OHIO ASPHALT PAVING CONFERENCE

38th Annual Conference
Wednesday, 2/6/2013
Fawcett Center
Campus of The Ohio State University
2400 Olentangy River Road
Columbus, Ohio 43210
Chicago attracted competing interests during the fur-trade era.

Trade between whites and Native Americans during Chicago's brief, but colorful, frontier era.
ASPHALT OVERLAYS (MS-17)
THESE 2 ARE NOT WHO I WORK FOR ANYMORE...
<table>
<thead>
<tr>
<th>Surface rating</th>
<th>Visible distress*</th>
<th>General condition/treatment measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Excellent</td>
<td>None.</td>
<td>New pavement, no maintenance required.</td>
</tr>
<tr>
<td>9 Excellent</td>
<td>Traffic wear in wheelpath. Slight map cracking or pop-outs.</td>
<td>Recent concrete overlay or joint rehabilitation, like new condition, no maintenance required.</td>
</tr>
<tr>
<td>8 Very Good</td>
<td>Pop-outs, map cracking, or minor surface defects. Slight surface scaling. Partial loss of joint sealant, isolated transverse cracks, light or well sealed. Isolated cracks at manholes, light or well sealed.</td>
<td>More severe wear or slight defects, little or no maintenance required.</td>
</tr>
<tr>
<td>7 Good</td>
<td>More extensive surface scaling. Some open joints, isolated transverse or longitudinal cracks, light or well sealed. Some manhole displacement and cracking. First utility patch, in good condition. First noticeable settlement or heave area.</td>
<td>First sign of transverse cracks (all light), first utility patch. More extensive surface scaling. Seal open joints and other routine maintenance.</td>
</tr>
<tr>
<td>6 Good</td>
<td>Moderate scaling in several locations. A few isolated surface spalls. Shallow reinforcement causing cracks. Several corner cracks, light or well sealed. Open (1/8&quot;) wedges, longitudinal or transverse joints and more frequent transverse cracks (some open 1/4&quot;).</td>
<td>First sign of shallow reinforcement or corner cracking; needs general joint and crack sealing. Scaled areas could be overlaid.</td>
</tr>
<tr>
<td>5 Fair</td>
<td>Moderate to severe polishing or scaling over 25% of the surface. High reinforcing steel causing surface spalling. Some joints and cracks have begun spalling. First signs of joint or crack faulting (1/8&quot;). Multiple corner cracks with broken pieces. Moderate settlement or frost heave areas. Patching showing distress.</td>
<td>First sign of joint or crack spalling or faulting. Grind to repair surface defects. Some partial depth patching or joint repairs needed.</td>
</tr>
<tr>
<td>4 Fair</td>
<td>Severe polishing, scaling, map cracking, or spalling over 50% of the area. Joints and cracks show moderate to severe spalling. Pumping and faulting of joints (1/2&quot;) with fair ride. Several slabs have multiple transverse or meandering cracks with moderate spalling. Scaled area broken into several pieces. Corner cracks with missing pieces or patches. Pavement bobbles.</td>
<td>Needs some full depth repairs, grinding, and/or asphalt overlay to correct surface defects.</td>
</tr>
<tr>
<td>3 Poor</td>
<td>Isolated joints and cracks are open, with multiple parallel cracks, severe spalling, or faulting. D-cracking is evident. Severe faulting (1&quot;) giving poor ride. Extensive patching in fair to poor condition. Many transverse and meandering cracks, open and severely spalled.</td>
<td>Needs extensive full depth patching plus some full slab replacement.</td>
</tr>
<tr>
<td>2 Very Poor</td>
<td>Extensive slab cracking, severely spalled and patched. Joints failed. Patching in very poor condition. Severe and extensive settlements or frost heaves.</td>
<td>Recycle and/or rebuild pavement.</td>
</tr>
<tr>
<td>1 Failed</td>
<td>Restricted speed. Extensive potholes. Almost total loss of pavement integrity.</td>
<td>Total reconstruction.</td>
</tr>
</tbody>
</table>

* Individual pavements will not have all of the types of distress listed for any particular rating. They may have only one or two types.
Concrete Pavement Restoration (CPR)

- Slab / joint replacement,
- Spall repair,
- Subsurface drainage,
- Diamond grinding,
- Joint sealing.
LOCALIZED REPAIR

Repair cost

Rehab cost

% Area repaired
INITIAL AND FUTURE COSTS

1. Straight overlay.
2. Joint repair and overlay.
3. Joint repair, level course, and overlay.
4. Joint repair, crack relief layer, and overlay.
5. Joint repair, level course, overlay, and saw & seal.
6. Joint repair, inter-layer, and overlay. (Saw & seal option)
7. Joint repair, level course, geotextile, and 2.5” thick overlay. (Saw & seal option)
8. Rubblization.
PAVEMENT LIFE CYCLE THEORY

- **Condition (PCI)**
- **Terminal (PCI)**
- **Time**

- **Maintenance** ~$1.00/Sy
- **Rehabilitation** >$10.00/SY
- **Reconstruction** >$$$$$

- 70/60? (PCI)
RESTORATION / REHABILITATION ALTERNATIVES

HMA Overlays

- Over intact PCC pavement
- Over fractured PCC

Total Reconstruction
ROBERT PALMER DRIVE

- Primary roadway through town.
- 8" pcc doweled section.
- Significant joint failure.
- Loss of friction.
- Deteriorating median.
- Poor cross slope.
- Greater than 5,000 vpd.

Failing structure, raised median, transverse joint failure, rocking patch.

Various City of Elmhurst pavement conditions on Palmer Dr.
INVESTIGATION

• Drove project;
• D- ride quality.
• Loss of skid resistance.

• Walked project;
• D cracked panels.
• Rocking panels.
• Failing joint materials.
INVESTIGATION

Project Analysis, Fix, and Future pcc Pavement Repairs made this project the ‘Village of Elmhurst’ prototype.
OPENING UP A TYPICAL PCC JOINT
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CITY EXCAVATION & EVALUATION OF PCC CRACKS
AREA OF FAILURE WAS WELL DEFINED AND CONFINED

Palmer Dr. excavation and evaluation of transverse joints.
NO AGGREGATE BASE PROBLEMS
WHAT WAS NEEDED ON PALMER DRIVE?

- Waterproofing of the pcc was needed.
- Patching was surface in nature, not full depth.
- Cold milled ‘rumble median’ and over layed with asphalt.
WATERPROOFING OF THE PCC WAS NEEDED
RELAXING AND REALIGNING THE PCC WAS NECESSARY

- 6-ft. wide asphalt patches from curb to curb.
- Transverse and longitudinal joint preparation. (Time & material)
- Installation of 'superelevation' of asphalt.
- Curb removal and replacement as needed.
COLD MILLED PCC PAVEMENT

- Curb reveal.
- Butt joints.
- Spot milling of high points.
JOINTS

• Important to define working versus non-working joints.
• Summarized quantities for each to make best decision.
• Developed ‘global’ treatment strategy for each.
THE MAJORITY OF SIDE STREETS AND THEIR CONDITION
REFLECTION CRACKING

- By far, the biggest problem in HMA overlays of PCC pavement is reflection cracking.

- Caused by movement at PCC joints and cracks.

- Load-induced movement:
  - PCC Slabs Contract Joint Opens
  - HMA Slabs Expand Joint Closes
HMA OVERLAYS ON INTACT STRUCTURALLY SOUND PCC PAVEMENTS

• Even with good load transfer, joints will eventually reflect from thermal movement

• Saw-cut and sealing over joints controls reflection cracking
  ✓ Provides maintainable joint
  ✓ Reduces spalling
SAW-CUT AND SEAL PROCEDURE  
(REF AI’S MS-17)

- Repair existing PCC, clean and fill joints
- Locate and reference existing joints
- Place and compact HMA
- Saw-cut overlay directly above referenced joints the following day
- Clean and dry saw-cut
- Apply sealant
SAW AND SEAL
(ASPHALT INSTITUTE MS-17)

Saw-Cut Dimensions

<table>
<thead>
<tr>
<th>PCC Slab Length (meters)</th>
<th>Metric Width (mm)</th>
<th>Metric Depth (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 15</td>
<td>12.5</td>
<td>16</td>
</tr>
<tr>
<td>15.5 - 19</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>19 - 23</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>23 - 26.5</td>
<td>22</td>
<td>19</td>
</tr>
<tr>
<td>26.5 - 30.5</td>
<td>25</td>
<td>22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PCC Slab Length (feet)</th>
<th>English Width (in.)</th>
<th>English Depth (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 50</td>
<td>0.5</td>
<td>0.625</td>
</tr>
<tr>
<td>51 - 62</td>
<td>0.625</td>
<td>0.625</td>
</tr>
<tr>
<td>63 - 75</td>
<td>0.75</td>
<td>0.625</td>
</tr>
<tr>
<td>76 - 87</td>
<td>0.875</td>
<td>0.75</td>
</tr>
<tr>
<td>88 - 100</td>
<td>1</td>
<td>0.875</td>
</tr>
</tbody>
</table>

Minimum of 2/3

Existing, underlying, primary working transverse joint

Required reservoir
Required ASTM D6690, Type II sealer
1" min. saw cut
5/8"
1/8"
THE MAJORITY OF SIDE STREETS AND THEIR CONDITION
ASPHALT NEEDS

- ¾” highly polymerized sand mix to level.
- 2” asphalt surface course overlay.
  - Similar to 448, Type 1.
  - Known as N50, IL-9.5 mm @ 4% Voids.
  - Utilized friction coarse aggregate.
- Saw and seal at ‘well defined’ transverse joints only.
TRANSVERSE IS TYPICAL, LONGITUDINAL SOMETIMES
TRANSVERSE IS TYPICAL, LONGITUDINAL SOMETIMES
Composite pavement, 8” pcc overlaid with 3” HMA
Composite pavement with reflective cracks
MINNEAPOLIS, MN [10-Y/O PROJECT]

Composite pavement saw & sealed with no reflective cracks
WHAT’S THE ANTICIPATED COST

• Anticipate $1.25 - $1.50 / lin. ft.

• Redeploy MFT / Federal Funding $ (versus maintenance budget).

• Increase pavement life due to:
  • Improved ride quality
  • Elimination of incompressible materials and water.
HMA OVERLAYS ON INTACT STRUCTURALLY SOUND PCC PAVEMENTS

Inter-layers such as:

- SAMI’s,
- Fabrics,
- HMA crack relief layer,
- 4.75 mm (#4)

Delay reflection cracking and their effectiveness depends on treatment, timing, climate, conditions, etc.
HOW ABOUT A COMBO SOLUTION?
INTERLAYERS

• **Stress Absorbing Membrane Interlayers (SAMI’s)**
• Fabrics/Geotextiles
  • Localized
  • Global
• Asphalt interlayer
3-LAYER SAMI

Asphalt Surface Course

Asphalt Rubber Membrane and Aggregate Chips

Conventional HMA Leveling Course

Existing Pavement
GEOTEXTILE APPLICATION

- Easier to install
- Best on leveling course
- At least 2.5 in. HMA cover and watch traffic volume and motion

Interlayer Stress Absorbing Composite ISAC®
GEOTEXTILE ISSUES

• Improper installation
   Wrinkles
   Bonding

• Thickness of overlay
   Leveling course (smooth surface required)
   Surface course = 2.5 in. cover

• Alternative; additional asphalt
CRACK RELIEF LAYER SYSTEM

- Repair Concrete Slabs
- Under Seal/Stabilize Slabs
- Install Pavement Edge Drains
- Place Crack Relief Layer - (3.5”)
- Place HMA Leveling Crse- (2.0”)
- Place HMA Surface Crse - (1.5”)

Typically asphalt; from 1” to ½” top size with no fines. May be aggregate base. Both require > 20% Voids. (Think OGFC or Porous Asphalt)
## MIX GRADATION

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5 mm (3/8 in.)</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm (No. 4)</td>
<td>90 - 100</td>
</tr>
<tr>
<td>2.36 mm (No. 8)</td>
<td>70 - 90</td>
</tr>
<tr>
<td>1.18 mm (No. 16)</td>
<td>50 - 65</td>
</tr>
<tr>
<td>600 μm (No. 30)</td>
<td>35 - 55</td>
</tr>
<tr>
<td>300 μm (No. 50)</td>
<td>15 - 30</td>
</tr>
<tr>
<td>150 μm (No. 100)</td>
<td>10 - 18</td>
</tr>
<tr>
<td>75 μm (No. 200)</td>
<td>7 - 9</td>
</tr>
<tr>
<td><strong>AC Content</strong></td>
<td><strong>7% to 9%</strong></td>
</tr>
</tbody>
</table>
DO NOT USE VIBRATORY ROLLERS
FRACTURED PCC SLABS

Fractured Slab Technology

- Rubblization
- Crack / Break and Seat

Alternatives to total reconstruction
Resonant Pavement Breaker

Result

• Low amplitude, ¾ inch
• High Frequency, 44 HTZ
• Single Breaking Shoe
• 9-12” per pass on free edge
Resonant Rubblizing

High Frequency (44Hz) Low Amplitude (3/4"

Interlocked rubble distributes loads

Slab fractured

Base integrity maintained

Flat Bottom maintains load-bearing capacity of rubble

No displacement into base
RUBBLIZED PCC

- 6 in. or minus pieces
- Most are 1-3 in. diameter
- Aggregate interlock
- Rolling
  - Resizes
  - Knits together surface particles
RUBBLIZED PCC @ JOINT

Remove excess joint Sealer
PAVEMENT LIFE CYCLE THEORY

- Maintenance: ~$ 1.00/Sy
- Rehabilitation: >$10.00/SY
- Reconstruction: >$$$$

Condition (PCI)

Time
COST ANALYSIS FROM AI – MS-17

<table>
<thead>
<tr>
<th>Repair / Replacement Activity</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCC Patching</td>
<td>$75 / sy</td>
</tr>
<tr>
<td>Saw &amp; Seal</td>
<td>$1.50 lin. ft.</td>
</tr>
<tr>
<td>Asphalt Base</td>
<td>$1.50 / sy / in.</td>
</tr>
<tr>
<td>Asphalt Surface</td>
<td>$1.75 / sy / in.</td>
</tr>
<tr>
<td>Rubblize</td>
<td>$1.50 / sy</td>
</tr>
</tbody>
</table>

COST OF PCC PATCHING PRIOR TO ASPHALT OVERLAY VERSUS FRACTURED SLAB REHABILITATION

BREAK EVEN ~13% PATCHING
INITIAL AND FUTURE COSTS

1. Straight overlay.
2. Joint repair and overlay.
3. Joint repair, level course, and overlay.
4. Joint repair, crack relief layer, and overlay.
5. Joint repair, level course, overlay, and saw & seal.
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QUESTIONS?