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# Asphalt Institute FHWA Study

## Best Practices for Constructing and Specifying HMA Longitudinal Joints

  
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U.S. Department of Transportation  
Federal Highway Administration

## Project Team

- Asphalt Institute
  - Mark Buncher
  - Carlos Rosenberger
  - AI Regional Engineers
- FHWA
  - Thomas Harman
  - Michael Arasteh
  - Stephen Cooper
- PA State Asphalt Paving Association
  - Gary Hoffman

CHALLENGES & CHANGES 2

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



CHALLENGES & CHANGES 3

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## 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 10

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**“ 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

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## Two Goals

**Best way  
To Build it.**

**Best way  
To Spec it.**

CHALLENGES & CHANGES 11

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### Take-a-ways from FHWA Survey to 52 Division Offices

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



CHALLENGES & CHANGES 13

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### Is it important for an Agency to understand LJ Construction?

 **Very Important**

 **Helpful**

 **Just Spec It**

CHALLENGES & CHANGES 14

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**Now let's talk about Specifying Longitudinal Joints**

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## Longitudinal Joint

### Literature Review

**Construction**  
*What are we getting?*

**Permeability**  
*What is the danger zone?*

CHALLENGES & CHANGES 16

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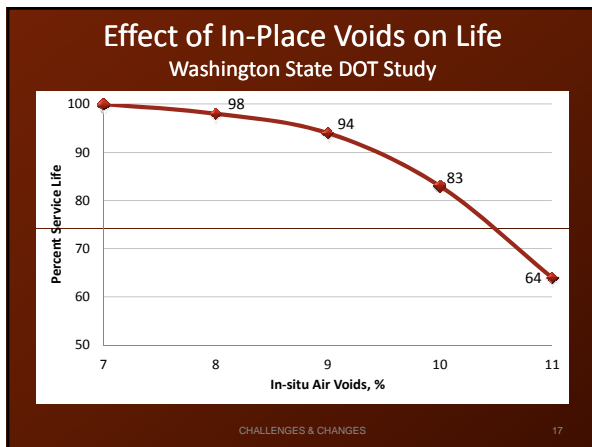
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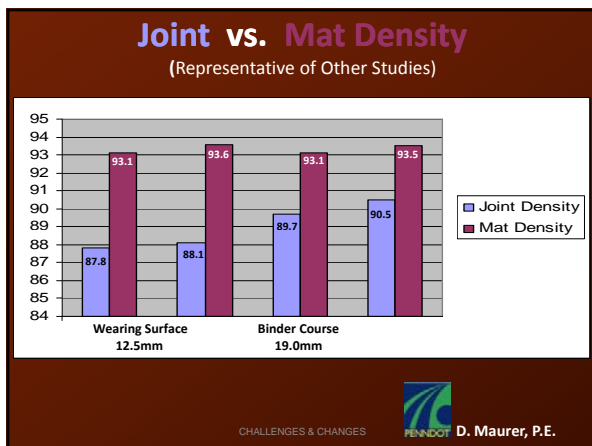
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**Construction**

	Avg	Std Dev	
2001 & 2002	89.5		
2003	90.3	1.62	
2004	90.0	1.71	<b>COLORADO</b>
2005	90.7	1.31	
2006	90.3		
2007	90.0		

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

**Connecticut**

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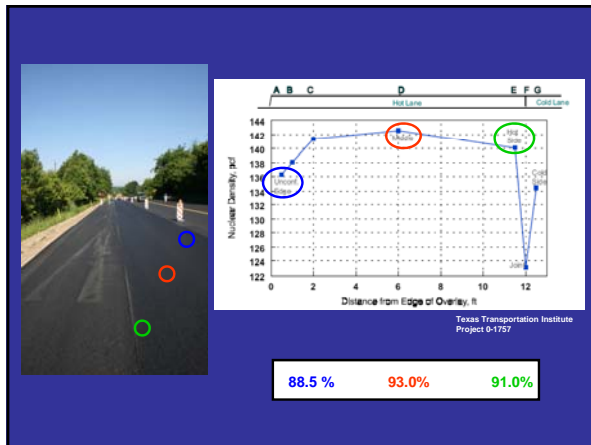
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**Methods for Evaluating Longitudinal Joint Quality in Asphalt Pavements**  
 - S. Williams, et al. Univ. of Arkansas

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

**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  $G_{mm}$ , then 98% of 94% is 92% (8%  $V_a$ )  
 then 95%                      is 89% (11%  $V_a$ )  
 then 93%                      is 87% (13%  $V_a$ )

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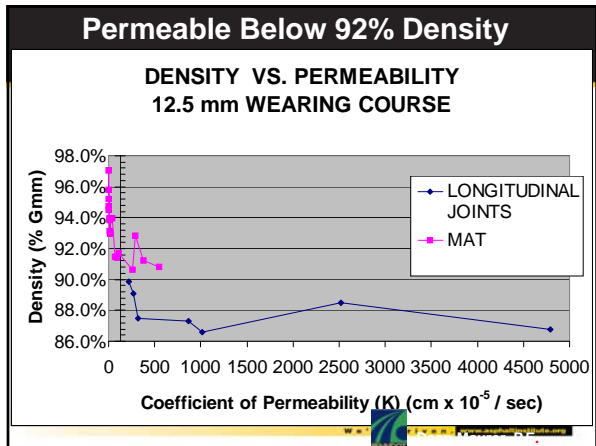
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### Dilemma at the Joint

Air void & Permeability  
 research says <7-8%  $V_v$   
 needed

Standard joint  
 construction practices  
 reach 9-10%

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### Method versus Density?

1 Best Method

Depends on Project

Nothing works well!

CHALLENGES & CHANGES 26

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### Various Approaches

INCREASING INNOVATION  
 INCREASING RISK

<b>No LJ Spec</b>	<ul style="list-style-type: none"> <li>High Agency Risk</li> <li>No Incentive for Quality</li> </ul>
<b>Method Spec</b>	<ul style="list-style-type: none"> <li>One size fits All</li> <li>Agency assumes some Risk</li> <li>No Incentive for Innovation</li> <li>Required State on-site Oversight</li> </ul>
<b>Density Spec</b>	<ul style="list-style-type: none"> <li>Allows Innovation for Contractor</li> <li>Balanced Risk, Includes Incentives &amp; Disincentives</li> <li>Not Appropriate for Small Jobs</li> <li>Has Trigger for ex. Sealing/Over-banding</li> </ul>
<b>Tiered Spec</b>	<ul style="list-style-type: none"> <li>Small jobs: Contractor follows Method Spec or Submits compaction plan</li> <li>Larger Jobs: Density</li> </ul>

CHALLENGES & CHANGES 27

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**Goal**

**Longitudinal Joint Performance equals Mat Performance**

CHALLENGES & CHANGES 28

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**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

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**Experts Interviewed...**

**10 Consultants**

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

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CHALLENGES & CHANGES 29

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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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**LONGITUDINAL JOINT CONSTRUCTION INTERVIEW**  
 This survey is part of the Asphalt Institute's cooperative agreement, "Study of the New Asphalt (SNA) Joint Construction Best Practices".

- 1) First year used for as single or possible. How do you accomplish that?
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 2) Do you use a...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 3) Do you use...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 4) Do you use...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 5) When using a...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 6) When using a...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 7) Have you ever used...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 8) Have you ever used...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 9) Have you ever used...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 10) How much do you...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 11) What do you do...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 12) Do you use...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 13) Do you use...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 14) Which type of...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 15) Does a...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 16) Does a...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 17) Could...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 18) Have you ever...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible
- 19) What are the...
  - a) Single or possible
  - b) Single or possible
  - c) Single or possible
  - d) Single or possible

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

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## Do the Experts Agree?

### Not Always

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**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

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**Prefer Notch-Wedge or Butt Joint?**

Pretty evenly divided




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**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)

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**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

**Stringline** 

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**Location of roller on first pass of unconfined edge?**

- Stay back 6" from edge

**OR**

- Overhang edge by 4-6"

**-Result: 50/50**

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**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

**Stringline** 

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**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

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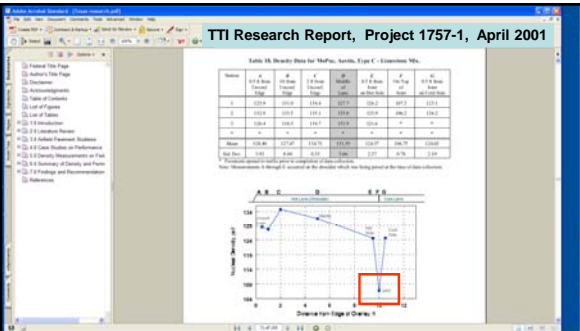
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**TTI Research Report, Project 1757-1, April 2001**

Table 18: Results from the TTI Research Report, Project 1757-1, April 2001. The table shows data for various test sections (A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z) and their corresponding void content percentages. A red box highlights the lowest void content at the joint.

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 Bognacki, Port Authority of NY & NJ

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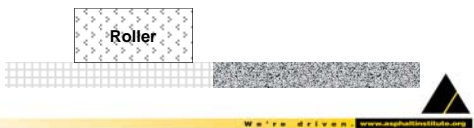
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**How to Roll the Hot Side?**

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- 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 2<sup>nd</sup> pass
- 2 said: start on the outside (unsupported) edge and work toward joint (allow heat transfer to cold joint)



Roller

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## Other Comments

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**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 2<sup>nd</sup> pass**

**Roller Vibrators ON**

**Use best practices**

**Training, Training, Training**

**Plan for the longitudinal joint, not afterthought**

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## Additional Considerations Related to Joint Density and Permeability

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- 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

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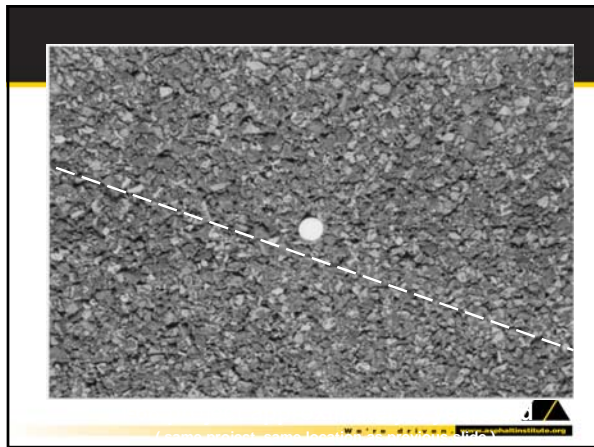
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### Longitudinal Joints

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- Tack cold edge
- Overlap screed 1-2 inches
- Leave alone or,
- "Bump" excess to hot side before compaction

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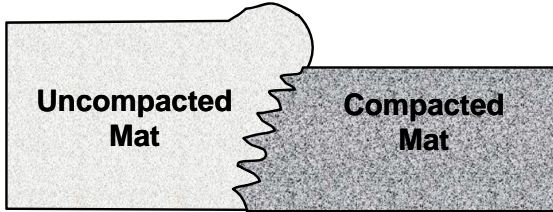
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# "Bumped" Joint

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# Bumping Longitudinal Joint



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## Longitudinal Joints

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



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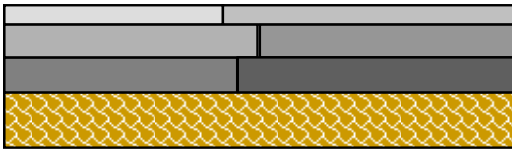
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## Stagger Joints for Multiple Lifts

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Longitudinal joints,  $\geq 12$  inches  
Transverse joints,  $\geq 10$  feet



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## Alaska Specification

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### 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.



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