High Friction Surface Treatment Site Selection using Curve Safety Assessment Devices - Georgia Department of Transportation

What was the safety issue, problem, or gap?

FHWA delivered a Roadway Departure (RwD) Safety Plan for GDOT in 2013 to help reduce RwD crashes in Georgia. Even though Georgia is no longer a RwD focus state under the FHWA 2015 focus state definition, RwD crashes remain a major emphasis area for Georgia. To address this crash type, the Georgia Department of Transportation (GDOT) investigated and implemented several solutions to crashes in horizontal curves. One solution that GDOT is using to improve safety is the installation of high friction surface treatment (HFST) at curves where roadway departure crashes have the greatest likelihood of occurring. GDOT initially identified these curves using a traditional ball bank indicator. This approach is both time and resource intensive requiring two to three workers (driving, reading, and writing), therefore a new approach was tested: a market-ready curve safety assessment device that utilizes an electronic ball bank indicator traditionally used for setting safe speeds in curves. This market-ready device also has a website/database where all the raw data could be stored and access at any time.

High friction surface treatments (HFST) are pavement treatments that dramatically and immediately reduce crashes, injuries, and fatalities associated with friction demand issues, such as:

- A reduction in pavement friction during wet conditions, and/or
- A high friction demand due to vehicle speed and/or roadway geometrics.

A research report published by FHWA showed HFST will reduce wet crashes by 83 percent and total crashes by 57 percent. (**Ref. FHWA-HRT-20-061**).

What were the key challenges that needed to be addressed before the new practice could be implemented?

Data collection logistics using the device presented the biggest challenge to GDOT before the new practice could be implemented. GDOT headquarters requested that the District offices collect data using the device. Some Districts were resistant due to lack of man power and the appearance that this new effort was a duplication of effort since some districts had already collected curve data using ball bank indicators.

The website/raw database presented its own set of challenges. While it is easier to collect and store the curve data, it can be time-consuming to extract the data for one or several corridors. To assist in the processing of the raw curve data, the Georgia Institute of Technology (Georgia Tech) is currently tasked with refining a curve analysis tool and developing a curve database. This database will assist the GDOT Safety Program is delivering safety projects in the most cost-effective manner.

Describe the new practice:

GDOT rents devices for each of its Districts to collect data on all curves on the road network. Once the data is collected, GDOT manually locates each curve on the road network since data from the devices are imported as individual data points and may not be geospatially located correctly. GDOT will use the tool and database developed from the Georgia Tech research project to determine potential safety projects. Crash and historical probe speed data will be used with the curve data to determine which projects are to be implemented first by using a benefit/cost ratio ranking. For potential HFST projects, GDOT will compare the ball bank indicator readings from the device against the threshold used in GDOT's ball bank indicator systemic process. The threshold is set as any curve that has a ball bank indicator reading of 12 degrees or larger qualifies for HFST.[1] Once curves are identified, GDOT Office of Traffic Operations and GDOT District Office identify the limits for the HFST.

[1] A 12 degrees of ball-bank should be design for posted speeds of 35 MPH to 45 MPH according to MUTCD. Hence this implies the device identified locations with posted speeds of 35 MPH or less for consideration to apply HFST.

Key accomplishments, including roadway safety improvements:

Using the device provides a safe and efficient method to gather curve data and identify locations that may benefit from HFST. Although there are still some inefficiencies, GDOT has taken a proactive, preventative approach to improving the safety of roadway curves by investing in HFST systemically to reduce the number of roadway departure crashes. (See Figure 1)

Figure 1: HFST Pavement Treatment
Photo Source: Georgia Institute of Technology, March 2020.

In addition, GDOT is currently working with Georgia Tech to enhance its current curve information extraction operation from the device's data web portal which stores the data already collected. GDOT is working with Georgia Tech to automatically and efficiently extract the curve information (including point of curve, point of tangent, radius, deviation, and length) from the already collected data to address crash problems systemically.

What technical and/or institutional changes resulted from the new practice?

Due to the continued inefficiencies in identifying curve locations, GDOT is working with Georgia Tech to develop a mobile-based tool to automate the identification of curve locations as part of the National Cooperative Highway Research Program's (NCHRP) Highway IDEA (Innovations Deserving Exploratory Analysis) program. The project - An Enhanced Network-Level Curve Safety Assessment and Monitoring Using Mobile Devices - includes computing curve geometry (radius, length, location of the point of curvature (PC) and the point of tangency (PT), super elevation, and grade) using ball bank indicators as a low-cost alternative to expensive devices. The mobile device with this application will be installed in the vehicle dashboard/windshield and will continuously collect the Global Positioning System, gyroscope and accelerometer data. The collected data will be processed to compute the location of PC, PT and other curve geometry. It is under development and should be available in the near future. GDOT hopes to use the tool for collecting raw data to be used to analyze the road network data to identify where HFST is needed.

In the near future, GDOT is developing a website that will provide a GIS map. This map will provide the location of all the curves on the GDOT system. In addition, countermeasures such as rumble strips and HFST will be a layer in this dataset.

In addition to improving efficiencies with a new tool, GDOT is working to address the costs of maintaining pavement with HFST. GDOT can manage initial construction cost of installing HFST by programming multiple applications under one contract. Recognizing not all locations need HFST treatment using Bauxite aggregate that can be costly, GDOT is currently evaluating using other friction materials such as lightweight aggregate for replacement at locations with lower friction demand and with low risk factors.

What benefits were realized as a result of the practice?

GDOT has utilized HFST on several roadways across the state to reduce head-on crashes, sideswipe-opposite direction, and roadway departure crashes along horizontal curves. Eight roadways with HFST implemented were analyzed to determine the effectiveness of this safety countermeasure. The locations were in District 4 (Grady County), District 5 (Telfair County) and District 6 (Murray, Walker, Catoosa, Whitfield, Dade and Cherokee Counties). While GDOT did not undergo an advanced statistical analysis of their crash reductions, a simple before and after analysis identified an average of 19 percent decrease in property damage only crashes and 49 percent decrease in injury/fatal crashes per year. Once curve data for all districts is collected, a data-driven process will be used to identify new locations for HFST projects.

Who can be contacted for more information about the practice?

Carlos Baker
Safety Engineer 3
Georgia DOT Office of Traffic Operations
cabaker@dot.ga.gov
404-635-2824

Joseph Cheung
Safety Engineer
FHWA Office of Safety
Joseph.cheung@dot.gov
202-366-6994