



**HIGH FRICTION SURFACE
TREATMENTS**



A ROAD SURFACE TREATMENT

**for Critical Safety Spot Locations that
Helps Vehicles Stay in Their Lane**



U.S. Department of Transportation
Federal Highway Administration



Do you have a high-crash location where you believe wet pavement combined with excessive speeds lead to loss of control?

You can reduce crashes if you install a high friction surface treatment (HFST).

If the friction demand on your roadways exceeds that which is available, such as on sharp horizontal curves, steep exit ramps or approaches to crosswalks, then you should consider spot application of HFST.

What are High Friction Surface Treatments?

Maintaining the appropriate amount of pavement friction is critical for safe driving. Challenging conditions require a higher friction demand from the road surface than is necessary on a flat, straight section of highway. Additionally, in particular locations where vehicles often brake excessively, the standard road surface may become prematurely polished, thereby reducing the available pavement friction.

HFSTs are pavement surfacing systems with exceptional skid-resistant properties not typically provided by conventional materials. The spot application of a thin layer of durable, high friction aggregates as a topping on specially engineered resin or a polymer binder affords long-lasting traction, while making the overlay much more resistant to wear and polishing.

The high-performance properties of the binder lock the aggregates firmly in place, creating an exceptionally durable surface capable of withstanding extreme roadway friction demands, such as heavy braking, severe horizontal curves and steep grades, particularly when the grade is in a horizontal curve. In this way, spot application of HFST more than restores pavement friction in specific locations where high traffic volumes have polished existing pavement surface aggregates. HFST can also mitigate vehicle speeds that exceed existing geometric designs for sharp curves and superelevations.



FIGURE 1: Open-grade surface course on the left and HFST on the right.





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How Do They Work?

Annually, over 25 percent of all highway fatalities in the United States occur at or near horizontal curves. Vehicle stopping and turning are critical safety functions, which begin with the tires contacting the pavement. All highway safety starts with the driver's ability to control the vehicle and keep it in the appropriate lane.



FIGURE 2: HFST at horizontal curve

Traversing a curve presents many challenges for those at all levels of driver experience. The combination of: 1) the complex driving task of negotiating the curve, 2) the pavement surface wear created by turning tires and 3) the higher friction demand of moving a vehicle through a curve compared to the rest of the road, results in increased potential for crashes.

Pavement improvements for surface characteristics, particularly for friction, at certain spot locations are an effective means to increase traffic safety and reduce crashes.

HFSTs can provide a long-lasting, higher level of pavement friction than traditional surfaces to meet the demand of the specific road. The treatment applies very high-quality aggregates that provide and maintain a higher level of pavement friction than conventional materials where the need exists, resulting in keeping vehicles in their lane around curves and allowing vehicles to stop in shorter distances at intersections. In addition to curves, other roadway characteristics create variable roadway friction demand.

QUICK FACTS

- ▶ The HFST can help decrease highway fatalities and serious injuries on our nation's highways.
- ▶ The HFST can be applied by machine at a similar speed to other paving surface treatments or can be applied with hand tools.
- ▶ The HFST can be installed on both asphalt and Portland Cement concrete surfaces. However, the pavement must be in good structural condition – with no or few cracks or correctable by remedial sealing.
- ▶ The HFST provides a durable and long-lasting solution to spot pavement locations where insufficient friction is a contributing factor in crashes. It is not just a pavement surface, it is a safety countermeasure.
- ▶ The European experience and the oldest United States' projects indicate that HFST service life is approximately 10 years.
- ▶ The benefit-cost ratio is good since the crash reductions continue for many years and the cost of rebuilding the curve can be prohibitive.
- ▶ Studies and road owner experience show that HFST can be used where most needed, such as ramps and freeways, two-lane urban or rural roads at horizontal curves, areas near steep grades, areas at or near lane changes, rural and urban intersections, approaches to pedestrian crosswalks or rail crossings.
- ▶ Typically, project lengths are very short and the materials set up very quickly so the treatments can often be applied in hours, requiring minimal impact on traffic.
- ▶ The HFST is safer for motorists, truckdrivers and bicyclists.

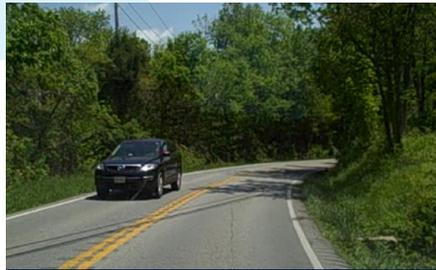


FIGURE 3: HFST installations – by hand and by machine

CASE STUDY: Kentucky Transportation Cabinet

The Kentucky Transportation Cabinet installed HFSTs at selected locations with a history of wet roadway departure crashes.

HFSTs were one of the eight countermeasures identified when the Kentucky Transportation Cabinet implemented a statewide Roadway Departure Safety Plan to address problem curve sites. They identified a list of the 30 worst curves: 15 for wet crash and 15 for total crash. Additionally, 10 of the worst ramps were also selected. One such location is Oldham County, KY 22. Through a 4-year before-and-after (August 2007 to August 2011) study period, lane-departure crashes were reduced from 47 crashes in the 2 years before to only 5 crashes in the 2 years after.



Oldham County, Kentucky, KY 22

Benefits

- ▶ The United Kingdom experienced a 31-percent reduction in crashes for over 800 intersections and other potential problem locations following spot application of HFST.
- ▶ A report commissioned by Transit New Zealand showed a benefit-cost ratio of 40 and a follow-up study on the before-and-after crash data showed a significant reduction of wet crashes by 30 percent following spot application of HFST.
- ▶ Surface Enhancements At Horizontal Curves (SEAHC) National Demonstration Program:
 - To date, there have been 23 installations in 10 States using six different HFST vendors on five pavement types.
 - Crash data provided to date indicates significant benefit for crash reduction. For example, preliminary review of crash data from before and after the demonstration installation in Wisconsin shows an overall 95-percent crash reduction in the first year.

- Participating State departments of transportation (DOTs) have enthusiastically embraced HFST as a cost-effective method for enhancing safety at horizontal curves.

Why High Friction Surface Treatments Now?

Systemically addressing crash-prone locations based on available data shows curves and intersections in the greatest need of safety improvements. Recent advances in pavement friction knowledge, polymer formulation, and durable aggregate production have resulted in greater awareness and appropriate application of HFST.

Several geometric factors can be considered with crash data to identify the specific curves where this treatment is appropriate. Although the product installation cost is not low, the durability and effectiveness make HFST an economical choice since it is only applied where needed and the life-cycle cost is excellent. The projects have produced very good benefit-cost ratios because the crash reductions continue for many years.

The product can be applied mechanically at speeds similar to other paving surface treatments, or with hand tools by local work forces. Typically, projects are short in length and the materials cure very quickly. The treatments can often be applied in just hours with minimal impact on traffic.

This safety treatment has been tried and proven at a wide variety of sites across the country as part of the Federal Highway Administration's (FHWA's) SEAHC demonstration program. State-of-the-art friction measurement equipment has been used to verify the improved friction available after installation.

The FHWA is currently partnering with the American Traffic Safety Service Association, Inc. (ATSSA) and the American Association of State Highway and Transportation Officials (AASHTO) to develop material and performance specifications to help State and local DOTs to implement HFST. Other technical assistance will also be available by FHWA through the Every Day Counts (EDC) 2 initiative.



FIGURE 4: Hand installation at night in NC



FIGURE 5: Close-up of typical aggregate used as surface topping showing angularity and size.

About Every Day Counts

Every Day Counts (EDC), a state-based initiative of FHWA's Center for Accelerating Innovation, is working with State, local and private sector partners to encourage the adoption of proven technologies and innovations aimed at shortening and enhancing project delivery. To learn more about the EDC Initiative, please visit <http://www.fhwa.dot.gov/everydaycounts/index.cfm>.



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