Project Summary

Texas Department of Transportation

0-5090: Analysis of Edge Line Treatments

Background

Two-lane rural roads account for 629,309 centerline miles in the U.S., representing almost 90 percent of the rural highway system. As highway travel demand grows and funding for new road capacity dwindles, the two-lane highway network may become more important in several ways. Current traffic volumes on many rural segments are very small, while volumes on urban segments are large and growing. Scarce maintenance funds have been traditionally allocated to highways with large and growing traffic demands, which represent a small fraction of the highway system. Thus, rural highways, representing the largest fraction of the total system, are viewed by some as a problematic drain on available maintenance resources. Maximization of the effectiveness of all rural highway maintenance expenditures is therefore very important. This study was charged with the task of determining the cost-effectiveness of edge line pavement markings on rural two-lane highways.

Clearly, if safety benefits of edge line pavement markings can be identified as significant, the cost-effectiveness could be easily demonstrated. Crashes on rural two-lane roads continue to be a concern. According to data from the Fatality Analysis Reporting System, in 1998 in the U.S., more than 20,000, or almost 50% of the nation's 41,471 fatalities, occurred on such roads.

What the Researchers Did

Because the impact of edge lines on traffic operation and safety can vary on different highway sections depending on roadway parameters, the first step of the study was to collect information regarding existing rural two-lane roads maintained by the Texas Department of Transportation (TxDOT), including typical dimensions, and identify highway sections with currently implemented edge lines. Criteria for roadway classification included traffic lane and shoulder widths, numbers of horizontal curves and their radii, and traffic volumes. Based on the rural two-lane road inventory, crash statistics for these facilities were analyzed to identify relationships between crash statistics and facility characteristics including edge lines. Next, a series of before-after field tests were conducted in which vehicle lateral positions and speeds were measured during day and night conditions both from fixed locations and through test driving. During test driving, driver physiology was monitored to determine heart rate and electrocardiogram waveform as a means of measuring the driver stress level. These tests were repeated before and after edge lines were added to test facilities to determine whether edge lines impact driver stress levels. Finally, laboratory tests were developed to determine whether edge lines help drivers detect curves and estimate curve sharpness. The field and laboratory observations were designed to test a carefully developed set of hypotheses.

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What They Found

The field and laboratory testing of the potential impacts of edge lines on driver behavior on two-lane rural roads led to the following conclusions:

- Edge lines may affect vehicle transverse position and speed.
- Edge lines may enhance the driver's perception of his (her) vehicle's transverse position on the roadway, and this may be measured as reduced oscillation around the trajectory centerline.
- Edge lines may reduce driver emotional tension due to enhanced transverse position sensing, especially when meeting oncoming vehicles.
- At night, edge lines may allow the driver's eyes to recover faster after the "blinding" effect of oncoming vehicle headlights, and this may reduce driver stress level during nighttime driving.
- Edge lines on two-lane roads provide much better driver perception of curvature than centerline markings only (without edge-line pavement marking), especially at nighttime when visual contrast between roadway edges and the environment is very low.
- Discontinuities in the edge line pavement marking may increase the distance for intersection advance recognition by drivers.

What This Means

Although edge lines were found to have both negative and positive impacts on driver behavior, the positives seem to outweigh the negatives. Therefore, after appropriate engineering studies, edge lines should be considered for implementation on rural two-lane roads having widths greater than 21 feet 8 inches or basically 22 feet. Facilities having less width should be considered special cases, and edge lines should be implemented on such facilities only after appropriate engineering analyses and using appropriate engineering judgment.

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