

Project Summary Report: 8224-001

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Safety and Operational Impacts of Differential Speed Limits on Two-Lane Rural Highways in Montana

http://www.mdt.mt.gov/research/projects/traffic/differential_speed.shtml

Introduction

Speed limit policies can be broadly classified into two categories. Uniform speed limit policies establish the same maximum limit for all vehicles, while differential speed limit policies set a lower limit for heavy trucks in comparison to cars and light duty trucks. While differential speed limits are common on limited access freeways in the United States, Montana is currently the only

state that maintains a differential speed limit policy on two-lane rural highways, with a current daytime statutory limit of 70 mph for cars and light duty trucks and 60 mph for trucks with greater than one-ton payload capacity.

However, in April 2013, speed limits were changed to a uniform 65 mph for all vehicles along 55 miles of MT-16 and MT-200 between Glendive and Fairview in eastern Montana. This change was made in response to observations of aggressive

passing behavior by motorists queued behind heavy trucks with little opportunity to pass. Consequently, it was necessary to assess the impacts associated with these speed limit changes to determine if further application of the uniform 65 mph speed limit is warranted.

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. Two-lane highways possess unique operational and safety issues related to queuing and passing behavior, making it difficult to relate conclusions from freeway-related speed limit research. To



Figure 1: Platoon Formation Behind a Heavy Truck

address this gap in knowledge, a comprehensive study related to the safety and operational impacts of differential speed limits on rural two-lane highways was initiated by MDT in 2014.

What We Did

The primary purpose of this research study was to assist MDT in determining conditions under which differential speed limits or, alternatively, uniform speed limits should be utilized on two-lane rural highways. The objectives of this study were as follows:

- Determine the safety impacts associated with the use of differential speed limits on rural two-lane roads, including the impacts on crash frequency and crash severity;
- Determine the operational impacts associated with the use of differential speed limits on rural two-lane roads, including the impacts on speeds, queues, and passing maneuvers; and
- Provide guidance towards the use or non-use of differential speed limits on two-lane rural highways in Montana.

The major tasks in this research project included:

- Review literature, policies, and practices related to speed limits in the United States
- Perform a field study to evaluate the impact of speed limit and other roadway factors on free flow speeds, platooning, and passing events on two-lane rural highways in Montana.
- Evaluate traffic crash data from two-lane rural highways in Montana, develop safety

performance functions using this data, and compare Montana safety performance with that of neighboring states.

- Survey Montana road users and registered motor carriers to determine preferences towards various speed limit policy alternatives and potential impacts (behavioral, safety, economic, etc.) associated with changes to speed limit policies.
- Synthesize the research findings and develop recommended guidelines for speed limit policies on two-lane highways in Montana.

What We Found

Impact of Speed Limit Policy on Free Flow Speeds

Using free flow speed data collected from 160 two-lane rural highway sites across Montana and the neighboring states of North Dakota, South Dakota, Wyoming, and Idaho, a series of ordinary least squares regression models were developed for mean speed, 85th percentile speed, and standard deviation of speed. The model results showed that both the mean and 85th percentile travel speeds and the variability (standard deviation) in

travel speeds are generally lower at two-lane highway locations with uniform 65 mph speed limits compared to locations with 70/60 mph differential limits. Overall, these results illustrate that statutory maximum limits play a meaningful role in affecting driver speed selection. Specifically, these results suggest that transitioning from a 70/60 mph differential speed limit to a uniform 65 mph speed limit on two-lane roadways in Montana would likely decrease the overall mean and 85th percentile travel speeds, although truck speeds would be expected to increase. Ultimately, the expected convergence of the speed profiles for passenger vehicles and heavy trucks associated with the change to a uniform speed limit would consequently reduce the variability in travel speeds. Table 1 presents the raw free flow speed summary statistics for the 160 sites separated by site speed limit.

Safety Performance Evaluations

An assessment of the relationships between crash occurrence and various traffic and roadway factors (e.g., speed limit, cross-section and geometry) was performed using historical data for the MDT's two-lane highway network. The

Speed Characteristic	Passenger Vehicles		Heavy Trucks		All Vehicles	
	Avg.	Std. Dev	Avg.	Std. Dev	Avg.	Std. Dev
<i>Mean Free Flow Speed (mph)</i>						
Speed Limit 65/65 mph	64.54	4.91	61.98	5.89	63.74	5.07
Speed Limit 70/60 mph	65.79	4.14	60.56	4.59	64.93	3.92
<i>85th Percentile Free Flow Speed (mph)</i>						
Speed Limit 65/65 mph	70.00	4.98	65.8	5.12	68.92	4.46
Speed Limit 70/60 mph	72.07	4.15	64.38	4.67	71.6	4.06
<i>Free Flow Speed Std. Deviation (mph)</i>						
Speed Limit 65/65 mph	5.53	1.29	4.17	1.77	5.45	1.23
Speed Limit 70/60 mph	6.28	1.24	4.17	2.16	6.48	1.19

Table 1: Summary Statistics for Free Flow Speeds by Site Speed Limit

model results found that crashes on two-lane highways in Montana tended to increase with driveway density, horizontal curvature, and on highways of higher functional class, as well as on segments located

occurrence in Montana to the base two-lane rural roadway models in the Highway Safety Manual. These safety performance comparisons are provided in Figure 2.

analysis should be performed once additional crash data become available.

Impact of Speed Limit Policy on Platoon Length and High-Risk Passing Behavior

To provide further insight into the safety and operational effects of speed limit policy, additional investigations were conducted using data for platoon length and passing behavior, which were obtained through a review of video data from 77 rural two-lane highway locations across Montana. The results showed that longer platoons and greater speed variability contributed to an increased occurrence of high-risk passing events. It follows that roadways with differential speed limits, particularly where high volumes of trucks or other slower moving vehicles are present, would likely experience greater platooning and subsequent high-risk passing attempts, thereby increasing the risk of passing-related crashes. Collectively, these findings support the results of the preliminary crash data analysis, providing further indication that use of the uniform 65 mph speed limit on two-lane highways may provide safety benefits over the prevailing 70/60 mph differential limit. As will be shown in the following subsection, these safety findings are further supported by the preferences of road users in Montana, particularly the trucking industry.

Speed Limit Preferences of Motorists and the Trucking Industry

Given that potential changes to Montana's two-lane highway speed limit policy would likely have a significant impact on road users, especially the trucking industry, a series of surveys were performed

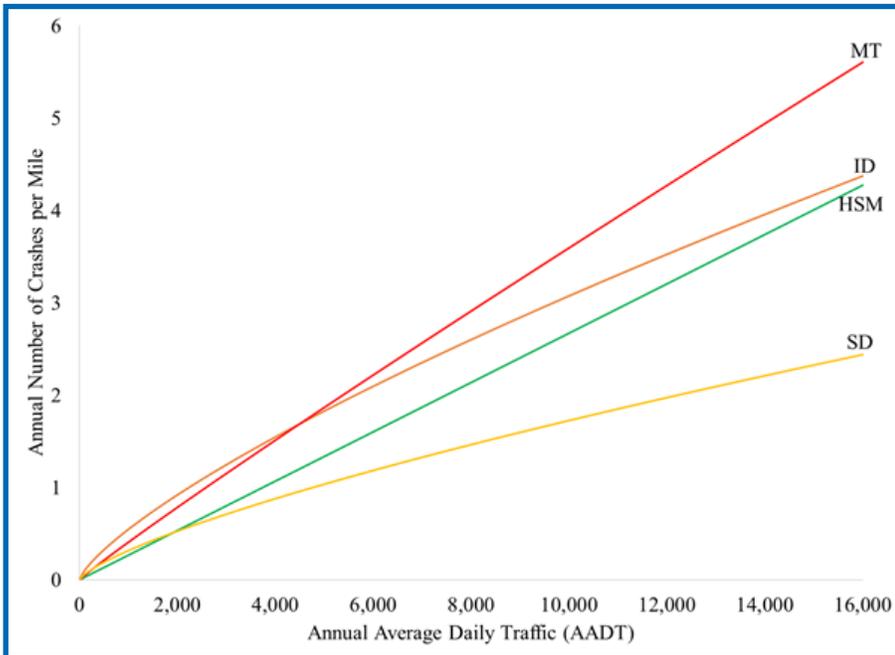


Figure 2: Comparison of Two-Lane Highway Crash Occurrence in Montana versus Idaho, South Dakota, and the Highway Safety Manual

in District 1, which includes the most urbanized areas of the state. In contrast, fewer crashes were experienced on segments with wider shoulders or where passing relief lanes were in place.

It was also possible to compare crash occurrence on two-lane highways in Montana to that of neighboring states, where 65 mph speed limits prevail. Within the typical range of traffic volumes, two-lane roadways in Montana were found to experience similar crash occurrence compared to Idaho, although both states tended to experience significantly greater crash occurrence compared to South Dakota. Similar results were found when comparing crash

This study also allowed for a preliminary assessment of the recent change from a differential 70/60 mph limit to a uniform 65 mph speed limit that occurred along the 55 miles of MT-16 and MT-200 between Glendive and Fairview in eastern Montana in April 2013. Implementation of the 65 mph limit reduced non-animal crashes on these segments to the point where crash occurrence was not significantly different from segments that retained the 70/60 mph differential limits during the post-implementation period. However, because only 21 months of data were available after the uniform 65 mph speed limit went into effect, these results are considered preliminary, and further

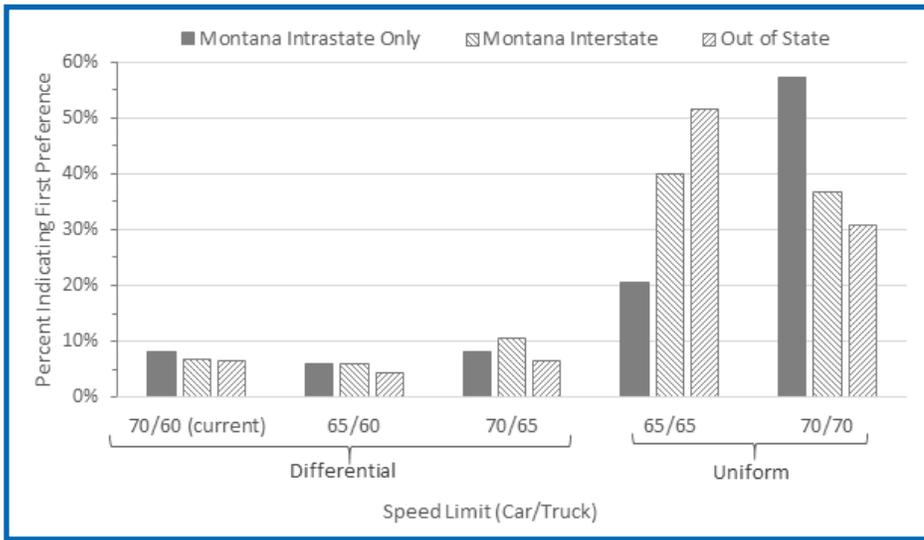


Figure 3: Two-Lane Roadway Speed Limit Preference by Motor Carrier Registration Classification

to assess preferences and opinions regarding speed limit policies among road users and registered motor carriers in Montana. The road user survey was administered in person to motorists at 10 MDT rest areas and/or weigh stations throughout the state in August 2014, and a total of 586 surveys were completed. The trucking industry survey was administered online to both in-state and out-of-state motor carriers registered to operate in Montana, with a total of 353 surveys completed.

Motorist support for the uniform 65 mph speed limit varied based on age and vehicle type, as motorists over the age of 30 showed greater support for the 65 mph limit than younger motorists, who favored the current 70 mph maximum limit. However, truck drivers, and the trucking industry in general, were overwhelmingly supportive of uniform speed limits, particularly 65 mph, while the current 70/60 mph limit garnered little support. As displayed in Figure 3, support for uniform 65 mph limits was particularly strong among motor carriers from outside of Montana, where such limits are common

two-lane roadways.

Not surprisingly, increasing the truck speed limit would likely increase truck travel speeds. Responding motor carriers noted that increasing the truck speed limit from 60 to 65 mph would increase the median fleet travel speeds from 60 to 65 mph, while the 85th percentile fleet travel speed would increase from 65 to 67 mph. Regarding the potential safety implications associated with moving to uniform speed limits on two-lane roadways, motorists reported that they would less frequently overtake vehicles traveling 5 mph slower compared to 10 mph slower. The responses were similar regardless of whether a passenger vehicle or heavy truck was the vehicle being overtaken and suggest that a uniform 65 mph speed limit may reduce passing activity, assuming that variability in vehicle travel speeds is reduced accordingly.

What the Researchers Recommend

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 uniform 65 mph speed limits, it may be initially advisable to continue selective implementation on candidate segments that meet certain criteria. The critical objective of the uniform 65 mph speed limit is to reduce queuing and subsequent high-risk passing behavior by reducing the speed variability between cars and trucks. Thus, potential candidate roadways should possess the following characteristics:

- Greater traffic volumes (e.g., above 3,000 AADT),
- Greater truck percentages (e.g. above 10 percent), and
- Limited passing opportunities (e.g., above 40 percent no passing zones, particularly with frequent horizontal curvature and infrequent passing relief lanes).

As crashes and platoon lengths tended to be higher in District 1, roadways within this district that meet the aforementioned criteria may serve as ideal initial candidates for further implementation of the uniform 65 mph speed limit. Furthermore, locations with low traffic volumes (e.g., below 1,000 AADT) or low truck percentages (e.g., below 5 percent) would not likely experience substantial operational or safety benefits after changing to a uniform 65 mph speed limit and should not be considered as initial candidates.

For More Details . . .

The research is documented in Report FHWA/FHWA/MT-16-006/8224-001
http://www.mdt.mt.gov/research/projects/traffic/differential_speed.shtml

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MDT Implementation Status: July 2016

The information gained from this research project will be used as appropriate and needed when making speed limit related decisions and policies.

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