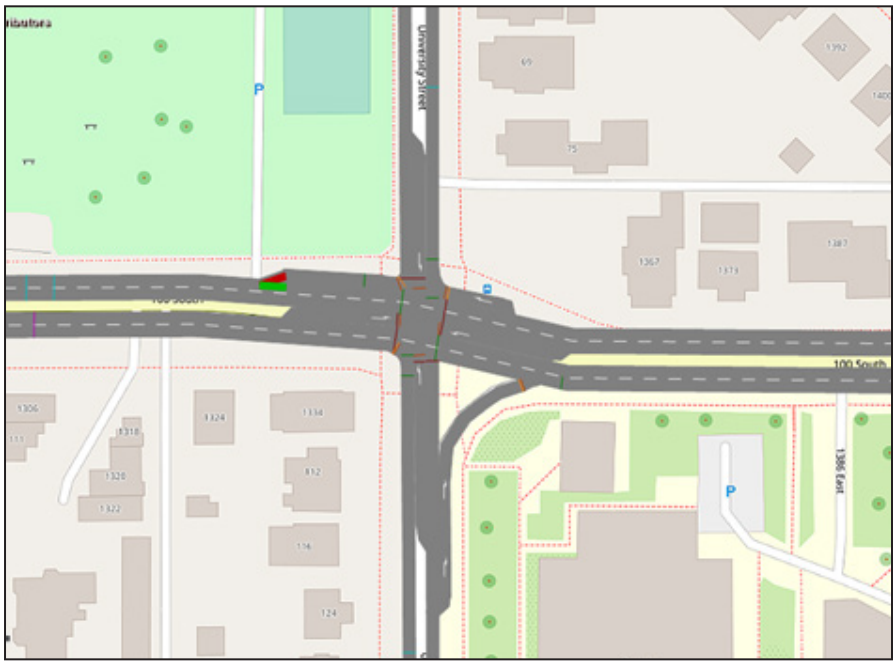
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 22-484 (project 590) | September 2022

Impact of Connected Vehicle Technology on Traffic Safety under Different Highway Geometric Designs



the ISSUE

Connected and automated vehicles (CAVs) can upgrade flow capacity, travel time, and, most importantly, safety. However, road geometric design elements such as number of lanes, design speed, curves, and slope are primarily based on human reactions and behavior. There is a need to evaluate how CAVs will impact traffic flow and how their presence in traffic will influence crashes and crash severity in potential crash hot spots.

the RESEARCH

To reflect CAV behavior and roadway elements, multiple simulation scenarios were designed to contain road features that can cause crashes. These scenarios were simulated with traffic composition, including conventional vehicles and CAVs with different penetration rates. Also, the driving behavior of each class of vehicle is included to account for their effect on traffic performance. These simulations are done in VISSIM traffic simulation software with scenarios that study the effects of the number of lanes, design speed, intersections, limited sight distance, conflict zones, and road grade on road safety. The trajectory of roads is used to analyze the safety performance quantitively. Safety analysis includes potential crash rates and severity. In addition, flow characteristics of conflicts are also evaluated for flow performance under different traffic combinations.

Researchers investigated how CAVs can affect safety performance under different geometric designs. Scenarios were designed based on the Salt Lake City, Utah, traffic network, and locations were picked based on recent crash locations and roadways that include elements that are primary contributors to crashes.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

Colorado State University
North Dakota State University
South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
University of Wyoming

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Project Title

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the FINDINGS

Results indicate that CAVs' presence in traffic flow can elevate safety performance, especially on freeways. Signalized intersections do not show an improvement in traffic safety because of the limited information available on the interaction of conventional vehicles and CAVs. Also, potential CAV safety features might not be fully applicable in controlled roadways. However, the reduced number of rear-end and lane-changing conflicts shows that CAVs successfully reduce crash rates. In addition, potential crash results demonstrate that because of smaller speed variances and reduced decelerations, crashes will be less severe. Safety performance evaluations show that safety improvements resulting from increased use of CAVs will be significant.

the IMPACT

This research shows the safety benefits of CAVs under various driving conditions and provides insight into how road geometric designs can affect CAV safety performance. The research also shows that the CAV penetration rate plays a key role in affecting road safety as well. The research will help roadway designers and transportation system designers adapt roadway systems to the emergence of CAVs.

For more information on this project, download the main report at https://www.ugpti.org/resources/reports/details.php?id=1103

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.