

## Priority, Market-Ready Technologies and Innovations

### Rumble Strips

#### **Problem: Roadway departures account for more than half of all roadway fatalities**

Roadway departure fatalities, which include run-off-the-road (ROR) and head-on fatalities, are a serious problem in the United States. In 2003, there were 25,562 roadway departure fatalities, accounting for 55 percent of all roadway fatalities in the United States. That same year:

- More than 16,700 people died in ROR crashes (39 percent of all roadway fatalities).
- Head-on crashes represented 12 percent of all fatal crashes.

#### *Why are there so many roadway departure crashes?*

There are many contributing factors. Driver fatigue and drowsiness can contribute to ROR crashes; a drowsy driver can be as dangerous as a drunk driver. In other cases, drivers are inattentive, careless, or distracted, and drift out of the lane and off the road. Visibility also is an issue. The majority of accidents happen at night. Moreover, 70 percent of ROR fatalities occur on rural highways, and about 90 percent occur on two-lane roads. Rural highways usually are not as well lit as urban roadways. Inclement weather such as fog, snow, smoke, or dust storms also can decrease the visibility of pavement markings. In these conditions, drivers may drive off the road accidentally.

#### **Solution: Rumble strips are a proven, cost-effective way to help prevent roadway departure crashes**

Shoulder rumble strips have proven to be very effective for warning drivers that they are about to drive off the road. Many studies also show very high benefit-to-cost (B/C) ratios for shoulder rumble strips, making them among the most cost-effective safety features available. For example,

#### **Putting It in Perspective**

- Approximately 60 percent of all fatal crashes were roadway departure crashes.
- On average, one roadway departure fatality crash occurred every 23 minutes.
- An average of one roadway departure injury crash occurred every 43 seconds.
- The estimated annual cost of roadway departure crashes is \$100 billion.

Nevada found that with a B/C ratio ranging from more than 30:1 to more than 60:1, rumble strips are more cost effective than many other safety features, including guardrails, culvert-end treatments, and slope flattening. And a Maine Department of Transportation (DOT) survey of 50 State DOTs identified a B/C ratio of 50:1 for milled rumble strips on rural interstates nationwide.

#### *What are rumble strips and how do they improve roadway safety?*

Rumble strips are raised or grooved patterns on the roadway shoulder that provide both an audible warning (rumbling sound) and a physical vibration to alert drivers that they are leaving the driving lane. In addition to warning inattentive drivers, rumble strips help drivers stay on the road during inclement weather when visibility is poor. Some States paint stripes over the rumble strips to make them visible; these are called rumble stripes.

There are three types of rumble strips. The most common type of strip is the continuous shoulder rumble strip. These are located on the road shoulder to prevent roadway departure crashes on expressways, interstates, parkways, and two-lane rural roadways. Centerline rumble strips are used on some two-lane rural highways to prevent

head-on collisions. Transverse rumble strips are installed on approaches to intersections, toll plazas, horizontal curves, and work zones.

*How can the adverse effects of rumble strips on bicyclists be reduced?*

Many bicyclists believe that rumble strips compromise their use of a paved shoulder. FHWA has considered the needs of bicyclists in our *Technical Advisory on Roadway Shoulder Rumble Strips*, which can be found at <http://www.fhwa.dot.gov/legsregs/directives/techadvs/t504035.htm>.

#### Benefits

- Reduce ROR crashes caused by driver inattention, driver error, visibility, and fatigue.
- Are inexpensive to install.
- Cause no noticeable pavement degradation.
- Require little or no maintenance.
- Can be installed on new or existing pavements (milled rumble strips).

#### Successful Applications: State studies show success in reducing ROR crashes

After Delaware DOT installed centerline rumble strips on U.S. Route 301—a two-lane, undivided rural highway with a high fatality rate—the head-on collision rate decreased 90 percent, and fatalities decreased to zero. These dramatic safety improvements were achieved despite a 30 percent increase in traffic.

A New York study showed a significant change in the number of ROR crashes, injuries, and fatalities after rumble strips were installed on the New York State Thruway. ROR crashes were reduced 88 percent, from a high of 588 crashes in 1993 to 74 in 1997. Total injuries were reduced 87 percent, from a 1992 high of 407 to 54 in 1997. Fatalities were reduced 95 percent, from 17 in 1991 and 1992 to 1 fatality in 1997.

Virginia DOT won the 2001 National Highway Safety Award for its experiment with continuous shoulder rumble strips (CSRS) on the State's 1,476-kilometer (917-mile) interstate highway system from 1997 to 2000. During this project, ROR crashes were reduced by 51.5 percent, saving an estimated 52 lives. It is estimated that CSRS technology has prevented 1,085 injuries and 1,150 ROR crashes, with a total cost savings of \$31.2 million.

#### Deployment Statement

The appropriate use of milled shoulder rumble strips has the potential to reduce single-vehicle

ROR crashes caused by driver inattention, distraction, or drowsiness. Similarly, the judicious use of centerline rumble strips on undivided roads can reduce the number of head-on collisions on those facilities.

#### Deployment Goal

All States will adopt a policy that mirrors the recommendations in FHWA's *Technical Advisory*: Milled shoulder rumble strips should be used on all appropriate rural freeways and on selected non-freeway facilities. Also, milled centerline rumble strips should be used on appropriate two-way roads based on crash data. To meet this goal, FHWA staff must convince staff at State DOTs to implement the appropriate policies and programs, which can be paid for using regular construction funds. Safety funds also can be used for 100-percent Federal financing of rumble strips.

#### Deployment Status

Several State DOTs are in substantial compliance with FHWA's *Technical Advisory on Shoulder Rumble Strips*, while others are proceeding toward fuller compliance. FHWA staff must now convince State DOT staff in those States where compliance is low to implement the appropriate policies and programs. Regular construction funds are available. Each Division Office and State DOT must track progress toward compliance on a routine basis and encourage the use of statistically valid technical evaluations to determine project effectiveness.

#### Additional Resources

Visit the FHWA Rumble Strip Web site at <http://safety.fhwa.dot.gov/programs/rumble.htm>.

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