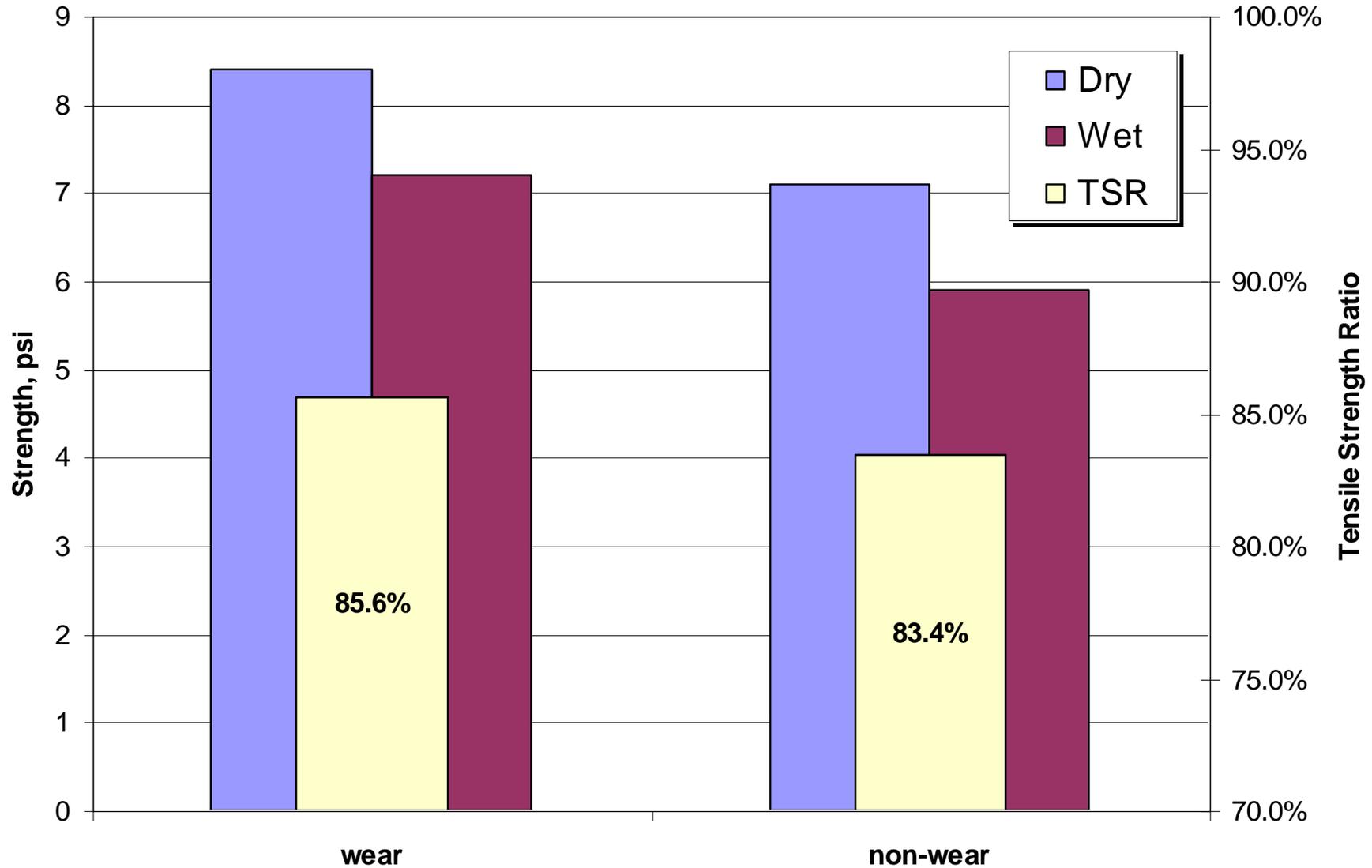
Binder DSR Testing



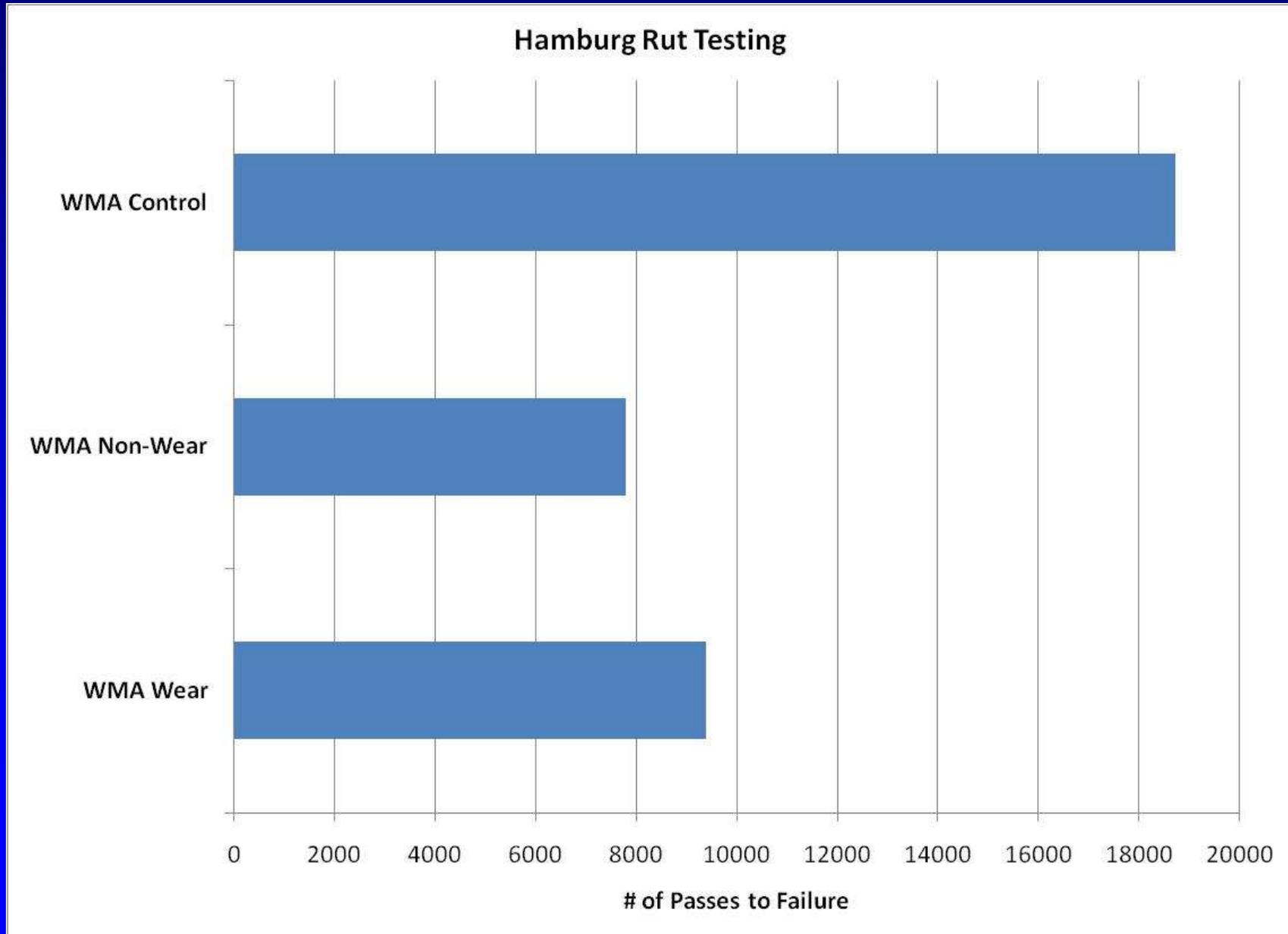
Binder Low Temperature Testing



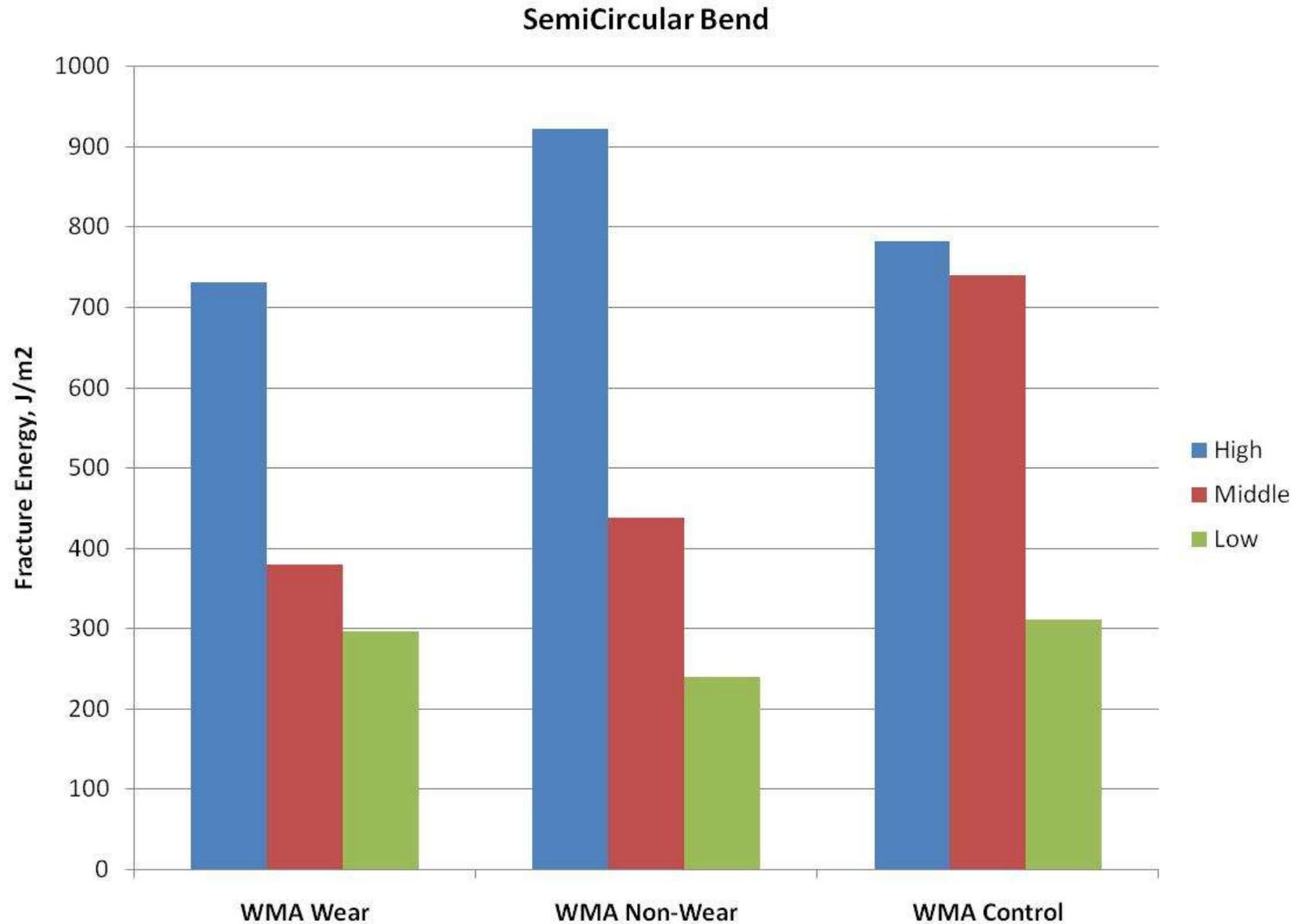
Moisture Damage Potential



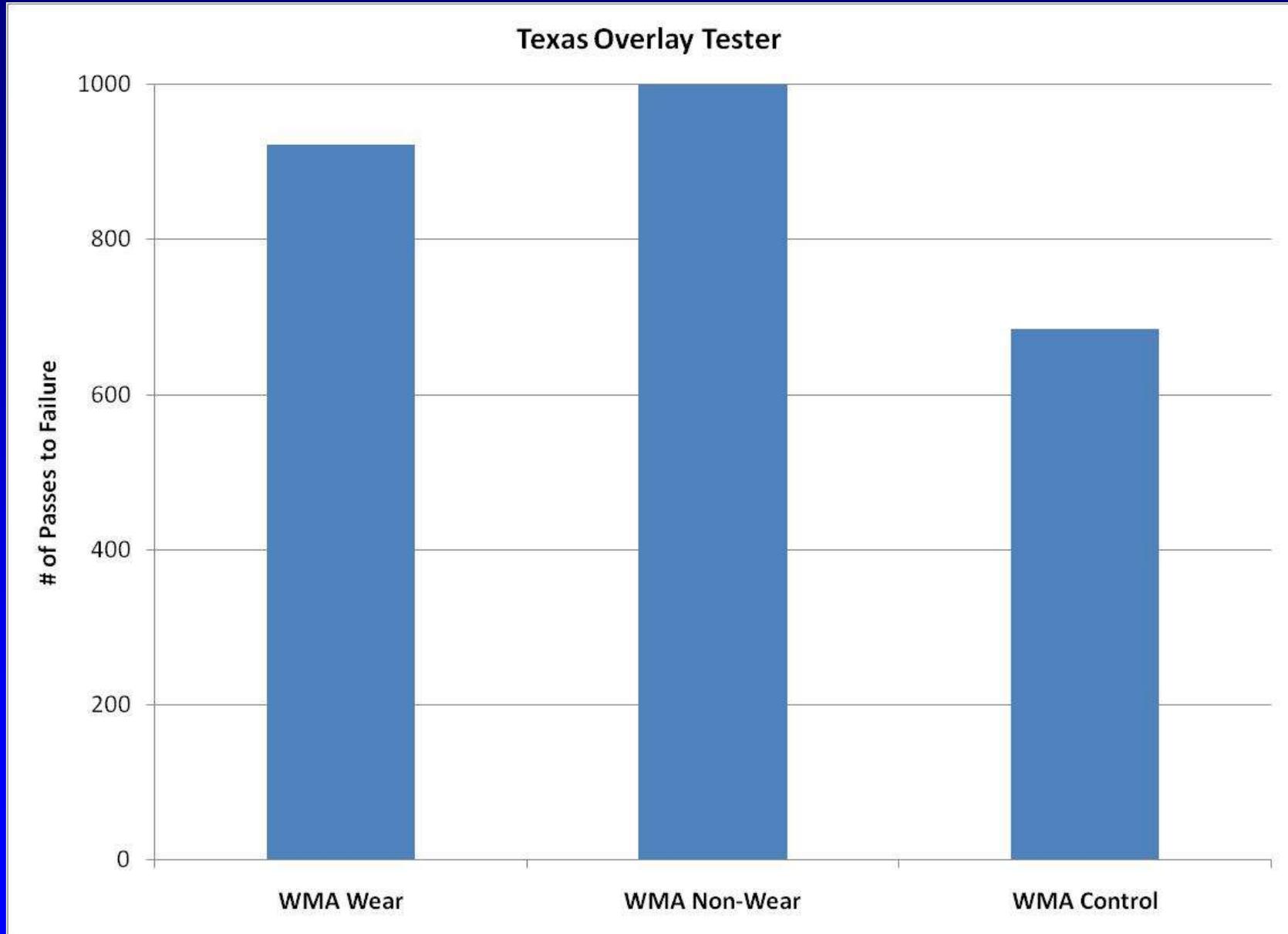
Hamburg Rut Testing



Lab Cracking Performance



Lab Cracking Performance (2)

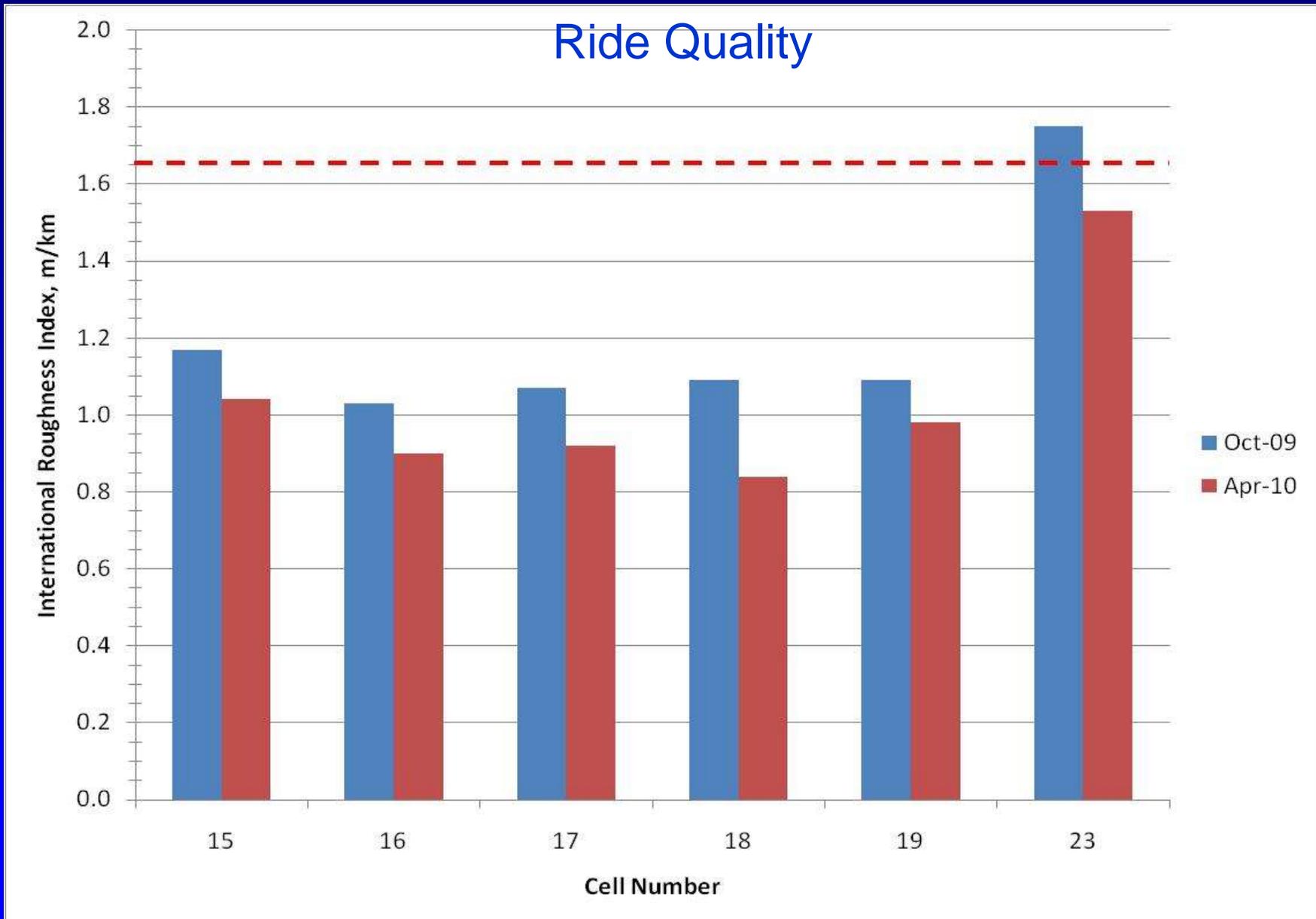


Field Performance Results

MnROAD Field Performance



MnROAD Field Performance (2)



MnROAD Field Performance (3)

1 transverse crack in 5 test sections

★ **Over instrumentation area (inadequate compaction)**

25% reflective cracking on 3" WMA overlay

So far, so good



WMA from a Wider View

Mn/DOT 2010 Bituminous Specification

Previously WMA was handled on a case-by-case basis

★ 2009 Position Memo

★ www.dot.state.mn.us/materials/bituminous.html

Table 2360.6-C5
Mixture Temperature Control^(C)

Air Temperature °F [°C]	Compacted Mat Thickness, inches ^(A)			
	1 inch [25 mm]	1-1/2 inch [40 mm]	2 inch [50 mm]	≥3 inch [75 mm]
+32-40 [0-5]	--	265 ^(B) [129]	255 [124]	250 [121]
+ 41-50 [6-10]	270 ^(B) [130]	260 [127]	250 [121]	245 [118]
+ 51-60 [11-15]	260 ^(B) [127]	255 [124]	245 [118]	240 [115]
+ 61-70 [16-21]	250 ^(B) [121]	245 [118]	240 [115]	235 [113]
+ 71-80 [22-27]	245 [118]	240 [115]	235 [113]	235 [113]
+ 81-90 [28-32]	235 [113]	230 [110]	230 [110]	230 [110]
91+ [+ 33]	230 [110]	230 [110]	230 [110]	225 [107]

(A) Based on approved or specified compacted lift thickness.

(B) A minimum of one pneumatic-tire roller shall be used for intermediate rolling unless otherwise directed by the Engineer. The Engineer may specify or modify in writing (with concurrence from the Department Bituminous Engineer) a minimum laydown temperature.

(C) Not applicable if a WMA additive or process is used.

Mn/DOT District 3 and 7 Projects in 2010

First Mn/DOT projects requiring WMA

S-1 (2360) PLANT MIXED ASPHALT PAVEMENT – USE OF WARM MIX ASPHALT TECHNOLOGIES

The provisions of the attached 2360 Plant Mixed Asphalt Pavement (Gyratory Design) Specification is hereby modified as follows in order to use Warm Mix Asphalt (WMA)

All provisions for the production and placement of WMA will be the same as the conventional HMA mixtures as stipulated in 2360 Plant Mixed Asphalt Pavement (Gyratory Design) Specification except as noted below.

S-2.1 MIXTURE DESIGN

The contractor is responsible to use the same design used to produce the Hot Mix Asphalt, then modifying it to accommodate products or processes to meet the Warm mix criteria. This modification process will be limited to the same as described by the WMA Technical Working Group and found at <http://www.warmmixasphalt.com/WmaTechnologies.aspx>

Recycled Asphalt Shingles will not be allowed in any mixes on this project.

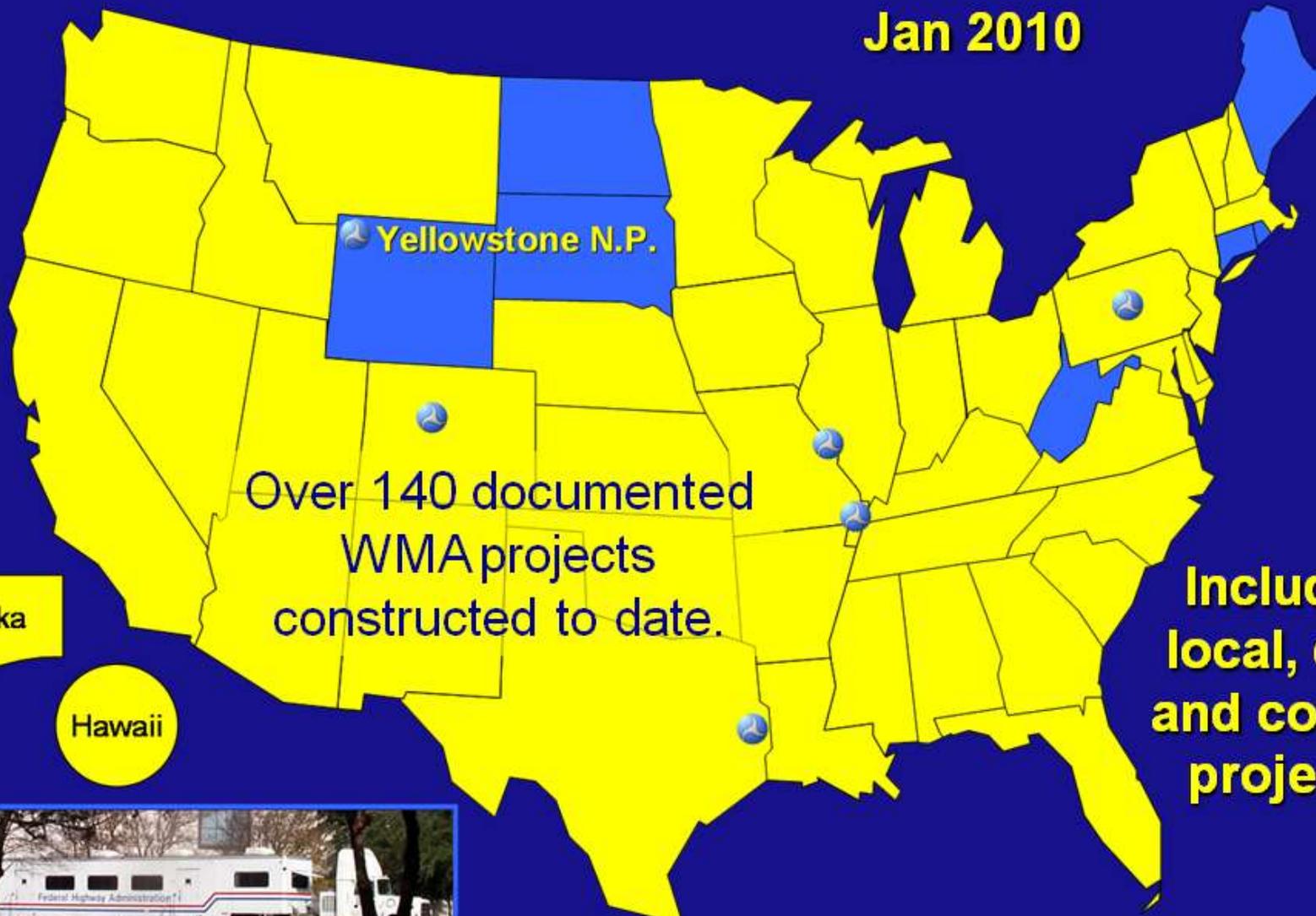
S-3.1 MIXTURE QUALITY MANAGEMENT

The Warm Mix Asphalt produced will not be allowed to exceed temperatures greater than 275 °F. Any WMA over that temperature will not be allowed to be used.



WMA Trials and Demonstrations

Jan 2010



Over 140 documented WMA projects constructed to date.

Includes local, city, and county projects



Outstanding Issues

Early Rutting

- ★ No known problems have occurred
- ★ Binder grade bump may be needed

Moisture Damage

Long Term Performance



WMA Investigation and Implementation

FHWA working in partnership with AASHTO and Industry to implement warm mix

WMA Technical Working Group (TWG)

FHWA Expert Task Groups

- ★ Binder, Mixture, RAP, and Modeling

Regional User-Producer Groups

- ★ Share data and information

Move out of demonstration phase

Training and Education



Online Resources

www.warmmixasphalt.com

www.fhwa.dot.gov/pavement/asphalt/wma.cfm

www.hotmix.org

www.asphaltisbest.com



Publications



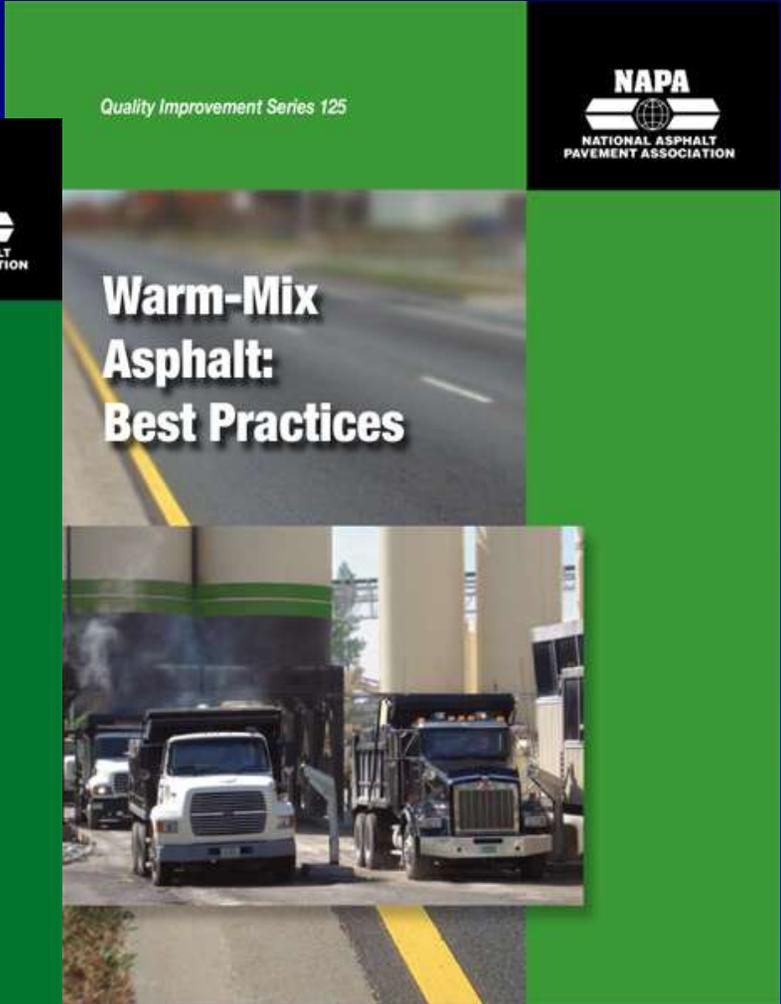
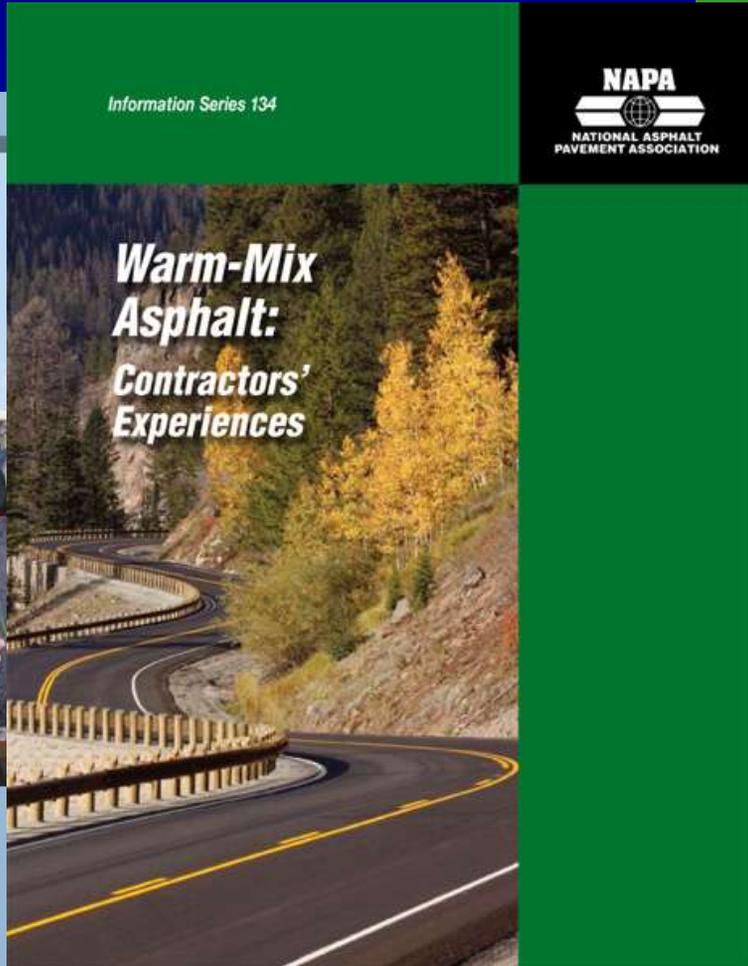
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IN COOPERATION WITH:

American Association of State Highway
and Transportation Officials
National Cooperative Highway
Research Program

FEBRUARY 2008



Conclusions

WMA should meet all Superpave requirements

Warm mix is the future of asphalt mixtures

Technology providers coming forward

Industry and agencies must work together to make it happen

Advantages far outweigh concerns

Thank You!

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MnROAD Operations Engineer

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