



Incorporating Safety into the Highway Design Process: Fifth-Year Report

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.

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. This research project has as its objectives: (1) the development of safety design guidelines and evaluation tools to be used by TxDOT designers, and (2) the



SAFETY BY DESIGN

production of a plan for the incorporation of these guidelines and tools in the planning and design stages of the project development process.

Research Approach

A six-year program of research was developed to satisfy the stated objectives. The project is now in its fifth year. The research approach consists of 10 tasks that represent a logical sequence of needs assessment, research, evaluation, and workshop development. Six tasks have been completed; they include:

- review current design and safety evaluation processes,

- identify safety information sources,
- determine the data needed for safety evaluation,
- assess the use of accident modification factors (AMFs) in design evaluation,
- develop calibrated safety prediction models for Texas application, and
- develop workshop education materials.

Three of the four remaining tasks are nearly completed, and the project is estimated to be 85 percent complete.

An early task was devoted to the development of the *Interim Roadway Safety Design Workbook*.¹ The workbook describes quantitative safety relationships for specific design components known to be correlated with crash frequency. It was developed to be used in the project development process to evaluate the safety impacts of highway geometric design alternatives. The role that is envisioned for safety evaluation



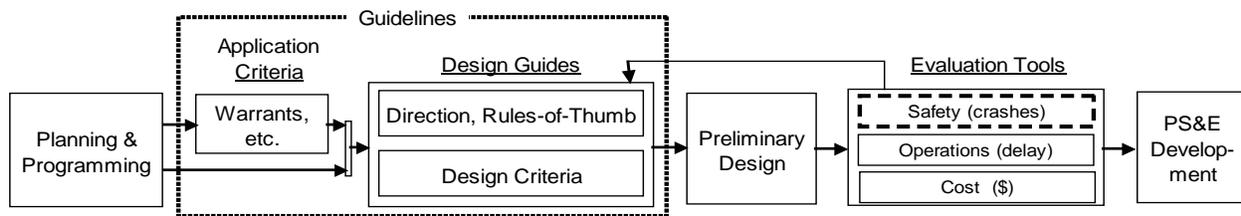


Figure 1. Components of the Project Development Process.

in the project development process is illustrated in Figure 1.

Currently underway is a task to develop the final version of the workbook. This task will update the *Interim Roadway Safety Design Workbook* to include the research conducted as part of this project since the interim workbook was published.

Safety Prediction Model Calibration

One recent notable task produced a series of safety prediction models that were calibrated using crash and geometric data from the Texas highway system. These models are more accurate than the existing models in the *Interim Roadway Safety Design Workbook*. They will be available in the final version of this workbook when it is released in 2009.

Workshop Education Materials

Another recent notable task produced materials for workshops based on the information in the *Interim Roadway Safety Design Workbook*. Specifically, materials for three one-day workshops

were developed. The following list provides the titles of these workshops:

- Rural, Two-Lane Roads Workshop;
- Urban and Suburban Arterial Highways Workshop; and
- Rural, Multilane Highways and Freeways Workshop.

The format of each workshop is consistent with that of the other workshops. Initial sessions describe the role of safety evaluation in the design process and highlight issues associated with crash data variability. Subsequent sessions describe the correct use and interpretation of the safety relationships provided in the workbook. Concluding sessions focus on the use of this information to quantify the safety associated with an intersection or highway segment. The role of safety evaluation in design alternative selection is described through an example application.

Findings

Safety-Conscious Design

To achieve further improvement in highway safety, it will be necessary to focus on design

policies and technologies that: (1) reduce the likelihood of a crash and (2) reduce the severity of the crashes that occur. The use of safety evaluation tools in the design process is one way to accomplish these goals.

Safety-conscious design represents the explicit evaluation of the safety consequences associated with design alternatives. In 1999, the Transportation Association of Canada incorporated safety-conscious design in its design guide for new location and reconstruction projects (i.e., the *Geometric Design Guide for Canadian Roads*²). The justification offered for this change was the observation that the traditional approach to design had become less dependent on experience and judgment and more dependent on adherence to minimum criteria. As stated in the American Association of State Highway and Transportation Officials (AASHTO) document, *Highway Safety Design and Operations Guide*,³ “[The use of] minimum design criteria may not ensure adequate levels of safety in all situations.”



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 often reserved for more complex design conditions or those that involve higher construction costs.

Project Development Process

The research team has recommended the incorporation of safety evaluation into the project development process. The implementation of these tasks 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).

Implementation Plan

A unique feature of this project is that implementation products have been developed throughout its duration. Several products developed early in the project facilitate timely dissemination of the research

findings. Some of these products will be updated during the research to ensure their content is current and comprehensive. The main products of this research that have been delivered thus far include:

- *Roadway Safety Design Synthesis* (Product 0-4703-P1),
- *Interim Roadway Safety Design Workbook* (Product 0-4703-P4), and
- *Procedure for Using Accident Modification Factors in the Highway Design Process* (0-4703-P5).

These products are available at the project website (<http://tcd.tamu.edu/documents/rsd.htm>).

Of particular note in the previous list is the workbook. The workbook describes procedures for predicting the crash frequency associated with alternative design components. The designer is able to use these procedures to evaluate the safety impacts of alternative designs. A spreadsheet has been developed to accompany the workbook. It automates the calculation of safety effect and minimizes the time required to complete a safety evaluation.

Materials for a series of three one-day highway safety design and evaluation workshops were also developed. These workshops address safety issues on rural highways, freeways, interchange ramps, and urban streets. The workshops have been presented at several TxDOT districts in recent years and are available for download from the aforementioned project website.

References

1. Bonneson, J.A., K. Zimmerman, and K. Fitzpatrick. *Interim Roadway Safety Design Workbook*. FHWA/TX-06/0-4703-P4, Texas Department of Transportation, Austin, Texas, April 2006.
2. *Geometric Design Guide for Canadian Roads*. Part 1 and Part 2. Transportation Association of Canada, Ottawa, Canada, 1999.
3. *Highway Safety Design and Operations Guide*. American Association of State Highway and Transportation Officials, Washington, D.C., 1997.



For More Details...

Related reports and tools:

- Strategic Highway Safety Plan Website. URL: <http://safety.transportation.org/>
- National Agenda for Intersection Safety. URL: <http://safety.fhwa.dot.gov/fourthlevel/intersafagenda.htm>
- Interactive Highway Safety Design Model (IHSDM). URL: <http://www.tfhr.gov/safety/ihsdm/ihsdm.htm>
- SafetyAnalyst Software for Identifying, Evaluating, and Treating Hazardous Locations. URL: <http://www.safetyanalyst.org>
- Highway Safety Manual. URL: <http://www.highwaysafetymanual.org/>

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