TDOT Department of Transportation

Research Summary

A Localized Safety Performance Functions Approach Accounting for "Within" Tennessee Variations on Freeways & Interchanges

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WHAT WAS THE RESEARCH NEED?

Safety Performance Functions (SPFs) in the Highway Safety Manual (HSM) are the core predictive models and can help identify high crash frequency locations. However, the default SPFs for freeways and interchange ramps may not truly represent the local conditions in a particular state, as researchers have typically developed them using data from other states. The geographical conditions of Tennessee can be considerably different from those of the states used to develop SPFs in the HSM and related studies. Therefore, TDOT needed to calibrate the SPFs using local data or developing jurisdiction-specific SPFs.

WHAT WERE THE RESEARCH OBJECTIVES?

The objectives of this research included:

- Develop calibration factors (CFs) for freeway segments (interstates and expressways) and interchange ramps.
- Estimate TN-specific SPFs for freeway segments and interchange ramps
- Provides "highly localized" SPFs for freeways.

WHAT WAS THE RESEARCH APPROACH?

The research team created a unique database for freeways and interchange ramps that includes crashes, roadway inventory, traffic, demographics, and other important attributes using various sources, such as the Enhanced Tennessee Roadway Information Management System (E-TRIMS), TDOT's Traffic History Data Applications, the Tennessee Traffic Information Management and Evaluation System (TN-TIMES), and Google Earth. The team

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applied traditional and advanced methods to estimate SPFs that can account for spatial and temporal variations in safety on freeways and interchange ramps within Tennessee. Specifically, this project demonstrates the application of Geographically and Temporally Weighted Regression models in the development of TN-specific SPFs. The study provides information on integrating the new concept of localized SPFs into TDOT's network screening process and more broadly in AASHTOware safety analysis tools being adopted by TDOT.

WHAT WERE THE FINDINGS?

The key findings of this research include:

- Generally, calibration factors for fatal and injury (FI) crashes are on the low side, which means that the observed crashes on Tennessee roadways are lower than the HSM 2010 prediction using default safety performance functions.
- Disaggregating crashes into ramps and interstate segments shows that entrance ramp-related property damage only (PDO) crashes have a higher CF (= 2.33), meaning that there is more potential for safety improvements for these types of crashes.
- For expressway segments, there are three types of crashes with a CF higher than 1.00, including ramp entrance speed-change lane PDO crashes (CF= 1.73), non-ramp-related PDO crashes (1.10), and PDO crashes in the first approach (CF= 1.11).
- Separate analysis of entrance and exit ramps in interchanges were found to have the potential for safety improvements, as all CFs calculated for these facilities are greater than 1.00. Furthermore, exit ramps were found to have higher CFs than entrance ramps.

IMPLEMENTATION AT TDOT

To enhance safety on Tennessee roadways, the following recommendations are provided:

- **Adoption of Highway Safety Manual procedures and calibration factors.** Given the investments in the calibration of HSM (2010) procedures, TDOT should implement the predictive procedures and information generated in this study to identify locations where safety countermeasures can be targeted.
- **Countermeasure selection.** Based on the findings of this study, TDOT can apply the HSM procedures to freeway segments and interchange ramps in Tennessee.
- **Potential to reduce high-risk crashes.** Higher Tennessee CFs indicate a relatively greater potential to reduce crashes. Freeways and interchange ramps where CFs are greater than 1 can be promising locations for safety improvements in Tennessee.
- **Consideration of regional and temporal differences.** This study demonstrates the use of more localized and accurate crash prediction models. Such models assist with prioritizing regions and roadways segments for implementing safety improvement projects.

MORE INFORMATION

Find the final report here: https://www.tn.gov/content/dam/tn/tdot/long-range-planning/research/final-reports/res2020-final-reports/RES2020-04_Part1_Final_Report_Approved.pdf.

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