

Pavement edge drop-off

Is pavement edge drop-off (PEDO) a significant safety issue on Iowa's rural roadways?

Shauna Hallmark, associate professor of civil engineering at ISU, and Tom McDonald, safety circuit rider at CTRE, recently studied the extent of edge drop-offs on Iowa's rural, two-lane paved roads with unpaved shoulders. They determined the number of crashes and the severity of crashes in which pavement edge drop-off may have been a contributing factor (2002–2004).

Based on the results of this and other studies, the team recommended actions for local road agencies.

What is PEDO?

Pavement edge drop-off is the difference in elevation between two adjacent roadway surfaces. This study focused on the difference between paved travel lanes and unpaved shoulders, where at least some difference in elevation is common. See figure 1.

Drop-offs can result from a variety of situations:

- If an unpaved shoulder is not well maintained, the shoulder material can migrate away from the pavement due to erosion, tire wear, and other environmental factors.
- When an overlay is placed on an existing pavement, the shoulder may not be subsequently raised to the new pavement height.

What's the safety impact of PEDO?

When a vehicle's right front tire drops off the pavement edge, the driver usually attempts to return immediately to the pavement. As the driver attempts to return to the travel lane, the pavement edge can rub against the tire(s) ("scrubbing"), preventing the car from re-entering the roadway. To compensate, the driver oversteers. Oversteering may cause the vehicle to sideswipe a passing car, veer into the opposite lane of traffic, and/or roll over. See figure 2.

The level to which a driver may lose control depends on many factors:

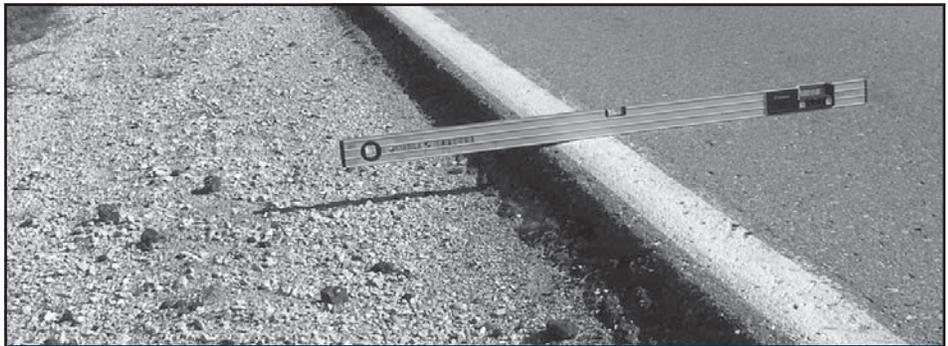


Figure 1. The ISU study focused on edge drop-off between a paved roadway and unpaved shoulder.

- Height and shape of the drop-off. See figure 3 (Zimmer and Ivey, 1982).
- Cross-section of the shoulder.
- Vehicle's size and speed.
- Driver's steering and braking response.
- Angle that the vehicle departs and/or returns to the pavement.

Note that only the first two of these factors—drop-off height/shape and shoulder cross-section—can be controlled by roadway agencies.

Iowa's data

Pavement edge drop-off was sampled in 21 Iowa counties. More than 12 percent of the sampled drop-off was 2.0 inches or greater. Only one percent was 3.0 inches or greater, and less than one percent was 4.0 inches or greater.

A sampling of crash reports was analyzed. Less than three percent of the crashes was determined to have been "probably" or "possibly" related to edge drop-off. This is a relatively small fraction of total crashes.

However, edge drop-off-related crashes are usually run-off-road crashes, which in general are likely to be more severe than other crash types. Crashes which were likely to have been edge drop-off related were more likely to be fatal or major-injury crashes than other run-off-road crashes on similar roadways.

The study found that, in Iowa, drop-offs of 2.5 inches or more correlated to an increased risk of potential edge drop-off-related crashes.

The study also indicated that the Iowa DOT has an aggressive maintenance policy.

Recommendations for local agencies

- Train all staff, especially maintenance and construction staff who will operate agency vehicles, about the following:
 - The dangers of pavement edge drop-offs.
 - How to recover safely when a tire drops off the edge of the pavement (see the sidebar on the next page).
 - Leaving adequate space between vehicles on the road.
- Adopt a policy for pavement edge maintenance if one does not exist. Such a policy may include the following:
 - Routine, comprehensive sampling, or inventorying, of edge drop-off heights in your jurisdiction.
 - A minimum drop-off height to be repaired or remediated. (Current practice in several states suggests 2.0 inches as a conservative threshold. This was consistent with Hallmark's and McDonald's findings.)
 - A toolbox of pavement edge maintenance strategies.

Implementing a thorough maintenance policy is one of your best defenses against tort liability claims that might result from potential pavement edge drop-off-related crashes.

Addressing edge drop-off

Edge drop-off should be addressed in a timely manner.

There are several maintenance strategies:

- Upgrade unpaved shoulders by paving them a minimum of two feet, when practicable.

- Resurface shoulders (or otherwise restore the shoulders so that the original roadway slope is maintained) at the same time the driving lanes are resurfaced.
- Paint the pavement edgeline at 11 feet on a 12-foot lane. This strategy has been shown to prevent motorists from driving too near the pavement edge. (See “Narrower’ road lanes may improve traffic safety” in the Mar–Apr 2005 issue of *Technology News*, www.ctre.iastate.edu/tech_news/2005/mar-apr/narrower_lanes.htm.)
- Construct a beveled edge between the pavement and shoulder. See the sidebar below.

For more information

This study was sponsored by the AAA Foundation for Traffic Safety. The final report and a short summary are online, www.ctre.iastate.edu/Research/detail.cfm?projectID=2073651291.

In addition to Hallmark and McDonald, the research team consisted of ISU doctoral student, David Veneziano, and Jerry Graham and other staff from the Midwest Research Institute in Kansas City, MO. Contact Hallmark, 515-294-5249, shallmar@iastate.edu. ■

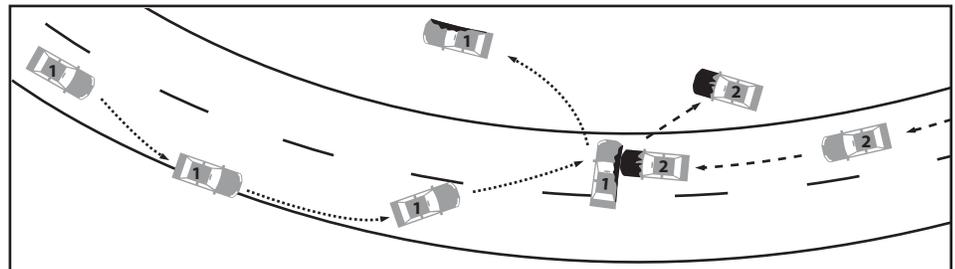


Figure 2. Crash diagram illustrates vehicle 1 dropping off the edge of the pavement, then oversteering into the opposite lane.

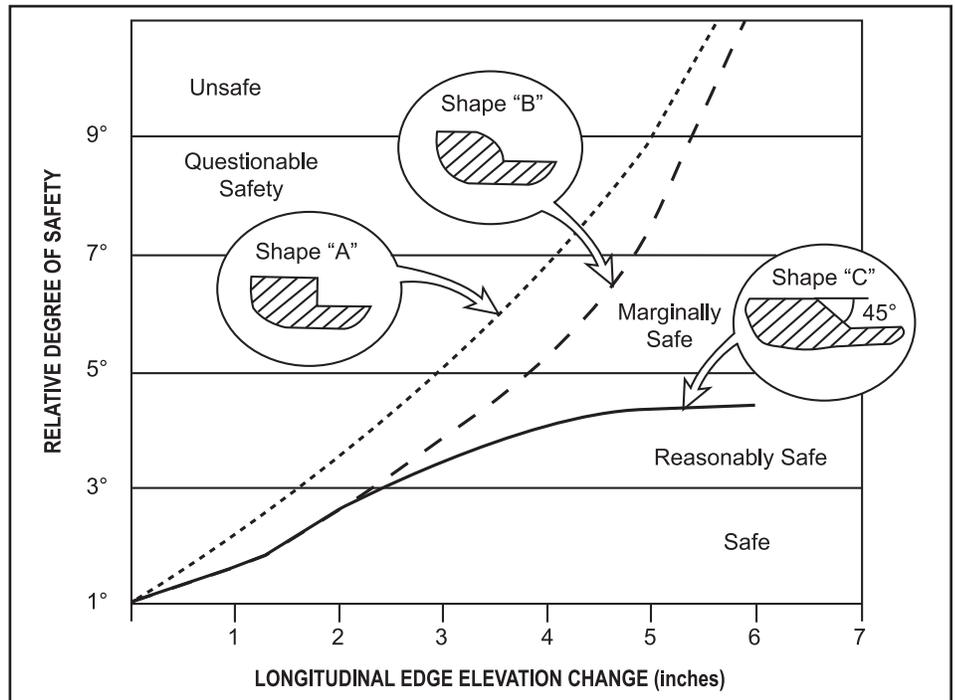


Figure 3. The shape of edge drop-off affects safety. A drop-off at a tapered angle is reasonably safe compared to 90-degree or rounded drop-offs.

Recovering safely if you drive off the edge

If your wheels drop off the pavement, stay calm and react gently:

1. Do not immediately steer back onto the pavement.
2. Slow down gradually to 30 mph or less.
 - Take your foot off the accelerator.
 - If braking is necessary, use a gentle braking action. (Different surfaces on pavement and shoulder will result in different skid resistances, which could cause you to lose control if you brake too forcefully).
 - Be careful not to be rear-ended.
3. Straddle the pavement edge while slowing.
4. When traffic is clear in both directions, turn the steering wheel one-quarter turn toward the pavement (that's a fairly sharp turn angle) and remount the pavement.
5. Carefully counter-steer to prevent veering into the opposite lane.
6. As soon as you've fully recovered, accelerate to normal traffic speed.

Note: If traffic is heavy, you may have to pull off onto the shoulder and stop.

Constructing a “safety edge”

Constructing a tapered transition—a safety edge—between the driving lane and the shoulder can significantly reduce the safety impact of edge drop-offs. Such a transition makes it easier to remount the pavement without oversteering. The safety edge is recommended by FHWA.

At a minimum, construct a 45-degree taper; a 30-degree transition is preferred. See figure 4 (FHWA).

Proprietary devices are available that can be mounted to the screed during asphalt construction or resurfacing to form the appropriate wedge.

See the FHWA's pamphlet “The Safety Edge,” FHWA-SA-05-004, http://safety.fhwa.dog.gov/roadway_dept/docs/sa05004.htm.

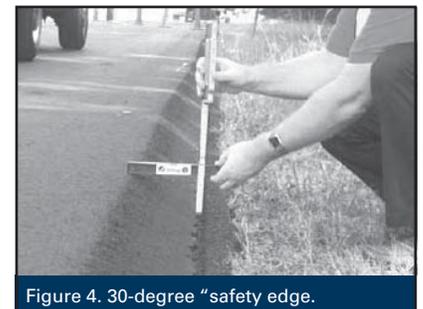


Figure 4. 30-degree “safety edge.”