



# Project Summary

Texas Department of Transportation

## 0-5008: Evaluation of Wet-Weather and Contrast Pavement Marking Materials and Applications

### *Background*

This 30-month research project looked into the performance of wet-night pavement markings and driver understanding of and preferences for contrast pavement markings. Two research reports were developed. The first report contains the literature review on wet-night markings and reports the Phase I effort on performance of wet-night pavement markings. The second report contains the Phase II effort on performance of wet-night pavement markings and includes a benefit-cost analysis and study of contrast markings.

The second phase of the wet-night project consisted of expanding the study design from Phase I to include additional wet-night pavement marking products, the effects of glare and dry pavement on detection distances, and a benefit-cost analysis with respect to the use of different pavement marking systems to accommodate drivers under wet-night conditions. In the contrast study, a literature review of contrast markings, a review of state-of-the-practice with respect to contrast markings, and a study of driver understanding and preferences with respect to contrast markings were all conducted.

### *What the Researchers Did*

The researchers evaluated 20 years of Texas nighttime rainfall data. From this review, they determined representative rainfall rates for the state and built a 1600-ft rain range capable of uniformly reproducing representative rainfall rates. The researchers then obtained pavement marking samples from a variety of sources and measured retroreflectivity under dry and wet conditions. Research participants were recruited to drive an instrumented vehicle through the rain range. Their task was to identify isolated skip lines randomly placed throughout the length of the rain range. The researchers measured the distances at which the research participants identified the pavement markings. Analyses of these distances included correlations with the dry and wet retroreflectivity measurements.

The researchers conducted a nationwide survey of contrast markings to identify usage throughout the country as well as maintenance or other issues associated with contrast markings. Using a laptop video survey, the researchers surveyed Texans to determine their understanding and preferences regarding various patterns of contrast markings.

### *Research Performed by:*

Texas Transportation Institute (TTI),  
The Texas A&M University System

### **Research Supervisor:**

Paul Carlson, TTI

### **Researcher:**

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### **Project Completed:**

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## What They Found

The researchers learned that the average intensity of statewide nighttime rainfall events is about 0.40 inches per hour, and about 88 percent of the nighttime rainfall events have intensities less than 0.75 inches per hour. They also found that only during about 1 percent of nighttime hours is it actually raining. The ASTM procedures for measuring retroreflectivity under continuous wetting, to simulate rainfall, call for over 9 inches per hour. Analyses showed that there is little correlation between the ASTM retroreflectivity measurements and detection distances of pavement markings under rainfall rates ranging from 0.25 inches per hour to about 0.8 inches per hour.

The researchers found that use of contrast markings is increasing across the country (22 percent of states in 2002 versus 64 percent in 2006). The most frequently used application is on high-volume portland cement concrete surfaces. The results of the laptop survey showed that Texans prefer contrast markings with black borders on the outside (long edges) of the marking.

## What This Means

Wet retroreflectivity measurements made in accordance with ASTM specifications are unreliable and have displayed weak correlation to performance. In addition, it was shown that the wet-night detection distances for raised reflective pavement markers (RRPMs) far exceed detection distances for other markings, even the most technologically advanced markings available on the market today. Since current Texas Department of Transportation (TxDOT) policy is to use RRPMs on all state roadways, the researchers recommend that TxDOT continue to use RRPMs as recommended wet-night delineation treatment and avoid specifying marking performance based on ASTM wet retroreflective standard measurement procedures.

In reference to life-cycle costs, the current TxDOT policies are also more economical with respect to wet-night delineation. The cost of installing and maintaining RRPMs is about \$75 per mile at 80-foot spacing. The cost of installing and maintaining the standard thermoplastic pavement markings is \$475 per mile. The RRPMs would supplement this line. The cost of installing and maintaining the best wet-performing pavement marking is \$3300 per mile. Therefore, with the current pricing, from a cost and visibility point of view, installing and maintaining RRPMs and a standard thermoplastic marking is much more effective than using a wet-weather product in most situations.

If contrast markings are used, the researchers recommend bordered or lead/lag shadow designs. These options allow for a standard tape product, which may be considered effective on concrete surfaces with high average annual daily traffic volumes, and a non-tape product for other applications. While the installation costs of these two options can vary considerably, they will help provide consistency across the state for the drivers.

### *For More Information:*

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