

# Longitudinal Joint Best Practices

**CAPRI Fall 2023 Meeting**

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# How many more years, if...?



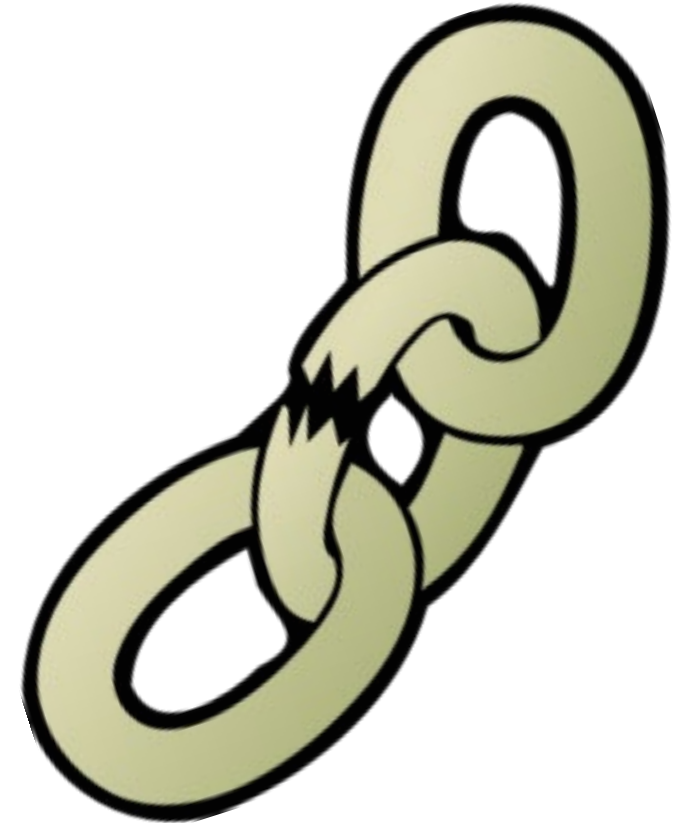
# How many more years, if...?



Credit: Jim Trepanier and IL DOT

Too often longitudinal joints are the weak link in an otherwise long-lasting asphalt pavement.

- Agency and industry concern!
- Offers greatest opportunity to improve overall life.



# Some have more challenges than others!



- Half Day L.J. Workshop by FHWA & AI
  - Recommendations based on Lit. Review and Interviews with 30 “Experts”
- What's Important
  - In-place Density at the L.J.
  - Relationship between Density and Performance
  - Permeability and Relationship to Density
- Agency – Best Practices
  - Proposed Acceptance Criteria for L.J. Density Spec
  - Key Steps in Implementing New L.J. Spec
  - Other Considerations & Innovative Techniques/Materials
- Contractor - Best Practices
  - Placing unconfined side
  - Rolling unconfined side
  - Placing confined side
  - Rolling confined side

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## 43 workshops

- 2012 thru 2016
- Requested, hosted by DOTs
- No cost to attend
- Audience: DOT and industry
- approx. 3800 attendees

## 34 additional presentations

- approx. 3600 attendees

## GOALS:

- improve specs
- improve practices
- more innovative techniques/mtrls
- improved performance



- Handout of workshop slides (180+)
- Video of entire 4-hr Workshop
- 2-hr webinar
- Magazine articles
- Project report
- 5-page “Summary of Recommendations”

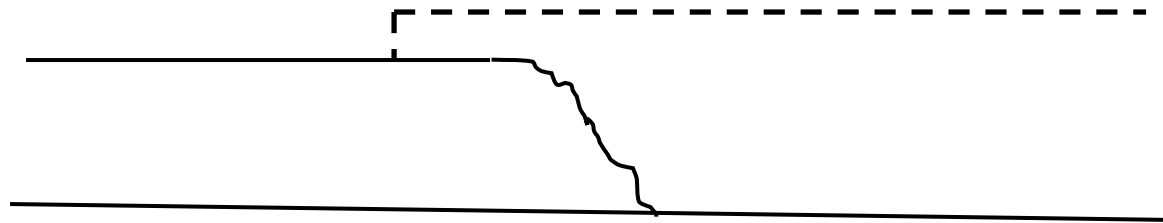


- **During Planning and Design**
- **During Lay Down Operations**
- **Treating the Cold Side Joint Face**
- **During Rolling and Compaction**
- **Testing and Specifications**

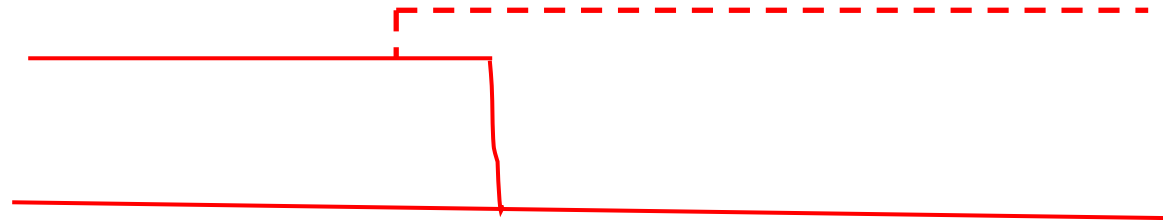


# Defining Different Types of Longitudinal Joints

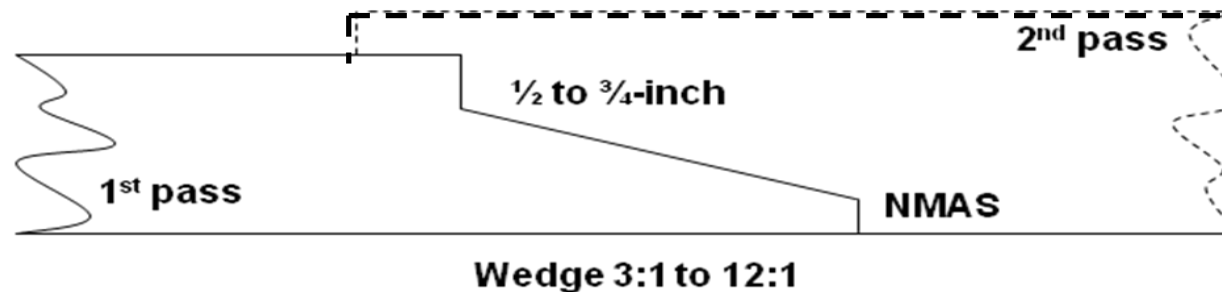
## Butt (Vertical) Joint



## Milled or Cutback Joint

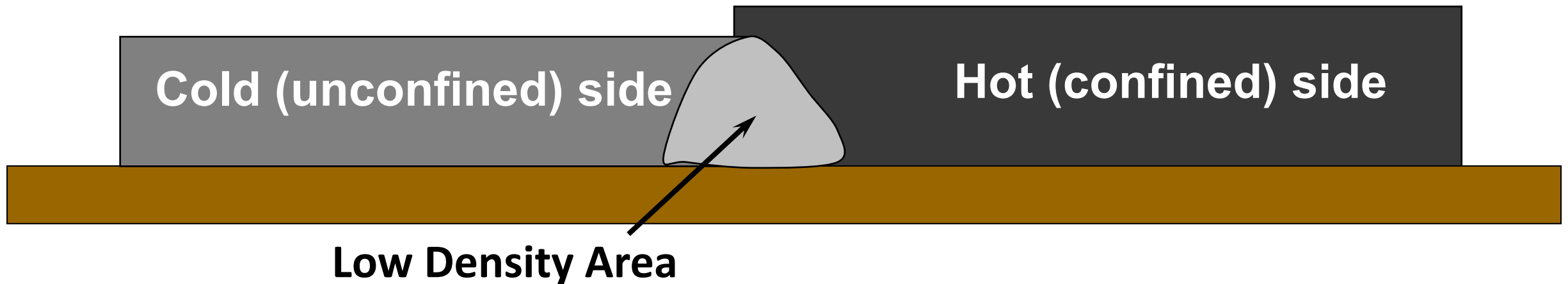


## Notched Wedge Joint



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# We Know Unsupported Edge Will Have Lower Density



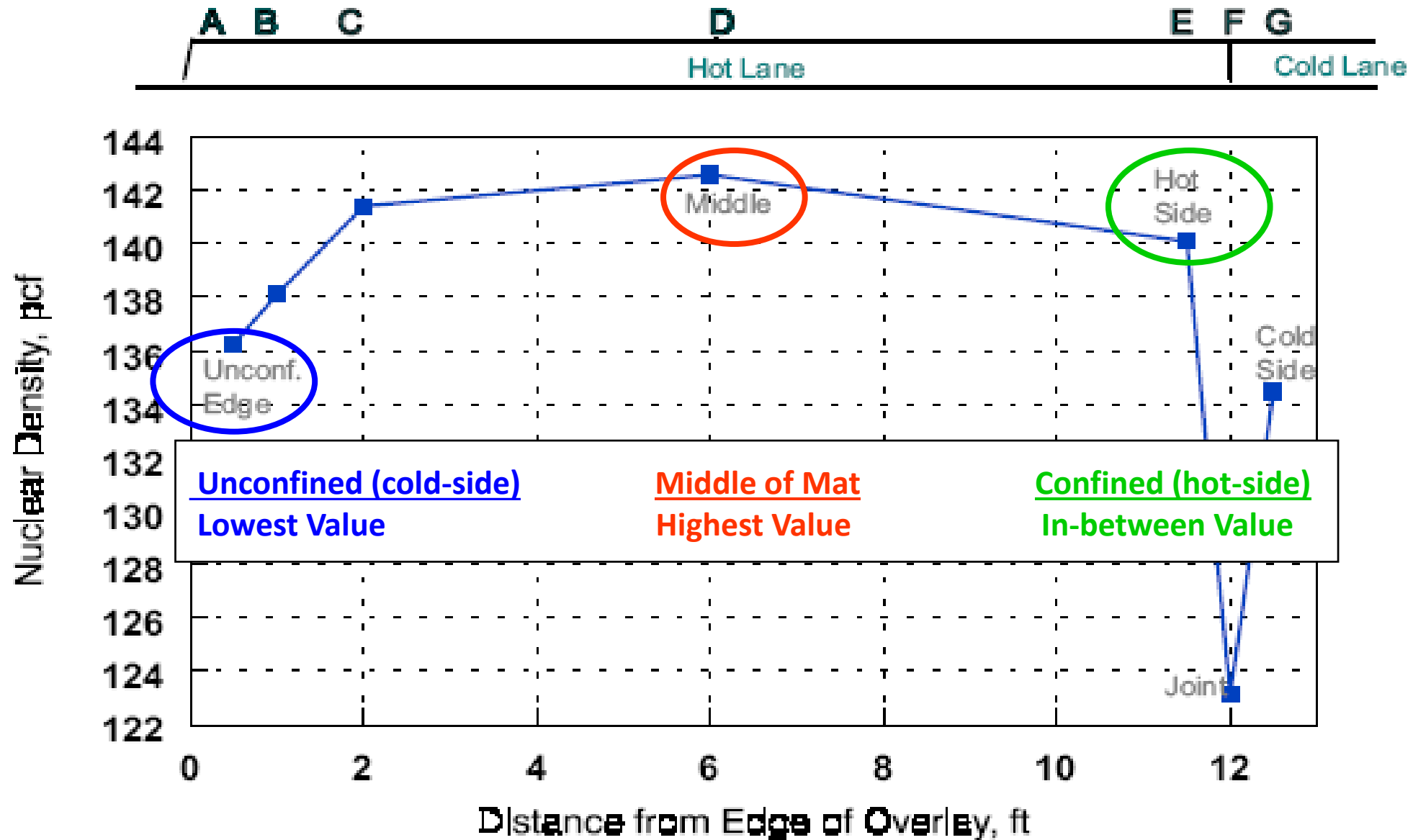
**Please note “Cold side” and “Hot side”, as they will be terms used in this Workshop.**

# Multiple Research Projects Recommended Minimum of 90% TMD, or 2% Less than Required Mat Density

- “It is recommended to specify minimum compaction level at the longitudinal joint (generally 2% lower than that specified for the mat away from the joint).” NCAT / PaDOT, 2002
- “Maximum of 2% less than the corresponding mat density and minimum of 90% of TMD at the specific location.” Nevada, 2004
- “The evaluation is considered failing if the joint density is more than 3.0 pcf below the density taken at the core random sample location and the correlated joint density is less than 90%.” TTI, 2006
- “Joint density, 2% less than mat density, is achievable when measured with cores.” NCAT, 2007

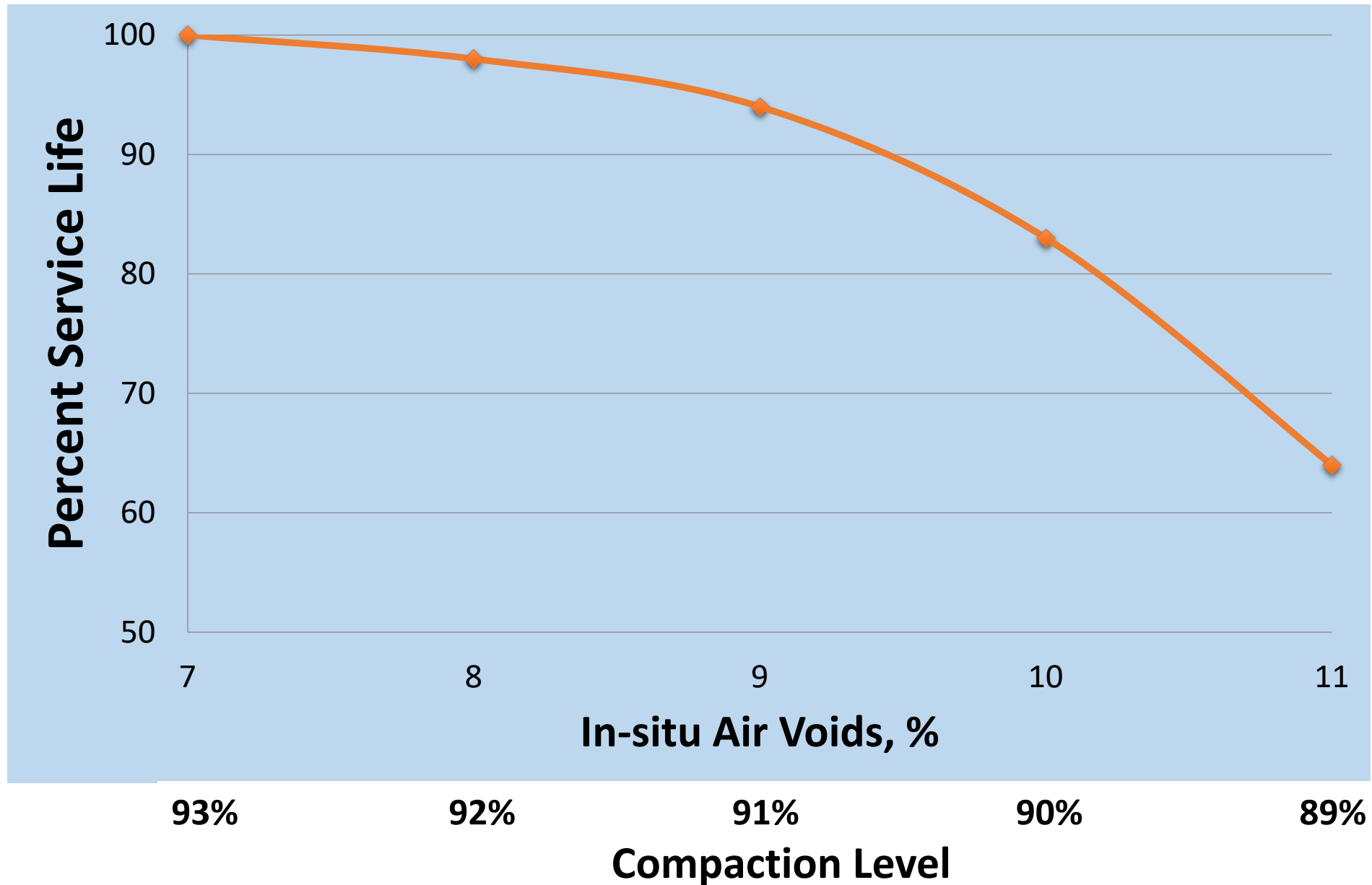
# Typical Nuclear Density Profile Across Mat

Texas Transportations Institute Study



# Effect of In-Place Voids on Life

Washington State DOT Study





...and then there's permeability



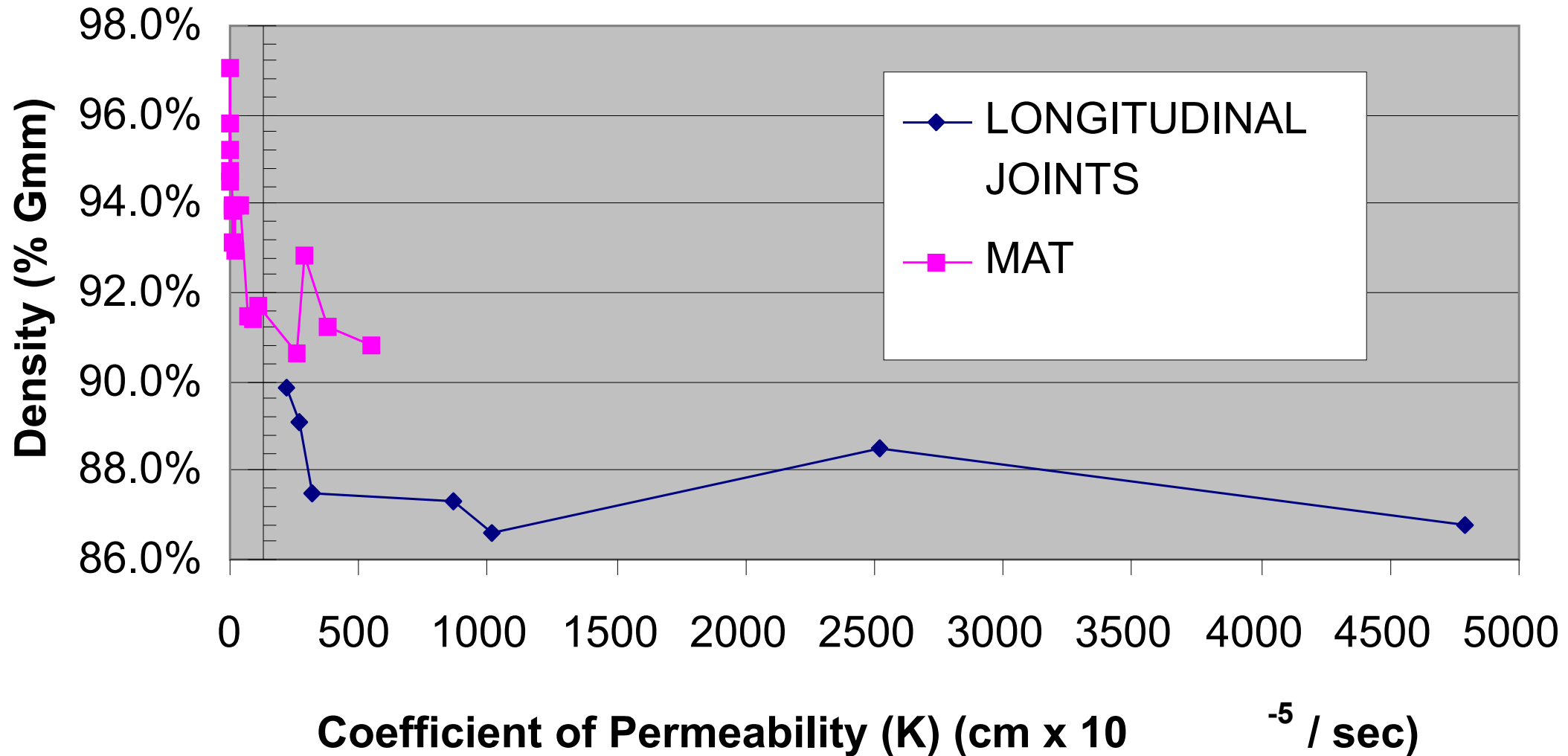
Photo: Wes McNett

**Permeability  
at the  
Longitudinal  
Joint**

# Permeability can be Catastrophic



## 12.5 mm WEARING COURSE



## For 9.5 mm Mixes

## Critical Void Level

E. Zube - California Dept. of Highways, 1962	8.0%
L. Cooley, B. Prowell, R. Brown – NCAT, 2002	7.7%
R. Mallick, et al – NCAT, 2003 (fine graded)	8.5%

## For 12.5 mm Mixes

B. Choubane, et al – Florida DOT, 1998	7%
J. Westerman – Arkansas HTD, 1998	6%
R. Mallick, et al - NCAT, 2003 (coarse graded)	7%

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**Six-inch Cores located either directly over visible joint for butt joint, or middle of wedge for wedge joint. This gives 50/50 split of material over the two lots, so can take average the  $G_{mm}$ s.**

- **$\geq 92\%$  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 L.J.**

- **Multi-year plan (versus all at once)**
- **Agency and industry work together**
- **Training (best practices, possible alternatives)**
- **Establish baseline of existing joint densities (randomly selecting projects to test)**
- **Make incremental changes (trying different techniques, products, or specs.)**
- **Evaluation Plan: measure densities to compare to baseline, monitor performance, etc.**

- **If requiring a minimal density for first time, take incremental steps:**
  - **First year require “report only” (calculate any bonus/penalty without adding/subtracting dollars)**
  - **Second year can start bonuses and penalties**
  - **Gradually increase density requirement to reach 90%, or possibly higher as it can be shown to be accomplished on regular basis**
  - **Evaluate progress, comparing densities to baseline**



- **Mix Selection and Design**
- **Consider Innovative Techniques/ Materials**

- **Using finer mixes on surface to minimize permeability**
- **Lowering design air void level for less permeability**
- **Ensure adequate lift thickness**
  - At least 4 times NMAS for coarse gradation, 3x for fine
- **Tack as separate bid item to facilitate proper application rate**
- **Warm Mix Asphalt can serve as compaction aid**
- **Consider use of the notch wedge joint (versus butt)  
for lift thicknesses  $\geq 1.5$  inches and  $\leq 3$  inches**
  - Has been shown to obtain higher joint densities

- **Treating Face of the Cold Side**
  - Joint Heaters
  - Joint Adhesives (rubberized asphalt)
- **Evaluate Project and Traffic Control for:**
  - Echelon Paving (hot-joints)
  - Mill / Fill One Lane at a Time
  - Cutting Back the Joint
- **Joint Treatments**
  - VRAM (LJS)
  - Post Applied Surface Sealers

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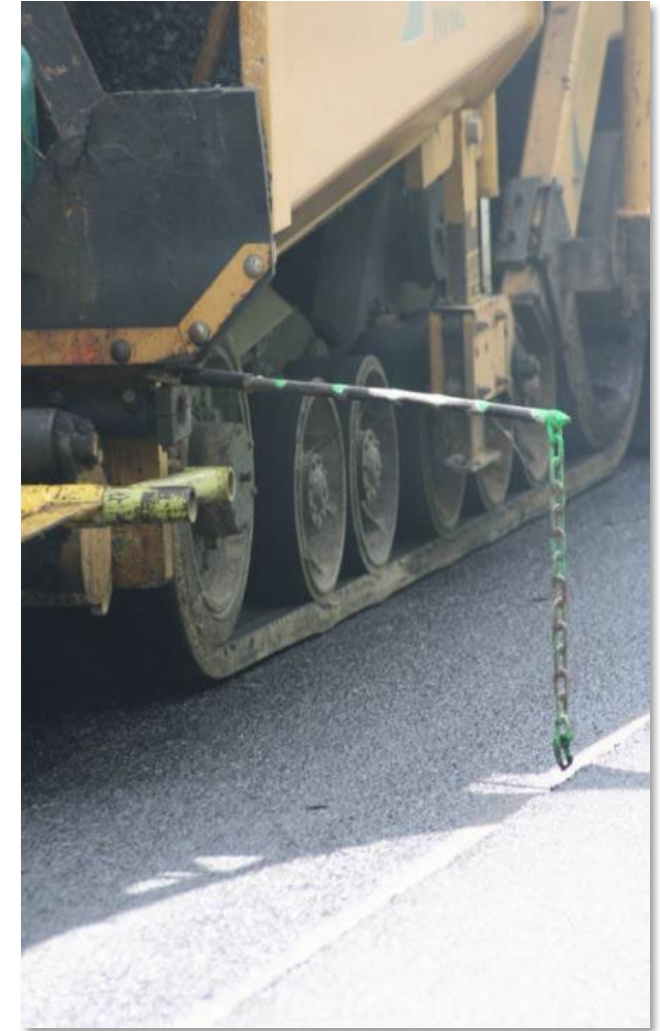
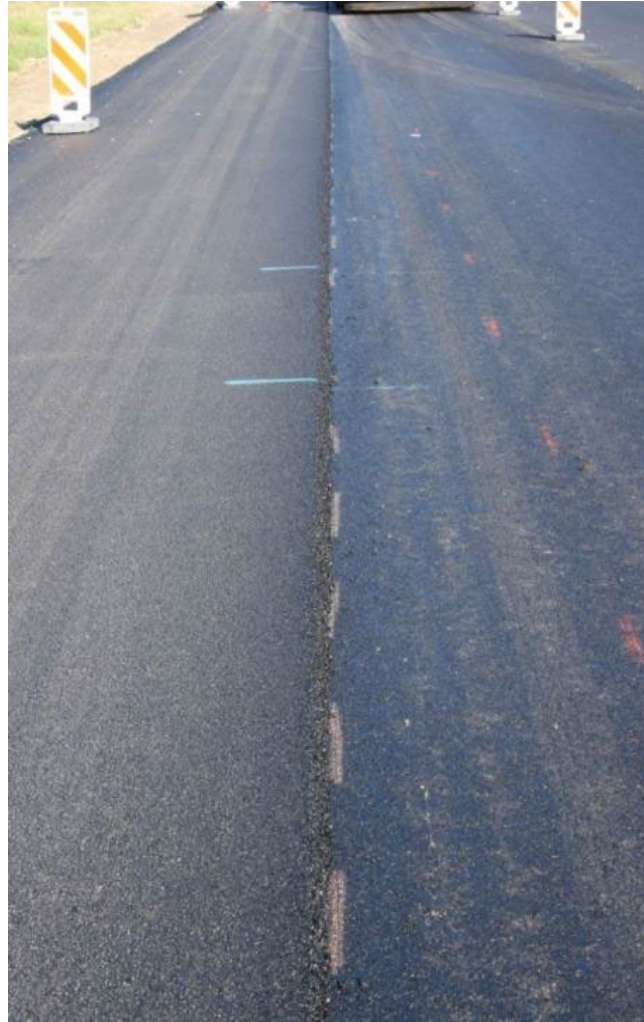
# Tack Coat



**Tack the full width of mat  
(or just beyond) 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



Stringline for reference, and/or Skip Paint, Guide for following



**Great Results**

# Impossible to get proper overlap (1") with next pass

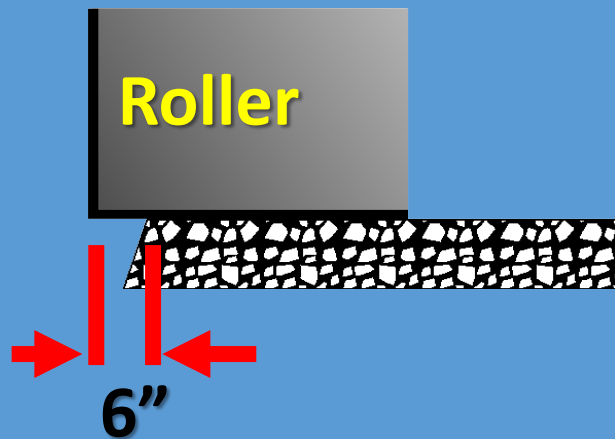




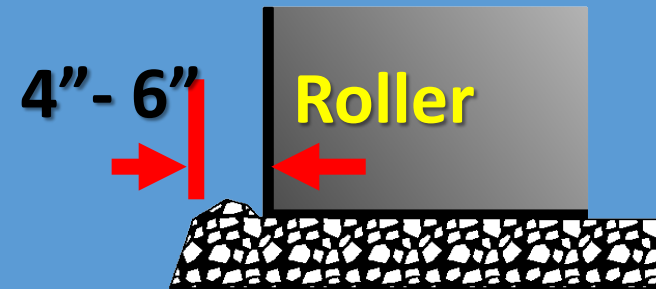
# Rolling Unconfined Side?

## 50-50 on Where to Put 1<sup>st</sup> Pass

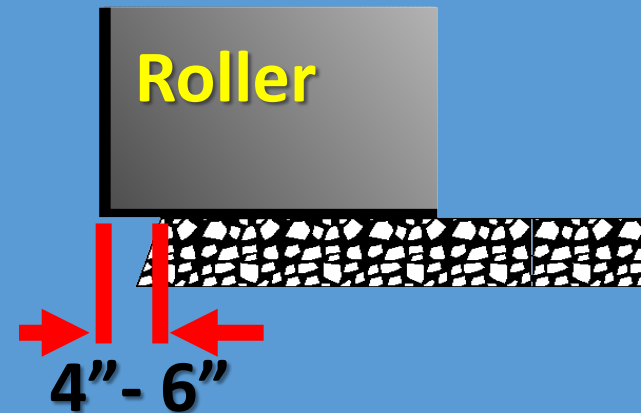
Option 1  
Hang over 4-6"



Option 2  
1<sup>st</sup> Pass 4"-6" inside

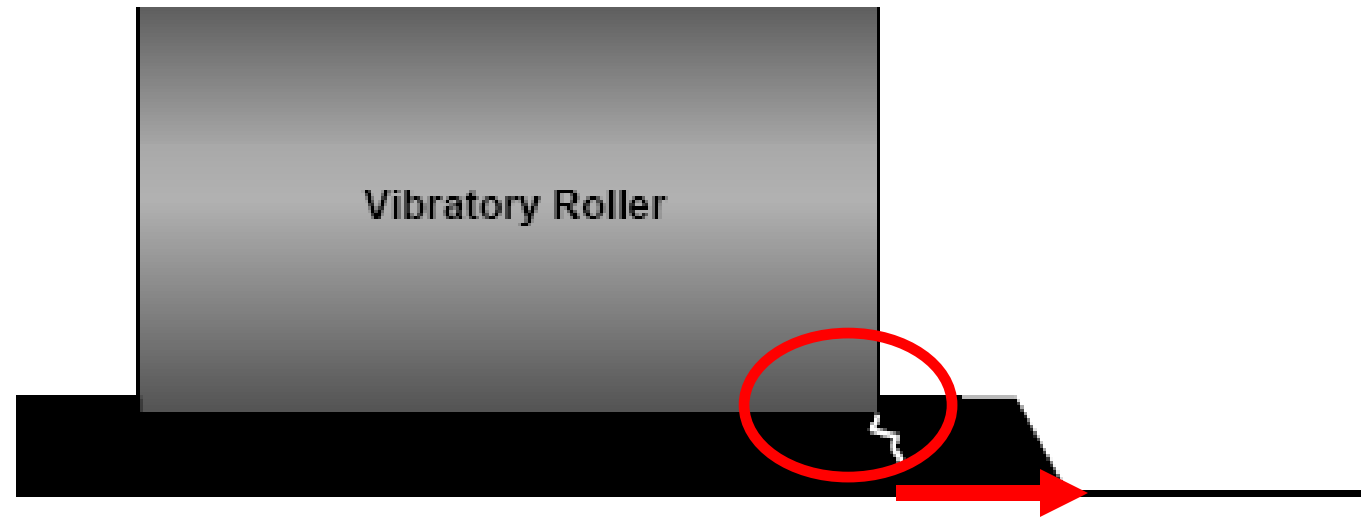


2<sup>nd</sup> Pass hang over 4"-6"



# 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.**

# Compacting Notched Wedge

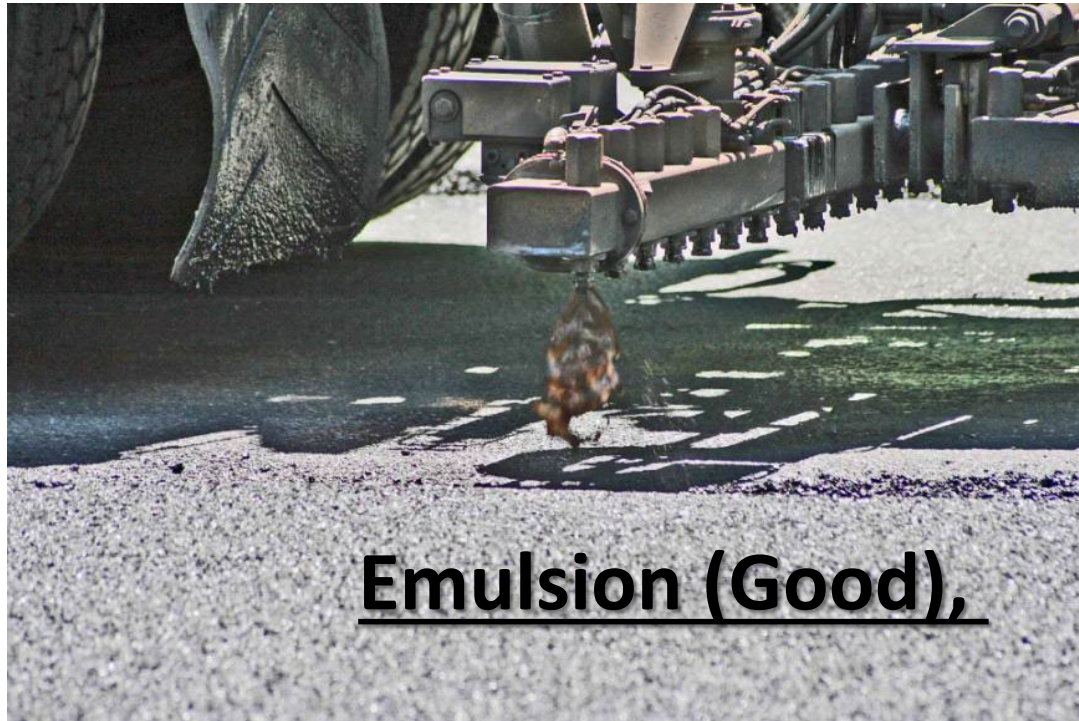


**Vibrating wedge**

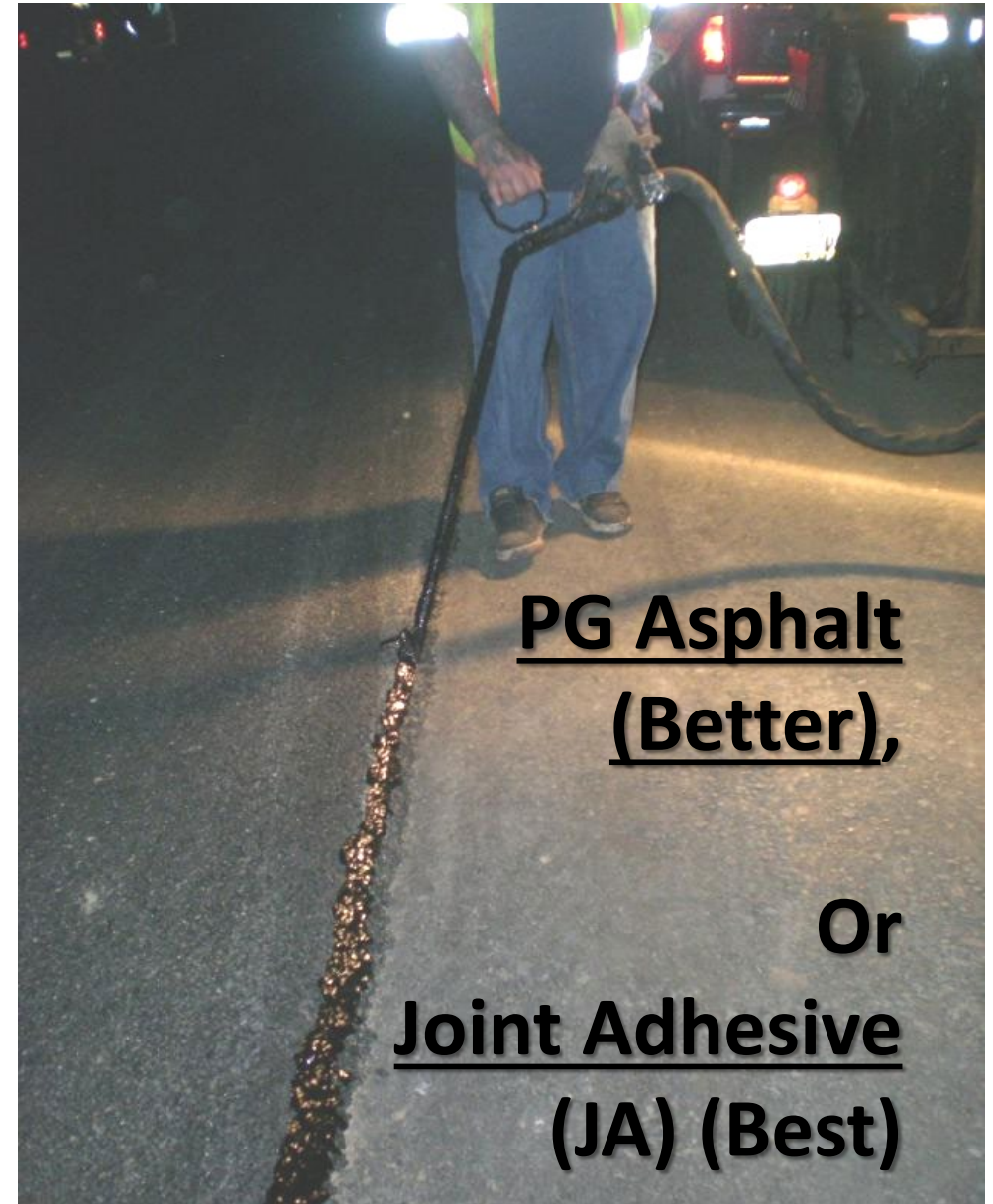


**Wheel compactor**

# Paint the Side of Joint (Butt or Wedge)



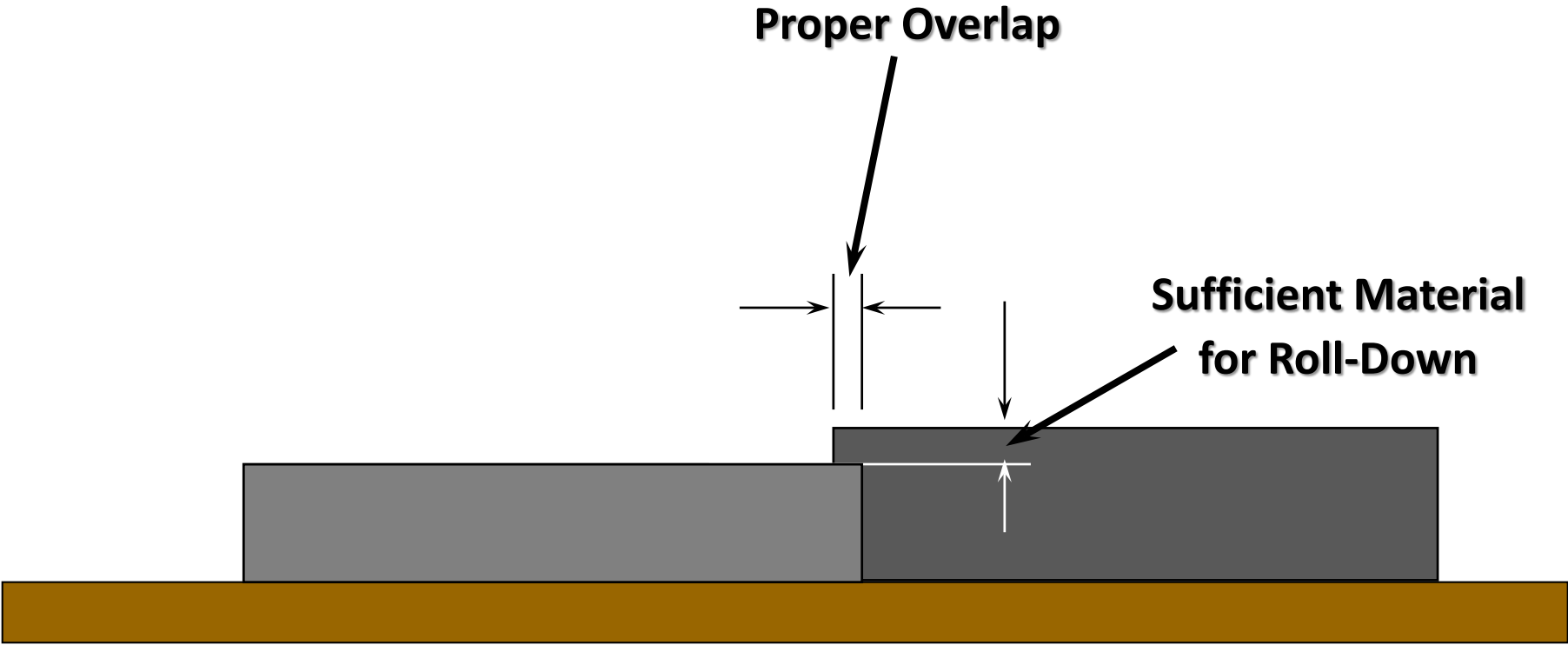
Emulsion (Good),



PG Asphalt  
(Better),

Or  
Joint Adhesive  
(JA) (Best)

# Two Critical Items for Good Joint Density

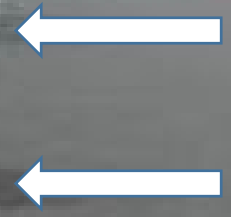


# When Closing Joint, Set Paver Automation to Never Starve the Joint of Material

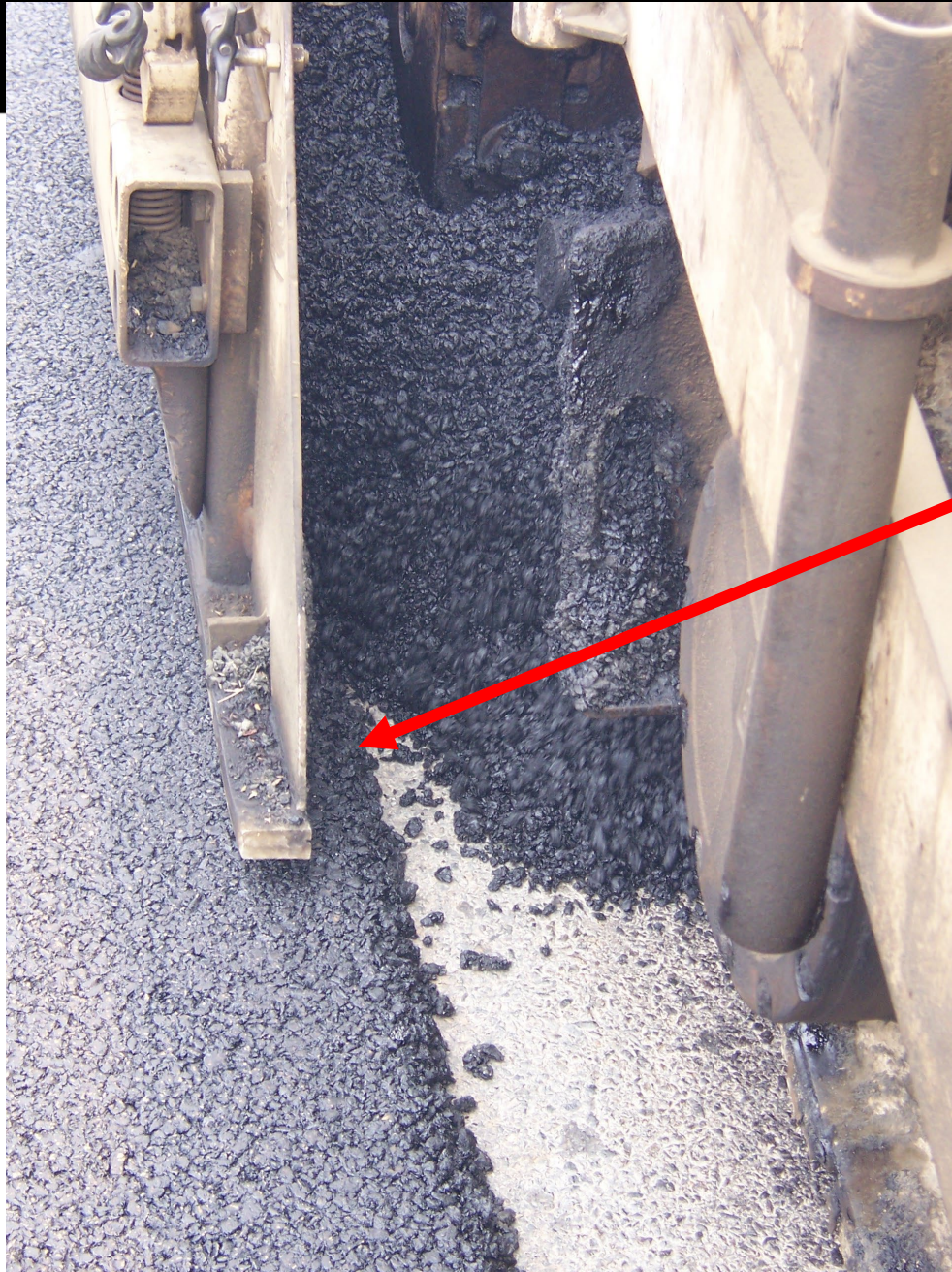
- See next slide: “Sufficient Material for Roll-Down”
- Target final height difference of +0.1” on hot-side versus cold side
  - NH spec requires 1/8” higher
- If hot-side is starved, roller drum will “bridge” onto cold mat and no further densification occurs at joint



***Destined for  
Failure***



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



## Proper Overlap:

- $1.0 \pm 0.5$  inches
- Exception: Milled or cut back joint should be 0.5 inches



# Bumping the Joint?



# Do NOT Rake Across the Joint



## Leads to:

- Segregation
- Poor density at joint

# Luting Not Necessary for Good Joint Density



This lute person is  
doing a great job

# Rolling Confined Side



**1<sup>st</sup> pass entire drum on hot mat with roller edge off joint approx. 6-12"**



**2<sup>nd</sup> pass overlaps on cold mat 3-6"**

# AI Members – Thank You!

