Impact of Pavement Edge Line on Vehicular Lateral Position on Narrow Rural Two-Lane Roadways in Louisiana

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Introduction

- Significant number of crashes occurred on rural 2-lane highways each year in Louisiana

- The dominate type of crashes is ROR
Percentage of crashes by crash type and road width on Louisiana rural 2-lane highways

(a) All crashes

(b) Fatal crashes.
Crash rate by crash type and road width

(a) All crashes

(b) Fatal crashes.
Proper pavement marking is considered one of inexpensive crash countermeasures.
Purpose of Pavement Marking

Marking edge lines intends to provide a visual guide which would help vehicles confining to the safer position within the travel lane.
# Guidelines on Edge Line Implementation for Rural 2-Lane Highways

<table>
<thead>
<tr>
<th>Road Width</th>
<th>Previous MUTCD (1994)</th>
<th>Updated MUTCD (2000)(^1)</th>
<th>Current LaDOTD Policy (1994)(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Requirement</td>
<td>20-ft or Wider</td>
<td>22-ft or Wider</td>
<td></td>
</tr>
</tbody>
</table>

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1. MUTCD the Millennium Edition
2. LaDOTD Engineering Directives and Standards Manual (EDSM)
Concerned Issues

- Edge lines on narrow roadways MAY make motorists operate vehicles closer to the centerline, resulting in an increase of the risk of head-on and sideswipe collisions.

- A thorough investigation of this assumption on edge line marking implementation are necessary before LaDOTD generates a policy and begins implementation of the new edge line requirement contained in the latest edition of MUTCD.
Objective

To investigate the impact of edge line markings on drivers’ behavior on narrow rural two-lane highways in Louisiana with traveled road width between 20 and 22 feet.
Measurements

- **Vehicle lateral position**
  - Close to or crossing the road edge
  - Close to or crossing over the centerline
  - Maintaining a centralized position within the traveled lane

- **Vehicle type (FHWA Schema F)**

- **Operating speed**
Vehicle Lateral Position

Centerline

Road Edge
Measurement of Vehicle Lateral Position

- 0-1 ft
- 1-2 ft
- 2 ft - Centerline
- Crossing Centerline
- Centerline
- Road Edge
After thoroughly experimenting with and evaluating several data collection methods, we used road tubes (also known as air-switch devices). If carefully designed, this method is more reliable, less intrusive, and easier to set up in the field than the other methods available.
Tube layout diagram

Target Lane

Opposing Lane

Traffic Direction

Counter 1

S1

S2

S5

S6

Counter 3

Dummy Tubes

S7

S8

Counter 2

ETW

Centerline

ETW

Dummy Tubes

S3

S4
<table>
<thead>
<tr>
<th>Site ID</th>
<th>State Highway #</th>
<th>Alignment</th>
<th>Speed Limit</th>
<th>Pavement Width</th>
<th>Pavement Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>LA367</td>
<td>Tangent</td>
<td>55 MPH</td>
<td>20</td>
<td>Good</td>
</tr>
<tr>
<td>Site 2</td>
<td>LA367</td>
<td>Curved</td>
<td>55 MPH</td>
<td>24¹</td>
<td>Good</td>
</tr>
<tr>
<td>Site 3</td>
<td>LA 1113</td>
<td>Tangent</td>
<td>55 MPH</td>
<td>18.5</td>
<td>Poor</td>
</tr>
<tr>
<td>Site 4</td>
<td>LA 98</td>
<td>Tangent</td>
<td>55 MPH</td>
<td>20</td>
<td>Good</td>
</tr>
<tr>
<td>Site 5</td>
<td>LA 98</td>
<td>Curved</td>
<td>55 MPH</td>
<td>20</td>
<td>Good</td>
</tr>
<tr>
<td>Site 6</td>
<td>LA 98</td>
<td>Tangent</td>
<td>55 MPH</td>
<td>21</td>
<td>Good</td>
</tr>
<tr>
<td>Site 7</td>
<td>LA 354</td>
<td>Tangent</td>
<td>55 MPH</td>
<td>21</td>
<td>Poor</td>
</tr>
<tr>
<td>Site 8</td>
<td>LA 354</td>
<td>Tangent</td>
<td>55 MPH²</td>
<td>20</td>
<td>Fair</td>
</tr>
<tr>
<td>Site 9</td>
<td>LA 354</td>
<td>Curved</td>
<td>55 MPH²</td>
<td>20</td>
<td>Fair</td>
</tr>
<tr>
<td>Site 10</td>
<td>LA 354</td>
<td>Tangent</td>
<td>55 MPH</td>
<td>20.5</td>
<td>Good</td>
</tr>
</tbody>
</table>

¹. Partially road widened at the curve
². Advisory speed limit of 45 MPH
Results
Speed Change

Average Speed (MPH)

Study Sites

T1 T2 T3 T4 T5 T6 T7 C1 C2 C3

Speed Limit 55 MPH
Advisory Speed 45 MPH

BEFORE AFTER
## Results

**Position Change**
in 0-1 ft & crossing centerline

<table>
<thead>
<tr>
<th>% Close to road edge</th>
<th>% Crossing center line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase</td>
<td>Undesirable</td>
</tr>
<tr>
<td>Decrease</td>
<td>Desirable</td>
</tr>
<tr>
<td>Increase</td>
<td></td>
</tr>
<tr>
<td>Decrease</td>
<td></td>
</tr>
</tbody>
</table>
Daytime changes

(a) Change in percentage

(b) Percentage change rate

\[ \Delta = \frac{p^A_x - p^B_x}{p^B_x} \times 100\% \]
Night Time Changes

(a) Change in percentage

(b) Percentage change rate

\[ \Delta = \frac{p_x^A - p_x^B}{p_x^B} \times 100\% \]
Results

Position Change

(before 1-foot and centerline)

(a) Daytime

(b) Nighttime
Conclusions

- With the edge line, vehicles tend to move away from the road edge; thus, the risk of having a running-off-roadway crash is likely to be reduced.

- The implementation of edge lines is likely to reduce the head-on and sideswipe collisions at night because of the reduced number of vehicles crossing the centerline in the nighttime.

- The benefit of having the edge line at night is significant since the distribution of vehicles is more centralized during this time period.
Conclusion

With ROR being the most common and deadiest type of crashes on rural narrow two-lane highways, the edge line marking does provide the positive guidance to drivers particularly when visibility is compromised at night. Even though the crossing centerline counts at few sites increased during the daytime, it should not increase the frequency of head-on and sideswipe collisions since the traffic volumes at narrow highways are usually small – less than 2,000 per day in this study. For instance, at site T2 where the increase in the crossing centerline counts is the highest during the day, the recorded ADT was only 78.
Future Work

Conducting before-and-after crash analysis to see how the edge line actually affecting the crash frequency at these sites
Acknowledgment

This study is a part of the research project “Impact of Edge Line on Safety of Rural Two-Lane Highways”, supported by the Louisiana Department of Transportation and Development (LaDOTD) through the Louisiana Transportation Research Center (LTRC). The authors wish to thank the project review committee at and LaDOTD and LTRC.
Any Questions?

Thank you!