

Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Update of Intersection/Interchange Guidelines for Rural Expressways in Nebraska

Research Objectives

- Assess the operational and safety performance and associated costs of different alternative design options available for reconfiguring rural two-way stop-controlled expressway intersections based on the current state-of-the-art method adjusted to Nebraska conditions.
- Assess the construction and maintenance cost of different options that are available for intersections/interchanges based on recent market values and practices.
- Develop rural expressway intersection reconfiguration guidelines based on benefit/cost analysis of the alternative design options.

This research will focus on the following intersection options: two-way stopped-controlled (TWSC) intersections, signalized intersections, diamond interchange, DDI, RCUT, and roundabouts. The analyses will include both four-legged and three-legged facilities, as appropriate. As part of the operational analyses, this research will develop 1) deterministic models (e.g., HCS) to assess the operational impacts of at-grade intersections and interchanges and 2) microsimulation models calibrated and validated for Nebraska conditions to assess in-depth operational impacts of location-specific facilities. Note that these models will be accessible to NDOT, if they wish to use them.

Research Benefits

The proposed research project will not only update existing guidelines utilizing the latest information available but also include new options for dealing with rural expressway intersections controlled by two-way stop signs. This will enable NDOT staff to make more informed decisions well into the future and improve expressway intersection operation and safety in Nebraska. The eventual benefits will be efficient operation and improved expressway intersection safety in Nebraska.

Background

NDOT staff frequently deals with the decision to change an existing two-way STOP-controlled expressway intersection to either a signalized intersection or an interchange. Current guidelines for such decisions are in the "Interchange vs. at-grade intersection on rural expressways" report No. TRP-02-25-91, May 1992. This report deals with conversion of two-way STOP-controlled intersections to either a signalized intersection or a full diamond interchange with STOP-controlled off ramps. The report is dated and NDOT staff needs guidance on additional options (e.g., roundabouts, RCUT) besides the two mentioned in the report. This research is proposed to update the guidance in the report using the latest cost components (e.g., crash costs) and newer methodology that incorporates additional options besides the original two (signalized intersection and full diamond interchange). The proposed research would consist of updated methodology for three major components: 1) Assessment of operational efficiency and associated costs based on current state-of-art method adjusted to Nebraska conditions, 2) Safety and associated cost estimations based on recent crash data, and 3) Construction cost assessment based on recent market values and practices. The original research relied on the Highway Capacity Software (HCS). The proposed research will also utilize calibrated and validated microsimulation models for Nebraska conditions to assess in-depth operational impacts.

Conclusion

Nebraska Department of Transportation (NDOT) staff frequently decide on changes to existing two-way stop-controlled (TWSC) intersections on rural expressway to alternative facilities, such as a restricted crossing U-turn (RCUT), a roundabout, a signalized intersection, or an interchange. As Nebraska makes progress toward completion of its expressway system, updated and defensible decision-making is essential for conversion of TWSC highway intersections. NDOT's existing guidelines, developed in the 1990s, no longer reflect current operations, safety performance, or modern intersection designs. This project updated and expanded NDOT's guidance using contemporary traffic operational and safety data, combined with robust microsimulation and safety performance modeling. Traffic operations data were collected from TWSC, RCUT, roundabout, and signalized intersections on rural Nebraska expressways, as well as from diamond interchanges with stop-controlled and signalized ramps and a diverging diamond interchange. These facilities were modelled in a microsimulation environment calibrated to Nebraska driving behavior, generating more than 11,500 scenarios covering a wide range of major road, minor road, and ramp volumes, turning combinations, and time-of-day conditions. The simulation results were used to develop statistical models for estimation of operational delays and predictions of the most suitable intersection/interchange alternatives. Safety analysis incorporated crash data from TWSC intersections along rural expressways to develop a negative binomial model for estimation of crash frequencies across different traffic scenarios. The safety performances of alternative at-grade facilities were estimated using appropriate crash modification factors. This study used the FHWA "Interchange Comparison Safety Tool" to estimate crash frequency at conventional diamond and diverging diamond interchanges. Furthermore, the research team compiled construction and retrofit cost information from national sources and Nebraska-specific projects for a comprehensive benefit-cost analysis. The resulting guidelines integrated benefit-cost outcomes with operational and safety analyses, engineering judgment, and national best practices. These data-driven guidelines provide NDOT with a modern, consistent, and defensible framework for evaluating intersection upgrades, selecting interchange types, and assessing grade-separation needs on Nebraska's rural expressways.

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Interested in finding out more?
Final report is available:
[HERE](#)

NDOT Recommendations Based Off Research Project – 2026 – RRL3

This project provides the NDOT with data-driven guidelines for evaluating intersection upgrades and selecting interchange types for existing two-way-stop-controlled intersections on rural expressways. This research focused mainly roundabouts, unsignalized RCUTs, and Diverging Diamond Interchanges (DDIs), along with conventional alternatives. There is still a gap in guidance for other unconventional designs, which the follow up project [SPR-FY27\(073\)](#) will provide.

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Research Readiness Level (RRL) Assessment

Level 3: Development

Follow up after completion of FY27(073) in 2028.

RRL 3

Technology Transfer

Transportation Research Board (TRB) papers and Publications

- Haque, MM Shakiul, and Aemal J. Khattak. Operational Performance Comparisons and Feasibility Assessment Framework for Diamond (Stop-Controlled), Diamond (Signal-Controlled), and Diverging Diamond Interchanges. To be presented at the 105th Annual Meeting of the Transportation Research Board, Washington, DC, January 2026 (TRBAM-26-03800).

**This brief summarizes Project SPR-FY24(032)
“Update of Intersection/Interchange Guidelines for Rural Expressways in Nebraska”
Nebraska Department of Transportation Research Program**