Executive Summary and Research Readiness Level Assessment

Offset Right-Turn Lanes on State Highway Systems

Research Objectives

Provided guidance to supplement NDOT's project development process and assisted with decisions regarding provision of right-turn lanes at two-way stop-controlled intersections on high-speed highways.

Provided guidance to supplement NDOT's project development process and assisted with the decision regarding when to offset right-turn lanes.

Items that may go into the guidance will include proposed project type, traffic volumes, applicable Highway Safety Manual procedures, benefit/cost analysis, and design considerations.

Research Benefits

The research enabled NDOT to make more informed and consistent decisions regarding provision of traditional right turn lanes, ORTLs, or removing existing right turn lanes at two way stop-controlled intersections on state highways.

The project results helped with more efficient use of limited funds available for reconstruction of two- way stop-controlled intersections and possibly improve public safety.

Principal Investigator

Aemal Khattak (P.I.)
University of Nebraska

Lead TAC Member

Alan Swanson
Traffic Engineer

Background

This research focused on two aspects related to Offset Right Turn Lanes (ORTLs) on Nebraska state highway two-way stop-controlled intersections. The first was the crash safety and economic benefits of ORTLs compared to intersections with no right turn lanes or traditional right turn lanes. The second was driver stopping behavior at stop signs at two-way stop-controlled intersections equipped with ORTLs. The research team reviewed information from various published studies, analyzed crash data reported at 47 two-way stop-controlled intersections as well as collected and analyzed driver stopping behavior at six ORTLs in Nebraska. Traffic volume and reported crashes during 2012-2015 were statistically analyzed to assess safety effectiveness of three different types of right-turn lanes at two-way stop-controlled intersections. The three categories included intersections with ORTLs, no right turn lanes, and traditional right turn lanes. Cost-benefit analysis was conducted to ascertain viability of ORTLs. Driver stopping behavior on the intersection minor approaches (controlled by stop signs) at six intersections was examined to evaluate if drivers take advantage of the improved sight distance afforded by the ORTL at an intersection.

Conclusion

ORTLs had the lowest crash rates among the three intersection categories (intersections with ORTLs, no right turn lanes and traditional right turn lanes); however, the difference was statistically not significant. Average annual daily traffic was the only statistically significant factor related to crash frequency among these categories. The cost-benefit analysis indicated that compared to intersections with no right-turn lanes, ORTL intersections had an annual reduction of 0.202 crashes per million entering vehicles, which translates to $22,662 savings in crash costs per year. When compared with intersections having no right-turn lanes, a traditional right-turn lane reduced 0.0758 crashes per million entering vehicles annually or $8,504 savings in crash costs per year. Results of driver stopping behavior data analysis showed that number of through lanes, width of right-turn lane and width of the ORTL offset were statistically associated with driver's stopping position on the minor approach and overall observed drivers were in good position to take advantage of the ORTLs improved sight distance.

In general, ORTLs have safety and economic benefits compared to two-way stop-controlled intersections with no right turn lanes and with traditional right-turn lanes. Given evidence that stopped drivers are in position to take advantage of improved sight distance afforded by ORTLs, they should be considered in the design/redesign of two-way stop-controlled intersections on priority basis. This recommendation is subject to site-specific conditions, which may vary considerably. Removal of right-turn lanes created from re-striped shoulders to intersections without right turn lanes is not recommended due to potential increase in crash rates.

Executive Summary and Research Readiness Level Assessment

Interested in finding out more?

Final report is available at:
NDOT Research Website

NDOT Recommendations Based Off of Research Project

Over the past couple years, the Traffic Engineering Division of the Nebraska Department of Transportation (NDOT) has reviewed several intersections related to this research report. Information from research M060 has been used for internal discussions with Traffic Engineering, Roadway Design, and District personal at the NDOT on project related decisions. In addition to NDOT projects, we have utilized some of the research in discussions with developers, when constructing new turn lanes along the State highway system.

With the completion of this research, the NDOT intends to re-visit guidance found in NDOT's Roadway Design Manual. Section 1.D of Chapter 4 is the primary location for information related to ORTLs, but other section of the manual will be updated as needed. This Section is used internally at NDOT with its' Engineering staff, private Consultants working on behalf of NDOT on State projects, and also by private Consultants working on permits to modify access along the State highway.

- *As provided by Alan Swanson, Lead TAC Member*

Research Readiness Level (RRL) Assessment

RRL 4

Level 4: (Implementation with Follow up)

-Research/Technology refined and adopted by the Department. Benefits of the implementation will be evaluated for a time frame of 5 years.

This brief summarizes Project SPR-1(17) M060
"Offset Right-Turn Lanes on State Highway Systems"
Nebraska Department of Transportation Research Program