Delaware Department of Transportation
Design Guidance Memorandum

Memorandum Number 1-18 Revised

1. Road Design 2. Bridge Design 3. Utilities Design
4. Right of Way 5. Other

Title: Longitudinal Center line and Shoulder Rumble Strips Effective date: 8/31/2026

I. Purpose

To define when and where longitudinal center line or shoulder rumble strips should be applied on Delaware roadways.

II. Background

The purpose of longitudinal center line or shoulder rumble strips is to enhance safety by mitigating the potential of lane departure crashes. Rumble strips are intended to alert drivers by creating an audible (noise) and tactile (rumble or vibratory) warning sensation to indicate to the driver that the vehicle is leaving the traveled way (traffic lane) and that a steering correction may be required. Before and after crash studies have indicated that roadway departure crashes may be reduced by the installation of rumble strips. A study conducted in Minnesota in 2004 found that the placement of shoulder rumble strips on a divided highway yielded a crash modification factor (CMF) of 0.83 for all crash types. Rumble strips are recognized by the Federal Highway Administration (FHWA) as a proven safety countermeasure. FHWA conducted a pooled-fund evaluation across rural two-lane roads, as documented in report **FHWA-HRT-15-048 (2015),** ***Safety Evaluation of Centerline Plus Shoulder Rumble Strips***. The study found that the combined installation of center line and shoulder rumble strips resulted in a crash modification factor (CMF) of 0.80 for all crash severities combined and 0.771 for fatal and injury crashes.

The intent of the rumble strip is to gain the attention of a driver. Naturally, the byproduct of this measure is noise, both inside and outside of the vehicle. In isolated areas, with little to no residential land use, the exterior noise generated by the rumble strip is usually not a problem. However, when installed in areas where housing is in close proximity to a roadway, even on roadways in rural areas, the exterior noise from rumble strips may impact nearby residents. To address concerns such as noise and cyclist rideability, DelDOT's rumble strip designs were modified in 2014 to reduce the widths and depths of the patterns, in turn reducing exterior noise levels.

More recently, DelDOT has experimented with the use of sinusoidal rumble strips, also known as "mumble strips." Sinusoidal rumble strips are similar to conventional longitudinal rumble strips but utilize a wave pattern ground into the pavement which reduces the external noise produced from a vehicle traveling across them. Conventional longitudinal rumble strips consist of a repeating rectangular pattern, which has been found to generate more external noise than the sinusoidal rumble strips. A study completed by the Minnesota Department of Transportation in 2016 compared various types of sinusoidal rumble strip patterns to determine the optimal pattern that provides for the most reduction in exterior noise, while maintaining an adequate level of interior noise. That study also included the standard rectangular pattern rumble strip to compare against. The study results indicate that the increase in exterior noise from no rumbles strip to a sinusoidal rumble strip was between 2.3 dBA and 6.4 dBA whereas the increase in exterior noise from no rumble strip to a conventional rumble strip was 18.3 dBA. This

indicates that the sinusoidal rumble strips produce 65% - 87% less additional exterior noise than a traditional milled rumble strip. There have not been studies to date documenting the difference in crash reduction between traditional and sinusoidal rumble strips.

Furthermore, in 2024**, NCHRP Research Report 1107**: ***Effective Low-Noise Rumble Strips*** recommended a sinusoidal rumble strip design that minimizes exterior noise while maintaining adequate interior auditory and vibratory feedback to alert vehicle operators of lane departures. The research specifies a sinusoidal rumble strip wavelength of approximately 14 to 15 inches. This revised Design Guidance Memorandum adopts the recommended sinusoidal design parameters of NCHRP 1107 to ensure consistency with the latest research findings.

III. Design Guidance and Warrants

Longitudinal center line and shoulder rumble strips should be considered and installed per the following guidelines and details.

A. Shoulder Rumble Strips

1. Guidelines for Use
    a. Interstates, Freeways and Expressways (Limited Access Facilities)
        i. Conventional longitudinal shoulder rumble strips shall be installed on new, reconstructed and resurfaced shoulders (inside and outside shoulders) of all Interstates, freeways and expressways, regardless of crash history.
        ii. Conventional longitudinal shoulder rumble strips shall be installed on both the inside and outside shoulders of new, reconstructed and resurfaced interchange on- and off- ramps regardless of crash history.
    b. Multilane Conventional Roadways
        i. Bicycle-friendly sinusoidal shoulder rumble strips should be installed on new, reconstructed or resurfaced shoulders of all multilane conventional roadways with a minimum outside shoulder width of 5.5 feet as shown in the details in Appendix B and C. The minimum 5.5-foot shoulder width is calculated as the sum of a 0.5-foot offset from the travel lane edge to the rumble strip, a 1.0-foot rumble strip width, and a minimum 4.0-foot clear shoulder beyond the rumble strip to accommodate bicycle travel.
        ii. Bicycle-friendly sinusoidal edge line rumble stripes should be installed on new, reconstructed or resurfaced inside shoulders of all multilane conventional roadways if a minimum shoulder width of 5.5 feet cannot be maintained.
    c. Two-Lane Two-Way Conventional Roadways
        i. Bicycle-friendly sinusoidal shoulder rumble strips should be installed on all two-lane two-way roadways with a minimum travel lane width of 11 feet, minimum shoulder width of 5.5 feet.
        ii. Bicycle-friendly sinusoidal edge line rumble stripes should be installed on all rural two-lane two-way roadways with a minimum travel lane width of 11 feet if a minimum shoulder width of 5.5 feet cannot be maintained.

iii. Bicycle-friendly shoulder rumble strips may be installed on all other two-lane roadways if an engineering study determines that roadway departure crash rates exceed statewide or national averages for similarly classified roadways or if rumble strips are determined to be an appropriate crash reduction countermeasure.

2. Design and Layout Guidelines

   a. Interstates, Freeways and Expressways:

      i. The design of the longitudinal shoulder rumble strips should be in accordance with Appendix A.

   b. Multilane Conventional Roadways:

      i. Rumble strips within the right shoulder of a multilane conventional roadway shall be of the bicycle-friendly sinusoidal design as shown in Appendix B.

      ii. Rumble strips within the left shoulder of a multilane conventional roadway shall be of the continuous sinusoidal design as shown in Appendix B.

   c. Two-Lane, Two-Way Conventional Roadways:

      i. Rumble strips on two-lane, two-way conventional roadways shall be of the bicycle-friendly sinusoidal design as shown in Appendix C.

   d. General Design and Layout Guidelines:

      i. The designer shall contact the Bridge Section to confirm the composition of the bridge deck prior to installation of rumble strips. Additionally, rumble strips shall not be cut into bridge deck patches or re-installed after a bridge deck has been patched within the rumble strip line.

      ii. Rumble strips are to be broken for all intersections and driveway entrances where the shoulder pavement markings tie into the driveway entrance or where the edge line pavement markings are broken. The installation of rumble strips should be stopped prior to the Point of Curvature (PC) and restarted after the Point of Tangency (PT) as shown in the details in Appendix B and C.

      iii. Rumble strips should not be installed in conjunction with or adjacent to acceleration, deceleration or bypass lanes on conventional roadways. Installation should stop prior to the diverge point of a deceleration lane and should not commence until downstream of the merge point for an acceleration lane as shown in the details in Appendix B and C.

      iv. Sinusoidal shoulder rumble strips or edge line rumble stripes should be installed in areas where the perpendicular distance to the nearest residential property is more than 50 feet. Engineering judgment should be used to determine if sinusoidal rumble strips or edge line rumble stripes should be installed in areas where the distance to the nearest residential home is 50 feet or less.

      v. If rumble strips are installed in a residential area where the distance is 50 feet or less, outreach to the area legislators should be conducted, informing them of the need for rumble strips.

      vi. Rumble strips should not be milled into pavements composed of slurry seals, microsurfacing, thin overlays or chip sealed surfaces.

B. Center line rumble stripes

1. Guidelines for Use
    a. Sinusoidal center line rumble stripes should be installed on all new, reconstructed or resurfaced conventional two-lane and undivided multilane roadways with a minimum travel lane width of 11 feet.
    b. Sinusoidal center line rumble stripes may be installed if an engineering study determines that roadway departure crash rates exceed statewide or national averages for similarly classified roadways or if rumble strips are determined to be an appropriate crash reduction countermeasure.
2. Design and Layout Guidelines
    a. Center line rumble stripes shall be of the sinusoidal design shown in Appendix D.
    b. Center line rumble stripes shall not be discontinued where striping indicates passing is permitted.
    c. The designer shall contact the Bridge Section to confirm the composition of the bridge deck prior to installation of rumble stripes. Additionally, rumble stripes shall not be cut into bridge deck patches or re-installed after a bridge deck has been patched within the rumble stripe line.
    d. In areas where the center line leads into a raised concrete island, the center line rumble stripes should be discontinued where the raised concrete island starts.
    e. Center line rumble stripes shall not be installed on either side of two-way left turn lanes.

C. Other Considerations

The composition of the new pavement section or the thickness, condition, and type of existing pavement needs to be determined prior to the application of longitudinal rumble strips. The installation of longitudinal rumble strips on pavement that is of questionable thickness, condition, or type (e.g. hot-mix over P.C.C. pavement) needs to be evaluated to ensure that the installation of the rumble strip will be possible without adverse impact to the pavement or the performance of the strip. The designer should contact the Materials and Research Section for existing pavement cores. If no core data is available, pavement cores should be obtained, and the information reviewed with the Materials and Research Section.

For long-term construction projects on roadways with existing rumble strips, the rumble strips should be removed if the temporary traffic control plans require traffic to be shifted onto the shoulder or crosses a center line. If rumble strips are removed by milling and overlaying the pavement, the rumble strips shall be re-installed at the end of the project.

The guidance and the figures herein do not account for all possible applications (e.g. rural gore areas, within municipalities, etc.). Therefore, it may be necessary for the designer to develop special application plans or details for the application of milled or alternative longitudinal rumble strip treatments or provide advance coordination with municipal officials. All such plans and details should be submitted to the Traffic Engineering Section for review prior to their use on a project. This includes the use of center line rumble stripes on two-way highways where additional factors such as lane width, total roadway width, etc. should be considered.

Requirements for placement of rumble strips including beginning and ending stationing, rumble strip type, etc. shall be depicted on the signing, striping and conduit plans within the project's construction plan package. Appropriate notes and details should be provided on these plan sheets as well.

IV. Justification

To improve safety, continuous longitudinal center line and/or shoulder rumble strips are used to alert inattentive drivers – through vibration and sound – that their vehicles are leaving the travel lane. This safety countermeasure has shown proven results, is a proven safety countermeasure within the Federal Highway Administration's Every Day Counts program and is a recommended strategy for reducing roadway departure crashes as part of Delaware's Strategic Highway Safety Plan.

Prepared by: Traffic Engineering Section — Revised Date: 7/28/2026



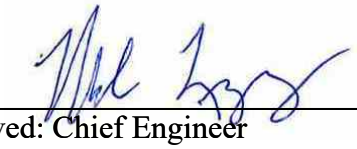
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Attest to Form and Process: Support Engineer — 8/6/2026 Date



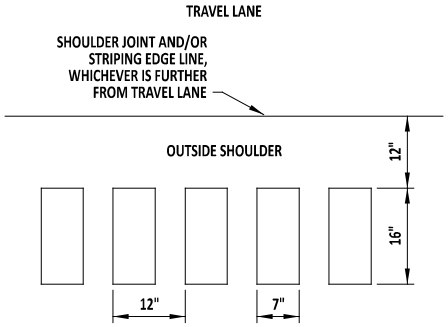
Recommended by: Deputy/Division Director — 8/6/2026 Date



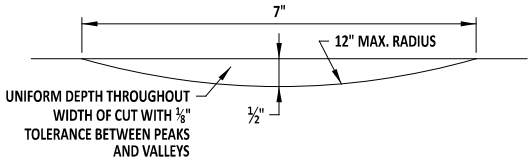
Approved: Chief Engineer — 08/31/2026 Date

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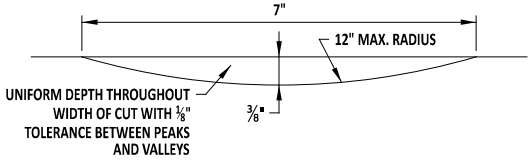
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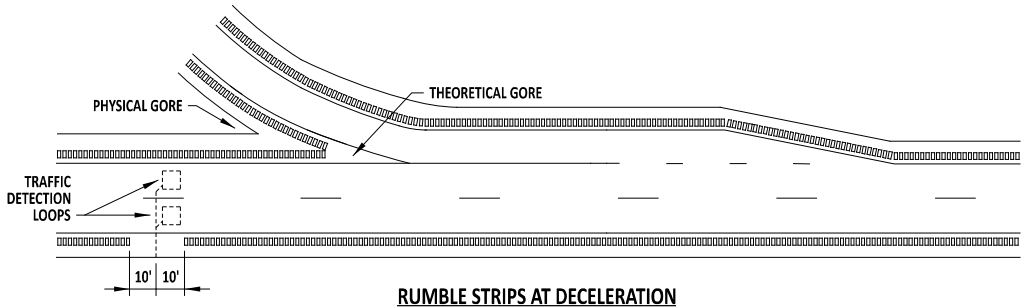
CONTINUOUS SHOULDER RUMBLE STRIP DETAILS



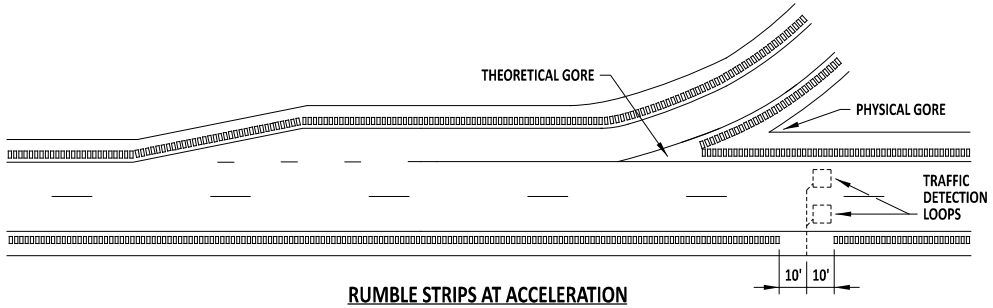
RUMBLE STRIP SECTION - INTERSTATES, FREEWAYS AND EXPRESSWAYS



RUMBLE STRIP SECTION - CONTINUOUS SHALLOW DEPTH RUMBLE STRIP



RUMBLE STRIPS AT DECELERATION LANES AND FREEWAY OFFRAMPS



RUMBLE STRIPS AT ACCELERATION LANES AND FREEWAY ONRAMPS

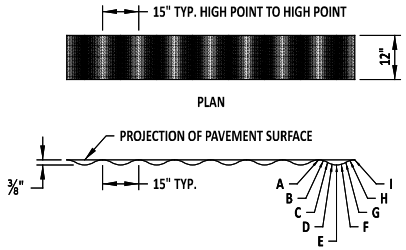
NOTES:
1.) DIMENSIONS MAY BE FIELD ADJUSTED AS DIRECTED BY THE ENGINEER.

2.) WHERE RUMBLE STRIPS ARE SHOWN ON THE PLANS TO BE ON BRIDGE DECKS, ONLY USE CONTINUOUS SHALLOW DEPTH RUMBLE STRIPS.

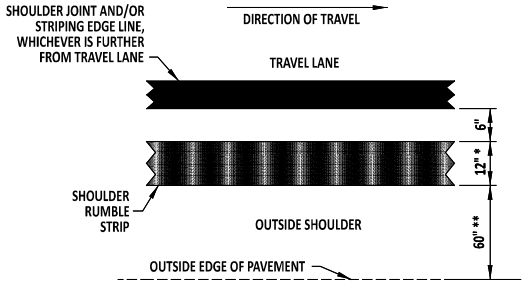
DelDOT	ENGINEERING SUPPORT / DATE RECOMMENDED	SHOULDER RUMBLE STRIPS ON INTERSTATES / FREEWAYS / EXPRESSWAYS STANDARD NO. P-5 (2026) SHT. 1 OF 4	REVIEWED DEPUTY DIRECTOR - DESIGN / DATE APPROVED CHIEF ENGINEER / DATE

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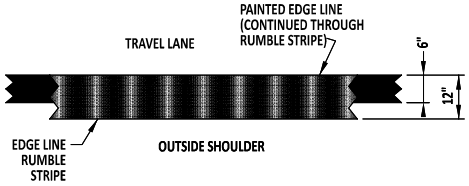
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A	1/16	0
B	1/8	1 7/8
C	7/32	3 3/4
D	11/32	5 5/8
E	3/8	7 1/2
F	11/32	9 3/8
G	7/32	11 1/4
H	1/8	13 1/8
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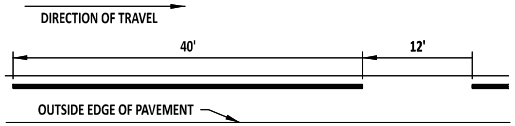
RUMBLE STRIP SECTION -
SINUSOIDAL SHOULDER RUMBLE STRIPS



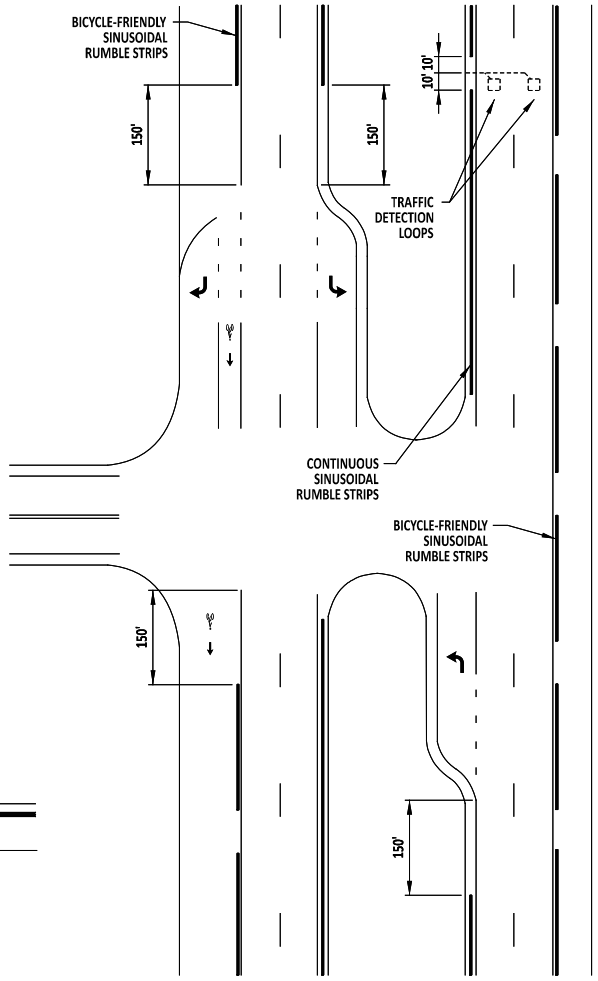
SINUSOIDAL SHOULDER RUMBLE STRIP



SINUSOIDAL EDGE LINE RUMBLE STRIPE



BICYCLE-FRIENDLY SINUSOIDAL SHOULDER
RUMBLE STRIP SEGMENT DETAILS



SINUSOIDAL SHOULDER RUMBLE STRIPS AT INTERSECTIONS

NOTES:
1.) DIMENSIONS MAY BE FIELD ADJUSTED AS DIRECTED BY THE ENGINEER.

*2.) INSTALL SINUSOIDAL RUMBLE STRIPS 12 INCHES WIDE WHEN POSSIBLE; A MINIMUM WIDTH OF 8 INCHES MAY BE USED IF NECESSARY.

**3.) TO ACCOMMODATE BICYCLISTS, PROVIDE A 5-FOOT (PREFERRED) OR 4-FOOT (MINIMUM) FROM THE OUTSIDE EDGE OF THE RUMBLE STRIP GROOVE TO THE OUTSIDE EDGE OF THE PAVED SHOULDER, FRONT FACE OF CURB, GUARDRAIL, OR BARRIER. RUMBLE STRIPS SHOULD BE DISCONTINUED 50 FEET BEFORE AND STARTED 50 FEET AFTER WHEN ADJACENT TO CURB, GUARDRAIL OR BARRIER WHERE THERE IS LESS THAN 5 FEET (PREFERRED), 4 FEET (MINIMUM) BETWEEN THE OUTSIDE EDGE OF THE RUMBLE STRIP AND THE FACE OF THE CURB, GUARDRAIL OR BARRIER.

4.) IF THE CLEAR AREA IN NOTE #2 CANNOT BE MAINTAINED, THEN CONSIDER INSTALLING BICYCLE-FRIENDLY SINUSOIDAL EDGE LINE RUMBLE STRIPES WITHIN THE PAINTED EDGE LINE.

5.) RUMBLE STRIPS MAY BE INSTALLED ON BRIDGE DECKS, UNLESS THE BRIDGE DECK HAS AN OVERLAY LESS THAN 2-INCHES THICK. THE DESIGNER SHALL CONTACT THE BRIDGE MANAGEMENT SECTION TO CONFIRM THE COMPOSITION OF THE BRIDGE DECK PRIOR TO INSTALLATION OF RUMBLE STRIPS.

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ENGINEERING SUPPORT _____ DATE _____
RECOMMENDED

SINUSOIDAL SHOULDER RUMBLE STRIPS ON MULTI-LANE CONVENTIONAL ROADWAYS

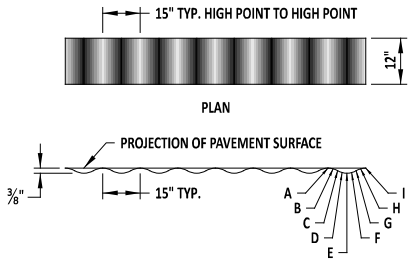
STANDARD NO. P(2025) | SHT. 2 OF 4

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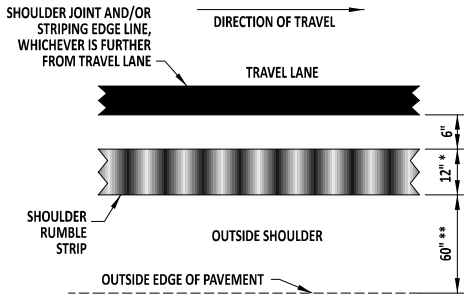
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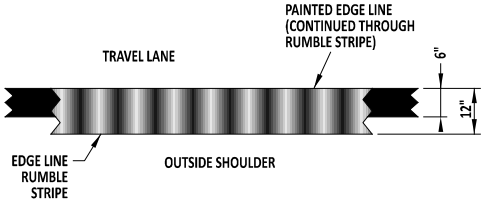
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POINT	DEPTH FROM PAVEMENT SURFACE (IN.) (+/- 1/32")	DISTANCE FROM HIGH POINT "A" (IN.)
A	1/16	0
B	1/8	1 1/8
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I	1/16	15



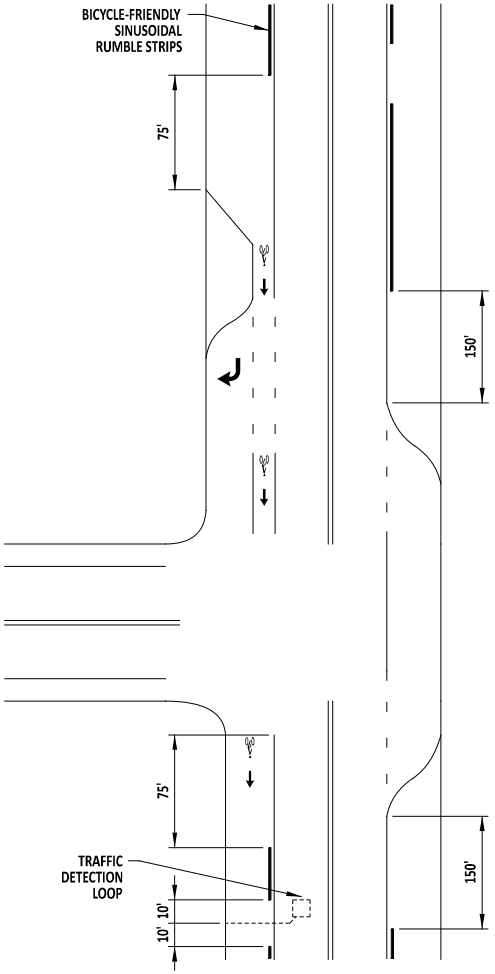
RUMBLE STRIP SECTION -
SINUSOIDAL SHOULDER RUMBLE STRIPS



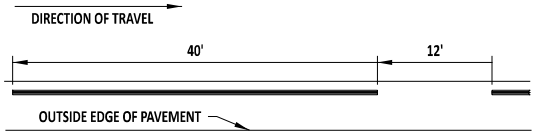
SINUSOIDAL SHOULDER RUMBLE STRIP



SINUSOIDAL EDGE LINE RUMBLE STRIPE



BICYCLE-FRIENDLY SINUSOIDAL SHOULDER RUMBLE STRIPS AT INTERSECTIONS



BICYCLE-FRIENDLY SINUSOIDAL SHOULDER RUMBLE STRIP SEGMENT DETAILS

NOTES:
1.) DIMENSIONS MAY BE FIELD ADJUSTED AS DIRECTED BY THE ENGINEER.

*2.) INSTALL SINUSOIDAL RUMBLE STRIPS 12 INCHES WIDE WHEN POSSIBLE; A MINIMUM WIDTH OF 8 INCHES MAY BE USED IF NECESSARY.

**3.) TO ACCOMMODATE BICYCLISTS, PROVIDE A 5-FOOT (PREFERRED) OR 4-FOOT (MINIMUM) FROM THE OUTSIDE EDGE OF THE RUMBLE STRIP GROOVE TO THE OUTSIDE EDGE OF THE PAVED SHOULDER, FRONT FACE OF CURB, GUARDRAIL, OR BARRIER. RUMBLE STRIPS SHOULD BE DISCONTINUED 50 FEET BEFORE AND STARTED 50 FEET AFTER WHEN ADJACENT TO CURB, GUARDRAIL OR BARRIER WHERE THERE IS LESS THAN 5 FEET (PREFERRED), 4 FEET (MINIMUM) BETWEEN THE OUTSIDE EDGE OF THE RUMBLE STRIP AND THE FACE OF THE CURB, GUARDRAIL OR BARRIER.

4.) IF THE CLEAR AREA IN NOTE #2 CANNOT BE MAINTAINED, THEN CONSIDER INSTALLING BICYCLE-FRIENDLY SINUSOIDAL EDGE LINE RUMBLE STRIPES WITHIN THE PAINTED EDGE LINE.

5.) RUMBLE STRIPS MAY BE INSTALLED ON BRIDGE DECKS, UNLESS THE BRIDGE DECK HAS AN OVERLAY LESS THAN 2-INCHES THICK. THE DESIGNER SHALL CONTACT THE BRIDGE MANAGEMENT SECTION TO CONFIRM THE COMPOSITION OF THE BRIDGE DECK PRIOR TO INSTALLATION OF RUMBLE STRIPS.

DelDOT

ENGINEERING SUPPORT _____ DATE _____
RECOMMENDED

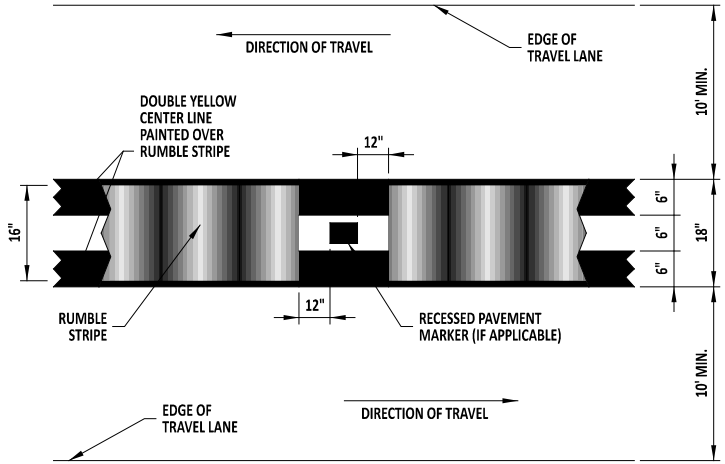
SINUSOIDAL SHOULDER RUMBLE STRIPS ON TWO-LANE TWO-WAY CONVENTIONAL ROADWAYS

STANDARD NO. P-5 (2026) | SHT. 3 OF 4

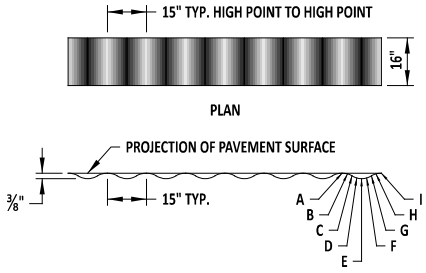
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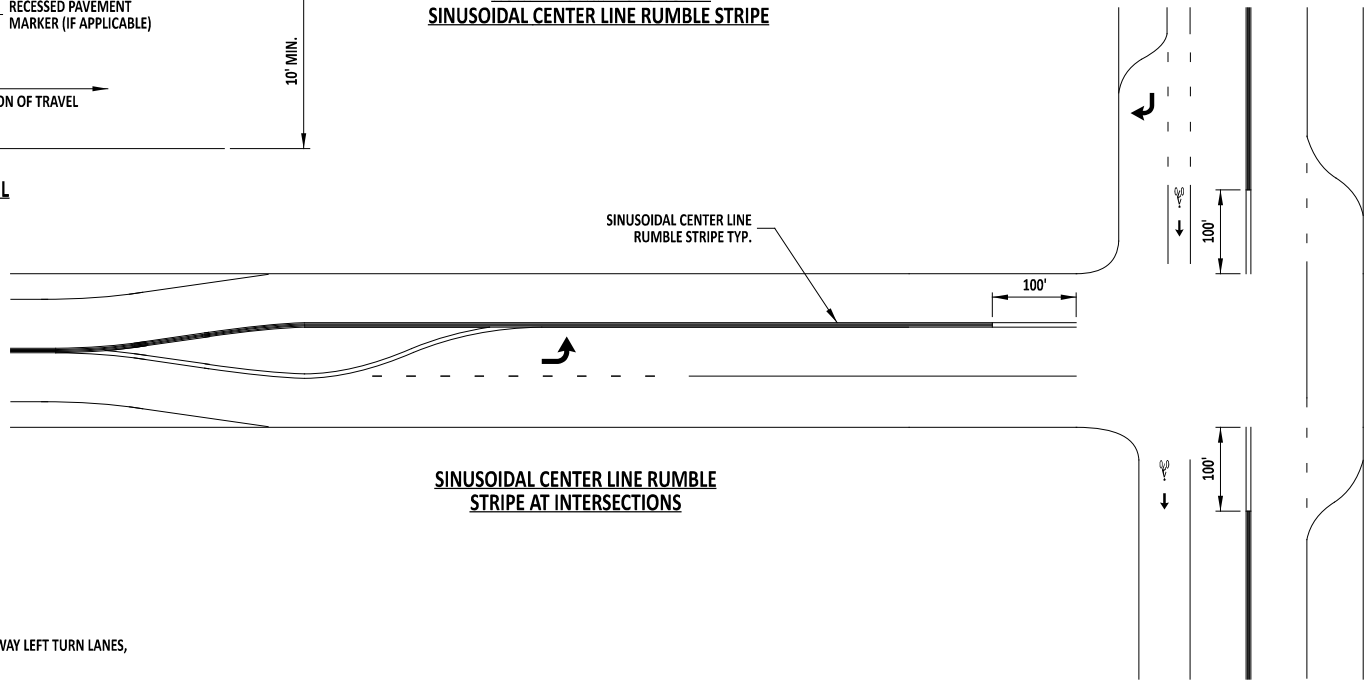


PLAN VIEW DETAIL



RUMBLE STRIPE SECTION - SINUSOIDAL CENTER LINE RUMBLE STRIPE

DESIGN OF CURVE PROFILE FOR SINUSOIDAL RUMBLE STRIPE		
POINT	DEPTH FROM PAVEMENT SURFACE (IN.) (+/- 1/32")	DISTANCE FROM HIGH POINT "A" (IN.)
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F	11/32	9 3/8
G	7/32	11 1/4
H	1/8	13 7/8
I	1/16	15



SINUSOIDAL CENTER LINE RUMBLE STRIPE AT INTERSECTIONS

NOTES:
1.) DIMENSIONS MAY BE FIELD ADJUSTED AS DIRECTED BY THE ENGINEER.

2.) SINUSOIDAL CENTER LINE RUMBLE STRIPE SHALL NOT BE INSTALLED ON TWO-WAY LEFT TURN LANES, UNLESS DIRECTED BY THE ENGINEER.

3.) SINUSOIDAL CENTER LINE RUMBLE STRIPE MAY BE INSTALLED ON BRIDGE DECKS, UNLESS THE BRIDGE DECK HAS AN OVERLAY LESS THAN 2-INCHES THICK. THE DESIGNER SHALL CONTACT THE BRIDGE SECTION TO CONFIRM THE COMPOSITION OF THE BRIDGE DECK PRIOR TO INSTALLATION OF RUMBLE STRIPE.

DelDOT

ENGINEERING SUPPORT _____ DATE _____
RECOMMENDED

SINUSOIDAL CENTER LINE RUMBLE STRIPES

STANDARD NO. P-5 (2026) | SHT. 4 OF 4

REVIEWED
DEPUTY DIRECTOR - DESIGN _____ DATE _____

APPROVED
CHIEF ENGINEER _____ DATE _____