Asphalt Institute FHWA Study

Best Practices for Constructing and Specifying HMA Longitudinal Joints

Project Team

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Don’t We Already Know How To Build a Longitudinal Joint?
• Note condition of the rest of the mat
• Also sealed each side of patch.

Pittsburgh Gazette Headline:
"Superpave Not All It's Cracked Up to Be"

Don’t We Already Know How To Build a Longitudinal Joint?

Maybe Not!
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...

CHALLENGES & CHANGES

“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

Two Goals

Best way To Build it.
Best way To Spec it.
Take-a-ways from FHWA Survey to 52 Division Offices

- ½ States are not satisfied with overall performance of L-Joints
- 2/3rds of States have a “L-Joint spec”
  - Half of those (17) have a min. density
    • Range from 89% - 92% min $G_{min}$ (Rice)
  - Other half are method specs
    • From Joint Adhesive to very prescriptive

Is it important for an Agency to understand LJ Construction?

- Very Important
- Helpful
- Just Spec It

Now let’s talk about Specifying Longitudinal Joints
Longitudinal Joint Literature Review

Construction
What are we getting?

Permeability
What is the danger zone?

Effect of In-Place Voids on Life
Washington State DOT Study

Joint vs. Mat Density
(Representative of Other Studies)
**Construction**

<table>
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<tr>
<th>Year</th>
<th>Avg</th>
<th>Std Dev</th>
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<tbody>
<tr>
<td>2004</td>
<td>90.0</td>
<td>1.71</td>
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<tr>
<td>2005</td>
<td>90.3</td>
<td>1.31</td>
</tr>
<tr>
<td>2006</td>
<td>90.3</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>90.0</td>
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</tr>
</tbody>
</table>

COLORADO

*It is unreasonable to expect the average density of the longitudinal joint to achieve a density of 92%.*

Connecticut

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**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%

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**Longitudinal Asphalt Pavement Joint Construction — Performance**

- D. Morian, et al. Quality Engineering Solutions

Significantly better performance 98% of the Mat 12 years vs 95% of the Mat 8 years

Assume mat is 94% of Gmm, then 98% of 94% is 92% (8% Va)
then 95% is 89% (11% Va)
then 93% is 87% (13% Va)
Permeable Below 92% Density

DENSITY VS. PERMEABILITY
12.5 mm WEARING COURSE

...and then there's permeability

Permeability at the Longitudinal joint

Destined for Failure
Air void & Permeability research says <7.8% V_a needed

Standard joint construction practices reach 9-10%

Method versus Density?

1 Best Method

Depends on Project

Nothing works well!

Various Approaches

No LJ Spec
- High Agency Risk
- No Incentive for Quality

Method Spec
- One size fits all
- Agency assumes some risk
- No Incentive for Innovation
- Required State on-site Oversight

Density Spec
- Allows innovation for Contractor
- Balanced Risk, includes incentives & disincentives
- Not Appropriate for Small Jobs
- Has trigger for ex. Sealing/Over-banding

Tiered Spec
- Small jobs: Contractor follows Method Spec or submits compaction plan
- Larger Jobs: Density
Maybe We Don't Already Know How to Build a Longitudinal Joint?

- **What We Know**
  - Certain Steps Everyone Agrees On

- **What We Don’t Know**
  - Differing Opinions on Other Steps
  - Developed Questionnaire for Experts
    - Interview Consultants, Manufacturers and Contractors (Sheldon Hayes winners since 2000)
    - Compile and Analyze Findings

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!

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Interview Questions

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Do the Experts Agree?

Not Always
Does a Minimum Density Spec Offer the Best Chance for Long Term Joint Performance?

13 of 17 “experts” said yes

Most suggested joint density of 2% less than mat density or minimum density of 90% TMD

BUT,

Opinions vary on type of acceptance test - Core vs Gauge

Prefer Notch-Wedge or Butt Joint?

Pretty evenly divided

All (but 1) Preferred Paver Automation Versus Manual Operation To Construct Best Joint

- Joint matcher over ski for joint
  - Joint matcher assures sufficient material at joint
  - Ski best to achieve smoothness and to meet ride spec (achieve bonus)
Unanimous that a stringline should be used to assure first pass is straight

Tips:
- survey crew to set
- use suspended chain or rod
- paint over string

Location of roller on first pass of unconfined edge?
- Stay back 6” from edge
- Overhang edge by 4-6”

Result: 50/50

Almost all “experts” suggest painting vertical face of both joint types:
- Emulsion
- PG binder
- Joint adhesive (rubberized asphalt)

Consultants tended to prefer joint adhesive (agreeing with recent research)
Contractors prefer to use same material as for tack
General agreement that overlap should be 1" ± .5"

What should you do with overlap material before rolling?
- 11 said: nothing
- 4 said: lute back
- 2 said: remove with shovel

Lowest void is at the joint. This is not always the case, but it is the norm. Is the void the result of not getting sufficient material to the joint (insufficient overlap?)

Cas Bogradzi, Port Authority of NY & NJ

How to Roll the Hot Side?
- 4 said: roll from cold side, overlapping onto hot
- 4 said: roll from hot side, overlapping on cold
- 7 said: roll from hot side and stay back 6-inches on first pass, then roll joint on 2nd pass
- 2 said: start on the outside (unsupported) edge and work toward joint (allow heat transfer to cold joint)
Vibratory Screed ON (estimates 30 to 50% of the time not on)
End gate tight to the pavement
Augers to within 12 to 18-inches of end gate
Automation ON w/ joint matcher
Sufficient depth of material on 2nd pass
Roller Vibrators ON
Use best practices
Training, Training, Training
Plan for the longitudinal joint, not afterthought

Impact of Mix Type (NMAS and gradation)
Impact of Lift Thickness
Avoid Segregation
Late season paving mandates best practices:
  - Consistent mix temperature
  - Consider warm mix
  - Paving train at speed where rollers can stay close
Longitudinal Joints

• Tack cold edge
• Overlap screed 1-2 inches
• Leave alone or,
• “Bump” excess to hot side before compaction
Longitudinal Joints

- Minimize Joints
- Stagger Joints
  - 6 to 12 inch offsets
- No Joints in Wheel Paths
- “Construct Properly”

Alaska Specification

401-3.14 JOINTS.

Minimize the number of joints. Ensure that all joints have the same texture and smoothness as other sections of the course. Remove to full depth improperly formed joints resulting in surface irregularities. Replace with new material, and thoroughly compact. Precut all pavement removal to a neat line with a power saw or by other approved method. Form transverse joints by saw-cutting back on the previous run to expose the full depth of the course or use a removable bulkhead. Skew transverse joints between 15-25 degrees. Offset the longitudinal joints in one layer from the joint in the layer immediately below by at least 6 inches. Align the joints of the top layer at the centerline or lane lines. Where preformed marking tape striping is required, offset the longitudinal joint in the top layer not more than 6 inches from the edge of the stripe. Core the longitudinal joint at the rate of 3 cores per lot. Maintain the joint densities above 91% of maximum specific gravity. Change method of joint construction, if necessary, to meet density requirements. The joint densities will not be included in the price adjustment calculations, but must be included in your Quality Control plan.
Questions?