Tack Coats – A Fundamental Topic with a Big Impact

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Scope

- Potential Distresses
- Surface Preparation
- Tack Coat Materials
- Tack Coat Application
- Tack Coat Rate

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Potential Distress – Delamination

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

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Potential Distress – Delamination

- Causes
  - —Low surface mat density
  - —Water gets beneath surface layer
  - —Poor/Inadequate bond allows portions to break loose under traffic

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Potential Distress – Slippage Cracking

Crescent or half-moon shaped cracks generally having two ends pointed in the direction of traffic.

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Potential Distress – Slippage Cracking

- Causes
  - —Poor/Inadequate bond between surface and underlying layer
  - —Braking or Turning
  - —Intersections/stop signs
  - —Downhill grades
  - —Mailboxes????

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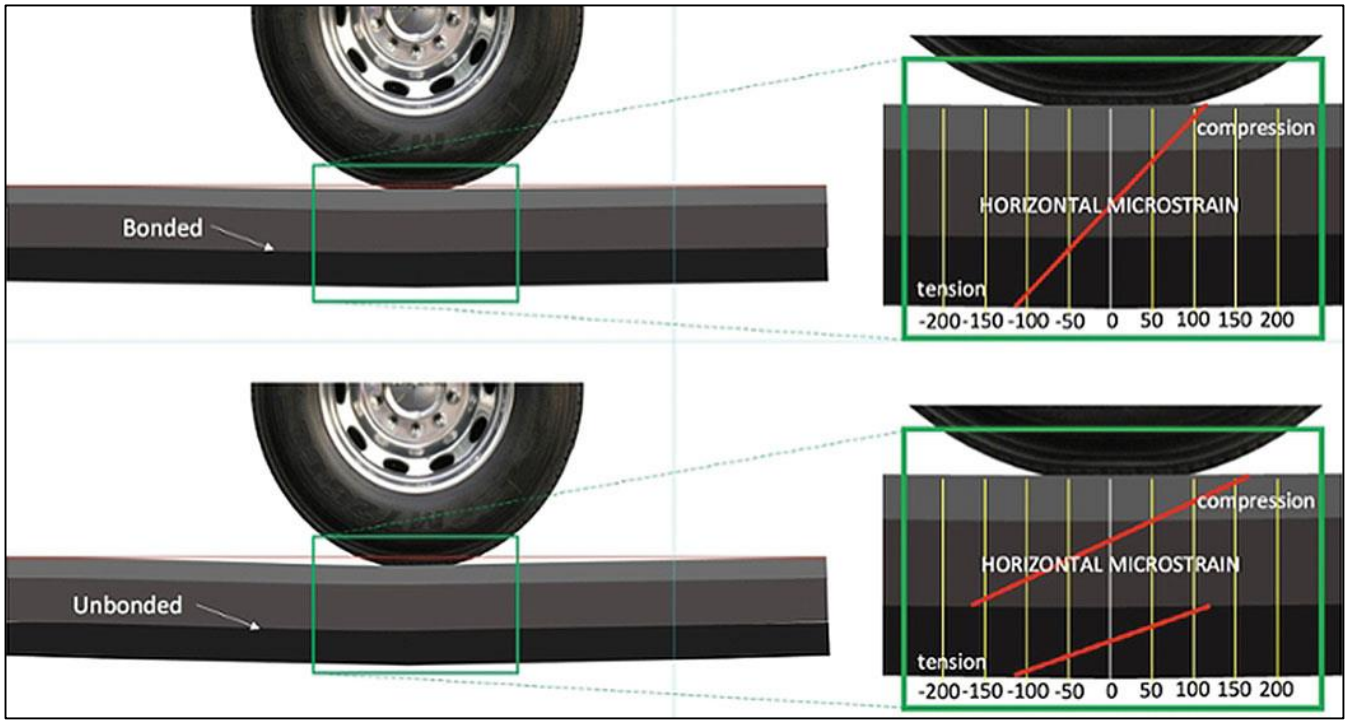
Potential Distress – Structural Cracking

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.



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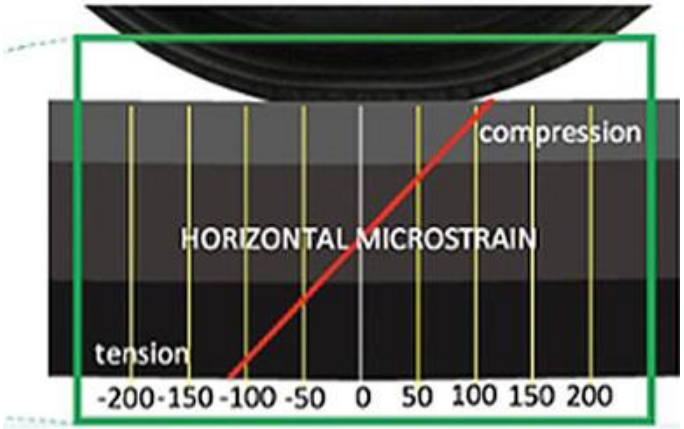
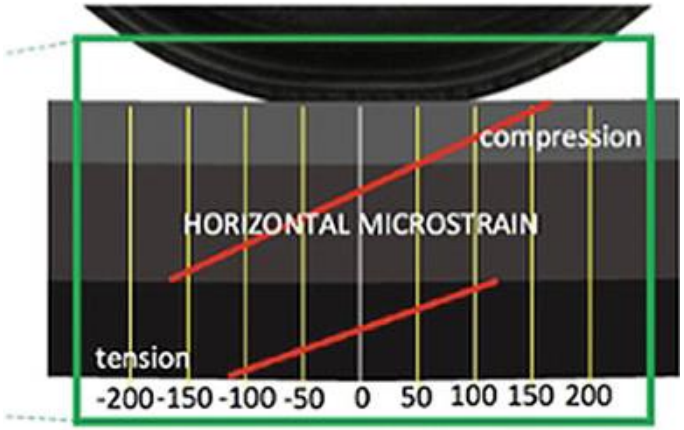
Potential Distress – Structural Cracking

- 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





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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.

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Surface Preparation

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

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Surface Preparation

… or it may involve numerous other procedures: Patching? Leveling? Milling?

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Surface Preparation

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

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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!

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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.

Surface Preparation

- 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

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Tack Coat Materials

TACK COAT – A thin layer of bituminous material placed between asphalt concrete pavement layers to bond the layers together.

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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!!!

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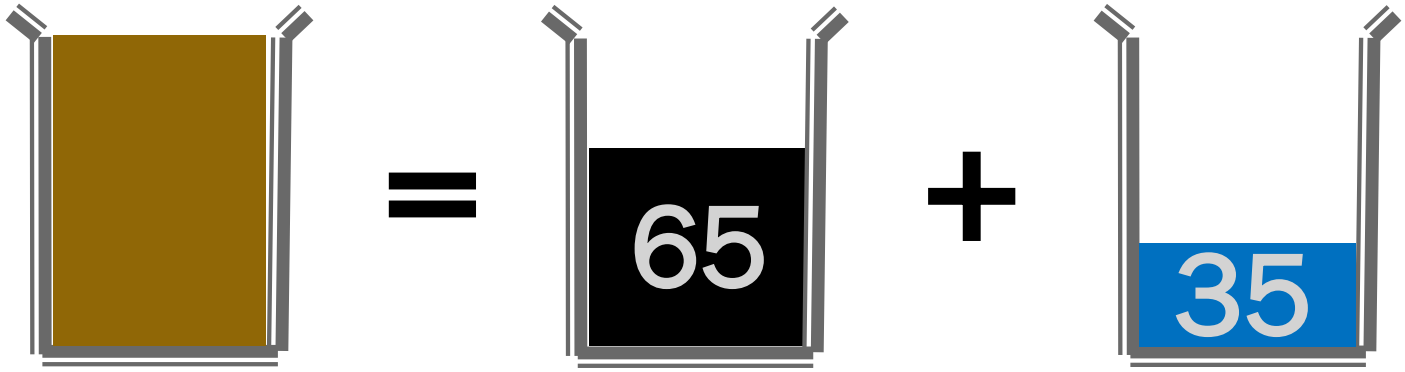
Tack Coat Materials

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



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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
  - Proprietary Products

Tack Coat Materials

- Advantages:
  - Application uniformity
  - Numerous choices
  - Contractor familiarity
- Disadvantages:
  - Break & Set times
  - Tracking potential

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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???

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Tack Coat Application

Looking Good!!!

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

Not Good!!!

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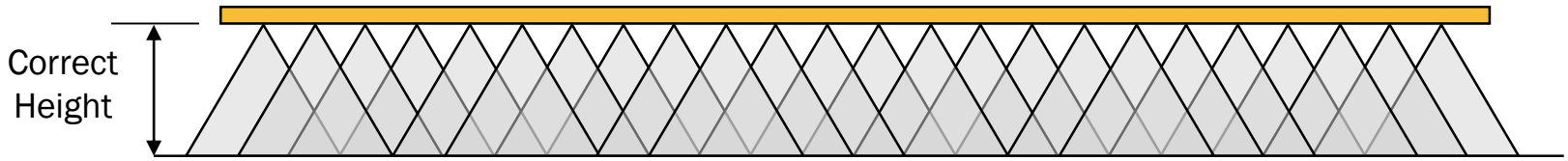
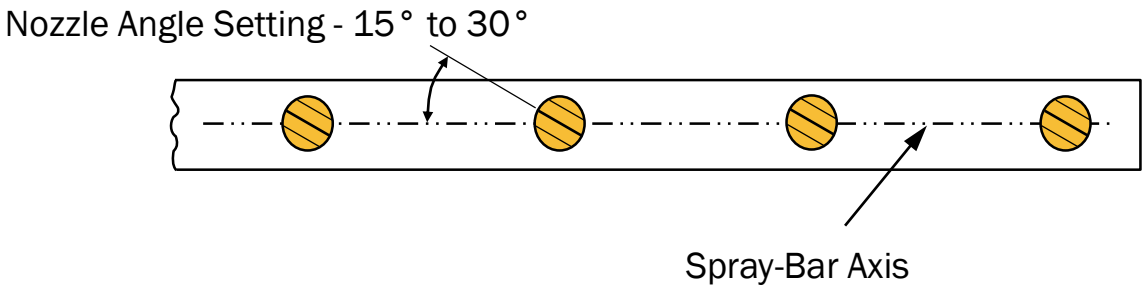
Tack Coat Application

Spray Pattern achieving Triple Overlap



Proper Settings of Nozzles



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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”!!!*

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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!!!*

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Tack : How much is enough?

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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.

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Tack Coat Rate

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

*Assume emulsion is 33% water and 67% asphalt.

FHWA-HIF-16-017: "*Tack Coat Best Practices*"

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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 (0.15 gal/sy applied)

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 was the application rate?

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Tack Coat 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**

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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

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Resource

- FHWA-HIF-16-017
  "Tack Coat Best Practices"
  April 2016
- https://www.fhwa.dot.gov/pavement/asphalt/pubs/hif16017.pdf

TechBrief

The Asphalt Pavement Technology Program is an integrated, national effort to improve the long-term performance and cost effectiveness of asphalt pavements. Managed by the Federal Highway Administration through partnerships with state highway agencies, industry and academia the program's primary goals are to reduce congestion, improve safety, and foster technology innovation. The program was established to develop and implement guidelines, methods, procedures and other tools for use in asphalt pavement materials selection, mixture design, testing, construction and quality control.

U.S. Department of Transportation
Federal Highway Administration

Office of Asset Management, Pavements, and Construction

FHWA-HIF-16-017

April 2016

Tack Coat Best Practices

This Technical Brief provides an overview of tack coats and their vital role bonding multiple asphalt layers into one monolithic system. Poor tack coat techniques result in compromised bonding of the asphalt layers. This leads to pavement distresses. Possible slippage cracking and delamination are associated with poor bonding. Additionally, poor bonding can lead to structural distresses, namely fatigue cracking and potholes. Often this lack of sufficient bonding is not recognized as the source of failures.

Introduction

A key, but sometimes overlooked, component of an asphalt pavement is the bond strength between asphalt pavement layers. Tack coat is a sprayed application of an asphalt binder upon an existing asphalt or Portland cement concrete pavement prior to an overlay, or between layers of new asphalt concrete. This thin membrane of asphalt binder provides the glue between the layers, creating a monolithic structure which performs as a unit as opposed to unbound, independent, layers. When properly built, a pavement will provide the desired characteristics for its users, while meeting the needs of an agency for an economical, environmentally friendly and sustainable material.

Poor bonding of a pavement surface layer is a direct result of inadequate tack coat practices resulting in slippage and shoving of the pavement, as seen in Figure 1. This type of failure is most frequently seen in locations where braking or acceleration is common, such as intersections. Other distresses can also be made related to poor tack coat bonding, most notably pavement fatigue cracking.

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Questions?

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