Pavement Preservation – Keys to Success with PCCP

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What is Preventive Maintenance?
- Planned strategy of cost-effective treatments
- Applied to structurally sound pavements with significant remaining life
- Maintain or improve functional condition

What is Pavement Preservation?
- Keeping good roads in good condition
- Long-term strategy for enhancing pavement performance
- Focus on extending pavement life and restoring functional condition
- Accomplished with a collection of preventive maintenance treatments and a few minor rehabilitation and routine maintenance treatments
Types of M&R vs. Condition/Time

Fig. 2.1 on p. 9
Pavement condition vs. age – current practice

Source: H.T. Yu, FHWA
Pavement condition vs. age – preservation approach

Source: H.T. Yu, FHWA
Benefits of Pavement Preservation

• Improved pavement condition
• Cost savings
• Improved safety
• Reduced environmental impact
• Higher customer satisfaction
Favorable Characteristics for Preservation

- Few or limited structural problems
- No materials-related distress
- Pavements in overall relatively good condition (minimal distress)
Typical Concrete Pavement Preservation Treatments

- Slab stabilization
- Slab jacking
- Partial-depth repairs
- Full-depth repairs
- Retrofitted edge drains
- Load transfer restoration
- Cross stitching
- Diamond grinding
- Diamond grooving
- Joint resealing
- Crack sealing
- Thin concrete overlay
How do these treatments differ from routine/reactive treatments?

Similar treatments…
different TIMING!
## Typical Performance of Selected Preservation Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Expected Performance (treatment life), years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete joint resealing</td>
<td>2 to 8</td>
</tr>
<tr>
<td>Concrete crack sealing</td>
<td>4 to 7</td>
</tr>
<tr>
<td>Diamond grinding</td>
<td>8 to 15</td>
</tr>
<tr>
<td>Diamond grooving</td>
<td>10 to 15</td>
</tr>
<tr>
<td>Partial-depth concrete patching</td>
<td>5 to 15</td>
</tr>
<tr>
<td>Full-depth concrete patching</td>
<td>5 to 15</td>
</tr>
<tr>
<td>Dowel bar retrofit</td>
<td>10 to 15</td>
</tr>
</tbody>
</table>

Table 2.5 on p. 14
Treatment Selection Process

1. Conduct pavement evaluation
2. Determine causes of distresses
3. Identify treatments that address distresses
4. Identify constraints, key selection factors
5. Develop feasible treatment strategies
6. Assess cost effectiveness of treatment strategies
7. Select preferred strategy
### Treatment–Distress Matrix

**Table 12.3 on p. 267**

<table>
<thead>
<tr>
<th>Distress</th>
<th>Slab Stabilization</th>
<th>Slab Jacking</th>
<th>Partial-Depth Repair</th>
<th>Full-Depth Repair</th>
<th>Retrofitted Edge Drains</th>
<th>Dowel Bar Retrofit</th>
<th>Cross Stitching/Slot Stitching</th>
<th>Diamond Grinding</th>
<th>Diamond Grooving</th>
<th>Joint Resealing</th>
<th>Crack Sealing</th>
<th>Thin Concrete Overlay</th>
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<tr>
<td>Corner breaks</td>
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<td>Linear cracking</td>
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<td>D-cracking</td>
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<td>Alkali-aggregate reaction</td>
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<td>Joint spalling</td>
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<td>Faulting</td>
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<tr>
<td>Bumps, settlements, heaves</td>
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<td>Polishing/Low Friction</td>
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</tbody>
</table>
## Trigger/Limit Values for Pavement Preservation

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>Trigger Value</th>
<th>Limit Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trans. Cracking</td>
<td>1.5-2.5% of slabs cracked</td>
<td>5-15% of slabs cracked</td>
</tr>
<tr>
<td>Joint Spalling</td>
<td>1.5-2.5% of joints</td>
<td>15-20% of joints</td>
</tr>
<tr>
<td>Joint Faulting</td>
<td>0.08 in</td>
<td>0.50-0.70 in</td>
</tr>
<tr>
<td>Roughness (IRI)</td>
<td>65-110 in/mi</td>
<td>160-220 in/mi</td>
</tr>
</tbody>
</table>
Two Dimensions of Paving

Coverage: lane-miles -> $/mi

Service Life: years

Unit of Paving = lane-mile-years
Pavement cost = $/lane-mi-yr

A network of x lane-miles of pavement requires an addition of x lane-mile-years of service life each year to maintain status quo

*A Quick Check of Your Highway Network Health: FHWA-IF-07-006*

Source: H.T. Yu, FHWA
Cost Considerations

• Highway investment decision is a resource allocation problem
• At any funding level the optimum solution is the one that adds the most lane-mi-years of service to the system (minimize $/lane-mi-yr)
• Long-life, maintenance-free pavement strategy offers
  – Significant improvement in network condition
  – Low cost and sustainability advantages

Source: H.T. Yu, FHWA
Treatment Sequencing for Concurrent Application

Distressed Concrete Pavement

Not all projects will require every procedure, but the sequence should be maintained.

Joint/ Crack Resealing
Grooving
Diamond Grinding
Tied PCC Shoulders
Cross-Stitching
Dowel Bar Retrofit
Full-Depth Repair
Partial-Depth Repair
Retrofit Edge Drains
Slab Stabilization

Restored Concrete Pavement

Fig. 12.1 on p. 269
Full-Depth Repairs

Primary keys for success:

- Selection of repair boundaries
- Re-establishing load transfer
Selecting Repair Boundaries

Potential Extent of Deterioration at Joint

Fig. 6.1 on p. 112
Selecting Repair Boundaries

Repair Dimensions

• Minimum dimensions
  – Use lane-width repairs
  – Length ≥ 1.8 m (6 ft) (doweled)
  – Length 1.8 - 3.0 m (6 -10 ft) (nondoweled)
• Long repairs (>4.6 m [15 ft])
  – Provide intermediate joint
• Independent repairs in adjacent lanes
• If distress falls within 0.6 m (2 ft) of joint, extend repair to joint
Selecting Repair Boundaries
Example Repairs in JPCP

Before

L, M, H = Low-, Medium-, High-Severity

After

L, M, H = Low-, Medium-, High-Severity

NOTES

a – Minimum length is 1.8 m (6 ft)
b – Check distance between patches and nearby joints
c – Replace the entire slab if there are multiple intersecting cracks

Fig. 6.2 on p. 113
Half-width Full-depth Repairs?

Iowa DOT Practice

Airfields

Tiebars

Joints

2 Feet (min)
Load Transfer Design

Dowel Bars

• Critical to long-term performance
• Dowel characteristics:
  – Diameter: Typically D/8 (or more)
  – Length: Typically 18 in (trending shorter)
  – Corrosion-resistant (typically epoxy)
  – Bond-breaking agent
Load Transfer Design

Example Layout

Mid-depth slab

3 – 5 dowels/wheel path (typical)

Smooth dowels
1.5 in dia.

12 ft

2 ft

12 in typical

6 ft minimum

Fig. 6.5 on p. 116
MN I-90 – Full Depth Repairs
Restoration of Load Transfer

Cleaning Holes (Air Blasting)
Restoration of Load Transfer
Injecting Anchoring Material
Restoration of Load Transfer

Dowel Bar Placement

1. Inject Grout to Back of Hole

2. Twist one turn while pushing in dowel

3. Place grout retention disk to hold in grout
Partial-Depth Repairs
Key Factors For Success

- Proper selection of candidate projects
- Proper material selection
- Identification of repair boundaries
- Use of joint/crack reformers
- Achieving good bond
  - Clean and dry repair area
  - Sandblasting sidewalls
  - Proper application of bonding agent followed by timely placement of repair material
- Proper placement and curing
Concrete Removal

Cold Milling

Milling Along the Joint

Milling Across the Joint
Joint Preparation

Fig. 5.18 on p. 5.19
Placement of Compression Relief (Waxed Cardboard)

- Often more easily fits the irregular nature of random cracks.
- Has the ability to maintain its rigidity for the concrete placement.
- Hold in place during concrete vibration so that it doesn’t float.

Concrete placement for Type 1 repair using waxed cardboard

Type 2B – Crack Repair
Bonding Agent

- Intended to enhance bond between repair material and existing pavement.
  - Can reduce bond if not installed properly
- Required for many cementitious repair materials.
  - Some agencies allow clean, SSD surface in lieu of bonding agent
- Manufacturer’s instructions should be consulted for proprietary mixes
Curing

• Prevent moisture loss
  – This is critical for partial-depth repairs!

• White-pigmented curing compound commonly used
  – Use good stuff
  – Timely application
  – Double-coat
Additional Resource

Reference Materials

- Numerous ACPA technical bulletins and publications
Thank You For Your Attention!

Questions?