

Polymer-Modified Asphalts – Enhancing HMA Performance

New Orleans, Louisiana

January 28, 2003





Presentation Overview

1. Introduction
 2. Phase I Overview
 3. Summary of Interim Results & Findings
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Study Objectives

1. Quantify the effect of using PMA as compared to conventional-unmodified HMA mixtures.
 2. Identify conditions that maximize effect of PMA to increase HMA pavement & overlay life.
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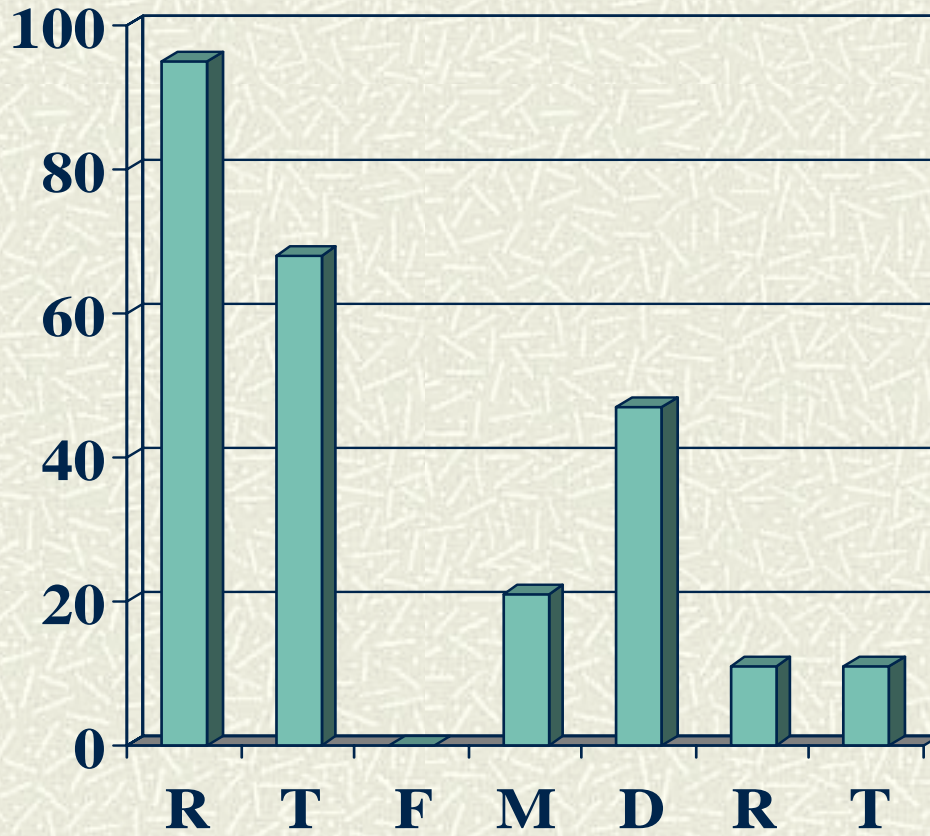
Phase I Tasks:

1. Update literature review.
 2. Update contacts with selected agencies.
 3. Review test sections with PMA mixes.
 4. Select companion PMA & unmodified HMA test sections.
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Phase II Tasks:

5. Predict performance of test sections.
 6. Compare performance characteristics of PMA & unmodified HMA pavements.
 7. Prepare study documents.
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Reason for using PMA?



■ Response, %

R = Rutting

T = Thermal Cracking

F = Fatigue Cracking

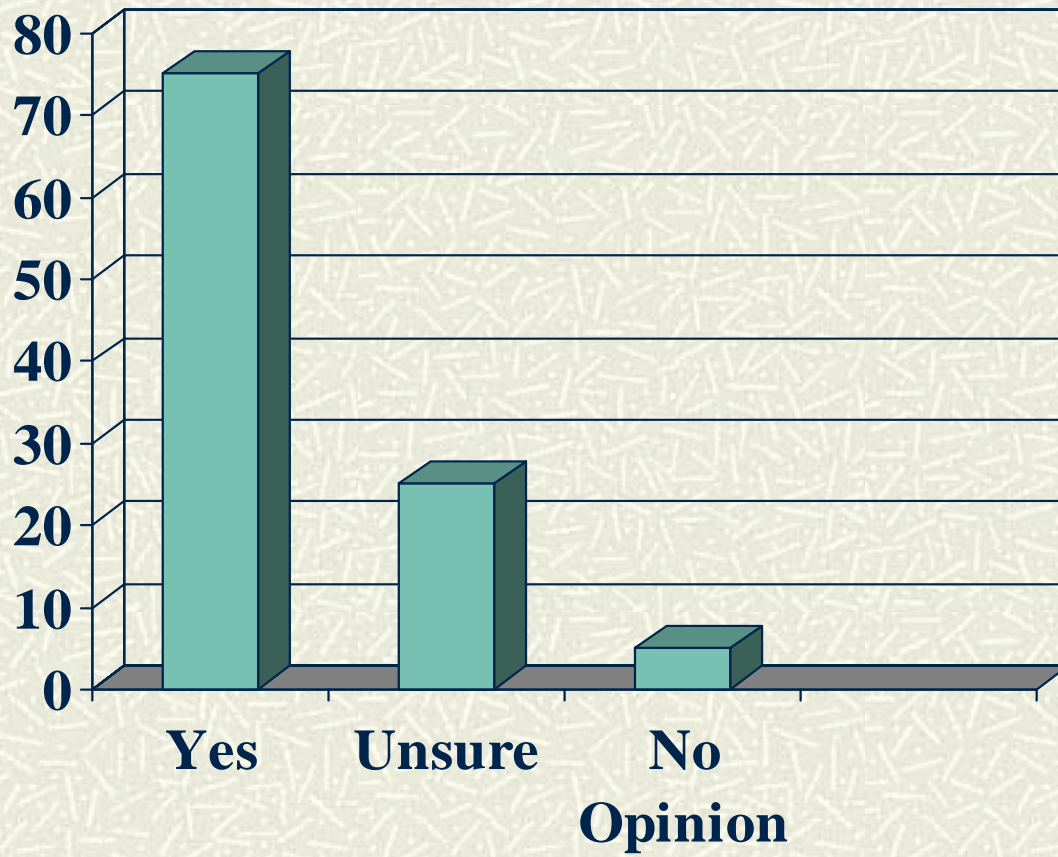
M = Moisture Damage
or stripping

D = Durability

R = Raveling

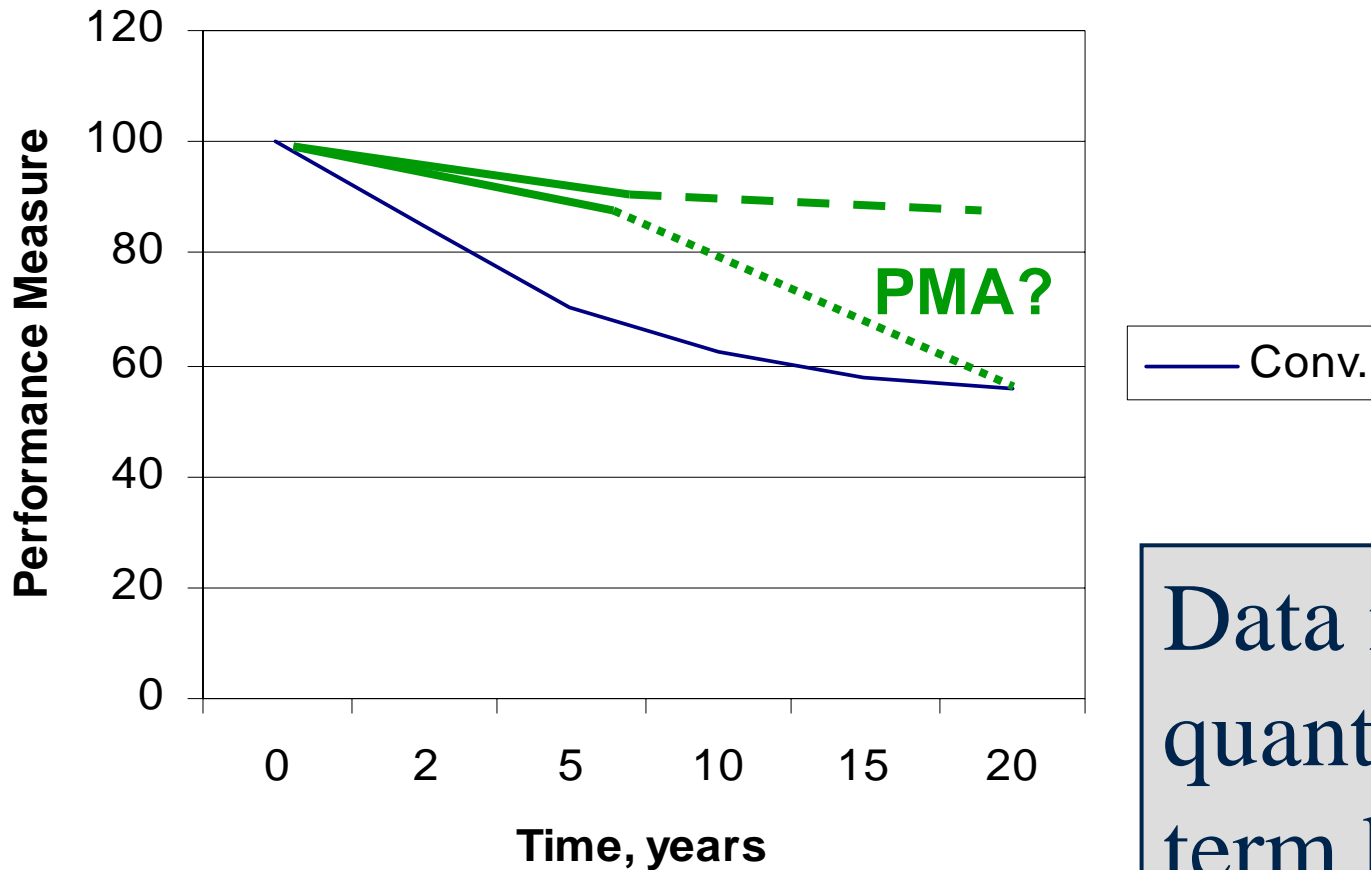
T = Tenderness

Is There a Benefit Using PMA?



Yes, ***BUT:***
Insufficient
data to
quantify that
benefit.

Concern: Short-Term versus Long-Term Benefit?

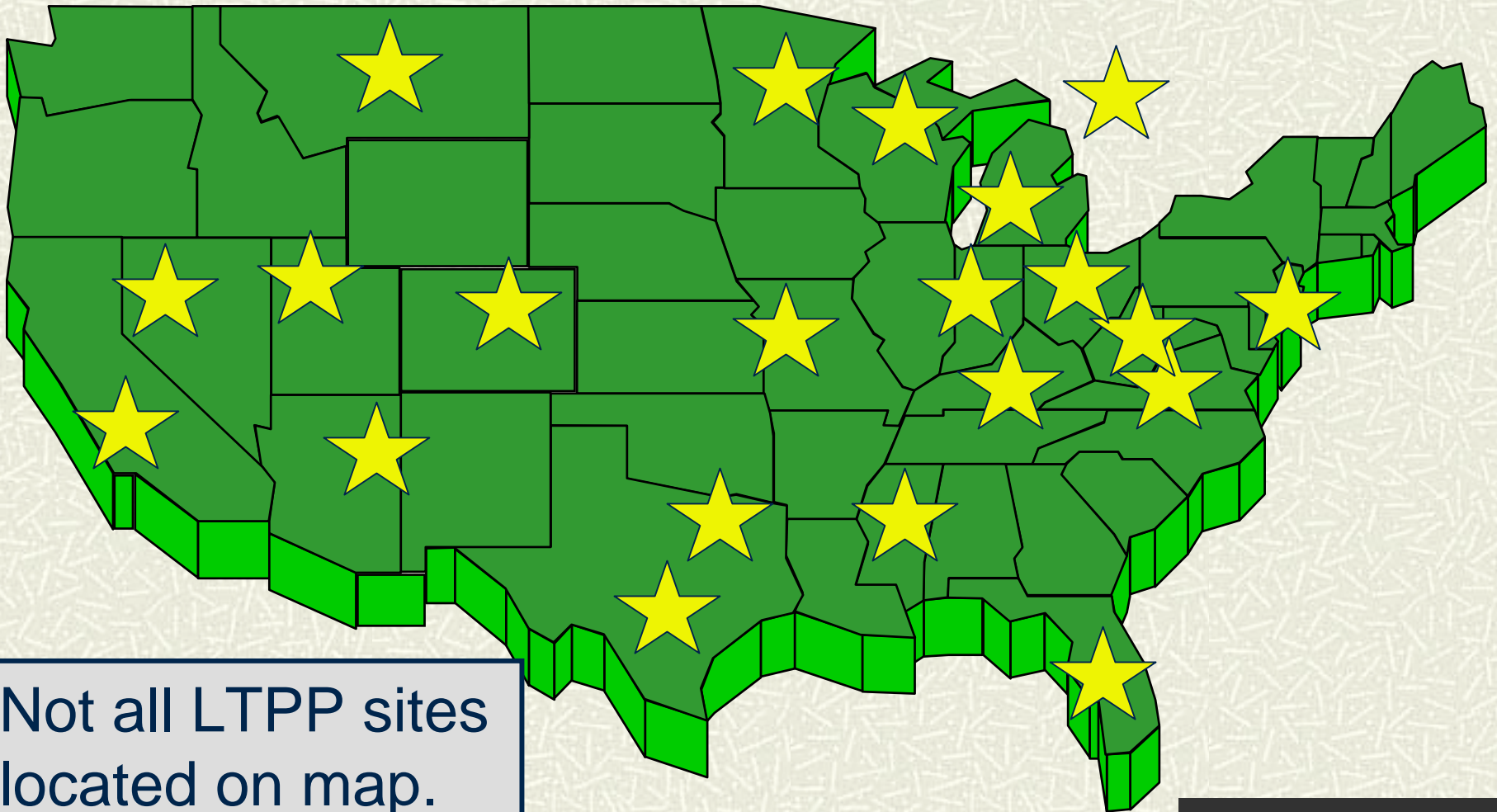


Data needed to quantify long-term benefit.

Test Sections - Experiments

- # LTPP: Core & Supplemental Sections
 - **SPS-1; SPS-5; SPS-6; SPS-9**
 - **GPS-1; GPS-2; GPS-6; GPS-7**
 - # MTO Modifier Study
 - # Accelerated Pavement Tests, examples
 - **FHWA ALF, Turner Fairbanks**
 - **NCAT Test Road**
 - **California HVS Studies**
 - # Individual State Agency Test Sections
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Selected Pavement Locations for Detailed Analyses in Phase II



Not all LTPP sites
located on map.

Experimental Factorial

Pavement Cross Section	Foundation	Climate			
		Freeze		Non-Freeze	
		Wet	Dry	Wet	Dry
Thin HMA	Fine-Grained	2	2	4	3
	Coarse-Grained	3	3	3	3
Thick HMA	Fine-Grained	2	2	2	3
	Coarse-Grained	2	2	3	2
Full-Depth	Fine-Grained	0	1	2	2
	Coarse-Grained	0	1	2	2
HMA	HMA	3	3	6	6
Overlays	PCC	4	3	4	4
Total No. PMA Sections		16	17	26	25

Phase I Comparisons:



#Load Related Cracking; area & longitudinal combined



#Rutting

#Thermal Cracking

#IRI, Smoothness

#Other Surface Distress

Types of Analyses; PMA Versus Unmodified Mixes

- # Comparison of actual distress observations; companion sections
 - # Mechanistic-empirical analysis of performance history:
 - **Fracture, Load Related**
 - **Distortion, Load Related**
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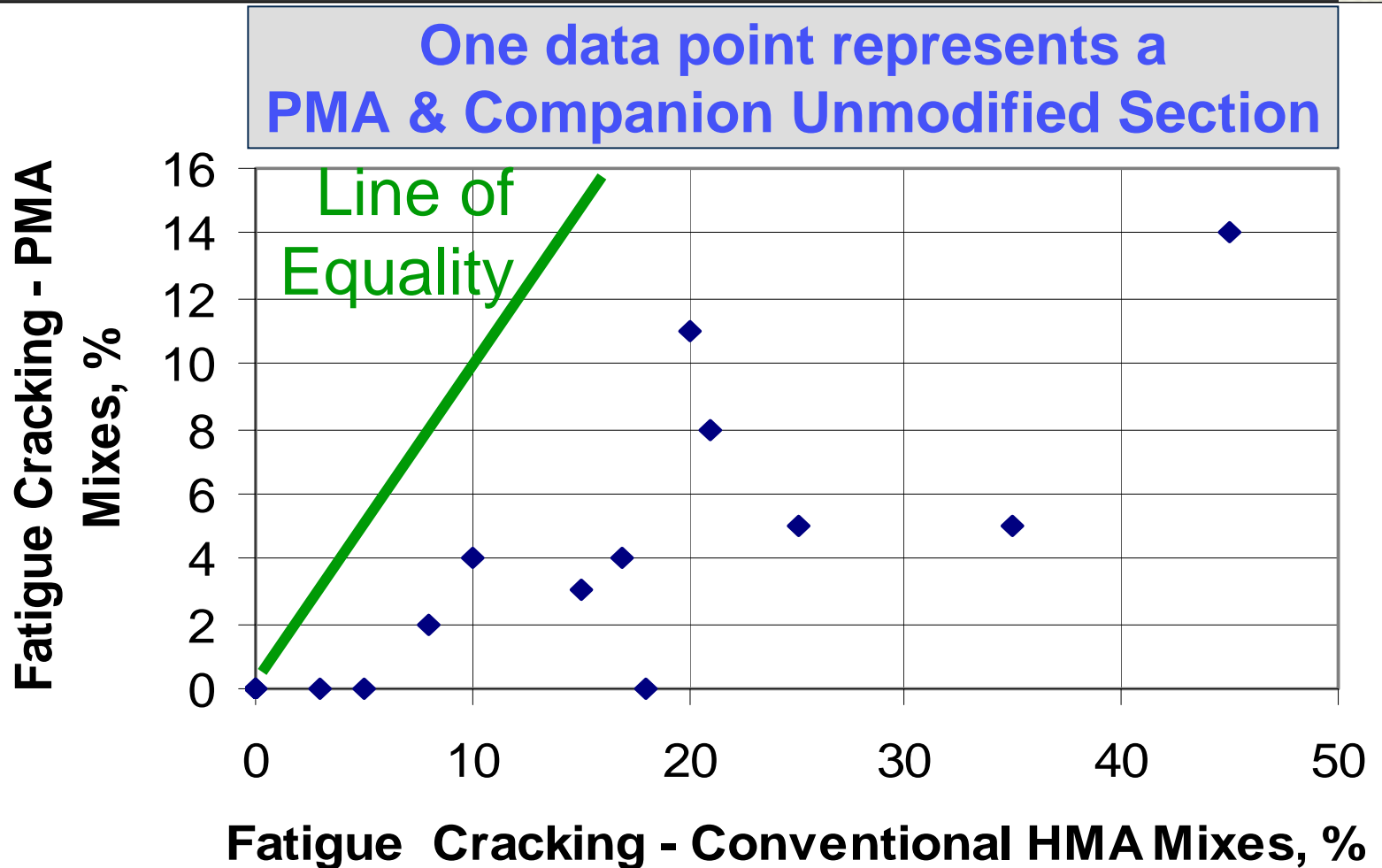


Load Related Cracking Analysis



**Unmodified Mixes
Versus
PMA Mixes**

Load Related Cracking: PMA Versus Unmodified Mixes



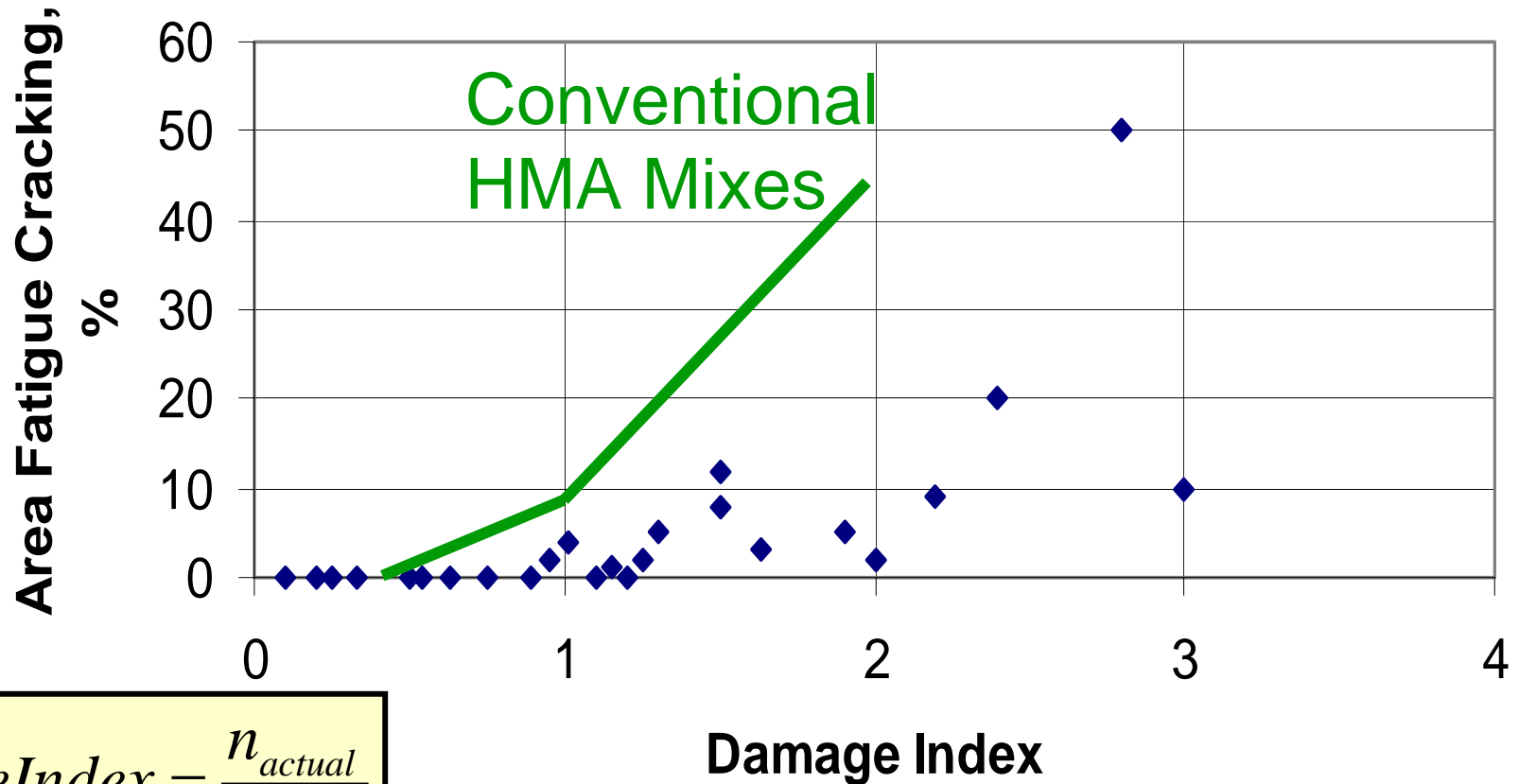
Fatigue Cracking Analysis

PDMAP Fatigue Curve initially used in fatigue analysis.

$$\begin{aligned} \text{Log}(N_f) = & 15.947\beta_{f1} - 3.291\beta_{f2}\text{Log}\left(\frac{\varepsilon_t}{10^{-6}}\right) \\ & - 0.854\beta_{f3}\text{Log}\left(\frac{E_{HMA}}{10^3}\right) \end{aligned}$$

Cracking versus Damage Index

Each data point represents a PMA Section



$$DamageIndex = \frac{n_{actual}}{N_f}$$

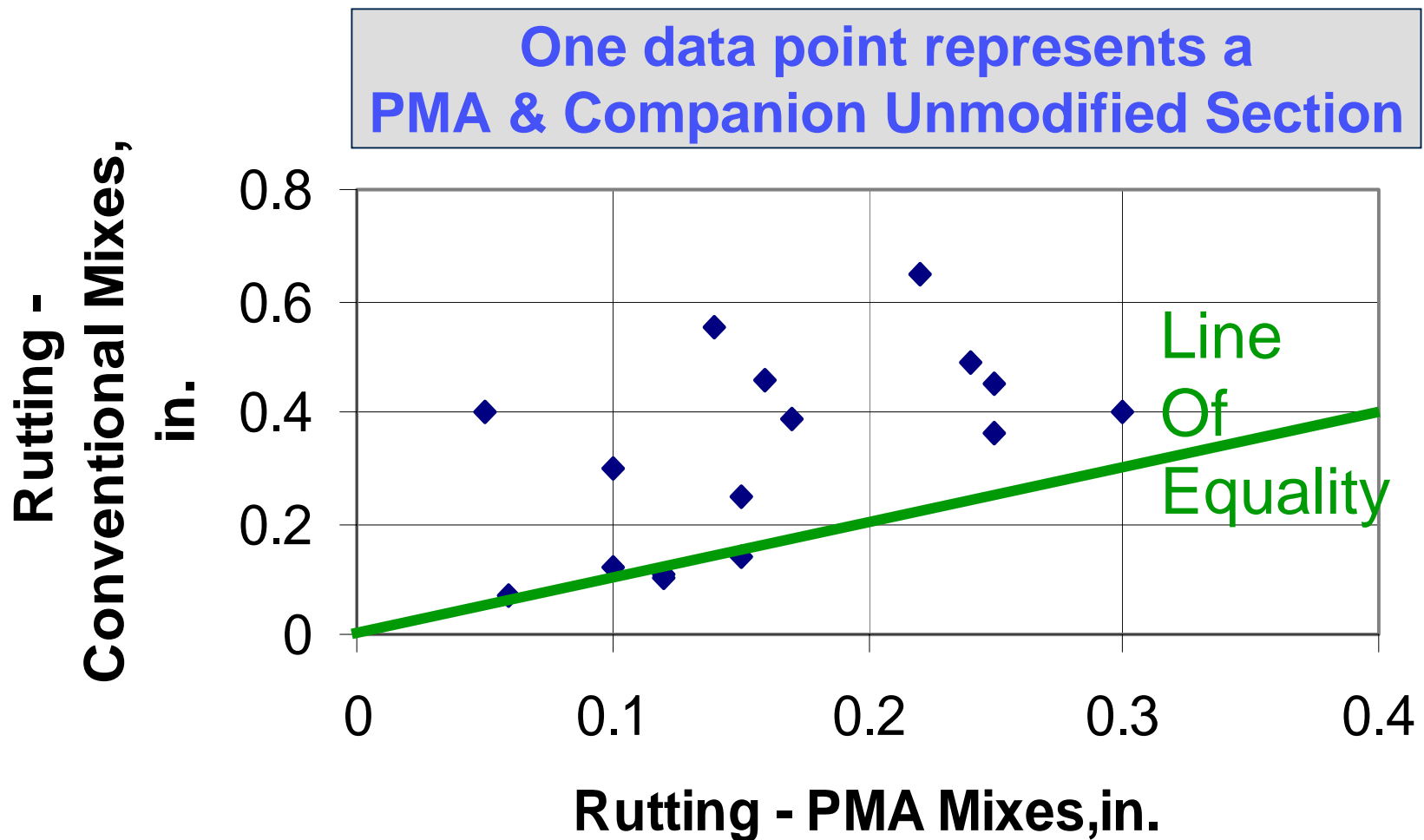


Rutting Analysis

**Unmodified Mixes
Versus
PMA Mixes**

Rutting:

PMA Versus Unmodified Mixes



Rutting Evaluation

Permanent-resilient strain ratio used in initial analysis.

$$\begin{aligned} \text{Log} \left(\frac{\varepsilon_p}{\varepsilon_r} \right) = & -6.3748\beta_{r1} + 0.4289\beta_{r2}\text{Log}(N) \\ & + 2.5896\text{Log}(T) + 0.1089\text{Log}\beta_{r3}(\sigma_d) - 0.0004\text{Log}(\eta) \\ & + 1.0057\text{Log}(V_{beff}) + 0.5213\text{Log}(V_a) \end{aligned}$$

Findings

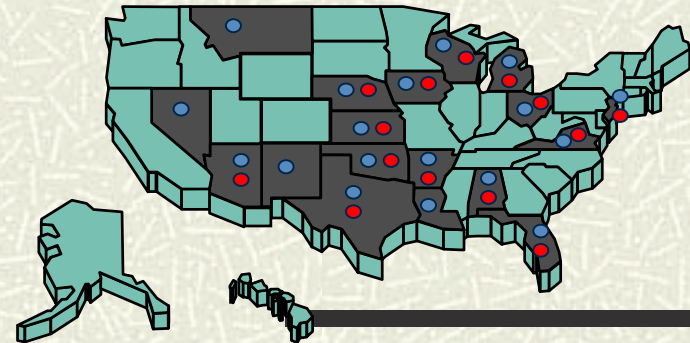
Field & laboratory investigations of PMA mixes, overall summary:

Enhanced Performance

- 25 to 100 % increase in service life
- 3 to 10 years increase in service life

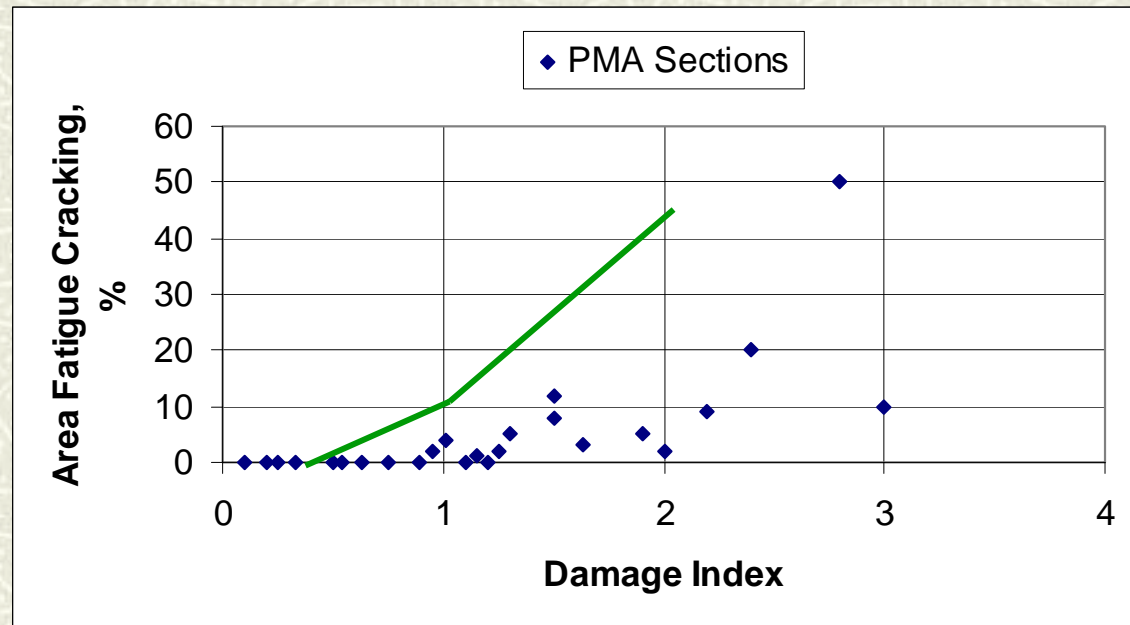
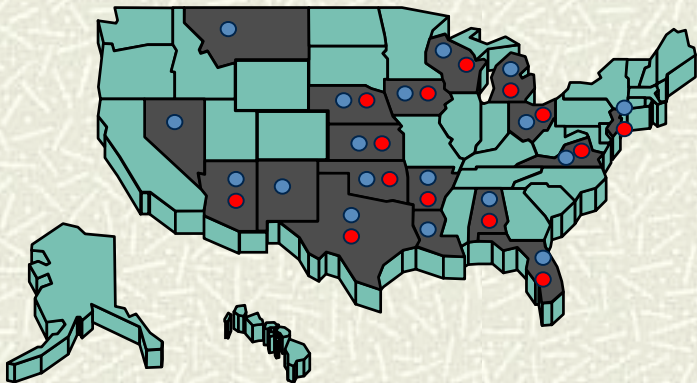
Reduced Maintenance Activities

- Crew Safety
- Traffic Delay

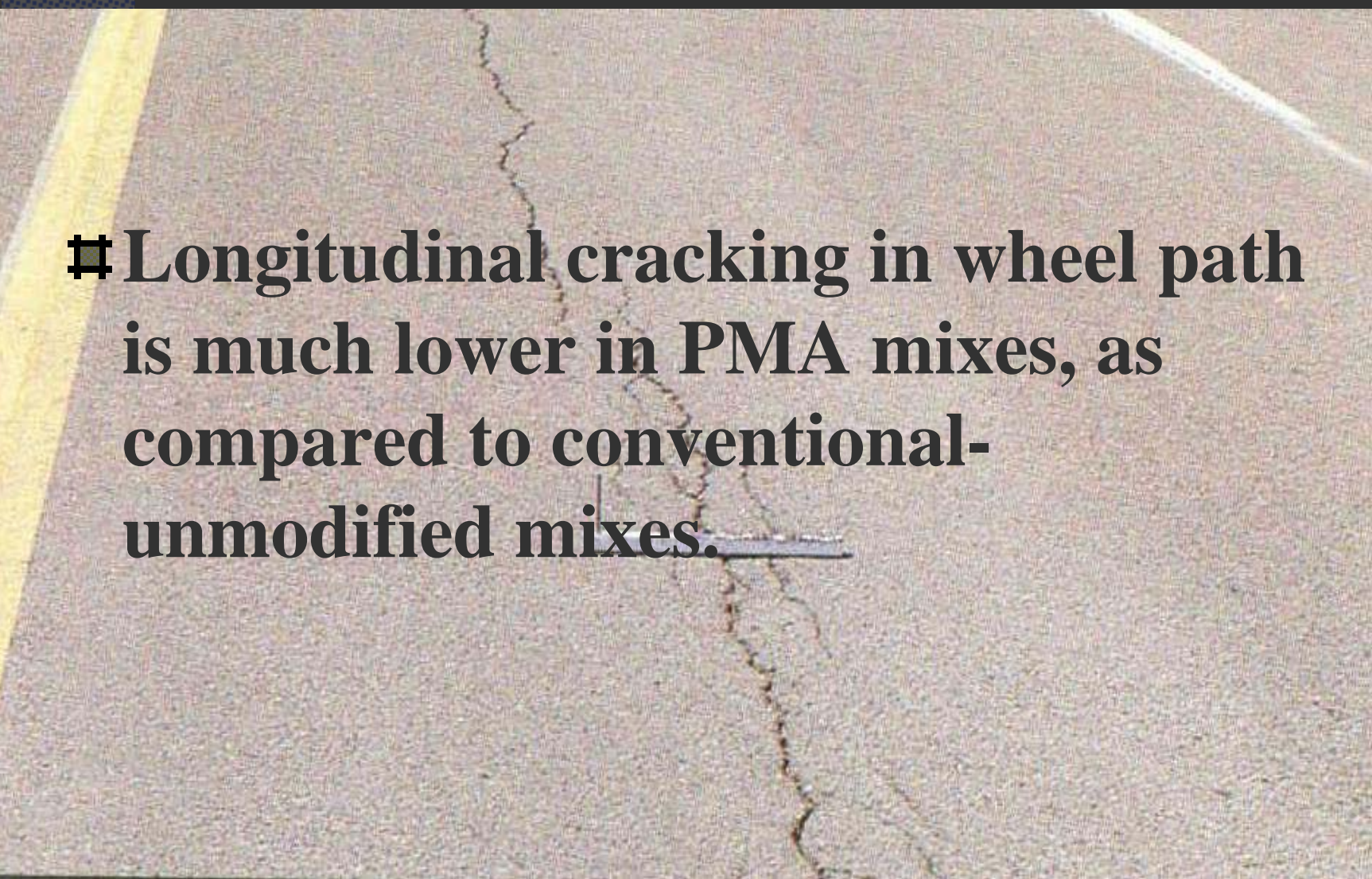


Finding

Mechanistic-empirical analysis confirms need for different calibration factors for predicting performance of PMA mixes.



Observation



Longitudinal cracking in wheel path is much lower in PMA mixes, as compared to conventional-unmodified mixes.

Finding and Conclusion

- PMA mixtures do extend the service life of HMA pavements & overlays.

The real issue is:

***QUANTIFICATION OF THE
INCREASE IN SERVICE LIFE.***

Performance Evaluations



Fatigue Cracking; Area & longitudinal cracking



Rutting

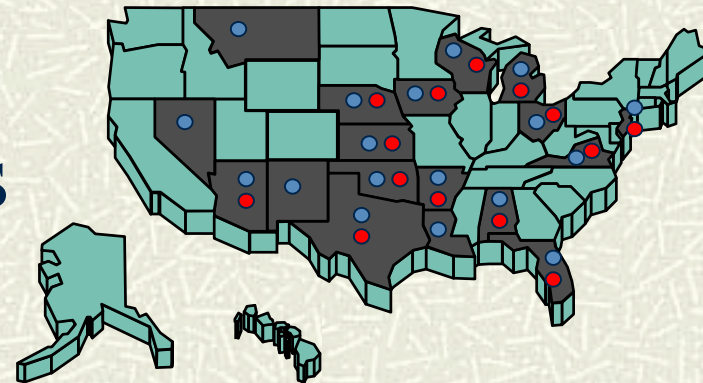


Thermal Cracking



IRI, Smoothness

Other Surface Distress



**Thank you for your attention -
Any questions?**

