Track A – Field & Lab Operations:
Surface Preparation
& Tack Coats

2020 MAPA Spring Training – Black to Basics
Holiday Inn Executive Center – Columbia, MO
February 27-28, 2020
Potential Distress – Delamination

Delamination occurs when pieces of asphalt pavement break loose and separate from the rest of the structure.
Potential Distress – Delamination

• Causes
  – Low surface mat density
  – Water gets beneath surface layer
  – Poor/Inadequate bond allows portions to break loose under traffic
Potential Distress – Slippage Cracking

Crescent or half-moon shaped cracks generally having two ends pointed in the direction of traffic.
Potential Distress – Slippage Cracking

• Causes
  – Poor/Inadequate bond between surface and underlying layer
  – Braking or Turning
  – Intersections/stop signs
  – Downhill grades
  – Mailboxes?????
NCAT’s engineering analysis of a pavement both with and without one of its layers bonded showed an increase in the tensile stresses beneath the load.
Potential Distress – Structural Cracking

• Causes
  – Poor/Inadequate bond between layers
  – Multi-layered system now acts as independent layers
  – Fatigue cracking initiates when one layer is unable to withstand the tensile stains it is experiencing
Surface Preparation

- The performance of an asphalt pavement under traffic is directly related to the condition of the surface on which it was placed.
- Surface can be subgrade, aggregate base, or an existing asphalt or concrete pavement.
- Surface preparation often doesn’t get the attention it needs.
- It is easy to cover up problems with a new asphalt layer, but rarely do the problems go away.
Surface Preparation

Preparing an existing asphalt pavement for an overlay may be as simple as sweeping the surface and spraying a tack coat...
Surface Preparation

... or it may involve numerous other procedures: Patching? Leveling? Milling?
Surface Preparation

- Fill or seal cracks > 1/8 in wide
- Repair structural distresses
- Milling – removal of distressed layers
- Thoroughly clean the surface
Surface Preparation

• Milling
  – Remove the high spots from an existing surface.
  – Used to maintain the surface profile, such as in curb and gutter situations.
  – Also used to remove mix related problems.
  – Avoid scabbing!
  – Extra effort sweeping!
Surface Preparation

• Sweeping
  – After patching, sealing, and/or milling, the surface MUST be properly cleaned.
  – Allowing traffic on milled surface helps clean it.
  – Typically, a power broom or street sweeper is used.
  – Any foreign material (dried mud, spilled asphalt, etc.) must be removed to insure a strong bond between layers.
  – Re-Sweeping is recommended immediately prior to placing the tack coat.
Tack Coat

A thin layer of bituminous material placed between asphalt concrete pavement layers to bond the layers together.
Tack Coat

• Tack Coat Application
  — While the surface is still clean and dry, place the tack coat immediately prior to the overlay
  — The tack coat ensures a bond between the existing pavement and the overlay.
  — Delamination, slippage cracking and/or structural cracking can occur if a bond is not formed between layers to create a “monolithic” structure
Tack Coat Materials

• Asphalt Emulsions:
  – Slow Setting: SS-1, SS-1h, CSS-1, CSS-1h
  – Rapid Setting: RS-1, RS-2, CRS-1, CRS-2
  – Polymer-Modified: SS-1hP
  – “NT”: Non-Tracking
  – “TT”: Trackless Tack
Tack Coat Materials

• Advantages:
  — Application uniformity
  — Numerous choices
  — Contractor familiarity

• Disadvantages:
  — Break & Set times
  — Tracking potential

CSS-1
Tack Coat Materials

• Depending on the formulation, asphalt emulsions are typically 60-70% asphalt cement and 30-40% water.

≈ 65 + 35
Tack Coat Materials

• Break & Set Times:
  – Formulation???
  – Application Rate
  – Climatic Conditions
    – Sunny vs. Cloudy
    – Daytime vs. Nighttime
    – Air, Surface, Emulsion Temperatures
  – Has it been diluted???
Tack Coat Materials

- Paving Grade Asphalt:
  - No Break or Set times
  - Cool weather/Nighttime paving
  - Excellent performance
  - Elevated storage and application temperature increases safety risk!!!
Tack Coat Application

- Nozzles must be appropriate size, clean and adjusted
- Height of spray bar and pressure will affect coverage

“Looking Good!!!”

“Not Good!!!”
Proper Settings of Nozzles

Nozzle Angle Setting - 15° to 30°
Tack Coat Application

• This application might have the correct amount of material, but will not have the same “bond strength” evenly across the interface between layers.

• *No “Corn Rows”!!!*
Tack Coat Application

- Milled surfaces can be more difficult to plan for, but are still recommended to be tacked.
- Increased texture will require more tack
- **Be sure to clean the surface thoroughly!!!**
Tack: How much is enough?
Tack : How much is enough?

- Too much tack is also a bad thing.
- Start with the application rate shown in the project paving plan
- Recommend placing a test strip in accordance with specifications, and adjust based on surface condition
- Even if the calculated rate is correct, the material MUST be distributed EVENLY.
Tack Coat Rate

**FHWA-HIF-16-017: “Tack Coat Best Practices”**

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Residual Rate (gsy)</th>
<th>Approximate Bar Rate Undiluted* (gsy)</th>
<th>Approximate Bar Rate Diluted 1:1* (gsy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Asphalt</td>
<td>0.02 – 0.05</td>
<td>0.03 – 0.07</td>
<td>0.06 – 0.14</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>0.04 – 0.07</td>
<td>0.06 – 0.11</td>
<td>0.12 – 0.22</td>
</tr>
<tr>
<td>Milled Surface</td>
<td>0.04 – 0.08</td>
<td>0.06 – 0.12</td>
<td>0.12 – 0.24</td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>0.03 – 0.05</td>
<td>0.05 – 0.08</td>
<td>0.10 – 0.16</td>
</tr>
</tbody>
</table>

*Assume emulsion is 33% water and 67% asphalt.
Tack Coat Rate

- Asphalt emulsions are applied brown, and then turn black after they break and set.
- The emulsion should be allowed break and set before placing the surface layer.
- For faster “breaks”, utilize “RS” emulsions, paving grade asphalt, or other specialty products.
- Tack coat “residual” rate should not typically need to exceed 0.10 gal/sy.
Tack Coat Rate

• Example Problem:
  • Initial Reading on Tack Truck: 470 gal
  • Final Reading on Tack Truck: 220 gal
  • Tack applied to 2500’ of a 12’ wide lane
  • Emulsion: 65% Residual (undiluted)

What’s the application rate?
Gallons Used = Initial Reading – Final Reading

= 470 – 220 = 250 gallons

Coverage (ft\(^2\)) = 2500’ x 12’ = 30,000 ft\(^2\)

Coverage (yd\(^2\)) = 30,000/9 = 3333.3 yd\(^2\)

Rate (gal/yd\(^2\)) = 250/3333 = 0.075 gal/yd\(^2\)

Residual Rate = 0.075 x 0.65 = 0.049 gal/yd\(^2\)
So, are tack coats worth the cost?

- **Asphalt Institute Investigation**
  - **Cost of Tack Coats**
    - New or Reconstruction: about 0.1 – 0.2% of Total Project Cost
    - Mill & Overlay: about 1.0 – 2.0% of Total Project Cost
  - **If Bond Failures Occurred**
    - Remedial Action: between 30 – 100% of Original Project Cost
Resource

- FHWA-HIF-16-017 “Tack Coat Best Practices” April 2016
Questions?

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