WAPA

WISCONSIN ASPHALT PAVEMENT ASSOCIATION

57TH ANNUAL

Best Practices for Specifying and Constructing HMA Longitudinal Joints

A Cooperative Effort between Asphalt Institute & FHWA

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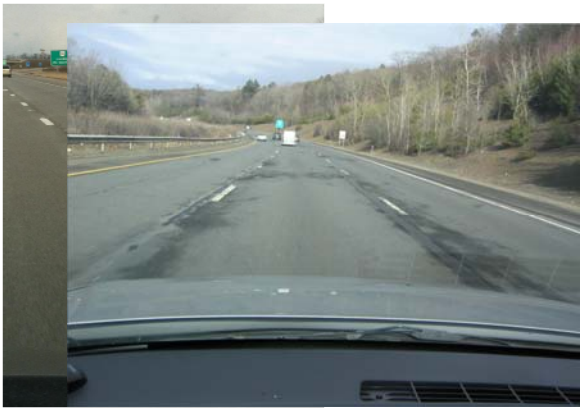
Longitudinal Joints



Longitudinal Joint Workshops (4-hrs) 2012 - 2014

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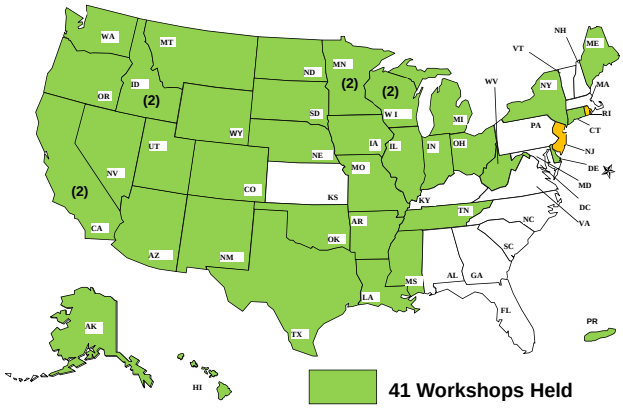
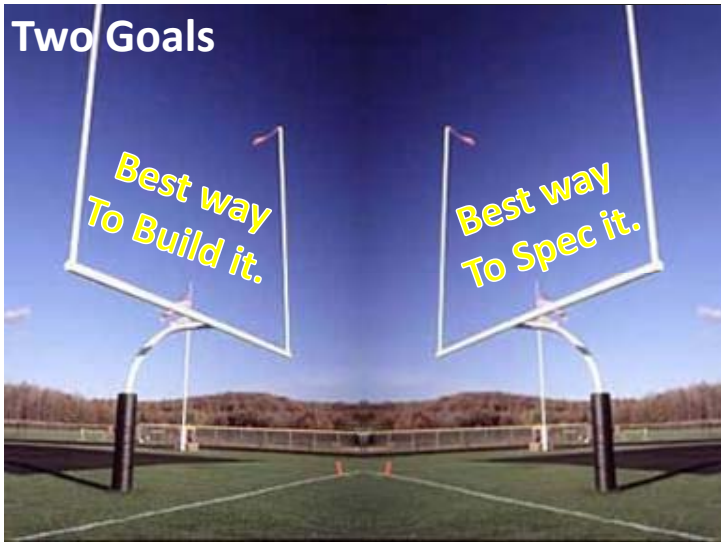


Two Goals



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 G. 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

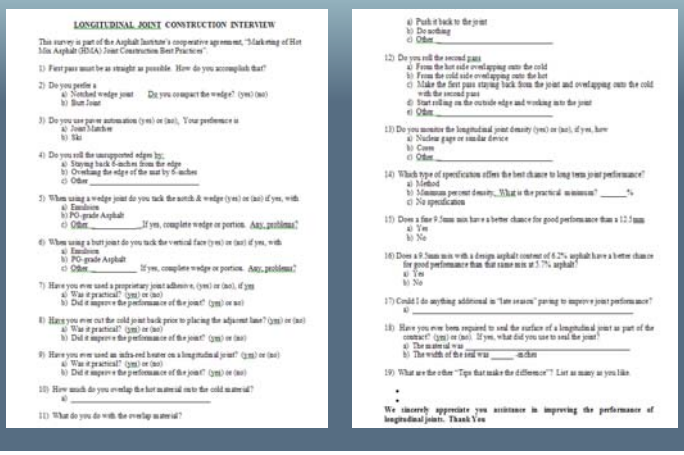
Des Moines Asphalt and Paving Company

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.
•
•

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

Five Initial State Visits

Connecticut
Colorado
Texas
Maryland
Pennsylvania

Note: Content grows and recommendations get tweaked as we visit and learn from each State Meeting and Workshop.

Do the Experts Agree ?

Not Always

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Literature Review on Longitudinal Joints

Construction

Actual in-place densities?

What is achievable?

Permeability/ Density

Relation to performance?

Where is danger zone?

We Know Unsupported Edge Will Have Lower Density

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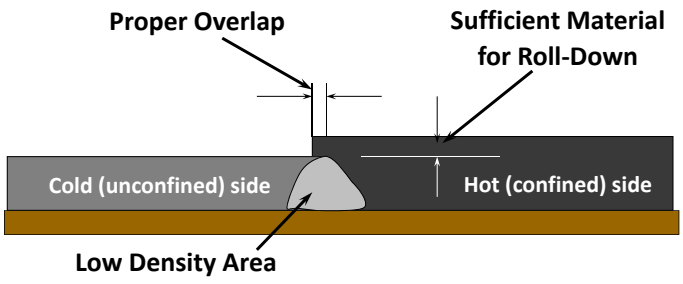

Please note Cold side and Hot side, as they are terms used throughout this Workshop.

Joint vs. Mat Density

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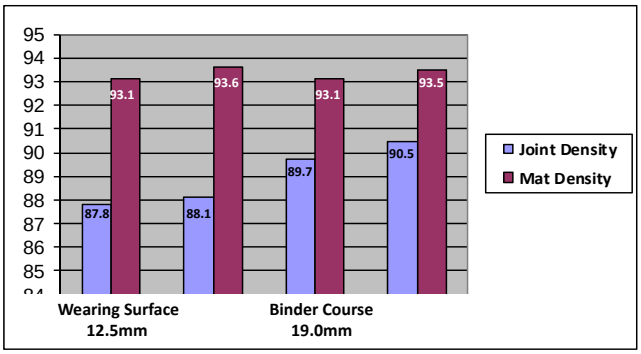
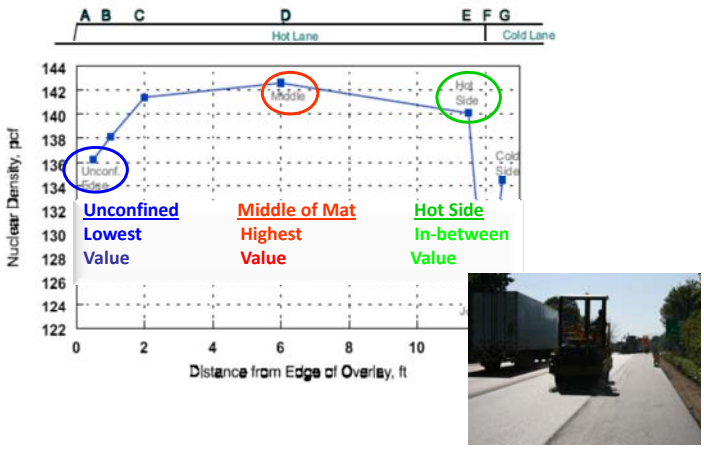


PENNDOT 2006-2007, with 6 cores taken over joint

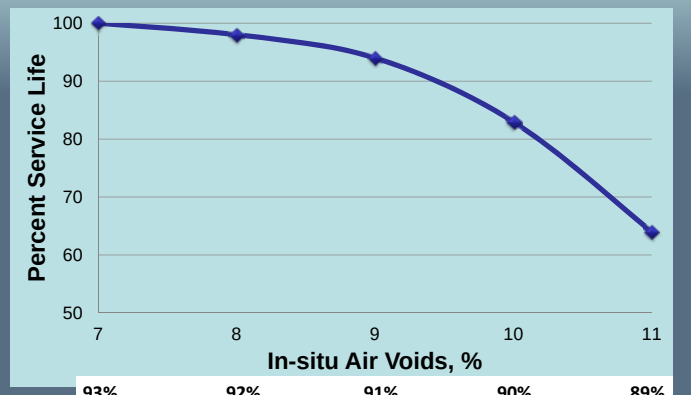
Typical Nuclear Density Profile

Texas Transportations Institute Study



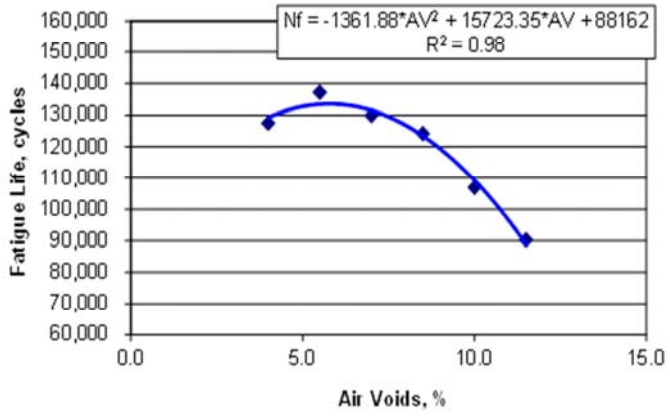
Effect of In-Place Voids on Life

Washington State DOT Study



Effect of Percentage of Air Voids on Fatigue Life

20C, 500 microstrain



Kentucky Study on Density

Permeability can be Catastrophic

Research a Decade Ago 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

1st Goal

Proposed Acceptance Criteria for an 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, in order to average the G_{mm} of both lots.

≥ 92% of G_{mm}: maximum bonus

Between 92% and 90% of G_{mm}:
100% pay, pro-rated bonus, suggest "overband" or "surface seal" joint

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

The Pennsylvania Example

Joint Issues In PA

PA Story on Longitudinal Joint Density

Article in NAPA's magazine, *Asphalt Pavement*, Sept/Oct 2012
http://www.nxtbook.com/nxtbooks/naylor/NAPS0512

- Increasing density was viewed as key
- 2007 - began measuring joint density
- 2008 - method specification of best practices
- 2008 and 2009 - continued gathering data on joints
- 2010 - New joint density specification. Transition year with no bonuses or penalties.
- 2011-2015 – bonuses and penalties on joint density

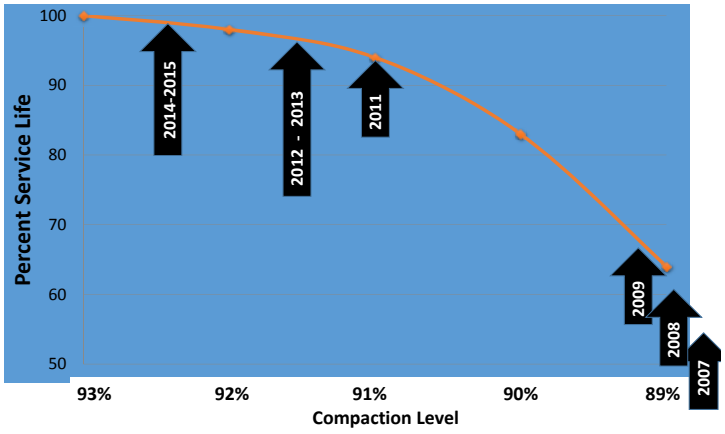
PA Joint Density Spec Highlights

- Both type of LJs allowed (butt or notch wedge)
- Joint Lot = 12,500'. Core every 2,500'. 5 cores per lot.
- Core location
  - For Butt: directly over visible joint
  - For Notch Wedge: middle of wedge
- Percent Within Limits (PWL)
  - Incentive starts at 80% PWL
  - Disincentive at <50% PWL
- Lower Specification Limit
  - 2010-2013: 89% TMD
  - 2014-2015: 90% TMD
- Corrective action for < 88% TMD

PA: How Did it Work?

In-place Density Summary, Reported by PA DOT				
Year	# Lots	Avg. Roadway Density, %TMD	**Avg. Joint Density, %TMD**	
2007	18	93.9	**87.8**	begin measuring at Jt.
2008	43	94.1	**88.9**	method spec
2009	29	94.1	**89.2**	method spec
2010	No data, transition to PWL spec			
2011	137	94.1	**91.0**	PWL, LSL 89%
2012	162	94.0	**91.6**	PWL, LSL 89%
2013	167	93.9	**91.4**	PWL, LSL 89%
2014	316	94.1	**92.3**	PWL, LSL 90%
2015	493		**92.6**	PWL, LSL 90%

PA: Increased Projected Life of Joints Due to Improved Joint Density



PA: Annual Statewide Totals on Incentives/Disincentives for Joint Density

Year	Incentive Payments	Disincentive Payments
2011	**$268K**	**$99K**
2012	**$489K**	**$63K**
2013	**$588K**	**$25K**
2014	**$1,002K**	**$127K**

Note: MI and CT have averaged over 91.5%, and AK over 92.0% density at the joint over recent construction seasons

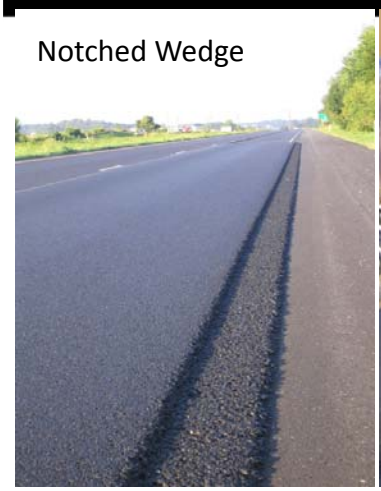
Constructing a Quality Longitudinal Joint

- Types of LJs
- Planning for the Joint
- Placement and Rolling

Use best practices for paving previously discussed!

Preferred Joint Type? Experts Evenly Divided.

Notched Wedge



Wedge Joints and Compaction

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%	

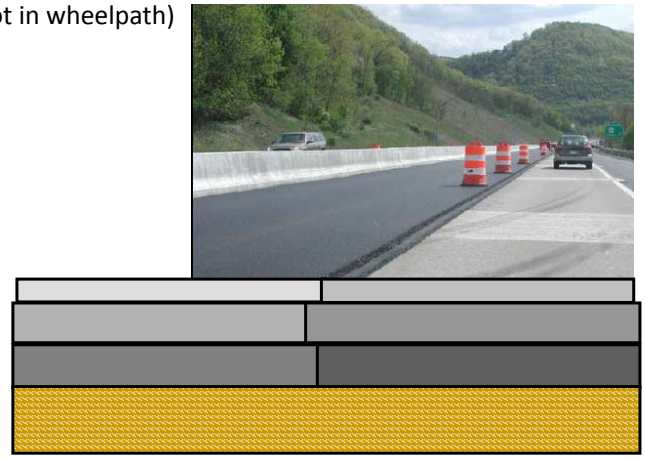
Plan for Longitudinal Joints…

(i.e. Discuss During Pre-Con Meeting)

- Joint Type
- Layout Plan of Final Lift showing joints (DelDOT)
  - Recognize need to offset joints between layers
  - Avoid wheel paths, RPMs, striping (if possible)
- Testing of Joint
  - Type, location, schedule, by whom
- Joint Construction Practices
  - Paving, rolling, materials
- Pave low to high when possible for *shingle effect*
  - Avoids holding rain water at joint by hot side being slightly higher (recommendation later)

Offset joints between layers by at least 6-inches; surface joint should be near centerline

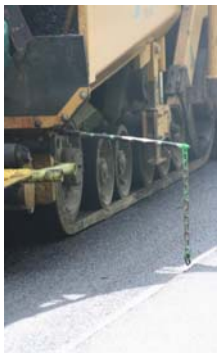
(not in wheelpath)



First Pass Must Be Straight!

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





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


Great Results

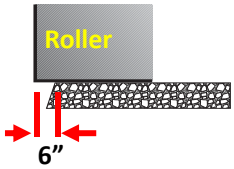
Tough to get proper overlap (1") with next pass


Best Way to Roll an Asphalt Joint

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

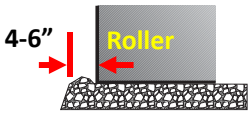
Option 1

Hang over 4-6"

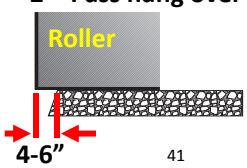


Option 2

1st Pass 4-6" inside



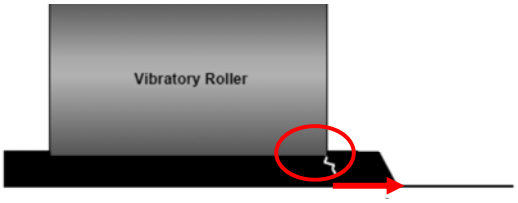
2nd Pass hang over 4-6"



What To Watch for With Option 2

Rolling Unsupported Edge

With First Roller Pass



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

So Our Recommendation: Option 1

1st Roller Pass Hangs Over 4-6 inches

Compacting Notched Wedge

Vibrating wedge

Wheel compactor

Paint the Side of Joint (Butt or Wedge)

Emulsion (Good),

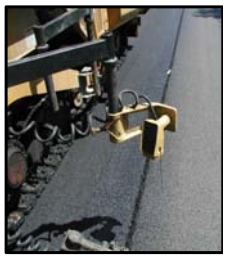
PG Asphalt (Better),

Or

Joint Adhesive (JA) (Best)

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

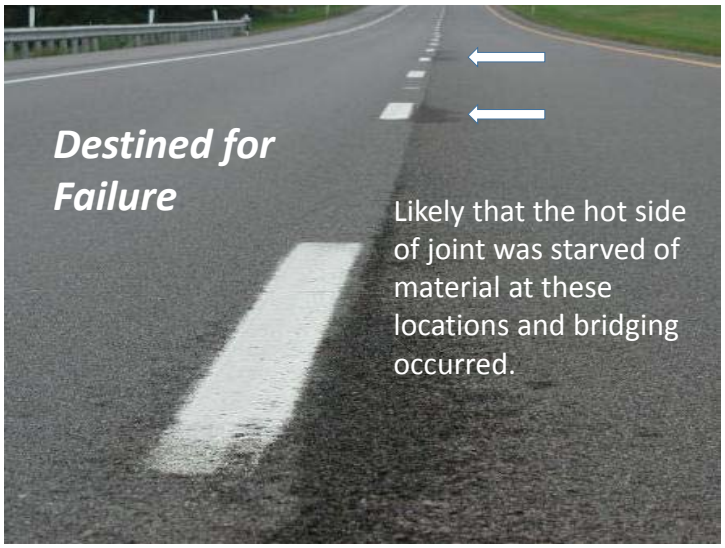


Ski Best for Smoothness

(reference is average over length of ski)

Versus Joint Matcher, which is best for joint (reference is exact location just in front of auger)

Note: If underlying pavement already smooth, some contractors feel they can get good joint with ski, but must finish 1/10" high



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 ½")

Core #10 (Overlap 1 ½")

Bridenbaugh & Colella

Do NOT Rake Across the Joint

Lute the Longitudinal Joint

This lute person is doing a great job

Rolling the Supported Edge

Our Recommendation:

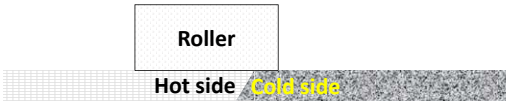
1st pass all on hot mat with roller edge off joint approx 6-12 inches

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)

Long. Joint Construction Example

Other Options / New Products

- 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

Details provided in full workshop
Asphaltinstitute.org/engineering

Bottom Line

Increased compaction = Increased Performance

Better "Return on Investment" for the taxpayers

More Successful Pavements = More Tonnage for the HMA Industry !!!

Thank you for your time!!!