TECHSUMMARY April 2012

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Safety Improvement from Edge Lines on Rural Two-Lane Highways

INTRODUCTION

The previous study "Impact of Edge Lines on Safety of Rural Two-Lane Highways" completed in 2005 concluded that, with edge lines, centralization of a vehicle's position is more apparent during nighttime, which reduces the risk of run-off-road (ROR) accidents and head-on collisions, and edge line markings generally cause drivers to operate their vehicles away from the road edge, irrespective of the roadway alignment. Does the changed vehicle lateral position reduce the frequency of crashes? Answering this question is important to the Louisiana Department of Transportation and Development (LADOTD) since implementing and maintaining edge lines on narrow two-lane highways require significant resources from LADOTD. There are more than 40 percent of rural two-lane highways in Louisiana with a pavement width (excluding shoulders) of less than 22 ft. with no edge lines.

OBJECTIVE

The goal of this project was to investigate the safety impact of edge lines on rural, two-lane highways in Louisiana. Specifically, the research objectives were to:

- Identify the segments that will benefit from implementing the pavement edge line the most;
- Implement pavement edge lines at selected locations; and
- Conduct a before-and-after study at these locations to estimate the crash modification factors (CMF)

SCOPE

The study was conducted on the selected narrow, rural two-lane highways from all LADOTD districts. It was done with the cooperation of all LADOTD districts for edge line implementation on selected segments.

METHODOLOGY

The study basically consisted of three steps: selection of the segments, edge line implementation, and crash analysis.

Selection of Segments

There are three stages in the selection of segments starting from crash data collection followed by ranking segments mainly based on the safety performance of the segments. Due to the discrepancies of highway attributes (such as existence of edge lines and types of highway), the last stage of the step one is to verify whether each selected segment is on a narrow, rural two-lane highway with no edge line. The final results of the step one are summarized in Table 1.

LTRC Report 487

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Table 1
Summary of selected segments by districts

District	Section Length	No. of Control Sections
2	5.79	2
3	39.80	10
4	5.93	2
5	24.75	5
7	12.51	2
8	4.91	3
58	1.17	1
61	7.85	3
62	13.90	6
Total	116.61	34

Implementation of Edge Lines

Edge lines were implemented on selected segments between March 2008 and June 2008 by districts and were partially verified by site visits during the summer of 2008 by the research team.

Crash Analysis

The third step in this study was to find out whether edge lines have an impact on crash reduction by three statistical methods. For comparison purposes, three statistical methods were used here for crash data analysis. Although it is not ideal to use crash data from three years prior and only one year after in the analysis, the already extended deadline of this project limited the scope. By adopting the latest crash data analysis techniques, the potential regression-to-the-mean effect was minimized with only one-year crash data from the "after" time period. The summary of crash data is given in Table 2.

Table 2
Summary of crashes by district

District	2005	2006	2007	2005-07	2009
	Total Crashes	Total Crashes	Total Crashes	Total Crashes K(j)	Total L(j)
2	23	34	24	81	19
3	86	68	67	221	81
4	12	16	8	36	21
5	84	74	84	242	90
7	21	30	14	65	10
8	16	13	15	44	10
58	5	3	4	12	2
61	32	36	17	85	15
62	85	103	83	271	70
	364	377	316	1057	318

For comparison and discussion purposes, three crash data analysis methods were applied. The last method was based on the well-established procedures for highway safety analysis in Ezra Hauer's book *Observational Before and After Studies in Road Safety* published in 2007. The calculation and results of Method One indicate that the crash reduction is somewhat confidently detectable. One obvious weakness of the previous analysis is that it does not account for the regression-to-the-mean and traffic change. Annual average daily traffic (AADT) has been recognized as the most influential factor on annual crash occurrences.

The final results by Method Two are summarized as: the expected crash reduction is 34 with a standard deviation of 20, and the estimated crash modification factor is 0.90 with a standard deviation of 0.056. This method accounts for different time durations between the "before" and "after" periods. But change in traffic volume is still not considered. The final results by the unbiased Method Three are shown that the crash reduction is 92 and the estimated unbiased crash modification factor is 0.784 with a standard deviation of 0.144.

CONCLUSIONS

The following are the major findings from this project:

1. Placing pavement edge lines on rural two-lane highways in Louisiana can not only change vehicle lateral positions but also reduce crashes.
2. The most reliable CMF for edge lines on narrow, rural two-lane highways is 0.78 based on Method Three.
3. Considering the safety trend in Louisiana, the final estimated CMF is 0.83, which means there is a 17 percent expected crash reduction in edge line implementation on narrow, rural two-lane highways.
4. The statistically estimated standard deviation for the CMF is 0.144.

RECOMMENDATIONS

This project recommends the use of edge lines on narrow, rural two-lane highways whenever it is feasible financially and operationally. Since each LADOTD district shoulders the responsibility of implementing pavement markings, LADOTD may want to establish a policy asking each district to implement edge lines if sufficient resources are available. Under financial or operational constraints, roadways with higher traffic volumes should have priority to have edge lines implemented first.