Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Research on Weather Conditions and Their Relationship to Crashes

Research Objectives

Correlated motor vehicle crash data to precise weather conditions associated with the time of the crash. Statistical analyses formulated what weather situation causes the greatest safety concerns, and what is the appropriate maintenance response to those weather conditions. The research team limited the investigation to when winter weather conditions could be a factor in the crash. The crash data was divided into fatalities/injuries and personal property damage. In addition, NWS forecasts were analyzed before/during a crash to determine what weather information was available during the event.

Research Benefits

A better understanding of weather conditions and their relationship to crashes and answered questions such as can drivers be warned of weather conditions preceding a snowfall event to reduce crashes. As well, Pathfinder, is a collaboration between NDOT, NWS and a private weather enterprise initiated during the 2018 winter season to better prepare Nebraska citizens for dealing with winter driving conditions. The proposed project benefited all the parties in better understanding what weather conditions precede crashes so that appropriate actions may be initiated to reduce crashes or crash severity in the future.

Principal Investigator

Mark Anderson (P.I.)
University of Nebraska

Lead TAC Member

Don Butler, Traffic Engineer
Matthew Baker, Operations Engineer

Background

This project investigated weather conditions and associated safety by analyzing start times of precipitation and the time of crashes on Nebraska Highways. The number of crashes and fatalities related to weather are relatively large when compared to other weather phenomena. Questions such as how long it had been precipitating before a crash occurred are relevant to improving highway safety. Crash reports lack detailed weather information; this is remedied by incorporating weather observations from National Weather Service (NWS) locations close to crash locations. It is also important to study whether there were NWS weather advisories, watches or warnings during or preceding a crash. There is literature regarding times of day and crashes with increases during the morning and evening commutes, however, there is not a lot of information dealing with weather conditions during those commute times. The case study analysis mined the weather data during the event, to derive the worst-case scenarios taking place during crashes so that maintenance can treat the road surfaces.

Conclusion

The objectives of the research were to conduct a seasonal investigation of when winter weather conditions are a factor in crashes reported in Nebraska, to perform statistical analyses on Nebraska crash and meteorological data and identify weather conditions causing the significant safety concerns, and to investigate whether knowing the snowfall amount and/or storm intensity/severity could be a precursor to the number and severity of crashes.

Nebraska Department of Transportation (NDOT) crash data were combined with meteorological data on winter weather season basis, reported road surface condition at crash time, and reported weather conditions at crash time. Overall, the key finding of the analysis was most winter-weather related vehicular crashes in Nebraska were associated with relatively minimal winter weather conditions. The reported crashes typically occurred either with relatively low snowfall amounts or as a result of residual snowfall on the ground highlighting the need for winter maintenance operations activities and public service announcements to continue well after a storm has exited the region. Another key finding was that most crashes were of lower severity (i.e., relatively minor injuries) and fatal crashes were rare. An important caveat of this result is that traffic volumes are typically lower during winter storms and must be taken into account. This makes the actual risk of a crash larger than the findings of this analysis alone would suggest.

Modeling of crash injury severity showed higher injury severity associated with icy pavements; higher visibility associated with greater likelihood of crashes involving visible injuries but lower likelihood of disabling injury/fatality crashes. Snowfall was associated with greater visible injury crashes while greater snow depth was associated with fewer visible injury and disabling injury/fatality crashes. The analysis also showed that the type of weather system had implications for the frequency of vehicular crashes. These global weather patterns can be forecast months in advance and allow for long-range strategic planning for transportation agencies regarding potential expected impacts. Limitations of the research include spatial and temporal aggregation of weather data, non-availability of winter maintenance activity data (e.g., plowing, material application), and detailed traffic counts during winter weather events.

Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Interested in finding out more?
Final report is available at:
NDOT Research Website

NDOT Recommendations Based Off of Research Project

This research provided the Department the key finding that most winter weather related vehicular crashes analyzed in this study were associated with relatively minimal winter weather conditions. The reported crashes typically occurred either with low snowfall amounts or with residual snowfall on the ground even though it was no longer precipitating. This highlights the need for winter maintenance operations activities to continue well after a storm has left the region and the need for continued messaging of hazardous winter weather road conditions even on seemingly clear roads.

The findings highlighted the need for safety improvements to reduce the severity of crashes on icy pavement. NDOT plans to continue targeted application of High Friction Surface Treatment, removal of objects near the roadway, and add cable median barrier on I-80 where traffic is heavier and the median is the narrower. Cable median barrier reduces the severity of vehicle crossover crashes due to icy conditions on roadways with divided medians. The barriers are designed to absorb the impact and stop out-of-control vehicles from entering oncoming traffic.

Research outcomes justify using intelligent transportation system (ITS) devices related to adverse road conditions. This implementation allows a process by which appropriate speeds can be determined and posted on VSL signs when lower speed limits are warranted by weather, accidents, or other extraneous situations.

The Department will fund deployment of VSL signs with Federal grant. Research follow up will compare crash data before and after the devices are deployed. Evaluation of the I-80 corridor will take about 4 years. This effort will have a decision support system using weather and traffic information by maintenance decision support system (MDSS) could prove to be an effective means of providing timely, accurate, and consistent messaging and posted speeds for the traveling public.

- *As provided by Don Buller and Mathew Baker, TAC Members Leaders*

Research Readiness Level (RRL) Assessment

RRL 3

Level 3: Development – Field Level

Research/Technology developed in an operational environment (real-world situation).

This brief summarizes Project SPR-P1 (20) M097
"Research on Weather Conditions and Their Relationship To Crashes"
Nebraska Department of Transportation Research Program