

## **0-6714: Evaluating the Need for Surface Treatments to Reduce Crash Frequency on Horizontal Curves**

### **Background**

Roadway safety continues to be a major national concern, with federal, state, and other authorities striving to reduce crashes and their associated costs in terms of fatalities, severe injuries, property damage, and traffic delays. According to the National Highway Traffic Safety Administration, motor vehicle crashes were a leading cause of death in the United States in 2006. Of the total economic losses associated with crashes, about 43 percent was related to poor road conditions (including inadequate pavement texture/friction).

Additionally, horizontal curves tend to be associated with a disproportionate number of severe crashes. Each year in the United States, about 38,000 fatal crashes occur on the highway system, with 25 percent of the fatalities found to occur on horizontal curves. Texas accounts for about 3,200 of these fatal crashes, with about 44 percent of Texas' crashes occurring on horizontal curves. Hence, Texas is overrepresented in terms of its proportion of fatal curve-related crashes, relative to the national average. Given this crash information, to have an impact on overall crash reduction, research needs to be conducted into methods for improving driver performance at horizontal curves, and a major component of this effort is evaluating surface treatments that can be used to improve roadway conditions on curves.

### **What the Researchers Did**

An analysis framework was developed to assess the need for surface treatments at curves based on the concept of margin-of-safety analysis. Models were developed to predict vehicle speeds throughout a curve, and calibrated using data from Texas curve sites. Safety prediction models were also developed to quantify the relationship between skid number and curve crash frequency. This information was assembled to develop guidelines that can be applied to assess the need and potential benefit of installing a high-friction surface treatment on a rural highway horizontal curve. The guidelines are formulated as an Excel<sup>®</sup>-based spreadsheet program called the Texas Curve Margin of Safety (TCMS). The TCMS program accepts curve geometric and traffic control characteristics as inputs, and provides information about margin of safety, expected crash frequency, and travel path distribution as outputs. The spreadsheet tool is envisioned to be incorporated into the Texas Department of Transportation's pavement design guidance.

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## What They Found

Margin of safety varies along the length of a curve due to differences in vehicle speeds, superelevation rate, and pavement friction characteristics. As a result, it is necessary to analyze the entire length of the curve to identify locations that may be in greater need of treatment. The models developed in the project allow vehicle speeds to be estimated, and margin of safety to be computed (Figure 1), along the entire length of the curve, so the locations in greatest need of treatment can be identified.

Furthermore, because drivers often do not track curves with geometric exactness, but rather cut the curve or make correcting maneuvers within the curve, it is necessary to consider the occurrence of course corrections during which the travel path may well be sharper than the geometric radius of the curve. A margin-of-safety analysis should account for the locally high levels

of side friction demand that occur during a correcting maneuver, a key moment during curve traversal when the driver faces an elevated risk of sliding off the road.

## What This Means

Practitioners interested in considering a high-friction surface treatment for a horizontal curve should conduct a margin-of-safety analysis to estimate the potential benefit of the treatment. The analysis framework developed in the research project can be implemented to determine the improvement in margin of safety that would result from the installation of a high-friction surface treatment, as well as the expected reduction in crash frequency. The practitioner must obtain data to describe the curve's geometric characteristics as well as the existing skid number and the expected improvement in skid number following the installation of the surface treatment.

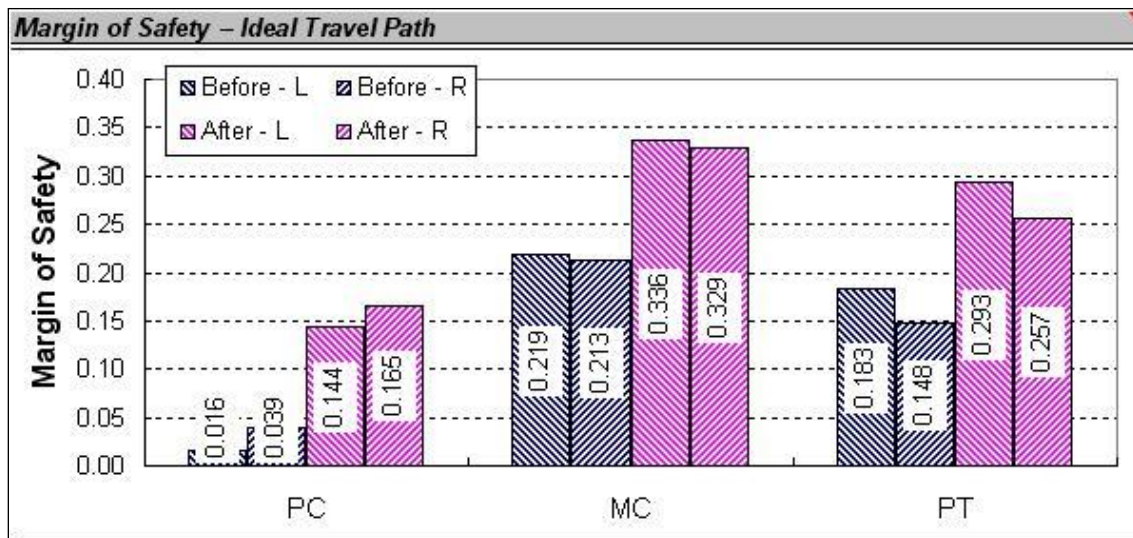


Figure 1. Margin of Safety.

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