Safety Impacts of Pavement Edge Drop-Off

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 Rush 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
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% is 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.