SOLUTIONS

MONTANA MDT DEPARTMENT OF TRANSPORTATION

RESEARCH PROGRAMS

Summer/Fall 2016

IN THIS ISSUE

PROJECT HIGHLIGHTS

Safety Impact of Differential Speed Limits on Rural 2-Lane Highways in Montana

Montana's rural roadways have had a diverse speed limit history; ranging from reasonable and prudent to the current law of differential speed limits between commercial and passenger vehicles enacted on May 28, 1999. Montana is currently the only state which maintains a differential speed limit (DSL) policy for passenger cars and heavy trucks on undivided rural highways. Although a considerable amount of prior research has investigated the impacts of speed limits on traffic safety and operations, much of this research, and nearly all of the research related to differential speed limits, has been specific to limited access freeways. The unique safety and operational issues on highways without access control creates difficulty relating the conclusions from prior freeway-related speed limit research to Montana's non-freeway DSL policy. To address this gap in knowledge pertaining to differential speed limits on non-freeways, a comprehensive study related to the safety impacts of differential speed limits on rural two-lane highways was performed for MDT.

The primary objective of this study was to assess differences in traffic operational and driver behavior characteristics along high-speed two-lane highways in Montana as a function of the posted speed limit and other factors. Across most of the state-maintained rural two-lane highway system in Montana, a maximum daytime speed limit of 70 mph for passenger vehicles and 60 mph is in effect for trucks and buses with greater than one-ton payload capacity. However, in April 2013, speed limits were changed along 55 miles of portions of two eastern Montana highways (MT-16 and MT-200) to a uniform 65 mph for all vehicles. It was necessary to determine the operational impacts associated with these speed limit changes and to determine if further application of the uniform 65 mph speed limit is warranted.

Data were collected at numerous locations from across Montana, where 70/60 mph differential speed limits are common, and also included the limited Montana two-lane roadway segments with

CONTINUED ON PAGE 2

uniform 65 mph speed limits. To provide additional uniform 65 mph highway locations, data were also collected on rural highway segments in the neighboring states of Idaho, North Dakota, South Dakota, and Wyoming.

Collectively, the findings from this study provide substantial evidence in support of uniform 65 mph speed limits for two-lane rural roadways in Montana. Although implementation of the 65 mph uniform limit will likely increase truck travel speeds by an estimated 1.5 mph on average, speed variability will likely be greatly reduced due to the reduction of passenger vehicle speeds by approximately the same amount. Such a reduction in the variability of speeds between passenger cars and trucks is expected to reduce platoon lengths and subsequent high-risk passing behavior, thereby reducing the risk of passing-related crashes. Although data for the post-implementation period of 65 mph uniform limits along MT-16 and MT-200 are limited, the crash data analysis provided some indication that use of the 65 mph uniform limits may provide safety benefits over the previous 70/60 mph limit. Furthermore, road users appear to generally be supportive of uniform two-lane roadway speed limits of 65 mph, particularly older motorists, although younger motorists are less supportive. Most notably, the trucking industry was found to be overwhelmingly supportive of uniform speed limits, particularly 65 mph. Based on the collective findings, uniform 65 mph speed limits are recommended for further implementation on two-lane highways in Montana.

Although the findings from this research support statewide implementation of 65 mph limits, it may be initially advisable to continue selective implementation of the speed limit on certain candidate segments. Initial candidates would include roadways with high traffic volumes (i.e., greater than 3,000 AADT), high truck percentages (i.e., greater than 15 percent), and limited passing opportunities (i.e., greater than 40 percent no passing zones, with few passing relief lanes).

To learn more about this project, visit the research project website. If you have questions, please contact Kris Christensen (krchristensen@mt.gov or 406.444.6125).

Speed Limits Set Lower than Engineering Recommendations

The Montana Department of Transportation (MDT) generally ensures that posted speed limits are set in accordance with engineering recommendations, which means that speed limits are typically set such that they are about equal to the observed 85th-percentile operating speed. However, for a variety of reasons, including the presence of school zones, citizen requests, political pressure, and perceived safety issues, posted speed limits on several roadways in Montana have been reduced to values lower than those recommended for the facility by engineering guidelines.

This study examined the safety and operational effects of posting speed limits lower than engineering recommendations. It involved four unique components: a comprehensive literature review, a survey of other state transportation agencies, the collection of speed and safety data from a variety of Montana roadways, and an analysis of these data.

The literature review revealed that little published information exists on the practice of setting posted speed limits lower than engineering recommended values. The survey was sent to all state transportation agencies with representation on the AASHTO Subcommittee on Traffic Engineering, which included a total of 71 representatives from 51 states or territories. Twenty-two of the 28 responding agencies indicated that they engaged in the practice of setting speed limits lower than engineering recommendations. About half of these agencies had a policy or guidance document describing the practice. Overall, few agencies reported evaluating the changes to operating speed or safety resulting from setting speed limits lower

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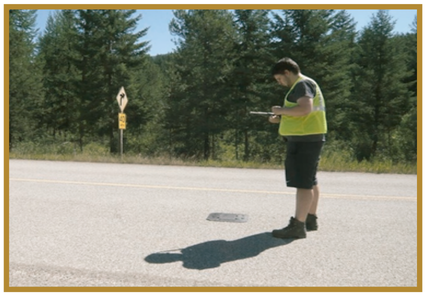
than engineering recommendations. About half of the 28 responding agencies evaluated driver compliance with the lower posted speed limit and found that the compliance was generally poor.

Operating speed analysis

The operating speed evaluation produced results that were consistent with other state transportation agency experiences when setting posted speed limits lower than engineering recommendations. When the posted speed limit was set only 5 mph lower than the engineering posted speed limit, drivers tended to more closely comply with the posted speed limit. Compliance tended to lessen as the difference between the engineering recommended posted speed limit and the posted speed limit increased. When the posted speed limit was set 15 to 25 mph lower than the engineering recommended speed limit, there appeared to be a low level of compliance with the posted speed limit. Introducing light enforcement, defined as highway patrol vehicles making frequent passes through locations with posted speed limits set lower than engineering recommendations, appeared to have only a nominal effect on vehicle operating speeds. Known heavy enforcement, defined as a stationary highway patrol vehicle present within the speed zone, reduced mean and 85th-percentile vehicle operating speeds by approximately 4 mph. Additionally, known heavy enforcement increased the likelihood of driver compliance with the posted speed limit.



Safety evaluation

The research team used the empirical Bayes (EB) before-after approach to develop crash modification factors (CMFs) to describe the expected change in crash frequency when setting posted speed limits lower than engineering recommendations. The proposed EB analysis properly accounts for statistical factors such as regression-to-the-mean, differences in traffic volume, and crash trends (time series effects) between the periods before and after posted speed limits were set lower than engineering recommendations.

While data were only available for a handful of sites that implemented this practice, the before-after analysis found a statistically significant reduction in total and fatal + injury crashes at locations with posted speed limits set 5 mph lower than engineering recommendations. Locations with posted speed limits set 10 mph lower than engineering recommendations experienced a decrease in total crash frequency but an increase in fatal + injury crash frequency. The safety effects of setting speed limits 15 to 25 mph lower than engineering recommendations are less clear, as the results were not statistically significant, likely due to the small sample of sites included in the evaluation.

When considering the experiences of other state transportation agency practices and the speed and safety evaluation results from the present study, it appears that setting posted speed limits 5 mph lower than the engineering recommended practice may result in operating speeds that are more consistent with the posted speed limits and overall safety benefits (defined as an expected decrease in total and fatal + injury crash frequency). The safety benefits are presumably observed because drivers tend to more closely comply with posted speed limits at locations where the posted speed limit is just 5 mph below the engineering recommended values. Police enforcement appears to only significantly impact operating speeds when heavy enforcement is present. However, the effect is likely to diminish when the enforcement period concludes. Although the sample size is small , the practice of setting posted speed limits 15 or 25 mph lower than engineering recommended speed limits does not appear to produce operating speeds consistent with the posted speed limit or provide safety benefits.

To learn more about this project, visit the research project website. If you have questions, please contact Kris Christensen (krchristensen@mt.gov or 406.444.6125).

LIBRARY CORNER

"Not Everything is Indexed by Google" (The Modern Search Engine and Its Short Comings)

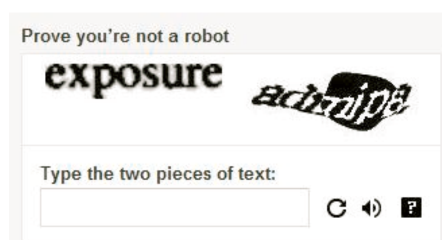
When scouring the web for information using Google, even the most experienced of searchers may be surprised to learn that they are not truly gleaning from the entirety of the internet. Instead, these individuals are actually searching Google's index of the internet. This index is derived from metadata which can be provided by the author directly, or obtained through the use of special software robots known as "web crawlers" or "spiders." Crawler bots start with a list of web addresses and recursively follow the links on those pages to other pages. Upon reaching their iterative end, these crawlers will have visited and gathered information from a large chunk of the web. Google then retrieves this information and indexes the sites. The engine also ranks each webpage based on the quality of its content. The indexing process makes for the quick recapture of results following the entry of search criteria.

The term "surface web" is used to refer to the portion of the internet that is indexable by conventional search engines. Not all of the surface web is indexed by the various engines, but all of it is indexable. The "deep web" (not to be confused with the dark web), on the other hand, is not indexable by these same engines.

This implies that the pages or materials on the deep web are not "Googleable."

There are several page types located on the deep web:

- Subscription-only pay-walled pages.
- Hidden pages – There are no hyperlinks to take you to these pages. Only people who know the addresses can access them.
- Dynamic pages – These pages are created in real-time. Scripting code instructs the page to access information from a database.
- Pages with symbols such as ?,$,+ in dynamic URLs.
- Non-commercial database pages – Academic, medical, governmental, etc.
- Robot excluded / technically limited pages – These pages disallow crawlers from harvesting the necessary information for indexing. One way this can be accomplished is with the use of Captcha technology:



Additionally, some bots are blocked entirely (often content copiers). Specific pages can also be blocked, such as admin request / username and password change.

For the typical user search query, there are thousands of results. In order to display only the most relevant information, Google uses algorithms capable (ideally) of discerning what results are relevant. Currently, these

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algorithms rely on over 200 unique signals, such as the searcher's region, the site's ranking, or the freshness of the site's content. Unfortunately, there are problems with the search engine optimization techniques (SEO) that support these algorithms.

Ideally, SEO would allow authors to improve the findability of their content. However, some sites abuse SEO to boost their viewership and profit from advertising. This is accomplished by tricking the ranking algorithms into awarding pages high ranks for common phrases, and it is known more formally as "spamdexing."

Forms of spamdexing include:

- Meta-tag stuffing – Webpage is loaded with inapplicable keywords.
- Invisible text – Webpage is full of text that is not seen by users, but is read by spiders.
- Cloaking – Webpage presents different information to an engine spider than to a user.
- Link Farm – Webpage seeks to be linked from a large number of unrelated sites or blogs to boost its quality ranking.
- Content Farm – Many freelance writers work to create a large number of low-quality articles.
- "Hack Writers of the Internet" - Writers are often paid on commission for search queries. This can also include news "Churnalism", which involves churning news wires or press releases into articles without additional research or fact checking.

In addition to the above limitations, search engines such as Google are handily surpassed by scholarly databases in their ability to provide published and peer-reviewed articles. Such articles will cite related research sources as well, perhaps leading the inquirer further down the path of discovery. With a search engine, a person would be fortunate to uncover a list of supporting URLs. Finally, search engines are often poorly equipped to handle open-ended questions. As queries move away from the "20 Questions" side of the spectrum toward the "The Answer to the Ultimate Question of Life, The Universe, and Everything" (Hitch Hikers Guide to the Galaxy) side, the client is all the more profited in querying a librarian.

"Google Can Bring You Back 100,000 Answers. A Librarian Can Bring You Back the Right One" – Neil Gaiman, Author.

**This article was written by MDT's summer 2016 library intern Keinan Balsam, who is studying computer science at Montana State University.

DID YOU KNOW?

Dr. Craig Shankwitz, Expert in Autonomous and Connected Vehicle Technologies

Connected vehicle technology has rapidly gained attention for the potential of not only greater mobility but also increased safety. The US Department of Transportation now has a Connected Vehicle program, dedicated to working with state and local transportation agencies to research this new technology. While it might be understandable as to its application in urban environments, rural settings will likely present new challenges to possible implementation. Montana State University's Western Transportation Institute (WTI), which specializes in rural transportation issues, is initiating steps to examine this topic and identify answers to the questions surrounding connected vehicle technology in a rural setting. Dr. Craig Shankwitz, nationally recognized autonomous and connected vehicle expert, has recently joined WTI staff to lead this effort. Dr. Shankwitz has served as the former director of the University of Minnesota's Intelligent Vehicles Laboratory and the principal research and development engineer at MTS Systems Corporation. To read more about Dr. Shankwitz and his new role with WTI, please read this MSU news article.

CALENDAR OF EVENTS

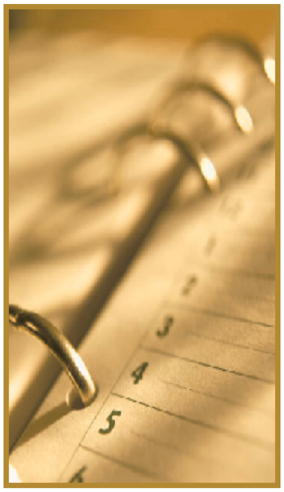
November
Transit IDEA Proposals Due - 11/2/16

December
MDT RRC Meeting - 12/16/16

January
TRB Annual Meeting - 1/8-12/17
AASHTO RAC Meeting - 1/8/17
MDT RRC Meeting - 1/25/16

February
NCHRP Synthesis Topic Statements Due - 2/15/17
MDT RRC Meeting - 2/22/17

March
NCHRP IDEA Proposals Due - 3/1/17
TCRP Synthesis Topic Statements Due - 3/15/17
ACRP Topic Statements Due - 3/20/17
MDT RRC Meeting - 3/22/17



For additional information, please see: http://rppm.transportation.org/Lists/Calendar/calendar.aspx

NEW RESEARCH REPORTS

Disparity/Availability 2016

MDT Special Events Planning Synthesis

Safety Impact of Differential Speed Limits on Rural 2-Lane Highways in Montana

Speed Limits Set Lower than Engineering Recommendations

A listing of all past and current projects can be found at http://www.mdt.mt.gov/research/projects/sub_listing.shtml.

NEW EXPERIMENTAL REPORTS

Evaluation of Durable Traffic Pavement Marking Tape (PMT) Construction Report & Annual Evaluation 2016

Wet-Reflective Bead Technology Pavement Marking Construction Report & Annual Evaluation 2016

A listing of all past and current projects can be found at http://www.mdt.mt.gov/research/projects/exp_sub_listing.shtml.

REMINDER

Information on research services and products, such as research and experimental project processes and reports and technology transfer services, can be found on the Research web site at www.mdt.mt.gov/research.

MDT's library collection can be searched through the library catalog. The catalog and other information resources are available through the MDT Library web site.

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