TECHSUMMARY *March 2021*

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Impact of Centerline Rumble Strips and Shoulder Rumble Strips on all Roadway Departure Crashes in Louisiana Two-lane Highways

INTRODUCTION

Roadway departure crashes are a serious concern in the state of Louisiana, specifically on rural two-lane (R2L) and urban two-lane (U2L) highways. Centerline rumble strips (CLRS) and shoulder rumble strips (SRS) are inexpensive countermeasures designed to prevent roadway departure crashes by creating a tactile vibration and audible rumbling by alerting distracted or inattentive drivers to take corrective action before roadway departure. In line with the nationwide urgency to cut down roadway departure crashes, the Louisiana Department of Transportation and Development (DOTD) continued to install rumble strips as part of preventing roadway departure crashes—one of the top priorities in halving the number of traffic fatalities and severe injuries from 2009 to 2030. This study investigated the impact of rumble strips that were installed between 2010 and 2016 on more than 1,600 miles of Louisiana two-lane highways. This project analyzed the crash characteristics of before and after years, used the state-of-the-art roadway safety evaluation methods to estimate the crash modification factors, and estimated the benefit-cost ratio of rumble strips.

Figure 1
A segment with both CLRS and SRS that has been Verified Using Google Street View

OBJECTIVE

The goal of this project was to evaluate the safety impact of CLRS and SRS, individually and combined together on rural and urban two-lane highways under the DOTD system. Specifically, the main objectives were to:

1. Investigate the safety effectiveness of CLRS and SRS (in single or combination) on two-lane highways under the DOTD system.
2. Estimate the safety benefit-cost ratio of the countermeasures.

SCOPE

This project focused on the rumble strips on the two-lane highways, rural and urban, under the Louisiana Department of Transportation and Development system.

METHODOLOGY

To capture all departure scenarios and take full advantage of crash data, the observed crash analysis includes not only conventional total crashes and targeted crashes, but also crashes with combined key crash attributes as well as selected crash report reviews, which helps to clarify the ambiguous or inconsistent information identified during the initial analysis. Crash modification factors (CMFs) are estimated through the before and after empirical Bayes (EB) analysis, comparison group EB analysis, cross-sectional analysis (with-and-without rumble strips), and autoregressive integrated moving average (ARIMA) intervention model of trend analysis.

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CONCLUSIONS

The analyses from all four methods yielded similar results on the effectiveness of rumble strips. The estimated CMF for total crashes with the before-and-after EB method is 0.835 for rural and 0.695 urban two-lane highways with rumble strips. The estimated CMFs for fatal and severe injury crashes are more impressive at 0.590 for rural and 0.463 for urban. The expected CMFs from before-after EB method are 0.845, 0.95 and 0.764 for CLRS, SRS, and a combination of CLRS and SRS on rural two-lane highways, respectively. They are 0.677, 0.655, and 0.839 on urban two-lane highways, respectively.

CLRS on two-lane highways is a very effective crash countermeasure for fatal and severe injury crashes. The fatal and severe crash reduction is as high as 35.8% on rural and 47.8% on urban—much better than the results from most of the previous studies. CLRS also significantly reduces the targeted head-on collisions—one of the deadliest crashes—41.8% and 50% for the rural and urban two-lane highways, respectively. The crash reduction is impressive for sites with both CLRS and SRS with the highest percentage reduction in fatal and severe injury crashes (22.2% for R2L and 75% for U2L). The estimated CMF with before-and-after EB method for R2L is 0.764 for total crashes and 0.556 for fatal and severe injury crashes.

The huge economic benefits of rumble strips are manifested by the ratio of benefit to cost—12.98 for combined all rumble strips cases on rural two-lane highways, and 14.64, 1.9, and 7.37 for the CLRS, SRS, and both (CLRS and SRS), respectively. The ratio is 37.2 for all rumble strips on urban two-lane highways, 38.27 for CLRS, and 83.55 for CLRS and SRS combined. This study demonstrates rumble strips as a low-cost, effective crash countermeasure on two-lane highways.

RECOMMENDATIONS

While the expensive crash countermeasures, such as flattening horizontal curves and roadside slopes (4:1 or flatter), widening lane width or shoulder width, and making roadside in higher degree of forgiving, are almost infeasible under the financial constraints, rumble strips at centerline, shoulder, or both locations are the best low-cost engineering solutions in reducing roadway departure crashes, particularly the fatal and severe injury crashes. To reach the state's goal of Destination Zero Deaths, rumble strips should be considered for installation along two-lane highways everywhere if financially feasible, or if not, by prioritizing the installation projects based on either the crash frequency or crash risk at the network level. Based on the findings of this project, the following recommendations are made to the state DOTD Safety Improvement Program:

- Continue the state current systematic safety improvement program for rumble strips installation at locations with high roadway departure crashes and or high targeted crashes such as head-on collisions.
- Consider utilizing systemic safety analysis method to select sites with low AADT but high risk of roadway departure crashes. The risk analysis considers not only crash frequency and severity but also the roadway design (for example horizontal curve with small radius) and traffic operation features (speed differential between adjacent segments and different type of vehicles).
- Support parish and local government in rumble strips installation on non-state highways since these roadways may have high roadway departure risk. The risk analysis considers not only crash frequency but also design features.
- Work with the state crash record committee to correct few crash recording errors on the sequence of harmful event that was discovered in this project.