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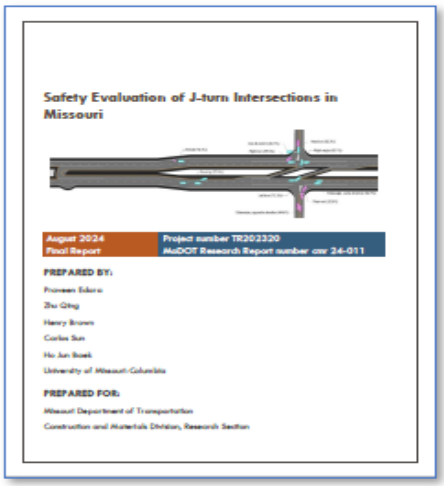
Research Summary

Safety Evaluation of J-turn Intersections in Missouri



The Missouri Department of Transportation (MoDOT) has implemented J-turn intersections to improve road safety on rural highways since 2007. Traditional two-way stop-controlled intersections present significant risks for severe crashes. J-turns, by design, mitigate these risks by directing vehicles to turn right and then perform a U-turn at a designated median opening. The primary objective of this study was to evaluate the safety performance of J-turn intersections in Missouri.

The research employs a robust methodological framework combining comparison group (CG) and empirical Bayes (EB) analyses, crash frequency modeling, and collision diagram analysis to provide a comprehensive evaluation. Data was collected from 47 J-turn intersections that have been installed across Missouri. The study period from 2005-2021 provided several years before and after the J-turn installations, allowing for a long-term steady analysis of crash data.

The CG analysis examined the data of 20 paired J-turns and traditional intersections. There were a total of 395 crashes, including 17 fatal and disabling injury (FDI) crashes, recorded at the 20 J-turns in the study. The results showed that the crash modification factor (CMF) values for 72% of the J-turn sites were below 1.0, suggesting a decrease in total crashes, fatal and injury (FI) crashes, and FDI crashes after their installation.

While the CMF exceeded 1.0 at five sites, these values were not statistically significant at the 95% confidence level. Overall, the CG results showed a reduction of 44.4% in total crashes, 46.6% in FI crashes, and 74.5% in FDI crashes at the 95% confidence level. The CG results demonstrate that converting from a two-way stop control to a J-turn significantly decreases the number of FI crashes, total crashes, and especially FDI crashes.

"The safety analysis of Missouri's J-turn installations provides robust evidence of a significant reduction in crashes."

The EB analysis examined the data of 32 J-turn intersections. There were 682 crashes, including 167 FI crashes, recorded at the 32 J-turn in the study. The results showed that 85.9% of sites had a CMF value below 1.0. For FI and FI (KAB) crashes, although eight sites had CMF values greater than 1.0, none was statistically significant. For total crashes, 17 sites demonstrated a significant reduction at the 95% confidence level, but two sites experienced a significant increase. After reviewing the CMF calculations and crash data, the likely cause of the unexpected increase was identified as the lack of minor road AADT data, which could have resulted in inaccurate crash predictions. Overall, the EB analysis showed J-turns reduced

FI crashes by 51.4%, FI (KAB) crashes by 52.3%, and total crashes by 40.3%.

J-turn crash frequency modeling provided insights into how J-turn-design characteristics impact safety. Using data from 26 J-turns and 412 crashes regression models were developed to predict crash frequency. The results showed that design features like the presence of deceleration/acceleration lanes, loons, and islands had a positive impact on safety. The J-turn sites with left turn lanes on the major road experienced a higher number of crashes than sites without any left turn lanes. This finding was expected as left turn lanes were typically provided at sites with high overall traffic volume and left turning volumes.

The collision diagram analysis helped identify crash types and locations within the J-turn area (as shown in Figure E.1). The analysis showed a shift from right-angle and left-turn collisions at traditional intersections to sideswipe collisions at J-turns. Notably, most crashes occurred where minor road traffic merges onto highways. The observed crash locations also suggest how J-turn designs can effectively mitigate risks.

In summary, the safety analysis of Missouri's J-turn installations provides robust evidence of a significant reduction in crashes. The CMFs and collision diagrams generated in this study can help MoDOT select sites and design criteria for future J-turn installations in the state.

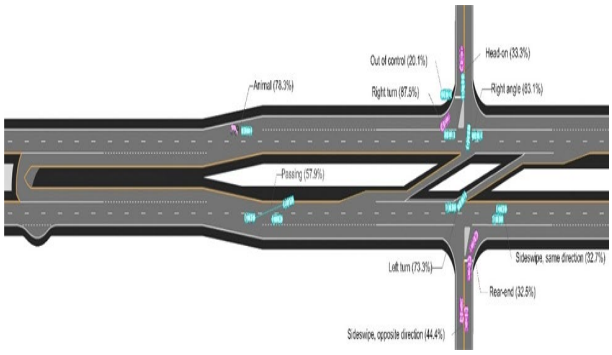


Figure 1: Most frequent crash location for each type of crash.

Project Information

PROJECT NAME: TR2023020—Safety Evaluation of J-turn Intersections in Missouri

PROJECT START/END DATE: January 2023-July 2024

PROJECT COST: $299,722

LEAD CONTRACTOR: University of Missouri-Columbia

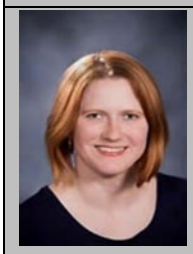
PRINCIPAL INVESTIGATOR: Praveen Edara

REPORT NAME: Safety Evaluation of J-turn Intersections in Missouri

REPORT NUMBER: cmr 24-011

REPORT DATE: August 2024

Project Manager



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