Rumble Strips
What’s All the Rumbling About?

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What Are Rumble Strips?

• Shoulder rumble strips are variations in the shoulder or pavement edge designed to alert drivers that they are leaving the traveled way

• Studies estimate that shoulder rumble strips can reduce run-off-road crash rates by 15% to 70%, depending on location
Shoulder Rumble Strip Types

- Rolled-in
- Ground-In
- Raised Materials
Rolled-In

- Used in many states from 1970s-1990s
- Placed in fresh AC pavement with roller
- Low cost, but had drawbacks
  - Couldn’t be retrofitted
  - Quality control problems
  - Width (24-36”) took up much of usable shoulder
Ground-In

- New design popular in late 1990s
- Uses a cutting wheel to grind indentations into the shoulder pavement
Advantages of Ground-In Rumble Strips

• Can be ground into most pavement types
• Can be installed at any time
• Low cost
  – Typical cost = $0.12 - $0.15 per linear foot
  – Slightly more expensive than rolled-in
• Eligible for HES (Hazard Elimination and Safety) funding
Problems with Ground-In Rumble Strips

• May not be effective in some locations
  – Too-narrow shoulders - no recovery room
  – Sharp curves

• Ineffective against some run-off-road crashes
  – Equipment failure
  – Departing the road at too-steep angle
Problems with Ground-In Rumble Strips

• Can be hazardous to bicyclists and motorcyclists
  – FHWA recommends a minimum of 4 ft clear shoulder width after rumble strip installation
    • not including guardrail, barrier, obstructions, etc.
    • also helps to ensure that drivers can recover while still on a paved surface
Effects of Rumble Strips on Bicyclists

• Bicycle wheel drops completely into grooves
  – 1/2” or more up & down for every foot of travel

• Can cause loss of control and crashes
  – Reports of serious injuries from several states
Balancing of Interests

- Agencies have a responsibility to operate and maintain roadways that are reasonably safe for users.
- Drivers cannot always operate perfectly, and roadways should not hurt or kill unwary drivers.
- However, safety features (such as rumble strips) cannot be a substitute for personal responsibility.
Balancing of Interests

- Large numbers of motorists running off the road

 vs.

- Smaller numbers of bicyclists and motorcyclists who are doing nothing wrong, yet may be at risk
What Can Be Done?

• Periodic Gaps
• Reducing Depth
• Raised Materials
• Signs & Markings
Periodic Gaps

• Bicyclists need to cross rumble strips
  – To avoid debris & obstructions
  – To avoid parked vehicles and equipment
  – To make left turns, or to merge over in advance of right turn lanes

• Gaps can be installed periodically in a rumble strip pattern
  – 12 ft gap every 40 to 60 ft is recommended
    • This still provides 70-80% coverage
    • Gap lengths below 10 ft are not recommended
Periodic Gaps

• Gaps allow bicyclists to cross rumble pattern without hitting grooves, even at higher speeds
• However, gaps will not solve the problem of insufficient shoulder width remaining after rumble strips are installed
Reducing Depth

- First generation of ground-in rumble strips used 1/2” - 5/8” milling depth
- Research has been conducted recently by Penn State, Caltrans, and CDOT to determine optimum depth
- Results indicate that 1/4” - 3/8” depths still provide adequate rumble to larger motor vehicles while being less jarring to bicyclists
Raised Materials

• Raised materials can be used in areas that are not subject to snow plows
• Typically much less jarring to bicyclists
• Still effective in providing tactile warning
• Two types in widespread use:
  – Profile thermoplastic
  – Raised pavement marker patterns
Signs & Markings

- Some states have installed signs for rumble strip warning
- Sample sign from Vermont:

- However, there is insufficient evidence that signs or markings will improve safety
ADOT Rumble Strip Policy

• Rumble strips are placed on rural highways with shoulder widths of 4 ft or greater
• Rumble strips may be placed on shoulders of less than 4 ft width only if a written study indicates there are a high number of run-off-road crashes in that area
  – Wider shoulders are desirable in these areas, but additional width cannot always be justified or funded due to low AADT and other constraints
ADOT Rumble Strip Policy

• Freeways:
  – 12” wide continuous ground-in rumble strip, 12” off edge line (both sides)

• Other Highways:
  – Shoulders greater than 5 ft in width: 8” rumble strip (gapped or continuous) 12” off edge line
  – Shoulders 5 ft or less: 6” rumble strip (gapped or continuous) under the edge line, or 6” profile thermoplastic edge line in non-snowplow areas
ADOT Rumble Strip Policy

• Rumble strip discontinued at:
  – Ramps
  – Crossroads and turnouts
  – Turn lanes
  – Guardrail or barrier that does not allow 2 ft clearance between rumble strip and face of barrier

• Rumble strip is typically not used in suburban or urban areas
  – Noise concerns
  – Fewer run-off-road crashes
ADOT Rumble Strip Standards

New ADOT Standard Drawing 4-M-2.11 - Sheet 1

GENERAL NOTES:
1. PLANS SHALL IDENTIFY SPECIFIC RUMBLE STRIP CONFIGURATIONS FOR THE PROJECT.
2. GUIDELINE - GUIDELINE MEANS THAT THE EDGE LINE SHALL BE PLACED AT THE INSIDE EDGE OF THE RUMBLE STRIP.
3. OFFSET - OFFSET MEANS THAT THE CONTINUOUS LONGITUDINAL RUMBLE STRIP WILL BE LOCATED AT A SPECIFIC DISTANCE FROM THE EDGE LINE.
5. THE PERMISSIBLE ADJUSTments TO THE POSITION OF THE RUMBLE STRIP SHALL BE CONSTRUCTED BY MILLING OR GRINDING THE INDENTATIONS IN THE ASPHALTIC CONCRETE PAVEMENT.
6. THE MILLING MACHINE SHALL BE EQUIPPED WITH AN ACCEPTABLE GUIDE THAT ALLOWS THE STRIP TO BE INSTALLED TO THE PROPER ALIGNMENT WITHIN ACCEPTABLE TOLERANCES.
7. IF THE RUMBLE STRIP AND EDGE LINE ARE TO BE INSTALLED AT THE SAME LOCATION, THEN THE RUMBLE STRIP IS TO BE INSTALLED PRIOR TO THE INSTALLATION OF THE PERMANENT EDGE LINE.
8. TO ENSURE PROPER RUMBLE STRIP LOCATION, A TEMPORARY PAINT EDGE LINE SHALL BE INSTALLED AT THE LOCATION PRIOR TO THE INSTALLATION OF THE GROUND-IN RUMBLE STRIP. THE RUMBLE STRIP SHALL FOLLOW THE LOCATION OF THE EDGE LINE.
9. THE RADIUS AND LOCATION OF THE CUTTING/MILLING DRUM AND MACHINE SHALL BE ADJUSTED TO PRODUCE A SMOOTH AND CONSISTENT GROOVE TO THE REQUIREMENTS OF THESE SPECIFICATIONS.
10. IF SHOULDERs ARE LESS THAN FOUR (4) FEET WIDE AND THE ELEVATION OF THE ROADWAY IS BELOW 4000 FEET, THEN THE SUBDIVISION OF A PROFIE RUMBLE STRIP, IN LIEU OF A RUMBLE STRIP, MAY BE CONSIDERED FOR ACCOMMODATING CYCLE TRAFFIC.
11. IF THE LEFT SHOULDER ON A DIVIDED HIGHWAY IS MORE THAN TWO (2) FEET WIDE, BUT LESS THAN FOUR (4) FEET WIDE, THE RUMBLE STRIP CAN BE OFFSET FOUR (4) INCHES FROM THE OUTSIDE EDGE OF EDGE LINE.
12. LONGITUDINAL RUMBLE STRIPS SHALL NOT BE PLACED ON CONSTRUCTION JOINTS OR UNLEVEL 1/4 INCH SURFACE TREATMENTS.

NOT TO SCALE
ADOT Rumble Strip Standards

New ADOT Standard Drawing 4-M-2.11 - Sheet 2

NOT TO SCALE

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMOST TRANSPORTATION DIVISION
STANDARD DRAWING

CONTINUOUS LONGITUDINAL RUMBLE STRIP EXCEPTION DETAILS

SHEET 2 OF 2

NOTES:
1. LONGITUDINAL RUMBLE STRIPS SHALL BE OMITTED ACROSS PRINCIPAL INTERSECTING ROADWAYS, OR OTHER INTERRUPTIONS AS SHOWN TYPICALLY HEREIN, ON THE PROJECT PLANS, OR AS DIRECTED BY THE ENGINEER.

2. IF APPRECIABLE BICYCLE TRAFFIC EXISTS OR IS ANTICIPATED, THEN A MINIMUM EFFECTIVE CLEAR SHOULDER WIDTH OF THREE (3) FEET, FIVE (5) INCHES SHOULD BE PROVIDED. IF HEAVY BICYCLE TRAFFIC EXISTS OR IS ANTICIPATED, THEN A MINIMUM OF FIVE (5) FEET IS DESIRABLE. THIS REQUIREMENT APPLIES TO BOTH SHOULders ON UNDIVIDED HIGHWAYS AND THE RIGHT SHOULDER ONLY ON DIVIDED HIGHWAYS.

3. ON HIGHWAYS WITH NO ACCESS CONTROL, THE RUMBLE STRIP PATTERN MAY CONSIST OF 30 FOOT LONG SEGMENTS OF RUMBLE STRIPS AT 12 INCH CENTERS, WITH 10 FOOT SEGMENTS OF NO RUMBLE STRIPS, ON A 40 FOOT CYCLE.
What’s in the Future?

• Possible future modifications to ADOT rumble strip policies and standards:
  – Gaps may become standard on non-freeways
  – Rumble strip depth may be reduced
  – Use of centerline rumble strips on selected roadways with high head-on crash rates
Conclusions

- Rumble strips can reduce run-off-road crashes at low cost
- Rumble strips can negatively affect some road users
- Competing interests must be balanced
- Agency policies should encourage installation of rumble strips where appropriate, but use design features (gaps, depth) to reduce negative impacts