Promoting Quality through the FHWA / AI Cooperative Agreement

Mark Buncher for ETG, Sept 2014
Co-op Subtasks Led by the AI Regional Engineers

- Best Practices for Constructing and Specifying HMA Longitudinal Joints
- Intelligent Compaction
- Tack Coat Best Practices
- MSCR Implementation at the State and Regional Level

All promote quality to agencies
Too often longitudinal joints are the **weak link** in an otherwise long-lasting asphalt pavement.

- Agency and industry concern!
- Offers greatest opportunity to improve overall life.
Some States have more challenges than others!
4-Hour Longitudinal Joint Workshops

- Requested and hosted by DOTs
- Taught by AI Engineers
- AI Meets with DOT beforehand
- No cost to DOT or attendees
- Audience: mix of agencies, contractors, others
Workshop Goals

- Create greater awareness
- Improve specs by agencies
- Improve practices by contractors
- Increase use of innovative techniques, equipment, and materials
- Overall improved LJ performance
Longitudinal Joint Workshops (4-hrs)
Jan 2012 thru Jul 2014

38 Workshops Held

4 More States Scheduled
# Reach of the LJ Project

## Attendance Totals for Workshops and Presentations Under Co-op

Jan 2012 thru Jul 2014

<table>
<thead>
<tr>
<th>Year</th>
<th>LJ Workshops</th>
<th>LJ Presentations</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>640</td>
<td>1963</td>
<td>2603</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>13 Workshops 20 Presentations</td>
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<tr>
<td>2013</td>
<td>2081</td>
<td>1218</td>
<td>3299</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>19 Workshops 10 Presentations</td>
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<tr>
<td>2014 (thru Jul)</td>
<td>612</td>
<td>400</td>
<td>1012</td>
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<tr>
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<td>7 Workshops 4 Presentations</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>3333</strong></td>
<td><strong>3581</strong></td>
<td><strong>6914</strong></td>
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<tr>
<td></td>
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<td></td>
<td>39 Workshops 34 Presentations</td>
</tr>
</tbody>
</table>
Project Website

http://www.asphaltinstitute.org/public/engineering/longitudinal-joint-information

- Contains:
  - Workshop information
  - Handout of workshop slides (180+)
  - Video of entire 4-hr Workshop in OH, Feb 2013
  - 2-hr webinar, Oct 2012
  - Project report
  - 5-page “Summary of Recommendations”
  - Magazine articles on project and findings
Defining Different Types of Longitudinal Joints

Butt (Vertical) Joint

Milled or Cutback Joint

Notched Wedge Joint

1st pass

½ to ¾-inch

NMAS

2nd pass

Wedge 3:1 to 12:1

Wedge 3:1 to 12:1
We Know Unsupported Edge Will Have Lower Density

Proper Overlap

Sufficient Material for Roll-Down

Cold (unconfined) side

Low Density Area

Hot (confined) side

Please note “Cold side” and “Hot side”, as they are terms used throughout this Workshop.
Typical Nuclear Density Profile
Texas Transportations Institute Study

Unconfined Lowest
Middle of Mat Highest
Hot Side In-between
Value Value Value
...and then there’s permeability

Permeability at the Longitudinal joint

Photo: Wes McNett
Permeability can be Catastrophic
DENSITY VS. PERMEABILITY
12.5 mm WEARING COURSE

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

Density (% Gmm)

Permeable Below 92% Density

Dean Maurer, P.E.
### Various Research Projects on Critical Air Void Level for Permeability

<table>
<thead>
<tr>
<th>Mix Size</th>
<th>Project Details</th>
<th>Critical Voids</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5 mm Mixes</td>
<td>E. Zube - California Dept. of Highways - 1962</td>
<td>8.0</td>
</tr>
<tr>
<td>12.5 mm Mixes</td>
<td>B. Choubane, et al – Florida DOT - 1998</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>J. Westerman – Arkansas HTD - 1998</td>
<td>6</td>
</tr>
</tbody>
</table>
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, need to “overband” or “surface seal” joint
- $< 90\%$ of $G_{mm}$: reduced payment, overband or surface seal joint
LJ Initiatives in PA, CT, MI
Joint Issues In PA
## PA Story on Longitudinal Joints

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity to Address Joint</th>
<th># Lots</th>
<th>Avg Joint Density, %</th>
<th>Avg Mat Density, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>Began measuring joint density on random projects</td>
<td>18</td>
<td>87.8</td>
<td>93.9</td>
</tr>
<tr>
<td>2008</td>
<td>Implemented new method spec from MD</td>
<td>43</td>
<td>88.9</td>
<td>94.1</td>
</tr>
<tr>
<td>2009</td>
<td>Continued with same method spec</td>
<td>29</td>
<td>89.2</td>
<td>94.1</td>
</tr>
<tr>
<td>2010</td>
<td>Transitioned to new joint density spec using PWL, no official data</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2011</td>
<td>Fully implemented new jnt spec, PWL w/ bonuses and penalties</td>
<td>137</td>
<td>91.1</td>
<td>94.1</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td>162</td>
<td>91.6</td>
<td>94.0</td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td>167</td>
<td>91.4</td>
<td>93.9</td>
</tr>
</tbody>
</table>

All joint densities by 6” cores over joint

3.8% increase over 5 years
Increased Projected Life of Joints Due to Improved Densities in PA, 2007 thru 2013
PA: Statewide Pay Impacts Since New Joint Density Spec (2011 - 2013)

2011
- $261,625 in bonuses
- $99,216 in penalties

2012
- $468,300 in bonuses
- $62,976 in penalties

2013
- $588,247 in bonuses
- $24,720 in penalties
### Average Joint Densities from PA DOT for Entire Paving Season

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notched Wedge</td>
<td>91.7%</td>
<td>91.7%</td>
<td>“mostly notched wedge joints”</td>
</tr>
<tr>
<td>Butt (vertical)</td>
<td>90.3%</td>
<td>90.7%</td>
<td></td>
</tr>
</tbody>
</table>
Connecticut Joint Density Spec

• Prior to 2011, acceptance from gauges only
  – Tested joints only on hot side of joint
  – Require notch-wedge joints (12:1 to 8:1)
• In 2011, moved to cores
  – 92% min average required in mat
  – 91% min average required over joint
    • Requirement only for surface lifts
      – typically 2” lifts of 12.5 SP mix
    • Cores taken over middle of wedge
## CT DOT Average In-Place Lot Density on Cores for Entire Year Roadway (Non-Bridge)

<table>
<thead>
<tr>
<th>Year</th>
<th>Mat (Rqd. Min. of 92%)</th>
<th>Joint (Rqd. Min. of 91%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>92.6%</td>
<td>91.6%</td>
</tr>
<tr>
<td>2012</td>
<td>93.0%</td>
<td>91.4%</td>
</tr>
<tr>
<td>2013</td>
<td>93.1%</td>
<td>91.8%</td>
</tr>
</tbody>
</table>

Prior to 2010: Acceptance from gauges

Std. Dev.  
(2.07)  
(on 2082 measurements)  
2.40  
(on 1863 measurements)
MI DOT Joint Densities

6" cores directly over visible joint
1 core per 2,000 ft, 10,000 ft per section
Bonus/penalty based on averages, not PWL

- 2009
  - Avg: 89.77%
- 2011
  - Avg: 90.71%
- 2012
  - Avg: 91.59%
    - 53% sections received bonus (Avg > 91.5%)
    - 20% sections received penalty (Avg < 90.5%)
    - 27% sections had no adjustment (90.5 < Avg < 91.5%)
Final Lift Joint Layout Plan

DELDOT
First Pass Must Be Straight!

Unanimous that a 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 a Joint
Paint the Side of Joint (Butt or Wedge)

- **Emulsion (Good),**
- **PG Asphalt (Better),**
- **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
Proper Overlap:

- $1.0 \pm 0.5$ inches
- Exception: Milled or sawed joint should be 0.5 inches
Bumping the Joint?
SECTION 5

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
GOAL
14 year old surface

- I-65 in IN: SR252 to US31
  - 12 inches HMA over Rubblized JCP
  - Warranty Project
Improving Quality Control with Intelligent Compaction
AI Participation in IC Research Projects Under FHWA/AI Co-op

- 10 FHWA IC Pooled Fund Projects (2008-2010)
- 4 FHWA IC / In-Place Density Projects (2012-2013)
- 4 FHWA IC / In-Place Density Projects (Summer 2014)
AI’s IC Workshops (4-hrs) and Presentations
Under FHWA/AI Co-op

13 Workshops Held (2013 – Jun 2014)
Tack Coat Workshop Coming Soon!

Subject Areas
• terminology related to tack
• purpose of tack coats
• materials commonly used
• properties of newer materials relative to those commonly used
• proper handling, storage, and testing
• past and current research findings
• bond testing options
• best practices for construction & inspection

Pilot TC workshop planned for MD DOT this Fall