U.S. Department of Transportation
Research and Innovative Technology Administration
RITA Office of Research, Development, and Technology

UTC Spotlight

University Transportation Centers Program

This month: Kansas State University | April 2012

Use of Center Line Rumble Strips to Improve Safety on Two-Lane Highways

According to the National Highway Administration, crashes caused by vehicles leaving their travel lanes led to more than 18,000 of the 33,808 motor vehicle traffic fatalities recorded in 2009[1]—53 percent of all traffic fatalities. Installing centerline rumble strips (CLRS) can be an effective, low-cost safety measure for preventing vehicles from crossing the centerline into oncoming traffic, and the Kansas State University (KSU) Transportation Center research team has been studying how to get the most from their use.

Rumble strips are raised or indented patterns installed to alert drowsy or inattentive drivers to the fact that they are drifting out of their lane. On two-lane, two-way highways rumble strips are often installed on the centerline to keep drivers from drifting into oncoming vehicles, causing a cross-over crash. However, there may be negative issues or concerns that question rumble strip use on some roads and under certain road conditions. Several Departments of Transportation (DOTs) have reported concerns from the public about exterior noise created by tires on rumble strips, of a perceived decrease in visibility of pavement markings installed over the strips, and the effect rumble strips may have on a vehicle's handling characteristics.

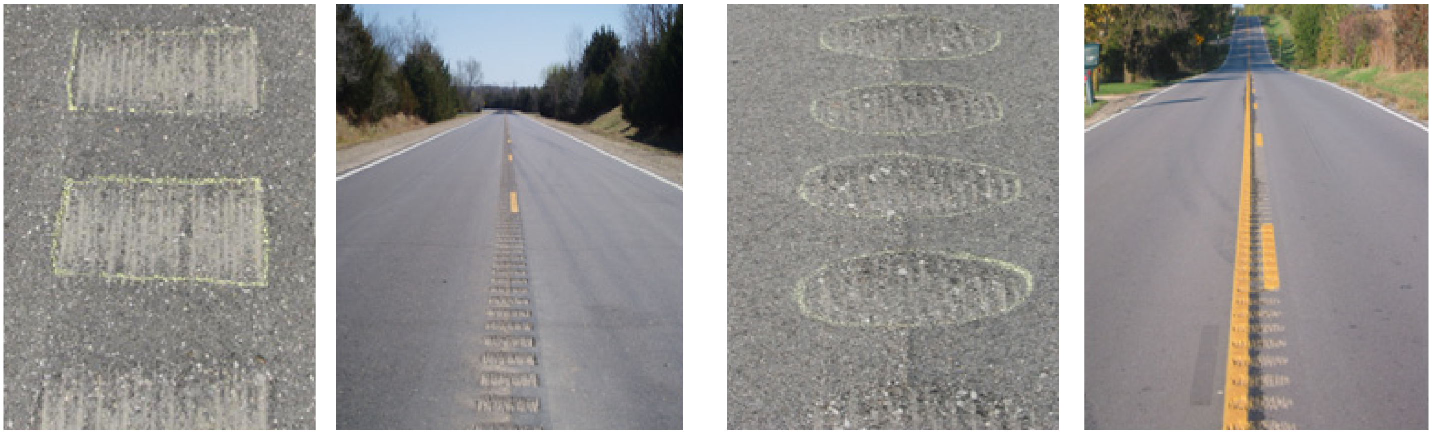
[1] The latest year for which data are available.

Over the past few years the KSU UTC research team has been studying these and other concerns to determine under what circumstances CLRS use could be maximized.

The methodologies that the KSU team applied included:

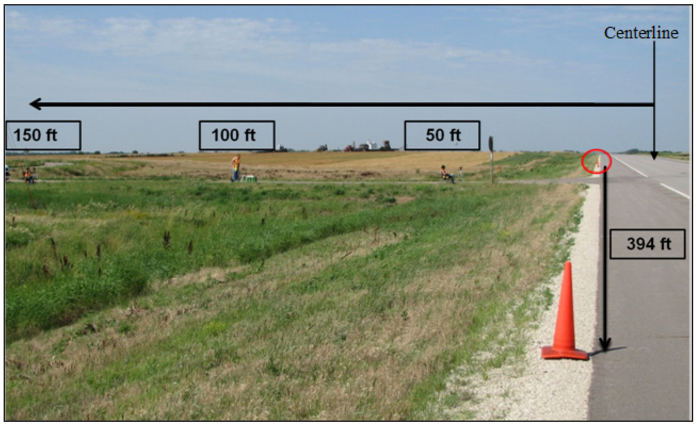
- surveying all State DOTs to verify their current guidelines for installation of CLRS,
- applying Bayesian before-and-after methods to investigate the safety effectiveness of CLRS in Kansas,
- collecting field data to document the extent of exterior noise levels that could disturb residents who live near highways with CLRS,
- collecting field data to investigate how CLRS impact vehicular lateral position and operational speed on lanes of varying lane and shoulder widths with and without shoulder rumble strips (SRS), and
- developing regression equations to predict the number of crashes expected with CLRS applications on these lanes.

The survey results indicate that the use of CLRS increased about 372% from 2005 to 2010. Currently there are 36 States using CLRS and 17 States have written policies



Kansas CLRS Patterns (Left – rectangular, Right – football)

or guidelines for CLRS installation. Guidelines for CLRS installation usually include crash history, annual average daily traffic (AADT), pavement structural condition, lane and shoulder widths, and posted speed limit. The combination of CLRS and shoulder rumble strips (SRS) is rarely used on sections of highways with narrow (typically 3 ft) or no shoulder.

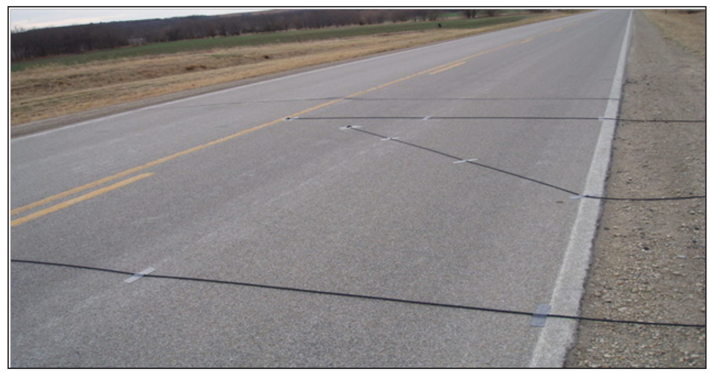


External Noise - Set up of the Experiment

The results of the before-and-after safety effectiveness study of CLRS in Kansas showed that after CLRS installation on several roads in Kansas, total correctable crashes (those not involving animals, intersections, or due to ice on the pavement) were reduced by 29.21%. Correctable crashes involving fatalities and injuries were reduced by 34.05%. Cross-over crashes were reduced by 67.19%. All of these reductions are statistically significant. Finally, the number of run-off-the-road crashes was reduced by 19.19 percent, although this reduction was not statistically significant. The two methods applied (Naïve and Empirical Bayes) presented statistically similar results with no statistical difference between the two shapes (football and rectangular) of CLRS used in Kansas.

External noise depends on speed (lower speeds result in lower noise), type of vehicles (heavier vehicles typically produce more noise), and distance from the strip (greater distances result in less perceived noise). Both football and rectangular CLRS substantially increased the levels of external noise at distances up to 150 ft. There was no statistical difference between the patterns. A distance of 200 ft, measured from the center of the roadway, was determined as the potential exterior noise concern area for the conditions studied, which did not include semi-trucks crossing over CLRS.

From the study of drivers' behavior, the configurations of rumble strips and shoulder widths with or without SRS affected vehicular lateral position and speed levels, although speed deviations were not practically significant. On roadways with narrow shoulders, for both *CLRS only* and *neither* (CLRS nor SRS) rumble strip conditions, drivers operated closer to the centerline. On roadways with medium shoulder widths, drivers tended to drive closer to the centerline if SRS were not present and closer to the edge line if SRS were present. On roadways with wide shoulders, drivers tended to travel closer to the centerline if CLRS were present and closer to the edge line otherwise.



Set up of Road Tubes Sensors for Data Collection on Vehicles' Lateral Position

The study of safety performance function models, developed using data from 29 highway sections with CLRS in Kansas, showed that the installation of SRS was effective in reducing correctible crashes for all road types studied, with the installation of both SRC and CLRS recommended when AADTs exceeded 3,000. On narrow roads that require a choice between SRS and CLRS, CLRS are favored on roads with AADTs between 3,000 and 5,750 AADTs.

About This Project

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This newsletter highlights some recent accomplishments and products from one University Transportation Center (UTC). The views presented are those of the authors and not necessarily the views of the Research and Innovative Technology Administration or the U.S. Department of Transportation, which administers the UTC program.

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