Identifying Numbers MPC-360

Project Title: Safety Impacts of Design Exceptions in Utah

University: University of Utah

Principal Investigator: Dr. Richard J. (R.J.) Porter
Assistant Professor
Department of Civil and Environmental Engineering

Description of Research Problem:

Construction and reconstruction projects on state facilities are usually designed to conform to state agency-adopted geometric design criteria. UDOT has adopted the AASHTO "Green Book" (1) as its standard for roadway design with some differences noted in the UDOT Roadway Design Manual of Instruction (2). Meeting established design standards is not always practical or cost-effective. Deviating from design criteria requires documentation and approval. This generally occurs at two levels in Utah: design exceptions and design waivers. Design exceptions will be the focus of this proposed research.

Design exceptions are prepared when a road design deviates from one or more of the FHWA 13 controlling design criteria for a construction or reconstruction project on the NHS or STRAHNET. Project costs with the design exception(s) are estimated and compared to project costs if the 13 controlling criteria are met (3). The FHWA Federal-Aid Policy Guide (4) states that an "exception should not be approved if the exception would result in degrading the relative safety of the roadway." Predicting the safety consequences of design exceptions is difficult, and the proposed principal investigator only knows of two studies where an attempt was made to track safety of road segments where design exceptions had been approved (5, 6).

A recent survey of transportation agencies revealed that design exception procedures for most states include safety assessments of the proposed exceptions; the types of safety analyses vary substantially between states and relatively little is known about actual, quantitative safety impacts of design exceptions (7). The soon to be published AASHTO Highway Safety Manual was intended to fill this void, but a significant amount of safety information related to the controlling criteria will be missing in the first edition.

Research to assess the safety impacts of design exceptions in Utah is needed. Research results will provide insights into the effectiveness of the current design exception preparation and approval process as well as whether deviations from some controlling criteria have different safety impacts than others.

Research Objectives:

Compare safety, measured by expected crash frequency and severity, on road segments where design exceptions were approved to similar road segments where no design exceptions were approved.

Research Approach / Methods:

The research objectives will be met through execution of the following eight tasks:

1) Identify road segments where design exceptions were approved and the resulting design constructed.
2) Collect traffic, geometric and other key characteristics (e.g., posted speed, functional classification) for the road segments with design exceptions.
3) Determine the number of crashes and their severity that have occurred on the road segments defined in tasks 1 and 2 over a defined time period. The time period may vary at each location based on the date of construction and available data, but is generally expected to be around 3 to 5 years for each segment.
4) For each road segment with a design exception defined in task 1 and 2, identify 2-4 road segments of the same functional classification as well as similar traffic volumes, geometrics, and traffic control but with no design exception.
5) Collect traffic, geometric and other key characteristics for the road segments without design exceptions.
6) Determine the number of crashes and their severity that have occurred on the road segments defined in tasks 4 and 5 during the same time periods used for in task 3.
7) Compare expected crash frequency and severity on road segments where design exceptions were approved to similar road segments where no design exceptions were approved using a combination of crash frequency models (e.g., negative binomial regression models),

crash severity models (e.g., multinomial logit models), and other alternative types of with-without comparisons.

8) Summarize results and conclusions related to safety on road segments where design exceptions were approved to similar road segments where no design exceptions were approved. In addition, compare safety on road segments with different types of design exceptions, with type defined by the design criterion or criteria that was/were not attained.

The eight defined tasks can be accomplished within the one year project timeframe.

MPC Critical Issues Addressed by the Research:

Effective Safety Management, Improved Infrastructure Design

Contributions/Potential Applications of Research:

Research results will provide insights into the effectiveness of UDOT's current design exception preparation and approval process as well as whether deviations from some controlling criteria have different safety impacts than others. These insights have the potential to improve the efficiency of the design exception preparation and approval process, reducing project delay and costs. Results will also contribute to FHWA/UDOT risk assessment activities and will support UDOT's ongoing practical design initiatives. The research methodology and results will have national impacts as well for the same reasons.

Potential Technology Transfer Benefits:

The research results have the potential to improve the efficiency of the design exception preparation and approval process by quantifying the effects of previous design exceptions. Dr. Porter will schedule one or two presentations of the findings to UDOT Traffic and Safety and Project Development engineers to promote implementation of the research results. Dr. Porter will also volunteer to present the findings at the annual UDOT Engineering Conference. Findings will be shared at a national level by submitting the results for presentation at a TRB Annual Meeting as well as for publication in *Transportation Research Record*, ASCE *Journal of Transportation Engineering*, or *Accident Analysis and Prevention*. The findings may also have international impacts. Dr. Porter will explore

presentation of the research at 2011 or 2012 Road Safety on Four Continents conference.

Time Duration:

July 1, 2010-June 30, 2011

Total Project Cost:

$44,996

MPC Funds Requested:

$30,000

Source of Matching Funds:

1) $14,996 from Utah Department of Transportation

TRB Keywords:

Design exceptions, highway safety, risk assessment

References:

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5) Malyshkina, N.V. and Mannering, F.L. (2010). “Empirical Assessment of the Impact of Highway Design Exceptions on the Frequency and

Severity of Vehicle Accidents." Accident Analysis and Prevention, 42, pp. 131-139.

6) Agent, K., Pitman, J., and Stamatiadis, N. (2002). Safety Implications from Design Exceptions. Kentucky Transportation Center. KTC-02-09/SPR230-01-1F. Lexington, KY.

7) Mason, J.M. and Mahoney, K.M. (2003). Design Exception Practices. National Cooperative Research Program Synthesis 316. Transportation Research Board. Washington, DC.