



High Friction Surface Treatment (HFST)

Best Practices for Effective Safety Treatment

NESMEA

Introduction/Background:

- American Civil Constructors West Coast
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- ACC West Coast– based in Benicia, CA
 - East Coast Offices in Long Island NY, Scranton PA and Greensboro, NC
 - The West Coast division has performed specialty bridge repair and infrastructure work for over 25 years.
 - ACCWC has been installing HFST for over 7 years
 - ACCWC has installed over 800,000 SY of HFST to date in multiple states including NJ, CA, AK, WA, IL, TX



West Coast

Agenda

- What is High Friction Surface Treatment?
- Why do we need it?
- How?-HFST Best 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.

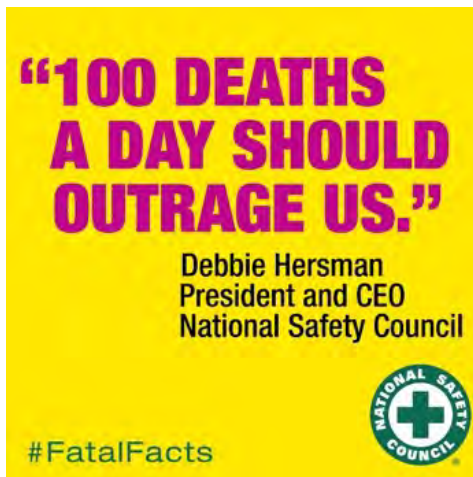
Why do we need HFST?

**An estimated
40,000 deaths
and rising**



- 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.”
 - Slight reduction in 2017, but still higher than 10 years ago
- Several Northeastern States had a 15-19% increase from 2013-2017

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*





FHWA Announces Next Wave of Highway Innovations Under its
Every Day Counts Initiative

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 Engineering Solution to Roadway Departure Crash Reduction– spot 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.

Caltrans HFST Case Study: Highway 17 at Laurel Curve

Summit's Deadliest Curve Gets Special Treatment

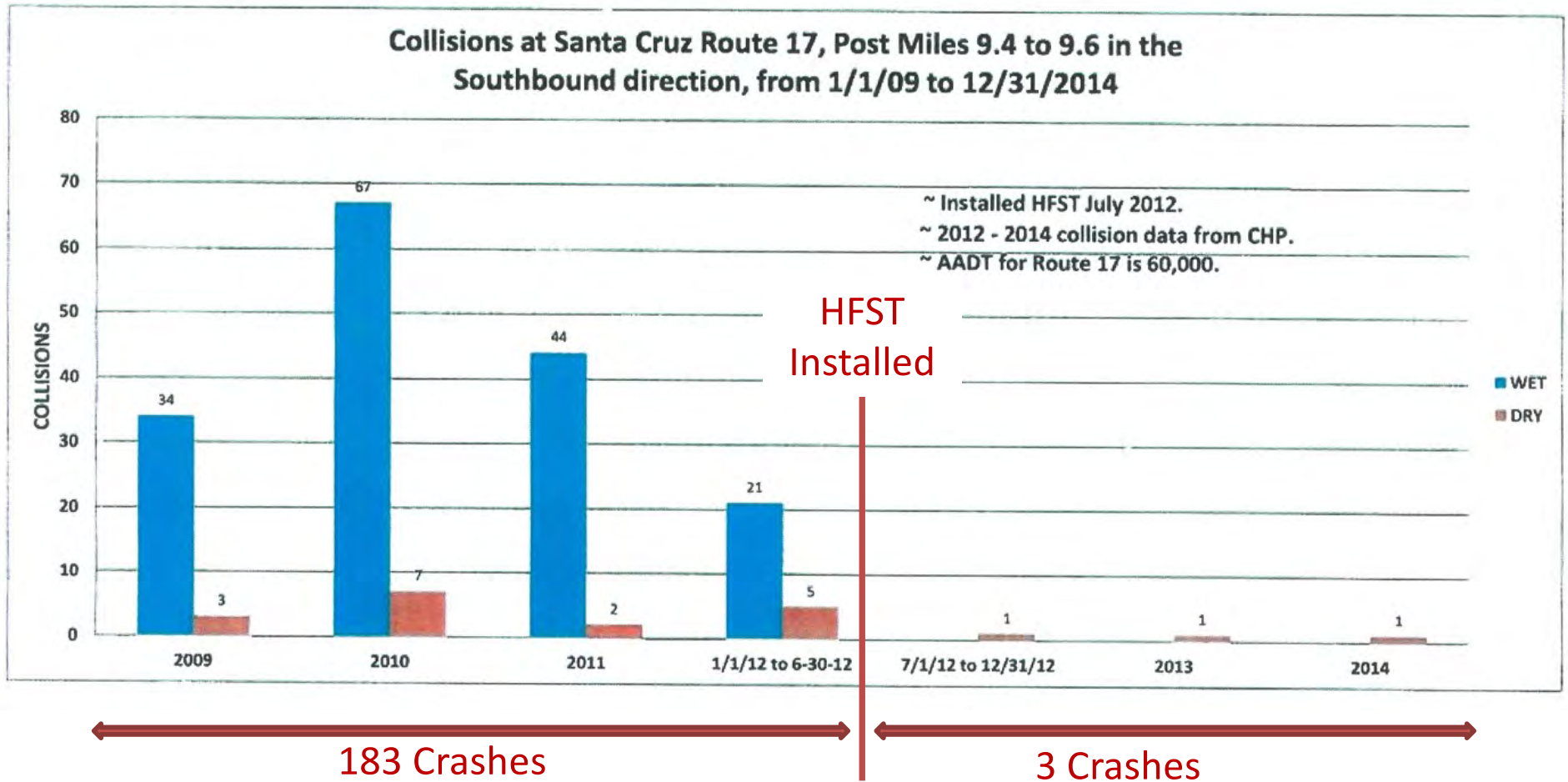
Laurel Curve will get guardrail, pavement treatment and more warning signs.

“Laurel Curve accounted for one in three crashes on Highway 17 between 2004 and 2010.”

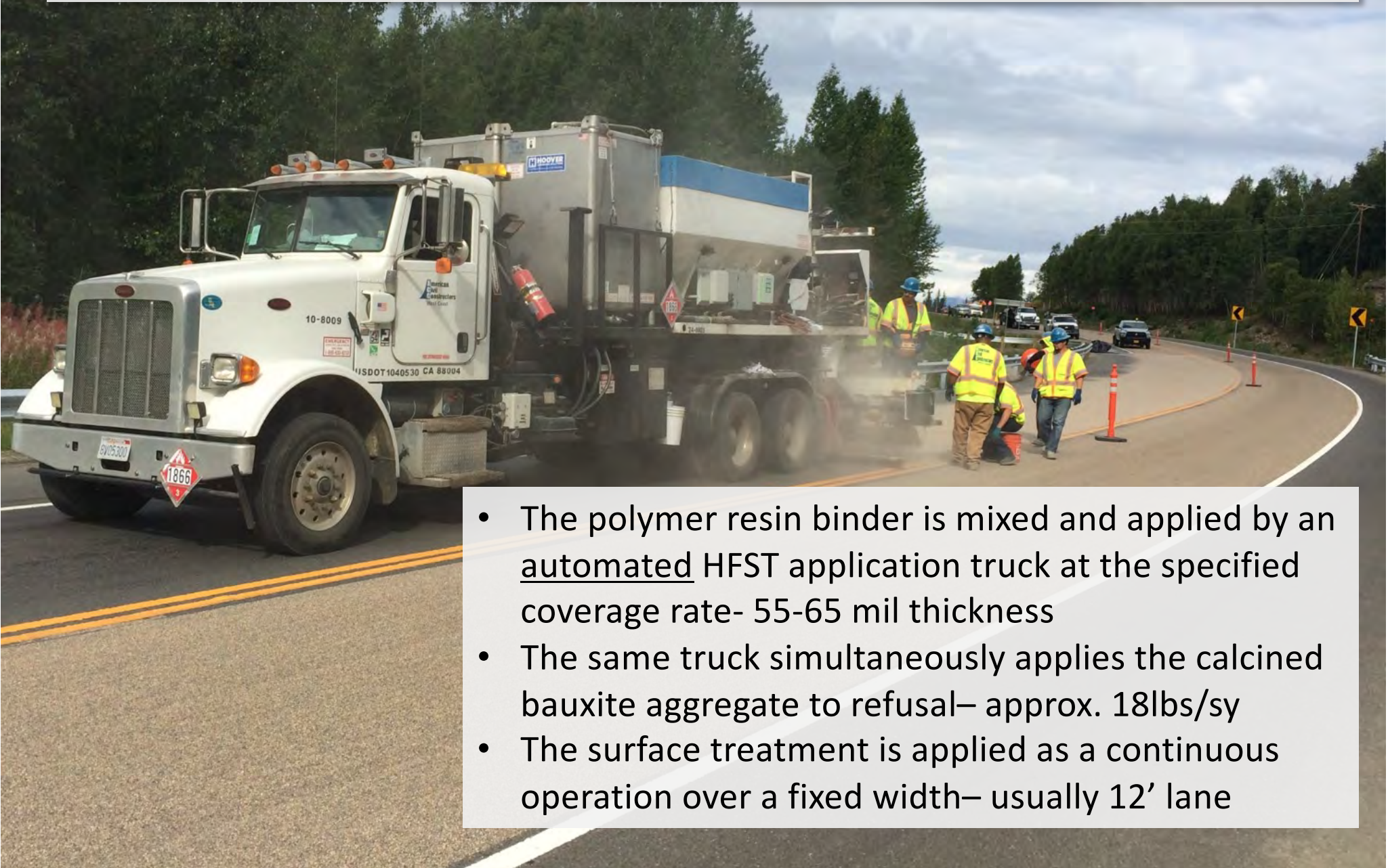
(From NBC Bay Area.com March 20, 2012)



HFST Crash Reduction California Highway 17 at Laurel Curve



How? HFST Installation-Best Practices



- 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
- New pavement is preferred substrate where possible
- Existing cracks larger than $\frac{1}{4}$ " should be prefilled with resin
- Bauxite should be placed as quickly as possible—especially on significant cross slopes

A close-up photograph of a Hot Fluid Stone Treatment (HFST) pavement surface, showing a dense, granular texture of dark and light-colored aggregate. A yellow painted line is visible on the right side of the image.

HFST Specification Best Practices

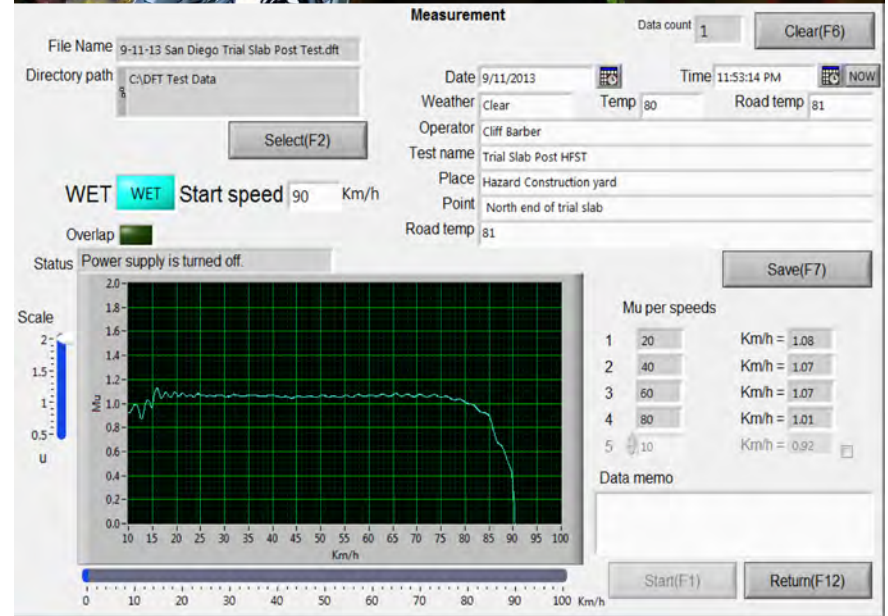
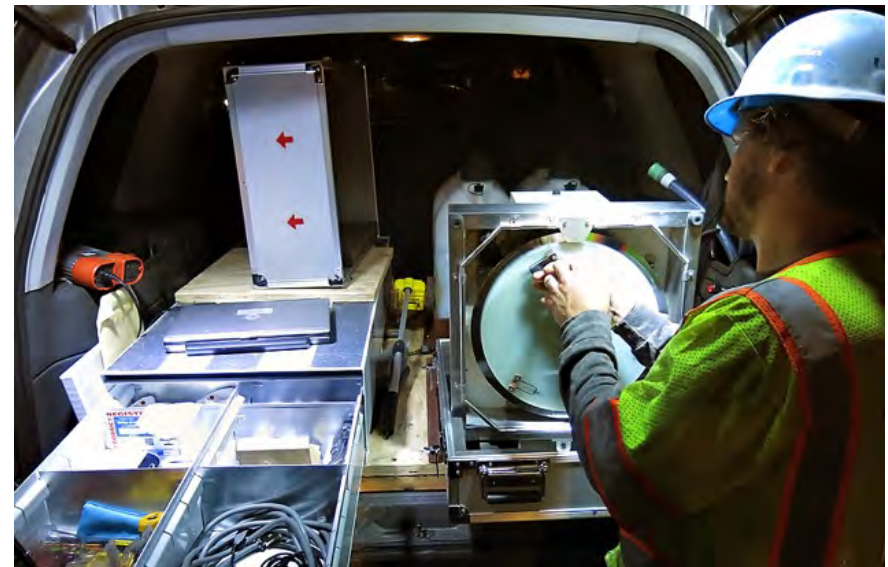
- Require highest quality materials
 - Calcined Bauxite >87% Aluminum Oxide
 - Polymeric Resin designed for HFST
- Require Quality Control Plan
 - Pre-testing and certification of material
 - Installation Plan (including contingencies)
- Daily Quality Control Reporting
- Trial Placement prior to installation
- Include experience requirements in spec– 5 projects
- Maintain compliance with the spec!

HFST Installation- Practices to Avoid

- Installing too thick leads to resin surface that is not compatible with substrate in modulus of elasticity
- 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

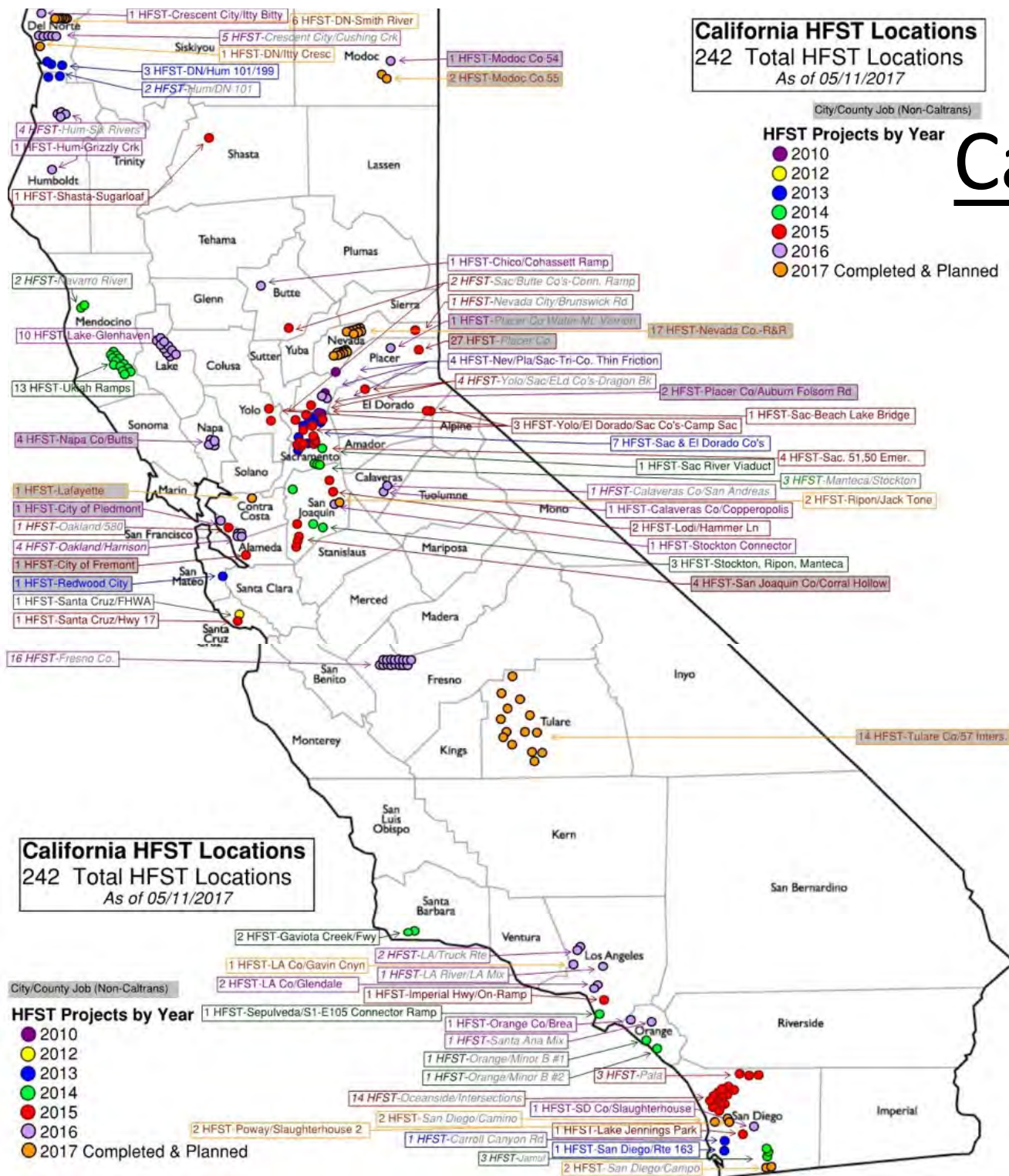
- The friction coefficient of the completed HFST can be tested after cure and prior to opening to traffic by ASTM E1911- the Dynamic Friction Tester or by Locked Wheel Skid Trailer later
- Typically tested once per location or per shift
- Results immediately available





Where to Install HFST?

- Horizontal Curves
- Intersections
- On and Off Ramps— especially with elevation change (loop ramps)
- Steep Grades
- Line of Sight problem locations
- High Speed connectors/Merge locations
- Where there are high crash clusters, roadway departures or poor roadway friction conditions
- TCMS Tool- Texas Curve Margin of Safety



California HFST Locations
 242 Total HFST Locations
 As of 05/11/2017

City/County Job (Non-Caltrans)

HFST Projects by Year

- 2010
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017 Completed & Planned

California HFST

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

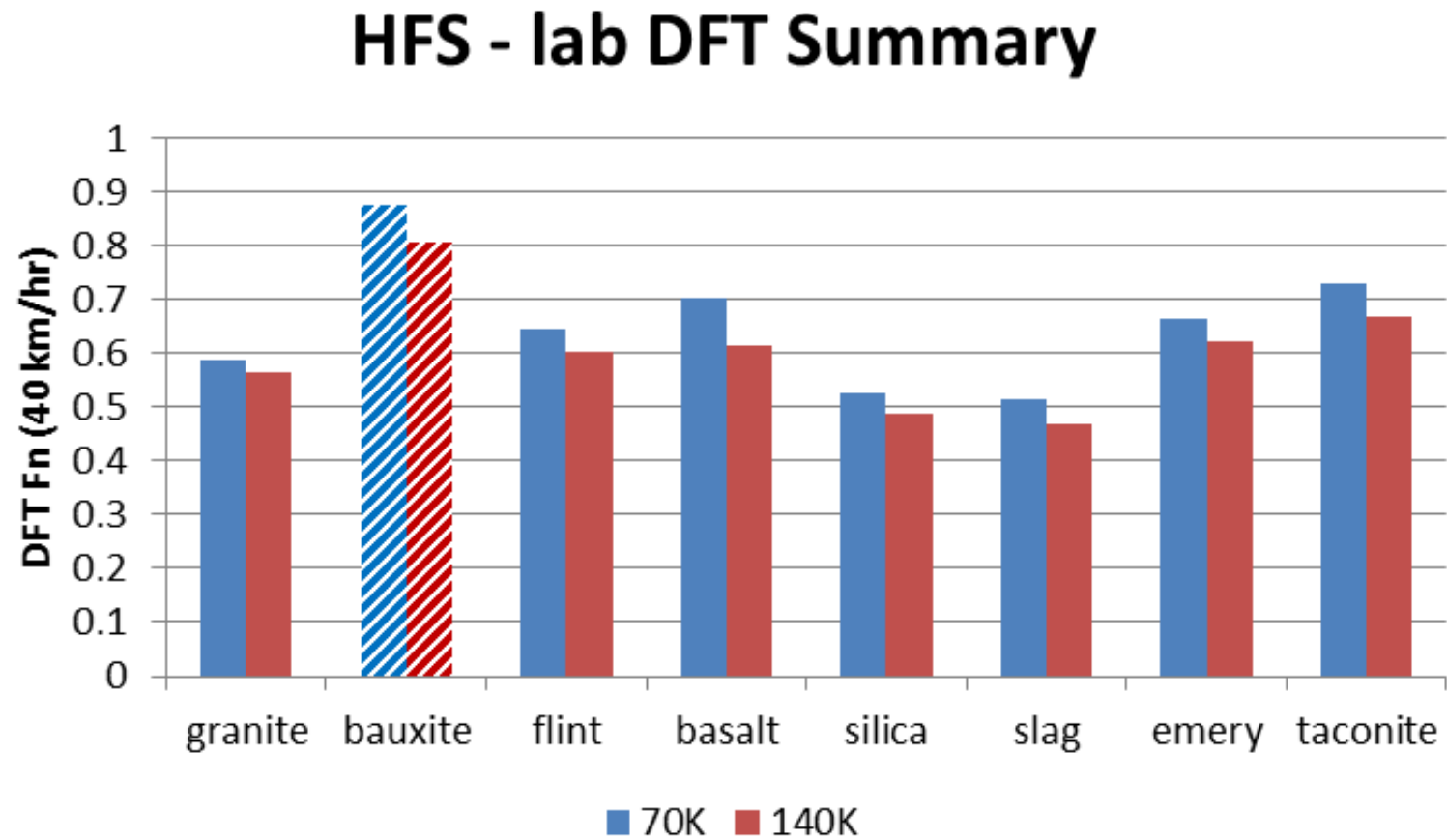


Frequently asked Questions:

“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

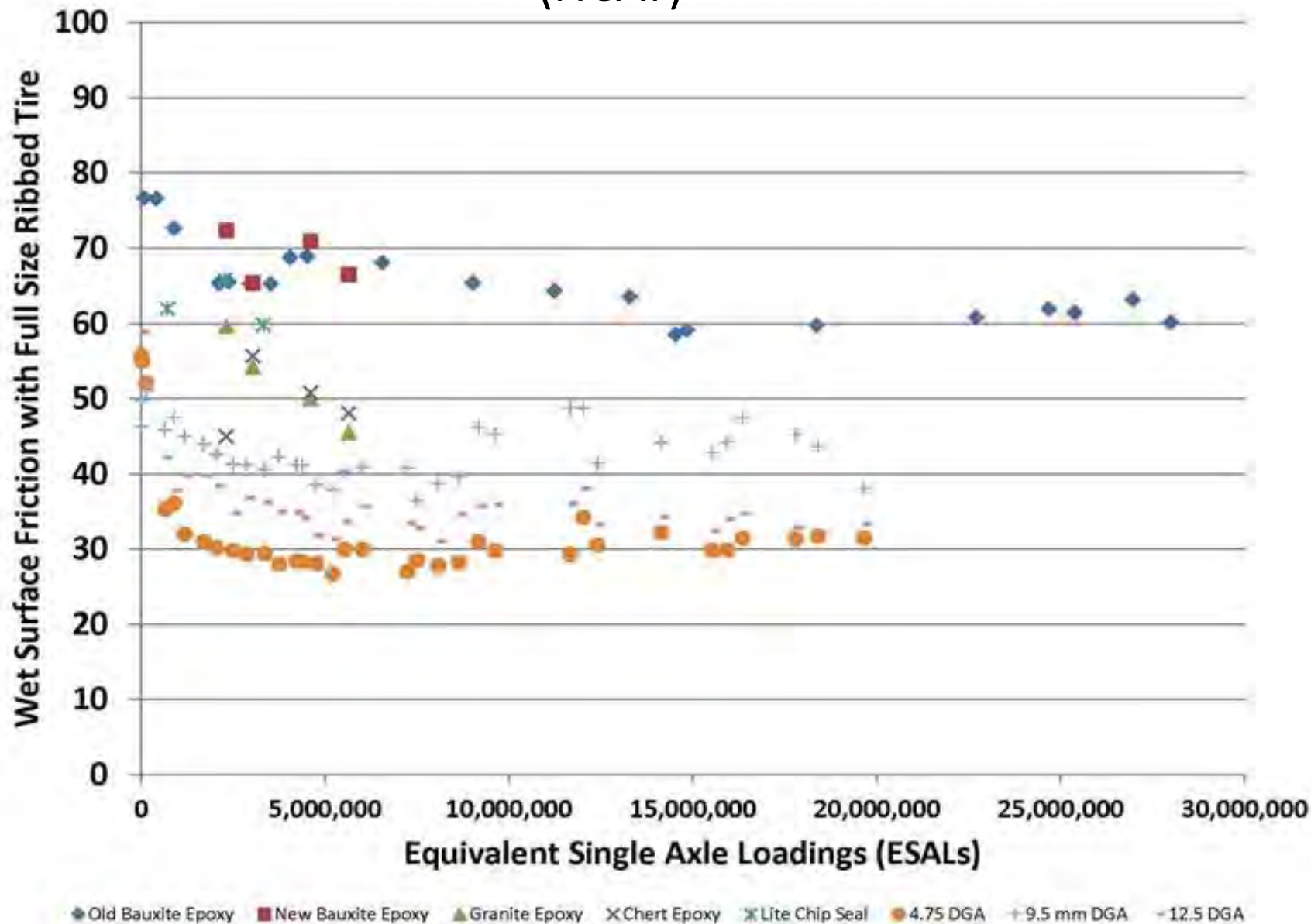
Early NCAT Testing of HFST Aggregates



Dynamic Friction Tester
ASTM E-1911



The National Center for Asphalt Technologies, Auburn University. AL (NCAT)



* Old bauxite and epoxy installed 2003

A photograph showing a construction site on a two-lane road. Several workers in high-visibility vests and hard hats are gathered around a piece of machinery, possibly a paver or spreader, on the left side of the road. The road surface is dark asphalt with yellow double lines. The background features a dense forest of evergreen trees under a cloudy sky.

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 (PA)
- FHWA FAQ says 7-12 years (based on Non-US data), ~15 on bridges, CA has several that are ~6 years old

A photograph showing a construction site on a road. Several workers in high-visibility vests and hard hats are gathered around a piece of machinery, possibly a paver or spreader, on the left side of the road. The road is paved and has a double yellow line. The background shows a forest of tall trees under a cloudy sky.

Frequently asked Questions-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:

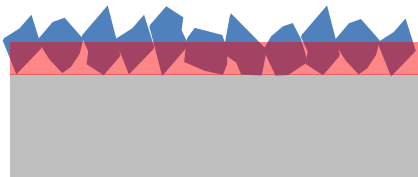
“Does resin thickness matter?”

- Short Answer: Yes! It is very important.
- Long Technical Answer: The resin thickness and aggregate sizing means that 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

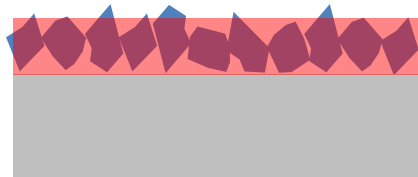
HFST Resin and Bauxite Aggregate

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

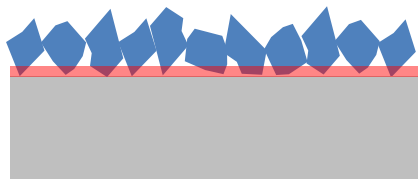
Resin Thickness Optimum: 55-65 mil



- 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, increased tension on roadway section.



- 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.

Summary: HFST Best Practices for Effective Safety Treatment

- TARGETED Solution— apply to curves, inters., problem areas where needed
- Choose SOUND pavements or repair prior to HFST
- Specify for QUALITY- QCP, Trial, Experience
- Use only the BEST materials- calcined bauxite, high strength polymers designed specifically for HFST
- PREPARE the roadway well
- Use the BEST INSTALLATION techniques- automated HFST installation trucks



Questions?

**High Friction Surface Treatment
Saves Lives!**

