

Best Practices for Constructing and Specifying HMA Longitudinal Joints

**A Cooperative Effort between
Asphalt Institute & FHWA**



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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

*Best way
To Build it.*

*Best way
To Spec it.*



Takeaways from FHWA Survey to 52 Division Offices

- $\frac{1}{2}$ States are not satisfied with overall performance of L-Joints
- $\frac{2}{3}$ 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.”



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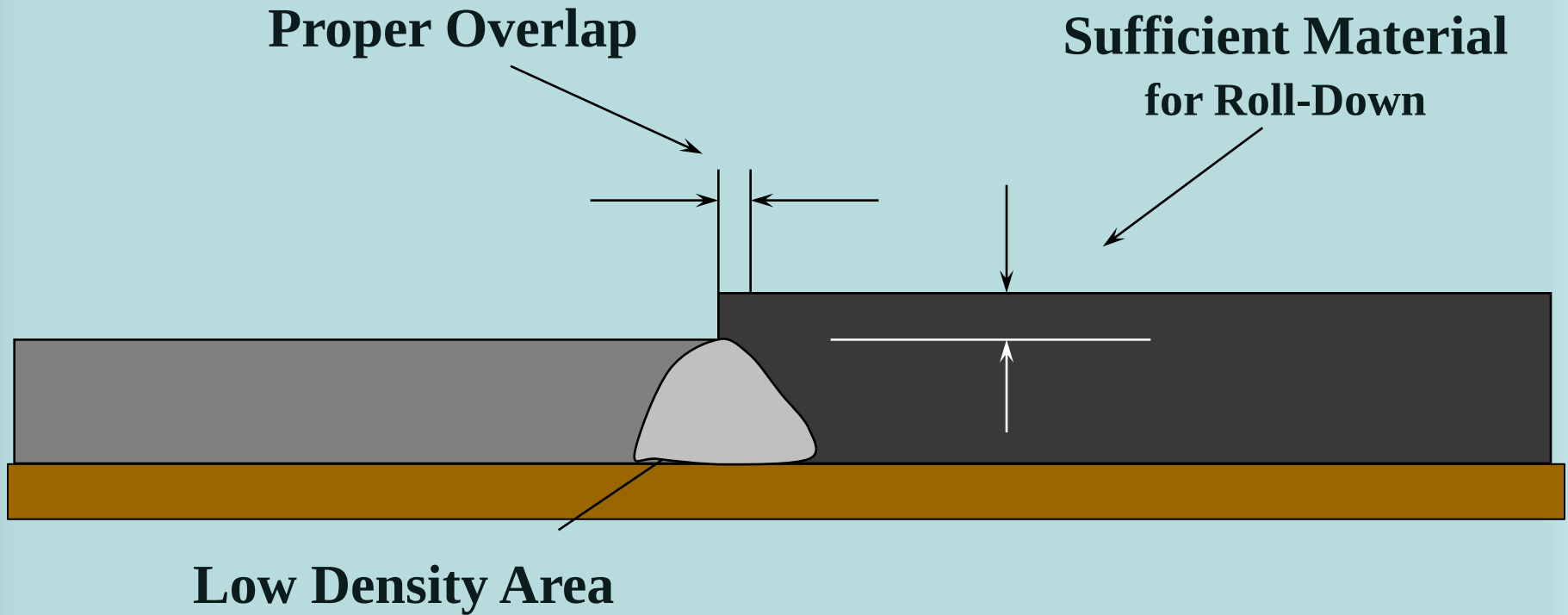
We sincerely appreciate your assistance in improving the performance of longitudinal joints. Thank You

Do the Experts Agree?

Not Always



We Know Unsupported Edge Will Have Lower Density



The Best Longitudinal Joint Echelon Paving



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?

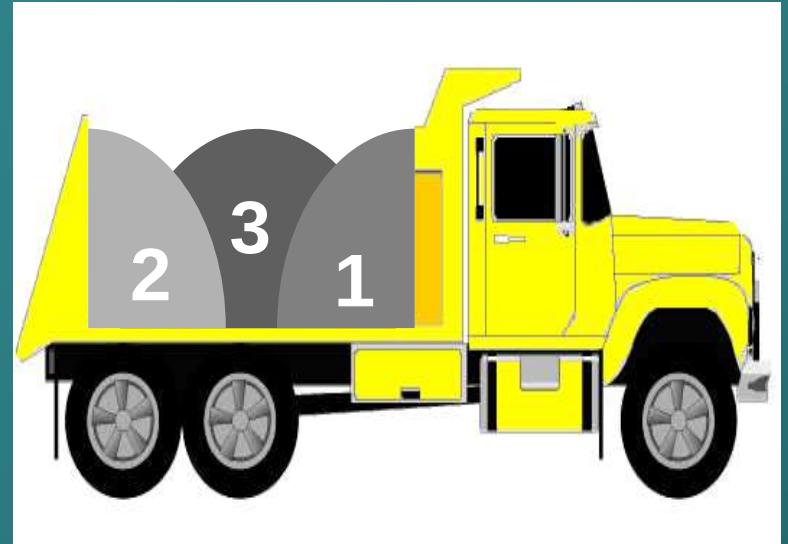
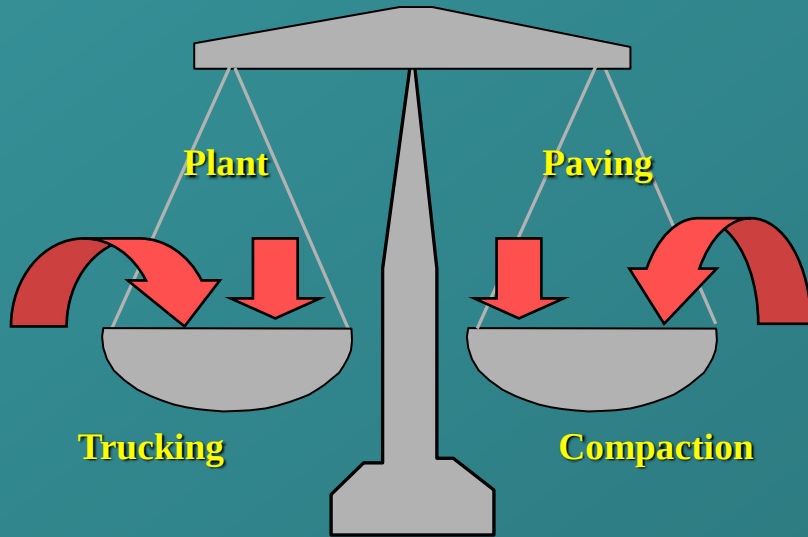
Nearly Divided



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

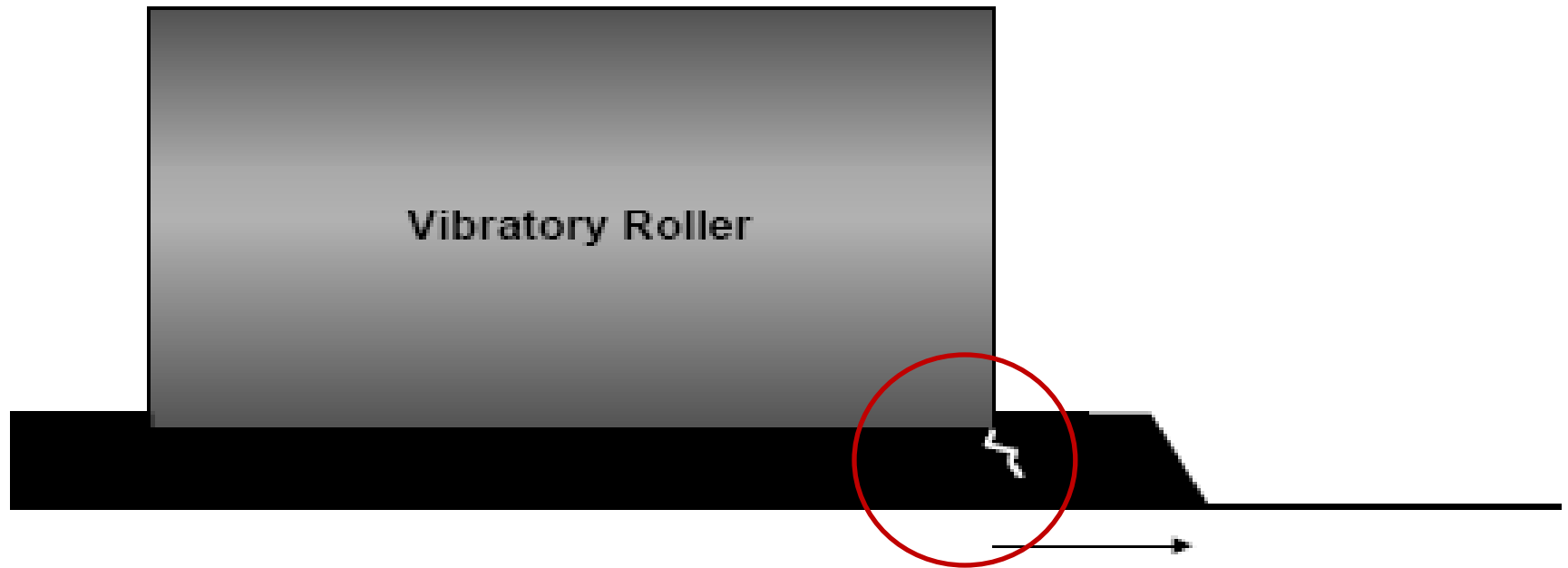
1st Roller Pass on Unsupported Edge

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

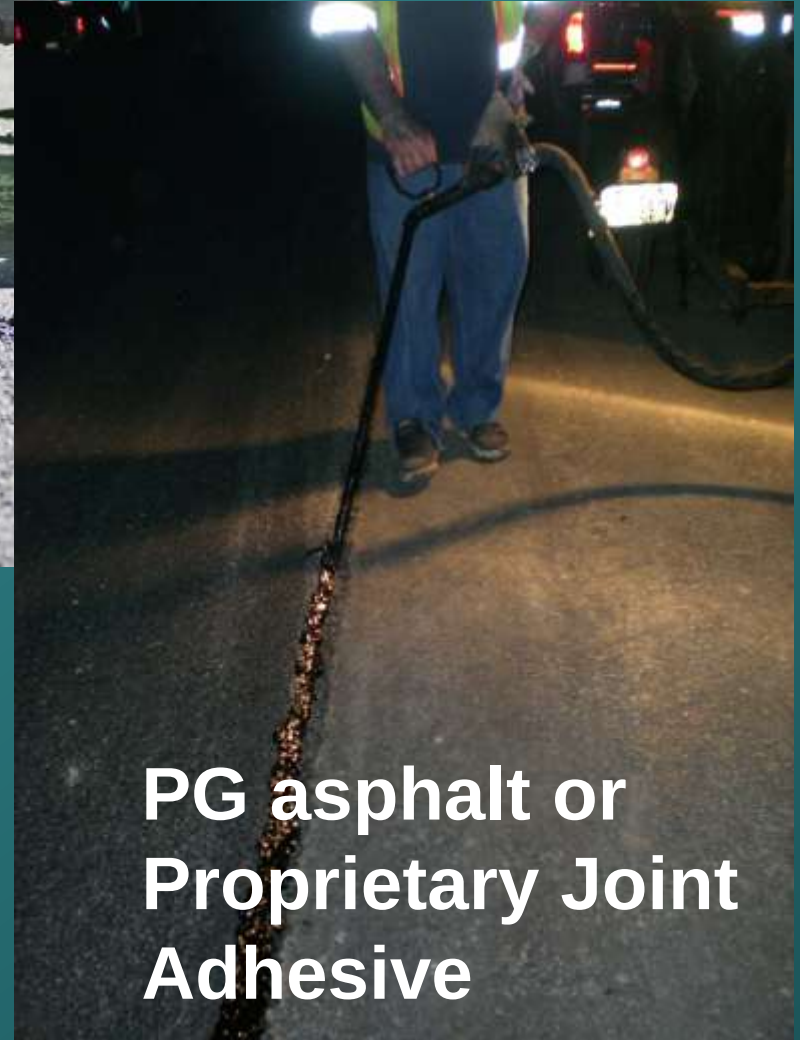
Quality Control, Monitor Joint Density



Tack the Joint! (Butt or Wedge)

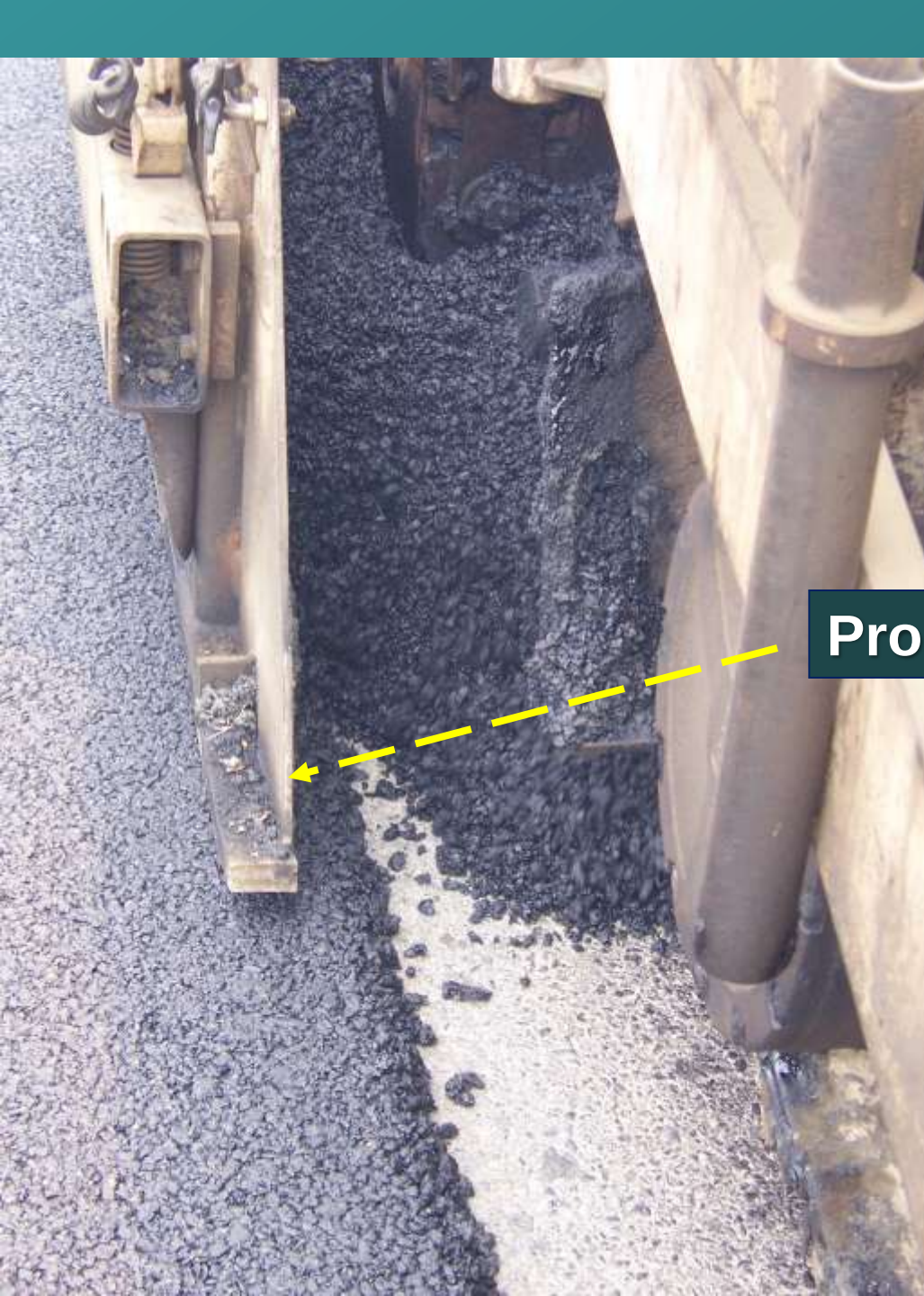


Emulsion, or



**PG asphalt or
Proprietary Joint
Adhesive**

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



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

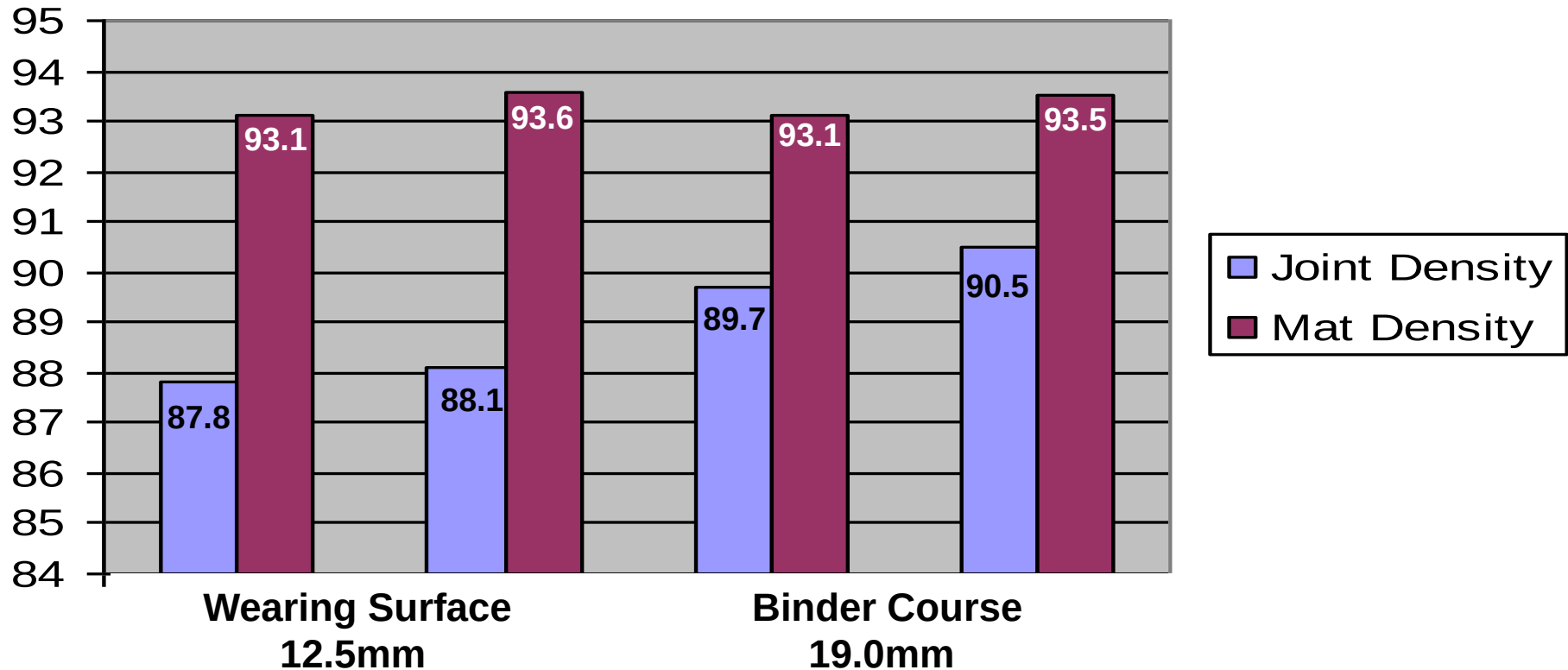
Literature Review

Construction
*What in-place
densities are we
getting?*

Permeability
*What is the danger
zone?*

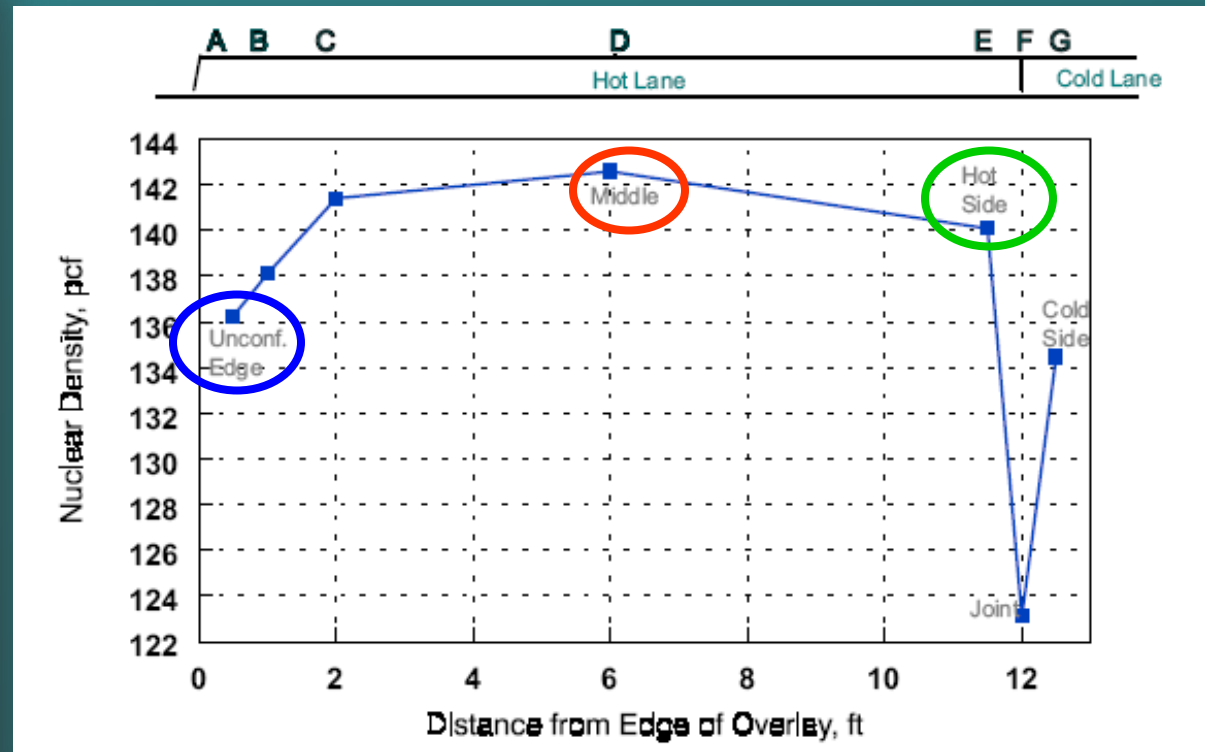
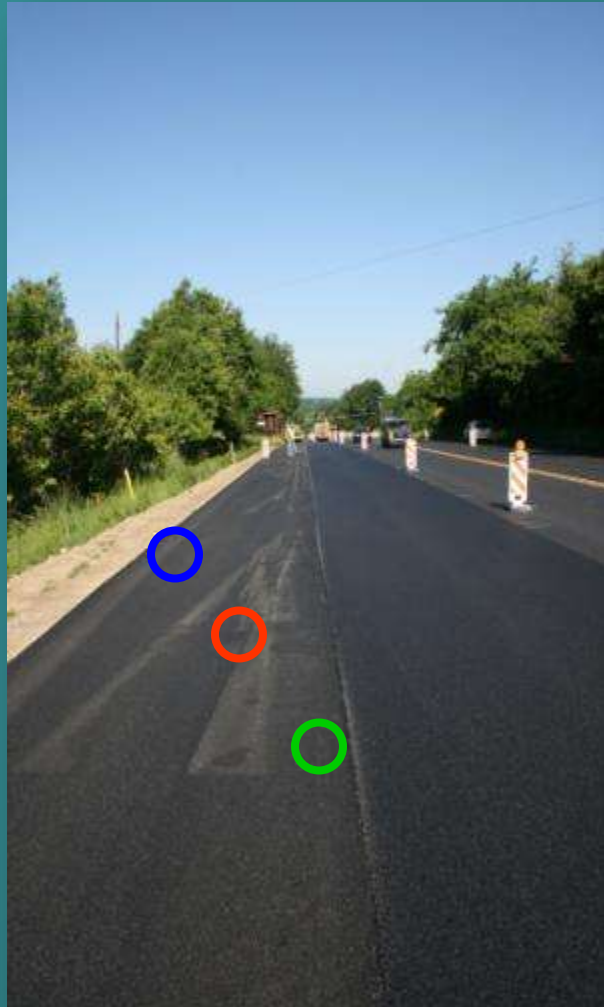
Joint vs. Mat Density

(Representative of Other Studies)



Nuclear Density Profile

Texas Transportations Institute Study



Unconf.
88.5 %

Middle
93.0%

Hot Side
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 ConstructionPerformance

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

Significantly better performance

	98% of the Mat	12 years
vs	95% of the Mat	8 years

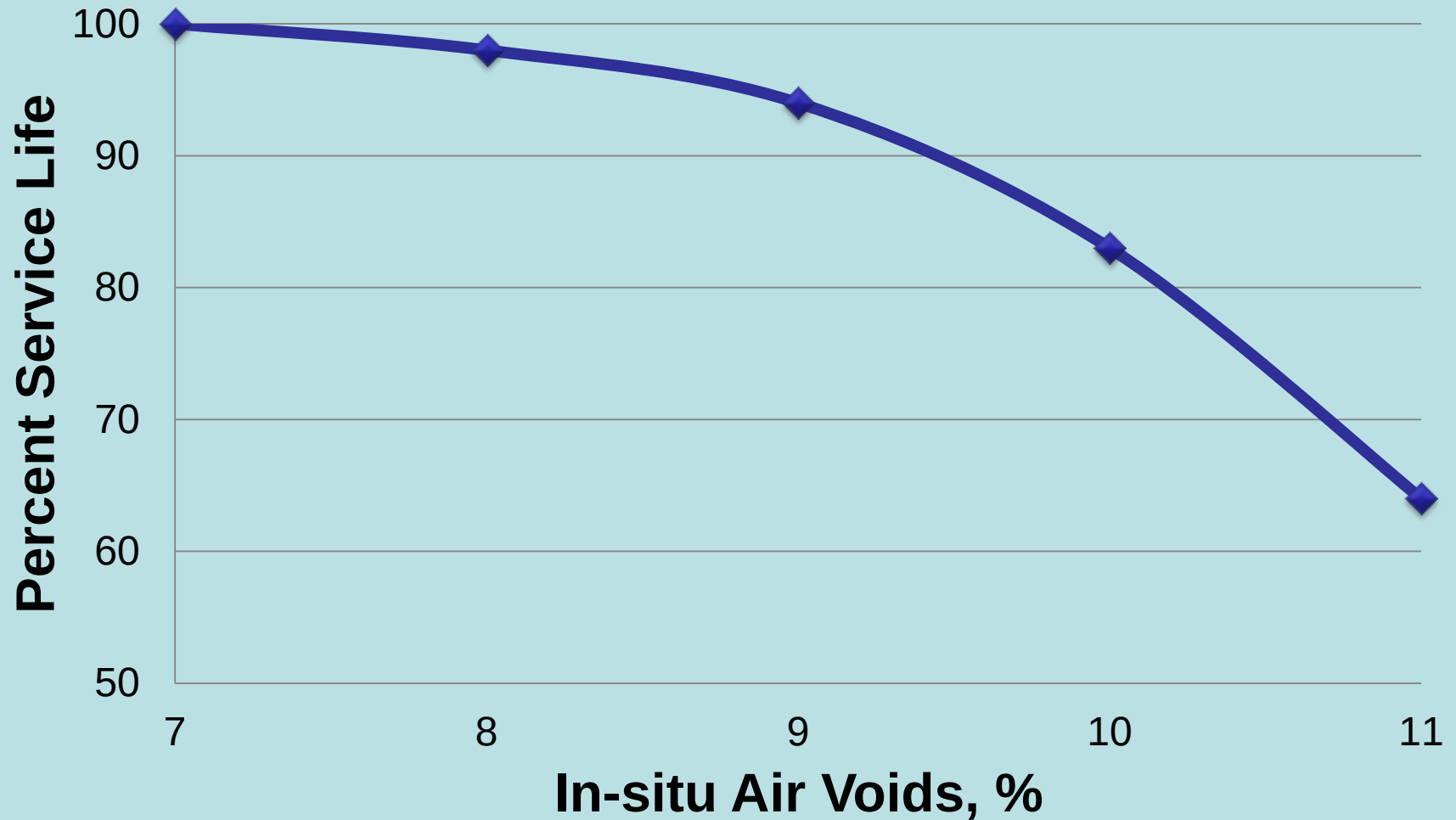
Assume mat is 94% of G_{mm} , then 98% of 94% is 92% (8% V_a)

then 95% is 89% (11% V_a)

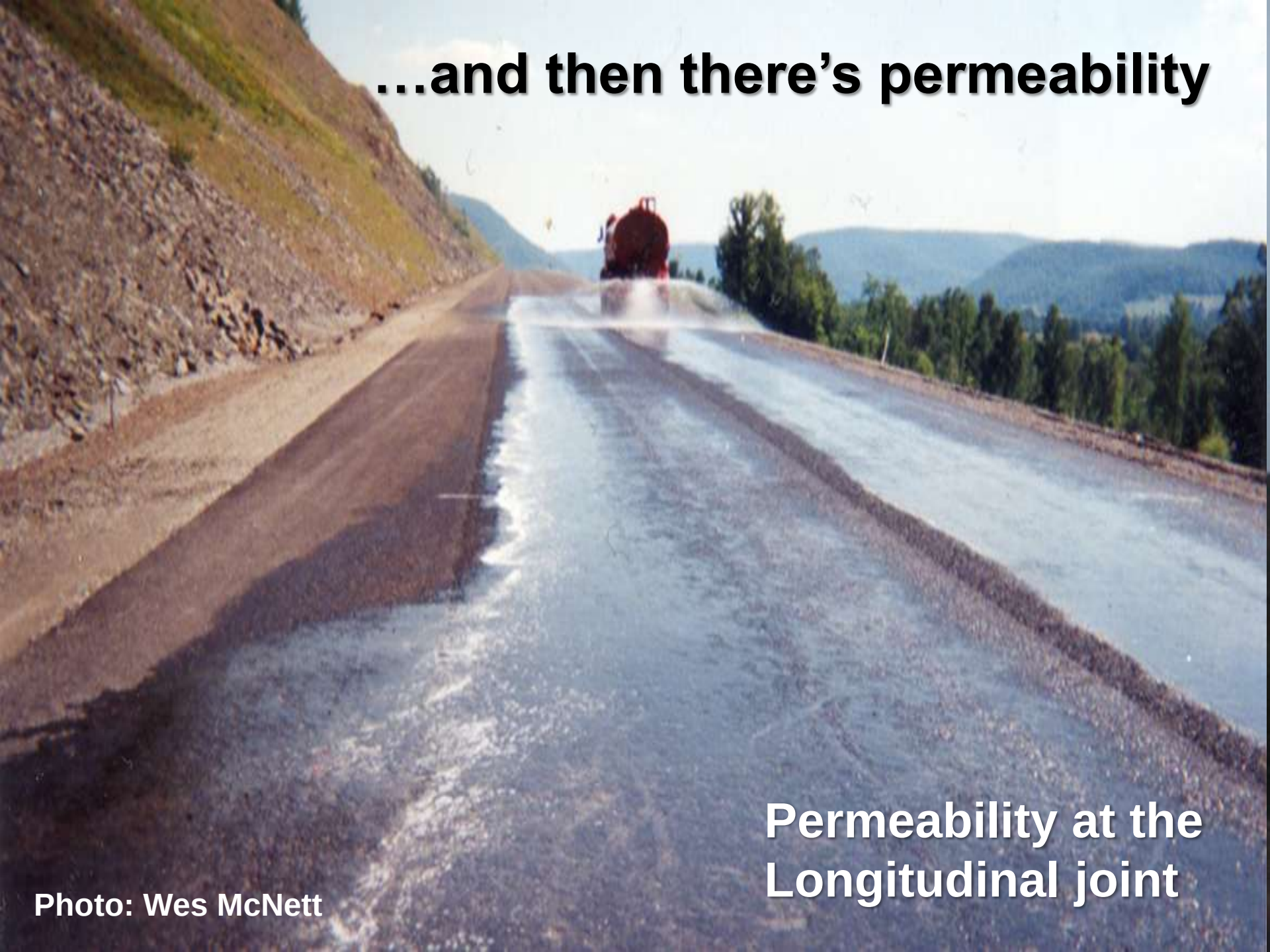
then 93% is 87% (13% V_a)

Effect of In-Place Voids on Life

Washington State DOT Study



...and then there's permeability



**Permeability at the
Longitudinal joint**

Photo: Wes McNett

A high-angle, perspective shot of a two-lane asphalt road. A large, thick white arrow is painted on the left lane, pointing straight ahead towards the horizon. The road is flanked by green grass and a metal guardrail on the left. The text "Destined for Failure" is superimposed in the center of the image.

Destined for Failure

Permeability can be Catastrophic



Various Research Reports on Critical Air Void Level for Permeability

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

Critical Voids where permeable

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

An aerial photograph of a lush green forested valley. A winding road or path is visible in the lower left portion of the image. The background shows rolling hills under a clear sky.

**Air void &
Permeability research
says $<7-8\%$ V_a needed**

**Standard joint
construction
practices reach 9-10%**



Proposed “End-Game” Criteria for LJ Density Spec

Six-inch Cores -

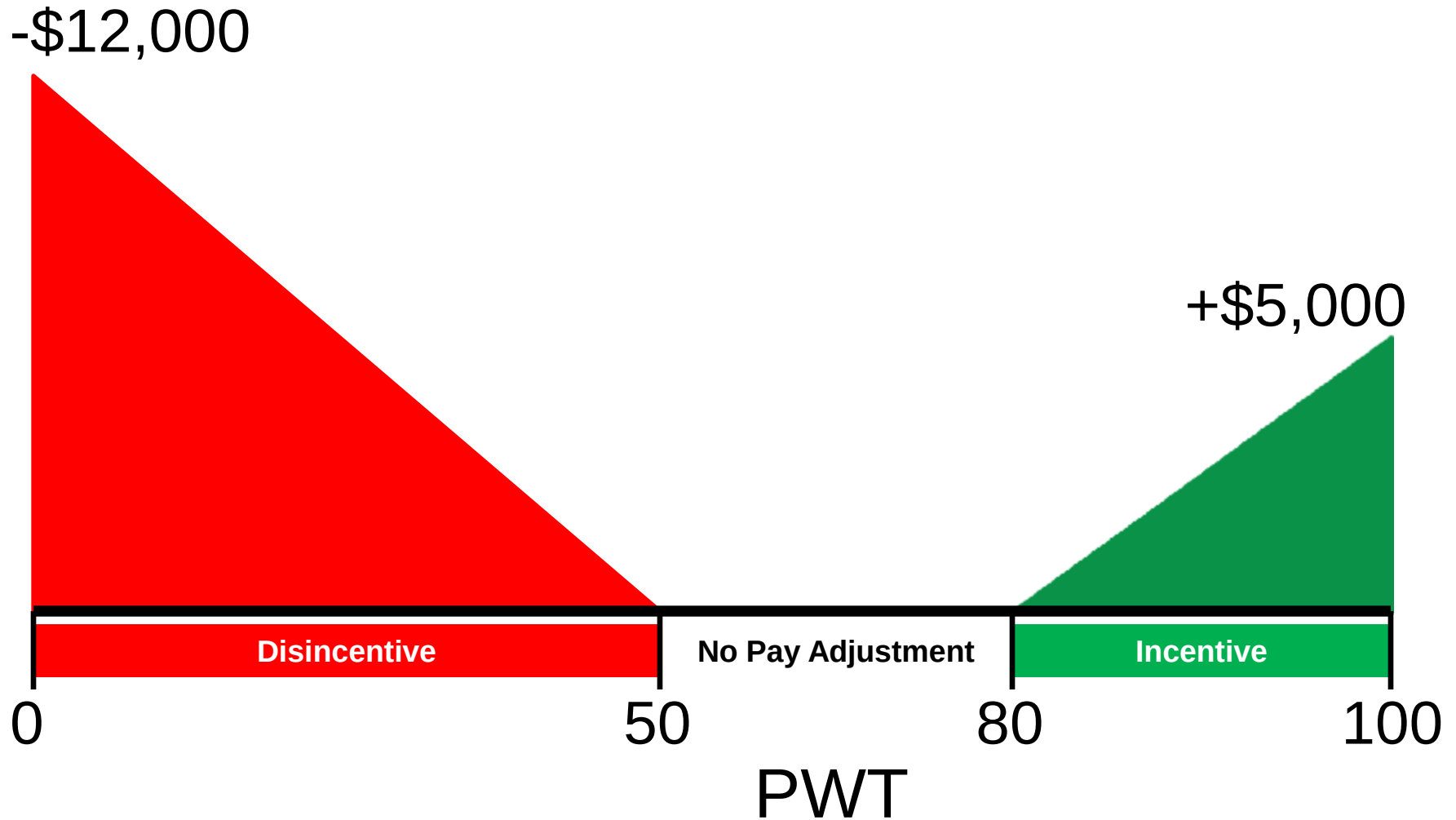
Centered on butt joint, or middle of wedge

$\geq 92\%$ 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



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Next Steps

1

- Finalize AI/FHWA Report
 - Soliciting review comments

2

- Workshop
 - 1/2 Day for Agency & Contractor

3

- Provide Training
 - Revise based on input

4

- Develop Other Training Tools