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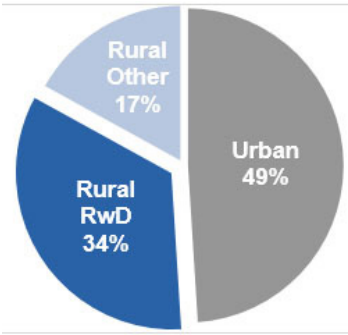
RoadTTAP Talk

# Roadway Departure Safety (Part 1 of 3)

*Edited by Airton G. Kohls and Matt Cate (Source: FHWA Office of Safety)*




*While less than 20 percent of the U.S. population lives in rural areas, NHTSA data shows that more than half of roadway fatalities occur on rural roadways.*

A roadway departure (RwD) crash is defined as a crash which occurs after a vehicle crosses an edge line or a center line, or otherwise leaves the traveled way. Roadway departure crashes encompass a variety of crash scenarios, including collisions between vehicles traveling in opposite directions on the same roadway, vehicles striking terrain and drainage features, and collisions with fixed objects such as trees and utility poles.

This article is the first of three articles we will be using in 2019 to highlight resources that can help your agency reduce RwD crashes. TTAP can also help you with training on several of these resources. Please check our training calendar at http://ttap.utk.edu/training/course-calendar.php

While less than 20 percent of the U.S. population lives in rural areas, NHTSA data shows that more than half of roadway fatalities occur on rural roads. Further, two-thirds of these rural fatalities involved a roadway departure (RwD). This means that not only are deaths on rural roadways severely overrepresented, so are fatalities and serious injuries related to RwD crashes.

As mentioned on a previous article of RoadTalk, to address this considerable safety issue on the Nation's rural road systems, FHWA has selected "Reducing Rural Roadway Departures" as 1 of the 10 innovations that are the focus of round 5 (2019-2020) of the Every Day Counts (EDC-5) initiative.

To effectively prevent RwD crashes and fatalities, FHWA's efforts are guided by the Strategic Approach & Plan that follows a clear framework prioritizing efforts to:

1) Keep vehicles on the roadway, in their appropriate directional lane,
2) Reduce the potential for crashes when vehicles do leave the roadway or cross into opposing traffic lanes, and
3) Minimize the severity of crashes that do occur.

Additionally, this approach aims to increase awareness of current safety needs, future priorities, and collaboration opportunities with other program areas to enhance the success of focused safety efforts.

### *Countermeasures to Keep Vehicles on Roadway*

The most cost-effective solution to reduce the number of crashes, injuries, and fatalities due to roadway departure is to strategically focus efforts on implementing countermeasures that will keep the vehicles on roadway.

Improving pavement friction, alerting drivers with rumble strips, enhancing delineation along horizontal curves, and improving nighttime visibility are effective practices that FHWA encourages agencies to explore in order to keep vehicles on the roadway.

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# From the Director

As I write to you today, spring has already sprung. Flowers are blooming, I've heard lawnmowers in the distance at times, and some people are already complaining about allergies. The basketball Vols survived the first weekend of the NCAA tournament and will soon face Purdue in the Sweet Sixteen. Hopefully I will be recounting a few more games past that when I deliver my next update in the Spring issue.

We should also talk a bit about the winter of 2019. Precipitation was a big part of the story this year. We did have some snowfall in December and January, but it was the rain that really caused problems for most of us. The Tennessee Valley Authority had already reported that 2018 was the wettest year on record for the Tennessee River valley. The 2018 average rainfall total of 67.1 inches surpassed the old record of 65.1 inches set in 1973. Average annual rainfall for the region is only 51 inches. February 2019 also set records. Knoxville set a new February record of 12.55 inches. Not to be outdone by the Scruffy City, Nashville set a new February record of 13.47 inches. The National Weather Service recorded more than 5 inches of rainfall in Knoxville on February 23rd.

Rainfall like this doesn't just ruin your picnic plans. Tennessee has experienced river flooding, flooded homes and businesses, flooded roadways, landslides, sinkholes, and potholes. Governor Bill Lee has requested federal disaster relief assistance for 58 of Tennessee's 95 counties. Roane County Road Superintendent Dennis Ferguson estimated that his department's roads suffered more than $3 million in flood-related damage. Multiple state routes were impacted by flooding and landslides, including Interstate 24 in Davidson County. Northshore Drive in Knox County remained closed for more than 2 weeks after the February 23rd flood.

Beyond the severity and extent of weather-related damage to the state's roadways, something else stood out to me. As news organizations, transportation agencies, and even private citizens shared their flood experiences, many of the photos and videos accompanying this information was captured using unmanned aerial systems (UAS, commonly referred to as "drones"). Drone footage showed flooded roads, landslides, submerged vehicles and homes, dams spilling water through floodgates, and more. It's clear that these small, relatively inexpensive devices provide us with a perspective that previously required the use of an airplane or a helicopter.

Many people have used drones to capture a moment, but to those of us in the business of transportation they represent a powerful new tool. Drones can be used to locate, document, and quantify storm damage. In better times, drones have many applications ranging from bridge inspections to construction monitoring to crash reconstruction. Unmanned Aerial Systems were already included in in FHWA's Every Day Counts program, and the real-world examples provided by our recent floods will only provide further evidence of their benefits.

That's all I have for now. With a little luck spring will bring something resembling normal rainfall (and hopefully UT's first appearance in the Final Four). Between now and then, please let me know if there is anything that TTAP can do to help you.

***Pavement Friction***

A roadway must have an appropriate level of pavement friction to ensure that drivers are able to keep their vehicles safely in the lane. Poor pavement conditions, especially wet pavement, have been identified as one of the major contributing factors in roadway departure crashes. When a pavement surface is wet, the level of pavement friction is reduced, and this may lead to skidding or hydroplaning.

Vehicles have different friction demands depending on the characteristics of the roadway. For example, a vehicle traversing a horizontal curve requires a greater level of friction than vehicles on a straight section. Common locations that require higher friction values are horizontal curves, steep grades, or intersection approaches. As a result of the increased friction demand, the roadway surface at these locations often becomes prematurely polished, reducing the pavement friction and contributing to higher crash rates. Excessive speeds or distracted driving can also contribute to the crash rates in areas where friction demand is high.

Pavement friction is critical for changing vehicle direction and ensuring the vehicle remains in its lane. Traditional friction courses or high friction surface treatments should be considered for curves with numerous wet weather crashes or severe curves with higher operating speeds.

For additional information on pavement friction, please go to: https://safety.fhwa.dot.gov/roadway_dept/pavement_friction/

***Rumble Strips and Rumble Stripes***

Rumble strips are an effective countermeasure for reducing roadway departure crashes. The noise and vibration produced by rumble strips alert drivers when they leave the traveled way. Rumble stripes is the term used for rumble strips painted with a retroreflective coating to increase the visibility of the pavement edge at night and during inclement weather conditions.

Research has shown that installing rumble strips can reduce severe crashes. The following tables illustrate the safety effectiveness of center line and shoulder rumble strips. This information, along with additional statistics, is contained in NCHRP 641: Guidance for the Design and Application of Shoulder and Center Line Rumble Strips, 2009.

For additional information on rumble strips and rumble stripes, please go to: https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/

| **Center line Rumble Strip – Reduction in crash frequency from before to after rumble strip implementation for head-on and opposite direction sideswipe fatal and injury collisions** | | |
|---|---|---|
| | Percent reduction in crash frequency from before to after rumble strip implementation | Standard Error |
| Rural two-lane roads | 45% | 6% |
| Urban two-lane roads | 64% | 27% |

*Excerpt from Table 67 of NCHRP Report 641.*

| **Shoulder Rumble Strip – Reduction in crash frequency from before to after rumble strip implementation for single-vehicle run-off-road fatal and injury crashes** | | |
|---|---|---|
| | Percent reduction in crash frequency from before to after rumble strip implementation | Standard Error |
| Rural two-lane roads | 36% | 10% |
| Rural freeways | 17% | 7% |

*Excerpt from Table 28 of NCHRP Report 641.*

*continued on page 4*

***Horizontal Curve Safety***

Horizontal curves are those that change the alignment or direction of the road (as opposed to vertical curves, which change the slope). More than 25 percent of fatal crashes are associated with a horizontal curve, and the vast majority of these crashes are roadway departures. The average crash rate for horizontal curves is about three times that of other types of highway segments. About three-quarters of curve-related fatal crashes involve single vehicles leaving the roadway and striking trees, utility poles, rocks, or other fixed objects—or overturning.

Most roadway departure countermeasures are effective when applied specifically at horizontal curves. A focus on horizontal curves can prove to be a cost-effective approach to reducing roadway departure crashes. Many of these countermeasures are low-cost and can be installed at prioritized horizontal curves to address safety issues.

Please go to the link below and check this new available resource (FHWA's Indoor Simulator and Field Study Evaluation of Sequential Flashing Chevron Signs on Two-lane Rural Highways):

https://safety.fhwa.dot.gov/roadway_dept/countermeasures/horicurves/docs/fhwasa18075.pdf

***Nightime Visibility***

About half of traffic fatalities occur at night, although only about one quarter of travel occurs after dark. While intoxication and fatigue contribute to the high rate of nighttime crashes, nighttime driving is inherently challenging due to decreased visibility. In dark conditions, retroreflective pavement markings and signs delineate the roadway alignment and improve the visibility of decision points such as intersections. Adequately maintained retroreflective signs improve nighttime highway navigation and reduce the risk of crashes by bouncing light from vehicle headlights back toward the vehicle and the driver's eyes, making the signs appear brighter and easier to see and read. Because the retroreflective properties of traffic control devices deteriorate over time, highway agencies need to actively manage the maintenance of signs in order to ensure that they remain clearly visible at night.

For additional information on nighttime visibility, please go to: https://safety.fhwa.dot.gov/roadway_dept/night_visib/

## A Reminder about the MUTCD Compliance Dates for 2019

*Edited by Airton G. Kohls*

The current (2009) edition of the Manual on Uniform Traffic Control Devices (MUTCD) outlines compliance dates established by FHWA for certain traffic control device standards. State DOTs, counties, municipalities, and other road owners are urged to meet the requirements. You can find a list of the target compliance dates established by the FHWA at https://mutcd.fhwa.dot.gov/knowledge/09mutcdproposedrev/compliance_dates/mutcd09prorevtbli2cl.pdf

Here are 4 items your agency needs to be aware of regarding MUTCD compliance dates for 2019:

*continued on page 5*

**2009 MUTCD Section 2B.40 – ONE WAY Signs (R6-1, R6-2)**

***Compliance Date:*** December 31, 2019

***What is it about:*** Requirements for the number and locations of ONE WAY signs (see Paragraphs 4, 9, and 10)

***What does the MUTCD say:***

04 - At an intersection with a divided highway that has a median width at the intersection itself of less than 30 feet, Keep Right (R4-7) signs and/or ONE WAY signs shall be installed (see Figures 2B-16 and 2B-17). If Keep Right signs are installed, they shall be placed as close as practical to the approach ends of the medians and shall be visible to traffic on the divided highway and each crossroad approach. If ONE WAY signs are installed, they shall be placed on the near right and far left corners of the intersection and shall be visible to each crossroad approach.

**Figure 2B-16. ONE WAY Signing for Divided Highways with Median Widths Narrower Than 30 Feet**

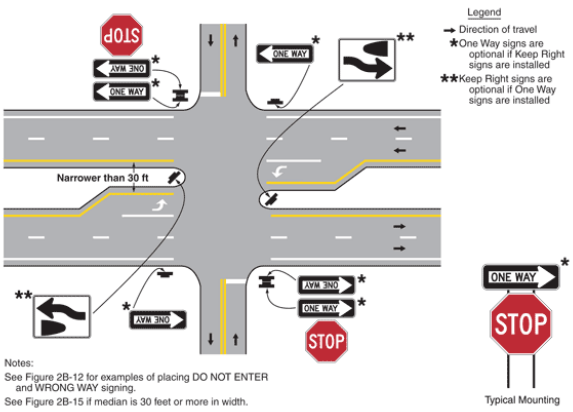
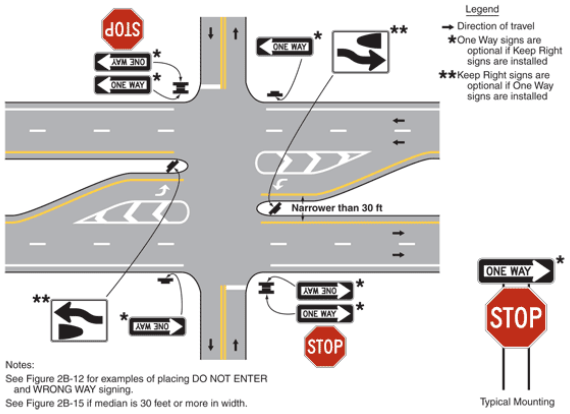
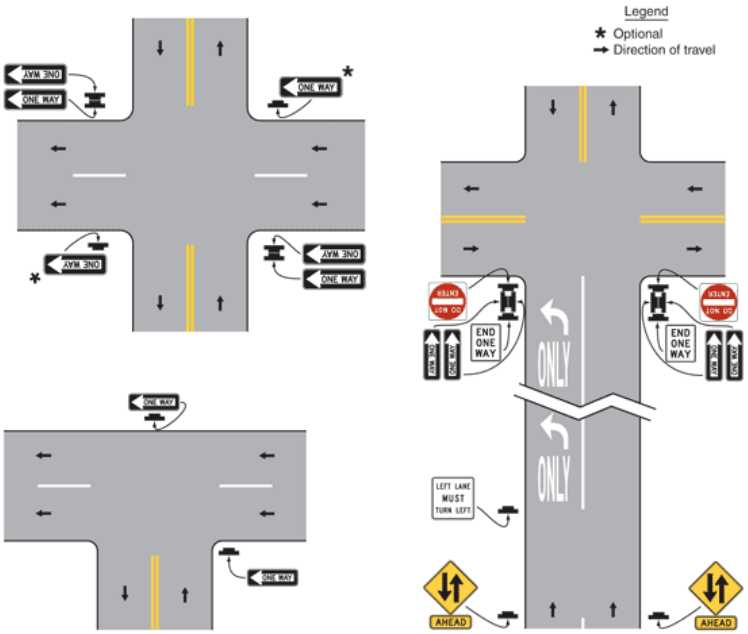



**Figure 2B-17. ONE WAY Signing for Divided Highways with Median Widths Narrower Than 30 Feet and Separated Left-Turn Lanes**




09- At unsignalized T-intersections where the roadway at the top of the T-intersection is a one-way roadway, ONE WAY signs shall be placed on the near right and the far side of the intersection facing traffic on the stem approach (see Figure 2B-14).

**Figure 2B-14. Locations of ONE WAY Signs**

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10 - At signalized T-intersections where the roadway at the top of the T-intersection is a one-way roadway, ONE WAY signs shall be placed near the appropriate signal faces, on the poles holding the traffic signals, on the mast arm or span wire holding the signals, or at the locations specified for unsignalized intersections.

**2009 MUTCD Section 2C.06 through 2C.14 – Horizontal Alignment Warning Signs**
***Compliance Date:*** December 31, 2019
***What is it about:*** Revised requirements in the 2009 MUTCD regarding the use of various horizontal alignment signs (see Table 2C-5)

**Table 2C-5. Horizontal Alignment Sign Selection**

| Type of Horizontal Alignment Sign | Difference Between Speed Limit and Advisory Speed | | | | |
|---|---|---|---|---|---|
| | 5 mph | 10 mph | 15 mph | 20 mph | 25 mph or more |
| Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), Winding Road (W1-5), and Combination Horizontal Alignment/Intersection (W10-1) (see Section 2C.07 to determine which sign to use) | Recommended | Required | Required | Required | Required |
| Advisory Speed Plaque (W13-1P) | Recommended | Required | Required | Required | Required |
| Chevrons (W1-8) and/or One Direction Large Arrow (W1-6) | Optional | Recommended | Required | Required | Required |
| Exit Speed (W13-2) and Ramp Speed (W13-3) on exit ramp | Optional | Optional | Recommended | Required | Required |

Note: Required means that the sign and/or plaque shall be used, recommended means that the sign and/or plaque should be used, and optional means that the sign and/or plaque may be used.

See Section 2C.06 for roadways with less than 1,000 ADT.

**2009 MUTCD Section 8B.03 and 8B.04 – Grade Crossing (Crossbuck) Signs and Supports**
***Compliance Date:*** December 31, 2019
***What is it about:*** Retroreflective strip on Crossbuck sign and support (see Paragraph 7 in Section 8B.03 and Paragraphs 15 and 18 in Section 8B.04)
***What does the MUTCD say:***
07 - A strip of retroreflective white material not less than 2 inches in width shall be used on the back of each blade of each Crossbuck sign for the length of each blade, at all grade crossings where Crossbuck signs have been installed, except those where Crossbuck signs have been installed back-to-back.
15 - A vertical strip of retroreflective white material, not less than 2 inches in width, shall be used on each Crossbuck support at passive grade crossings for the full length of the back of the support from the Crossbuck sign or Number of Tracks plaque to within 2 feet above the ground, except as provided in Paragraph 16.
18 - If a Crossbuck sign support at a passive grade crossing does not include a YIELD or STOP sign (either because the YIELD or STOP sign is placed on a separate support or because a YIELD or STOP sign is not present on the approach), a vertical strip of retroreflective white material, not less than 2 inches in width, shall be used for the full length of the front of the support from the Crossbuck sign or Number of Tracks plaque to within 2 feet above the ground.

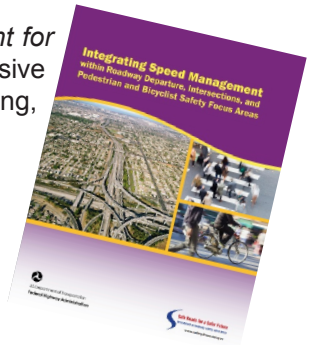
**2009 MUTCD Section 8B.04 – Crossbuck Assemblies with YIELD or STOP Signs at Passive Grade Crossings**
***Compliance Date:*** December 31, 2019
***What is it about:*** New requirement in the 2009 MUTCD for the use of STOP or YIELD signs with Crossbuck signs at passive grade crossings.

*continued on page 7*

***What does the MUTCD say:***
01- A grade crossing Crossbuck Assembly shall consist of a Crossbuck (R15-1) sign, and a Number of Tracks (R15-2P) plaque if two or more tracks are present, that complies with the provisions of Section 8B.03, and either a YIELD (R1-2) or STOP (R1-1) sign installed on the same support, except as provided in Paragraph 8. If used at a passive grade crossing, a YIELD or STOP sign shall be installed in compliance with the provisions of Part 2, Section 2B.10, and Figures 8B-2 and 8B-3.

## Speed Management for Safety

*Edited by Airton G. Kohls (Source: Institute of Transportation Engineers and Road to Zero Coalition)*




The *Institute of Transportation Engineers* developed the *Speed Management for Safety Hub,* in partnership with the *Road to Zero Coalition,* to provide a comprehensive overview of factors and resources to transportation professionals when evaluating, designing, implementing, and enforcing safe speeds.

Practitioners can explore resources on the following 4 focus areas:

- Speed as a Safety Problem
- Setting Speed Limits
- Measures for Managing Speed
- Creating a Speed Management Program

You can access the Speed Management for Safety Hub at https://www.ite.org/technical-resources/topics/speed-management-for-safety/

TTAP is working on a ***Speed Management Techniques workshop*** that will soon be available for registration on our calendar! Stay tuned!

In the meantime, here are a few speed management resources available for FREE for you to download:

***Integrating Speed Management within Roadway Departure, Intersections, and Pedestrian and Bicyclist Safety Focus Areas***

Speeding contributes to nearly one-third of all roadway fatalities, and this proportion has remained largely unchanged for the past decade. Since roadway departure, intersection, and pedestrian and bicycle crashes have been identified by the Federal Highway Administration (FHWA) as the three areas with great potential to reduce fatalities, States are being encouraged to integrate speed management into these three safety focus areas. To assist agencies with integrating speed management into their policies, practices, and safety plans, this report presents information on national speeding-related crash trends, promotes a speed-related crash data analysis approach, and recommends strategies and initiatives for integrating speed management into an agency's overall policies, as well as their roadway departure, intersection, and pedestrian/bicyclist safety programs.
https://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa16017/spd_mgt_rwdpdbik.pdf

***Speed Management: A Manual for Local Rural Road Owners***

This document is intended to provide local road practitioners with information on how to address speeding-related crashes through the implementation of a comprehensive Speed Management Program. An effective program addresses all factors that influence speeding through engineering, enforcement, education, and emergency services—known as the four E's of safety.
https://safety.fhwa.dot.gov/local_rural/training/fhwasa010413spmgmt/speedmanagementguide.pdf

***Speed Management: Toolkit***

This document is a collection of resources available from FHWA on speed management countermeasures, successful speed management program tips sheets, etc.
https://safety.fhwa.dot.gov/speedmgt/ref_mats/docs/speedmanagementtoolkit_final.pdf

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