Pavement Friction Management

- “...Purpose: Minimize friction-related vehicle crashes by ensuring pavement surfaces are designed, constructed and maintained to provide adequate and durable friction, identify and correct roadway sections which have elevated friction-related crash rates, and prioritize...resources to reduce friction-related crashes in a cost effective manner...” [Technical Advisory T 5040.38, June 17, 2010]

Expert Task Group on Pavement Preservation
Oklahoma City, OK
May 3-4, 2011

Steve Healow
FHWA California Division
A little skid history

- Highway Safety Act of 1966 “…Each State shall have a highway safety program ...designed to reduce traffic accidents and deaths, injuries, and property damage...surveillance of traffic for detection and correction of high or potentially high accident locations...”
- 23-Dec-1980 FHWA Technical Advisory 5040.17 “Skid Accident Reduction Program”
- 2003 U.S. Supreme Court upholds 23 U.S.C. 409 - “...data ...collected for... identifying, or planning the safety enhancement of hazardous roadway conditions or potential accident sites... shall not be subject to discovery or admitted into evidence in a Federal or State court...”
- (2008) AASHTO Guide for Pavement Friction
- 17-Jun-2010 FHWA Technical Advisory “Pavement Friction Management”
2009 traffic stats

• 33,808 traffic fatalities on U.S. highways
• 3,000,000 traffic injuries
• 6,000,000 traffic crashes (only 1/3 => F or I)
• 80% of crashes occur on dry pavement
• Costs = f(F, I, delays, et al) > $230B
Elements of Pavement Friction Management

- Identify engineering practices which provide road surfaces with adequate and durable friction properties
- Data collection and analysis to ensure effectiveness of the engineering practices
  - gather and analyze data to prioritize projects;
  - design and construct pavement surfaces with good friction characteristics;
  - I.D. and investigate locations with elevated wet-weather crash rates;
FHWA Pavement Policy

• “...Pavement shall be designed to accommodate current and predicted traffic needs in a safe, durable and cost effective manner...” [ 23 CFR 924.5]

• “......Each State shall develop, implement and evaluate on an annual basis a Highway Safety Improvement Plan (HSIP) that has the overall objective of significantly reducing the occurrence of and the potential for fatalities and serious injuries resulting from crashes on all public roads...the HSIP shall be data-driven...and shall incorporate a process for collecting and maintaining a record of ...roadway...data on all public roads...and a process for analyzing available safety data that...identifies safety improvement projects on the basis of crash experience, crash potential...and establishes the relative severity of those locations...” (TA5040.38)
Design, Construction and Maintenance Practices which provide good friction characteristics

- Construct surface texture properties which meet design needs
- Use fine and coarse aggregates which have preferred properties, e.g. shape, wear resistant,
It continues to be FHWA policy that pavement surfaces provided on federal aid highway projects have a skid resistant surface. (1995)

- "Pavements shall be designed to accommodate current and predicted traffic needs in a safe, durable, and cost-effective manner." [23 CFR 500.205]
## Testing Standard Aggregate Properties

<table>
<thead>
<tr>
<th>Select aggregate Properties</th>
<th>Concrete Pavement</th>
<th>Asphalt Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toughness and Abrasion Resistance</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Durability and soundness</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Particle Shape and surface texture</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Cleanliness (SE, PI, other)</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Specific Gravity and Absorption (coarse &amp; fine)</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Size and Gradation</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Surface Area</td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Freeze-Thaw resistance</td>
<td>√</td>
<td></td>
</tr>
</tbody>
</table>
Test Methods to Measure Surface Friction

Locked Wheel Trailer (ASTM E-274)

Dynamic Friction Tester (ASTM E 1911)

British Pendulum Tester (ASTM E 303)

Caltrans Skid Tester (CTM 342)
Standard Test Methods for Texture

Sand Patch (ASTM E 965)

Outflow Meter (ASTM E 2380)

Circular Texture Meter (ASTM E 2157)
Automated data collection on your network
e.g. Mean Profile Depth
Texture Wavelength Influence on Surface Characteristics

- Microtexture
- Macrotecture
- Megatecture
- Roughness

- Rolling Resistance
- Ride Quality

- Wet Weather Friction
- Dry Weather Friction
- Splash and Spray

- Tire Wear
- Vehicle Wear
- In-Vehicle Noise
- Tire-Pavement Noise

Key: Good (lighter shade) Bad (darker shade)
Influence of Texture on some variables

<table>
<thead>
<tr>
<th>Effect on Vehicle, Driver or Environment</th>
<th>Road Surface Characteristic of Importance</th>
<th>Magnitude of the Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skid Resistance (Friction)</td>
<td>Macrotecture</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Megatecture</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Microtexture</td>
<td>Very high</td>
</tr>
<tr>
<td>Rolling Resistance/</td>
<td>Macrotecture</td>
<td>High</td>
</tr>
<tr>
<td>Fuel Consumption/</td>
<td>Megatecture</td>
<td>Very high</td>
</tr>
<tr>
<td>Air Pollution</td>
<td>Unevenness</td>
<td>High</td>
</tr>
<tr>
<td>Tire Wear</td>
<td>Macrotecture</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Megatecture</td>
<td>Very high</td>
</tr>
<tr>
<td></td>
<td>Microtexture</td>
<td>High</td>
</tr>
<tr>
<td>Exterior Noise</td>
<td>Macrotecture</td>
<td>Very high</td>
</tr>
<tr>
<td></td>
<td>Megatecture</td>
<td>Very high</td>
</tr>
<tr>
<td>Water Runoff</td>
<td>Macrotecture</td>
<td>High</td>
</tr>
<tr>
<td>Splash and Spray</td>
<td>Macrotecture</td>
<td>High</td>
</tr>
<tr>
<td>Light Reflection</td>
<td>Macrotecture</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Megatecture</td>
<td>Little known</td>
</tr>
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<td>Microtexture</td>
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<td>Interior Noise</td>
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<td>Very high</td>
</tr>
<tr>
<td></td>
<td>Unevenness</td>
<td>High</td>
</tr>
</tbody>
</table>

![Diagram of texture types](image)
PCCP Surface Textures commonly used on new construction
PCCP re-texturing commonly used for maintenance/rehab.
Maintenance/Rehabilitation on Flexible Pavement

– Surface Seals
– Overlays
  • Dense graded if friction is most important
  • Gap- or open-graded if splash & spray, hydroplaning are most important
High Friction Surface Course

Good grip \((f > 0.45)\);
- Fairly good grip \((0.35 < f < 0.45)\);
- Fairly slippery \((0.25 < f < 0.35)\); and
- Slippery \((f < 0.25)\).
How to find roadway sections which have elevated levels of friction-related crashes
Identify/Classify Locations with elevated wet-weather crashes

Figure 3  Average Injury Crashes on Slippery Pavements, 1995-2001 (31)
Pending issues

• Is Enhanced Data Collection and Analysis needed?
• What are the best practices?
• Is there a priority system for surface treatments to restore texture/friction?
Thank you; questions?

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