Rehabilitating and Preserving Joints to Extend Service Life

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Presentation Outline

• Why Do We Make and Seal Joints
• Partial-Depth Repairs
• Sealant Considerations
• Sawing Equipment
• Sealant Types
• Major Steps in Joint Sealing
• Troubleshooting
• References
Reasons for Joint Sealing

- Minimizes water & incompressibles into pavement system
- Reduces subgrade softening, pumping and erosion of fines and spalling
- Prevents Joint Associated Distress?
- Reduces Noise (Joint Slap)
Why Seal Joints and Cracks

Prevent Incompressibles from Lodging in the Joint — Slab Growth and Blow Ups
PCC Pavement Deterioration

Influence of Moisture Infiltration

Cracks/Joints + Moisture Infiltration

Base/Subbase Softening

Corner Breaks

Loss of Fines (Pumping)

Transverse Joint Faulting
The Top Doesn’t Always Tell the Story
Partial-Depth Repairs

Removal and replacement of small, shallow areas of deteriorated PCC at spalled or distressed joints.

• Distress limited to upper 1/3 to 1/2 of slab thickness

• Existing load transfer devices are functional

Benefits

• Restores slab integrity

• Improves ride quality

• Extends the service life

• Restores a well-defined uniform joint sealant reservoir
Good Candidate Projects

- Spalls caused by:
  - Incompressibles in joints
  - Localized areas of weak material
  - Joint inserts

- Surface deterioration caused by:
  - Reinforcing mesh too close to surface
  - Poor curing or finishing practices
Material Selection Factors

- Allowable lane closure time
- Ambient temperature
- Material and placement Cost
- Material properties (shrinkage, CTE, bond strength)
- Compatibility between repair material and existing pavement
- Size and depth of repair
- Performance capabilities
Repair Dimension Selection

Min. Patch Length 10 in
Min. Patch Width 4 in
Construction Steps

1. Repair dimension selection
2. Concrete removal
3. Repair area preparation
4. Joint preparation
5. Bonding agent application
6. Patch material placement
7. Curing
8. Diamond grinding (optional)
9. Joint resealing
Municipal Projects

Credit: Adam Lust, City of Ankeny

Credit: Jeff Nash, City of West Des Moines
Sealant Performance Depends On

- Design Factor
  - Anticipated Movement
  - Construction Schedule and Installation Conditions
  - Required Performance Period
  - Noise Considerations
- Sealant Selection---Proper Design and Specification for Application
- Joint Preparation---Clean, Dry, and Bondable
- Sealant installation
  - Silicone & Compression Seal Should be Recessed
  - Hot Pour Should be Flush Filled
  - Backer Rods Appropriate for Sealant Type
  - Primer?
Allowable Joint Opening Movements

- Hot Pour Sealants: 25% Extension
- Silicone Sealants: 50% Compression to 100% Extension
- Compression Seals: 15% min Compression to 50% Extension
# Joint Sealing Materials

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Specs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymerized/Rubberized Asphalt</td>
<td>ASTM D6690, Type I-IV (AASHTO M324)</td>
<td>Thermoplastic I: Mod climates II-III: Most climates IV: Very cold climates</td>
</tr>
<tr>
<td>Silicone</td>
<td>ASTM D5893, Type NS or SL</td>
<td>Thermosetting NS: Non-sag SL: Self leveling</td>
</tr>
<tr>
<td>Polysulfides, polyurethane</td>
<td>Fed Spec SS-S-200E, type M or H</td>
<td>Thermosetting</td>
</tr>
<tr>
<td>Preformed</td>
<td>ASTM D2628</td>
<td>Polychloroprene</td>
</tr>
<tr>
<td>Backer Rod</td>
<td>ASTM D5249</td>
<td>For hot- or cold-applied sealants</td>
</tr>
</tbody>
</table>
Joint Sealant Installation
Major Steps in Joint Sealing

**Step 01**
- Saw Joint or Crack Reservoir
- Remove Old Sealant (Opt.)

**Step 02**
- Water Flush Joint or Crack

**Step 03**
- Abrasive Blast Joint or Crack

**Step 04**
- Air Blow Joint or Crack

**Step 05**
- Install Backer Rod (if required) and Sealant or Seal
Percent of Total Cost For Each Operation of Sealing a Joint*

* ACPA Relative Cost Study
Joint Sawing Equipment

- Wet Saws
- Early Entry Saws
- Dry Saws
- Crack Chaser Saws
Aggregate Hardness: Key Factor for Sawing Operations

<table>
<thead>
<tr>
<th>Mohs Hardness</th>
<th>Aggregate Used In Concrete Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Very Hard Aggregate (flint, chert)</td>
</tr>
<tr>
<td>7</td>
<td>Hard Aggregate (quartz, hard gravels)</td>
</tr>
<tr>
<td>6</td>
<td>Medium Hard Aggregate (medium gravels, granites)</td>
</tr>
<tr>
<td>5</td>
<td>Medium Soft Aggregate (soft granite, dolomite)</td>
</tr>
<tr>
<td>4, 3</td>
<td>Soft, Abrasive Aggregate (limestone)</td>
</tr>
</tbody>
</table>
Reservoir Design and Cutting

- Unfilled (open)
- Filled (in single saw cut)
- Filled (in reservoir cut)
- Sealed (in reservoir cut)
- Compression Seal (in reservoir cut)
Install Hot-Pour Sealant

• Follow proper heating, safety, and installation procedures
• When installing:
  • Fill the reservoir from the bottom upward
  • Use nozzle that fits into reservoir
  • Pull the wand/nozzle toward you to avoid trapping air pockets
  • Do not dispense sealant until it reaches proper manufacturer-recommended temperatures (300–400 °F)
  • Discard over-heated material and do not reheat material more than recommended by the manufacturer
  • Dispense sealant to create flush-filled condition
  • Use a constant, uniform flow
• Do not open to traffic until sealant cools
• Use blotters or anti-tack aids if opening early
Sealant Performance and Defect Terminology

**Adhesion Loss**
Sealant loses bond to one or both joint reservoir walls

**Cohesion Loss**
Tearing along the surface and through the depth of sealant

**Oxidation/Hardening**
Degradation of sealant material as a result of natural aging, long-term exposure to oxygen, ozone, ultra-violet radiation, or the embedment of incompressibles

**Compression Set**
Seal webs stick together or seal rubber loses ability to rebound and seal loses contact with side walls
The Most Common Distresses

<table>
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<tr>
<th>Hot-Pour Sealants</th>
<th>Silicone Sealants</th>
<th>Preformed Compression Seals</th>
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<tbody>
<tr>
<td>Adhesion loss</td>
<td>Adhesion loss</td>
<td>Compression set</td>
</tr>
<tr>
<td>Cohesion loss</td>
<td>Cohesion loss</td>
<td>Dislodging or missing</td>
</tr>
<tr>
<td>Bubbling</td>
<td>Sliver spalling</td>
<td>Improper sizing (not a distress but can lead to problems)</td>
</tr>
<tr>
<td>Hardening</td>
<td>Dislodging or missing</td>
<td></td>
</tr>
<tr>
<td>Embedding of incompressibles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dislodging or missing</td>
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When the Sealant is No Longer Serving its Intended Function

- Adhesive Failures
- Cohesive Failures
- % Damaged or Missing
Clean Isn’t an Option
Tech Briefs

https://www.sealnoseal.org/news.htm
NHI Contractor Training Courses

Web Based Training at no cost to the participant

- FHWA-NHI-134207A How to Construct Durable Full-Depth Repairs in Concrete Pavements
- FHWA-NHI-134207B How to Construct Durable Partial-Depth Repairs in Concrete Pavements
- FHWA-NHI-134207C Proper Diamond Grinding Techniques for Pavement Preservation
- FHWA-NHI-134207D Proper Construction Techniques for Dowel Bar Retrofit and Cross-Stitching
- FHWA-NHI-134207E Proper Joint Sealing Techniques for Pavement Preservation
• Introduction to Partial-Depth Repairs
• Types of Partial-Depth Repairs
• Planning and Preparing for Partial-Depth Repairs in the Field
• Identifying and Marking Repair Boundaries
• Options for Concrete Removal
• Preparing the Repair Area after Concrete Removal
• Selecting and Handling Repair Materials
• Installing a Compressible Joint Insert
• Placing Repair Material and Completing the Repair
• Quality Control and Opening to Traffic
Introduction to Sealing and Resealing Pavement Joints and Cracks

Material Types, Standards, and Details

Equipment Types and Use

Construction Operations for Joint or Crack Sealing

Quality Control and Inspection

Sealant Performance and Troubleshooting
Summary

• Design Joint Sealant System for the Expected Joint Movements
• Select a Joint Sealant Material and Backer Rod Appropriate for the Intended Purpose
• Ensure Proper Cleaning and Preparation—Clean, Dry and Bondable
• Inspect the Work and Verify its Acceptability
Thanks for your time

Convict Road, Louisa County 1914