Bonding of Asphalt Pavement Layers
Slip on 2003 Track
Content

• Why worry about bond strength?
• How can you measure bond quality?
• Comprehensive study (lab vs field)
• Results from 2009 & 2012 Tracks
• Conclusions & recommendations
Impact of Slip on M-E Response

- Full Bond
- SMA Slip
- Double Slip
Measuring Bond Strength
M-E Predictions + Field Measurements

Shear Stress, psi

Wearing Course Thickness, in.

- 100K/250K_E
- 250K/100K_E
- 500K/250K_E
- 750K/500K_E
- 1000K/750K_E
- 1500K/1000K_E
Comprehensive Tack Study Design

• Results from both laboratory & field

• New, milled, and micro milled surfaces

• Representative products and practical rates
  – PG67-22 at 0.03, 0.05, 0.07 gal/yd²
  – NTSS-1HM at 0.04, 0.06, 0.08 gal/yd²
  – CRS-2, CRS-2L, CQS-1h at 0.05, 0.075, 0.10 gal/yd²
Lab Results for PG67-22

- Bond Strength, psi
- Surface Type and Application Rate, gal/sy

- Micro-milled
- Milled
- New

Bar graph showing bond strength in psi for different surface types and application rates.
Field Rate Measurements

[Images of road construction and measurements]

[Images of trucks and machinery on the road]

[Images of workers making measurements]

[Images of the finished road surface]

[Images of the road curvature and alignment]
Field Results for PG67-22

![Graph showing bond strength over time for different mixtures of asphalt.](image-url)

- **0.0246 gal/sy & existing**
- **0.0473 gal/sy & existing**
- **0.0625 gal/sy & existing**
- **0.025 gal/sy & milled**
- **0.0348 gal/sy & milled**
- **0.0639 gal/sy & milled**

**Test Track**
Comprehensive Tack Study Findings

• Results from both laboratory and field
  – Laboratory bond strengths higher than field

• New, milled, and micro milled surfaces
  – Milling and micro milling improves bond in lab
  – Debris necessitates higher rate (x2) in field

• Representative products and rates
  – Bond develops quicker for PG67-22 & NTSS-1HM
  – Traffic does not increase bond strength
Wheelpath Pickup
Spray Paver on 2009 Track
Spray Paver (Top) vs Conventional
2012 Tack Coat Study

- N1A eTac 0.10/0.06
- N1B UltraFuse 0.15/0.15
- N2 Trackless 0.05/0.03
2012 Tack Coat Study

N1A eTac 0.10/0.06

N1B UltraFuse 0.15/0.15

N2 Trackless 0.05/0.03
2012 Tack Coat Study
### 2012 Tack Coat Study

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#### Values
- **Average of BOND_STRENGTH**
- **Sum of % INTERFACE**
FDOT Tack Coat for PFCs

Crack Map (Recent Cracks in Solid Red, Potential Reflective Cracks in Blue, Patches Outlined in Green, and Trucking Percent Complete via Height of Gray Map Date Box)

N1A - eTac

N1B - UltraFuse

N2 - Trackless
Bottom Line for Asphalt Layer Bonding

- 100 psi minimum bond strength
- PG67-22
  - 0.03 to 0.07 gal/yd$^2$ on new pavement
  - 0.05 to 0.09 gal/yd$^2$ on milled surface
- NTSS-1HM (undiluted bar rates)
  - 0.04 to 0.08 gal/yd$^2$ on new pavement
  - 0.06 to 0.10 gal/yd$^2$ on milled surface
- CQS-1H and CRS-2 (undiluted bar rates)
  - 0.05 to 0.10 gal/yd$^2$ on all surfaces
- High end for higher RAP/RAS mixes!
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  – 0.05 to 0.10 gal/yd² on all surfaces
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1. Weak bond between binder and base layers
2. Debonding between binder and base layers
3. “Middle-up” crack initiated at bottom of binder
4. “Middle-up” crack reaches surface of pavement
5. Full depth crack extends to bottom of base
Questions?

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