Project Summary

Texas Department of Transportation

0-4703: Incorporating Safety into the Highway Design Process

Background

There is a growing public demand for safer streets and highways. In response to this demand, state and national transportation agencies have developed safety programs that emphasize public education, accelerated highway renewal, community-sensitive street systems, and innovative technology to facilitate safe highway design.

Historically, information about the safety effect of a design component has been based on anecdotal evidence, laws of physics, or before-after studies. However, the accuracy of this information is often suspect because of the inherently random nature of crash data and the many factors that can lead to a crash at a specific location. As a result of this uncertainty, engineers have traditionally come to rely on design standards and policies to guide them in the design process, with the underlying premise that compliance with warrants and design controls will yield a "safe" roadway.

Highway safety concerns are also evident in Texas. Crashes in Texas continue to increase and currently exceed 300,000 per year. Nearly 3800 motorists die annually on Texas highways. As part of its proactive commitment to improving highway safety, the Texas Department of Transportation (TxDOT) is moving toward including quantitative safety analyses throughout the project development process.

The objectives of research project 0-4703 were: 1) to develop safety design guidelines and evaluation tools that can be used by TxDOT designers, and 2) to produce a plan for incorporating these guidelines and tools in the planning and design stages of the project development process.

What the Researchers Did

The project objectives were achieved through a series of research tasks. These tasks included:

- review the TxDOT project development process and identify steps in the process that are amenable to safety evaluation,
- develop and calibrate safety prediction models that are applicable to Texas streets and highways,
- describe the models in a workbook suitable for use by TxDOT engineers and technicians, and
- develop procedures for incorporating quantitative safety analyses in the project development process.

The research was structured as a 6-year program of field investigation, data analysis, model calibration, and guideline development.

Research Performed by:

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What They Found

To achieve further improvement in highway safety, it will be necessary to focus on policies and technologies that reduce the likelihood of a crash and reduce the severity of the crashes that occur. The use of safety evaluation tools in the highway geometric design process is one way to accomplish these goals.

Highway geometric design is becoming less dependent on experience and judgment and more dependent on adherence to minimum criteria. However, the use of minimum design criteria may not ensure adequate levels of safety in all situations. One approach to reversing this trend is the use of safety-conscious design. This type of design includes in the design process the explicit evaluation of safety consequences associated with design alternatives. It has been a part of the highway design process in Canada since 1999.

Safety-conscious design involves the use of safety prediction models and economic principles to evaluate the benefits and costs of design alternatives. In recognition of the time required for this evaluation, it is typically reserved for more complex design conditions or those that involve higher construction costs.

What This Means

The main product of this research project is the *Roadway Safety Design Workbook*. This document provides the best-available information describing the relationship between various highway geometric design components and crash frequency. It is intended to be used by engineers for the purpose of explicitly evaluating the potential safety trade-offs associated with various design alternatives. This document focuses on quantitative safety relationships for specific design components known to be correlated with injury and fatal crash frequency. It is intended for engineers responsible for the geometric design of streets and highways. A spreadsheet has been developed to accompany the workbook and facilitate its implementation.

A safety evaluation of design alternatives will add time to the design process. However, it is believed that the additional time invested will be offset by a reduction in crashes and lower construction costs. This latter benefit is derived by limiting instances where a design component is over-designed (i.e., when estimated road-user benefits do not justify the component's construction cost).

For More Information:

0-4703-2 Role and Application of Accident Modification Factors in the Highway Design Process
0-4703-4 Development of Tools for Evaluating the Safety Implications of Highway Design Decisions
0-4703-5 Calibration Factors Handbook: Safety Prediction Models Calibrated With Texas Highway System Data
0-4705-6 Incorporating Safety into the Highway Design Process: Fifth-Year Report

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