



Florida Department of Transportation

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ROADWAY DESIGN BULLETIN 18-03

(FHWA Approved: 03/07/18)

DATE: March 14, 2018

TO: District Directors of Transportation Operations, District Directors of Transportation Development, District Design Engineers, District Construction Engineers, District Maintenance Engineers, District Consultant Project Manager Engineers, District Roadway Design Engineers, District Traffic Operations Engineers, District Program Management Engineers, District Materials Engineers

FROM: Michael Shepard, P.E., State Roadway Design Engineer 

COPIES: Brian Blanchard, Tom Byron, Courtney Drummond, Tim Lattner, Rudy Powell, David Sadler, Amy Tootle, Dan Scheer, Vern Danforth, Gregory Schiess, Trey Tillander, Stefanie Maxwell, Dan Hurtado, Robert Robertson, Lora Hollingsworth, Kevin Burgess (FHWA), Nick Finch (FHWA), Chad Thompson (FHWA), Bren George (FHWA)

SUBJECT: Audible and Vibratory Treatments (AVTs)

This bulletin implements a new policy for the use of audible and vibratory treatments on arterials and collectors. **This new policy affects the Standard Plans, the Plans Preparation Manual (PPM) and the FDOT Design Manual (FDM).**

REQUIREMENTS FOR STANDARD PLANS

1. Standard Plans, Index 546-010 and the associated instructions have been updated and are released as a Standard Plans Interim Revision to the *FY 2018-19 Standard Plans*.

REQUIREMENTS FOR FDM

1. Replace *FDM 210.4.6* with the following:

210.4.6 Audible and Vibratory Treatment

Provide audible and vibratory treatment (AVT) on flush-shoulder roadways with a posted speed of 50 mph or greater. Do not exclude sections of the project where advisory speeds are

used due to restricted horizontal or vertical geometry. Do not place AVTs within the limits of crosswalks.

Figure 210.4.4 provides guidance for placement of AVTs.

AVTs on arterials and collectors are any of the following:

- Cylindrical Ground-In Rumble Strips,
- Sinusoidal Ground-In Rumble Strips, or
- Profiled Thermoplastic.

Consider potential noise impacts to residents and businesses adjacent to the roadway when selecting an appropriate AVT. A higher probability of strikes should be expected on the inside radius of horizontal curves. The expected increase in noise levels over typical road noise is as follows:

- Approximately 6 decibels for cylindrical ground-in rumble strips.
- Approximately 4 decibels for sinusoidal ground-in rumble strips.
- Approximately 2 decibels for profiled thermoplastic.

AVT type selected for each edge line or centerline should be consistent throughout the project length; however, there may be a clear change in condition for which a change in AVT type is appropriate. Use the same type of treatment for centerlines as is used for edge lines on undivided roadways.

Determine the appropriate AVT in accordance with **FDM 210.4.6.1** and **FDM 210.4.6.2**.

2. Replace **FDM 210.4.6.1** with the following:

210.4.6.1 Ground-in Rumble Strips

Standard Plans, Index 546-010 provides three configurations (Types A, B, and C) for ground-in rumble strips along edge lines. The selection of Type A, B, or C is as follows:

- Use Type A on outside paved shoulder when width is between 1 and 5 feet. Do not use this type for sinusoidal ground-in rumble strips, or when there are residences within a minimum of 650 feet of the proposed edge line.
- Use Type B on outside paved shoulder when width is ≥ 5 feet, and on inside paved shoulder when width is ≥ 1 foot.
- Use Type C on flush shoulder roadways with buffered striping.

Sinusoidal ground-in rumble strips produce less noise, and are an alternative to the cylindrical ground-in rumble strips. They may be used for Types B and C in noise-sensitive locations.

Ground-in rumble strips are to be detailed (i.e., limits, Type A, B, or C) and quantified in the Signing and Marking Plans component set. Include “1” for cylindrical ground-in rumble strips or “2” for sinusoidal ground-in rumble strips; e.g., A1, B1, B2, C1, C2.

See *Exhibit 210-7* for common placement of AVTs.

3. Add Attachment ‘A’ to the *FDM* as *Exhibit 210-7* following *Figure 210.4.4*.

4. Replace *FDM 210.4.6.2* with the following:

210.4.6.2 Profiled Thermoplastic

Use profiled thermoplastic when any of the following conditions exist:

- Rigid pavement
- The requirements for installing ground-in rumble strips cannot be met
- Paved shoulder width prevents the construction phasing required for installation of ground-in rumble strips
- Restriping projects where the District Maintenance Engineer has determined ground-in rumble strips are not cost effective based on the remaining service life of the pavement
- Edge lines for bridges with narrow shoulders as a countermeasure for barrier impacts

REQUIREMENTS FOR PPM

1. Replace *PPM, Volume 1, Chapter 2, Section 2.3.2* with the following:

2.3.2 Audible and Vibratory Treatment

2.3.2.1 Limited Access Facilities

The safety of freeways and other limited access facilities on the State Highway System is to be enhanced by the installation of audible and vibratory treatments (AVT) in the form of cylindrical ground-in rumble strips. Include ground-in rumble strips in the design of projects on limited access facilities. Several types of applications have been tested. The ground-in strips provide the desired warning to the driver and consistency in application has been possible using this construction process.

These ground-in strips are installed using two patterns. The skip array is the standard array. These are used on both inside and outside shoulders on divided highway sections. Install the

continuous array in advance of bridge ends for a distance of 1000 ft. or back to the gore recovery area for mainline interchange bridges. Other areas may be specified in plans.

The [*Standard Plans, Index 546-010*](#), has been prepared to provide all needed details. This index also gives standards for raised rumble strips for use at structures where the bridge shoulder width is less than the width of the useable shoulder on the approach roadway. Notes for locations of raised rumble strip applications are also included on the index.

2.3.2.2 Arterials and Collectors

Provide audible and vibratory treatment (AVT) on flush-shoulder roadways with a posted speed of 50 mph or greater. Do not exclude sections of the project where advisory speeds are used due to restricted horizontal or vertical geometry. Do not place AVTs within the limits of crosswalks.

AVTs on arterials and collectors are any of the following:

- Cylindrical Ground-In Rumble Strips,
- Sinusoidal Ground-In Rumble Strips, or
- Profiled Thermoplastic.

Consider potential noise impacts to residents and businesses adjacent to the roadway when selecting an appropriate AVT. A higher probability of strikes should be expected on the inside radius of horizontal curves. The expected increase in noise levels over typical road noise is as follows:

- Approximately 6 decibels for cylindrical ground-in rumble strips.
- Approximately 4 decibels for sinusoidal ground-in rumble strips.
- Approximately 2 decibels for profiled thermoplastic.

AVT type selected for each edge line or centerline should be consistent throughout the project length; however, there may be a clear change in condition for which a change in AVT type is appropriate. Use the same type of treatment for centerlines as is used for edge lines on undivided roadways.

Determine the appropriate AVT in accordance with *Sections 2.3.2.2.1* and *2.3.2.2.2* of this Volume.

2.3.2.2.1 Ground-in Rumble Strips

[*Standard Plans, Index 546-010*](#) provides three configurations (Types A, B, and C) for ground-in rumble strips along edge lines. The selection of Type A, B, or C is as follows:

- Use Type A on outside paved shoulder when width is between 1 and 5 feet. Do not use this type for sinusoidal ground-in rumble strips, or when there are residences within a minimum of 650 feet of the proposed edge line.
- Use Type B on outside paved shoulder when width is ≥ 5 feet, and on inside paved shoulder when width is ≥ 1 foot.
- Use Type C on flush shoulder roadways with buffered striping.

Sinusoidal ground-in rumble strips produce less noise, and are an alternative to the cylindrical ground-in rumble strips. They may be used for Types B and C in noise-sensitive locations.

Ground-in rumble strips are to be detailed (i.e., limits, Type A, B, or C) and quantified in the Signing and Marking Plans component set. Include “1” for cylindrical ground-in rumble strips or “2” for sinusoidal ground-in rumble strips; e.g., A1, B1, B2, C1, C2.

2.3.2.2.2 Profiled Thermoplastic

Use profiled thermoplastic when any of the following conditions exist:

- Rigid pavement
- The requirements for installing ground-in rumble strips cannot be met
- Paved shoulder width prevents the construction phasing required for installation of ground-in rumble strips
- Restriping projects where the District Maintenance Engineer has determined ground-in rumble strips are not cost effective based on the remaining service life of the pavement
- Edge lines for bridges with narrow shoulders as a countermeasure for barrier impacts

2. Replace *PPM, Volume 1, Chapter 7, Figure 7.6.1* with Attachment ‘B’.

3. Replace *PPM, Volume 1, Chapter 7, Section 7.6.1.2* with the following:

7.6.1.2 Standard Thermoplastic with Ground-in Rumble Strips

Standard Thermoplastic with ground-in rumble strips is an audible and vibratory treatment (AVT) that is used on asphalt pavement as a countermeasure for lane departures and centerline crossover crashes. See *Section 2.3.2* of this Volume for AVT criteria.

4. Replace *PPM, Volume 1, Chapter 7, Section 7.6.1.3* with the following:

7.6.1.3 Profiled Thermoplastic

Profiled Thermoplastic is an AVT that is typically used on concrete pavement as a countermeasure for lane departures and centerline crossover crashes. See *Section 2.3.2* of this Volume for AVT criteria.

COMMENTARY

The new approach for the placement of AVTs on arterials and collectors provide considerations for potential noise pollution and national best practices for accommodating cyclists. The developmental phase for Design Standard, Index 519 *Rumble Striping* is concluded with the following key changes implemented:

- Reduced the depth of the cylindrical ground-in rumble strips from 1/2 inch to 3/16 inch based on noise testing of various patterns and depths.
- Reduced the width of centerline rumble strips from 16 inches to 8 inches.
- Modified the array dimensions to better accommodate cyclists.
- Researched and implemented the use of a sinusoidal ground-in rumble strip pattern that lessens the potential for noise pollution.
- Created ground-in configurations (Types A, B, and C) for consistent placement of edge line rumble strips.

IMPLEMENTATION

The requirements of this bulletin are effective on all projects with lettings on or after January 1, 2019. These requirements may be implemented beginning with July 2018 lettings at the discretion of the Districts.

CONTACT

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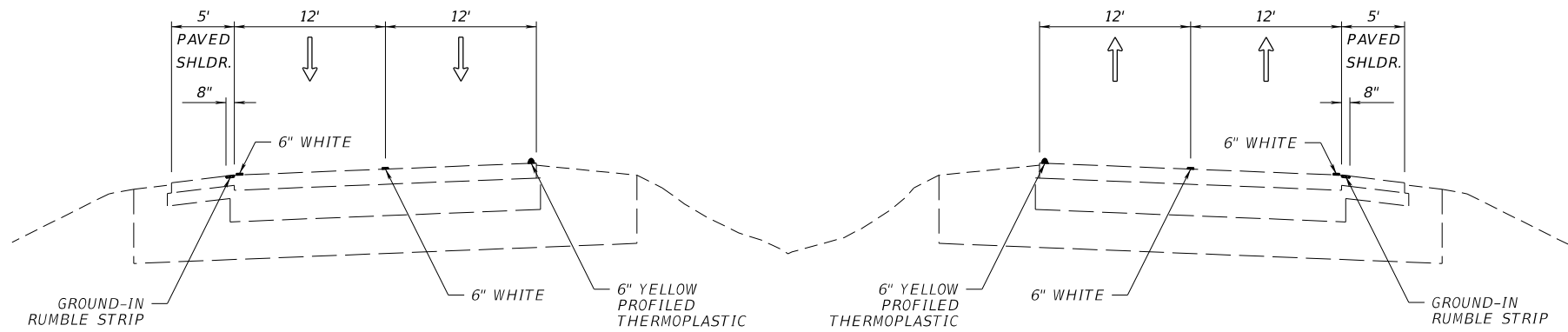
Mary Jane Hayden, P.E., PMP
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MS/ec/mjh

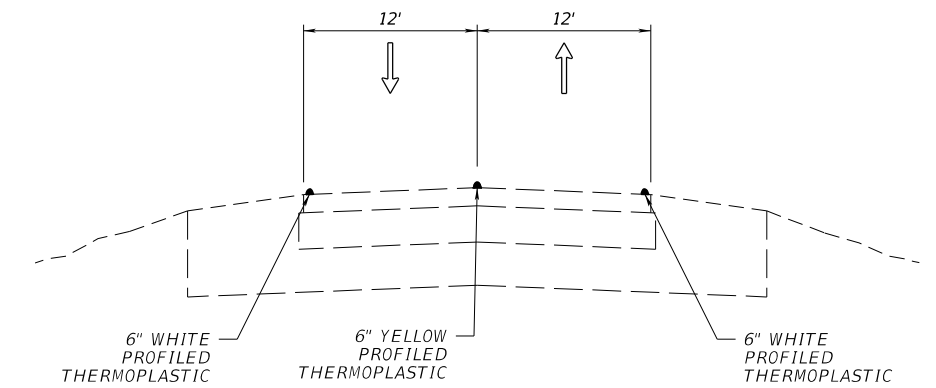
Attachment 'A'

FDM Exhibit 210-7

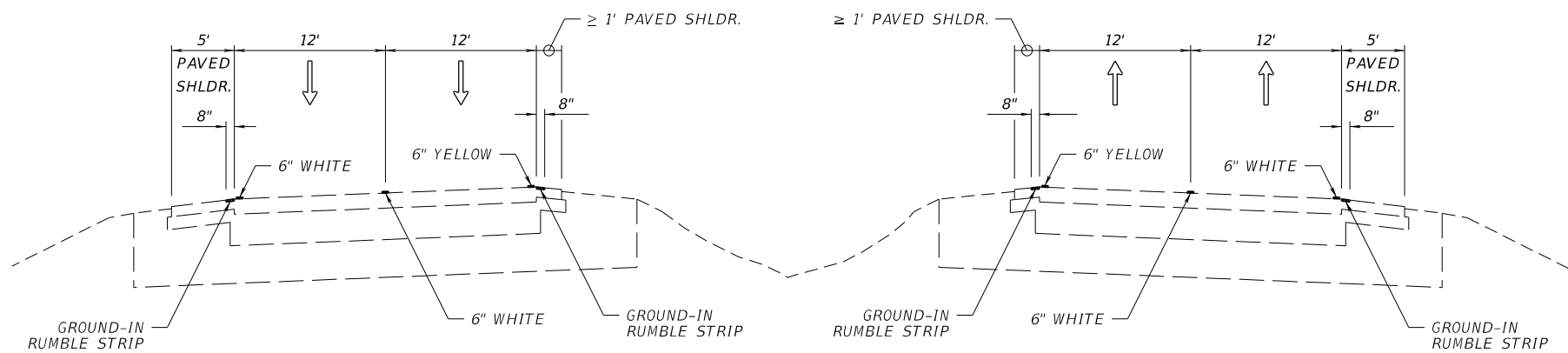
COMMON PLACEMENT OF AUDIBLE AND VIBRATORY TREATMENTS



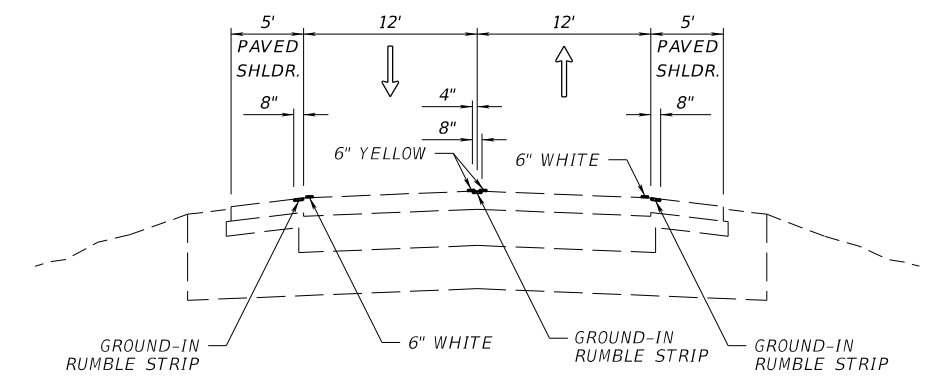
MULTILANE DIVIDED WITHOUT PAVED INSIDE SHOULDERS



UNDIVIDED WITHOUT PAVED SHOULDERS



MULTILANE DIVIDED WITH PAVED INSIDE SHOULDERS



UNDIVIDED WITH PAVED SHOULDERS

NOT TO SCALE

Attachment 'B'

PPM Figure 7.6.1

Figure 7.6.1 Pavement Marking Material Selection

