Utilizing Weigh-In-Motion for Integrated Average Speed and Weight Enforcement

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Introduction

Vehicle safety is a very important issue in North America. This study looks at alternative uses to current transportation technologies Numerous engineering safety countermeasures are deployed in order to reduce the number and severity of collisions on the road. Speed limits are one example of a traditional method of imposing safety restrictions on the travelling speed of vehicles.

Differential Speed Limits

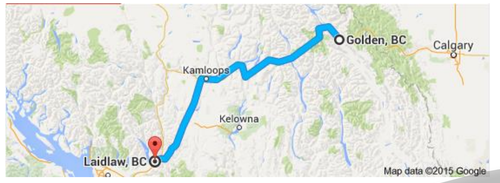
Differential speed limit are when different vehicles have a different maximum speed limit imposed on them depending on some established criteria like vehicle classification or gross vehicle weight. Differential speed limits based on gross vehicle weight are difficult to enforce, as current technology capable of effectively and automatically doing this is not being utilized.

Weigh-In-Motion

Weigh-In-Motion, or **WIM**, are systems designed to capture and record axle weights and gross vehicle weights as vehicles drive over a measurement site. Unlike static scales, WIM systems are capable of measuring vehicles traveling at a reduced or normal traffic speed and do not require the vehicle to come to a stop. This makes the weighing process more efficient, and, in the case of commercial vehicles, allows for trucks under the weight limit to bypass static scales or inspection.

This Study

This study examines a collection of WIM data collected from two different locations in British Columbia, Canada, and examines the statistical relationships between a vehicle's speed, classification, and gross vehicle weight (GVW). Data comes from the WIM stations outside of Laidlaw and Golden, spaced 560km apart located on the Trans Canada Highway. Data comes from the year of 2014, and the associated weather data has been obtained from Environment Canada.

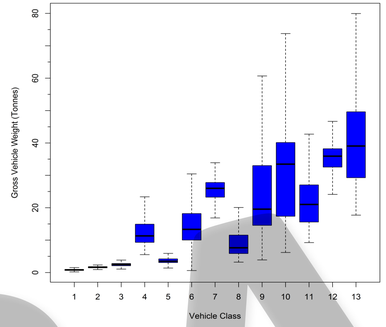


Methodology

In order to properly analyse the large amounts of data, the statistical language R is used to produce figures and to interpret data. Data is examined separately from each site and the influence of factors such as time of day, season, temperature, wind speed, and weather conditions are examined. As well, specific vehicle trips are analysed by using Weigh2GoBC Automatic Vehicle Identification (AVI) system, and conclusions can be drawn from the vehicles that travel the route that qualify for this program.

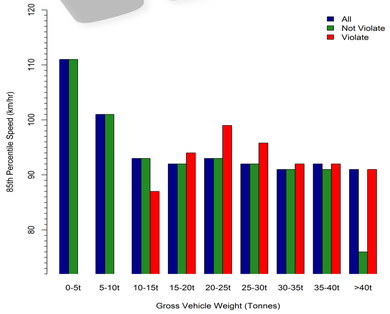
GVW and Vehicle Classification

Initial analysis shows that despite vehicle classification often being used to determine differential speed limits, GVW is a statistically more significant factor in calculating differences in 85th percentile speed. This draws the conclusion that GVW should be used to set differential speed limits, and not vehicle classification which is often arbitrary. A truck's GVW can very greatly depending if it is loaded or not, but it retains the same vehicle class and reduced speed limit in areas that use differential speed limits based on classification.



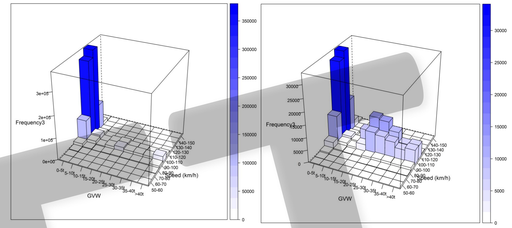
The above figure shows the variation in GVW in the vehicle classes in the FHWA 12-class scheme. Data is used from the Golden station.

By switching to a GVW differential speed limit, speed limits can be set more appropriately for lower and higher weight vehicles. 85th percentile speeds are shown below for different GVW groups. The chart also includes individual data for vehicles with favorable and overweight GVWs.



Influencing Factors

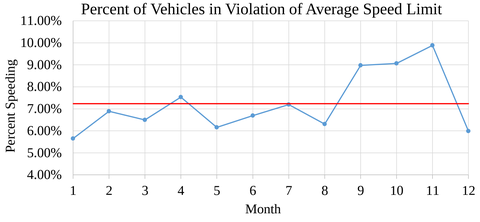
The single site analysis also looked at some possible influencing factors that affect drivers speed. It is found that time of day, season, and weather all influence drivers speed in all classifications and GVWs.



The above figures shown the difference in distribution of the frequency of drivers occurring in different GVW-Speed groups. The left figure (day) shows a higher percentage of low GVW vehicles and a higher overall speed, where the right figure (night) shows higher percentage of high GVW vehicles and a lower overall speed. This suggests that factors such as time of day, season, and weather could be included in a highly efficient variable differential speed limit based on GVW.

Average Speed Enforcement

Using WIM technology as a speed enforcement tool has been something the industry has been apprehensive of due to the perception that this will cause drivers to slow down only for the sensors and then immediately speed up again. However, using the concept of average speed enforcement over a distance with WIM sensors on either end would eliminate this concern and would force drivers to obey the average speed limit over the entire section of face automatic penalty. Using licence plate recognition or some other form of vehicle identification would allow jurisdictions to automatically enforce both average speed and GVW in areas, and would even allow the implementation of variable differential speed limits based on GVW. To explore this option, average speeds of vehicles registered with Weigh2GoBC in 2014 were calculated. Vehicles in this program are only heavy trucks with good vehicle history, so the results can be said to be very conservative.



As shown in the above figure, the percentage of vehicles speeding varied by month, but given the very conservative data set on average 7.24% of vehicles average trip speed was above the average speed limit.

Conclusion

The conclusion of this study is to recommend that jurisdictions and professionals in the transportation industry begin to look at using WIM technology as a tool to enforce integrated average speed and weight enforcement. It is also recommended that variable speed limits be implemented based on GVW and not vehicle classification. This would allow more appropriate speed limits to be set based on the 85th percentile speed of groups of similarly weighted vehicles. Lastly, it is recommended that if jurisdictions implement these methods that they also look at varying the speed limits based on factors that influence vehicle speed in their area, including but not limited to time, season, and/or weather. It is the conclusion of this study that implementing these methods could allow for safer, more efficient speed limits for modern drivers.

Future Direction

It is recommended that further study be done on shorter routes to access the efficiency of average speed enforcement based on GVW. Additionally, it is recommended that jurisdictions complete their own study to determine which factors are the largest influence on vehicle speeds in their areas.

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