Florida DOT Motorist Warning System

The tropical climate in south Florida typically causes heavy rainfall in the afternoon. A Florida Department of Transportation (DOT) study of the Florida Turnpike/Interstate 595 interchange found that 69 percent of crashes on a two-lane, exit ramp occurred when the pavement was wet and that only 44 percent of these wet-pavement crashes happened when it was raining. The wet-pavement crash rate on this ramp was three times higher than the national average and nearly four times greater than the statewide average. To demonstrate how advanced warning of the safe travel speed under wet pavement conditions can reduce crash risk, the DOT installed an automated motorist warning system on the ramp, which has a sharp curve and an upgrade.

System Components: As shown in the figure, a sensor embedded in the road surface was used to monitor pavement condition (i.e., dry or wet). On a pole adjacent to the ramp, a microwave vehicle detector was installed to record traffic volume and vehicle speed, and a precipitation sensor was mounted to verify rainfall events. A pole-mounted enclosure housed a remote processing unit (RPU), which was hard-wired to flashing beacons atop static speed limit signs. A dedicated telephone line was also connected to the RPU to facilitate data retrieval from an Internet server in the turnpike operations center located in Pompano Beach.

Florida DOT Pavement Sensor

System Operations: The RPU collected, processed, and stored traffic and pavement data from the sensors. When pavement moisture was detected, the RPU activated the flashing beacons to alert motorists that speeds should not exceed the posted limit of 35 mph (56.3 kph).

Transportation Outcome: The warning system improved safety by reducing vehicle speeds and promoting more uniform traffic flow when the ramp was wet. In light rain conditions, the 85th percentile speed decreased by eight percent from 49 to 45 mph (78.8 to 72.4 kph). During heavy rain, there was a 20 percent decline in 85th percentile speed from 49 to 39 mph (78.8 to 62.7 kph). Speed variance was reduced from 6.7 to 5.7 mph (10.8 to 9.2 kph) in light rain and from 6.1 to 5.6 mph (9.8 to 9.0 kph) in heavy rain. Thus, speed variance decreased by eight to 15 percent, minimizing crash risk. Four crashes occurred during the first week of warning system activation. Three happened when the pavement was wet and one occurred during rainfall. After this initial week, there were no reported crashes the during nine-week evaluation period.

Implementation Issues: The DOT evaluated the geometry, road surface conditions, and crash history of the ramp, which had the highest travel speeds and the highest crash rate of all the ramps in the interchange. It was concluded that wet pavement and excessive travel speeds were the primary factors contributing to run-off-the-road crashes that occurred at the beginning of the sharp ramp curve. These conditions warranted the development and demonstration of a motorist warning system. The demonstration project was a joint effort of the Florida DOT, the University of South Florida, and a private vendor.

The DOT erected a 25-foot (7.6-meter) equipment mounting pole 8 feet (2.4 meters) from the edge of the travel lane, installed flashing beacons on two existing ramp signs, and arranged power and telephone service connections. The pole was installed approximately 180 feet (55 meters) in advance of the speed limit signs. The vendor furnished and installed field sensors, the RPU, and the Internet server. The pavement sensor was installed at the lowest elevation point of the ramp.

After installation, the project partners verified the accuracy and reliability of system components. Vehicle detector data accuracy was validated by comparing speed measurements with those from a hand-held radar gun. The private vendor calibrated the dry-wet threshold of the pavement sensor. Beacon activation by the RPU and field data downloading to the turnpike operations center were successfully tested. Through the server, the University retrieved pavement condition, speed, and volume data at one-minute intervals to evaluate system performance before and after activation.

Contact(s):
- Michael Pietrzyk, University of South Florida, Center for Urban Transportation Research (CUTR), 813-974-9815, pietrzyk@cutr.eng.usf.edu.

Reference(s):
- Pietrzyk, M., “Are Simplistic Weather-Related Motorist Warning Systems ‘All Wet’?”, University of South Florida, presented at the Institute of Transportation Engineers (ITE) Annual Meeting, August 2000.
- Collins, J. and Pietrzyk, M., ”Wet and Wild: Developing and Evaluating an Automated Wet Pavement Motorist System,” Kimley-Horn and Associates, presented at the Transportation Research Board (TRB) Annual Meeting, January 2001.

Keywords: rain, pavement condition, pavement friction, motorist warning system, freeway management, traffic management, advisory strategy, pavement sensor, vehicle detection, speed, driver behavior, crashes, safety