



Center for Transportation
Research and Education

Safety Impacts of Pavement Edge Drop-Off

tech transfer summary

July 2006

RESEARCH PROJECT TITLE

Safety Impacts of Pavement Edge Drop-Off

SPONSORS

AAA Foundation for Safety
Federal Highway Administration

PRINCIPAL INVESTIGATOR

Shauna Hallmark
Assoc. Prof., Center for Transportation
Research and Education
Iowa State University
515-294-5249
shallmar@iastate.edu

CO-PRINCIPAL INVESTIGATOR

Tom McDonald
Program Coordinator, Center for
Transportation Research and Education
Iowa State University
515-294-6384
tmcdonal@iastate.edu

MORE INFORMATION

www.ctre.iastate.edu

CTRE

Iowa State University
2711 S. Loop Drive, Suite 4700
Ames, IA 50010-8664
515-294-8103

The mission of the Center for Transportation Research and Education (CTRE) at Iowa State University is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, and reliability while improving the learning environment of students, faculty, and staff in transportation-related fields.

The sponsors of this research are not responsible for the accuracy of the information presented herein. The conclusions expressed in this publication are not necessarily those of the sponsors.

By understanding the relationship between pavement edge drop-off characteristics and crash frequency, agencies can target resources to critical locations.

Objectives

- Understand the extent to which pavement edge drop-off contributes to crash frequency and severity on rural two-lane paved roadways.
- Evaluate federal and state guidance in sampling and addressing pavement edge drop-off and recommend methods for mitigating drop-off related safety hazards.

Problem Statement

Pavement edge drop-off, a vertical elevation difference between two adjacent road surfaces, can reduce vehicle stability and impede a driver's ability to handle a vehicle. Edge drop-off is especially hazardous on unpaved shoulders when a vehicle leaves the travel lane, whether due to driver error, poor surface conditions, or avoidance of a collision with another vehicle. A driver's ability to recover safely when encountering edge drop-off depends on several factors, including the magnitude and geometry of the drop-off, driver ability, vehicle characteristics, and vehicle speed.

The impact of pavement edge drop-off on a driver's ability to recover safely is not well understood under actual driving conditions. Additionally, little information is available that quantifies the number or severity of crashes that occur where pavement edge drop-off may have been a contributing factor. Without sufficient information about the frequency of edge drop-off related crashes, agencies are not fully able to measure the economic benefits of investment decisions, evaluate the effectiveness of different treatments to mitigate edge drop-off, or focus maintenance resources.

Data Collection Methods

To examine the relationship between pavement edge-drop off characteristics and crash rate and severity, this study collected data from three main sources. First, edge drop-off height and shape, as well as other roadway characteristics such as lane width, shoulder type, and shoulder width, were documented along rural two-lane paved roadways with unpaved shoulders in Iowa and Missouri. Roadway characteristics were correlated to the likelihood of edge drop-off.

Second, the frequency and characteristics of edge drop-off related crashes were assessed in four states—Iowa, Missouri, South Carolina, and Illinois—by evaluating crash reports. (The data from South Carolina and Illinois were drawn from a report on unrelated research by Rushi Patel and Forrest Council.) A sample of crashes suspected to be edge drop-off related were selected (e.g., run-off-road crashes), and crash reports were evaluated to determine whether edge drop-off was likely to

Continued on next page

IOWA STATE UNIVERSITY

Continued from previous page

have contributed to each crash. This investigation also examined the severity of edge drop-off related crashes in terms of injuries and fatalities.

Third, the relationship between edge drop-off related crashes and roadway characteristics was explored for Iowa and Missouri. To consider how roadway characteristics may predict the potential for edge drop-off related crashes, roadway characteristics, such as edge drop-off and shoulder width, were correlated to the frequencies of edge drop-off related crashes.

To consider ways of mitigating pavement edge drop-off related crashes, this research included reviews of federal and state guidelines for addressing pavement edge drop-off and drivers' education materials from several states. The report presents two educational messages to assist drivers in negotiating pavement edge drop-off.

Key Findings

- A very small percentage of edge drop-off sampled in Iowa and Missouri was greater than or equal to three inches in height (1% and 3%, respectively). A little over 12% of drop-off in Iowa and 18.6% in Missouri was greater than or equal to two inches in height.
- In Iowa, Missouri, Illinois, and South Carolina, crashes that were probably or possibly edge drop-off related and involved tire scrubbing (when the tire's inside sidewall creates friction with the pavement edge) comprised less than 2% of rural crashes on similar roads. Crashes that were probably or possibly edge drop-off related, without considering scrubbing, comprised less than 3% of rural crashes on similar roads.
- In Iowa, the rate of potential edge drop-off related crashes at 1,000 vehicles per day is predicted to more than double when the amount of measured drop-off 2.5 inches or greater exceeds 30% of the roadway segment. This agrees with current maintenance thresholds, which many states have set at 2.0 inches.
- While they constitute a small percentage of rural crashes, edge drop-off related crashes are more likely to involve fatalities or severe injuries and consequently should be addressed.
- Most roads included in this research had posted speed limits of 55 mph or 60 mph, but higher speeds may increase the danger associated with a given depth of edge drop-off.
- Edge drop-off related crashes are usually run-off-road crashes, generally more severe than other crash types.
- Several national agencies provide guidance and recommendations related to pavement edge drop-off for highway design, construction, and maintenance. The FHWA has instituted an aggressive Safety Edge program to address edge drop-off. However, no national standards exist for pavement edge drop-off.

Implementation Benefits

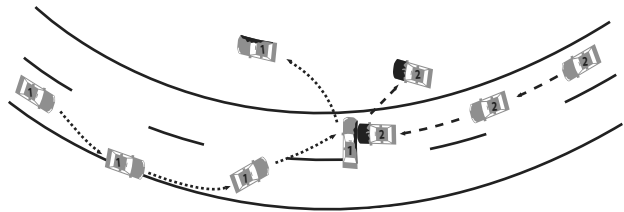
The number of edge drop-off related crashes is relatively small compared to other crash types, but the numbers are large enough to warrant attention and treatment. Understanding the relationship between drop-off characteristics, such as height, and crash frequency will allow agencies to determine critical locations at which to address edge drop-off. With this information, needed maintenance can be scheduled efficiently and resources can be targeted to locations most likely to benefit.

Implementation Readiness

- The report presents both a full educational message about pavement edge drop-off that can be included in drivers' manuals and a brief educational message that can be included in instructional DVDs and other materials.
- The report recommends policies and procedures for agencies to consider, including the following: provide specific training on the potential hazards of pavement edge drop-off, adopt a policy for shoulder maintenance that includes routine comprehensive sampling procedures and requires prompt remediation of any edge drop-off that meets or exceeds a prescribed threshold, and review crash databases to assess possible edge drop-off contribution to crashes.



Measuring pavement edge drop-off



Crash diagram of a potential edge drop-off related crash