Best Practices for Specifying and Constructing HMA Longitudinal Joints
A Cooperative Effort between Asphalt Institute & FHWA

Longitudinal Joint Workshops (4-hrs) 2012 - 2014

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

Two Goals
Best way To Build it.
Best way To Spec it.

9 NAPA Sheldon G. Hayes Winners
“Single best paving project of the year.”

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

Do the Experts Agree?
Not Always

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.

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

Proper Overlap
Sufficient Material for Roll-Down

Cold (unconfined) side
Low Density Area
Hot (confined) side

Joint vs. Mat Density

2006-2007, with 6" cores taken over joint
Effect of In-Place Voids on Life  
Washington State DOT Study

Effect of Percentage of Air Voids on Fatigue Life  
20C, 500 microstrain

Typical Nuclear Density Profile  
Texas Transportations Institute Study

Permeability can be Catastrophic

Dilemma at the Joint

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 3.0pcf 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**

*Best way To Spec it.*

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**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

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**The Pennsylvania Example**

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**PA Story on Longitudinal Joint Density**

*Article in NAPA’s magazine, Asphalt Pavement, Sept/Oct 2012*

- 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

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**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

<table>
<thead>
<tr>
<th>Year</th>
<th># Lots</th>
<th>Avg. Roadway Density, %TMD</th>
<th>Avg. Joint Density, %TMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>18</td>
<td>93.9</td>
<td>87.8</td>
</tr>
<tr>
<td>2008</td>
<td>43</td>
<td>94.1</td>
<td>88.9</td>
</tr>
<tr>
<td>2009</td>
<td>29</td>
<td>94.1</td>
<td>89.2</td>
</tr>
<tr>
<td>2010</td>
<td>No data, transition to PWL spec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>137</td>
<td>94.1</td>
<td>91.0 PWL, LSL 89%</td>
</tr>
<tr>
<td>2012</td>
<td>162</td>
<td>94.0</td>
<td>91.6 PWL, LSL 89%</td>
</tr>
<tr>
<td>2013</td>
<td>167</td>
<td>93.9</td>
<td>91.4 PWL, LSL 89%</td>
</tr>
<tr>
<td>2014</td>
<td>316</td>
<td>94.1</td>
<td>92.3 PWL, LSL 90%</td>
</tr>
<tr>
<td>2015</td>
<td>493</td>
<td>92.6</td>
<td>PWL, LSL 90%</td>
</tr>
</tbody>
</table>

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

Next: 2nd Goal

Best way To Build it.

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Incentive Payments</th>
<th>Disincentive Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>$268K</td>
<td>$99K</td>
</tr>
<tr>
<td>2012</td>
<td>$489K</td>
<td>$63K</td>
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<tr>
<td>2013</td>
<td>$588K</td>
<td>$25K</td>
</tr>
<tr>
<td>2014</td>
<td>$1,002K</td>
<td>$127K</td>
</tr>
</tbody>
</table>

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!

The Best Longitudinal Joint: Echelon Paving

New Jersey

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

Preferred Joint Type? Experts Evenly Divided.

- Notched Wedge
- Butt

Wedge Joints and Compaction

Vibratory Wedge Compactor

Plate Compactor

| Joint Type      | 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)

Poor planning – joint 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

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

Destined for Failure
Likely that the hot side of joint was starved of material at these locations and bridging occurred.
Proper Overlap:
- 1.0 ± 0.5 inches
- Exception: Milled or sawed joint should be 0.5 inches

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

GOAL
14 year old surface

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

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!!!