

BICYCLING AND RUMBLE STRIPS

Problems for Cyclists

What are rumble strips?: Rumble strips are raised or grooved patterns in a road's shoulder designed to alert drivers with noise and vibrations that they are drifting off the roadway.ⁱ They can be an effective safety measure to prevent run-off-the-road (ROR) crashes, especially on limited-access highways and rural two-lane highways with long straight sections. (Rumble strips placed on the centerline can help prevent head-on crashes.)

How do rumble strips impact cyclists?: Rumble strips are virtually impossible to ride a bicycle on or over – they are at best uncomfortable, even for a very short distance, and at worst can cause a cyclist to lose control of their bike and fall. They can damage a bicycle wheel, can cause a flat tire, and/or shake loose parts off a bicycle. Consequently, cyclists will avoid riding over themⁱⁱ – and when rumble strips leave no room on a shoulder, the cyclist will have no other option than to ride in the travel lane. While rumble strips do not deter car, truck or bus travel, they have a severe impact on bicycling travel, and have ruined popular cycling routes.

The negative impact of rumble strips on the ride-ability of a roadway has prompted American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA) to provide guidance to follow when considering rumble strips on roadways used by cyclists. They recommend that rumble strips should not be used indiscriminately on roadways that are not limited-access. Rumble strips should be used where there is a history of run-off-the-road crashes; especially where there is sufficient recovery room for a motorist to react to the alert provided by the rumble strip; and when the impact cyclists can be minimized. This means that at least four feet of unobstructed roadway shoulder remains after the rumble strips have been installed.

States should train and monitor contractors to ensure best practices are followed. Advocates should work with their state DOTs, Municipal Planning Organizations (MPOs), and county road commissions to verify that unnecessary rumble strips are not installed and that preferred bicycling routes, especially, are kept free of rumble strips. It is important to get it right the first time. Improperly installed rumble strips are expensive to repair – often costing many times more than the original installation – and usually cannot be repaired without leaving behind an uneven surface or a shoulder prone to early failure.

Specific Elements to Address

1. Too wide – many rumble strips are excessively wide, removing limited space on the shoulder for bicyclists to travel.
2. Too deep – most rumble strips are ground-in to depths that are excessive and dramatically more dangerous for cyclists.
3. Continuous – rumble strips without gaps in the strip do not allow a safe way for cyclists to cross, merge or turn without hitting rumble strips.
4. Placement – the lateral placement in a shoulder can make a shoulder that was once very comfortable to a bicyclist unusable.

Existing National Guidance

Many states develop their own rumble strip policies. National organizations and agencies such as the AASHTO and the FHWA have issued guidance on how state agencies can balance the motorist safety benefits of rumble strips with the needs of bicyclists. The following includes guidance to install rumble strips in ways that can minimize the harmful impact on bicycling. Ideally, rumble strips would rarely be used on roads where bicycling is expected. Rumble strips should be used only when careful study determines that they are needed to reduce risk in high ROR crash locations and when there is adequate space on the shoulder for drivers to recover. The following guidance should be considered the minimum standard.

AASHTO's [Guide for Development of Bicycle Facilities](#)ⁱⁱⁱ says that rumble strips “are **not recommended where shoulders are used by bicyclists** unless there is a minimum clear path of 0.3 m (1 foot) from the rumble strip to the traveled way, 1.2 m (4 feet) from the rumble strip to the outside edge of paved shoulder, or 1.5 m (5 feet) to adjacent guardrail, curb or other obstacle. If existing conditions preclude achieving the minimum desirable clearance, the width of the rumble strip may be decreased or other appropriate alternative solutions should be considered.” **Cyclists find that placing the rumble strip 1 foot to the right of the edge line is unsatisfactory and strongly recommend a minimum of four or five feet on the outside of the shoulder.**

The [FHWA guidance on Roadway Shoulder Rumble Strips](#)^{iv} supports this policy, saying, “**Rumble strips should only be installed when an adequate unobstructed width of paved surface remains available for bicycle use.**” The guidance notes that 12 feet gaps placed periodically in the strips allow cyclists to avoid debris and parked vehicles on the shoulder, or safely pass over the rumble strip for any reason. Because rumble strips occupy the favored part of the shoulder closest to the roadway, which generally remains clearer of debris due to the draft caused by passing automobiles, the FHWA guidance recommends that highway maintenance agencies regularly sweep the entire shoulder along bike routes and high bike-traffic areas. The guidance states that shallower (“reduced depth”) rumble strips, which are less jarring to cyclists, are a good compromise to accommodate bicyclists.

For rural freeways and expressways on the National Highway System, the FHWA guidance endorses “system-wide installation” of rumble strips to take advantage of economies of scale. Since bicyclists are generally prohibited from these highways,^v and there is often a wide shoulder when they are allowed, this guidance is appropriate

For non-freeway roads, such as rural multi-lane and two-lane roads, rumble strips should only be used if an engineering study or crash analysis shows that rumble strips would effectively reduce ROR crashes. **If an engineering study recommends rumble strips, they should follow these guidelines:**

1. Rumble strips can be used when eight feet remain clear on the shoulder (recommended for 10-foot shoulders). They should be installed as close to the edge line as practical.

2. Along shoulders of 6 or 8 feet, the FHWA calls for shallower depths, narrower strips, and gaps in the strip to allow cyclists to cross, merge, turn, avoid debris, or pass other cyclists and parked cars. The guidance adds: “Consideration should be given to increasing the gap spacing, narrowing the width of the rumble strips, widening the shoulders for bicycle use, or all of the above on long downhill grades where bicycle speeds are likely to increase significantly.”

3. Rumble strips should **not** be used when they would leave less than 4 feet to the edge of the pavement or five feet if a curb or guardrail is present on the shoulder.

Given the safety benefits of rumble strips for drivers, their use is appropriate under the right conditions. However, transportation agencies should – at a minimum – follow the guidance of AASHTO and FHWA. Rumble strips should not be installed on popular bicycle routes, or anywhere with insufficient shoulder width. If a rigorous crash analysis or engineering study finds rumble strips appropriate, their installation should follow the guidance above.

State Policies and Practices

Rumble strip policies and adherence vary by state. The range of differences in operating speeds, road designs, and expected users means that there is no single standard design for rumble strips used across all fifty states. However, state agencies accommodate bicycling in their rumble strip practices in a number of ways.

In May 2010, 31 states reported that they have rumble strip policies that require 4 feet of clear space, but several states reported incorrectly, or the policy can't be easily confirmed.



The Adventure Cycling Association has compiled information on policies and practices from many of the fifty states (via the Alliance for Bicycling & Walking and Association of Pedestrian and Bicycle Professionals listservs). See the [complete matrix of state policies](#), including trouble spots and role-models.^{vi}



Here are some findings regarding bicycling-accommodating practices reported in other sources.

Best Practices^{vii}

Not installing rumble strips on designated bicycle routes and other roads where bicycling is expected. For non-freeway rural roads, strips should be installed only after proper study confirms a documented need.

Providing minimum shoulder width – 4-foot shoulder, or 5 feet with guardrail are the bare minimum. Better examples include Alaska and Colorado that require a minimum 6 ft shoulder.

Adjusting placement of the rumble strips by placing strips close to edge line to increase available shoulder area, or on low speed roads by placing stripe away from edge line to allow cyclists to ride on the left side of the strip. Placing rumble strips on the edge line (a rumble stripe) both increases visibility of the white line and maximizes available shoulder area.

Providing gaps in regular intervals to give cyclists a chance to avoid debris along the shoulder, merge, turn, or pass other cyclists, some states include periodic gaps in the strips – at least 12 feet, every 40 or 60 feet^{viii} of rumble strip.

Adjusting rumble strips dimensions – Pennsylvania,^{ix} California,^x and Colorado^{xi} have studied bicycle-tolerable rumble strip designs. The studies come to similar conclusions about the dimensions for such rumble strips.^{xii}

- Width: 5 inches (127 mm)
- Depth: 0.375 inches (10 mm), and
- Spacing: 11 or 12 inches (280 or 305 mm)

When bicyclists need more of the shoulder or rumble strips are needed along a narrow shoulder, Torbic et al. report that narrower strips can “still generate the desired sound level differences in the passenger compartment.”

Survey Results

Torbic, et al. conducted a survey of 27 DOTs and four Canadian provincial transportation agencies on their rumble strip practices.^{xiii} Here are the answers to the questions that relate to bicycling:

- A majority of transportation agencies (17 agencies, 54.8 percent) said that bicycles “affect installation requirements” for their rumble strip policy or guidelines.
- A larger majority (19 agencies, 61.3 percent) said they had a “minimum shoulder width requirement for the installation of shoulder rumble strips.” Minimums ranged from 2 to 6 feet; 4 feet and 6 feet were the most common answers, but 4 feet are considered a bare minimum by bicyclists.
- Nearly 40 percent (12 agencies, 38.7 percent) said their rumble strip policy changes depending on “whether shoulder rumble strips will be installed along a designated bicycle route.” According to the report: “Responses included: (a) rumble strips are not installed along designated bicycle routes, (b) need to consider available lateral clearance, (c) rumble strip patterns/ dimensions change, and (d) gaps are provided rather than installing the rumble strips on a continuous basis.”
- Many agencies (11 agencies, 35.5 percent) said their policy / standard provides “a gap in the shoulder rumble strip pattern to allow bicyclists to maneuver from the travel lane to the

shoulder and back without traversing the rumble strips.” Typical responses were 12-foot gaps in 40- or 60-foot cycles.

- Most agencies (26, 83.9 percent) will install rumble strips both as part of larger projects and as a stand-alone improvement. Two agencies (6.5 percent) install as stand-alone only and two agencies (6.5 percent) install only as part of larger projects.
- Notably, but not surprisingly, no agencies collected data on “bicycle-only crashes or non-crash injuries related to rumble strip encounters.”

Examples of state policies accommodating bicycling

Frequently states go beyond the minimum guidance in one or more aspect of their rumble strip policy. [Alaska](#) requires 6-7 foot shoulders for rumble to be added and periodic 12-foot gaps in the rumbles to allow bicycles to cross; and [Colorado](#), in which no rumble strips are added on shoulders less than 6’ when a guardrail is present, requires a 12 foot gap every in every 60 foot section.

A 2007 Study by the National Center for Transportation and Industrial Productivity, in cooperation with the New Jersey DOT and the US DOT FHWA, reported the following state-specific practices to accommodate bicycling:^{xiv}

1. Minimum shoulder width to accommodate rumble strips. Do not use rumble strips if the shoulder width is less than 8 feet.
2. Widen the shoulder to provide at least a 4-foot-wide continuous riding surface (Florida).
3. Provide an offset of 1.2 m (4 feet) from edge of shoulder for bicycles and motorcycles (Hawaii).
4. Moving the rumble strip as close to the travel lane as possible (Minnesota)
5. Use of continuous rumble strips only on limited access facilities.
6. Use periodic gaps in the rumble strip on non-controlled access highways. Gaps of 12 feet in every 40 to 60 feet of rumble strips used in Arizona.
7. Not allowing rumble strips on roadways used by bicyclists. (Maine)
8. Reducing the width of the rumble strip (Kentucky).
9. Requiring approval of the Pedestrian/Bicycle Coordinator if rumble strip is to be installed on a shoulder width less than 8 feet.

Risk of Rumble Strips for Bicyclists

Shoulder rumble strips are problematic for bicyclists for a number of reasons. Research into bicyclists’ perceptions of rumble strips confirms that cyclists reliably report discomfort while riding over shoulder rumble strips and a limited tolerance for it.^{xv} Debris can collect on the shoulder if it gets caught in the rumble strips or it is too distant to be swept away by automotive traffic, making that section inhospitable to bicyclists. This can lead bicyclists to ride in the travel lane on high speed roads that they might otherwise avoid or abandon routes all together (even limiting their bicycling altogether). There are numerous examples of rumble strips leading to bike-auto crashes.

The bulk of this report has focused on shoulder rumble strips. However, there is a concern associated with rumble strips installed along a centerline as well. Centerline strips are intended to prevent head on collisions by drivers who cross the middle line. Studies show that center line rumble strips cause motorists to drive closer to the shoulder. This can lead drivers to pass bicyclists dangerously close. The noise created by drivers passing over center line rumble strips may also startle bicyclists on the shoulder and cause them to lose control of their bicycle.

Conclusion

While there are safety benefits to rumble strips for drivers of motor vehicles, there are considerable drawbacks for cyclists, who are vulnerable next to high-speed traffic. In accordance with FHWA guidance, rumble strips should be used on roads where bicyclists are prohibited or not expected. On routes used by bicyclists, rumble strips should not be installed indiscriminately; a careful traffic safety study should be conducted to demonstrate a clear problem and a projected impact on safety.

In the event that rumble strips are appropriate, states should follow bicycle-tolerable practices that provide maximum clear shoulder space for cyclists. Using an implementation checklist based on the above rumble strip practices, state agencies and local road authorities should closely monitor contractors to ensure that the policy is being followed. Finally, agencies should follow the FHWA guidance, which recommends that agencies work closely with bicycling organizations to make sure they “address the safety and operational needs of all roadway users.”

- ⁱ FHWA http://safety.fhwa.dot.gov/roadway_dept/research/exec_summary.htm
- ⁱⁱ “Bicyclist struck by truck in south Bryan County,” <http://savannahnow.com/bryan-county-now/2010-04-26/bicyclist-struck-truck-south-bryan-county>
- ⁱⁱⁱ AASHTO Guide for the Development of Bicycle Facilities, http://www.sccrtc.org/bikes/AASHTO_1999_BikeBook.pdf
- ^{iv} FHWA Roadway Shoulder Rumble Strips, http://safety.fhwa.dot.gov/roadway_dept/policy_guide/t504035.cfm
- ^v Statewide Safety Study of Bicycles and Pedestrians on Freeways, Expressways, Toll Bridges, and Tunnels <http://transweb.sjsu.edu/mtiportal/research/publications/documents/BikesAndPeds.htm>
- ^{vi} State Policy Matrix, www.adventurecycling.org/routes/nbrn/resourcespage/StateRumblePoliciesIssues.pdf
- ^{vii} Torbic, D.J., J. M. Hutton, C. D. Bokenkroger, K. M. Bauer, D. W. Harwood, D. K. Gilmore, J. M. Dunn, J. J. Ronchetto, E. T. Donnell, H. J. Sommer III, P. Garvey, B. Persaud, and C. Lyon, “Guidance for the Design and Application of Shoulder and Centerline Rumble Strips,” NCHRP Report 641, Transportation Research Board (2009). http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_641.pdf. This is the most comprehensive and up-to-date source on rumble strip research and practice.
- ^{viii} Moeur, R. *Analysis of Gap Patterns in Longitudinal Rumble Strips to Accommodate Bicycle Travel* <http://www.enhancements.org/download/trb/1705-015.pdf>
- ^{ix} Elefteriadou, L., M. El-Gindy, D. Torbic, P. Garvey, A. Homan, Z. Jiang, B. Pecheux, and R. Tallon, *Bicycle-Tolerable Shoulder Rumble Strip*, Report Number: PTI 2K15. The Pennsylvania State University, The Pennsylvania Transportation Institute, March 2000.
- ^x Bucko, T. R., and A. Khorashadi, *Evaluation of Milled-In Rumble Strips, Rolled-In Rumble Strips and Audible Edge Stripe*, Office of Transportation Safety and Research, California Department of Transportation, April 2001.
- ^{xi} Outcalt, W., *Bicycle-Friendly Rumble Strips*, Report No. CDOTDTD-R-2001-4. Colorado Department of Transportation. May 2001.
- ^{xii} Torbic, et al. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_641.pdf
- ^{xiii} Torbic, et al. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_641.pdf
- ^{xiv} *Shoulder Rumble Strips and Bicyclists*, http://transportation.njit.edu/nctip/final_report/RumbleStrip.pdf
- ^{xv} Torbic, et al. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_641.pdf, Appendix A