Understanding How Weather Impacts Road Safety

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Weather can be an unexpected and dangerous road risk. Approximately 21% of vehicle crashes are related to weather — about 1.2 million every year — resulting in almost 5,000 people killed and over 418,000 people injured in weather-related crashes annually, according to the Federal Highway Administration (FHWA). About 15% of fatal crashes and 19% of injuries happen under conditions of adverse weather and/or slick pavement.

When people think of dangers caused by weather, the assumption might be that hurricanes, tornadoes and floods are the most threatening, but weather.com points out that weather-related vehicle accidents kill more people annually than large-scale weather disasters.

Weather can cause several problems that increase crash risk, including:

- Impairing driver visibility
- Impacting vehicle performance, such as traction, stability and maneuverability
- Impeding traffic flow

This blog outlines the most problematic weather conditions that impact traffic safety, and recommends some potential solutions.

Rain and Precipitation: Wet Pavement Is Greatest Weather Risk

FHWA reports that the majority of weather-related crashes happen on wet pavement (70%) and during rainfall (46%).

Rain and precipitation cause the following roadway risks:

- Wet pavement results in a loss of vehicle traction and maneuverability.
- Water on the road can cause hydroplaning or aquaplaning, where the water actually lifts a vehicle's tires off the pavement.
- During rain, drops of oil and dust on the road can mix with water to produce a slippery road surface.
- Heavy rain can reduce driver visibility to the point where even driving the speed limit is unsafe.
- Flooding can submerge lanes.

Snow and Ice: Winter Weather Results in Multiple Hazards

With over 70% of U.S. roads located in areas that experience more than five inches of snowfall annually, snow and ice present concerning risks on the road. Winter storms, bad weather and sloppy road conditions are factors in nearly half a million crashes and more than 2,000 road deaths every winter, according to the AAA Foundation for Traffic Safety.

FHWA reports that 18% of weather-related crashes occur during snow or sleet, and 29% occur on snowy, icy or slushy pavement. Similar to rain, snow and ice reduce traction on the pavement, and blowing snow can significantly reduce driver visibility.

The Canadian Association of Road Safety Professionals (CARSP) also warns about black ice, a thin transparent layer of ice caused by melting ice and snow that re-freezes on the road. Black ice is the same color as the road surface, causing a hazard because it is difficult for drivers to detect.

Wind: Reducing Visibility and Stability

Wind can substantially reduce driver visibility. Wind-blown snow, dust, sand and smoke not only cause crashes directly due to low visibility, they also cause speed variance, which further exacerbates crash risk.

In addition, research from the National Academy of Sciences found that "winds greater than 25 mph can inhibit the maneuverability and stability of high-profile vehicles, including recreational vehicles, trucks and buses. Stronger winds can even topple high-profile vehicles, particularly when they are traveling empty."

Fog: The Highest Number of Fatalities per Crash

While rain, snow and wind all reduce visibility, fog is especially dangerous. Over 38,700 vehicle crashes occur in fog annually, with more than 600 people killed and more than 16,300 injured, according to FHWA.

FHWA also reports that 3% of weather-related crashes happen in the presence of fog. While this may not seem like a large percentage, the impact of those accidents is alarming. A report by AAA Foundation for Traffic Safety found that fog-related incidents result in 155% more fatalities per crash, compared with accidents that happen in clear weather. The AAA report also indicates that fog-related crashes result in 17.3 fatalities per 1,000 crashes, significantly more than any other weather condition.

"Reduction in visibility below a quarter mile poses a threat to driver safety by hampering the ability to see and be seen within a safe reaction distance," the National Academy of Sciences report states. "When encountered unexpectedly while traveling at high speed, such hazardous conditions can cause serious driver disorientation and lead to dramatic multivehicle accidents."

Mitigating the Risk of Weather

Weather is unpredictable and basically beyond human control, but transportation authorities can take certain actions to mitigate the roadway risks posed by weather, and ultimately save lives.

First, DOTs need to gain accurate weather information. By using Road Weather Information Systems — involving the deployment of environmental sensors that measure atmospheric, pavement and water level conditions — transportation agencies can collect data and produce roadway weather forecasts. DOTs can also use mobile sensors that observe environmental conditions from a vehicle, and remote sensors that are deployed in drones, radar or satellite systems.

The weather data can then be used to inform appropriate personnel and other agencies. When provided with accurate data, transportation agencies can take proactive actions to reduce weather-related accidents by restricting access to bridges, lanes and even entire road segments. Treatment strategies — such as application of sand, salt and anti-icing chemicals to improve traction and prevent ice bonding — can also minimize weather impacts.

DOTs should also warn drivers about impending bad weather so the public can make safe travel decisions. These warnings can be sent via a variety of methods including:

- Roadside displays such as dynamic message signs (DMS)
- Broadcast messages over Highway Advisory Radio (HAR)
- Wireless Emergency Alerts (WEA) sent to drivers' mobile phones
- 511 national traveler information phone number
- State agency websites
- Kiosks in rest areas

To reach the goal of zero traffic deaths, transportation authorities must understand the roadway risk from weather. Weather-related accidents, while challenging, can be abated with the right tools and procedures, and a strong commitment.