



Enhanced Durability Through Increased In-Place Pavement Density

FHWA Asphalt Mixture
Expert Task Group (ETG)
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ADMINISTRATION

Title 23 Code of Federal Regulations CFR Subchapter G – Engineering and Traffic Operations



Part 626.3 Policy.

“Pavement shall be designed to accommodate current and predicted traffic needs in a safe, **durable**, and cost effective manner.”



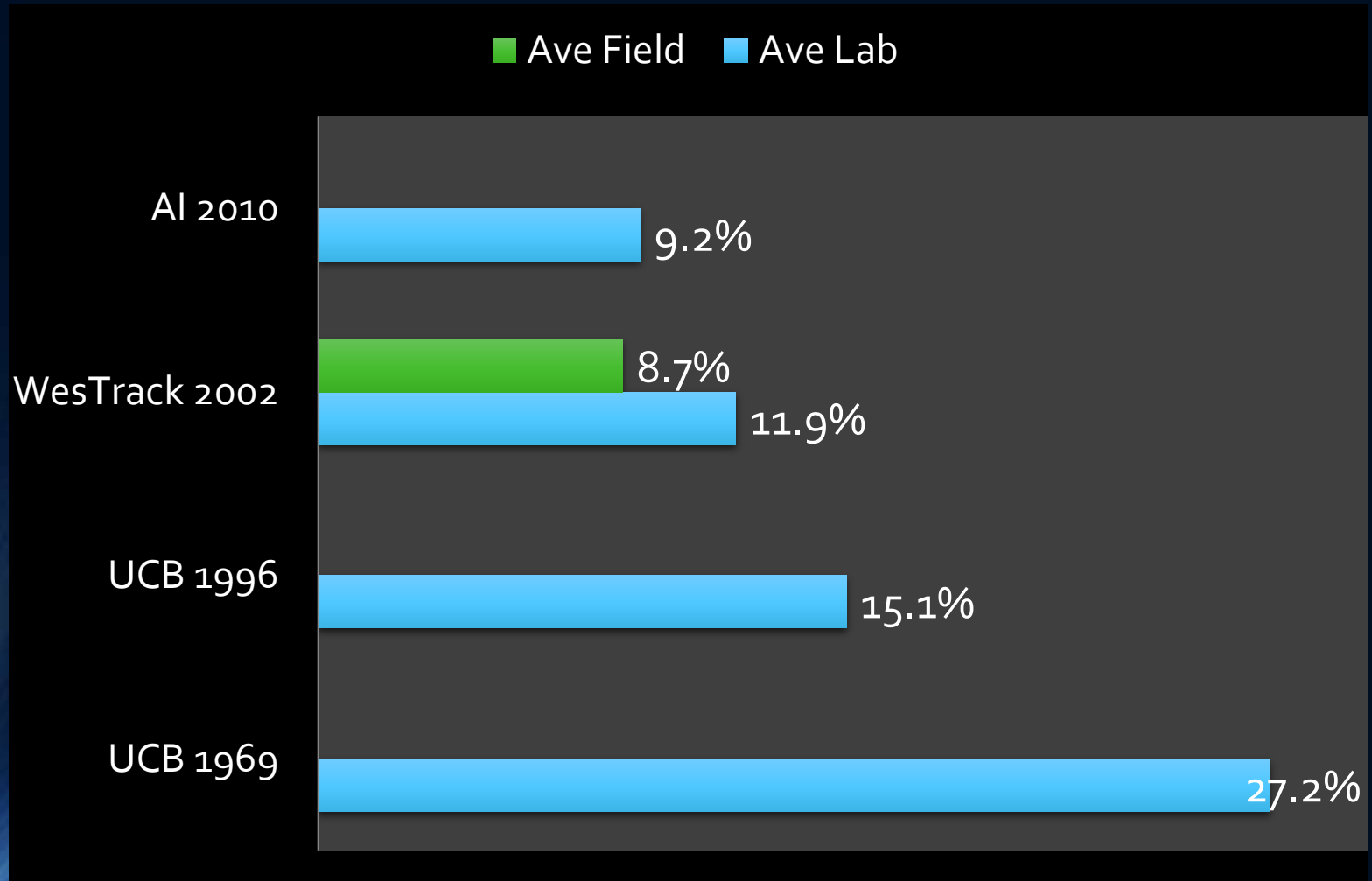
Premise:

- ✓ Compaction is essential for long-term pavement performance
- ✓ There are many compaction enhancements currently in use
- ✓ Compaction goals can be improved

Effect of Air Voids on **Fatigue Cracking**

Study	Lab/ Field	Mix Type	Air Voids Evaluated	Reduction in Fatigue Life for 1% Void Increase
UC Berkeley (1969)	Lab	British Std	4 - 14%	20.6%
		CA Fine	5 - 8%	43.8%
		CA Coarse	2.5 - 7%	33.8%
UCB (1996)	Lab	CA Dense- Graded	1 - 3%	15.1%
			4 - 6%	
			7 - 9%	
WesTrack (2002)	Lab	Fine	4, 8, 12%	13.5%
		Fine-Plus	4, 8, 12%	13.3%
		Coarse	4, 8, 12%	9.0%
	Field	Fine/Fine-Plus	4, 8, 12%	21.3%
		Coarse	4, 8, 12%	8.2%
AI (2010)	Lab	9.5 mm Dense	4 - 11.5%	9.2%

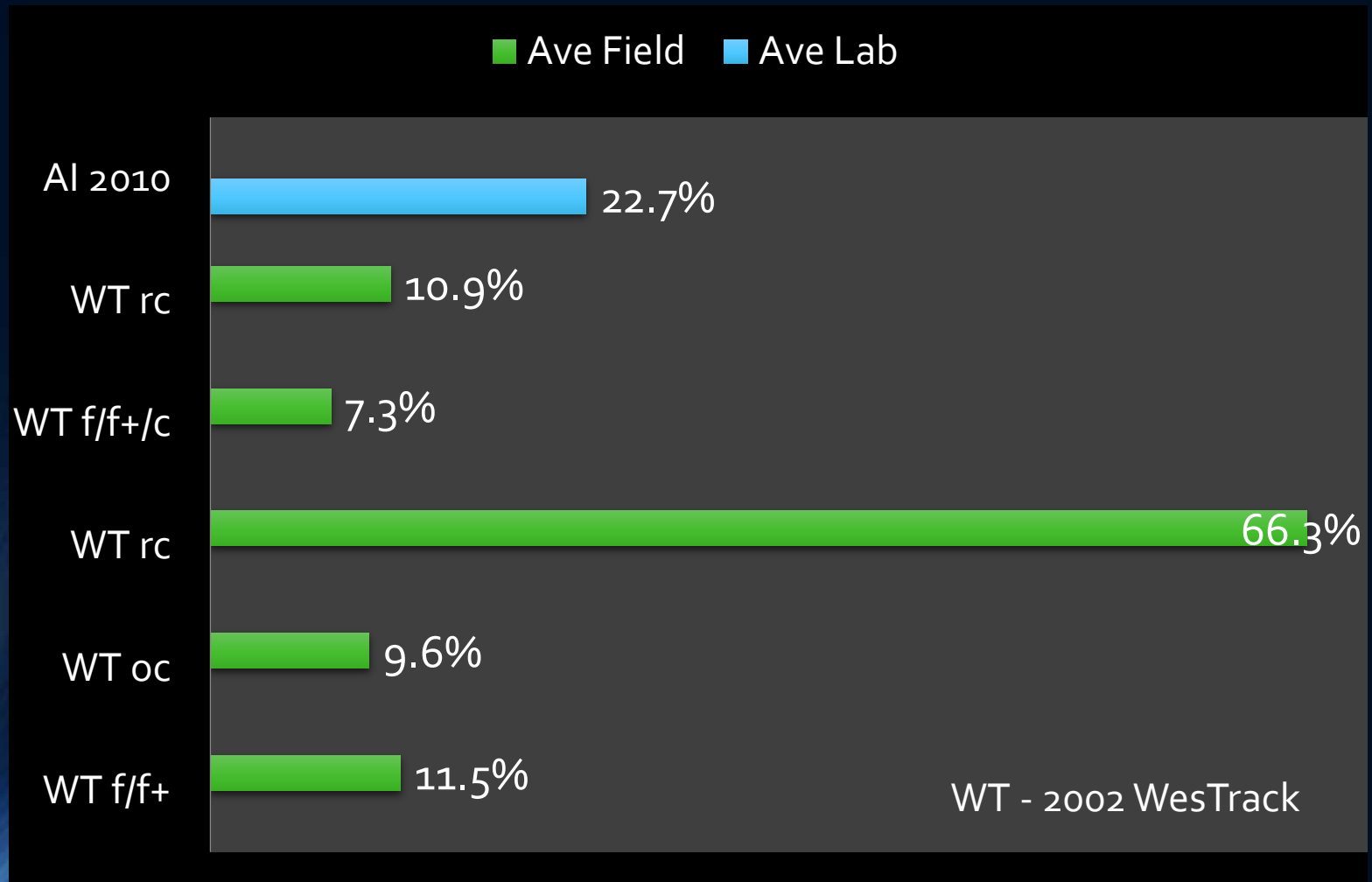
Average Reduction in **Fatigue** Life for 1% increase in Air Voids



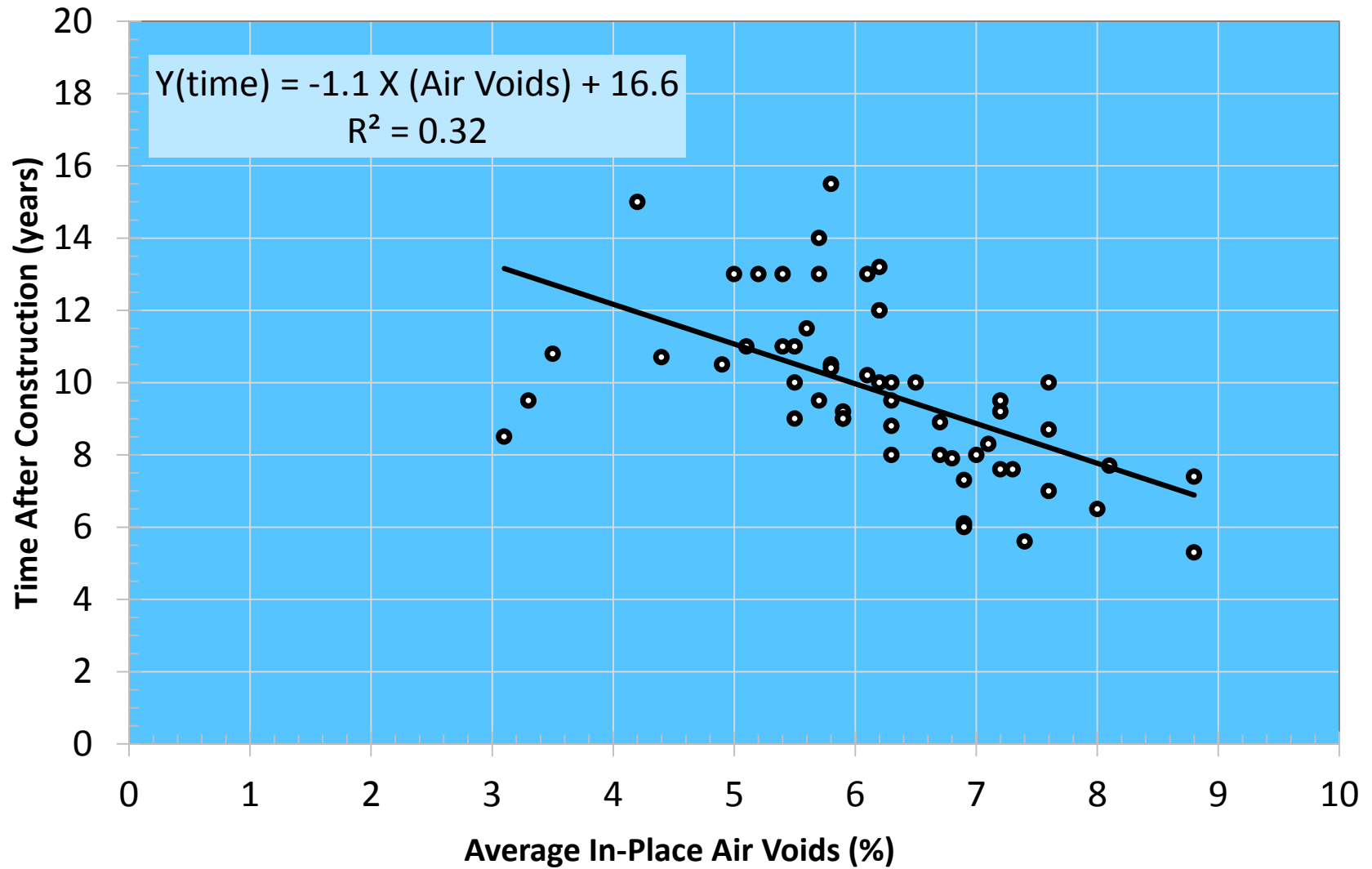
Effect of Air Voids on Permanent Deformation

Study	Lab/ Field	Mix Type	Air Voids Evaluated	Final Field Rut Depth (mm)	Increase in Rut Depth for 1% Void Increase
WesTrack (2002)	Field	Fine/Fine-Plus	4, 8, 12%	9 - 35	11.5%
		Original Coarse	4, 8, 12%	13 - 36	9.6%
		Replacement Coarse	4, 8, 12%	12 - 26	66.3%
	Field	Fine/Fine- Plus/Coarse	4, 8, 12%	9 - 36	7.3%
		Replacement Coarse	4, 8, 12%	12 - 26	10.9%
AI (2010)	Lab	9.5 mm Dense- Graded	4 – 11.5%	N/A	22.7%

Average Increase in Rut Depth for 1% increase in Air Voids



Research from New Jersey



Enhanced Durability through Increased In-Place Pavement Density

- Assumption – Pavement density can be increased with a minimum of additional cost
- Long-Term Objective – States will increase their in-place asphalt pavement density requirements resulting in increased pavement life



Enhanced Durability through Increased In-Place Pavement Density

- A 1% increase in field density (1% less air voids) is claimed to increase asphalt pavement service-life 10+%! (conservatively)
- Today's compaction target is typically 92% of maximum (G_{mm}) (8% air voids), with varying requirements for the area near the longitudinal joint



Enhanced Durability through Increased In-Place Pavement Density

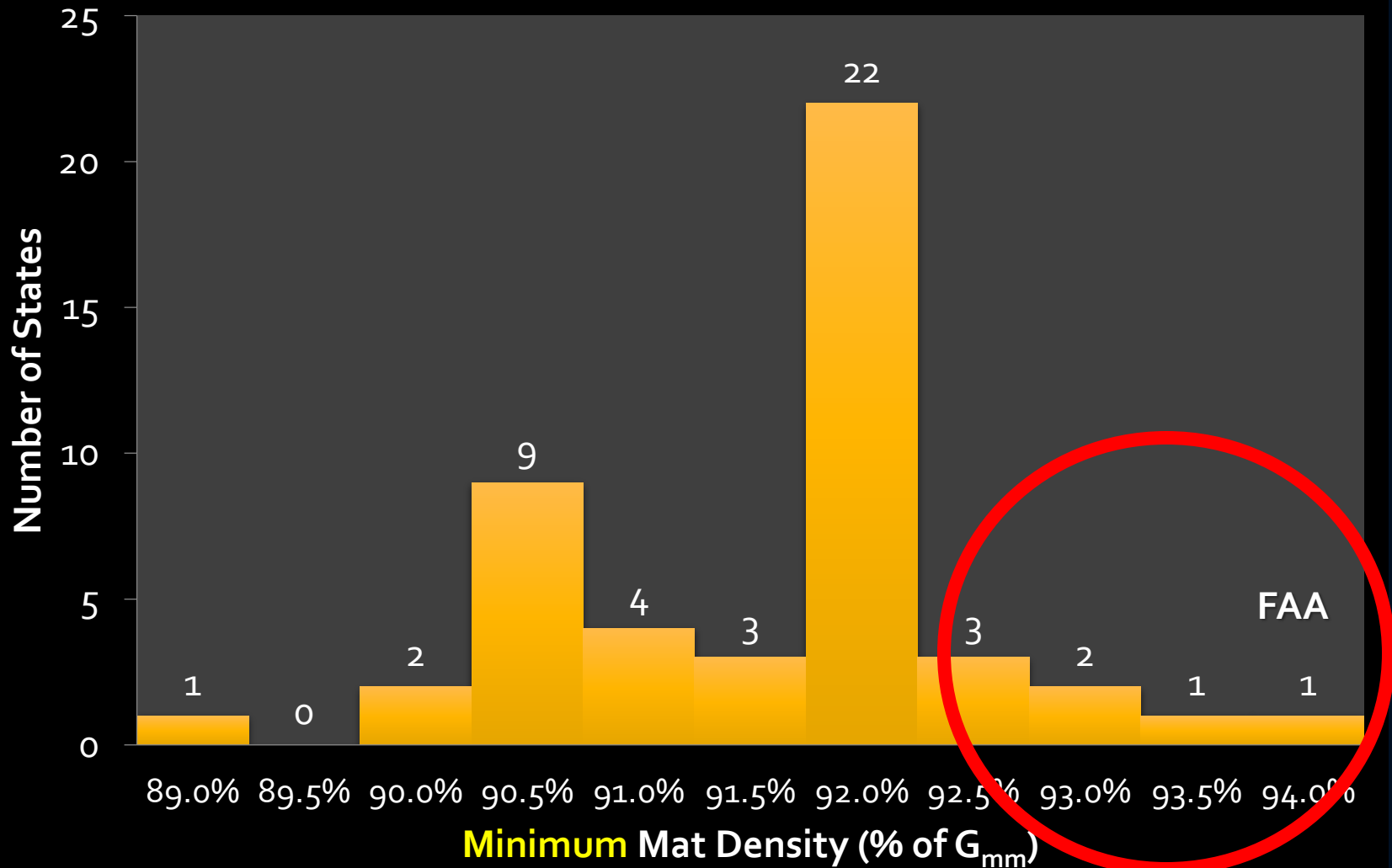
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❖ **Increased Density Pavements** target a 2% increase across the entire pavement!

- Just 2% more... makes a huge difference!

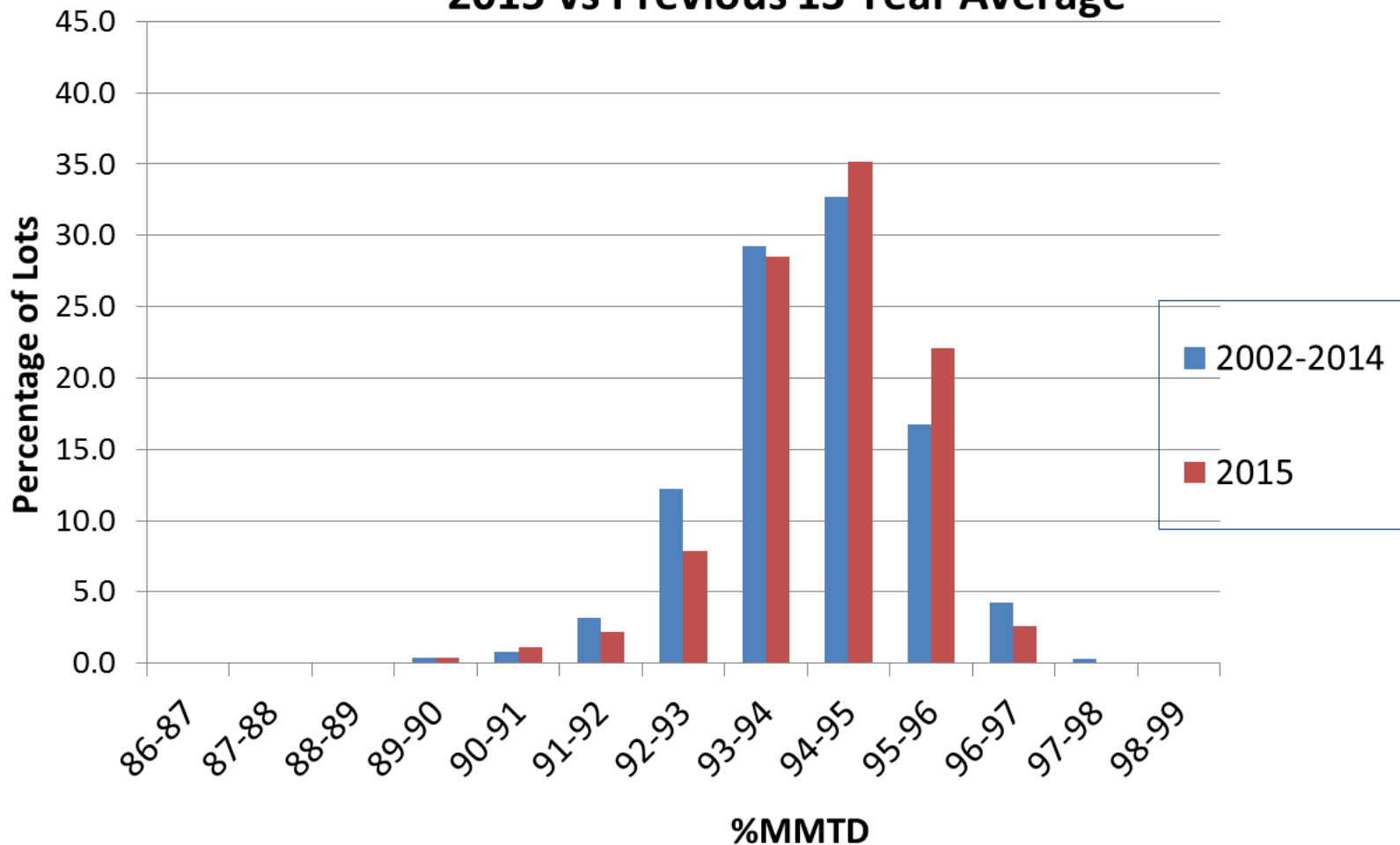


2003 AASHTO SOM Survey



NYSDOT Case Study

50 Series Comparison 2015 vs Previous 13 Year Average

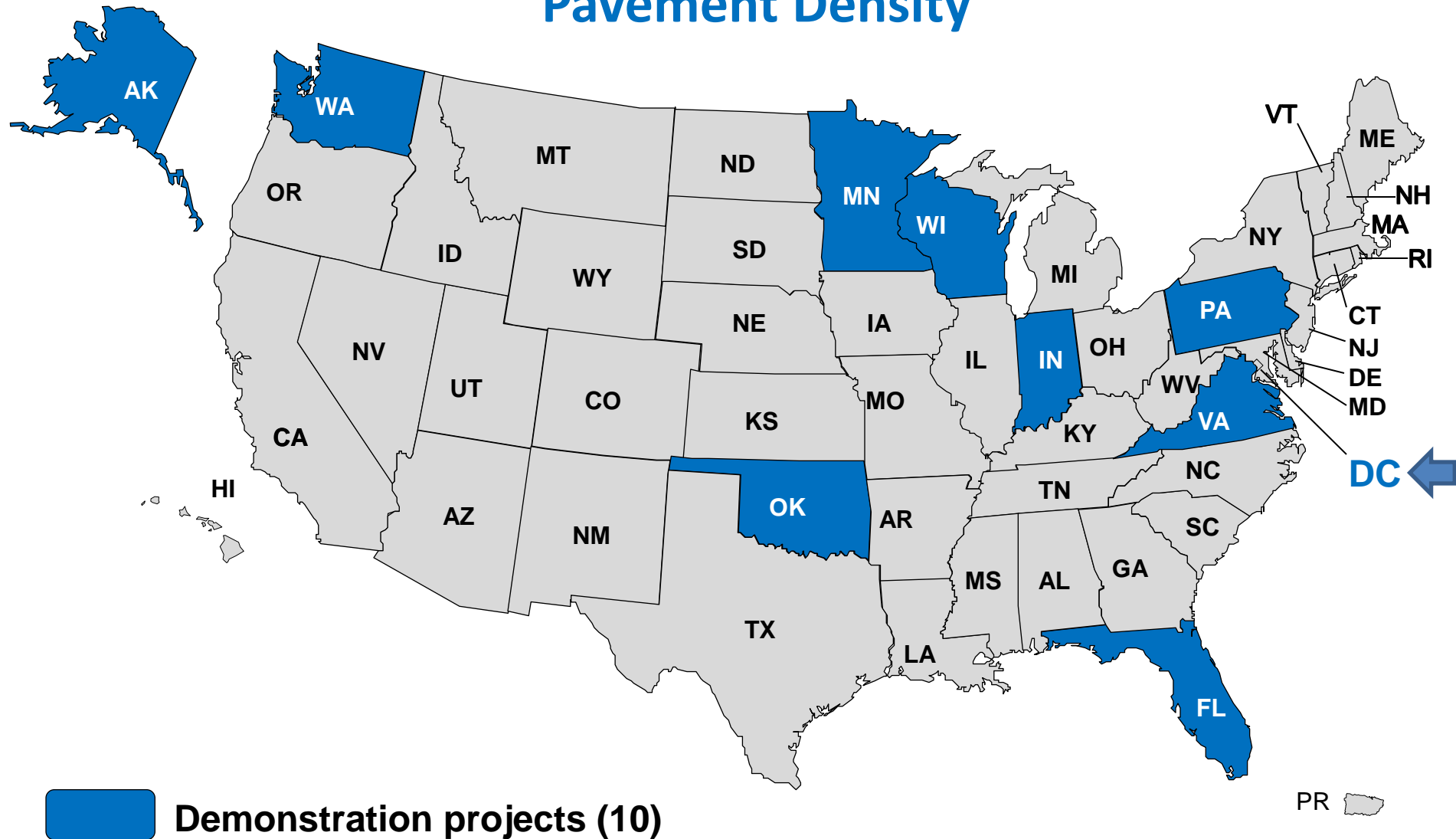


Increased Density Initiative

Next Steps :

1. Contact FHWA Division Engineers, discuss project goals and identify potential state participants.
2. Fund (FMIS) State Agency trials/reports on feasibility
3. On-site training (AI), Information search (NCAT), Conduct Webinars (NAPA)

Enhanced Durability of Asphalt Pavements through Increased In-Place Pavement Density



Current Specifications (1 of 2)

- **4 States (MN, OK, PA, WI)**
 - Minimum lot average
 - Set at 89.5, 90 to 92% of G_{mm}
- **2 States (DC, PA)**
 - Minimum individual test
 - Set at 90 to 92% of G_{mm}
 - Note: G_{mb} used by 1 state

Current Specifications (2 of 2)

- **1 State (VA)**
 - Minimum control strip density
 - Lot average set at 90% of G_{mm}
- **5 States (AK, FL, IN, PA, WA)**
 - Percent within Limits (PWL)
 - Setting LSL and USL
 - LSL set at 91 to 92% of G_{mm}
 - Average generally 93 to 94% of G_{mm}

Experimental Plan

Control Section

Test Section #1

Test Section #2 (optional)

Unique Enhancements

- Support new specification or research (4 states)
- Incentives (3 states)
 - \$ to achieve increased density
 - Partnering with contractor
- Mix adjustments (3 states)
- Additional rollers (2 states)
- IC rollers (2 states)
- SHRP2 IR scan (2 states)
- Statistical evaluation (1 state)

Increased Density Pavements

Planned Schedule

- By March 2016, 10 State projects were identified
- By December 2016, 10+ State highway agencies will host an “Increased Density” Asphalt Construction Workshop
 - SHA, Contractors, Equipment Supplies, and Academia
- By December 2016, 10 State highway agencies will place a “Increased Density “ Pavement Section
 - FHWA funding evaluations on existing pavement projects
- 2017, document number of states that modify existing standards
 - Goal 10+ states.....



THANK YOU..... and Questions

Enhanced Durability Through
Increased In-Place Pavement Density

