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Best Practices for Road Weather Management

Course Number: GE-02-802

PDH: 7

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Introduction

Weather threatens surface transportation nationwide and impacts roadway safety, mobility, and productivity. Weather affects roadway safety through increased crash risk, as well as exposure to weather-related hazards. Weather impacts roadway mobility by increasing travel time delay, reducing traffic volume throughput and speeds, increasing speed variance (i.e., a measure of speed uniformity), and decreasing roadway capacity (i.e., maximum rate at which vehicles can travel). Weather events influence productivity by disrupting access to road networks, and increasing road operating and maintenance costs.

There is a perception that transportation managers can do little about the average 7,130 fatalities and 629,000 injuries that occur every year during adverse weather conditions. However, three types of road weather management strategies may be employed in response to environmental threats: advisory; control; and treatment strategies. Advisory strategies provide information on prevailing and predicted conditions to both transportation managers and motorists. Control strategies alter the state of roadway devices to permit or restrict traffic flow and regulate roadway capacity. Treatment strategies supply resources to roadways to minimize or eliminate weather impacts. Many treatment strategies involve coordination of traffic, maintenance, and emergency management agencies. These mitigation strategies are employed in response to various weather threats including fog, high winds, snow, rain, ice, flooding, tornadoes, hurricanes, and avalanches.

This course contains 27 case studies of systems in 22 states that improve roadway operations under inclement weather conditions. Each case study has six sections including a general description of the system, system components, operational procedures, resulting transportation outcomes, implementation issues, as well as contact information and references.

Version 2.0 presented 30 case studies from municipal and state transportation agencies. At this point, those solutions are either mainstreamed or have been surpassed by even better solutions. Version 3.0 captures the state-of-the-art, presenting 27 all-new practices that build upon these agencies' previous successes.

Alabama DOT Low Visibility Warning System

In March 1995 a fog-related crash involving 193 vehicles occurred on the seven-mile (11.3 kilometer) Bay Bridge on Interstate 10. This crash prompted the Alabama Department of Transportation (DOT) to deploy a low visibility warning system. The warning system was integrated with a tunnel management system near Mobile, Alabama.

System Components: Six sensors with forward-scatter technology are used to measure visibility distance. The visibility sensors are installed at roughly one-mile (1.6 kilometer) intervals along the bridge. Traffic flow is monitored with a Closed-Circuit Television (CCTV) surveillance system. Video from 25 CCTV cameras is displayed on monitors in the Traffic Management Center (TMC). Field sensor data is transmitted to a central computer in the TMC via a fiber optic cable communication system. The computer controls 24 Variable Speed Limit (VSL) signs and five Dynamic Message Signs (DMS), which are used to display advisories or regulations to motorists.

In 2008, a system upgrade was performed to the fog system. These upgrades included updating devices, improving the method of communication with these devices by going from a point-to-point system to Ethernet, and the addition of Radar Vehicle Detection (RVD) devices every one-third of a mile along the Bayway.

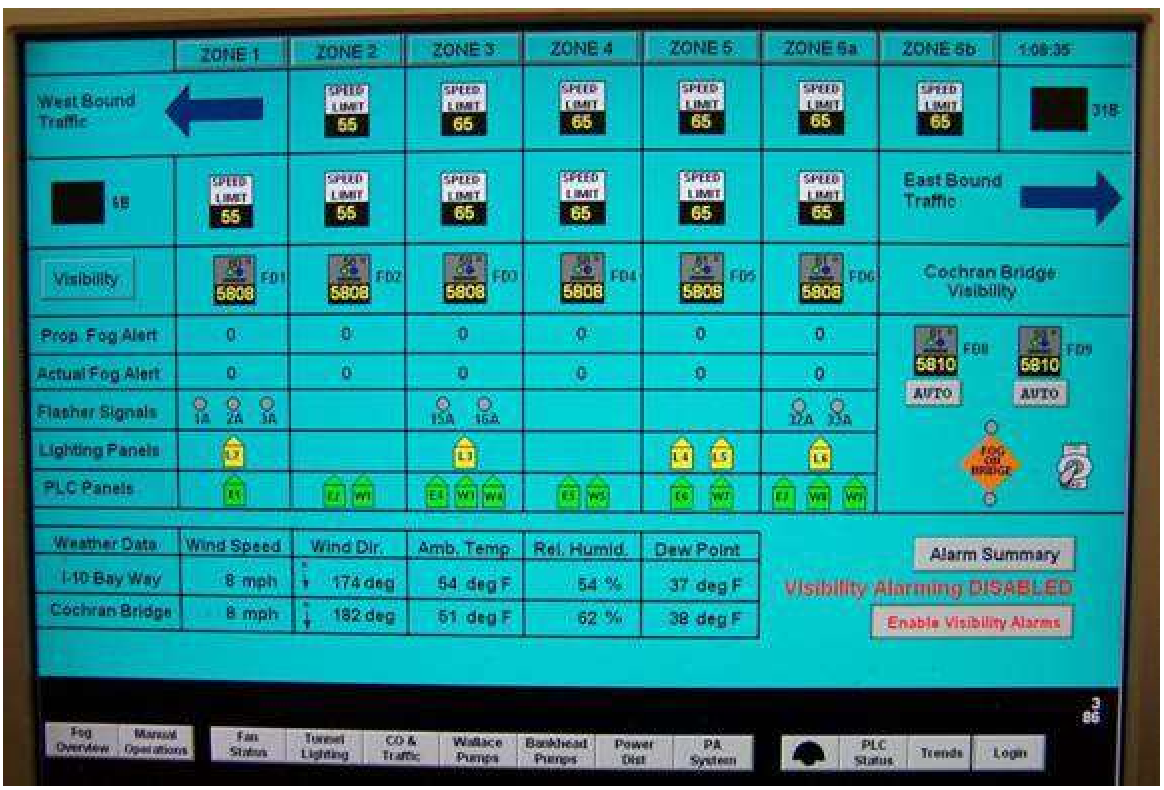

Figure AL-1. Screen Shot of Low Visibility Warning System.

System Operations: At least two Automated Transportation System (ATS) Operators staff the TMC twenty-four hours a day. When fog is observed via CCTV, ATS Operators consult the central computer, which displays visibility sensor measurements by zone. The warning system is divided into six zones which can operate independently. Depending on visibility conditions in each zone, operators may display messages on DMS and alter speed limits with VSL signs (as shown in the Table AL-1, Visibility Warning System Strategies).

Table AL-1. Low Visibility Warning System Strategies.

Visibility Distance	Advisories on DMS	Other Strategies
Less than 900 feet (274.3 meters)	"FOG WARNING"	Speed limit at 65 mph (104.5 kph)
Less than 660 feet (201.2 meters)	"FOG" alternating with "SLOW, USE LOW BEAMS"	"55 MPH" (88.4 kph) on VSL signs "TRUCKS KEEP RIGHT" on DMS
Less than 450 feet (137.2 meters)	"FOG" alternating with "SLOW, USE LOW BEAMS"	"45 MPH" (72.4 kph) on VSL signs "TRUCKS KEEP RIGHT" on DMS
Less than 280 feet (85.3 meters)	"DENSE FOG" alternating with "SLOW, USE LOW BEAMS"	"35 MPH" (56.3 kph) on VSL signs "TRUCKS KEEP RIGHT" on DMS Street lighting extinguished
Less than 175 feet (53.3 meters)	I-10 CLOSED, KEEP RIGHT, EXIT	½ MILE Road Closure by Highway Patrol

When the speed limit is reduced, notices are automatically faxed to the DOT Division Office, the Highway Patrol and local law enforcement agencies in Mobile and neighboring jurisdictions (i.e., Daphne and Spanish Ford). If necessary, ATS Operators request that the Highway Patrol utilize vehicle guidance to further reduce traffic speeds. During vehicle guidance operations a patrol vehicle with flashing lights leads traffic across the bridge at a safe speed.

Transportation Outcome(s): Although labor-intensive, the warning system has improved safety by reducing average speed and minimizing crash risk in low visibility conditions.

Implementation Issues: The original system design included a vehicle detection subsystem, backscatter visibility sensors, and automated activation of signs. Bridge deck construction precluded the installation of inductive loop detectors and vibration prevented the use of microwave vehicle detectors. Thus, the vehicle detection subsystem had to be eliminated. Visibility sensors with backscatter technology were deployed along the bridge in the fall of 1999. However, problems with accuracy and reliability caused the DOT to replace them with forward-scatter visibility sensors in 2000.

The original George C. Wallace tunnel control room was modified to incorporate monitoring and control functions for the warning system, which began operating in September 2000. By 2004, control of the warning system was transferred to the new Traffic Management Center.

Contact(s):

- David M. Johnson, Alabama DOT, ATS Center Manager, 251-432-4069, johnsond@dot.state.al.us
- Daniel Driskell, Alabama DOT, Acting Traffic Engineer, 251-470-8231, driskelld@dot.state.al.us

- Lee Reach, Alabama DOT, Division Maintenance Engineer, 251-470-8230, reachl@dot.state.al.us

Reference(s):

- Schreiner, C., "State of the Practice and Review of the Literature: Survey of Fog Countermeasures Planned or in Use by Other States," Virginia Tech Research Council, October 2000.
- U.S. DOT, "Mobile, Alabama Fog Detection System," *2001 Intelligent Transportation Systems (ITS) Projects Book*, FHWA, ITS Joint Program Office.

Keywords: fog, visibility, low visibility warning system, tunnel management system, speed management, traffic management, law enforcement, traveler information, advisory strategy, traffic control, control strategy, bridge, lighting, high-profile vehicles, motorist warning system, closed circuit television (CCTV), dynamic message sign (DMS), institutional issues, speed, safety

Alaska DOT&PF Temperature Data Probe Program

The Alaska Department of Transportation and Public Facilities (ADOT&PF) has developed an effective seasonal weight restriction program that uses temperature data probe (TDP) profiles as one tool to issue fact-based weight restriction notices. TDP sensors deployed at strategic locations provide a vertical temperature profile in the six-foot layer below the pavement surface. The TDP sites are polled periodically, data are collected and loaded into an Oracle relational database, and then are available under *Alaska's Road Weather (RWIS) and Temperature Data Profiles TDPs for M&O* on the ADOT&PF internal web page <web.dot.state.ak.us> and the Road Weather Information System (RWIS) public web site <http://roadweather.alaska.gov>.

Weight limitations during the spring thaw restrict the Maximum Allowable Axle or Axle Group Weights to less than the typical summer/winter loads. These restrictions help prevent pavement damage, avoid higher road maintenance costs, and limit vehicle wear and tear. Additionally, timely weight restriction notices allow commercial trucking the opportunity to plan their work schedules and minimize the impacts of hauling less than full loads.

The regional maintenance engineers base these temporary weight restrictions on the downward thaw progression; inputs to their decision process include:

- Past weather – includes the past week and conditions from the previous fall such as amount of rainfall
- National Weather Service forecasts – solar insolation, temperatures, precipitation
- Local maintenance and operations staff experience – including local TDP measurements
- Roadway pavement structure – roadbed materials, soil characteristics, pavement age, and drainage capabilities
- Site observations – standing water, water seepage through pavement cracks, precipitation, and remaining snow cover

The weight restriction decision-making process involves multiple ADOT&PF work centers. Communication among state, local government, and commercial trucking agencies provide for an effective restriction notice distribution process.

System Components: The temperature probe program started with the Northern Region Fairbanks Research Section more than 20 years ago. In 1990 there was a coordinated effort to install statewide permanent data recorders and collect telemetry. The TDP program continues with new installations as construction projects and funding allows. There are over 75 sites around the state where TDP are installed in the road section.

Figure AK-1. Thermistor string and temperature probe casing.

Figure AK-2. Boring hole for temperature probe.