High Friction Surface Treatment (HFST)
Installation and Constructability
Arizona Pavements/Materials Conference
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Introduction/Background:

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- ACC West Coast— based in Benicia, CA
  - Part of the ACC companies-Offices in Phoenix, Las Vegas, Denver, Salt Lake and Birmingham
  - West Coast division has performed specialty bridge repair and infrastructure work for over 25 years.
  - ACCWC has installed HFST for over 5 years
  - ACCWC has installed over 500,000 SY of HFST to date in multiple states including CA, AK, WA, IL, TX
• **What** is High Friction Surface Treatment?
• **Why** do we need it?
• **How?**-Constructability
  – HFST Installation Practices and Tips
• **When? Where? And More--FAQ**
• Questions
What is High Friction Surface Treatment?

HFST is a low-cost safety countermeasure which is composed of a polish-resistant calcined bauxite aggregate bonded to the pavement surface using a polymer resin binder.
What is High Friction Surface Treatment?

• HFST is installed as a thin overlay (~3/16”)
• Single surface layer/ Two layers of HFST are recommended over open graded “friction” courses or on bridge decks
High Friction Surface Treatments

• Are NOT designed as:
  - Pavement preservation methods
  - Pavement repair methods
  - Bridge deck overlays
  - Educational or driver alert systems (not rumble strips)
  - Only wet weather systems

• HFSTs ARE: Designed to act mostly invisibly, under all times of the day or night, in all weather conditions to dramatically enhance the friction and reduce or eliminate roadway departure crashes.
Why do we need HFST?

- Since 2010...
  - Safer vehicles
  - New road safety standards
  - New safety programs
  - Better road technology
  - But Fatalities are going up!
  - “The estimated spike in deaths from 2014-2016 marks the most dramatic two-year escalation in 53 years.”

- Arizona saw a 24% increase from 2014-2016!
Why do we need HFST?

- We lose 100 people every single day in car crashes. Most of them are preventable.
Why do we need HFST?

The #1 killer of teens is sitting right in your driveway”-National Safety Council
Arizona - Roadway Departure Crashes

- >53% of all Arizona fatalities
- >71% of all rural road fatalities (AZDOT SHSP 2014)
High Friction Surfaces (EDC 2 Initiative for 2012)

Critical locations make up a small percentage of U.S. highways. In 2008 for example, horizontal curves made up only 5 percent of our Nation’s highway miles. Yet, more than 25 percent of fatal crashes occurred on horizontal curves. High friction surface (HFS) treatment is an emerging technology that dramatically and immediately reduces crashes and the related injuries and fatalities. With friction values far exceeding conventional pavement friction, high-quality aggregate is applied to existing or potential high-crash areas to help motorists maintain better control in dry and wet driving conditions.
Why do we need HFST?

- Targeted Solution to Roadway Departure Crash Reduction—curve location only
- Friction Crashes
- Distracted Driving?- HFST does not need to communicate with the driver to work
- Speeding?- HFST does not enhance driver comfort or promote higher speeds
- It’s a Proven, Effective Solution.
Summit's Deadliest Curve Gets Special Treatment
Laurel Curve will get guardrail, pavement treatment and more warning signs.
“Laurel Curve accounted for one in three crashes on Highway 17 between 2004 and 2010.”
HFST Crash Reduction
California Highway 17 at Laurel Curve

Collisions at Santa Cruz Route 17, Post Miles 9.4 to 9.6 in the Southbound direction, from 1/1/09 to 12/31/2014

~ Installed HFST July 2012.
~ 2012 - 2014 collision data from CHP.
~ AADT for Route 17 is 60,000.

183 Crashes
3 Crashes
How? HFST Installation-ACC

- The polymer resin binder is mixed and applied by an automated HFST application truck at the specified coverage rate- 55-65 mil thickness
- The same truck simultaneously applies the calcined bauxite aggregate to refusal– approx. 18lbs/sy
- The surface treatment is applied as a continuous operation over a fixed width– usually 12’ lane
HFST Installation

- Only short term traffic control is required
- HFST typically cures in 1-2 hours, varies with surface temperature, but cure rate may be adjusted with some resins
- After cure, surface is swept with a mechanical broom street sweeper to remove excess aggregate
- Friction testing is typically performed prior to return to traffic
HFST Installation Keys

- May be installed over new or old pavements, AC or Concrete.
- Pavement must be a minimum of 30 days old prior to installation.
- Shotblasting of concrete surfaces is recommended.
- All surfaces are swept and blown off with compressed air prior to application.
- Pavement must be dry, surface temperature 40-105 deg F.
- Existing Striping/markings/markers usually removed and replaced.
- May be placed in traveled lanes only or to edge of pavement.
- Bridge joints protected, Drains or manholes in roadway covered.
HFST Installation Tips

- Damaged or deteriorated pavement should be repaired prior to HFST application
- Existing cracks larger than ¼” should be prefilled with resin
- Bauxite should be placed as quickly as possible—especially on significant cross slopes
HFST Installation- Practices to Avoid

- Contact with the resin after placement should be avoided since it will disturb the resin thickness.
- Moving or disturbing the resin beyond its working time will dramatically reduce the final strength.
- Walking or Driving on the aggregate surface prior to resin cure should be avoided—no compaction needed!
- High Velocity aggregate distribution can affect the resin surface thickness and can “roll” the aggregate in the resin. Also a safety concern with adjacent traffic lanes.
HFST Friction Testing

• The friction coefficient of the completed HFST can be tested after cure and prior to opening to traffic by ASTM E1911—the Dynamic Friction Tester
• Typically tested once per location or per shift
• Results immediately available
Frequently asked Questions: “Why Calcined Bauxite?”

• Short Answer: It works—long term!
• Long Technical Answer: Calcined Bauxite is used due to its ability to outperform other natural aggregates in resistance to polishing
• This means that the high initial friction readings are maintained at high levels even with significant traffic wear
Early NCAT Testing of HFST Aggregates

HFS - lab DFT Summary

DFT Fn (40 km/hr)

granite  bauxite  flint  basalt  silica  slag  emery  taconite

70K  140K

Dynamic Friction Tester
ASTM E-1911
The National Center for Asphalt Technologies, Auburn University, AL (NCAT)

* Old bauxite and epoxy installed 2003
Frequently asked Questions:

“How long will it last?”

• Short Answer: Probably as long as your pavement.
• Long Technical Answer: HFST will last and remain an effective safety countermeasure if:
  – Done correctly—high quality resin, bauxite, installation
  – Installed over pavement in good condition
• Several US installations are 8+ years old
• FHWA FAQ says 7-12 years (based on Non-US data), ~15 on bridges, CA has several that are ~5 years old
When: "Do I have to wait 30 days?"

- **Short Answer:** Yes!
- **Long Technical Answer:** The 30 day cure period prior to HFST is important.
  - Concrete- allows full hydration/strength
  - AC- allows release of volatile compounds, full compaction of roadway, wearing of surface oils
Frequently asked Questions:

“Can I mill it out later?”

• Short Answer: Yes!

• Long Technical Answer: You can mill it like all asphalt roadways with a rotary mill with bullet style teeth. Not with a diamond grinder

• You can recycle and reuse the material as RAP or shouldering if desired - it is inert and very hard aggregate
Frequently asked Questions:

“Does resin thickness matter?”

• Short Answer: Yes! It is very important.
• Long Technical Answer: The resin thickness and aggregate sizing means that an optimum thickness of resin bonds the aggregate solidly without flushing.
• Too Thin- premature wear or less durability
• Too Thick- loss of texture, lower friction
HFST Resin and Bauxite Aggregate

Bauxite Aggregate: #6-#16 sieve, 1.18-3.36mm

Resin Thickness Optimum: 55-65 mil

• Optimum Thickness: Bauxite is embedded approx. 50% in resin, very little exposed resin, good texture

• Too Much Resin: Not enough surface relief for friction in wet conditions, exposed resin surface

• Not Enough Resin: Bauxite is barely bonded, easily dislodged under wear, leads to premature wear, shorter life, loss of friction
Frequently asked Questions:

“Does application method matter?”

• Short Answer: Yes!
• Long Technical Answer: The fully automated systems in use by multiple contractors provide consistent optimum resin thickness, higher production rates, digital reporting and much lower chance of poor mixing of chemicals.
• Fully automated systems also provide even and quick distribution of aggregate into the resin surface for maximum retention and skid value.
California HFST

- Caltrans, Counties, Cities
- Curves, Tangents, Intersections, Bridges, Tunnels
- Multi-Lane Highways, Ramps Rural Roads
- Segments from 200’ to 2+ miles
Questions?

High Friction Surface Treatment saves lives!