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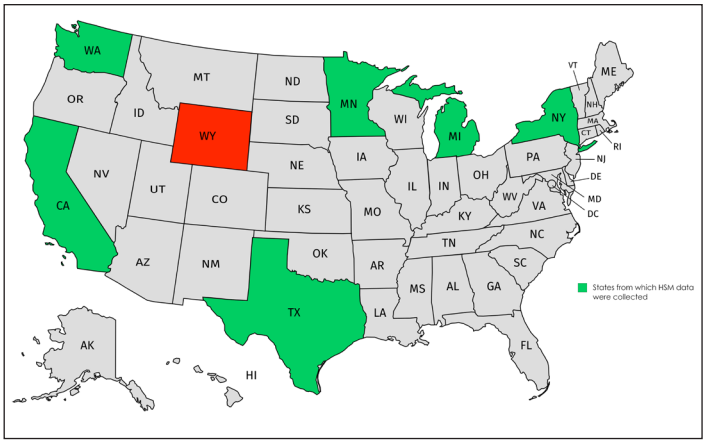
Research Helps Local Agencies Predict Accidents to Make Rural Highways Safer

New data collection methods and computing techniques are powerful tools for improving the safety of the nation's roads. Researchers and road agencies use those tools to predict accidents so they can focus efforts on designing highways and making improvements that minimize crashes.

Researchers at the University of Wyoming, a member of the Region 8 Mountain-Plains Consortium led by North Dakota State University, have developed procedures that allow those general tools to be calibrated so that their predictions are more accurate for roadways with unique properties and conditions like those found in the Great Plains and Intermountain West.



Dr. Mohamed Ahmed

States from which data were collected

In 2010, the American Association of State Highway and Transportation Officials (AASHTO) published its first highway safety manual that included safety performance functions (SPFs), regression models used to predict the expected number of crashes for a particular geographic space per unit of time. Those SPFs were based on data from only a few states, which does not adequately represent all U.S. states and regions. The manual does, however, provide guidance for calibrating the SPFs to local roads.

"The SPFs are important because, as we look at the safety of a road segment, we need something to compare ourselves to," noted Mohamed Ahmed, an associate professor of civil and architectural engineering at the University of Wyoming. Many agencies use the manual to guide decisions on road investments to improve the safety of roads and intersections. "We can't use SPFs from the AASHTO manual, because they are based mostly on highways in East and West Coast states" he said.

Ahmed points out that most highways in Wyoming and surrounding states are rural two-way, two-lane highways in sparsely populated areas and the region experiences significantly more snow than many other states. Similarly, the mix of cars and trucks as well as the number of rural road segments in mountainous terrain are significantly different from other areas. While the AASHTO manual presented the first collection of quantitative safety analysis methods and has been a great asset for traffic safety researchers and practitioners, "we needed to invest the time and money to calibrate the SPFs to local conditions in Wyoming," he said.

In the work, Ahmed looked at 10 years of crash data including the number and severity of crashes from selected rural two-way, two-lane road segments, characteristics and features of the roadway (number of lanes, lane width, curves, hills, types of shoulders, traffic control devices, etc.), average daily traffic, and weather data. During the study period of 2003 to 2013, 21,423 crashes occurred on rural two-lane two-way roadways in Wyoming. At the same time there were 131,778 million vehicle miles traveled on those same roadways.

Using the collected data, Ahmed created a modeling framework and established estimation methodologies that resulted in SPFs that were calibrated specifically for Wyoming and similar roadways on the Northern Plains and Intermountain West.

The work is already being used by the Wyoming Department of Transportation (WYDOT).In one case, WYDOT was

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Mountain-Plains Consortium researchers calibrated safety performance functions from the AASHTO Highway Safety Manual to local road conditions in Wyoming, enabling road agencies to better predict accidents and focus efforts on improvements to minimize crashes.

considering adding three miles of passing lanes to a segment of Wyoming State Highway 50 based on previous successes in reducing crashes elsewhere in the state by adding passing lanes to two-lane, two-way highways. The road in question, on the rolling plains of eastern Wyoming about 50 miles south of Gillette, carries agricultural and industrial truck traffic and has some hills that limit sight distances. In a study for WYDOT that analyzed the potential benefits of the project, Ahmed and graduate student Irfan Ahmed used the newly calibrated SPFs and determined that the proposed passing lanes would not reduce crashes enough to warrant their construction.

By not constructing the passing lanes, WYDOT saved approximately $2.5 million that could be used for highway and safety improvements elsewhere and avoided the hazards and inconvenience that would have accompanied the two-year construction project. “That’s the value of the calibrated safety performance factors,” Ahmed said. “They guide the state in implementing improvements and they are able to defend those decisions scientifically.”

With additional funding from the Mountain-Plains Consortium, Ahmed is continuing the research by calibrating another portion of the manual called crash modification factors. Those factors are used to compute the expected number of crashes after implementing a safety improvement or set of improvements (signs, signals, highway design, turn lanes, passing lanes, etc.). The crash modification factors, used in conjunction with safety performance functions, are particularly useful for choosing the most cost effective option when there are multiple alternatives to address safety concerns.

About This Project

The objectives of this research at the University of Wyoming are to identify the adequacy of the first edition of the AASHTO’s Highway Safety Manual (HSM) to quantify the safety performance of different roadway facilities in the region, calibrate and assess Safety Performance Functions based on regional data and to provide guidelines and recommendations for future research. The University of Wyoming is a member of the Region 8 Mountain-Plains Consortium led by North Dakota State University. The consortium also includes Colorado State University, South Dakota State University, University of Colorado Denver, University of Denver, University of Utah, and Utah State University.