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LRRB
LOCAL ROAD RESEARCH BOARD

TECHNICAL SUMMARY

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LRRB PROJECT COST:
$181,686

While some drivers veer to avoid rumble strips, the act of doing so indicates awareness of an approaching intersection.

DEPARTMENT OF TRANSPORTATION
OFFICE OF RESEARCH & INNOVATION

Using Rumble Strips to Encourage Stops at Rural Intersections

Vehicle crashes in rural areas often happen at intersections. Transverse rumble strips placed before a stop sign can be an effective safety measure that warns drivers approaching an intersection. Increased understanding of the most effective designs and noise characteristics can help county traffic engineers decide when and where to deploy rumble strips.

What Was the Need?

While rural counties in Greater Minnesota strive to meet the state's Toward Zero Deaths goal, fatal crash rates are two times higher in rural areas than in urban areas. A substantial portion of rural crashes happen at intersections due to high speeds and drivers failing to stop. In addition to resulting in fatalities and injuries, rural intersection crashes cost Minnesota an estimated $90 million in 2018 alone.

Transverse rumble strips (TRS), which run across a traffic lane, are a low-cost and easily deployable safety countermeasure for intersection approaches. Grooved into the pavement or installed as ridges on the surface, rumble strips provide an audible and tactile warning to drivers and are effective in all conditions but particularly when it's dark or visibility is low.

While some studies have shown TRS are effective at slowing speeds and encouraging stopping, there is little consistency in placement or design. Variables include the number of panels (or sets of strips), strips per panel, dimensions of strips and distances to traffic signs. To decrease crash risk, the Local Road Research Board wanted to understand which TRS designs are most effective in changing driver behaviors.

What Was Our Goal?

The goal of this project was to evaluate the effectiveness of different TRS designs on driver speed and stopping behavior at rural intersections.

What Did We Do?

A review of previous studies on rumble strip effectiveness in reducing speed and improving stopping behavior and noise considerations preceded a thorough search of other state department of transportation (DOT) websites for TRS standard plans or specifications. After adding information gathered in a brief survey of states and counties to the results of the review, investigators produced a summary of TRS dimensions and designs in 24 states.

The Technical Advisory Panel (TAP) assisted investigators in identifying eight rural intersections in St. Louis County to test rumble strip designs. The TAP also participated in deciding to use MnDOT's standard rumble strip dimensions but varying the numbers of panels and strips. Four designs included either two or three panels with six or 12 strips per panel. The first panels were placed 200 feet before the stop signs in each location.

Two data collection trailers—one upstream and one downstream of the stop signs—at each site collected vehicle speed and video data. For roughly a week at each location, equipment recorded vehicle movements before, at one month after and at nine months after rumble strip installation. Video cameras recorded driver behavior variables, including stopping behavior. Investigators also noted whether drivers maneuvered to avoid rolling over the strips.

Lastly, sound measurements, in accordance with the Federal Highway Administration's noise measurement process, illustrated how the number of panels and strips affected in-vehicle and exterior noise.

continued

"Though the project didn't clearly identify a superior transverse rumble strip design, we are comfortable that we have a better idea of design characteristics that are generally effective in encouraging drivers to stop at intersections."

—Victor Lund,
Traffic Engineer, St. Louis County Public Works

"While the three-panel, 12-strip-per-panel design performed the best, all designs showed a positive impact. One notable finding: There was no noise difference inside or outside of a vehicle between six- and 12-strip designs."

—Shauna Hallmark,
Professor, Iowa State University Department of Civil, Construction and Environmental Engineering

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Rumble strips milled into pavement can be filled in later, if necessary. Also, placing the strips closer to the centerline than to the road's edge can encourage drivers who choose to maneuver around the strips to move away from the opposite lane toward the road's shoulder.

What Did We Learn?

While rumble strip dimensions such as strip depth and width were common among some state DOTs, other state transportation agencies used rumble strips with dimensions and design factors that varied significantly, including number of strips per panel, number of panels and spacing.

In the evaluations of different TRS configurations, researchers concluded that the presence of rumble strips in general provides important safety benefits. Regardless of design, for example, most sites in this study experienced decreases in vehicles traveling over 40 mph to 45 mph. Speed changes from upstream to downstream of the intersections, however, did not show much improvement, indicating that drivers were less likely to reduce speeds after traversing the strips. Additionally, most sites saw increases in vehicles coming to a rolling or full stop. While stopping vehicles was the most important metric, all sites also had an increase in the percentage of vehicles that stopped behind the stop bar.

Given the low number of sites tested, investigators used a qualitative point system to compare TRS designs. The three-panel, 12-strip-per-panel design installed at three sites performed the best on most metrics followed by the three-panel, six-strip-per-panel design installed at one site. Researchers recommend a consistent TRS design across a jurisdiction.

The noise evaluations found no significant differences in interior and exterior sound between the six- and 12-rumble strip designs. Inside a vehicle, in fact, both designs provided sound above the level needed to alert a drowsy or distracted driver.

What's Next?

Minnesota county engineers will continue to consider TRS as a safety measure for rural intersections. While these areas are not generally densely populated, the main barrier to using TRS is noise to residents living nearby. The results of this project could also inform MnDOT if the agency considers changing the standard detail for TRS from the current five-panel design. The research team believes that implementation of TRS should follow a consistent approach. Ideas to consider for selecting intersections to implement TRS include primary intersections, such as state/county intersections, and intersections that are identified in a local road safety plan.

This Technical Summary pertains to Report 2023-17, "Transverse Rumble Strips at Rural Intersections," published April 2023. More information is available at mdl.mndot.gov.