Best Practices for Constructing and Specifying HMA Longitudinal Joints

A Cooperative Effort between Asphalt Institute & FHWA

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Sr. Regional Engineer
Asphalt Institute

Don’t We Already Know How To Build a Longitudinal Joint?

Photo: Carlos Rosenberger

Photo: Carlos Rosenberger

Photo: Carlos Rosenberger

- Note condition of the rest of the mat
- Also sealed each side of patch.

Photo: Carlos Rosenberger


“ In recent years, it has become evident how critical longitudinal joint construction is to the life of the pavement structure…
Many pavements have been or are in the process of being resurfaced as a direct or indirect result of longitudinal joint deterioration.”
Kentucky Transportation Center
College of Engineering

Project Team

- Asphalt Institute
  - Mark Buncher
  - Carlos Rosenberger
  - AI Regional Engineers
- FHWA
  - Thomas Harman
  - Michael Arasteh
  - Stephen Cooper
- PA State Asphalt Paving Association
  - Gary Hoffman

Our Approach

1. Benchmark Survey – FHWA Divisions
2. Literature Review
3. Identify… What we know? Things we don't?
4. Interview the Experts (19)
5. Visit select State DOT's (5)
6. Report & Develop Training Tools…

Two Goals

Takeaways from FHWA Survey to 52 Division Offices

- ½ States are not satisfied with overall performance of L-Joints

- 2/3^{rds} of States have a "L-Joint spec"
  - Half of those (17) have a min. density
    - Range from 89% - 92% min G_{mm} *(Rice)*
  - Other half are method specs
    - From Joint Adhesive to very prescriptive

1st Goal

Best way
To Build it.

Experts Interviewed…

10 Consultants

- Jim Scherocman
- Chuck Deahl
- Jim Heddrich
- Ron Corun
- Larry Michael
- Steve Neal
- Brian Prowell
- Tom Skinner
- Frank Colella
- Wes McNett

9 NAPA Sheldon D. Hayes Winners

"Single best paving project of the year."

N.A.P. CO.
NORRIS ASPHALT PAVING CO.

DUININCK
INCORPORATED

LINDY PAVING
PJ DICK • TRUMBULL

FLANIGAN
SINCE ★ 1885

DES MOINES Asphalt and Paving COMPANY

Michigan Paving & Materials Co.

K.Barnett & Sons Inc.

Note: *Lindy Paving has won 3 times in the last 10 years!*

Interview Questions

LONGITUDINAL JOINT CONSTRUCTION INTERVIEW

This survey is part of the Asphalt Institute's cooperative agreement, "Marketing of Hot Mix Asphalt (HMA) Joint Construction Best Practices".

1) First pass must be as straight as possible. How do you accomplish that?

2) Do you prefer a
   a) Notched wedge joint Do you compact the wedge? (yes) (no)
   b) Butt Joint

3) Do you use paver automation (yes) or (no), Your preference is
   a) Joint Matcher
   b) Ski

4) Do you roll the unsupported edges by:
   a) Staying back 6-inches from the edge
   b) Overhang the edge of the mat by 6-inches
   c) Other _____

5) When using a wedge joint do you tack the notch & wedge (yes) or (no) if yes, with
   a) Emulsion
   b) PG-grade Asphalt
   c) Other _____ If yes, complete wedge or portion. Any problems?

6) When using a butt joint do you tack the vertical face (yes) or (no) if yes, with
   a) Emulsion
   b) PG-grade Asphalt
   c) Other _____ If yes, complete wedge or portion. Any problems?

7) Have you ever used a proprietary joint adhesive, (yes) or (no), if yes
   a) Was it practical? (yes) or (no)
   b) Did it improve the performance of the joint? (yes) or no)

8) Have you ever cut the cold joint back prior to placing the adjacent lane? (yes) or (no)
   a) Was it practical? (yes) or (no)
   b) Did it improve the performance of the joint? (yes) or (no)

9) Have you ever used an infra-red heater on a longitudinal joint? (yes) or (no)
   a) Was it practical? (yes) or (no)
   b) Did it improve the performance of the joint? (yes) or (no)

10) How much do you overlap the hot material onto the cold material?
   a) _____

11) What do you do with the overlap material?
   a) Push it back to the joint
   b) Do nothing
   c) Other _____

12) Do you roll the second pass
   a) From the hot side overlapping onto the cold
   b) From the cold side overlapping onto the hot
   c) Make the first pass staying back from the joint and overlapping onto the cold with the second pass
   d) Start rolling on the outside edge and working into the joint
   e) Other _____

13) Do you monitor the longitudinal joint density (yes) or (no), if yes, how
   a) Nuclear gage or similar device
   b) Cores
   c) Other _____

14) Which type of specification offers the best chance to long term joint performance?
   a) Method
   b) Minimum percent density. What is the practical minimum? _____%
   c) No specification

15) Does a fine 9.5mm mix have a better chance for good performance than a 12.5mm
   a) Yes
   b) No

16) Does a 9.5mm mix with a design asphalt content of 6.2% asphalt have a better chance for good performance than that same mix at 5.7% asphalt?
   a) Yes
   b) No

17) Could I do anything additional in "late season" paving to improve joint performance?
   a) _____

18) Have you ever been required to seal the surface of a longitudinal joint as part of the contract? (yes) or (no). If yes, what did you use to seal the joint?
   a) The material was _____
   b) The width of the seal was _____ -inches

19) What are the other "Tips that make the difference"? List as many as you like.

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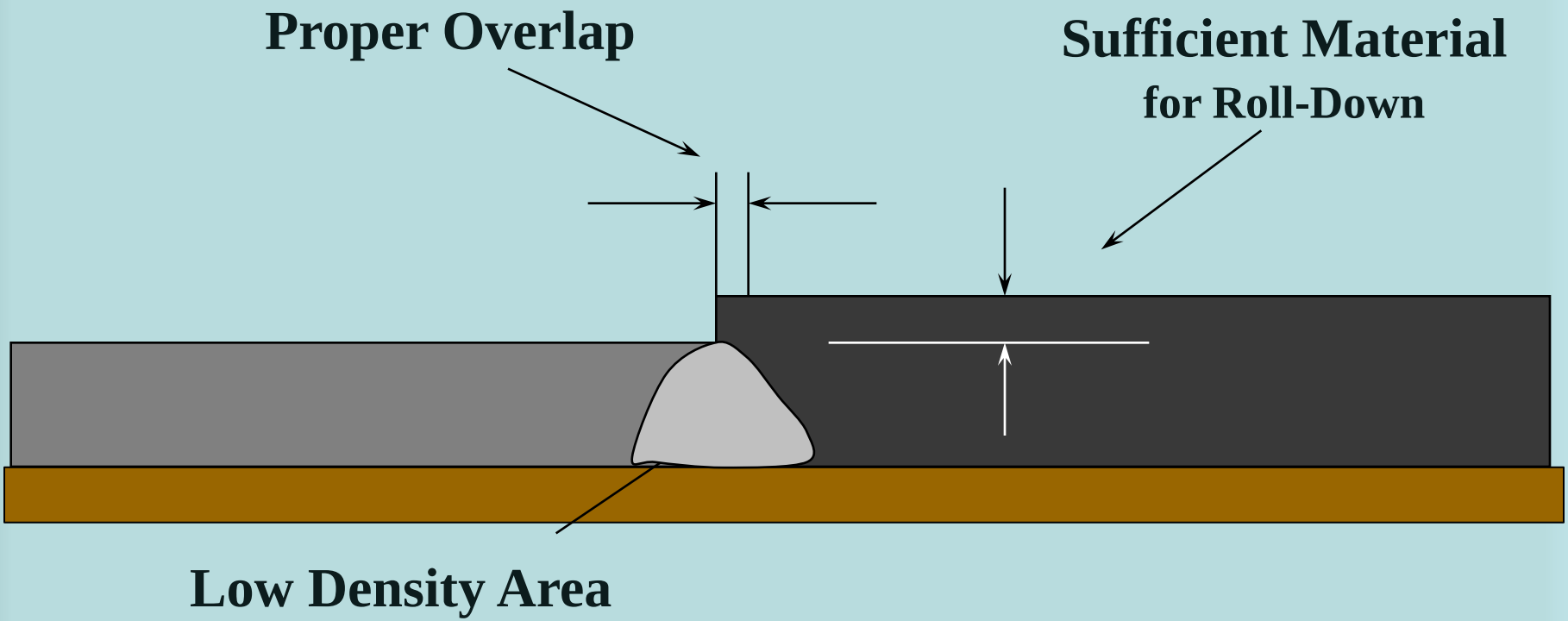
-

We sincerely appreciate you assistance in improving the performance of longitudinal joints. Thank You

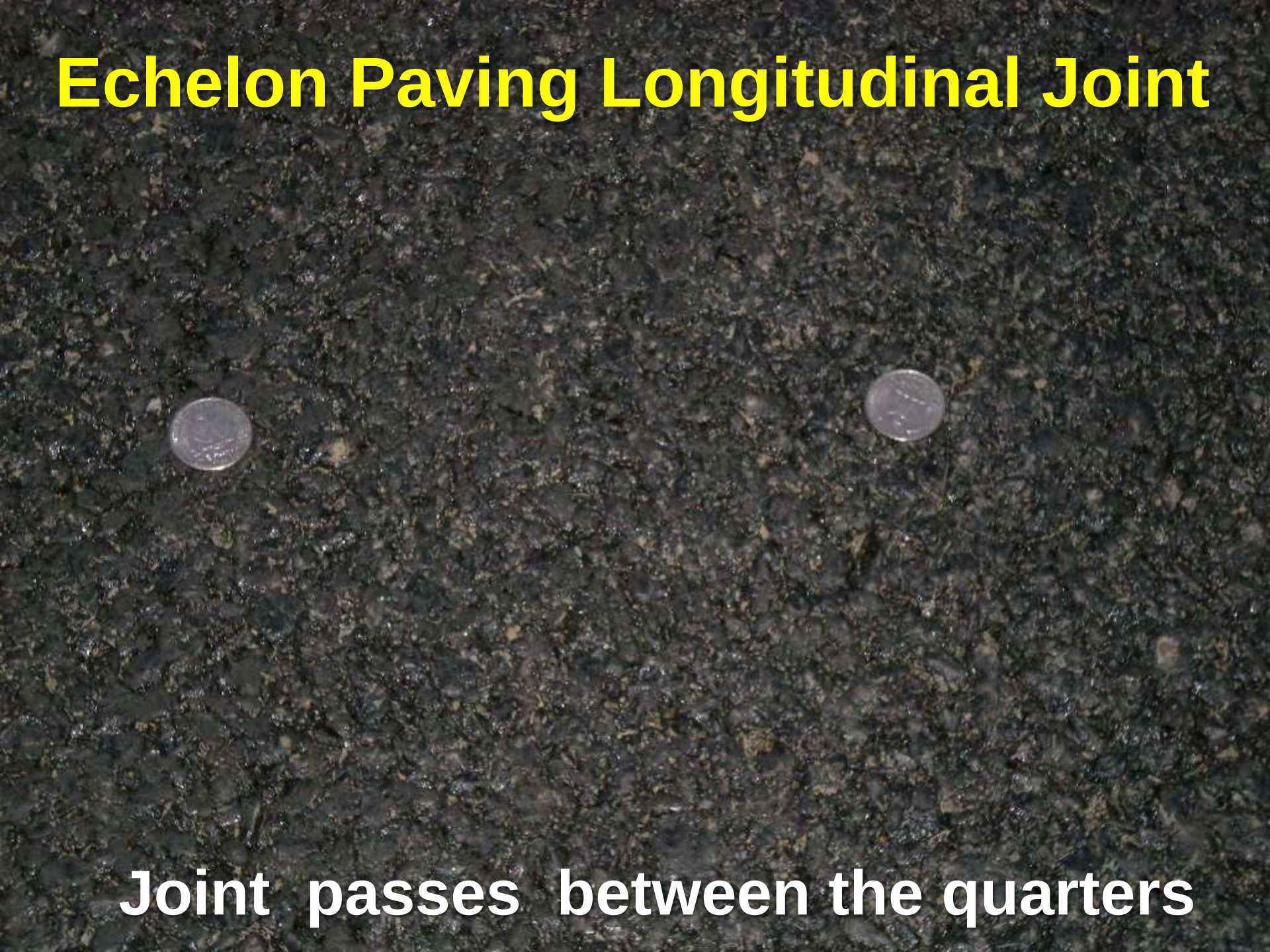

Do the Experts Agree?
Not Always

We Know Unsupported Edge Will Have Lower Density




The Best Longitudinal Joint
Echelon Paving
INTERSTATE
295
New Jersey
BOMAG
BOMAG
HYPAC
HYPAC
Rolled Hot

Echelon Paving Longitudinal Joint



Joint passes between the quarters


But, the need to maintain traffic limits
the opportunities to pave
in echelon
Consequently, most longitudinal joints are
built with a cold joint.

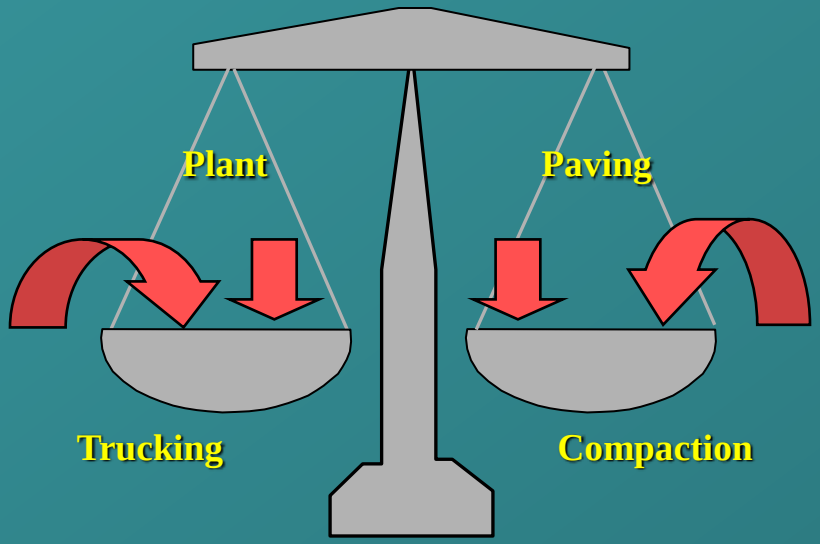
Experts, Q. Prefer Notch-Wedge or Butt Joint?

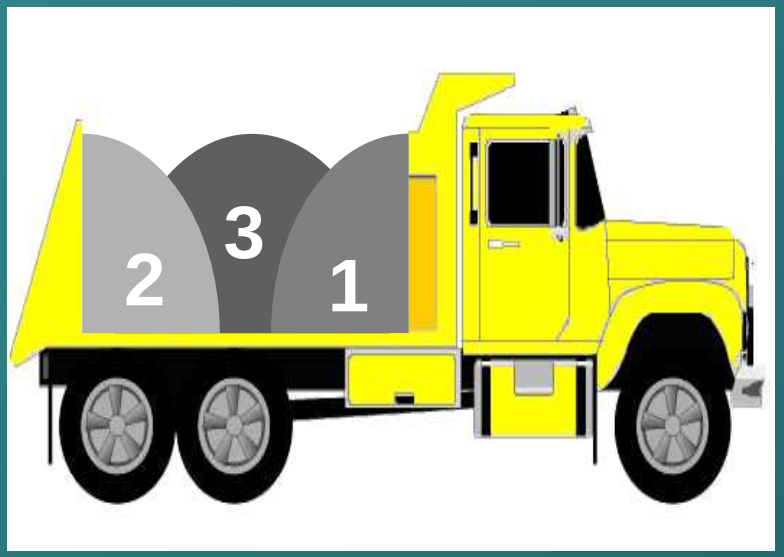
Nearly Divided

Prior Planning Key!

- Select joint (butt or wedge) best suited for that job
- Choose smallest NMAS that will do the job
- Consider using a “fine” gradation
- Lift thickness = NMAS x 4, exception “fine” gradation, NMAS x 3
- Offset the L. J. on multiple lifts.
- Longitudinal joint should be included in construction plan & sequence

GETTING STARTED OFF RIGHT





Dump Person

MTV

Tack Coat

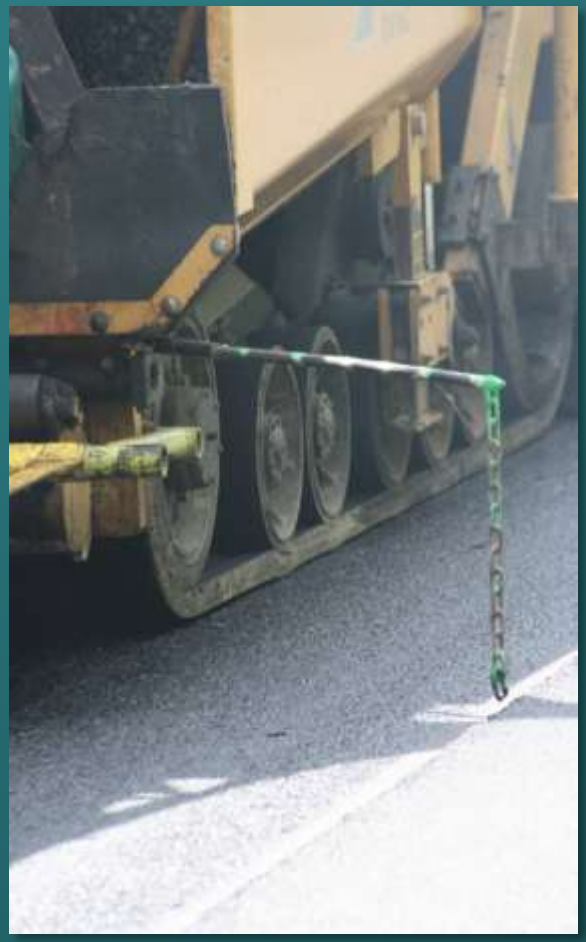
Full width of mat to minimize movement of unsupported edge

First Pass Must Be Straight!

Unanimous that a string-line should be used to assure first pass is straight

String-line

Skip Paint



Reference

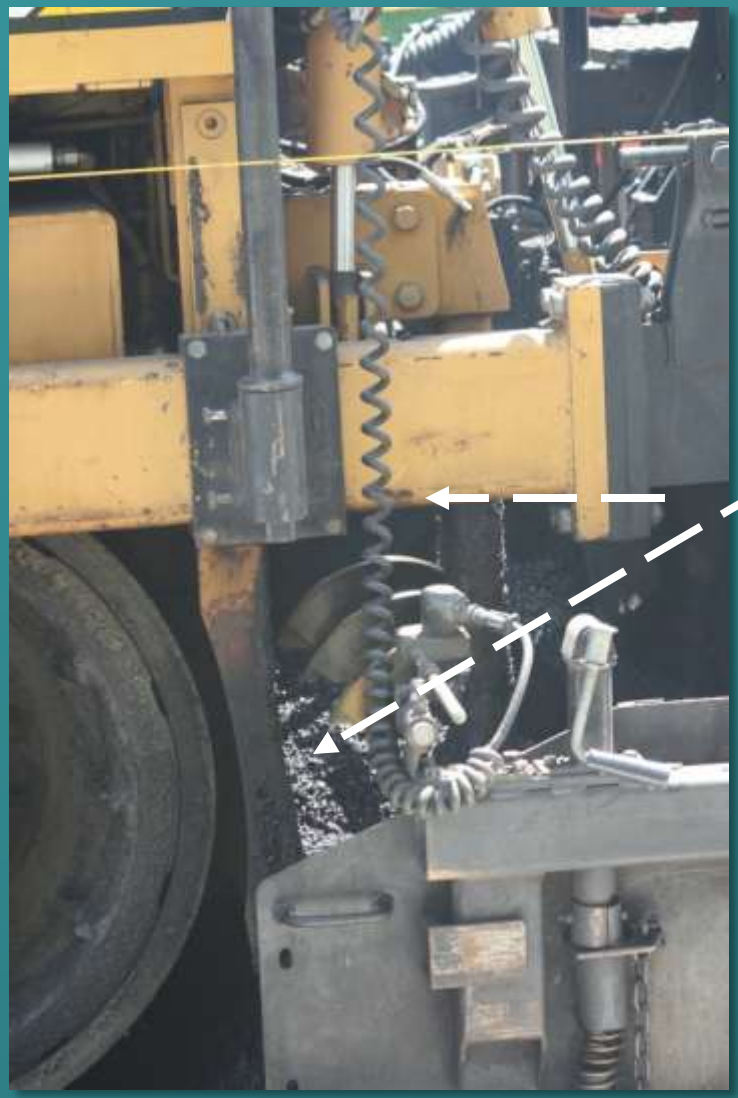
Great Results

Tough to get proper overlap (1”) with next pass

Paver on Automatic with Joint Matcher

Vibratory Screed should always be On

Auger



Uniform Head of Material
Across the Entire Screed

Carry Material Within
12 – 18-inches of
the End Gate

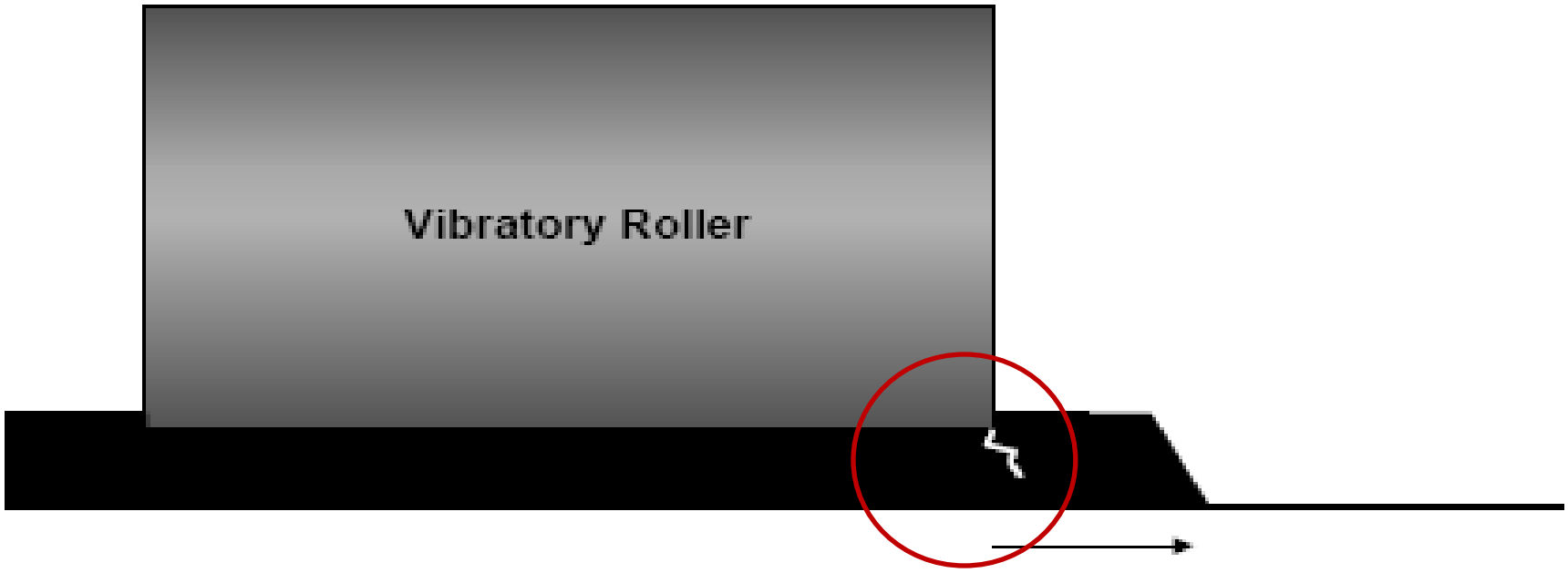
This is unacceptable


Auger not extended to within 12 to 18-inches of the end gate.
The result -
SEGREGATION at joint

1st Roller Pass on Unsupported Edge 50/50: Overhang vs. Stay Back 4-6”

- Roll When HOT!

If staying back 6”, Watch for lateral movement and stress crack



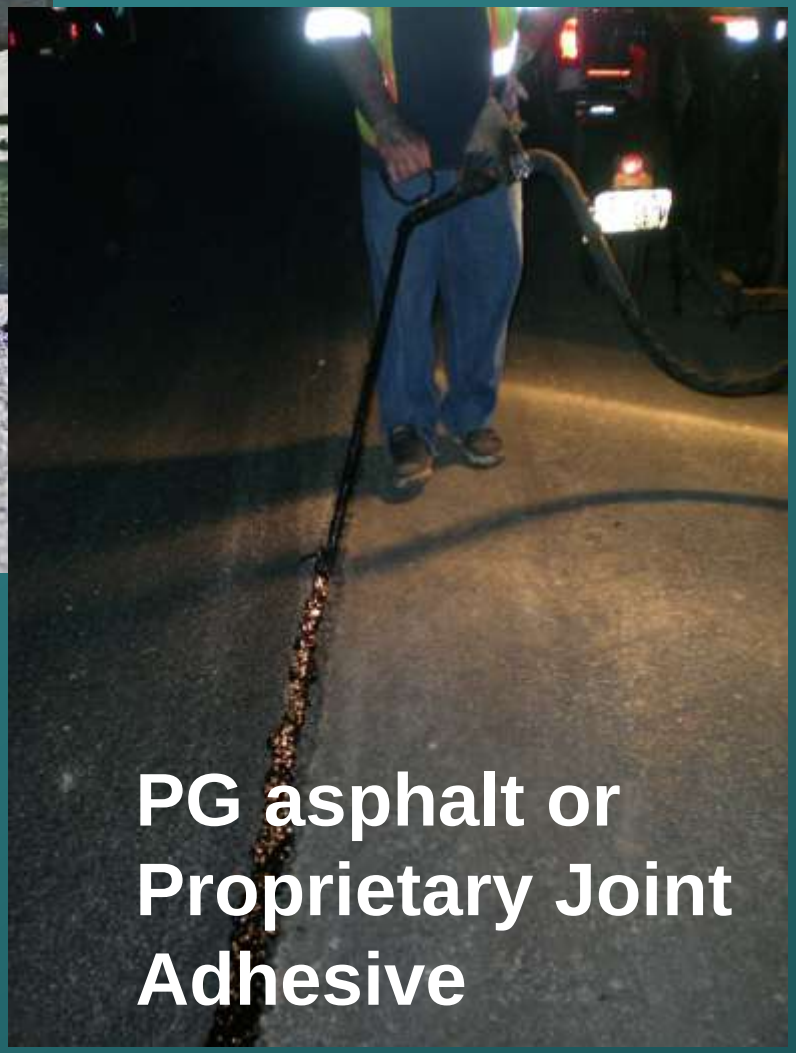
Edge of drum inside unsupported edge

Can cause cracking near the edge and lateral mix movement at the unsupported edge

Quality Control, Monitor Joint Density

Tack the Joint! (Butt or Wedge)

Emulsion, or



Matching Joint

Proper Overlap: 1.0 ± 0.5 inches

Sufficient Depth of HMA to avoid “starving” joint and “bridging” with roller

After all rolling, desired height diff. about 0.1”

Don’t Lute the Longitudinal Joint

This lute person is doing a great job

Bumping Joint Properly

Don’t push across!

Rolling the Supported Edge
(many different opinions and approaches)

Staying off the Joint by 6”
with 1st Pass Avoids Bridging

but, watch for stress cracks along the edge of the drum. May be more of a concern with rolling unsupported edge

2nd Goal

Best way
To Spec it.

Longitudinal Joint

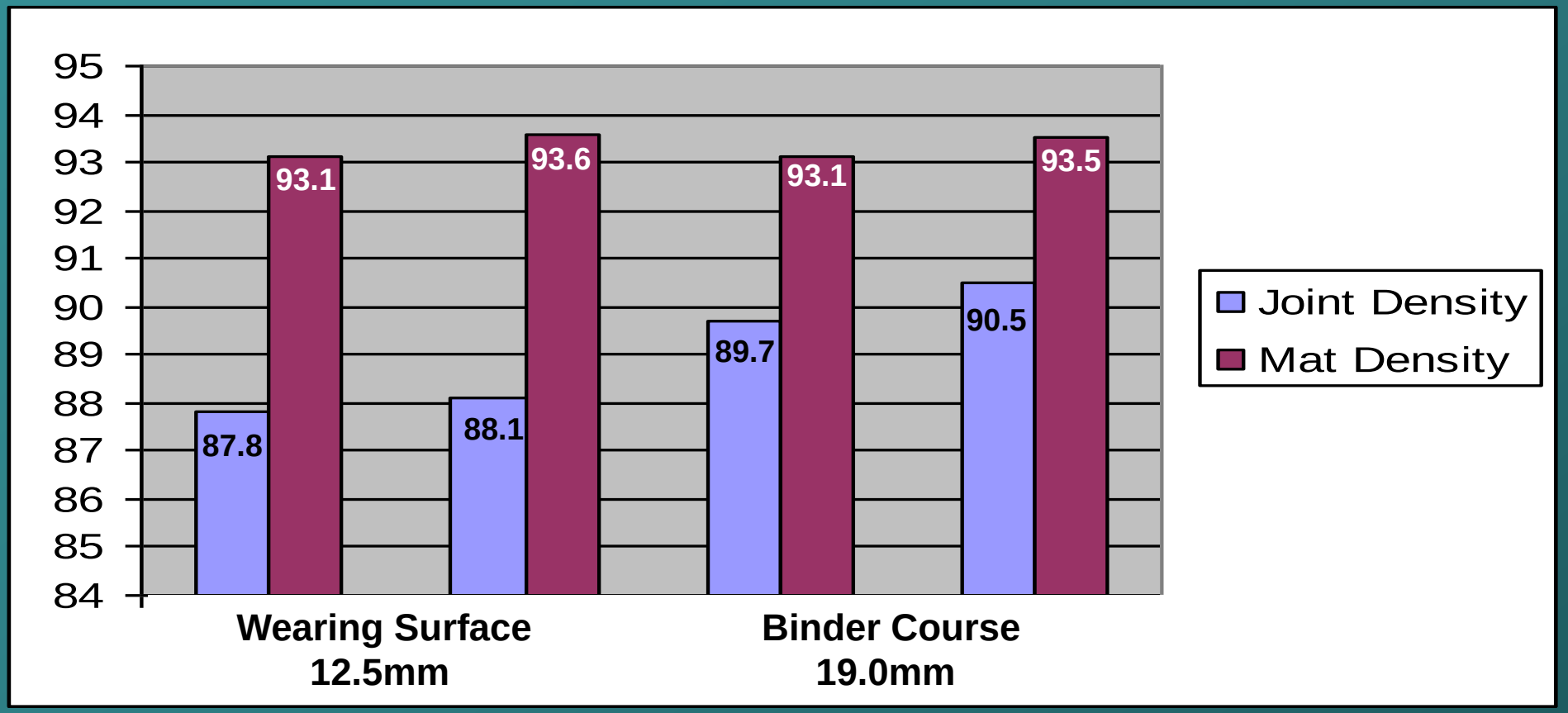
Literature Review

Construction
What in-place densities are we getting?

Permeability
What is the danger zone?

Joint vs. Mat Density

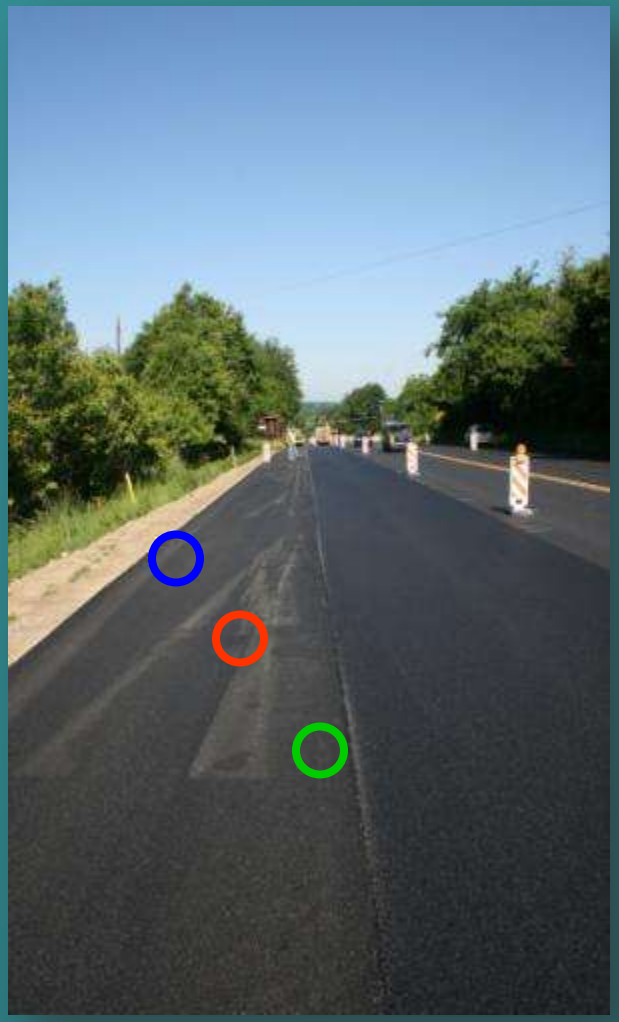
(Representative of Other Studies)

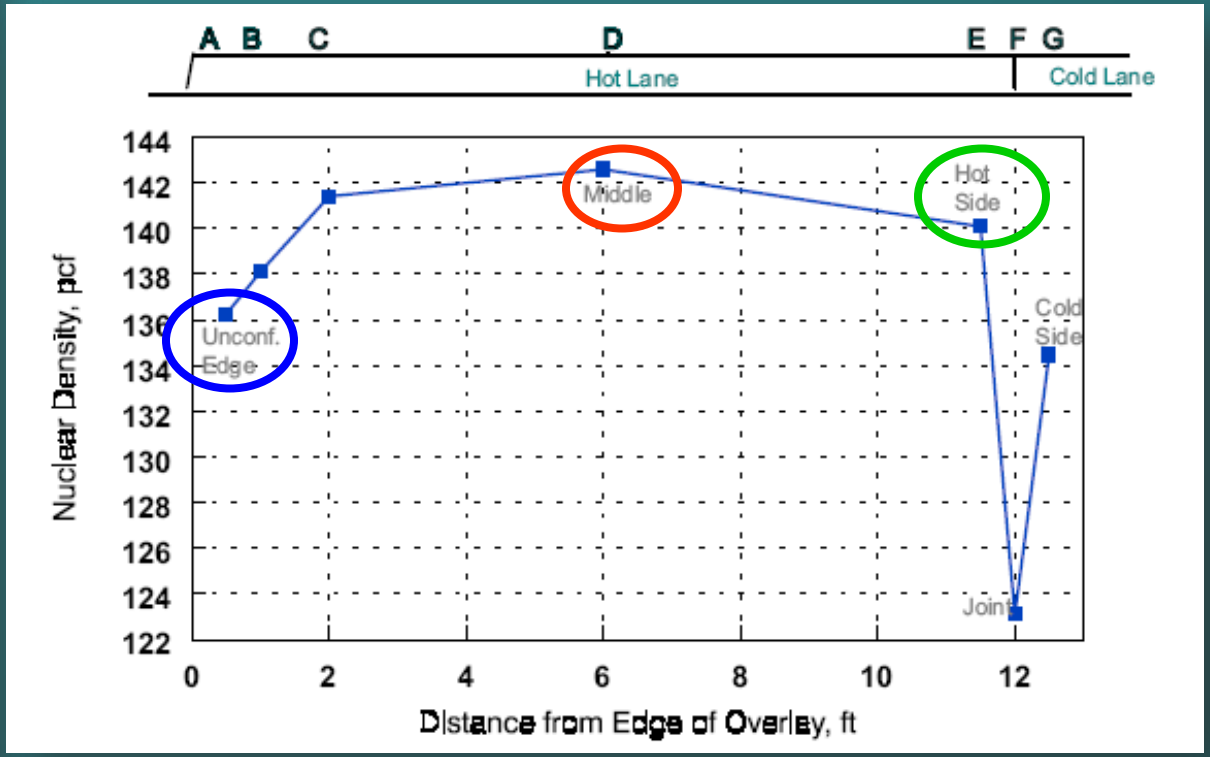


D. Maurer, P.E.

Nuclear Density Profile

Texas Transportations Institute Study





Unconf.	Middle	Hot Side
88.5 %	93.0%	91.0%

Methods for Evaluating Longitudinal Joint Quality in Asphalt Pavements

- S. Williams, et al. Univ. of Arkansas

Good Joint Performance	97% of the Mat
Fair	93 to 97%
Poor	< 93%

Longitudinal Asphalt Pavement Joint Construction ……Performance

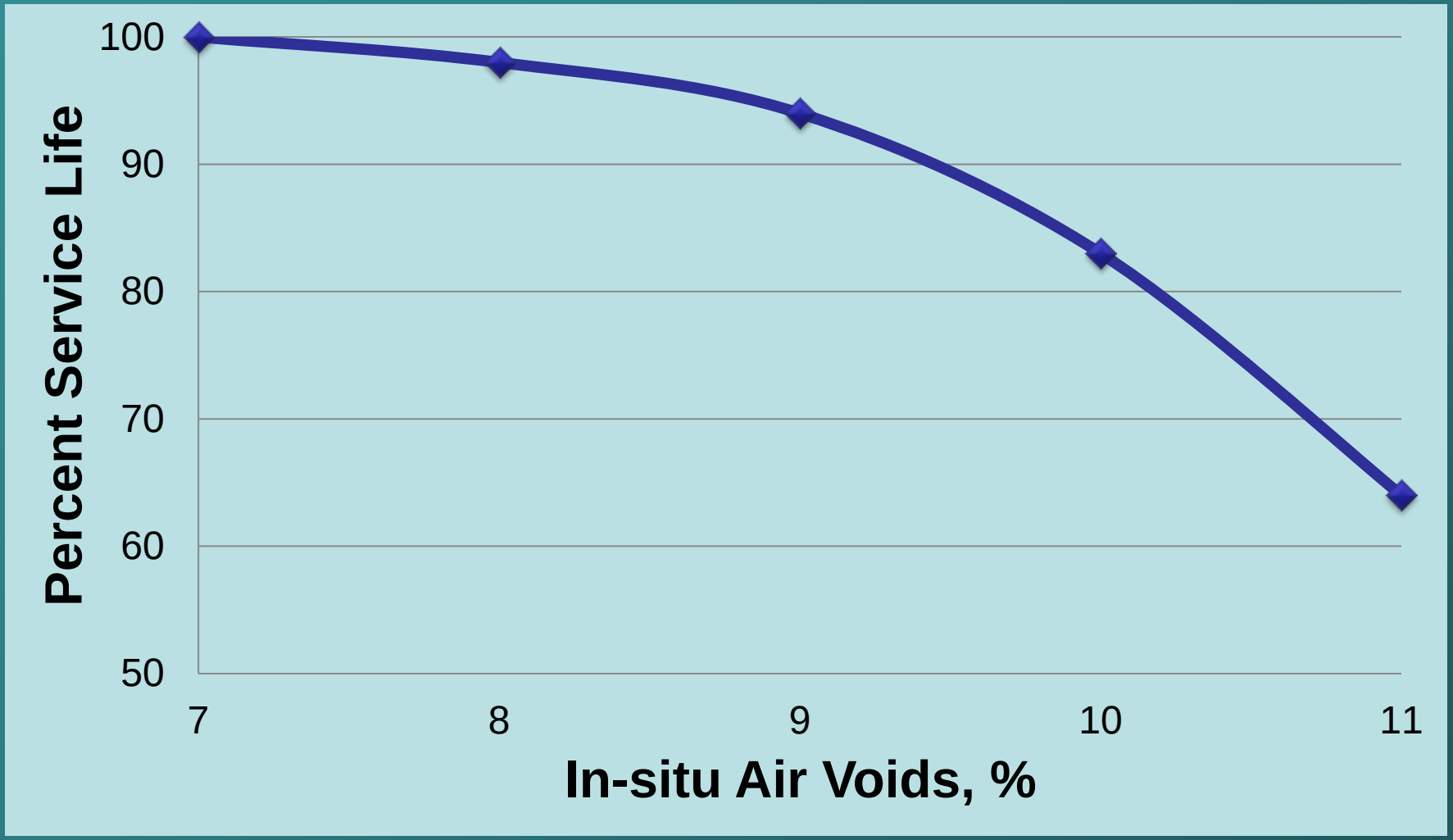
- D. Morian, et al. Quality Engineering Solutions, NV

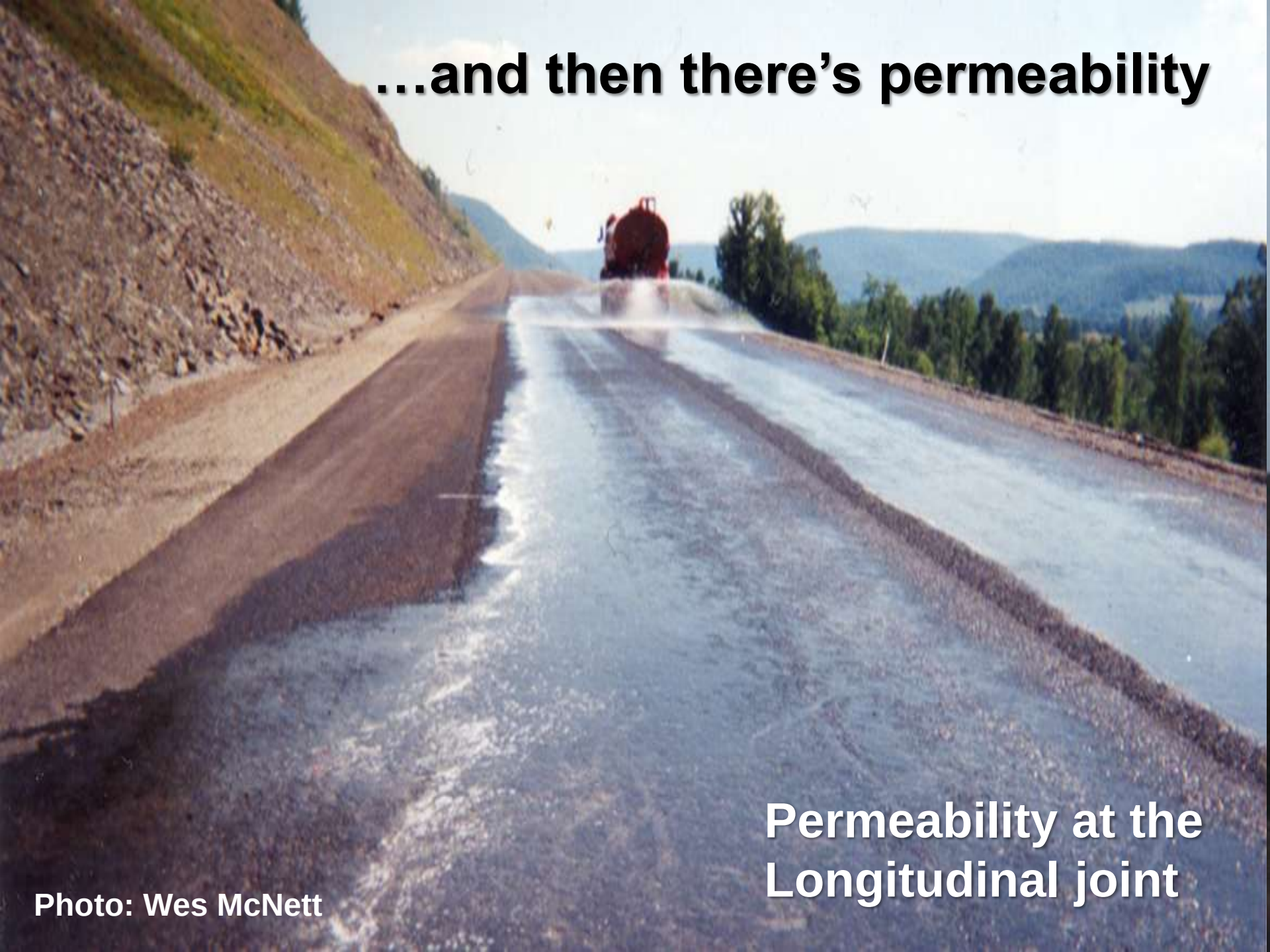
Significantly better performance		98% of the Mat	12 years
	vs	95% of the Mat	8 years

Assume mat is 94% of G_{mm},	then 98% of 94% is 92%	(8% V_a)
	then 95% is 89%	(11% V_a)
	then 93% is 87%	(13% V_a)

Effect of In-Place Voids on Life

Washington State DOT Study




…and then there's permeability
Permeability at the Longitudinal joint
Photo: Wes McNett


Destined for Failure

Permeability can be Catastrophic

Various Research Reports on Critical Air Void Level for Permeability

	Critical Voids where permeable
9.5 mm	
E. Zube - California Dept. of Highways - 1962	8
L. Cooley, B. Prowell, R. Brown – NCAT - 2002	7.7
R. Mallick, et al - (fine graded)	8.5
12.5 mm	
B. Choubane, et al – Florida DOT - 1998	7
J. Westerman – Arkansas HTD - 1998	6
NCAT 03-02 – (coarse graded) - 2003	7

Dilemma at the Joint

Proposed "End-Game" Criteria for LJ Density Spec

Six-inch Cores -

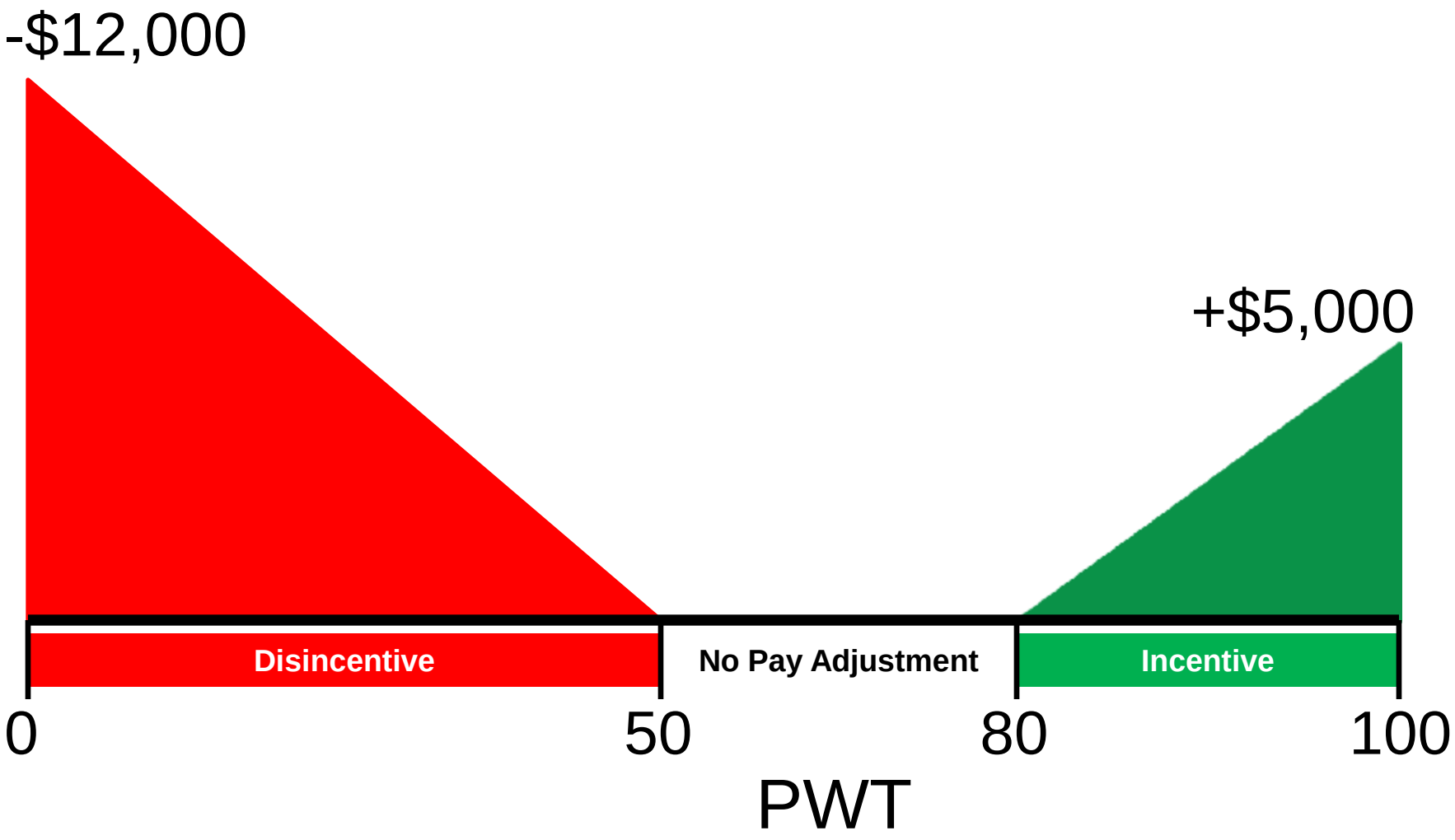
Centered on butt joint, or middle of wedge

≥ 92% of G_{mm} : maximum bonus

Between 92% and 90% of G_{mm}: pay 100%, possible pro-rated bonus, and overband joint

< 90% of G_{mm} : reduced payment, overband joint

Impact on Lot Payment Summary



Option: Sealing the LJ

Overbanding is not Unusual

Many Agencies require for patching

Other Options / New Products

- Mill & Pave One Lane at a Time
- Cut Back Joint
- Wedge Compactors
- Joint Heaters
- Joint Adhesives (hot rubberized asphalt)
- Surface Sealers Over Joint

Cutting Back the Joint

B. Prowell photos

Cutting Wheel Fixed to Roller in Europe

- Best practice in Europe on Dense Graded mixes on large projects when traffic is managed.
- Cut when mix is warm and plastic.
- Watering of blade prevents tearing.
- Joint then painted with 50pen binder.
- Cutting and painting not done on open mixes.

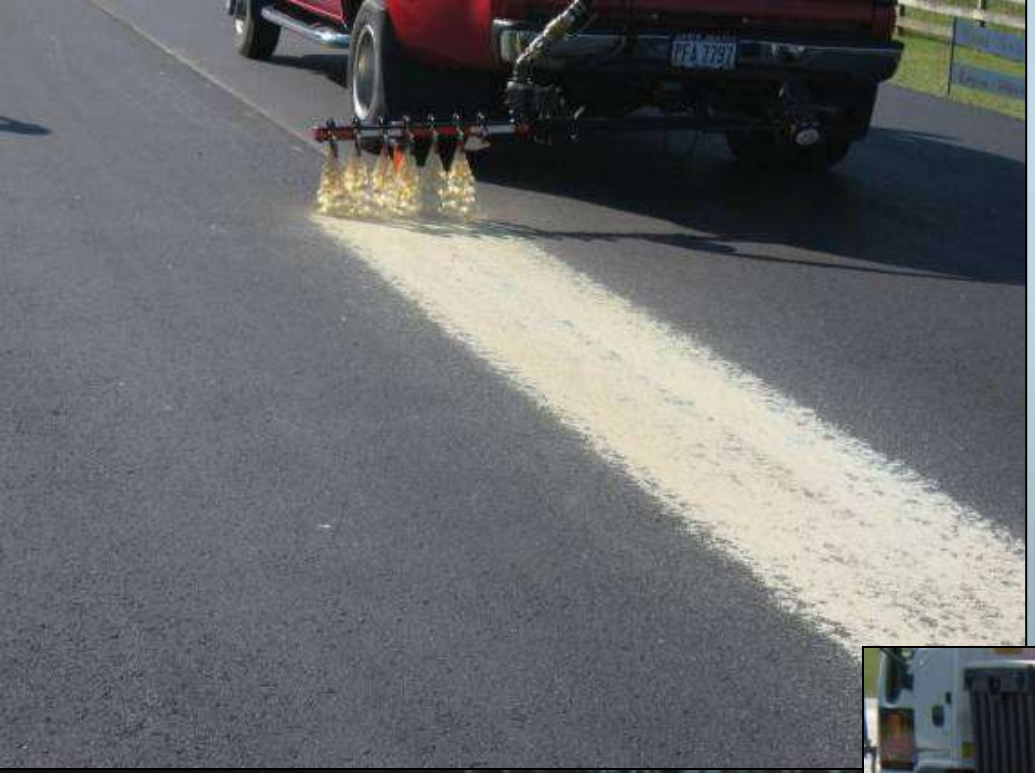
http://www.highwaysmaintenance.com/kraktext.htm

CEM Vibratory Wedge compactor

Joint Heaters

Application of proprietary joint adhesive (JA)

Surface Sealers



Next Steps

1. Finalize AI/FHWA Report
   - Soliciting review comments
2. Workshop
   - ½ Day for Agency & Contractor
3. Provide Training
   - Revise based on input
4. Develop Other Training Tools