Best Practices for Constructing and Specifying HMA Longitudinal Joints

A Co-operative Effort between AI and FHWA

Mark Buncher
Asphalt Institute

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

I-81 in Pennsylvania

I-84 in New York

I-84 Connecticut

Pittsburgh Gazette Headline:
“Superpave Not All It’s Cracked Up to Be”
"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

“Everyone’s Concern
Joint Life vs Pavement Life

A reduction in the agency’s assumed performance period (i.e. 10 yrs vs. 15 yrs) may have a significant impact on the LCCA, and ultimately the pavement selection process.

Current Project Team

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

PROJECT STEPS

- FHWA “Benchmark” Survey to Divisions
- Literature Review
- Identify What We Know/ Things We Don’t
- Interview 19 Experts
- Visit Five Select State DOTs
- Draft/ Final Report
- Develop Training Tools

Takeaways from FHWA Survey to 52 Division Offices

- 1/2 of states not satisfied with overall performance of L-Joints.
- Lots of best practices available
- 2/3rds of states have a L-Joint spec
  – Half of those (17) have a LJ density spec
    • Range from 89% - 92% min TMD
  – Other half were method specs
    • From Joint Adhesive to very prescriptive
- Great start to point us in the right direction, but no definitive answers
Longitudinal Joint Research

Construction

Air Voids/Permeability

(what is typically achieved)

(critical point for long-term performance)

Effect of Voids on Life

Methods for Evaluating Longitudinal Joint Quality in Asphalt Pavements

- S. Williams, et al., Univ. of Arkansas

Good Joint Performance
Fair
Poor

97% of the Mat
93 to 97%
< 93%

Longitudinal Asphalt Pavement Joint Construction Performance
- D. Morian, et al., Quality Engineering Solutions, NV

Significantly better performance

98% of the Mat
95% of the Mat

12 years
8 years

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

Connecticut

Avg
Std Dev

2001 & 2002
89.5

2003
90.3
1.62

COLORADO

2004
90.0
1.71

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%"
and then there’s permeability

Sometimes
Catastrophic

Permeable Below 92% Density

DENSITY VS. PERMEABILITY
12.5 mm WEARING COURSE

Coefficient of Permeability ($K$) (cm x 10^-5 / sec)

Critical % AVs
where permeable

$9.5 \text{ mm}$
- E. Zube - California Dept. of Highways - 1962: 8

$12.5 \text{ mm}$
- J. Westerman - Arkansas HTD - 1998: 6
- NCAT 03-02 - (coarse graded) - 2003: 7

Dilemma at the Joint

Permeability research says <7-8% AVs needed

Standard joint construction practices bring 9-10%

Various Research Reports on Critical Air Void Level for Permeability

Some Actual LJ Specs with Min. Density

- State 1: Cores, test only the hot side, minimum 92% of $G_{mm}$
- State 2: Cores, directly on the joint, minimum 88% of $G_{mm}$
- State 3: Gauge, cold side minimum 90% of $G_{mm}$
  hot side minimum 92% of $G_{mm}$
- State 4: Cores, centered on the wedge or over butt, min. of 89% of $G_{mm}$

Many other variations being used. In some cases, perceived practice by HQ agency doesn’t match actual practice in field.
Proposed Specification?

Cores -
  - Centered on butt joint, or middle of wedge
  - > 92% of G_{mm} : maximum bonus
  - Between 92% and 90%: seal and possible bonus
  - > 90% of G_{mm} : pay 100%
  - < 90% of G_{mm} : reduced payment

Sealing the LJ

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

19 Experts Interviewed

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

Sheldon Hayes Winners
- Lindy Paving (PA)
- P. Flanagan & Sons (MD)
- Duininck Bros (TX)
- Thompson-McCully (MI)
- DesMoines Asphalt & Paving (IA)
- K Barnett & Sons (NM)
- Norris Asphalt Paving (IA)

Interview Questions
Do the Experts Agree?

Not Always

Prior Planning

- Select joint (butt or wedge) best suited for that job
- Choose smallest NMAS that will do the job
- Consider using a “fine” gradation
- Lift thickness = NMAS x 4, exception “fine” gradation x 3
- Longitudinal joint should be included in construction plan & sequence

Getting Started Off Right

Tack Coat

Full width of mat 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 Skip Paint Reference
Tough to get proper overlap (1") with next pass

Paver on Automatic w/ Joint Matcher

Vibratory Screed Should Always Be On

Auger
- Uniform Head of Material Across the Entire Screed
- Carry Material Within 12 – 18-inches of the End Gate

END GATE
- Seated on the Existing Surface

Compacting Notched Wedge
- add-on vibratory compactor
- plate compactor
1st Roller Pass on Unsupported Edge
50/50: Overhang vs. Stay Back 4-6”

Quality Control, Monitor Joint Density

Tack the Joint! (Butt or Wedge)

Matching Joint
Proper Overlap: 1.0 ± 0.5 inches
Sufficient Depth of HMA to avoid “starving” joint and “bridging” with roller
Final overlap height: 0.1”

Lute the Longitudinal Joint

This lute person is doing a great job

Rolling the Supported Edge
(many different opinions and approaches)
Stay off the Joint by 6” with 1st Pass to Avoid Bridging.
but, watch for stress cracks along the edge of the drum. May be more of a concern with rolling unsupported edge
Quality Control and Acceptance of Joint Density

- Density Gauge
- 6-inch Core

Other Options / New Products
- Echelon paving
- Mill & pave one lane at a time
- Cut back joint
- Surface sealers over joint
- Joint Adhesives (hot rubberized asphalt)
- Joint Heaters

The Best Longitudinal Joint

- Echelon Paving
- Rolled Hot

Joint Heaters

Surface Sealers

GOAL

I-295 in New Jersey

I-68 project approximately 5 years old
I-68 project approximately 5 years old
(same project, same location as previous slide)