

Federal Highway Administration – Federal Lands Highway Division

Rumble Strip Guidelines

FOR SHOULDER AND CENTER LINE APPLICATIONS

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SHOULDER AND CENTER LINE RUMBLE STRIPS

Introduction

This document is intended to provide guidance to Federal Lands Highway (FLH) Designers, Project Managers, and Safety Engineers on when and where to install rumble strips, while minimizing the adverse effects for bicyclists and residents. The use of rumble strips is encouraged on all appropriate FLH projects. The installation of shoulder and center line rumble strips should be discussed with the Federal Land Management Agency (FLMA) and other partners during project scoping, or no later than the 70% design completion.

Research has shown that rumble strips are an effective countermeasure for reducing the number and severity of roadway departure (RwD) crashes, such as single-vehicle run-off-road (SVROR), head-on, and opposing-sideswipe.ⁱ An FHWA-sponsored research project with Texas Transportation Instituteⁱⁱ has shown that rumble strips are an effective means to alert drivers and promote proper positioning within the lane. In addition, the National Cooperative Highway Research Program (NCHRP) has published data on the effect of rumble strip installation on crash reduction.ⁱⁱⁱ

Rumble strips are milled or raised patterns on the roadway pavement that produce audible and vibratory warning to the driver. The warning alerts the driver who may have inadvertently encroached onto the shoulder or crossed the centerline. A rumble strip becomes a “rumble stripe” when an edge line or center line pavement marking is placed on the rumble strip. Both the milled and the raised rumble strips are recommended for use on FLH projects.^{iv}



Figure 1a. Milled Rumble Strip/Stripe

(Source: FHWA)



Figure 1b. Raised Rumble Stripe

(Source: <http://www.contrafedpublishing.co.nz/site/contrafed/images/Features/Rumble.jpg>)

- Milled rumble strips are the most frequently used type. They are made by a machine with a rotary cutting head which creates a smooth, uniform, and consistent groove into the pavement. Figure 1a shows a milled rumble strip/stripe installation.
- Raised rumble stripes, also known as profiled rumble stripes, are 2 inches to 12 inches wide (50 mm to 300 mm), rounded or rectangular markers or strips. Typically they are polymer resin round or rectangular markers or strips that adhere to new or existing pavement. Because their height ranges

from ¼ inch to ½ inch (6 mm to 13 mm), they are typically not used in snowy climates. Raised rumble stripes can be used in a permanent or temporary installation. Figure 1b shows a type of raised rumble stripe installation.

Issues and Concerns

There are several known issues and concerns to be aware of when deciding to install rumble strips and rumble stripes. Consult with the Safety Engineer to determine if the issues and concerns are such that the installation would be inappropriate. The following are a list of common issues and concerns that apply to the types of roads found on FLH projects:

- Pavement performance concerns^v
 - Some pavement performance concerns have been identified with shoulder and center line rumble strips, but most appear to be minor or unwarranted. Consult with the Materials and Pavements unit to determine if there are unique concerns on the project that might indicate a different rumble strip location or design, or if they are not appropriate.
- Noise associated with rumble strips
 - Rumble strips are intended to help the driver stay within the lane, so there should be little to no noise; however, if there is a high potential for noise, such as near frequent access points, campgrounds, residences, the rumble strips can be discontinued in these specific areas.
 - Currently there are ongoing studies looking at enhanced rumble strip designs that maintain current in-vehicle vibration, but lower the external decibel level. Enhanced rumble strips may be a viable option in the near future.
- Use of rumble strips at intersections and access points
 - On facilities with higher speeds, vehicles may take longer to stop or slow down to make a turn, and they may start moving across the shoulder rumble strips sooner than designed for. As a result, there may be more noise and resulting negative public reaction to the installation of the rumble strips.
 - At private or minor approaches (like field access and residential driveways), there is less potential for noise related issues due to the limited number of turning vehicles. Conversely, near commercial areas or major approaches there is a higher potential for noise.
- Evidence of worn pavement markings
 - During the scoping trip or PS&E milestone review, worn pavement markings in certain areas may indicate that drivers are not staying in their lane, and there might be a greater need for the installation of rumble strips at those locations. However, installing rumble strips in those areas may generate undesirable noise.
- Use of rumble strips on curve widening
 - Similar to pavement marking locations, the rumble strip is to be located at the outer edge of the widening.

- Cost of rumble strips
 - The cost of installing rumble strips varies across the nation. Based on the length of the installed rumble strips, recently published costs^{vi} of installing rumble strips vary from 10 cents to \$1.20 per linear foot (3 to 37 cents per meter) which translates to about \$500 to \$6000 per mile (\$800 to \$9700 per km).

Design Parameters, Guidelines, and Recommendations

The designer should consult with the Safety Engineer, Project Manager, and the FLMA or other agency partner to choose the appropriate location and design for the installation of rumble strips and rumble stripes. The following are basic design parameters, guidelines and recommendations for the designer to consider when preparing the plans. However, not all guidelines and recommendations are feasible for all types of FLH projects. As more information is gathered through research and application, these recommendations will be updated.

- Indicate on the construction plans the recommended rumble strip locations and gaps.
- Advance warning signs are not necessary.
- Mill the rumble strip prior to the application of a chip seal surface. Placing chip seal on top of the rumble strip will cause some loss in cross section; however, studies have shown that milling into the chip seal causes an unfavorable increase in noise and vibration.
- Milled rumble strips are commonly 8 inches and 12 inches (200 mm, or 305 mm) in width. While there are some applications of 4 inch and 16 inch (100 mm and 400 mm) widths, they are not generally suitable for the low-speed, low-volume roads found on most FLH projects. The most appropriate shoulder rumble strip width for FLH projects is 8 inches. The most appropriate center line rumble strip width for FLH projects is 12 inches, regardless of the center line pavement marking application. If required, indicate the width in the project SCRs.
- Raised rumble stripes are commonly 4" (100 mm) or 6" (150 mm) in width since they are installed as part of the pavement marking application. When considering raised rumble stripes, the designer should keep in mind that smaller dimensions (width and length) and greater spacing between rumbles are commonly associated with less alerting noise and vibration, and therefore less effectiveness.
- When installing center line rumble strips where bicyclists share the lane, maintain a minimum of 14 feet (4.3 m) of pavement from the outer edge of the center line rumble strip to the edge of the pavement (Figure 2a).
- When installing shoulder rumble strips in areas where bicyclists are present, maintain a minimum clear shoulder width of 4 feet (1.2 m). An additional 12 inches (305 mm) of width is recommended if the shoulder is adjacent to guardrail (Figure 2b).
- When providing a rumble strip offset, place the shoulder rumble strip a maximum of 12 inches (305 mm) from the outer edge of the edge line pavement marking in order to provide as much room as possible for bicyclists to comfortably maneuver within the minimum clear shoulder area. Indicate on the plans the offset distance used on the project.
- For rumble stripes, mill the rumble strips prior to the installation of pavement markings.

- Provide a gap in the center line rumble strip installation at public road intersections and major approach roads.
- Provide a gap in the shoulder rumble strip installation at the following locations (Figures 3a and 3b):
 - 10-12 feet (3.7 m) for bicycle use after a maximum 48 feet (14.6 m) continuous installation,
 - at least 15 feet (4.6 m) prior to the beginning of the taper for a right turn deceleration lane,
 - at least 75 feet (22.9 m) prior to a pullout, mailbox turnout, or radius return of an intersection without a deceleration lane,
 - at least 15 feet (4.6 m) beyond a pullout, mailbox turnout, or radius return of an intersection,
 - at least 25 feet (7.6 m) prior to a minor approach, such as a driveway, and
 - at least 15 feet (4.6 m) beyond a minor approach.
- **Avoid** the installation of rumble strips and stripes at the following locations:
 - bridge deck and approach slabs,
 - right turn acceleration and deceleration lanes,
 - pavement less than 2 inches (50 mm) in depth (applies to milled rumble strips only),
 - after pavement markings have been placed, and
 - when pavement exhibits alligator and fatigue cracking, or generally in poor condition. For rumble strips installed on existing pavement, consult with the pavement engineer to verify a suitable pavement condition.

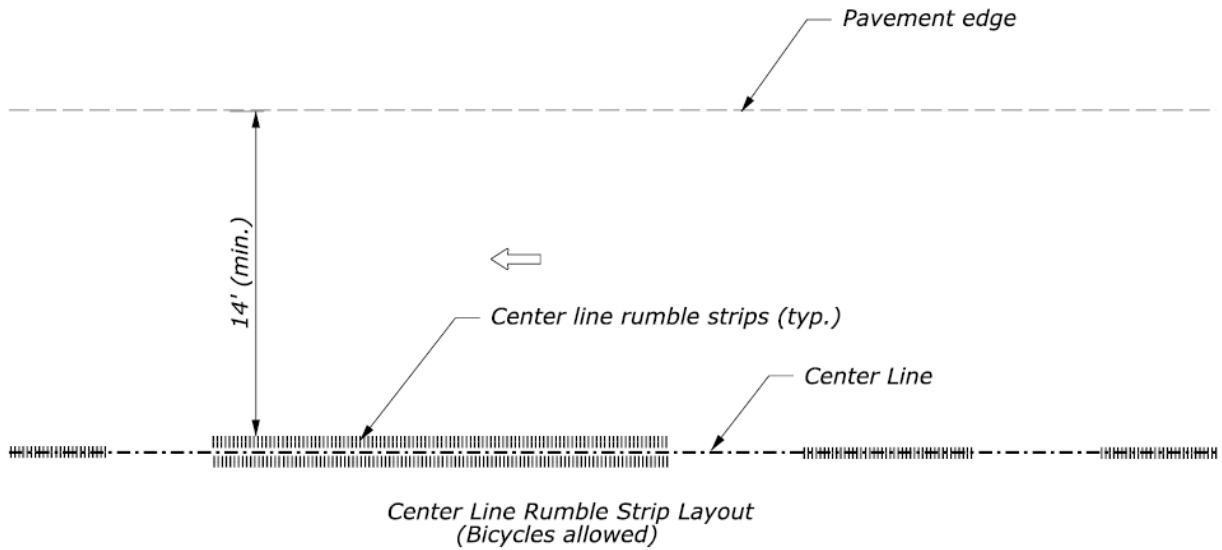


Figure 2a. Center Line Rumble Strips Where Bicycles are Allowed

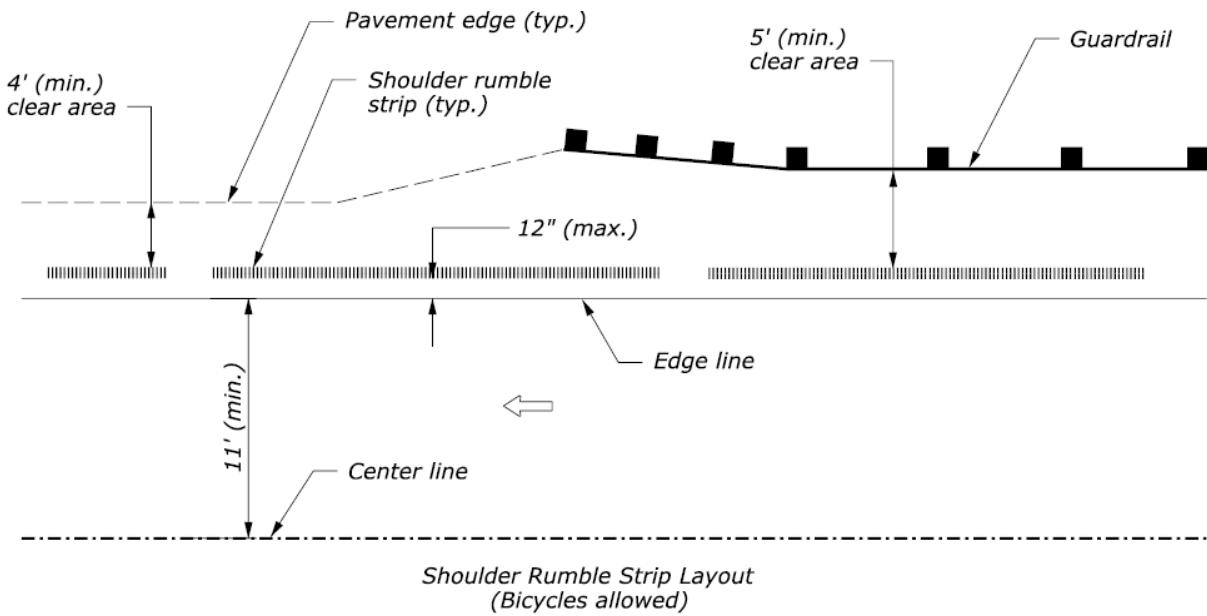


Figure 2b. Shoulder Rumble Strips Where Bicycles are Allowed

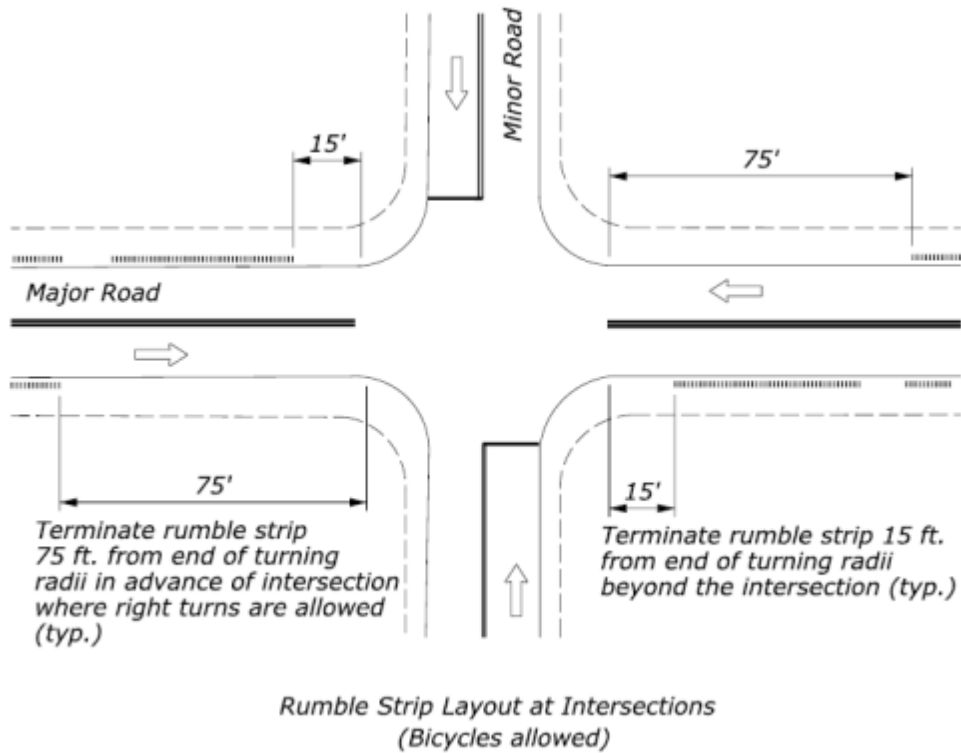


Figure 3a. Schematic of Rumble Strip Layout at Intersections

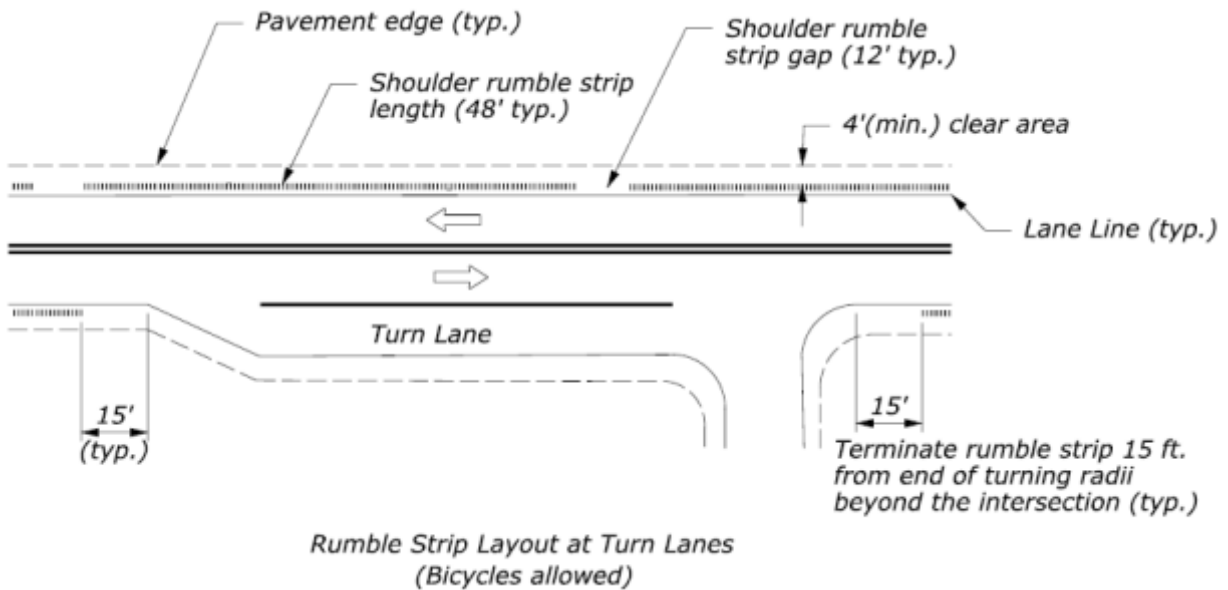


Figure 3b. Schematic of Rumble Strip Layout at Auxiliary Lanes

(Source: Alaska Department of Transportation & Public Facilities)^{vii}

Appropriate Installation Locations

The placement of shoulder rumble strips can be site-specific or project-wide. Examples of appropriate installation locations include:

- at high incident roadway departure (RwD) crash sites,
- when a minimum 11 foot lane can be maintained,
- at limited clear zone areas (steep slopes, trees, utilities, rock outcrops, etc.),
- on horizontal curves,
- on long tangent sections, and
- at approaches to a narrow bridge.

The placement of center line rumble strips can be site-specific or project-wide. Examples of appropriate installation locations include:

- at high incident head-on and opposing-sideswipe crash sites,
- when a minimum of 22 feet of total pavement width can be maintained,
- along roadways with frequent horizontal curvature,
- through a continuous area; or less commonly at specific spot locations, and
- in passing and no-passing zones.

Pay Items

63313-0000 Rumble strip (LNFT) – main pay item for center line or shoulder installation by LNFT.

63313-1000 Rumble strip, shoulder (LNFT) – pay item not commonly used. Check with Project Manager.

63314-0000 Rumble strip (MILE) – main pay item for center line or shoulder installation by MILE.

63314-1000 Rumble strip, shoulder (MILE) – pay item not commonly used. Check with Project Manager.

634 Pavement Markings – for Rumble Stripes, use the same pavement marking type (A, B, C, D, etc.) as indicated in the 634 Special Contract Requirement (SCR).

Applicable SCRs

Central Federal Lands: Section 633

REFERENCES

ⁱ FHWA, *Technical Advisories, Rumble Strips and Stripes*

http://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/index.cfm

ⁱⁱ Texas Transportation Institute, *Studies to Determine the Operational Effects of Shoulder and Centerline Rumble Strips on Two-lane Undivided Roadways*, The Texas A&M University System, FHWA/TX-09/0-5577-1, October, 2008.

<http://tti.tamu.edu/documents/0-5577-1.pdf>

ⁱⁱⁱ NCHRP Report 641, *Guidance for the Design and Application of Shoulder and Centerline Rumble Strips*, Transportation Research Board of the National Academies, 2009.

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_641.pdf

^{iv} FHWA, *Technical Advisories*

^v Texas Transportation Institute

^{vi} FHWA, *Frequently Asked Questions, Rumble Strips and Stripes*

http://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/faqs.cfm

^{vii} Alaska Department of Transportation & Public Facilities, Standard Drawing T-25.00

http://www.dot.state.ak.us/stwddes/dcsprecon/stddwgspages/traffic_eng.shtml