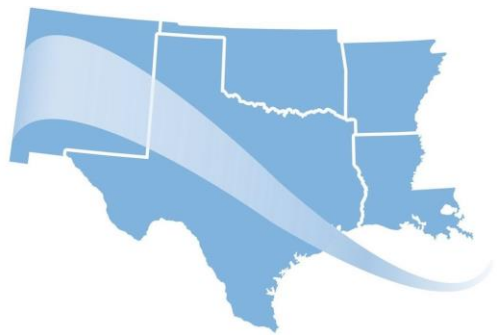


Longitudinal Joint Specifications and Construction

Best Practices



SOUTHERN PLAINS
TRANSPORTATION CENTER

Danny Gierhart, P.E.

Asphalt Institute

Deputy Director of Engineering

Presentation Outline

- 1) The Problem**
- 2) Specifications**
- 3) Design**
- 4) Placement**
- 5) Compaction**
- 6) Other Options**

Presentation Outline

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Longitudinal Joints Are An Agency and Industry Concern

Longevity is very important - it impacts:

- DOT Program Costs
- Asphalt Industry's Livelihood
 - LCCA
 - Alternate Bid Competitiveness
- Traveling Public
 - "...Stay Out"

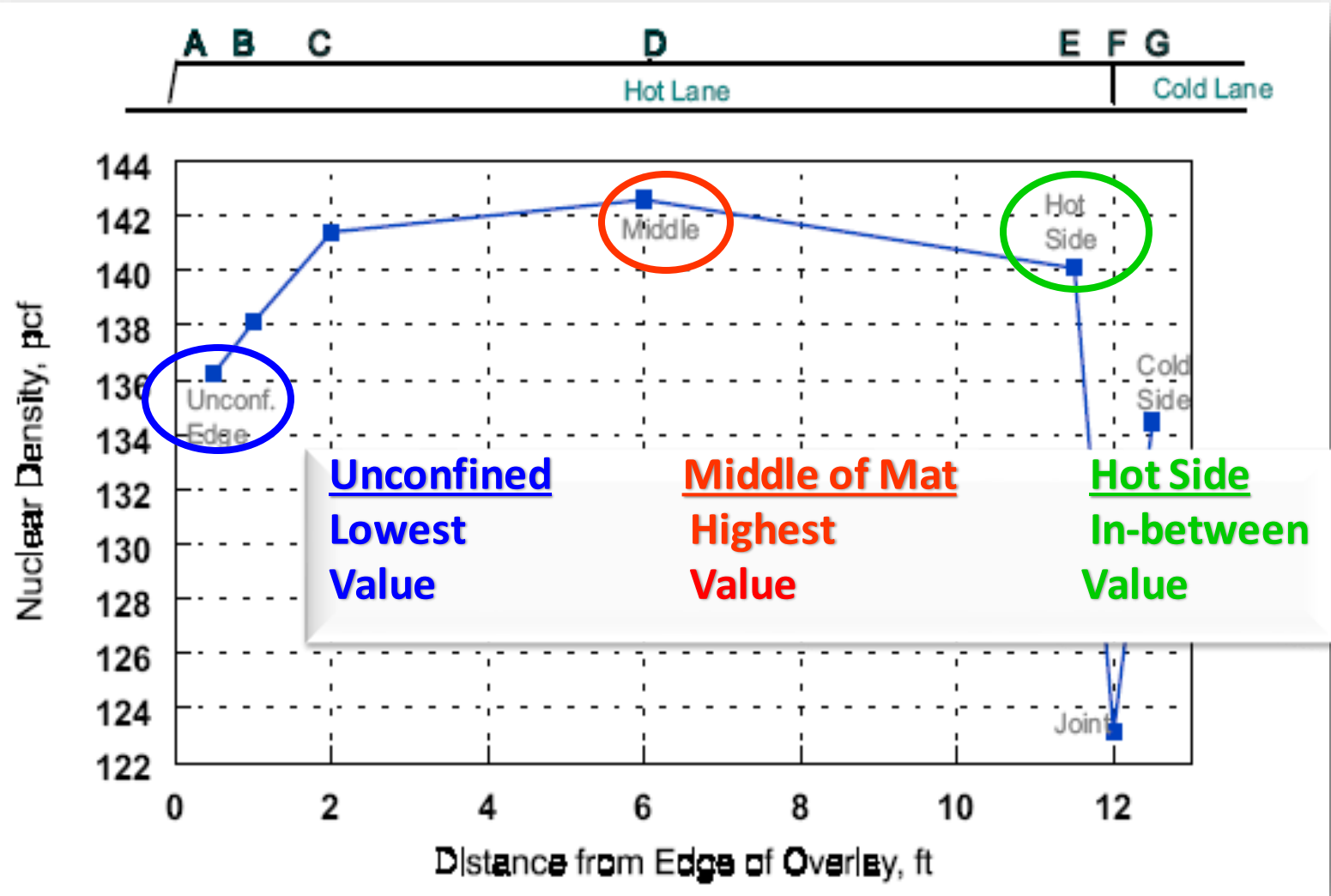
Clarification of Terms

- **Density:** weight per volume (i.e. 140 pcf)
- **Percent Relative Compaction:** Comparison of a measured density to a reference density
 - i.e. in place density of 94% Theoretical Maximum Density (G_{mm})
- All industries have jargon
 - Shorthand to simplify communications
- When speaker and slides refer to **density**, it is jargon for **percent relative compaction**
 - i.e. 94% density really means 94% TMD, or 94% of G_{mm}

Typical Nuclear Density Profile

Texas Transportations Institute Study

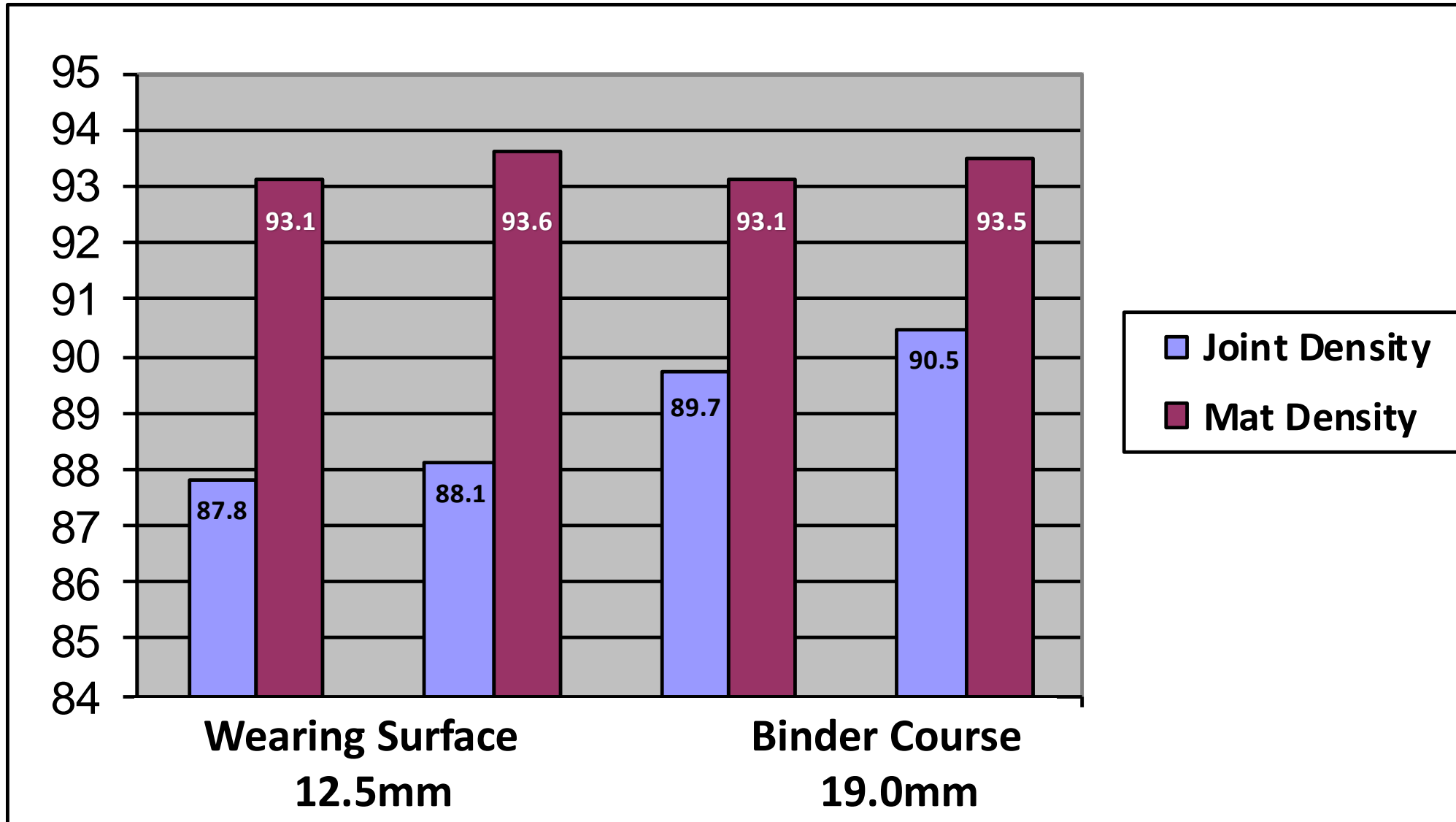
In this case, "density" actually means "density!"



- Terms:**
- Hot side
 - Confined side
 - Supported side
 - Cold side
 - Unconfined side
 - Unsupported side

Joint vs. Mat Density

(Representative of Other Studies)



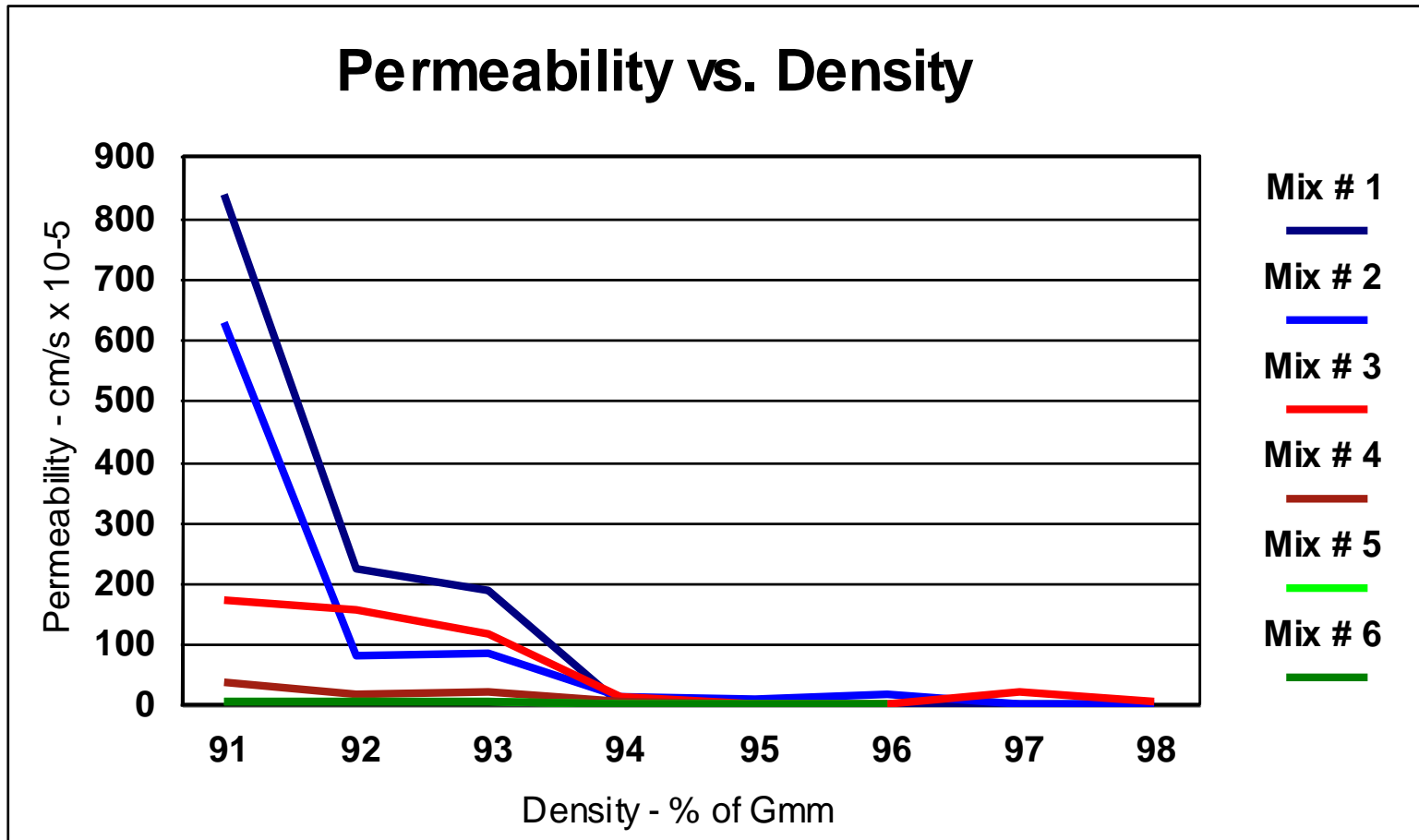
2006-2007, with
6" cores taken
over joint



**New construction
in Oklahoma back
in 2003 - not yet
opened to traffic.**

**Permeable at the
Longitudinal Joint
several days after
a rain event**

Oklahoma DOT Research on 25.0 mm Superpave Mix Permeability



Mix # 1
(coarsest possible)



Mix # 6
(finest possible)



**Permeability:
can be catastrophic!**



What typically affects longitudinal joint density and/or creates longitudinal joint problems?

- the way the specifications are written
- the way the asphalt is placed
- the way the asphalt is compacted

Presentation Outline

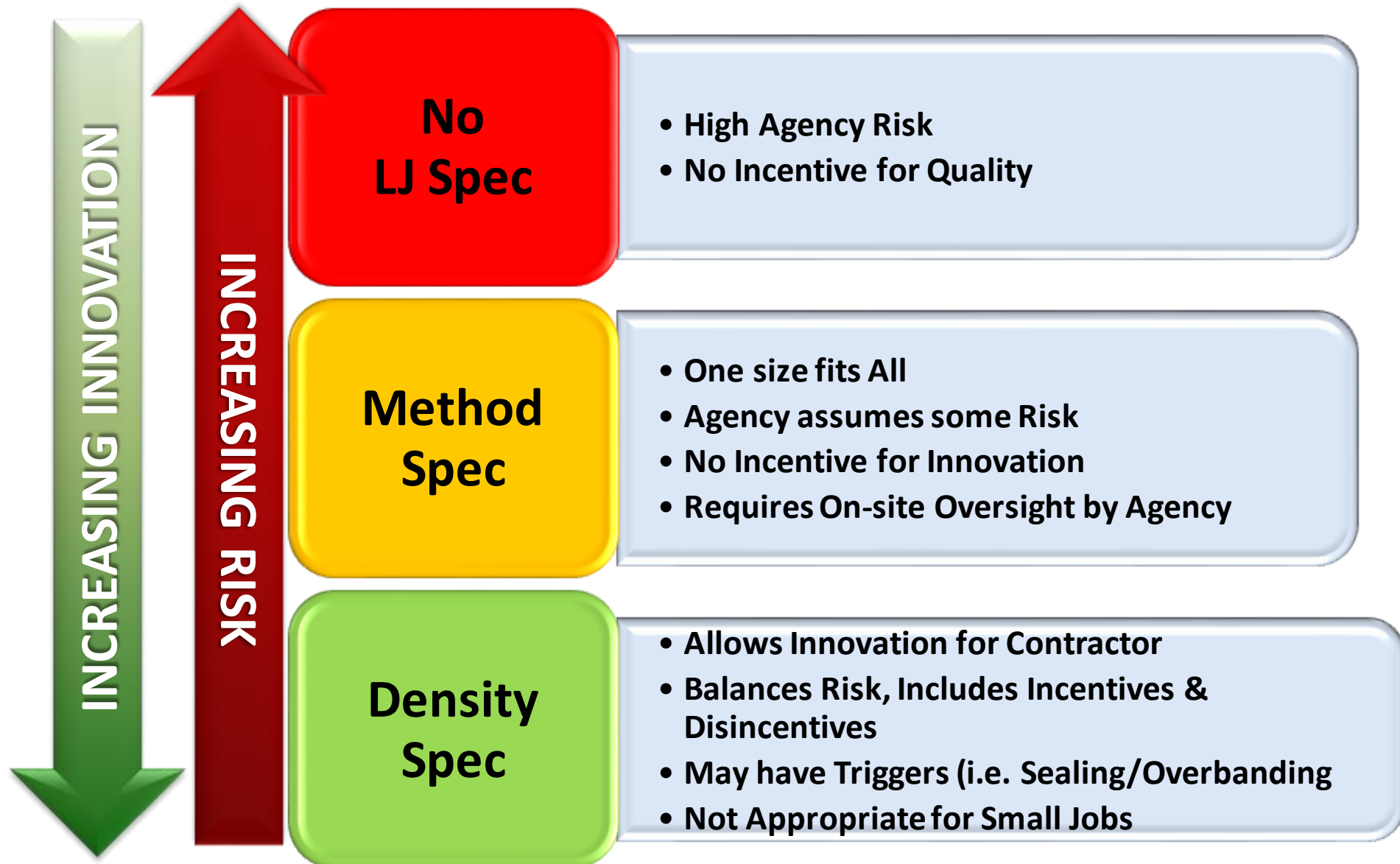
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***“If you can’t
measure it, you
can’t manage it.”***

Peter Drucker

Various Approaches



Tiered Approach to Spec (i.e. Include Small Quantity Spec)

Tiered Approach

- **For small jobs** where limited density measurements are attainable, contractor follows method spec or submits compaction plan
- **On larger Jobs** where a statistically based sample size is attainable, the Contractor follows a density specification with incentives and disincentives



Joint Performance vs. Joint Density (as % of Mat)

Methods for Evaluating Longitudinal Joint Quality in Asphalt Pavements

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

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

Longitudinal Asphalt Pavement Joint Construction...Performance

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

Significantly better joint performance (12 yrs.) when; 98% of the Mat
versus lesser joint performance (8 yrs.) when 95% of the Mat

Assuming mat density is 94% of G_{mm} , then:

- 98% of the mat density is 92% G_{mm} (8% P_a), = Good Performance
- 95% of the mat density is 89% G_{mm} (11% P_a), = Fair Performance
- 93% of the mat density is 87% G_{mm} (13% P_a), = Poor Performance

AI Acceptance Criteria for a LJ Density Spec

Six-inch Cores located either directly over visible joint for butt joint, or middle of wedge for wedge joint. This gives a 50/50 split, requiring an average of the G_{mm} of both lots.

- **$\geq 92\%$ of G_{mm} : maximum bonus**
- **Between 92% and 90% of G_{mm} :
100% pay, pro-rated bonus, need to “overband” or
“surface seal” joint**
- **$< 90\%$ of G_{mm} : reduced payment, overband or
surface seal joint**

Intended for highway work -
may be too difficult to meet on parking lot, city, county projects where there is limited room for full paving / compaction train

“Overbanding” the Longitudinal Joint



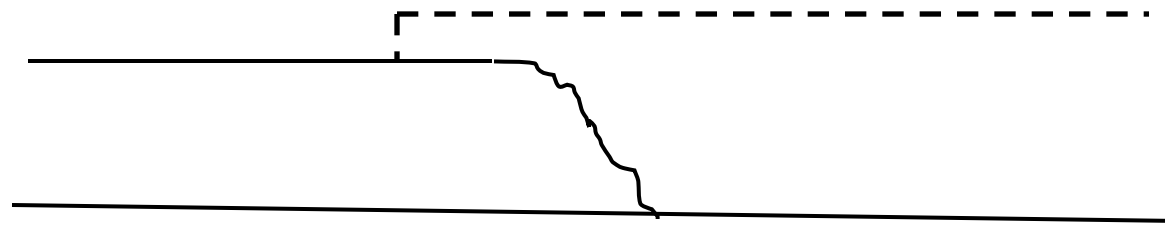
Frequently Done in
AK and PA

Presentation Outline

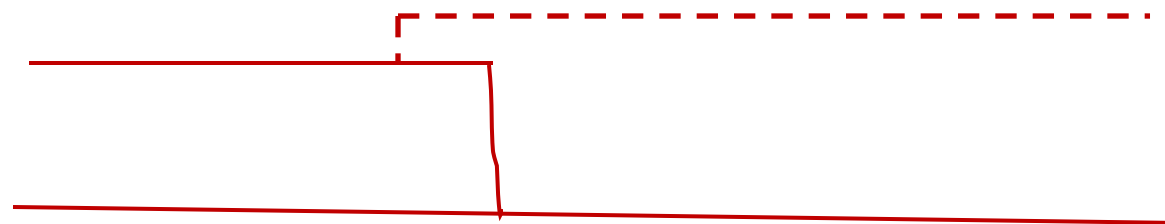
- 1) The Problem
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Defining Different Types of Longitudinal Joints

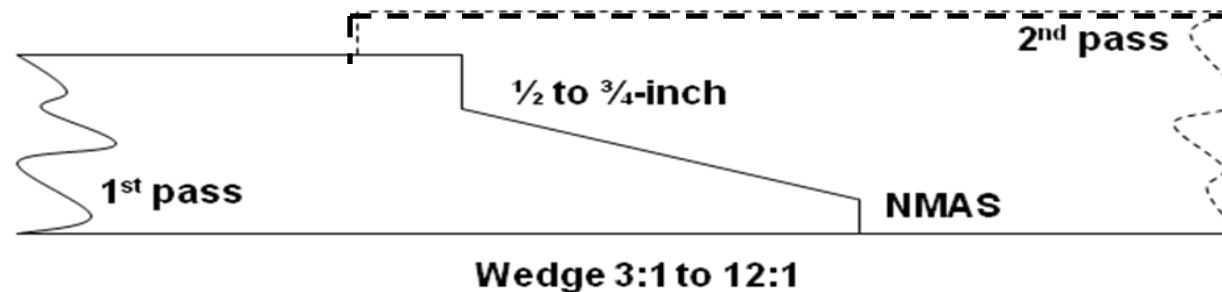
Butt (Vertical) Joint



Milled or Cutback Joint



Notched Wedge Joint

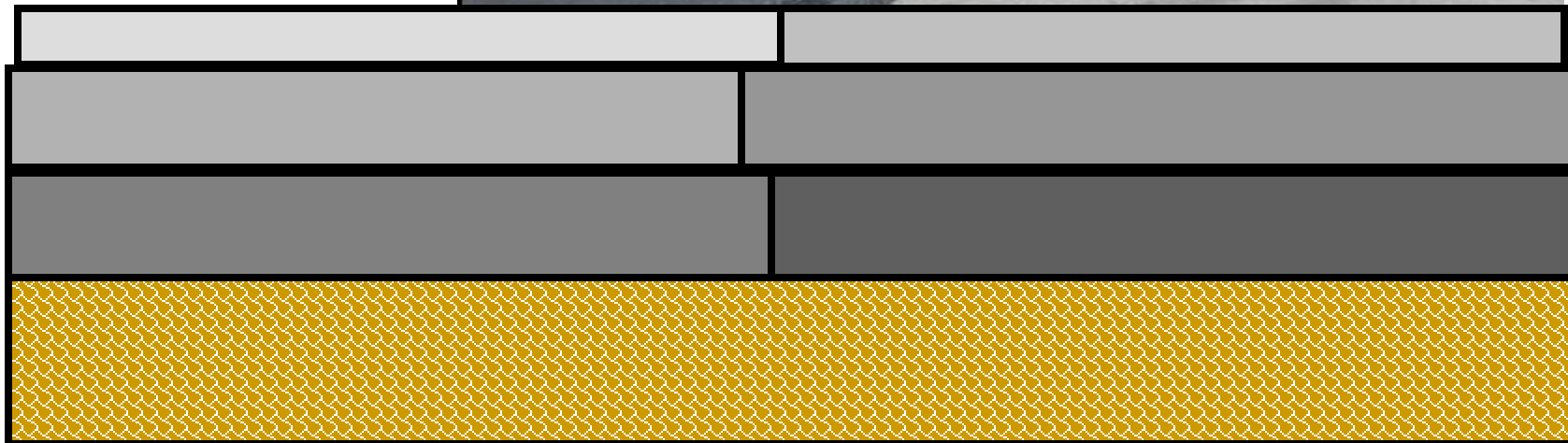




**Poor planning –
joint in wheelpath**

Danny Gierhart photo

**Offset joints between layers by at least 6-inches;
surface joint should be near centerline (not in wheelpath)**



Avoid Placing the Joint Where Striping Will Go



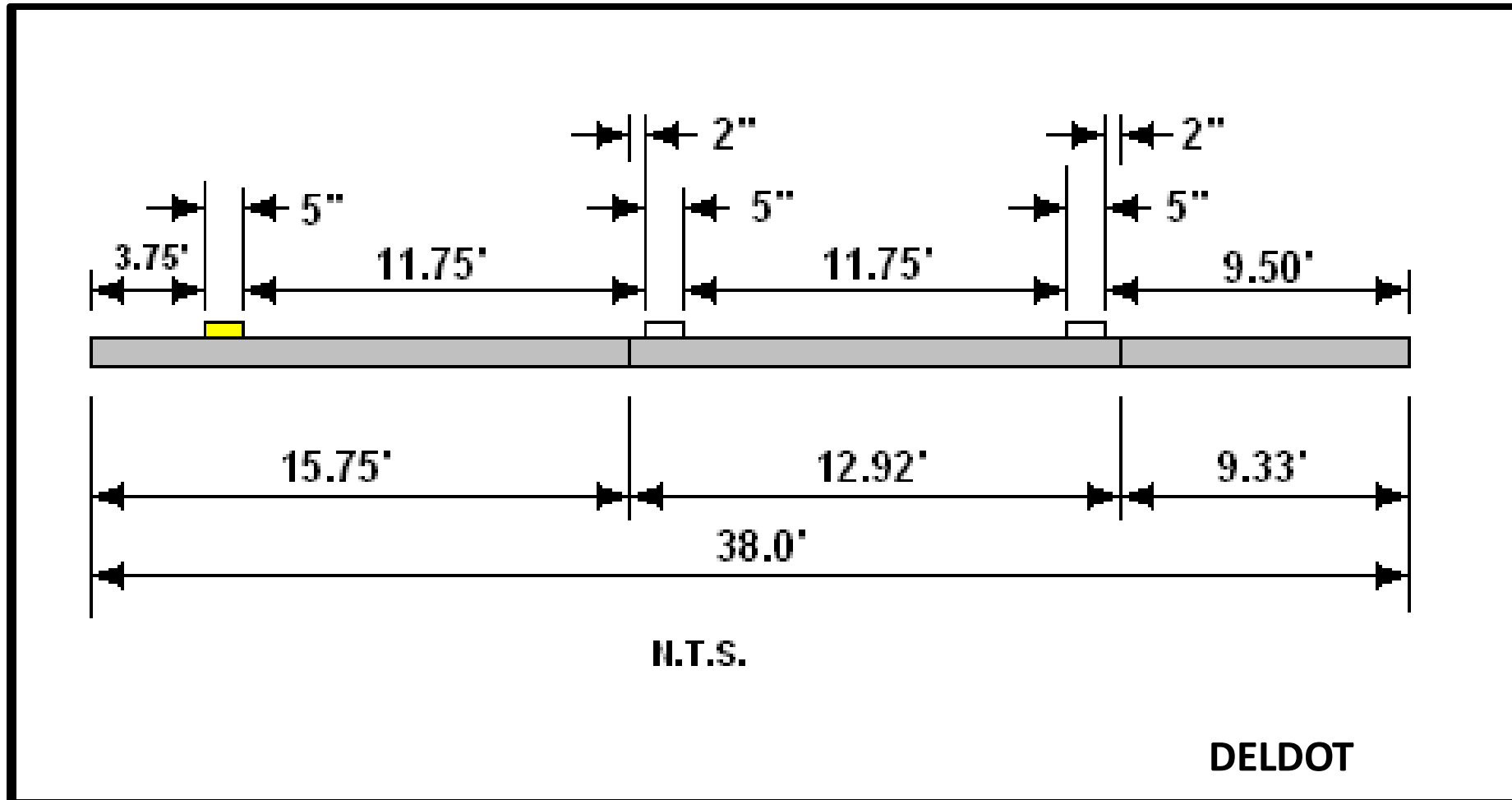
DELDOT

Which Can Eventually Result In This



DELDOT

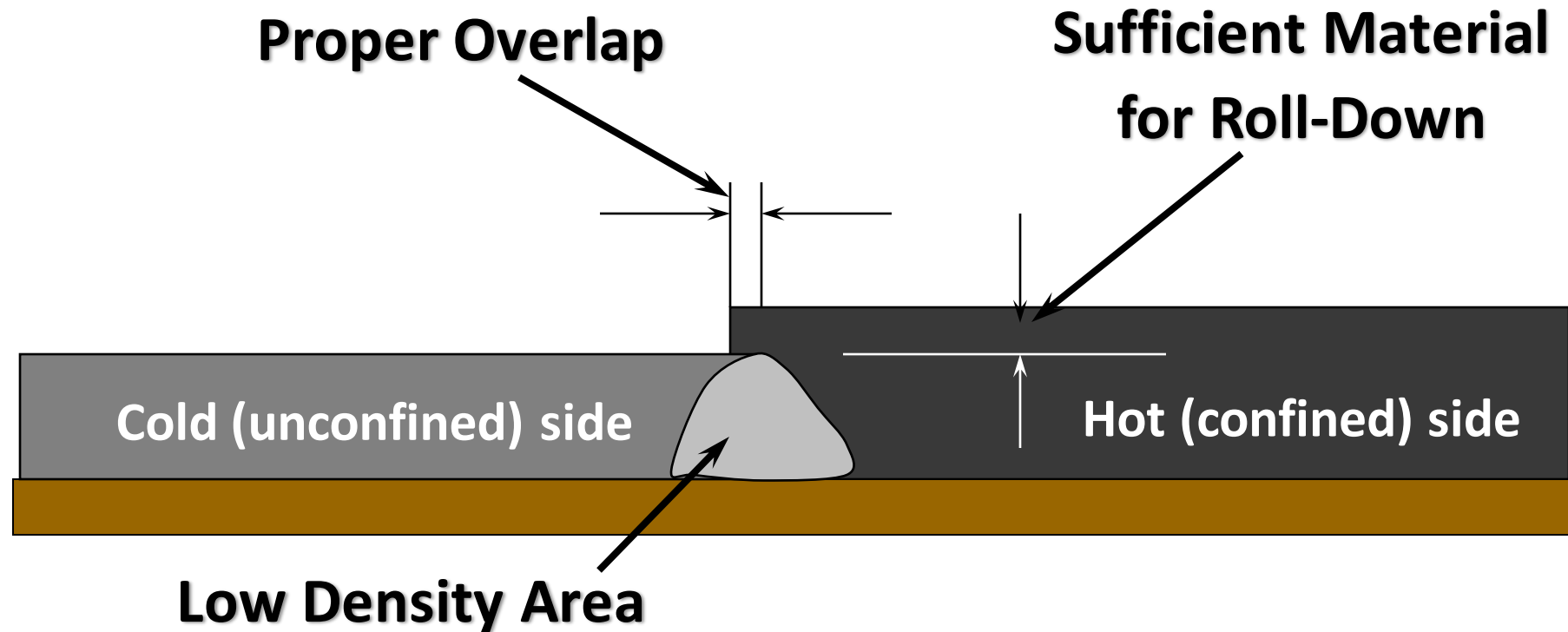
Final Lift Joint Layout Plan



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Unsupported Edge Typically Has Lower Density



The Best Longitudinal Joint: *Echelon Paving*



Echelon Paving - DFW Airport, Runway 17C/35C



Echelon Paving Longitudinal Joint



Joint passes between the quarters

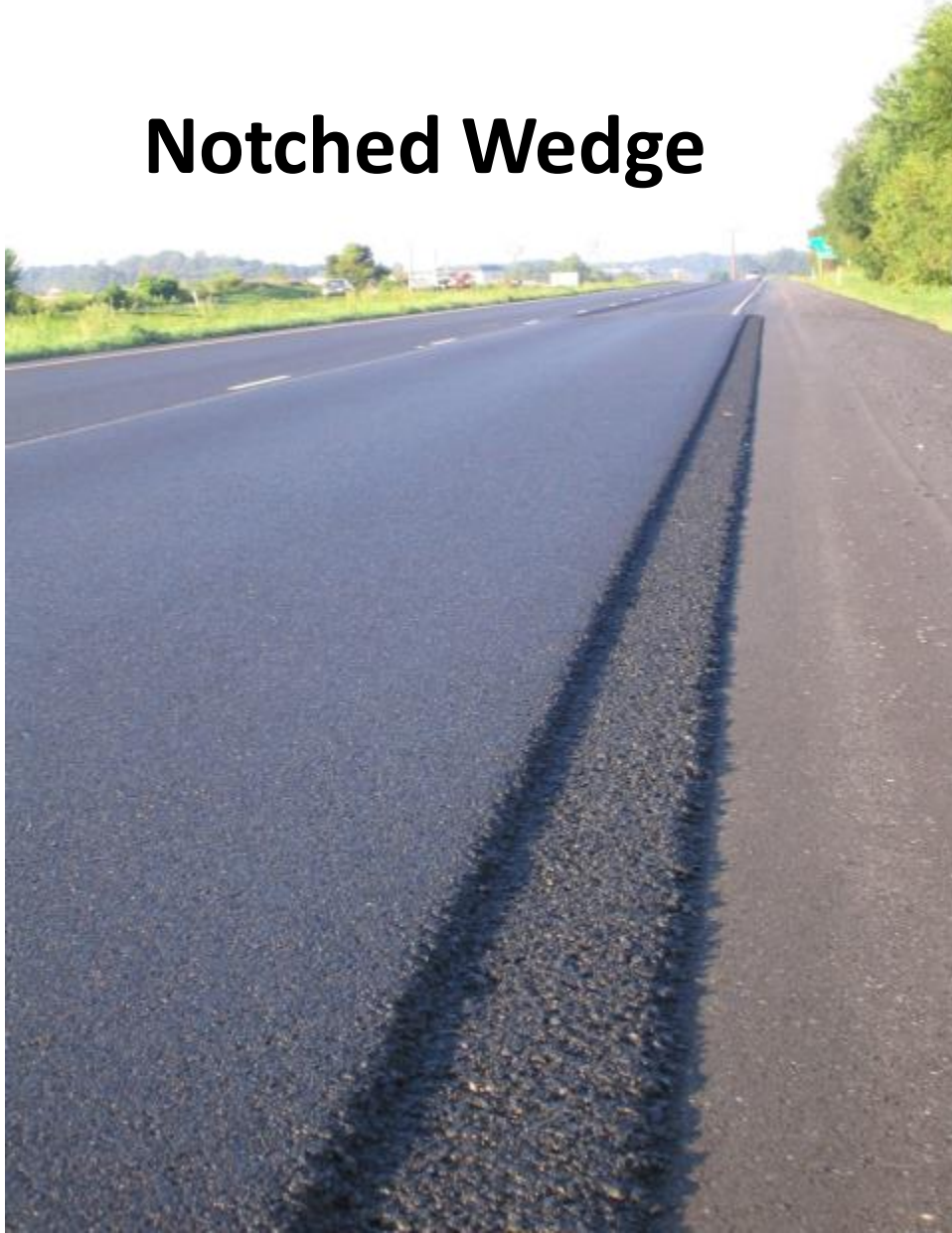
Need to maintain traffic limits opportunities to pave in echelon



Consequently, most longitudinal joints are built with a cold joint.

Preferred Joint Type? Experts Evenly Divided.

Notched Wedge



Butt



and Compactors



Vibratory Wedge Compactor



Plate Compactor

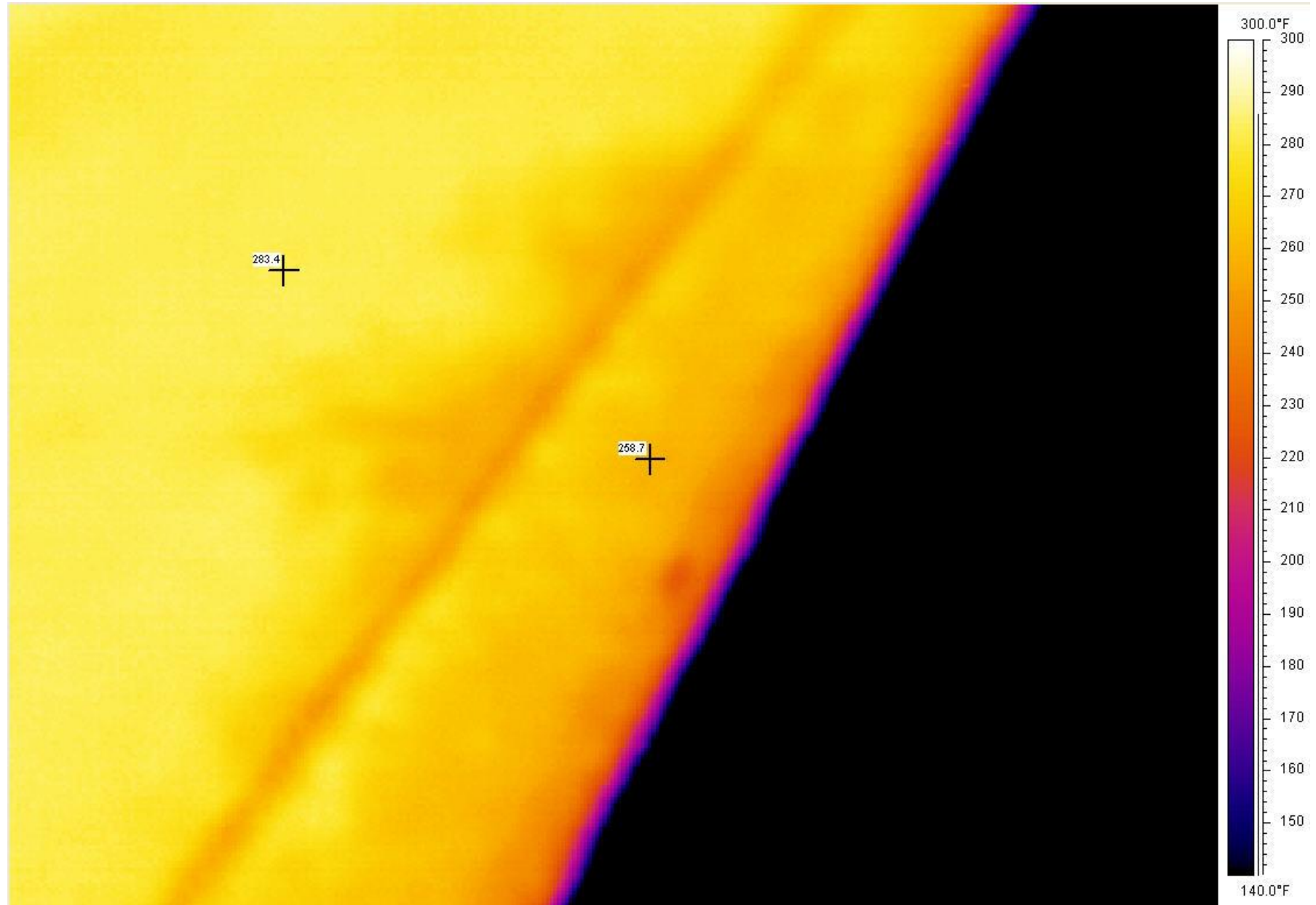
Average Joint Densities from PA DOT for Entire Paving Season

	2011	2012	2013
Notched Wedge	91.7%	91.7%	"mostly notched wedge joints"
Butt (vertical)	90.3%	90.7%	

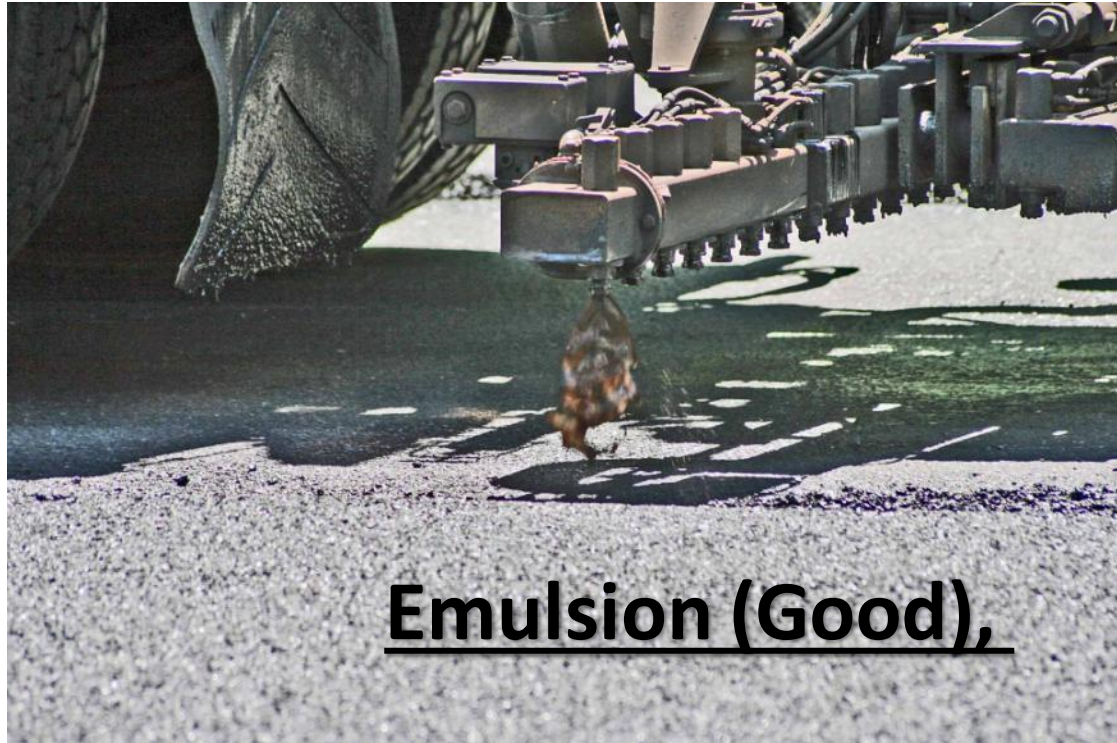
**Thermal Image of 2" mat
with wedge joint in CT
(foamed 76-22 PMA).**

**- 25-30 feet
behind paver, no rollers
yet.**

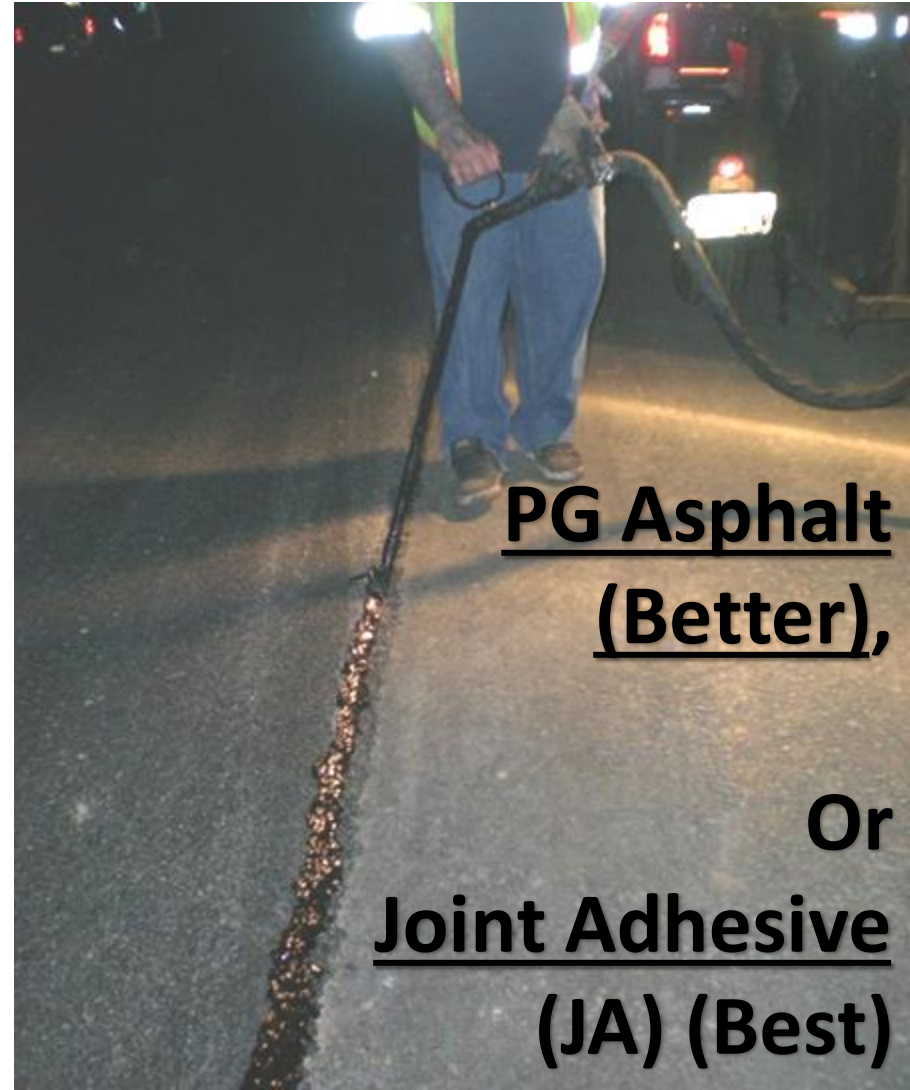
**- Surface Temp of
mat is 283F, but wedge
has cooled to 258F -
CONFINEMENT**



Paint the Side of Joint (Butt or Wedge)



Emulsion (Good),



PG Asphalt
(Better),

Or
Joint Adhesive
(JA) (Best)

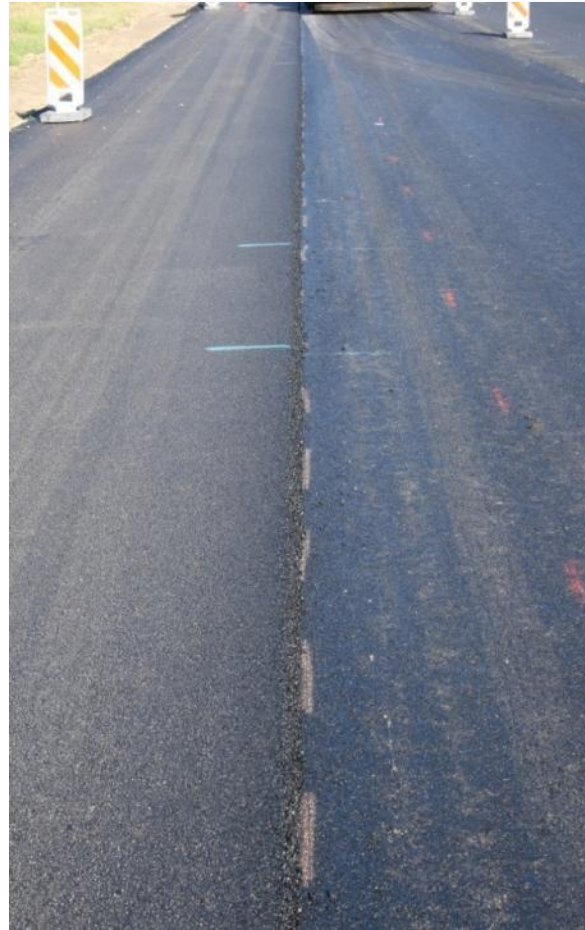
Tack Coat



**Tack past full width of mat
to provide confinement,
minimize lateral movement
of unsupported edge**



First Pass Must Be Straight!

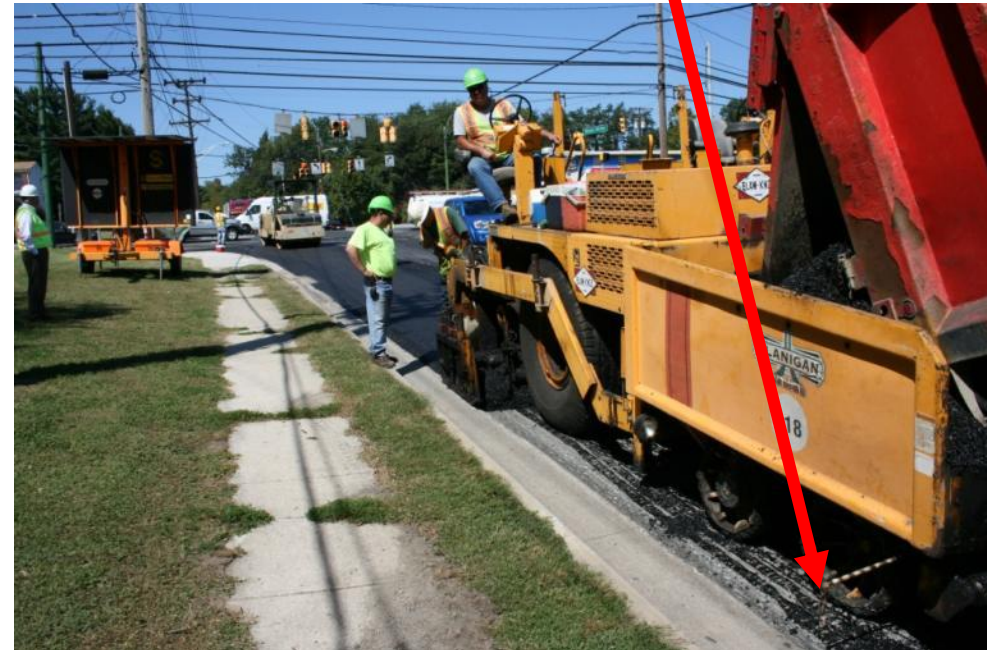


Stringline for reference, and/or skip paint, guide for following



Great Results

Paver operator using the curb as his reference



Variable Joint - Tough to get proper overlap (1") with next pass





Proper Overlap:

- 1.0 ± 0.5 inches
- Exception:
Milled or sawed joint
should be
0.5 inches

**All Photos show Bottom of Lift
Note voids in top two from no overlap)**



Core #2 (No Overlap)



Core #7 (No Overlap)



Core #9 (Overlap 1 1/2'')



Core #10 (Overlap 1 1/2'')





END GATE

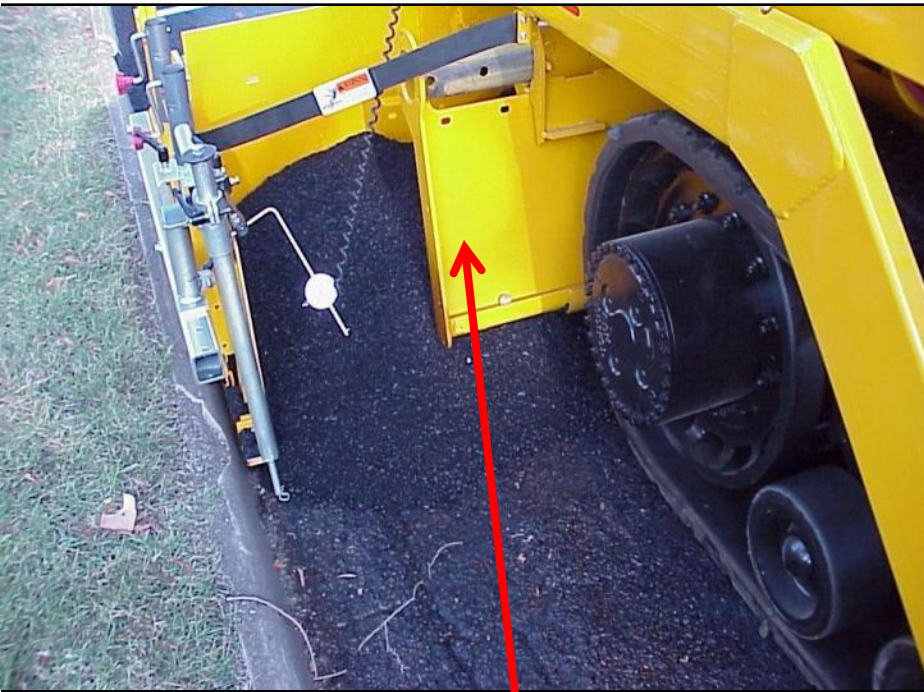
**Seated Flat on the
Existing Surface**

Examples of Auger Overload... Likely to Segregate



Extend Tunnels the Same Distance

To control material flow at outer edges of screed
and deliver homogenous HMA at joint



Tunnels



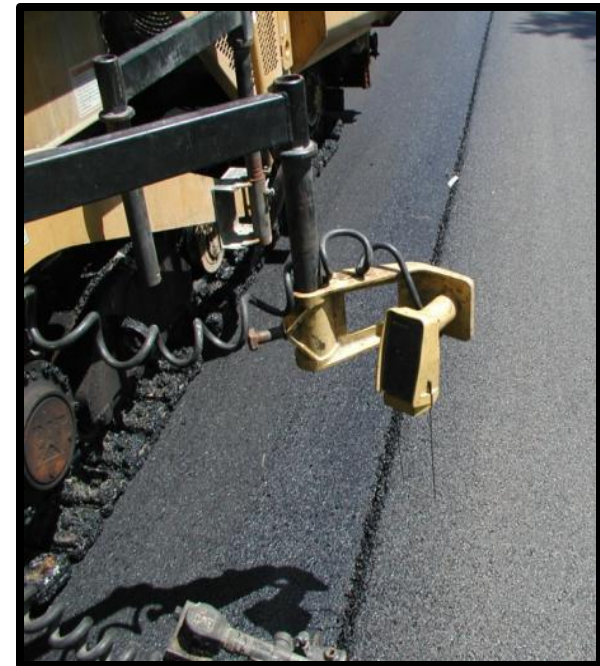


Auger and Tunnel likely not extended
within 12 to 18-inches of the end gate.


The Result - SEGREGATION at joint

When Closing Joint, Set Paver Automation to Never Starve the Joint of Material

- **Target final height difference of +0.1” on hot-side versus cold side**
 - NH spec requires 1/8” higher
- **Joint Matcher (versus Ski) is best option to ensure placing exact amount of material needed**
- **If hot-side is starved, roller drum will “bridge” onto cold mat and no further densification occurs at joint**



Destined for Failure



Likely that the hot side of joint was starved of material at these locations and bridging occurred.

Bumping the Joint?



Do NOT Rake Across the Joint



Presentation Outline

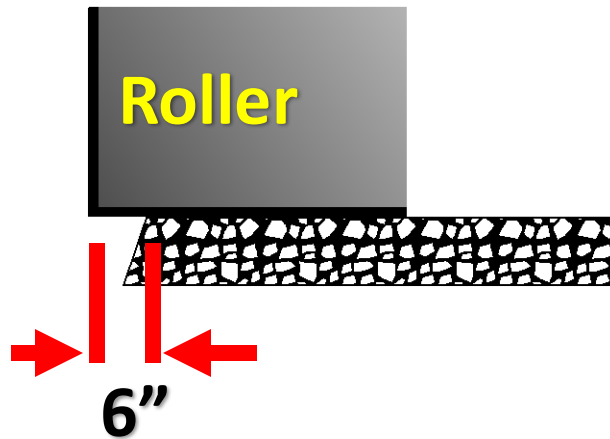
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Rollers Need to Be Kept Close to the Paver

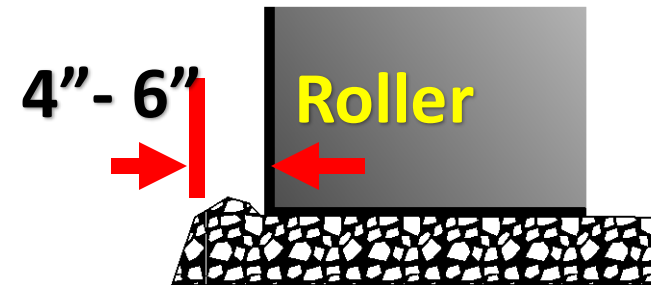


Rolling Unconfined Side? 50-50 on Where to Put 1st Pass

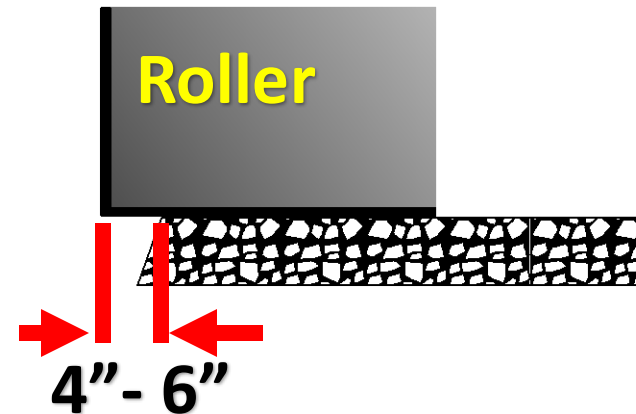
Option 1
Hang over 4-6"



Option 2
1st Pass 4"-6" inside

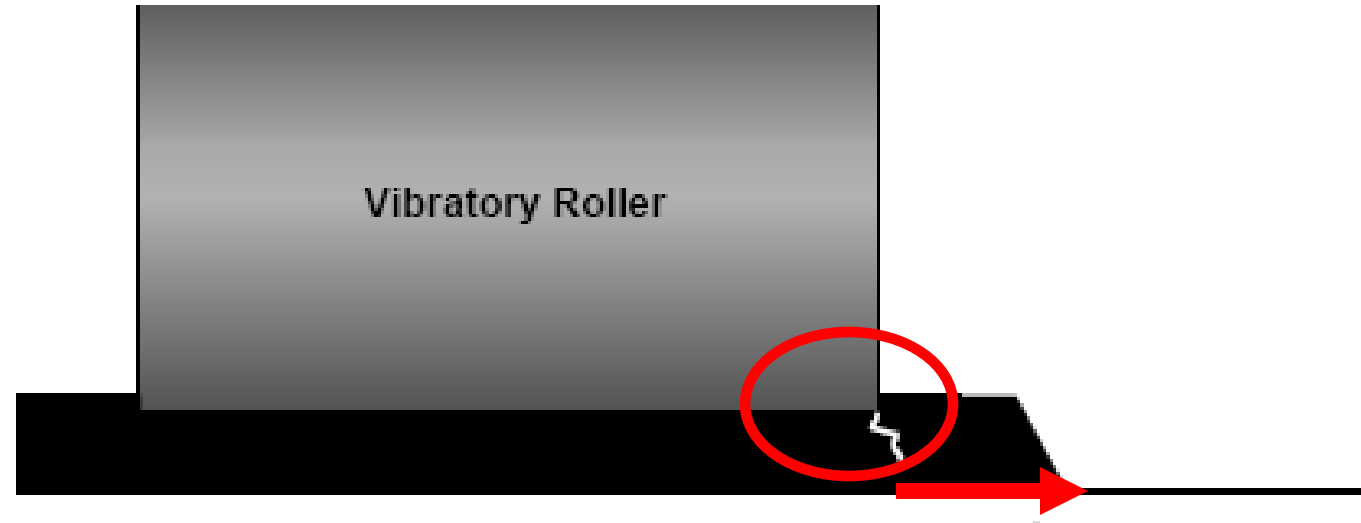


2nd Pass hang over 4"-6"



What We Don't Want

Rolling Unsupported Edge With First Roller Pass



If edge of drum is located just inside the unsupported edge, a stress crack can occur here.

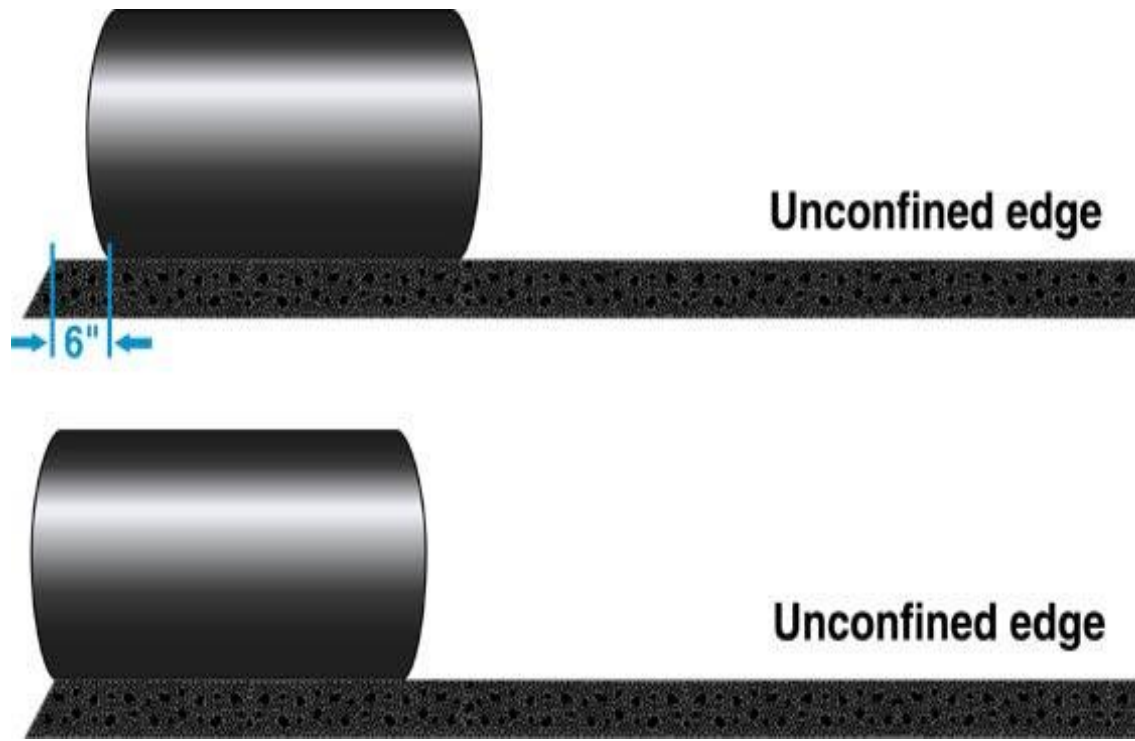
Our Recommendation: Option 1

1st Roller Pass Hangs Over 4-6 inches



Alternative: Option 2

Stay Back 4-6 inches on 1st pass, then roll 2nd



- **Concern:**
 - **developing stress crack?**
- **Merit:**
 - **minimize lateral movement?**

Rolling the Supported Edge

Our Recommendation:



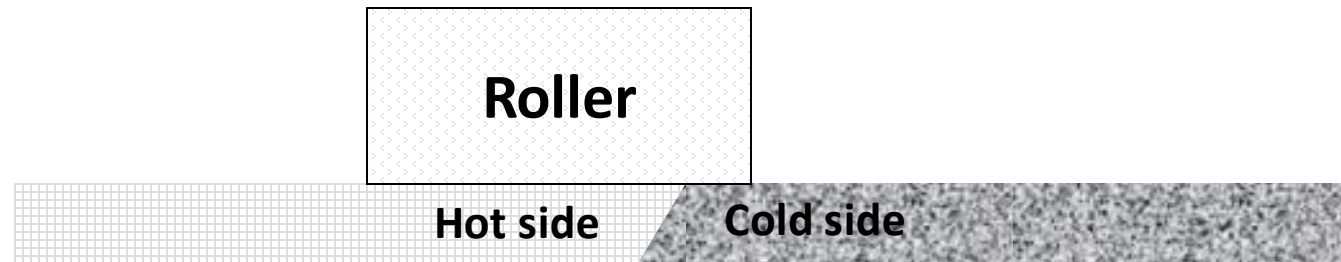
**1st pass all on hot mat
with roller edge off
joint approx 6-12 inches**



**2nd pass overlaps on
cold mat 3-6 inches**

Versus an Alternate Method of 1st Pass over the Supported Edge

Roller in vibratory mode with edge of drum
overhanging 2 to 4-inches on cold side.



**Concern with this method is if insufficient HMA
laid on hot side at joint, then bridging occurs
with first pass (roller supported by cold mat)**

**Data from Oklahoma DOT field
investigation of a permeable pavement:
(at the longitudinal joint)**

LIFT		% DENSITY	
		6" LEFT	6" RIGHT
Surface		82.6	86.1
Intermediate		83.3	87.2
2 nd Lift Base		88.8	93.4
1 st Lift Base		90.6	90.2

With Recommended Method, Still Must Watch for Stress Cracks



During Site Visit to CO,
Staying off 6" on 1st Pass



Stress cracks evident at edge of the drum

(while more likely from rolling unsupported edge, can also occur from rolling supported edge)

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- **Mill & Pave One Lane at a Time**
- **Cut Back joint**
- **Joint Heaters**
- **Joint Adhesives (hot rubberized asphalt)**
- **Surface Sealers Over Joint**
- **Rubber Tire Rollers**
- **Warm Mix Asphalt**
- **Intelligent Compaction**

GOAL

14 year old surface

- **I-65 in IN: SR252 to US31**
 - 12 inches HMA over Rubblized JCP
 - Warranty Project

QUESTIONS?

- **Course Outline**

- Module 1: Inspector's Authority and Responsibility
- Module 2: Materials
- Module 3: Mixtures and Mix Design
- Module 4: Plants & Production
- Module 5: Transportation, Delivery, & Preparation
- Module 6: Placement
- Module 7: Compaction
- Module 8: Acceptance and Testing

- **Each module roughly 90-120 mins**

- **Modules consist of ppt slides with audio, exam**

<http://www.asphaltinstitute.org/training/seminars/paving-inspector-certification-pic/>

