Thin Asphalt Overlays for Pavement Preservation

February 2, 2017
WRAPP Pavement Preservation Workshop
Doubletree Ontario Airport, Ontario, CA
CalAPA Strategic PLAN

- Promoting
- Learning
- Advocating
- Networking
Green = Sustainable = Harmony
We are ENGINEERS

HOW do we make it happen!!!
Innovation
Why Thin Asphalt Overlays?

- Shift from new construction to renewal and preservation
- Functional improvements for safety and smoothness are needed more than structural improvements – Perpetual Pavements
- Material improvements
  - Binders – PG, PM, AR
  - Gap Graded, OGFC and Dense-Graded
  - Warm Mix Asphalt (WMA)
  - Reclaimed Asphalt Pavement (RAP)
  - Reclaimed Asphalt Shingles (RAS)
Benefits of Thin Asphalt Overlays

• Long life and low life-cycle cost!

• Safety / User
  – Minimize traffic delays
  – Staged construction
  – Smooth surface
  – Restore skid resistance
  – Reduce noise

• Structural
  – Maintain grade & slope
  – Withstands heavy traffic
  – Easy to maintain

• Sustainable
  – Recycled materials
  – WMA - OK
Topics

- Project Selection
- Materials Selection and Mix Design
- Construction and Quality Control
- Performance
- Conclusions
Project Selection

Avoid Projects Needing Structural Rehabilitation!!
Basic Evaluation

- Visual Survey
- Structural Assessment
- Drainage Evaluation
- Functional Evaluation
- Discussion with Maintenance Personnel
Visual Survey

- Part of a good Pavement Management System
- Get current project-specific data
- Need to know:
  - Type of distress
  - Extent
  - Severity
- Visit the site and validate data.
Types of Distress

- Raveling
- Longitudinal Cracking (not in wheelpath)
- Longitudinal Cracking (in wheelpath)
- Transverse Cracking
- Alligator Cracking
- Rutting
Raveling
Longitudinal Cracking
(not in wheelpath)
Longitudinal Cracking (in wheelpath)

Temporary Fix for Minor Distress
Transverse Cracking
Temporary Fix for Minor Distress
Rutting or Shoving

Severe Structural Failure

Surface Failure – Milling Required
Rough surfaces should be milled

Skid problems can be milled, but not required
Noise can be reduced

NCAT Noise Trailer

<table>
<thead>
<tr>
<th>Aggregate Size</th>
<th>Noise Level, dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5 mm (Rt. 50)</td>
<td>95</td>
</tr>
<tr>
<td>12.5 mm (I-270)</td>
<td>96</td>
</tr>
<tr>
<td>12.5 mm (I-495)</td>
<td>97</td>
</tr>
<tr>
<td>19 mm (I-83)</td>
<td>99</td>
</tr>
</tbody>
</table>

Smaller Aggregate = Less Noise
Drainage Evaluation
Materials & Mix Design

- Materials Selection
- Mix Designs/Types
Materials Selection - Aggregate

- Thin overlays need small NMAS
  - Thin overlays ≤ 1.5 inches thick
  - Aggregate size between ¼” and ½” NMAS
  - Ratio of lift thickness to NMAS range 3:1 to 5:1
Materials Selection - Binder

- PG Graded – Unmodified
- PG Graded Modified
- Asphalt Rubber
Materials Selection - RAP

- Small NMAS mixes should utilize fine RAP
- RAP or RAS will help
  - Stabilize cost by reducing added asphalt and added aggregate
  - Prevent rutting
  - Prevent scuffing
- Use maximum allowable while maintaining gradation and volumetrics (typically <25% ABR for surface mixes)
Mix Design

- Dense Graded
- Gap Graded
- Open Graded
Construction & Quality Control

- Surface Prep
- Quality Control
- Construction
  - Production
  - Paving
Quality Control - Plant

- Aggregate
  - Gradation
  - Moisture Content

- Mix Volumetrics
  - Air Voids
  - VMA
  - Asphalt Content
  - Gradation
Quality Control - Field

- **Field Density**
  - Thin-lift NDT gauges
    - Use to establish a roller pattern
  - Cores may not be representative

- **Smoothness/Ride Quality**
  - Depends on
    - Condition of existing pavement
    - Surface preparation
    - Overlay thickness
  - Specification should be based on existing condition
Construction - Production

➤ Aggregate
  ▪ Proper stockpiles
    ▪ Slope and Pave
    ▪ Cover, if needed
  ▪ Moisture content

➤ Plant operations
  ▪ Slower because
    ▪ More time to coat
    ▪ Higher moisture content
    ▪ Thicker aggregate veil
  ▪ Aggregate moisture management
  ▪ WMA can help coat aggregates - lubricity
Construction - Production

- RAP – Process for size and consistency
  - Max size ≤ NMAS
- Storage and Loading
  - Follow normal best practices
- Warm Mix
  - Increase haul distance
  - Pave at cooler temperatures
  - Achieve density at lower temperatures
  - Extend paving season
  - Pave over crack sealer
# Construction – Paving Surface Preparation

<table>
<thead>
<tr>
<th></th>
<th>Mill</th>
<th>Fill Cracks with Mix</th>
<th>Clean and Tack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raveling</td>
<td></td>
<td></td>
<td>✅</td>
</tr>
<tr>
<td>Transverse Crack</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>Alligator Crack</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>Rutting</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
</tbody>
</table>
Construction – Paving Surface Preparation

- **Milling**
  - Remove defects
  - Roughen surface
  - Improve smoothness
  - Provide RAP
  - May eliminate need for tack
  - Size machinery properly

- **Tack**
  - Emulsion or hot asphalt
  - Polymer emulsion or unmodified
  - Rate: 0.10 to 0.15 gal/sy (undiluted emulsion)
Construction – Paving Placement and Compaction

- Paving
  - Best to move continuously
  - MTV or windrow can help
  - Cooling can be an issue
    - 1” cools 2X faster than 1.5”
  - Warm mix
- Compaction
  - Seal voids & increase stability
  - Low permeability
  - No vibratory on < 1”
Performance

- Immediate Benefits
- Pavement Life
- Economics
Immediate Benefits

- Pavement Condition (Labi et al. (2005))
  - 18 to 36% decrease in roughness
  - 5 to 55% decrease in rut depth
  - 1 to 10% improvement in condition rating

- Noise
  - FHWA (2005): 5 dB reduction on overlaid PCC in Phoenix

- 3dB reduction = ½ traffic volume
### Pavement Life

<table>
<thead>
<tr>
<th>Location</th>
<th>Traffic</th>
<th>Underlying Pavement</th>
<th>Performance, yrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio</td>
<td>High/Low</td>
<td>Asphalt</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>Composite</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Composite</td>
<td>7</td>
</tr>
<tr>
<td>North Carolina</td>
<td>----</td>
<td>Concrete</td>
<td>6 – 10</td>
</tr>
<tr>
<td>Ontario</td>
<td>High</td>
<td>Asphalt</td>
<td>8</td>
</tr>
<tr>
<td>Illinois</td>
<td>Low</td>
<td>Asphalt</td>
<td>7 – 10</td>
</tr>
<tr>
<td>New York</td>
<td>----</td>
<td>Asphalt</td>
<td>5 – 8</td>
</tr>
<tr>
<td>Indiana</td>
<td>Low</td>
<td>Asphalt</td>
<td>9 – 11</td>
</tr>
<tr>
<td>Austria</td>
<td>High/Low</td>
<td>Asphalt</td>
<td>≥10</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Concrete</td>
<td>≥8</td>
</tr>
<tr>
<td>Georgia</td>
<td>Low</td>
<td>Asphalt</td>
<td>10</td>
</tr>
</tbody>
</table>
CA-1 Point Arena

- ~4000 ton 3/8” OGFC PG58-34PM
- ~1000 ton ½” HMA–A PG64-16
- Low ambient temps
  - Northern California Coast
  - Low: 50°F; High 60°F
  - Fog and drizzle
- Mix Produced in Santa Rosa
- 4 hour haul!!!

3-Years Later
Then and Now

2011

2008
Conclusions - Benefits

- Thin Overlays for Pavement Preservation
  - Improve Ride Quality
  - Reduce Distresses
  - Maintain Road Geometrics
  - Reduce Noise
  - Low Life Cycle Costs
  - Provide Long Lasting Service
- Place before extensive rehab required
- Expected performance
  - 10 years or more on asphalt
  - 6 to 10 years on PCC
Conclusions – Check-list

- Evaluate
  - Candidate for thin asphalt overlay?
  - Distresses
- Determine Mix Type
- Proper Surface Preparation
- Materials
- Thickness
- Production, Construction and Quality Control
Thin asphalt overlays are a popular solution to pavement preservation. They are economical, long-lasting, and effective in treating a wide variety of surface distresses to restore ride quality, skid resistance, and overall performance.
Resources

- NCAT website: [www.ncat.us](http://www.ncat.us)
- New NAPA Publication:
  - IS-135, “Thin Asphalt Overlays for Pavement Preservation”
- Transportation Research Record:
- Ohio DOT:
Contact

Brandon Milar, P.E.
Technical Director
California Asphalt Pavement Association
(916) 995-0086
bmilar@calapa.net
www.calapa.net