High Friction Surface Treatments
An Every Day Counts 2 Technology

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Safety & Design Team
What is a High Friction Surface Treatment?

• High Friction Surface Treatments (HFST) are pavement surfacing overlay systems with:
  - exceptional skid-resistant properties that are not typically acquired by conventional materials
  - and retains the higher friction property for a much longer time.

• Commercially available resin-based products and processes

• Generally applied in short sections to improve spot locations where friction demand is critical.
Key Benefits

- **HFST reduce crashes, injuries, and fatalities.**
- Additional benefits include:
  - Excellent pavement surface functional durability
  - Provides an efficient critical spot safety improvement for a wide variety of urban or rural locations.
  - Good benefit/cost ratio
  - A solution that can be implemented quickly
  - Minimal impact to traffic during construction
  - Negligible environmental impact.
  - Don’t receive complaints from any road user groups
HFST Aggregates

- Recommended aggregate is calcined bauxite which provide the highest resistance to polishing.
- Generally maximum size 3 mm
HFST Binder Materials

- Polymer system (proprietary blends)
  - Epoxy-resin
  - Polyester-resin
  - Polyurethane-resin
  - Acrylic-resin

- Thin layer that allows for 50% aggregate embedment depth
HFST Installation (Manually)

Manual mixing of binder and application with notched squeegee
HFST Installation
(Mechanically Assisted)

Machine mixing of binder and aggregate placement assistance.
HFST Installation
(Automated)

Application of binder and aggregate by machine (limited hand work)
AUTOMATED APPLICATION
HFST Finished Product
Fatal Horizontal Curve Crashes

- 72% Straight
- 28% Curve
Average crash rates for horizontal curves is about 3 times that of tangent segments.

Source: Glennon, et al, 1985 study for FHWA
Development of a Speeding-Related Crash Typology

Speeding, the driver behavior of exceeding the posted speed limit or driving too fast for conditions, has consistently been shown to be a contributing factor to a significant percentage of fatal and non-fatal crashes. Between 1990 and 2006, the frequency of speeding-related (SR) fatal crashes ranged from 11,000 to 13,000 each year, and the percentage of SR total fatal crashes ranged between 30 and 33 percent according to data observed in the Fatal Analysis Reporting System (FARS). Thus, speeding is a significant safety issue warranting attention based on its size and impact on society. While the United States has seen progress in other major safety issues such as occupant restraint use and driving under the influence of alcohol, little if any progress has been made with speeding. In response to this issue, the United States Department of Transportation has instituted the Speed Management Strategic Initiative, seeking more effective ways to manage the crash-related effects of speeding. In support of this initiative, this study examined recent crash data through the development of an SR crash typology. Such a typology can help define the crashes, and driver characteristics that seem to result in a higher probability of SR crashes. Thus, the goal of this study was to determine the "what", "where", "when", and "who" descriptors of SR crashes in order to provide guidance to the future development of new treatments and to better target new and existing treatments to subgroups of drivers and types of roadway (e.g., two-lane rural) or roadway locations (e.g., unsignalized intersections).

Literature Review

While numerous research studies have explored the effects of speed on crash frequency and severity and on the effect of treatments aimed at managing speed (e.g., TRB Special Report 266), two studies have developed typologies similar to those developed in this effort. Bowie and Wals used data from the 1986 Crash Avoidance Research Data (CARDEx) from six States as well as from the Indiana Tri-Level Study and the 1989 FARS data. (See references 4-6 and 1.) Based on CARDEx, speed was a factor in about 12 percent of all crashes. Data from the Indiana Tri-Level Study indicated that excessive speed was a factor in 7.1 to 16.9 percent of crashes. Key findings from the FARS data indicate that fatal SR crashes are usually single-vehicle and that there is a higher percentage of SR crashes on rural roads, on curves, and at night. In these fatal crashes, males were more likely than females to be speeding, and drivers under the influence of alcohol were more likely to be speeding than those who were not drinking. Occupant restraint usage was lower for SR drivers. In addition, more than 45 percent of all motorcycle drivers involved in fatal crashes were speeding.

Ehrlich et al. examined data from in-depth investigations and driver interviews from a sample of 723 relatively severe crashes involving 1,284 drivers collected in a special study as part of the National Automotive Sampling System Crashworthiness Data System (NASS CDS) program. Researchers
Speeding-Related Crash Typology

When crash types were examined for these drivers excessively speeding, researchers found that speeding was the leading cause of single-driver right or left roadside departure with traction loss and the third leading cause of head-on crashes. 

...primarily on curves, at night, on local or collector roadways, and during clear weather.
Strategies for Reducing Crashes
(Where Can HFST Benefit Safety?)

1. Horizontal curves
2. Approach to intersections
3. Grades

When the pavement has:
- Marginal friction effected from weather
- Low friction
- Friction values not compatible with approach speeds and geometrics (friction demand)
PennDOT

State Route 0611, Northampton County, PA in Segment 40 along the Delaware River
An area commonly known as the “Canal Locks”
About 5 miles south of Easton, PA
## Crash Data for Rte 611 Curve

### Northampton Rte 611 Seg 40 (off 1000-1900) Years 1997 to 2005

**21 Crashes Southbound Lane**

<table>
<thead>
<tr>
<th>CRASH YEAR</th>
<th>DIST</th>
<th>CO</th>
<th>COLL TYPE</th>
<th>INT TYPE</th>
<th>URBAN</th>
<th>ILLUMINATION</th>
<th>WEATHER</th>
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Lane closure begins at 8:30 AM
6/13/07
• The 2 part epoxy resin is mixed and applied by spreading with a serrated squeegee.

• Epoxy application begins at 9:15am
2:30 PM, Swept, Dry and Ready for Traffic

200 s.y. HFST
Applied on one side of the road
# Friction Testing & Crash Results

## Friction Results

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<th>Control Lane</th>
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<tr>
<td>Before Installation</td>
<td>= avg 24 *</td>
<td></td>
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<tr>
<td>After Installation</td>
<td>(June 13th, 2007)</td>
<td></td>
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<tr>
<td>Aug ’07</td>
<td>= avg 75</td>
<td>avg 34</td>
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<tr>
<td>Apr ’08</td>
<td>= avg 75</td>
<td>avg 40</td>
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<td>Nov ’08</td>
<td>= avg 72</td>
<td>avg 44</td>
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<tr>
<td>Mar ’09</td>
<td>= avg 74</td>
<td>avg 58 * Repaved</td>
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<tr>
<td>Nov ’09</td>
<td>= avg 72</td>
<td>avg 44</td>
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<tr>
<td>Jun ‘10</td>
<td>= avg 71</td>
<td>avg 44</td>
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## Reportable Crash Results

Before Installation = 21 (south lane)

After Installation = 0 as of 4/12/2012
Thank you!

Questions

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