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Setting Work Zone Speed Limits

tech transfer summary

Temporary speed limit reductions in work zones can help improve work zone safety by reducing travel speed variability and average speeds.

Problem Statement

The effects of temporary speed limit reductions on highway work zone safety need to be examined to determine whether a speed limit reduction is warranted and the optimum speed limit reduction under given work zone conditions.

Background

The Iowa Department of Transportation (DOT) estimates that there are up to 500 road construction work zones in and around Iowa's cities and counties from March through November each year.

Work zone environments introduce hazards for both motorists and construction workers due to disruptions to the normal driving environment, including narrower lanes, closed shoulders, lane closures, lane shifts, and reduced traffic mobility. Moreover, Iowa work zones have seen an increase in crashes over the past 10 years.

Temporary speed limit reductions in work zones are a common countermeasure for improving work zone safety, particularly when THE work is occurring on or near the roadway. Reduced speed limits may serve at least three important functions:

- Reduce variability in travel speeds and the potential for work zone crashes
- Reduce average travel speeds and the severity of the crashes that do occur
- Enhance worker safety

Google Street View image in a work zone near Sergeant Bluff, Iowa

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RESEARCH PROJECT TITLE
Setting Work Zone Speed Limits

SPONSORS
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The mission of the Center for Transportation Research and Education (CTRE) at Iowa State University is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, reliability, and sustainability while improving the learning environment of students, faculty, and staff in transportation-related fields.

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Objectives

The objectives of this project were to assess the effectiveness of speed limit reductions in work zones and investigate the impacts of different speed limit reduction schemes on capacity.

Research Description/Methodology

Sites and Data Sources

Initially, 21 work zone projects—12 completed in 2014, 6 completed in 2015, and 3 ongoing in 2016—were chosen from among the Iowa DOT's Traffic Critical Projects (TCP). Projects varied from urban high-density to rural high-speed areas, and Intelligent Work Zone (IWZ) systems had been deployed at these sites.

More than 7 gigabytes of data were initially collected. Vehicle speed data before and during the construction periods on each road were collected using Wavetronix sensors. Data included vehicle counts, average speeds, and sensor time occupancy in five-minute intervals for each traffic lane.

Spatial-temporal information for when and where each work zone was in place and its layout and activities could not be collected directly due to privacy policies. This information was deduced from Iowa DOT construction contract documents, which provided planned start and end dates for each work zone; Iowa 511 archives, which provided start and end times for events such as road closures; and Advanced Traffic Management System (ATMS) message archives, which provided traffic control plans. However, the information was inconsistent and could not be resolved at 5 minute temporal resolution.

Data Validation and Reduction

Data reduction and quality assurance/quality control techniques were used to validate and reduce the initial data:

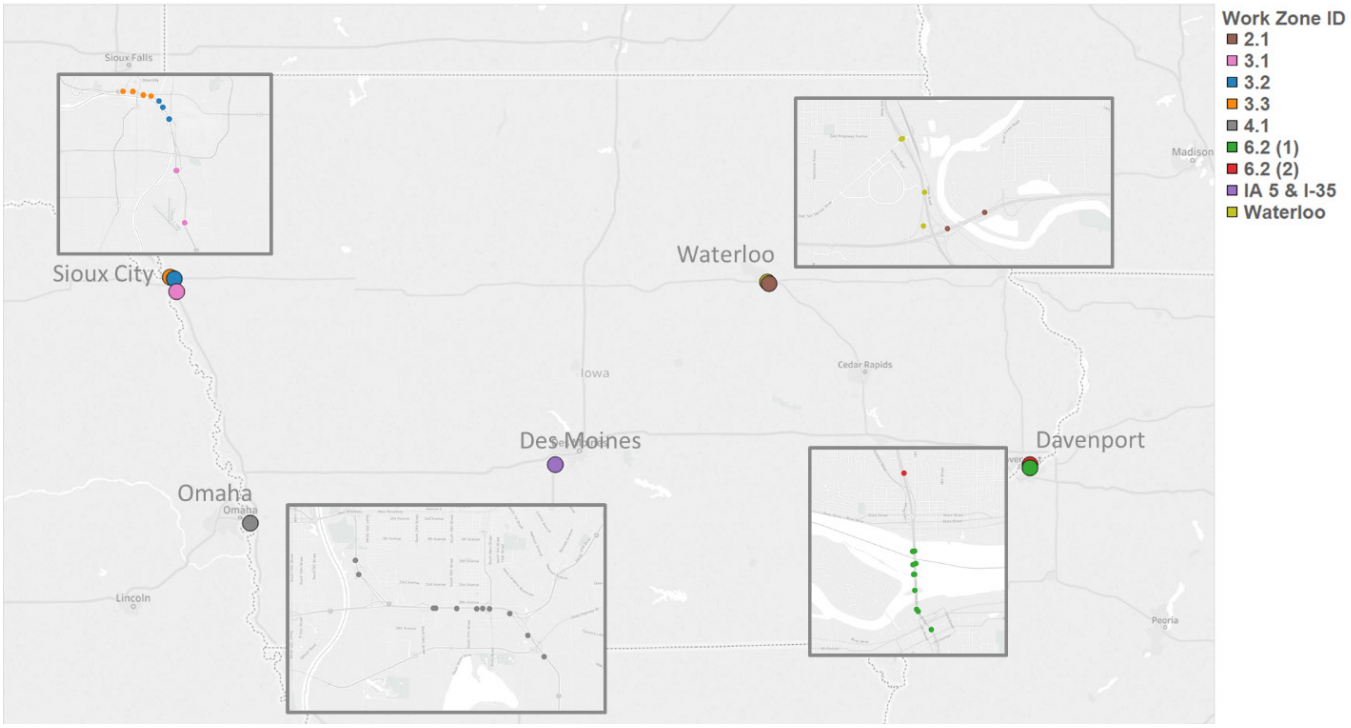
1. Traffic flow theory was used to identify faulty sensors and other data quality issues.
2. The spatial-temporal data were compared to determine periods when a work zone was in place.
3. Only those data corresponding to daytime traffic, free-flow conditions, and good weather conditions were used.

After reduction and validation, 14.9 megabytes of data from nine work zone sites completed in 2014 and 2015 remained for modeling. The work zones' normal speed limits were verified by reading the speed limit signs in the corresponding Google Street View images.

Analysis

A crash analysis was not deemed reliable due to inconsistencies among the datasets used to determine the location, time, and type of work zone activity.

Quantile regression models were estimated to examine how speed distributions varied depending on whether a work zone was in place and the posted statutory and work zone speed limits. Separate models were estimated for the 15th, 50th, and 85th percentile speeds of the vehicles at each work zone.



Locations of nine work zones and some of the sensors

Key Findings

- The regression models showed that, in general, drivers maintained good compliance with both the original speed limit and the work zone speed limit.
- Level of compliance was found to vary from site to site, which likely reflects important unobserved factors related to the work zone's characteristics or to the specific road segments.
- Overall, speed variation may not be affected by congestion when the occupancy rate on the road is less than 20%.
- Overall, reduced work zone speed limits helped to reduce drivers' speeds when they were traveling through a work zone. Speeds were consistently reduced when work zone speed limits were in place.
- Work zone speed limit reductions of 10 mph in locations where the normal statutory speed limit was 65 mph showed the largest reduction in all speed percentiles.

Recommendations and Future Research

- Speed limits should be reduced in work zones with high speed limits, while the speed limit should be kept to at least 55 mph to avoid affecting capacity.
- Given that extensive data are collected annually at many high-priority work zones, subsequent research covering additional work zones can provide further information to help inform work zone speed limit policy decisions.
- The present research couldn't include the exact type of work activity due to data inconsistencies. This affects the transferability of results to other sites, and it is highly recommended that work zone activity type should be included in future research to further corroborate the above results.
- Improvements in data resolution and availability, especially in terms of a traffic control diary, will make future studies more precise. Moreover, including weather variables during modeling could improve the model's results and help us verify the influence of weather on work zone traffic characteristics.
- The statistical analysis used in this study could be extended to include real-time data to evaluate speed limit reduction strategies.
- A near-real-time work zone performance analysis tool created to analyze 2016 work zones for the Iowa DOT could utilize speed data updated every 20 seconds and video images updated every 5 minutes to show near-real-time speeds. The tool could also be used to generate daily slowness cumulative distribution functions, which can provide a more straightforward, quicker way than statistics to discern latent impacts on speeds.

Implementation Readiness and Benefits

Temporary speed limit reductions in work zones can help improve work zone safety in at least three ways: by reducing variability in travel speeds and the potential for work zone crashes and by reducing average travel speeds and the severity of the crashes that do occur, and by enhancing worker safety.

This project identified some effects of speed limit reduction, even if the findings could not generally be applied to all situations. The work zone activity type could not be parsed effectively from the existing datasets and, hence, some of the speed reductions might be dependent on the work type.

The findings warrant the recommendation that speed limits be reduced in work zones with high speed limits, while the work zone speed limit should be kept to at least 55 mph to avoid affecting capacity.