Montana Department of Transportation
Research Programs
November 2011

EXPERIMENTAL PROJECT

EVALUATION OF AN AUTOMATED FIXED ANTI-ICING DEVICE FOR USE ON BILLINGS DISTRICT BRIDGE DECK

EVALUATION REPORT

Location:	Yellowstone County: West Laurel, Interstate 90-RP 433
Project name:	West Laurel Interchange
Project Number:	IM STPHS 90-8(152)433
Type of Project:	Installation of the Boschung Anti-icing Fixed Automated Spray Technology (FAST) for the reduction of winter related accidents on an area bridge
Principal Investigator:	Craig Abernathy Experimental Program Manager
Date Constructed:	August 2006-February 2007
Evaluation Date:	February 2007-Janaury 2010

Update – November 2011: Discontinuing Project Due to System Failures

Due to continuing problems with the TMS Boards (power supply and central processing unit (CPU) which operates the FAST system, the Billings District has elected not to activate the unit for the 2011-12 winter season; and choose to use conventional means in controlling ice accumulation on the deck. The District is also unsure whether the unit will be activated beyond the 2011-12 timeframe. Due to this development Research will formally discontinue reporting on the project until a decision is made to put the FAST system back into service.

Objective

The Billings District has experienced winter icing related accidents on the eastbound approach and bridge of the West Laurel interchange with enough frequency to determine to test the FAST system in an effort to reduce the severity of these types of accidents. The FAST device is a fully automated system that recognizes the environmental conditions in which ice may form on the pavement surface and distributes an anti-icing fluid (calcium chloride) to embedded spray heads to mitigate the formation of ice.

Technical Attributes

The FAST system uses active and passive sensors, imbedded in the road surface, to predict the surface temperature and activate the spray system. This technology anticipates the surface freezing point, regardless of what type of material is present, with sensors that artificially cool themselves to determine the exact temperature at which the surface will freeze, so anti-icing applications occur just before the roadway freezes.

Combined with a Road Weather Information System (RWIS), The FAST device can spray different volumes of anti-icing agent to meet the surface condition.

The spray units are fully integrated into the road surface, are traffic-proof, and distribute anti-icing agent at the same volume and pressure over the entire treated surface. The caveat with this system is amount of product which is applied at any given spray event. It is estimated that 11.4 liters (approximately three (3) gallons) are discharged when the unit is activated. The action of the traffic helps to distribute the anti-icing product to the pavement, specifically; tires pick up the applied chlorides and spread it to the surface while traversing across the approach and bridge. Forty (40) micro-spray nozzles were place approximately five meters (16.4 ft.) apart for a total length of 197 m (216 yards).

The pumping system is designed to keep the accumulators (located at the road surface) full of anti-icing agents at all times, and monitors and adjusts pressure levels according to the needs of the system.

The eastbound deck received an asphalt cement (AC) overlay prior to the installation of the sensors and spray units, the overlay allowed a medium for the embedded equipment. After the installation a seal and cover (chip seal) was applied. The spray nozzles and sensors were protected by a durable adhesive tape.

Documentation

The main measure of effectiveness (MOE) in the use of the FAST system is to reduce the incident of accidents caused by the formation of ice on the bridge deck and approach. Secondly is to document the durability and maintenance requirements of the FAST system. Since the unit was fully activated in late February 2007, a complete accident analysis will be available by the spring of 2011 (based on a three-year winter-spring evaluation period). The following are representative images taken during installation, ongoing site visits and supplemental information.

August 2006-February 2007

View looking west on eastbound deck: Technicians have delineated where the piping, spray heads, and sensors will be located as seen by the white paint. In this image they have just completed routing out the asphalt cement (AC) pavement to install the hardware. The AC millings are being washed out of the routed channels.

The white arrow shows where the pressure tubing and spray nozzles will be located on the centerline. The red arrow shows the supply product lines. The yellow circle area is where the sensors will be installed.

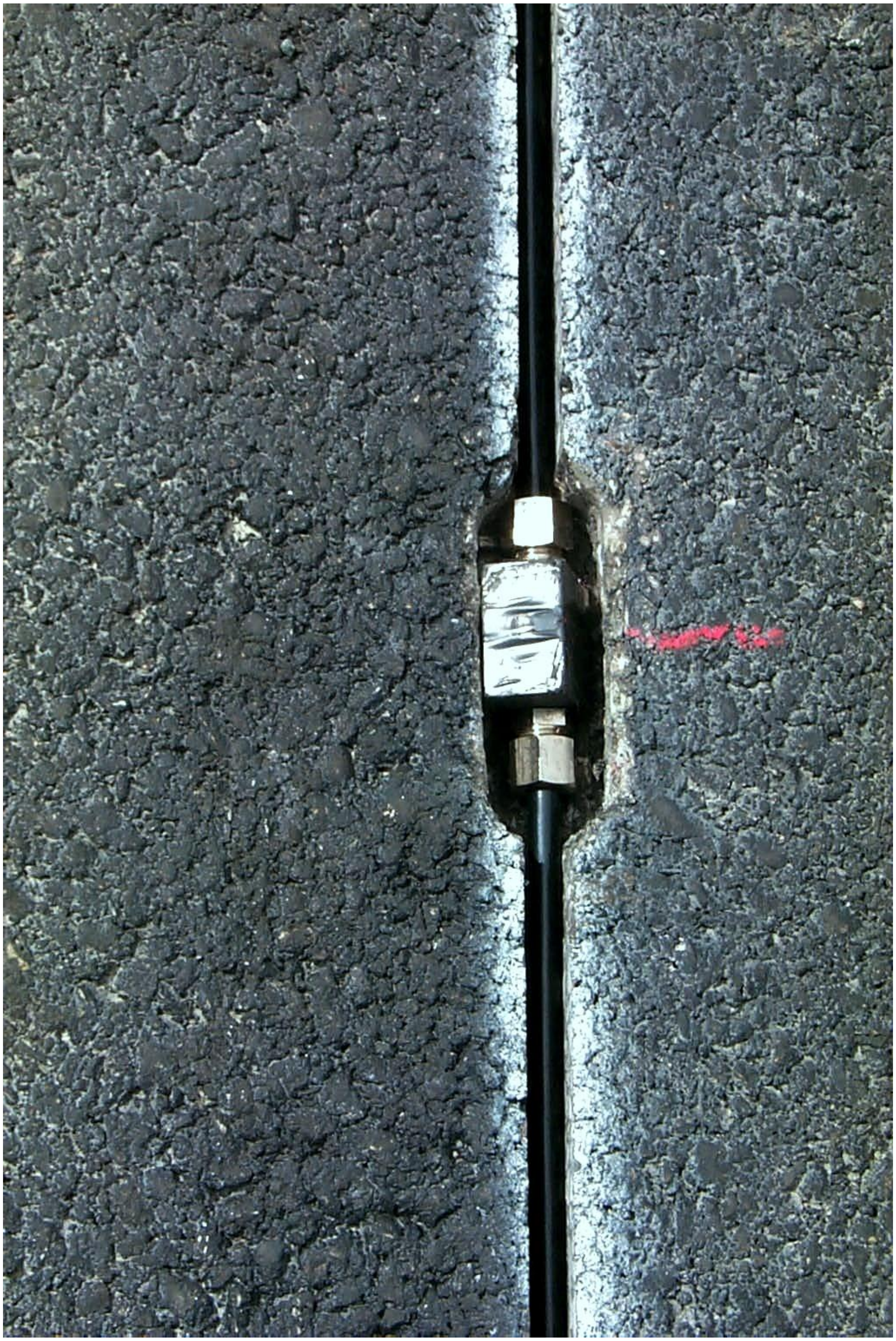
↑ Here is a closer view of the sensor locations prior to installation (yellow arrows).

↑ This is the passive (Boso) sensor which reads the temperature of the road and humidity to determine the short-range freeze point.

🡅 Above is the active sensor (Arctis) which senses a lower and longer freeze point than the passive sensor.

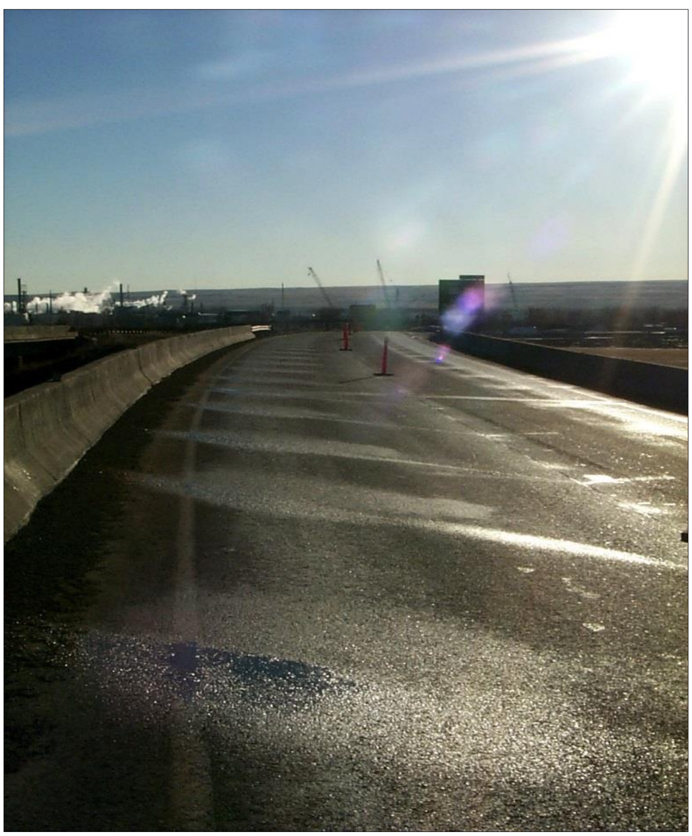
Between the active and passive sensors, along with information provided by the RWIS, the FAST system will determine when to activate the spray event to mitigate the formation of ice.

🡄 Control boxes are installed on the exterior of the bridge rail. The yellow arrow shows the control for the product supply lines, the red arrow for the sensor conduits.



↑ The micro spray nozzle block and tubing are placed within the grooved and milled AC. A backer rod is place over the pressure tube, then an asphaltic sealer and elastic cement will be injected to secure the tube and nozzle head to AC. Tape is applied to the spray head to protect it from cement residue.

🡹 The spray nozzles and piping have been cemented and cured. This also shows an intital test of the system as you can see the wet areas on the pavement (red arrows).



🡸 This image is the east view over the span during the FAST system spray test. As stated earlier, a limited amount of chloride is applied. Where other anti-icing systems depend on larger quantities of product to cover the road surface to mitigate the formation of ice, the FAST system relies on the pick-up action of vehicle tires to assist in transmission of the anti-icing chlorides.

🡅 Location of FAST pump house situated on the north side of the westbound lanes.

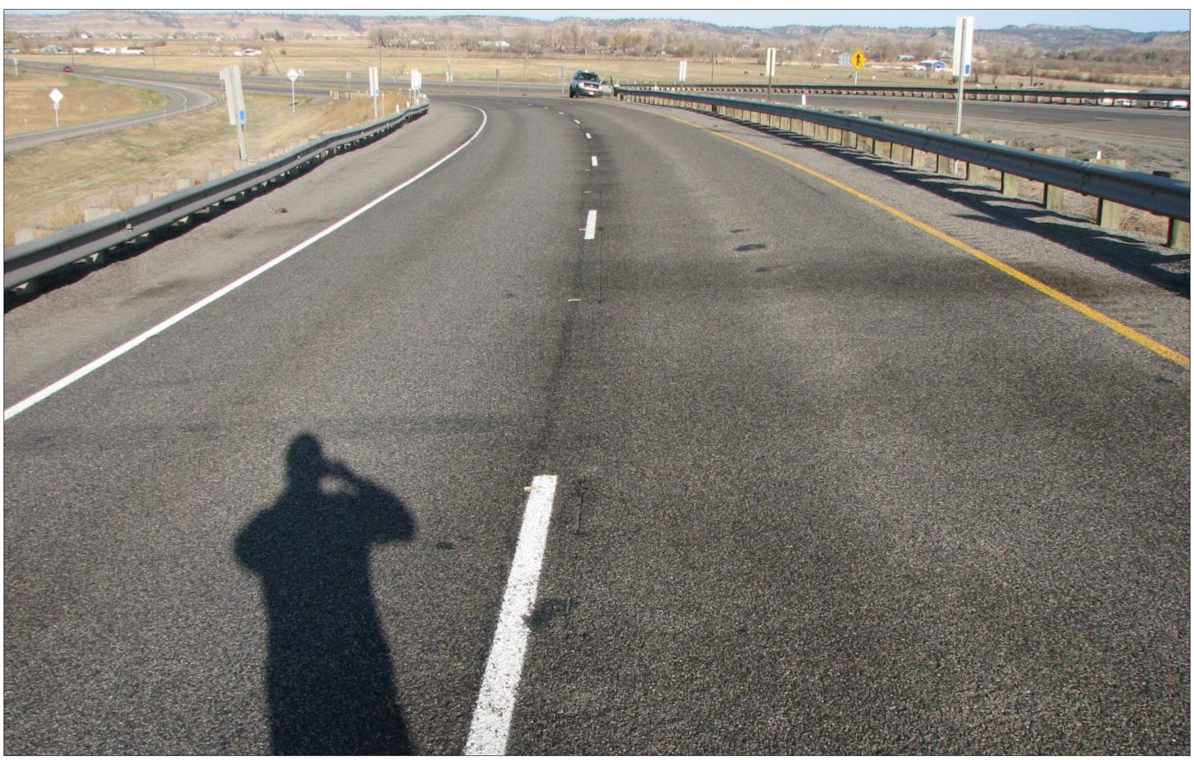
🡅 Interior shot of the FAST pump house.

🡡 View west of eastbound approach showing the delineation of the beginning of the spray nozzle section (red bracket).

🡠 Condition of Micro-spray nozzle after seal & cover (chip seal) application. Yellow arrows denote where anti-icing is dispensed.

August 2008

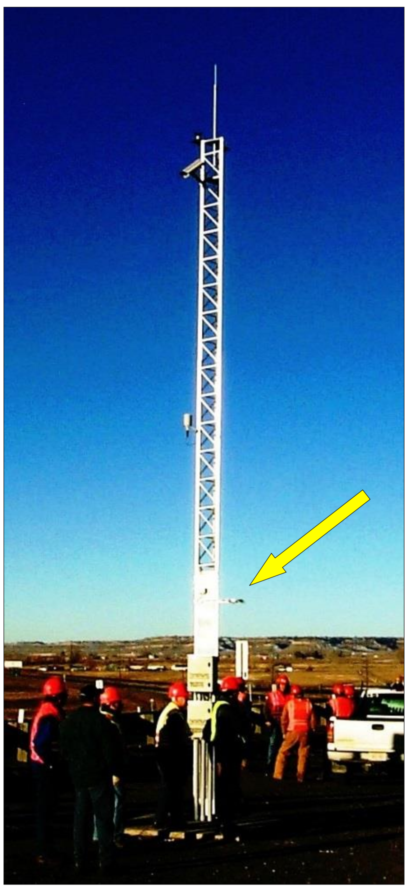
↑ Condition of deck August 2008 – view west.



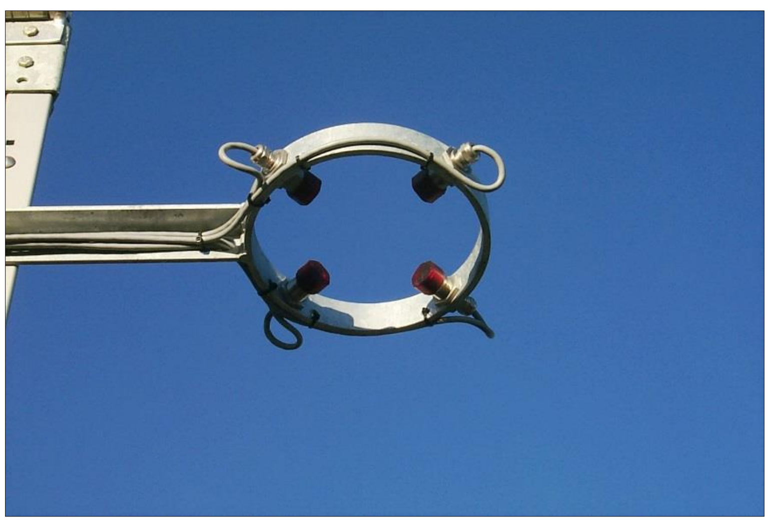
↑ Condition of approach August 2008 – view west.

August 2009

🡅 Condition of deck August 2009 – view east.



🡄 Representative image of the RWIS: Note the yellow arrow shows the original location of the precipitation sensor. It was found at this height that overspray from passing snow plows would coat the sensor with debris and diminish its effectiveness. The sensor was relocated higher up the RWIS and since has not been an issue. The image below is the close-up of that sensor.



Meeting with District Maintenance Staff

In July of 2008 Research met with the MDT Billings personnel responsible for the maintenance and operation of the FAST system at the West Laurel interchange. They stated that there had been no problems with the unit to date and seemed to perform as advertised. The Boschung company provided excellent back-up and technical support when needed. It was speculation by several staff that the application of the seal and cover (chip seal) to the deck may also attribute to a decrease of ice related accidents.

Preliminary Accident Analysis

The MDT Safety management Section issued a preliminary accident analysis in April of 2008. The following is the direct text of that document:

The anti-icing spray system on the eastbound lane of the bridge at the Interstate 90 West Laurel interchange was fully functional in March 2007. The center of the bridge is located at reference point 432.9.

The Montana Highway Patrol records show three crashes for the 9-month period from April 1, 2007 to December 31, 2007. One eastbound vehicle crashed on icy pavement in the curve on the approach to the bridge at reference point 432.7. There was one sideswipe collision involving two eastbound vehicles by reference point 432.6 under dry pavement conditions and one rear end collision between two eastbound vehicles by reference point 433.3, beyond the bridge, under dry pavement conditions.

To fully evaluate the system, three complete winter-spring seasons of data should be available.

The Safety Management Engineer has stated that these preliminary numbers are promising. The upcoming three-year analysis will be more comprehensive.

FAST Operating Update October 2009-Janaury 2010

The FAST system spray program was reported not to be functioning properly at the end of the 2009-2010 winter season. It was unsure the exact time-frame when the unit was non-operational but is reported it may have encompassed most of the winter season. The Billings District contacted the Boschung technical support staff to ascertain the problem. It was found that one of the TMS Boards (power supply and central processing unit (CPU) that contains the program which tells the system when to activate the spray) was defective and has been replaced. It has been reported that further problems did exist with the CPU operations of the FAST system but with assistance from the manufacturer they have been corrected and ready for the 2010-2011 winter season.

Note: The District in 2008 switched from calcium chloride to magnesium chloride as the anti-icing agent.

Conclusion

Based on the preliminary results from the safety analysis and the operational effectiveness of the FAST system this project has been rated as performing well when fully operational. The current issue of problems with the operating systems may generate concern of long-term durability.

This report will be amended once additional information becomes available.