

Horizontal Curve Countermeasure Reference List for CMV Safety

Systemic Selection of Horizontal Curve Locations for Implementing Countermeasures to Improve CMV Safety. Funded by the Federal Motor Carrier Safety Administration (FMCSA) FM-MHP-0591.

Selecting countermeasures is a critical component of the safety management process. When proper countermeasures are selected and implemented, target crashes can be reduced. Numerous studies and evaluations have documented countermeasures and their effects on reducing crash frequency and severity. This reference list focuses on roadway-related countermeasures that can reduce Commercial Motor Vehicle (CMV) crashes on horizontal curves on rural two-lane roadways. Table 1 provides an alphabetized list of the countermeasures and their relative cost.

You can view which countermeasures are recommended for horizontal curves on rural two-lane roadways in Texas by utilizing the interactive Horizontal Curve CMV Crash Risk Map at [ttishiny.shinyapps.io/FMCSA Truck Curve Safety/](http://ttishiny.shinyapps.io/FMCSA_Truck_Curve_Safety/).

Table 1. Roadway-related Countermeasures and Relative Cost

Roadway-related Countermeasure	Relative Cost
Center line rumble strips	Medium
Increase Clear Zone	Medium to High
Reduce posted speed limits	Low
Sequential dynamic curve warning systems	Medium
Shoulder rumble strips	Medium
Speed advisory signs	Low
Static advance warning signs	Low
Widen lane width on curve	High
Widen shoulder width on the curve	High

Countermeasures

The following sections describe and provide example photos of each countermeasure. Countermeasures may be used individually or in combination with other countermeasures.

Center Line Rumble Strips

A center line rumble strip is a series of milled or raised elements installed at or near the center line of a paved roadway. Traversing the rumble strips creates an audible and vibratory warning to alert drivers that their vehicles have left the travel lane.

Refer to the [FHWA Center Line Rumble Strips Technical Advisories](#) for detailed application considerations and technical specifications.



Figure 1. Center line rumble strip on two-lane roadway.

Increase Clear Zone

A Clear Zone is a roadside area that is free of fixed objects and non-traversable terrain. They improve safety by providing space for a driver to stop or regain control of a vehicle that has departed the road.

Refer to the [FHWA Clear Zones](#) webpage for detailed application considerations and technical specification.



Figure 2. Clear Zone on two-lane roadway.

Reduce Posted Speed Limits

When appropriate, the posted speed limit should be reduced to the speed at which a large truck can safely navigate a curve. Reducing the posted speed, rather than just providing an advisory speed, may be advantageous since posted speed limits are enforceable and may reduce the speed differential between large trucks and other vehicles on the roadway.

Refer to the [Texas Department of Transportation Procedures for Establishing Speed Zones Manual](#) for detailed application considerations and technical specifications.



Figure 3. Speed limit sign on two-lane roadway.

Sequential Dynamic Curve Warning Systems

Sequential Dynamic Curve Warning Systems (SDCWS) are horizontal curve chevron signs with embedded solar powered flashing lights. The flashing lights are most often used with a sequential pattern, moving toward or away from the approaching driver, but can be flashed simultaneously (i.e., each sign is flashing at the same time as the other signs).

Refer to the [FMCSA Low Cost Treatments for Horizontal Curves Appendix E: Application Of Sequential Dynamic Curve Warning Systems](#) for detailed application considerations and technical specifications.



Figure 4. Solar-powered Sequential Dynamic Curve Warning Systems on two-lane roadway. Image from the Pennsylvania Department of Transportation, <https://www.penndot.pa.gov/about-us/StateTransportationInnovationCouncil/Innovations/Pages/Lighting-Curves.aspx>

Shoulder Rumble Strips

A shoulder line rumble strip is a series of milled or raised elements installed at or near the outer edge of the travel lane on a paved roadway. Traversing the rumble strips creates an audible and vibratory warning to alert drivers that their vehicles have left the travel lane.

Refer to the [FHWA Shoulder and Edge Line Rumble Strips Technical Advisories](#) for detailed application considerations and technical specifications.



Figure 5. Shoulder Rumble Strip on two-lane roadway.

Speed Advisory Signs

Speed advisory signs may be added prior to horizontal curves to inform drivers of the speed at which it is generally safe to drive given the change in roadway geometry.

Refer to the [FHWA Procedures for Setting Advisory Speeds on Curves](#) or [Texas Enhancing Curve Advisory Speed and Curve Safety Assessment Practices](#) for detailed application considerations and technical specifications.



Figure 6. Speed advisory sign (45 MPH), placed under a static advanced warning sign.

Static Advance Warning Signs

Static advance warning signs are yellow signs with black icons or text that can be installed to alert drivers that there are changes in the horizontal road alignment. These warning signs can be used alone or in conjunction with an advisory speed limit.

Refer to the [Texas Manual on Uniform Traffic Control Devices](#) for proper application of these signs.



Figure 7. Static advance warning sign before series of horizontal curves.

Widen Lane Width on the Curve

Increased lane width on a horizontal curve allows drivers to utilize more space to navigate the curve without departing the roadway. Wider lanes increase the lateral space between vehicles in adjacent lanes and provide a wider buffer to accommodate minor deviations of vehicles from their intended path.

Refer to the [Crash Modification Factors \(CMF\) Clearinghouse](#) for the safety benefits of widening a lane in the rural areas.



Figure 8. Wide lane on horizontal curve.

Widen Shoulder Width on the Curve

Widening the shoulder on a horizontal curve allows drivers more space to safely recover if they depart the roadway.

Refer to the [CMF Clearinghouse](#) for the safety benefits of widening shoulders in the rural areas.



Figure 9. Wide shoulder on horizontal curve.