CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY

Texas Department of Transportation

Project 0-6995: Determine Use of Alternative Retroreflective Pavement Markers (RPMs) on Highways with Centerline Rumble Strips and Winter Weather Pavement Marking Improvements

Background

The use of snowplows in northern Texas results in the loss of retroreflective pavement markers (RPMs). Most of the northern districts of the Texas Department of Transportation (TxDOT) reported more than 70% RPMs getting damaged each year due to snowplow winter operations. This loss of RPMs is not only costly but also creates unsafe driving conditions during inclement weather. Pavement sections in many regions across the state of Texas often use a center-line rumble strips to alert drivers that they have drifted from their lane. To overcome the loss and damage of RPMs due to snowplow operations, a novel approach in which RPMs are embedded in the trough region of existing rumble strips was investigated. While embedding the RPM into the rumble strips may protect the RPMs from the force exerted on them by snowplows, the grooves of the rumble strips may hinder drivers from being able to detect the RPMs during nighttime conditions. Thus, this research project also assesses whether RPMs embedded within rumble strips (herein called rumble insert markers) can be used for nighttime centerline delineation. One potential challenge to this approach is that if the rumble insert markers sit too deep within the rumble strip, then the lenses on the RPMs may not provide enough retroreflectivity to provide nighttime visibility.

What the Researchers Did

The research team developed two innovative approaches to arrive at a cost-effective and snow-plowable resistant configuration for roadways containing rumble insert markers: (1) use of existing commercially available RPMs inset within the trough regions of existing rumble strips and (2) use of innovative newly developed flexible memory markers as rumble inserts markers. For Approach 1, the physical condition and nighttime visibility of the RPMs were evaluated using laboratory tests, test section pilot tests, and field studies. In the field study, select RPMs were installed in existing rumble strips in two in-service TxDOT highway sections; the performance of the installed rumble insert markers after multiple cycles of real-event snow plowing operations was evaluated. Additionally, the research team conducted a wet weather performance study for RPMs installed using Approach 1. With respect to Approach 2, the research team designed a new marker system consisting of flexible memory markers using resilient materials and spring support systems. To test the flexible memory markers, the research team designed and built an impact testing setup that mimics the snowplow blades impact on the markers.

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Project Completed:
08-31-2021

What They Found

The results showed that the approach of embedding commercial RPMs into rumble strips is an effective method to reduce losses and damages to RPMs during snowplow operations. The majority of the markers remained in service after snowplow operations, in some cases 100% of the markers remained present. Additionally, it was determined that both epoxy and bitumen are suitable adhesives for embedding commercially available RPMs into rumble strips and that the rumble groove depth plays a significant effect on visibility and snowplow resistance of the RPMs. Low profile markers showed better snowplow withstand capability over regular profile markers. However, the regular profile RPMs showed better nighttime visibility than low profile markers.

The researchers showed that the innovative flexible memory markers could be a promising technology for highway centerline delineation for region with high winter weather operations. A prototype for the flexible memory markers was made and it was seen that the newly designed markers demonstrate elastic behavior when subjected to impact loads.

What This Means

Conventional rumble strips can be converted into multifunctional rumble strips that provides not only auditory and vibratory warning to drivers, but also increases roadway safety by enhancing the ability of drivers to detect lanes during nighttime conditions prior and after snow plow operations. This research provides insight into the opportunities and challenges of embedding RPMs in existing rumble strips as an approach to provide centerline delineation in regions with winter weather operations. Embedding RPMs in existing highway rumble strips reduce the dislodgment of RPMs due to winter weather operations significantly, which in turn results in reducing the money spent by TxDOT in replacing RPMs, improving nighttime lane delineation detection by drivers on roadways, and enhancing roadway safety conditions. The research team recommends implementation of this approach on multiple highways in regions of Texas that experiences snowfall events to evaluate life cycle performance of the approach and validate the RPM detection distance. The innovative flexible memory markers designed and developed in this project is a new product that is promising for roadway delineation, especially in regions with high winter weather operation and maintenance. Based on this study, the research team recommends that the innovative flexible memory marker is further investigated with by manufacturing commercially viable prototypes.

For More Information

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Keyword: Research