North Carolina Department of Transportation
Division of Highways
Transportation Mobility and Safety Division

STANDARD PRACTICE
for
Milled Rumble Strips/Stripes on Non-Full-Controlled Facilities

It will be the standard practice of NCDOT to consider rumble strips/stripes at locations on partially, limited, or non-controlled facilities that have a documented pattern of treatable lane departure events based on an engineering study and investigation. Roadways with full access control shall have rumble strips regardless of the presence of a documented pattern of lane departure events. Rumble strips/stripes have proven to be an effective, yet low cost, safety countermeasure to address lane departure events resulting from drowsy or inattentive motorists. All rumble strips/stripes shall be installed, marked, and signed in compliance with the Manual on Uniform Traffic Control Devices (MUTCD), the North Carolina Supplement to the MUTCD, the NCDOT Roadway Standard Drawings, the NCDOT Roadway Design Manual, NCDOT Roadway Details, and the standards and technical drawings herein. The State Traffic Engineer shall approve all deviations from this practice with coordination from other units.

General Criteria

The following is general criteria for the installation of milled rumble strips/stripes:

- Rumble strip shall be installed on both sides (right and median shoulders) of roadways with full access control (see roadway standards section 665 for more details). On full control roadways where a paved shoulder is intended for future travel lane use, rumble strip installations shall still be implemented. Additionally, full control roadways with bus-on-shoulder policies shall still have rumble strips installed on both shoulders.

- Rumble strips/stripes should be considered on both sides (right and median shoulders) of partial/limited access control roadways with a speed limit of 55 mph or greater.

- Rumble strips/stripes should be considered on partial/limited/no access control roadways where an NCDOT engineering study and investigation determines that lane departure events exist, or roadway characteristics exist for potential lane departure events.

- Turn bay rumble strips/stripes may continue to the beginning of the full width lane, if the paved shoulder width remains the same as the through-lane shoulder width.

- Noise generated by rumble strips/stripes may be an issue for residences or land uses that are very near to the roadway. Along partial/limited/no access control roadways where noise is a concern, sinusoidal rumble strip/stripe design options are provided for these sections.

- Prior to the installation of rumble strip/stripes, the roadway's pavement should be deemed to be in sufficiently good condition, as determined by division staff, to effectively accept the milling process without raveling or deteriorating.

Shoulder and Edge Line Rumble Strip/Stripe Installation Guidance

For shoulder or edgeline rumble strip/stripe installations, the following design guidance should be used:

Table 1. Shoulder and Edge Line Rumble Strip/Stripe Specifications

Access Control of Roadway	Number of Lanes	Paved Shoulder Width	Potential for Noise Concerns	Shoulder/Edge Line Rumble Specification	Placement	Maximum Depth	Reference Drawing
Full	All	All	n/a	16" Traditional Strip	6" offset from edge line	1/2"	665.01 / 720.01
Partial/Limited/None	Multi-Lane	< 2'	no	6"-12" Traditional Stripe	Even with inside edge of edge line	3/8"	Trad.Stripe
Partial/Limited/None	Multi-Lane	< 2'	yes	8"-14" Sinusoidal Stripe	Even with inside edge of edge line	3/8"	Sin.Stripe
Partial/Limited/None	Multi-Lane	≥ 2'	no	6"-16" Traditional Strip	6"-12" offset from edge line	3/8"	Trad.Strip
Partial/Limited/None	Multi-Lane	≥ 2'	yes	8"-14" Sinusoidal Strip	6"-12" offset from edge line	3/8"	Sin.Strip
Partial/Limited/None	2-Lane	All	no	6"-12" Traditional Stripe	Even with inside edge of edge line	3/8"	Trad.Stripe
Partial/Limited/None	2-Lane	All	yes	8"-14" Sinusoidal Stripe	Even with inside edge of edge line	3/8"	Sin.Stripe

- General:
  - In the above table, paved shoulder width is defined as the nominal width of the pavement from the outside of the edge line to the edge of the pavement/edge of travel (see roadway standard drawing 1205.01)
  - Shoulder rumble strips/stripes should have a nominal 2” minimum distance from the outside edge of the paved surface (edge of asphalt).

- Minimum Widths:
  - For all partial/limited/no access control roadways, a minimum width of six (6) inches shall be used for traditional rumble strip/stripe designs and a minimum width of eight (8) inches shall be used for sinusoidal rumble strip/stripe designs.
  - If there is a documented lane departure pattern involving vehicles that have higher than average tire widths, wider rumble strips will be more desirable to ensure a larger contact area between the tire and the rumble depression.

- Accompanying Pavement Markings:
  - Shoulder and edge line rumble strip/stripe installations on partial/limited/no access control roadways selected for lane departure crash treatment should be accompanied by a coinciding upgrade to six (6) inch wide edge lines using durable pavement markings. Durable pavement marking materials include thermoplastic or polyurea.

- Additional Options:
  - Width ranges are provided in the above table to allow for engineering judgement to choose the most suitable design based on local conditions.
  - For partial/limited/no access control multi-lane roadways with nominal paved shoulder widths greater than or equal to two (2) feet, a rumble stripe could also be implemented in lieu of an offset rumble strip if locational context dictates this placement more desirable.

Center Line Rumble Stripe Installation Guidance

For center line rumble stripe installations, the following design guidance should be followed:

Table 2. Center Line Rumble Stripe Specifications

Lane Configuration	Total Pavement Width	Centerline Marking Widths	Potential for Noise Concerns	Center Line Rumble Stripe Specification	Installations on Center Line and Shoulder/Edge Line Allowable?	Reference Drawing
Multi-Lane	All	4" *(4-6-4)*	no	14" Traditional Stripe	yes, combo allowed	Trad.CL
Multi-Lane	All	6" *(6-6-6)*	no	18" Traditional Stripe	yes, combo allowed	Trad.CL
Multi-Lane	All	4" *(4-6-4)*	yes	14" Sinusoidal Stripe	yes, combo allowed	Sin.CL
Multi-Lane	All	6" *(6-6-6)*	yes	18" Sinusoidal Stripe	yes, combo allowed	Sin.CL
2-Lane	≥ 20'	4" *(4-6-4)*	no	14" Traditional Stripe	yes, combo allowed	Trad.CL
2-Lane	≥ 20'	6" *(6-6-6)*	no	18" Traditional Stripe	yes, combo allowed	Trad.CL
2-Lane	≥ 20'	4" *(4-6-4)*	yes	14" Sinusoidal Stripe	yes, combo allowed	Sin.CL
2-Lane	≥ 20'	6" *(6-6-6)*	yes	18" Sinusoidal Stripe	yes, combo allowed	Sin.CL
2-Lane	< 20'	All	no	none	n/a	n/a
2-Lane	< 20'	All	yes	none	n/a	n/a

- General:
  - Center line rumble stripes should not be installed on two-lane roadways with a total nominal pavement width less than 20 feet. Engineers may use locational context, including crash history, when determining the viability for a centerline rumble stripe installation along a narrow 2-lane roadway.
  - A sinusoidal design is recommended for center line rumble stripes along roadways with potential noise concerns.

- Accompanying Pavement Markings:
  - In general, the width of the centerline rumble stripe should equal the width of the accompanying centerline pavement markings. This will allow for the centerline pavement markings to be contained within the milled groove which results in an additional benefit to the durability and lifespan of the accompanying pavement marking.
  - If the nominal road width and locational context allows for wider centerline pavement markings, centerline rumble stripe installations along undivided roadways selected for lane departure crash treatment should be accompanied by a coinciding upgrade to six (6) inch wide center lines using durable pavement markings. Durable pavement marking materials include thermoplastic or polyurea.

Considerations For Bicycle Traffic

State law considers bicycles to be vehicles and allows for bicyclists to ride amongst other roadway users in the roadway. Bicyclists may choose to ride in bicycle lanes, on paved shoulders, or in all-purpose travel lanes. Bicyclists make their choice of where to ride based on existing and upcoming roadway conditions, a desire to avoid hazards in the roadway/shoulder, and potential conflicts with right-turning traffic. Motorists should expect to see bicyclists in the roadway and understand that traffic operations may require bicyclists to make use of a paved shoulder when available or full travel lane and move between the shoulder and lane when needed. When selecting roadways for treatment of lane departure crashes with rumble strip/stripe installations, engineers must consider the impact on bicyclists.

The following should be considered for all roadways where bicycles are legally allowed to operate:

- The purpose of this section of the standard practice is to provide guidance on the technical design of rumble strip/stripe installations while accommodating the movement of bicycles on roadways where they are legally allowed to operate. The movement of bicyclists should not prevent the installation of shoulder or edge line rumble strips/stripes where there are lane departure events. Also, the implementation of shoulder or edge line rumble strips/stripes should not overly inhibit the legal operation of bicyclists.

- The beginning of a rumble strip/stripe pattern should be delineated in accordance with MUTCD criteria (Section 9C.06) on any facility that bicycles are legally allowed to operate.

- It is desirable to provide a nominal width of five (5) feet between the outside edge of the shoulder or edge line rumble strip/stripe to the edge of pavement. The installation of rumble strips/stripes for the treatment of lane departure crash locations should still be considered for locations where less than the desirable shoulder width for bicyclists is present. The condition of the shoulder should be considered in determining whether five-foot nominal riding width for bicycle traffic is available.

- For roadways with nominal paved shoulder widths of at least five (5) feet, gaps in milled patterns, varying between 6 and 12 feet, shall be provided to allow bicyclists to move between the through lane and the right shoulder to avoid vehicles, debris, etc. The pattern should be a minimum of a 5:1 rumble-to-gap ratio. The Engineer should determine design and placement. For roadways with a paved shoulder width of less than five (5) feet, rumble strip/stripe gaps are not required but are encouraged when a useable shoulder width is present.

- No gaps should be provided on the left (median) side of divided highways. Gaps should not be provided on interstate or freeway roadways.

- Consideration should be given to the grade and speed at which bicyclists may be traveling when determining the length of the gap. See the final report for NCDOT research project 2014-16 for further guidance on selecting gap length.

- The NCDOT Integrated Mobility Division (IMD) should be notified of proposed rumble strip projects on roadways subject to this practice. Additional coordination for roads identified as a current or prospective bicycle route such as a US Bicycle Route, state or local bicycle route or route mapped by a local bicycling organization is expected. The IMD should assist in making this information available where possible. If a route is the only practical route between two destinations additional consideration should be given regarding bicycle travel and any identified justification for rumble strips.

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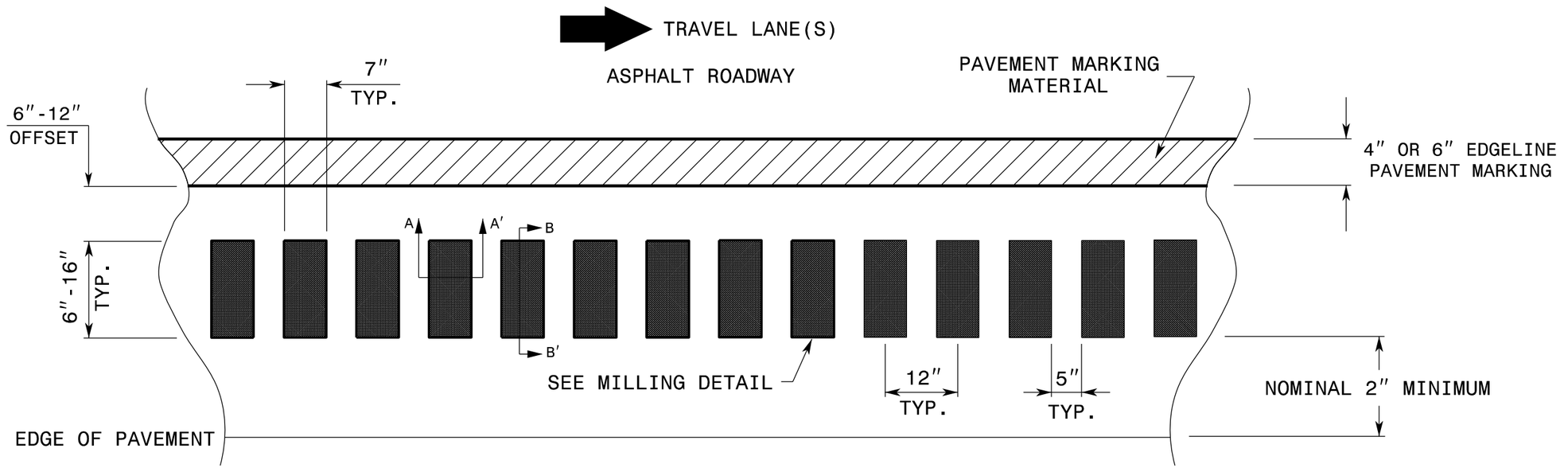
DIVISION OF HIGHWAYS
RALEIGH, N.C.

2-23

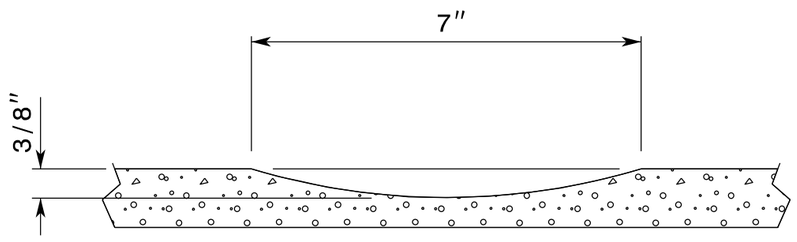
ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
TRADITIONAL SHOULDER RUMBLE STRIP

SHEET 1 OF 7

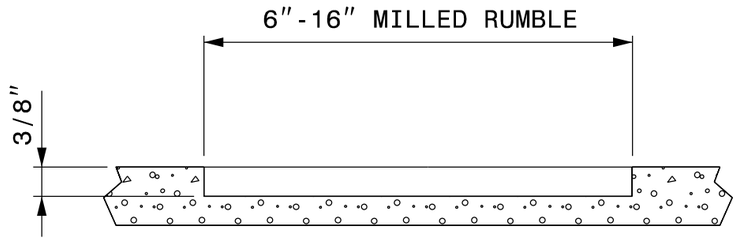
See Table 1 within Rumble Strip Policy for Design Guidance



MILLING DETAIL:



SECTION A-A′



SECTION B-B′

REFERENCE DRAWING ID: Trad.Strip

STATE OF
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2-23

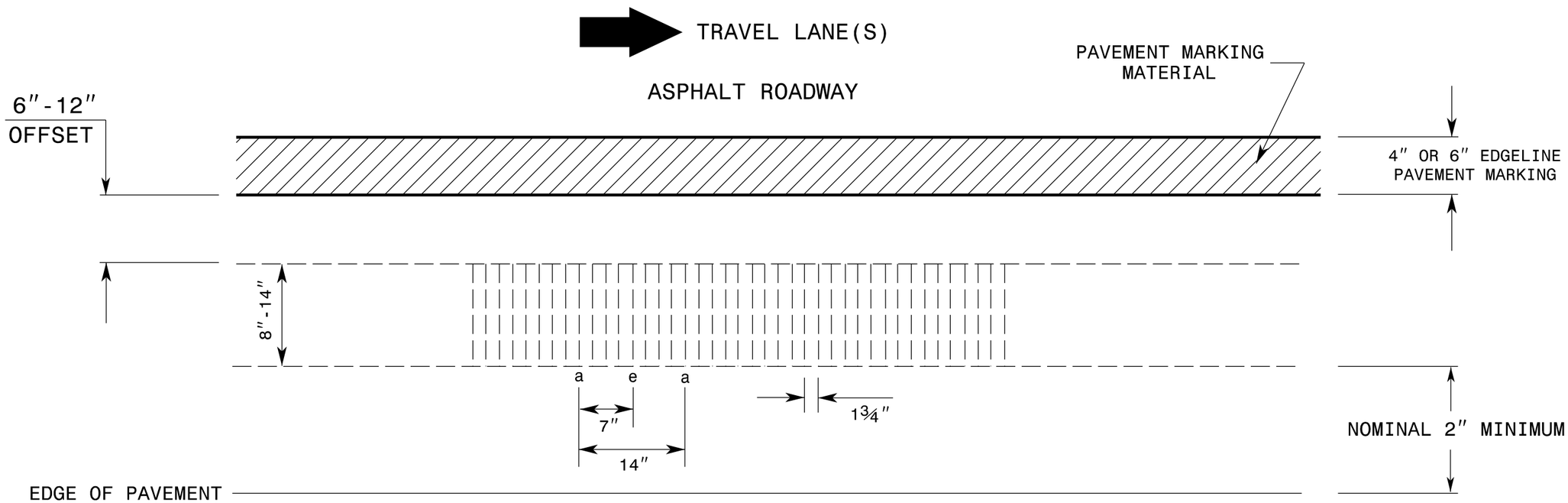
ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
TRADITIONAL SHOULDER RUMBLE STRIP

SHEET 1 OF 7

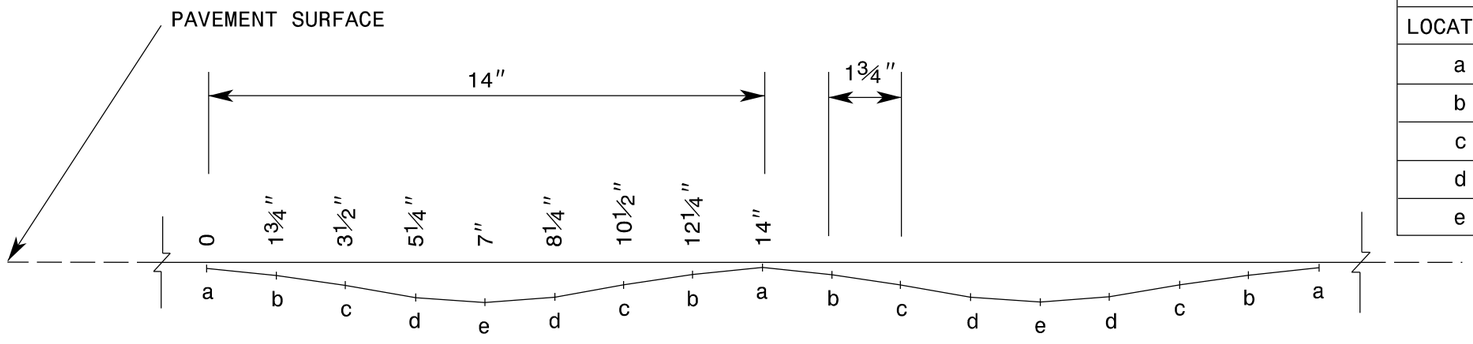
ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
SINUSOIDAL SHOULDER RUMBLE STRIP

See Table 1 within Rumble Strip Policy for Design Guidance

PLAN VIEW



PROFILE VIEW



	DEPTH	
LOCATION	MIL	INCHES
a	62.5	1/16″
b	125	1/8″
c	219	7/32″
d	344	11/32″
e	375	3/8″

REFERENCE DRAWING ID: Sin.Strip

NOTES:

1) Specification in table taken from MNDOT Research Project Final Report 2016-23: *Sinusoidal Rumble Strip Design Optimization Study By: Terhaar et. al, June 2016*

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ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
SINUSOIDAL SHOULDER RUMBLE STRIP

SHEET 2 OF 7

STATE OF
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DIVISION OF HIGHWAYS
RALEIGH, N.C.

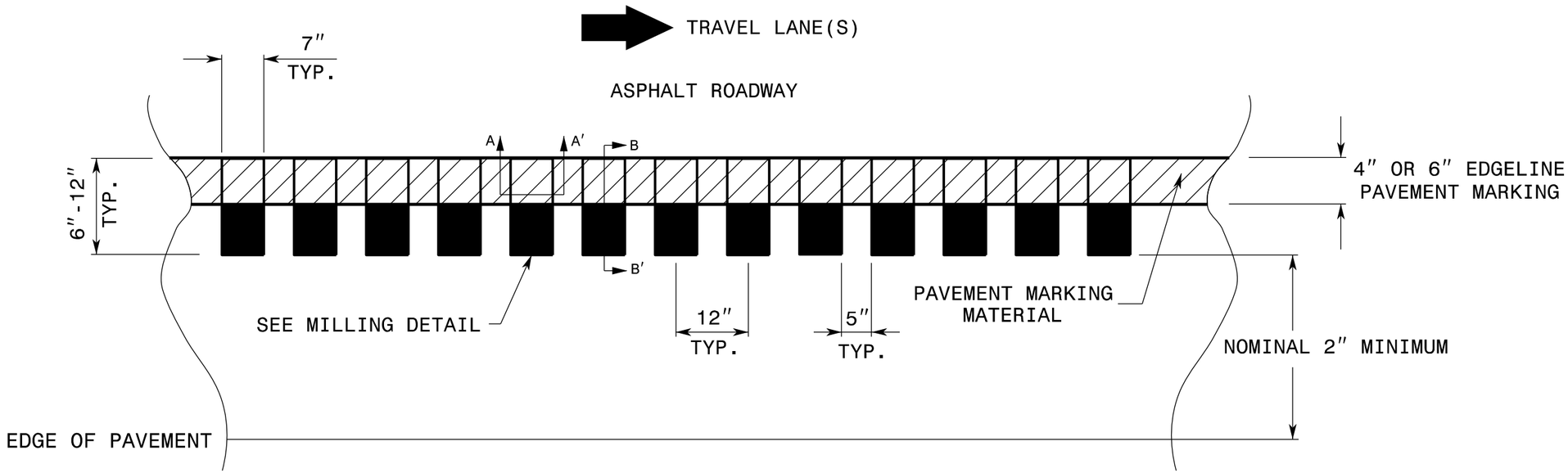
2-23

ENGLISH DETAIL DRAWING FOR

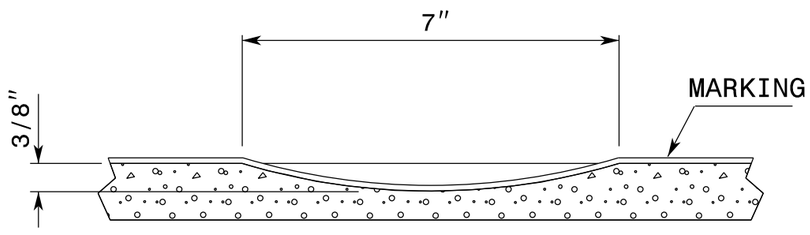
RUMBLE STRIPS / STRIPES

TRADITIONAL EDGELINE RUMBLE STRIPE

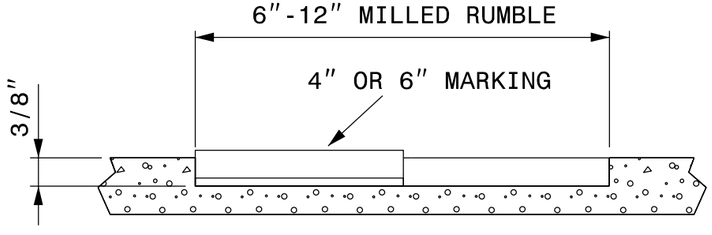
See Table 1 within Rumble Strip Policy for Design Guidance



MILLING DETAIL:



SECTION A-A′



SECTION B-B′

REFERENCE DRAWING ID: Trad.Stripe

NOTES:

1) USING A VACUUM, REMOVE ALL DEBRIS FROM THE MILLINGS JUST PRIOR TO PLACING ANY PAVEMENT MARKINGS.
2) ENSURE GLASS BEADS ARE SPREAD UNIFORMLY OVER THE ENTIRE SURFACE OF THE PAVEMENT MARKING MATERIAL.

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ENGLISH DETAIL DRAWING FOR

RUMBLE STRIPS / STRIPES

TRADITIONAL EDGELINE RUMBLE STRIPE

SHEET 3 OF 7

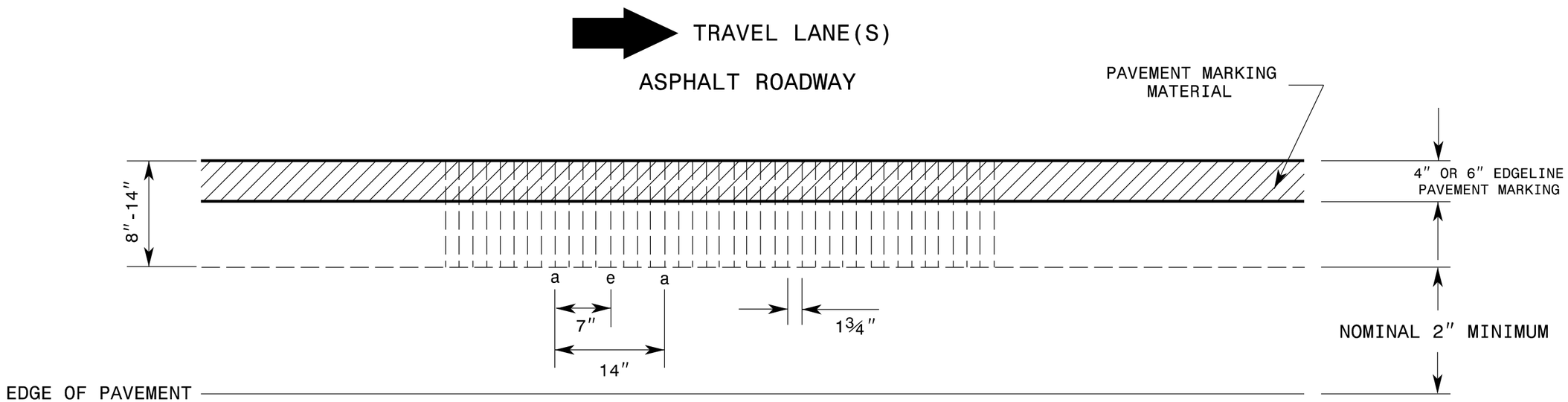
STATE OF NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.

2-23

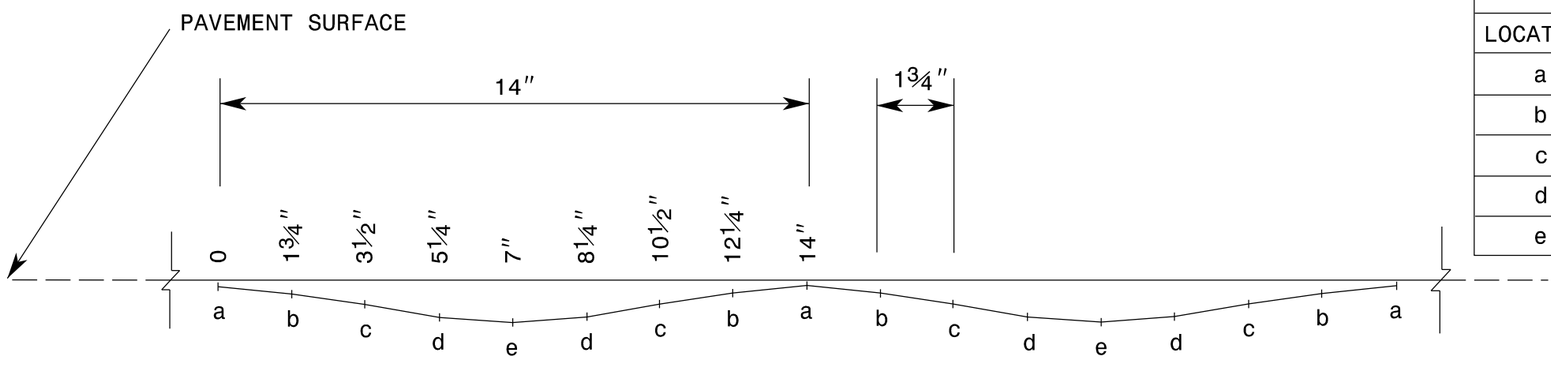
ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
SINUSOIDAL EDGELINE RUMBLE STRIPE

See Table 1 within Rumble Strip Policy for Design Guidance

PLAN VIEW



PROFILE VIEW



	DEPTH	
LOCATION	MIL	INCHES
a	62.5	1/16″
b	125	1/8″
c	219	7/32″
d	344	11/32″
e	375	3/8″

REFERENCE DRAWING ID: Sin.Stripe

NOTES:

1) Specification in table taken from MNDOT Research Project Final Report 2016-23: *Sinusoidal Rumble Strip Design Optimization Study By: Terhaar et. al, June 2016*
2) USING A VACUUM, REMOVE ALL DEBRIS FROM THE MILLINGS JUST PRIOR TO PLACING ANY PAVEMENT MARKINGS.
3) ENSURE GLASS BEADS ARE SPREAD UNIFORMLY OVER THE ENTIRE SURFACE OF THE PAVEMENT MARKING MATERIAL.

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ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
SINUSOIDAL EDGELINE RUMBLE STRIPE

SHEET 4 OF 7

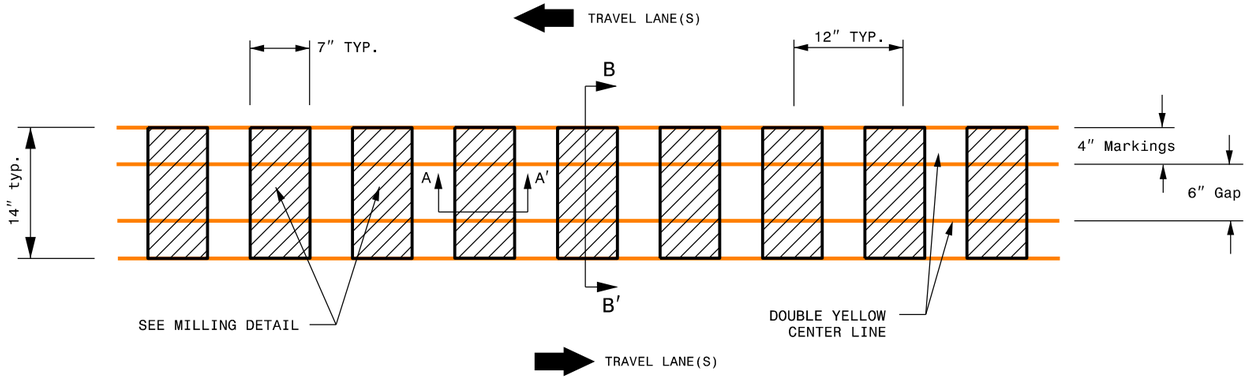
ENGLISH DETAIL DRAWING FOR

RUMBLE STRIPS / STRIPES

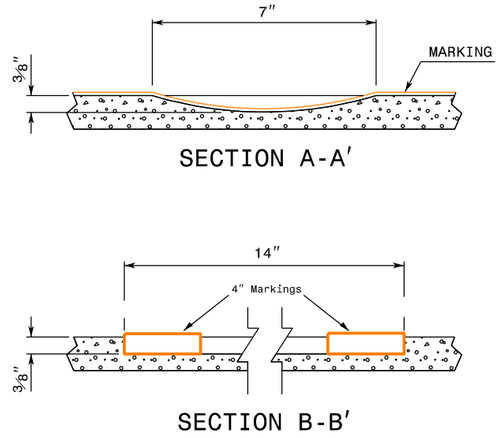
TRADITIONAL CENTERLINE RUMBLE STRIPE

See Table 2 within Rumble Strip Policy for Design Guidance

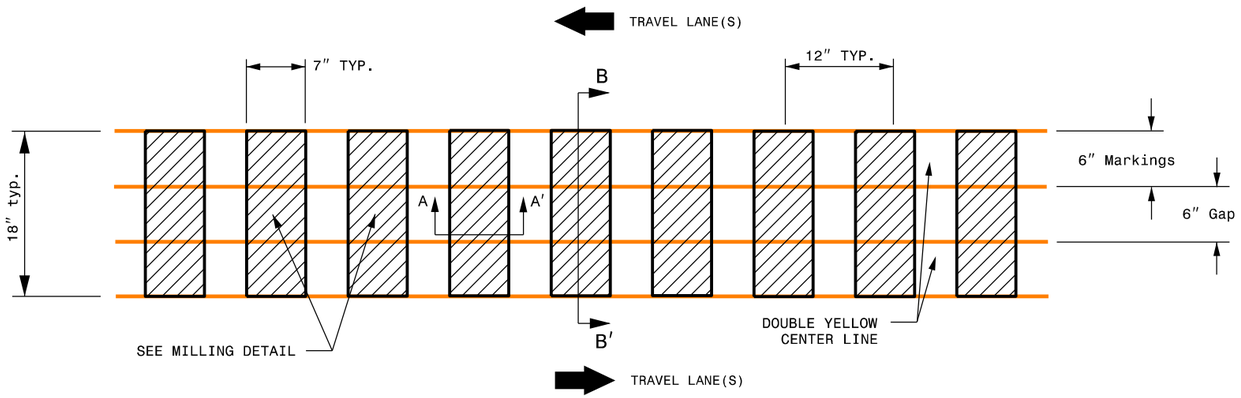
If 4″ Markings will be used:



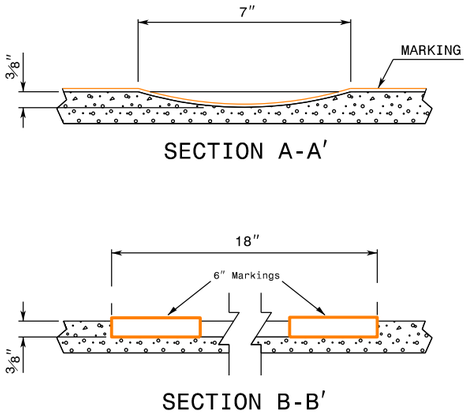
MILLING DETAIL - 4″ Markings



If 6″ Markings will be used:



MILLING DETAIL - 6″ Markings



REFERENCE DRAWING ID: Trad.CL

NOTES:

1) USING A VACUUM, REMOVE ALL DEBRIS FROM THE MILLINGS JUST PRIOR TO PLACING ANY PAVEMENT MARKINGS.
2) ENSURE GLASS BEADS ARE SPREAD UNIFORMLY OVER THE ENTIRE SURFACE OF THE PAVEMENT MARKING MATERIAL.

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ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
TRADITIONAL CENTERLINE RUMBLE STRIPE
SHEET 5 OF 7

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ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
SINUSOIDAL CENTERLINE RUMBLE STRIPE

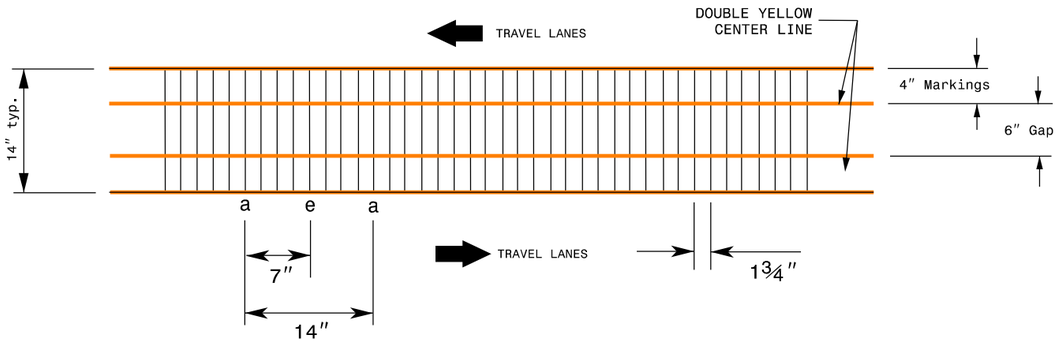
ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
SINUSOIDAL CENTERLINE RUMBLE STRIPE

See Table 2 within Rumble Strip Policy for Design Guidance

Rumble Dimensions

Markings Dimensions

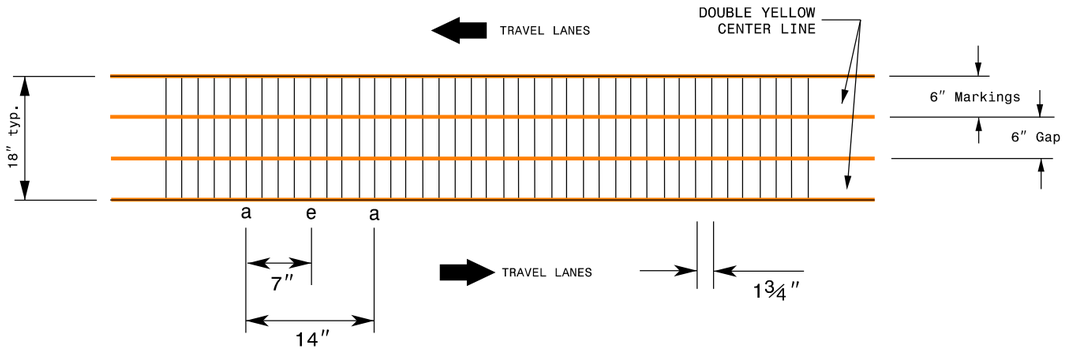
If 4″ Markings will be used:



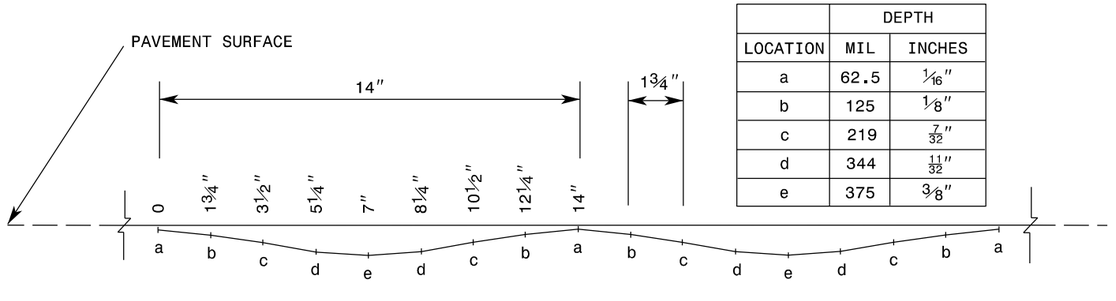
Rumble Dimensions

Markings Dimensions

If 6″ Markings will be used:



PROFILE:



	DEPTH	
LOCATION	MIL	INCHES
a	62.5	1/16″
b	125	1/8″
c	219	7/32″
d	344	11/32″
e	375	3/8″

REFERENCE DRAWING ID: Sin.CL

NOTES:

1) Specification in table taken from MNDOT Research Project Final Report 2016-23: *Sinusoidal Rumble Strip Design Optimization Study By: Terhaar et. al, June 2016*
2) USING A VACUUM, REMOVE ALL DEBRIS FROM THE MILLINGS JUST PRIOR TO PLACING ANY PAVEMENT MARKINGS.
3) ENSURE GLASS BEADS ARE SPREAD UNIFORMLY OVER THE ENTIRE SURFACE OF THE PAVEMENT MARKING MATERIAL.

SHEET 6 OF 7

STATE OF
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DEPT. OF TRANSPORTATION
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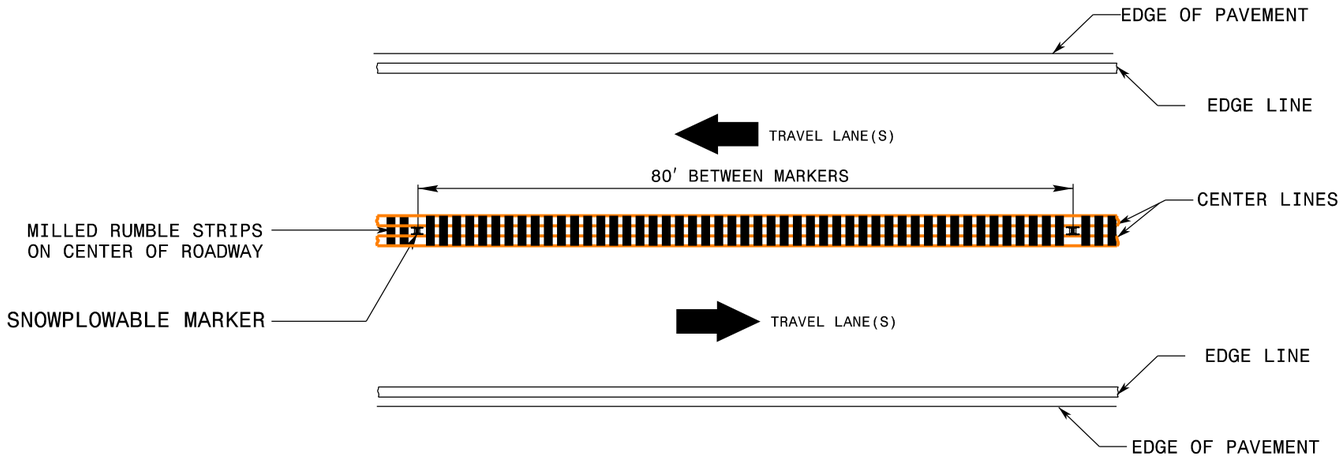
RALEIGH, N.C.
2-23

ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
TRADITIONAL CENTERLINE RUMBLE STRIPE WITH SNOWPLOWABLE MARKERS

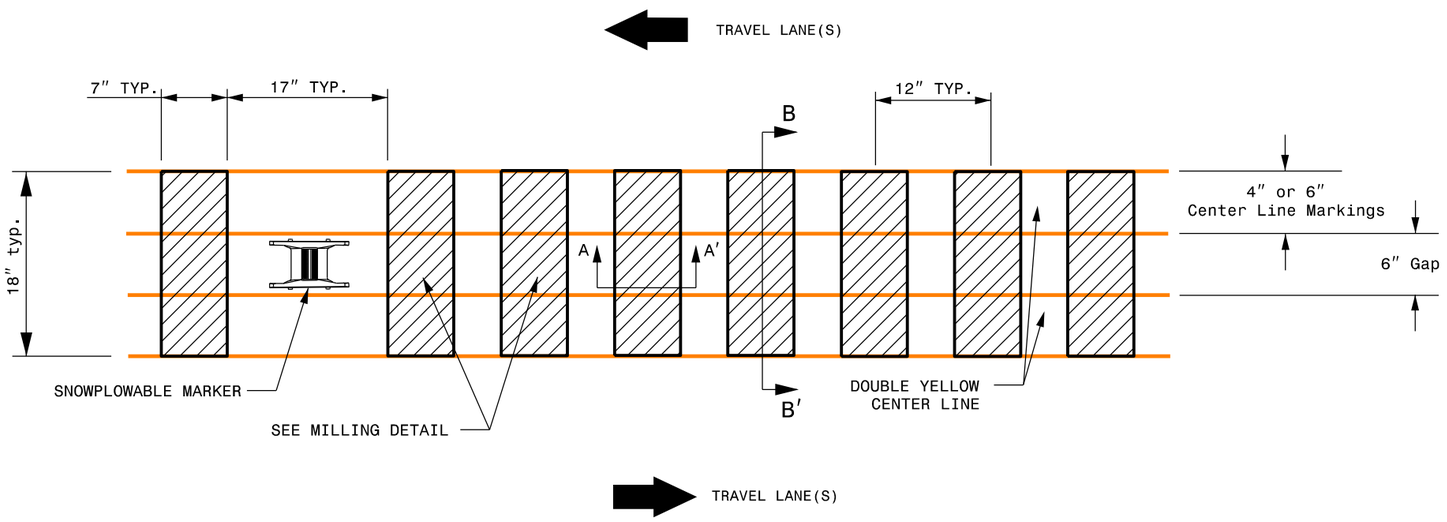
ENGLISH DETAIL DRAWING FOR
RUMBLE STRIPS / STRIPES
TRADITIONAL CENTERLINE RUMBLE STRIPE WITH SNOWPLOWABLE MARKERS

See Table 2 within Rumble Strip Policy for Design Guidance

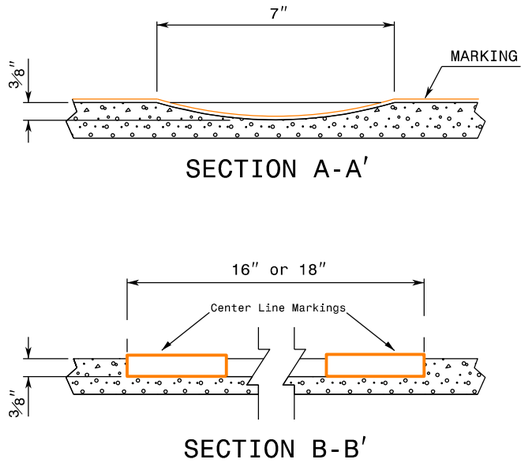
LANE TREATMENT



CENTER LINE



MILLING DETAIL



REFERENCE DRAWING ID: Trad.CL with Snowplowable Markers

NOTES:

1) USING A VACUUM, REMOVE ALL DEBRIS FROM THE MILLINGS JUST PRIOR TO PLACING ANY PAVEMENT MARKINGS.
2) ENSURE GLASS BEADS ARE SPREAD UNIFORMLY OVER THE ENTIRE SURFACE OF THE PAVEMENT MARKING MATERIAL.
3) INSTALL SNOWPLOWABLE MARKERS AT APPROXIMATELY 80′ INCREMENTS. DO NOT MILL RUMBLE STRIPS IN SECTION WHERE SNOWPLOWABLE MARKERS ARE INSTALLED.

SHEET 7 OF 7