

0-6888: Audible Lane Departure Warning Treatments for Seal Coat Road Surfaces

Background

In an effort to reduce the number of single-vehicle run-off-the-road and two-lane two-way crossover crashes, the Texas Department of Transportation (TxDOT) has implemented various audible lane departure warning systems on seal coat road surfaces. These audible lane departure warning systems are typically profiled pavement markings and, recently, have included rumble bars (preformed thermoplastic strips). Figure 1 provides an example of these treatment. These countermeasures are typically used on, but not limited to, seal coat road surfaces where milled rumble strips cannot be used or on roadways where shoulders are too narrow for milled rumble strips.

What the Researchers Did

This 20-month research project explored the effectiveness of these various treatments using several performance metrics and provided recommendations on implementation of these types of treatments. Researchers conducted a survey of the TxDOT districts on the current state of the practice. Researchers then gathered noise (interior and exterior), vibration, and visibility data for different treatments and conducted a crash study to evaluate the safety and benefit-cost impact of implementing these treatments. Researchers evaluated performance at 24 unique field sites that had 51 treatments



Figure 1. Shoulder Rumble Bars (Left) and Audible Profile Markings (Right).

and at test decks that had 12 different variations of audible markings. The field sites consisted of varying designs and spacing of audible markings, rumble bars, and milled rumble strips. Some sites had each of these treatments, but they had been seal-coated over one time. For the crash study, researchers considered 77 treatment sites and appropriate comparison sites.

What They Found

The crash study showed that the installed treatments reduced total crashes by about 19 percent across all the sites considered

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Project Completed:

4-30-2017

(30 percent reduction in fatal and injury crashes). These crash reductions were considered statistically significant. Based on the crash study, installation of these alternative treatments results in crash reductions that are in line with those of standard milled rumble strips. Based on this, the installation of the combinations of treatments studied should be considered as a viable option when milled rumble strips cannot be used.

The noise and vibration data collection found that the most effective marking spacing was the standard audible marking with 12-inch spacing and the variable spacing with the longer profiled bumps. In general, closer spacing, higher profile, and/or a longer treatment result in higher noise and vibration levels. Generally, the audible markings produced higher interior noise levels than the rumble bars. The standard audible marking performed better than the inverted profile audible marking. The vibration performance was similar for the audible markings and rumble bars. All treatments tested increased noise pollution outside the vehicle when driving on the treatment. Increases in noise levels were less than 10 dBA at the source and approximately 5 dBA for the audible markings tested 25 ft from the roadway. The profile marking and profile marking with dot pattern both increased the wet visibility of the markings compared to standard flat markings. Benefit-cost ratios in excess of 11 to 1 were found for the treatments included in the crash study, which indicates a positive investment.

In many cases, the alternative treatments to milled rumble strips can produce adequate performance and result in crash reductions and a positive benefit-cost ratio. The results were somewhat variable in that not all treatment types within a similar category resulted in similar performance. This indicates the need for added inspection and performance monitoring. After seal coating over the treatments, the performance was reduced and may no longer be acceptable.

What This Means

Audible markings and rumble bars are viable alternative lane departure warning treatments from a noise and vibration performance standpoint, from a crash reduction standpoint, and from a benefit-cost ratio (at least 11:1) standpoint. These treatments should be considered when traffic volumes, speeds, and crash history indicate a need for increased attention to reduce single-vehicle run-off-the-road and two-lane two-way crossover crashes.

The research team recommends requiring retroreflectivity performance on profiled pavement markings. To increase consistency in performance, the research team recommends TxDOT consider including noise performance levels in the specifications. A minimum of a 6-dBA change in the interior noise should be required for audible lane departure warning treatments. The report provides recommendations for updating the specifications and plans for profile pavement markings and rumble bars.

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Keyword: Research