Advance Stop Line Rumble Strips

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Description

Advance stop line rumble strips (ASLRS) (also called transverse rumble strips or in-lane rumble strips) are grooved strips placed upstream of a stop-controlled intersection. ASLRS are transverse to the direction of travel and provide an audible and tactile warning to the drivers.

Placement

Placement and design of ASLRS is covered in the *Iowa DOT Design Manual*, Chapter 6, 6A-7 (Iowa DOT 2014a), and in the *Iowa DOT Traffic and Safety Manual*, Chapter 18, 18A (Iowa DOT 2014b):

- It is suggested that rumble strips should not be added to reconstruction or resurfacing projects that do not involve geometric changes or changes in stop conditions unless the Office of Traffic and Safety requests them.
- It is also recommended that rumble strips be placed only on approaches with a speed limit of 55 miles per hour (mph) or more.

ASLRS are most appropriate where a crash pattern is present related to a lack of driver recognition of the stop sign (Antonucci et al. 2004). Sparing use of the countermeasures is recommended since their effectiveness depends on being unusual (Antonucci et al. 2004)

ASLRS should be considered after less intrusive countermeasures like markings or flashes have been tried (Antonucci et al. 2004)

Harwood (1993) suggests that when rumble strips are used to prompt the driver to engage in a particular action, the rumble strips should be placed so that either the upcoming decision point or sign identifying the action to be taken (e.g., stop ahead) is clearly visible as the driver passes over the rumble strips. This provides sufficient time for the driver to take the appropriate action. Harwood (1993) also suggests that rumble strips in the traveled way, such as ASLRS, are best limited to locations where there is a documented safety problem and where other treatments have not been effective. He also cautioned that overuse of rumble strips may lessen their impact.

Effectiveness of ASLRS

Iowa Specific Studies

Srinivasan et al. (2012) evaluated crash data for intersections in Minnesota and Iowa at locations where ASLRS had been installed. Minnesota initially used a full-width pattern. However, more recently, they changed to a pattern where the wheel path is not grooved. This way drivers are able to position their vehicle to avoid the rumble strips. Up to five sets of grooves are allowed but three are recommended. They are placed at 250 feet before the stop ahead, 500 feet from the stop sign, and around 15 feet from the set nearest the stop sign. Currently only two sets of rumble strips are required in Iowa. Until 2006, three sets were typically used.

Minnesota provided data for 20 intersections where installation of ASLRS occurred between 1990 and 2000. Iowa provided data for 134 intersections where ASLRS had been installed between 1992 and 2005. Control sites were also identified. Data were provided for an average of 10 years before and 6 years after installation in Minnesota and 13 years before and 6 years after in Iowa.

Both safety performance functions and crash modification factors (CMFs) were developed. Empirical Bayes methods were used to analyze and evaluate the data. Results are shown in Table 1.

Other Studies

Harder et al. (2006) evaluated the impact of ASLRS in Minnesota by comparing speeds at 10 intersections (five with and five without the ASLRS). Speeds were collected at various points upstream of the intersection using a radar gun. The researchers compared speeds for drivers at the point after they crossed the first set of rumble strips. In general, the researchers found that on average drivers slowed 2.0 to 5.0 mph more on approaches with rumble strips than those without. The researchers also compared speed profiles and found drivers slowed sooner when the rumble strips were present. This study indicated that the effect of the rumble strips was greater for approaches where the drivers have sight distance issues in viewing traffic on the major road.

A study by Brewer and Fitzpatrick (2003) evaluated ASLRS on 11 approaches at 8 intersections. Two different patterns were used. One pattern had pairs of rumble strips adjacent to each other, while the second type had staggered pairs of rumble strips. Speed data were collected at various locations upstream before and after installation of the ASLRS. Decreases of up to 3.2 mph were found at distances 1,000 to 1,200 feet upstream of the intersection stop bar. Decreases between 2.2 to 5.0 mph were noted within the rumble strips.

In a later study, Brewer and Fitzpatrick (2004) investigated various treatments for rural highways and intersections. They evaluated two intersections where approach rumble strips were installed. The crash rate was reduced by 43 percent (0.34 to 0.19 crashes per month) from the three-year period before to the three-year period after the improvement was installed.

Thompson et al. (2006) evaluated change in approach speed for ASLRS at five rural intersections that were considered to be hazardous. Speed was measured at three locations: an upstream location where speeds were not likely to be influenced by the presence of advance stop line rumble strips; the location of a warning "Stop Ahead" sign; and the intersection. Sites were evaluated before and after placement of the ASLRS. Overall, researchers found small but statistically significant changes in traffic speeds after installation of the rumble strips.

Advantages

- Short term implementation
- Relatively low cost
- Can be used with other countermeasures

Disadvantages

- Noise
- Potential loss of control for motorcycles and bicycles (Antonucci et al. 2004)
- Issues for winter maintenance (Antonucci et al. 2004)
- Drivers using opposing lane to avoid

References

Antonucci, Nicholas D., Kelly Kennedy Hardy, Kevin L. Slack, Ronald Pfefer, Zikhron Yaacov, and Timothy R. Neuman. *A Guide for Reducing Collisions at Signalized Intersections.* NCHRP Report 500: Guidance for Implementation of the AASHTO Strategic Highway Safety Plan Volume 12, Transportation Research Board of the National Academies, Washington DC, 2004.

Brewer, Marcus A. and Kay Fitzpatrick. "Effects on Driver Speeds of In-Lane Rumble Strips on Approaches to Rural Intersections." ITE Conference 2004, Institute of Transportation Engineers, 2003.

Brewer, Marcus A. and Kay Fitzpatrick. *Preliminary Evaluations of Safety Treatments on Rural Highways in Texas*. Report FHWA/TX-05/0-4048-5. Texas Transportation Institute, 2004.

Harwood, Douglas W. *Synthesis of Highway Practice 191: Use of Rumble Strips to Enhance Safety*. National Cooperative Highway Research Program, 1993.

Harder, K. A., J. R. Bloomfield, and B. J. Chihak. *Stopping Behavior at Real-World Stop-Controlled Intersections With and Without In-Lane Rumble Strips*. Report MN/RC-2006-42. Minnesota Department of Transportation, St. Paul, Minnesota, 2006.

Iowa DOT. *Iowa DOT Design Manual*, Chapter 6, 6A-7. www.iowadot.gov/design/dmanual/manual.html?reload. 2014a.

Table 1. Crash Reduction Factors for Installation of ASLRS (Iowa and Minnesota)

Intersection type	Crash type	CMF (standard error)
Three-approach	Total	1.22 (0.14)
	Fatal and incapacitating	0.41 (0.24)
Four-approach	Total	1.07 (0.104)
	Fatal and incapacitating	0.65 (0.17)

Iowa DOT. *Iowa DOT Traffic and Safety Manual*, Chapter 18, 18A. Office of Traffic and Safety, Iowa Departement of Transportation. 2014b.

Srinivasan, Raghavan, Jongdae Baek, and Forrest Council. *Safety Evaluation of Transverse Rumble Strips on Approaches to Stop-Controlled Intersections in Rural Areas*. Report FHWA-HRT-12-047. Highway Safety Information System, 2012.

Thompson, Tyrell D., Mark W. Burns, and Paul J. Carlson. "Speed Changes Due to Transverse Rumble Strips on Approaches to High-Speed Stop Controlled Intersections." *Journal of the Transportation Research Record* 1973 (2006): 1-9.

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