TECHSUMMARY *December 2020*

State Project No. DOTLT1000217 / LTRC Project No.18-4SA

Intersection on Horizontal Curves: Problems and Potential Solutions

INTRODUCTION

Horizontal curves and intersections pose challenges to drivers and other roadway users because of their unique design and function, which is why both features have been recognized as the target areas for safety improvement in many states' highway safety strategies. There is little research on assessing the safety of intersections on horizontal curves, particularly the two-way stop-controlled (TWSC) intersections on two-lane highways since many such intersections were constructed after the major roadway was built in order to provide accessibility to a minor street. There are more than 5,000 TWSC intersections and 33% of them are on horizontal curves (a radius less than 1,500 ft.) on state-owned and locally owned rural two-lane highways in Louisiana. To improve roadway safety, we need to better understand the magnitude of the problem and identify the risk factors or roadway characteristics that contribute to crashes and the distribution of crash severity at curved intersections in Louisiana.

OBJECTIVE

The goal of this project was to quantify the safety performance of TWSC intersections on horizontal curves of Louisiana state and non-state roads. Specifically, the objectives were to:

1. Determine significance, magnitude, and relevance of the problem
2. Identify risk factors or roadway characteristics associated with intersections on horizontal curves
3. Develop a list of possible countermeasures that target the identified risk factors

SCOPE

This research is on Louisiana TWSC intersections that consist of either a state roadway intersecting another state roadway or a state roadway with a non-state roadway. In all cases, a state roadway is the major roadway.

METHODOLOGY

By developing a comprehensive database containing more than 8,600 TWSC intersections from all 64 parishes in Louisiana, this project compares the safety performance of curved TWSC intersections to the tangent intersections and investigates the impact of curve radius, speed limit, and intersection layout on crash rate by highway type and AADT at aggregate level first, and then develops a risk assessment method to rank the intersections at disaggregate level. Taking advantage of the rich database, the research develops the TWSC intersection safety performance models with negative binomial regression for rural two-lane highways. Through visiting and analyzing the selected intersections, the project demonstrates crash countermeasure selection for the targeted problems.

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CONCLUSIONS

The study results reveal that there is clearly a safety problem associated with intersections on horizontal curves. The magnitude of the problem depends on the AADT, curve radius, intersection skewness angle, number of intersection legs, and speed limit on major road. On rural two-lane highways, the average crash rates for the curved and tangent intersection are 0.261 and 0.186, respectively. The single vehicle crashes are the most common type of crashes (51%) on the curve intersections on rural two-lane highways. The single vehicle crash rate of the curved TWSC intersections with a radius less than or equal to 500 ft. is 1.17 times higher than that with a radius between 1,000 and 1,500 ft. Speeding, or improper operating speed, is a major contributing factor to single vehicle-running-off-roadway crashes. Lack of the warning signs on upcoming curved intersections could also explain the high single vehicle ROR crashes. It is clear some drivers are challenged at curved TWSC intersections particularly at night, which is evidenced by a higher percentage of night-time crashes and higher fatal alcohol involvement crashes. There is clearly a need to improve TWSC intersections on curves at the system level. The low-cost countermeasures are more economical for the intersections with low traffic volume but high crash risk, and the more costly measures are suitable for the locations with high traffic volume and high crash risk. To maintain a sustainable crash reduction trend, the safety problem at TWSC intersections calls for the targeted solutions at the system level with systemic safety approach. Considering 72% or 1,671 curved TWSC intersections and 73.6% of intersections with a radius less than or equal to 500 ft. on rural two-lane highways, it is necessary to tackle these problems now, starting with rural two-lane highways.

RECOMMENDATIONS

Based on the results, the following recommendations are made to the state DOTD Safety Improvement Program to consider:

- Ranking all state TWSC intersections with the weighting factor reflecting DOTD's safety goals and objectives on the emphasized areas for improvement.
- Setting up plans to annually program the low-cost countermeasures implementation for the TWSC curve intersections with low AADT at the state or district level.
- Setting up plans to target the top-ranking locations with high AADT and consistent high crash occurrences in three years for more expensive countermeasures.
- Considering to adopt the developed safety model for rural two-lane TWSC intersection performance prediction and evaluation.
- Re-examining TWSC intersections where AADT on both major and minor roadways are high and similar for alternative traffic control method (roundabout, signalized, or all-way stop sign).