

April 21, 1995

470-95-27

SUBJECT: Milled Shoulder Rumble Strips (MSRS)
Safety Enhancement

TO: DISTRICT ENGINEER
ENGINEERING DISTRICT _____

FROM: Michael M. Ryan P.E.
Deputy Secretary
Highway Administration



This Strike-Off-Letter (SOL) supersedes SOL# 470-93-45, dated June 23, 1993, "Milled Shoulder Rumble Strips Safety Enhancement".

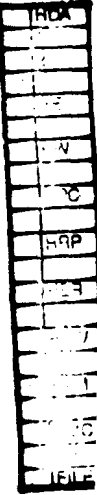
All PS&E's submitted to Central Office, as of July 1, 1995, shall incorporate the provisions of this SOL. Additionally, all limited access projects, possessing a PSLE date prior to July 1, 1995, should be given strong consideration for placement of milled shoulder rumble strips as outlined in this SOL.

This SOL requires that milled shoulder rumble strips be included on all limited access highway projects for both bituminous and concrete shoulders when shoulder resurfacing or reconstruction is included as part of the project. Refer to the attached guidelines for the specific requirements.

Milled shoulder rumble strips (MSRS) provide low-cost safety benefits by warning motorists when they drift off the travel lane, thereby, providing an opportunity for the driver to react and possibly recover control of the vehicle. Estimated prices (per shoulder) are approximately \$0.50/linear foot on a bituminous shoulder, and \$0.90 to \$1.00/linear foot on a concrete shoulder for milled shoulder rumble strips.

Enclosed for your immediate use are the guidelines for installation of milled shoulder rumble strips.

Attachments



4700/JPT/car
\STRIP95.sol

cc: Secretary Mallory
Manuel A. Marks, FHWA
Larry King, Deputy Secretary, Planning
Gerald R. Fritz, Director, Program Center
Louis C. Schultz, P.E., Program Center
Michael M. Ryan, P.E., Dep. Secretary, Hwy. Admin.
Chief Engineer, Highway Administration
Joseph A. Filippino, P.E., Director, Const. & Materials
M.G. Patel, P.E., Acting Director, Bureau of Design
V. C. Shah, P.E., Bureau of Design
John Faiella, P.E., Bureau of Design
Paul Kokoş P.E., Design, Standards Section
Gary Hoffman, P.E., Director, BOMO
Dan Dawood, P.E., BOMO-Pavement Section
Thomas E. Bryer, P.E., Director, BHSTE
Arthur H. Breneman, P.E., BHSTE
Donald J. Jacobs, P.E., BHSTE
James P. Tenaglia, P.E., BHSTE
Matthew R. Weaver, BHSTE
BHSTE, Hwy. Safety & Congestion Mgmt. Division File

ADE -Design, Engineering District _____
ADE - Maintenance, Engineering District _____
Plans Engineer, Engineering District _____
Maintenance Services Engineer, Engineering District _____
Maintenance Program Engineer, Engineering District _____
Traffic Engineer, Engineering District _____
SIP Engineer, Engineering District _____

Library Services
All Design Consultants

Guidelines

GUIDELINES FOR INSTALLATION
OF
MILLED SHOULDER RUMBLE STRIPS (MSRS)

Rumble Strip Specification Requirements:

1. Milled shoulder rumble strips are for use on bituminous and concrete shoulders as indicated in the following guidelines, special provision, and details.

The milled strips are:

- ▶ 16 inches to 17 inches long, measured transverse to the centerline.
 - ▶ 7 inches + 1/2 inch wide, measured longitudinal to the centerline.
 - ▶ 1/2 inch to 5/8 inch deep, at concave center of strip.
 - ▶ spaced 12 inches, center to center, with the exception of spacing at the transverse pavement joints on concrete shoulders (refer to details).
 - ▶ offset 18 inches \pm 1/2 inch from the pavement/shoulder joint for the right shoulder. (For free (non-limited) access highways, refer to page A-4 for further guidance).
 - ▶ offset 12 inches \pm 1/2 inch from the pavement/shoulder joint for the left (median) shoulder.
2. Use the attached Standard Special Provision and details when developing projects with milled shoulder rumble strips. Pavement details contained in RC-25, sheet 1 of 3, will be replaced by the guidelines for Type 1-I shoulders as listed on page A-3 under limited access highways until such time as RC-25 is revised to reflect current changes. In addition, rumble strip details contained in RC-25, sheet 3 of 3, will be replaced by this standard special provision and details until RC-25 is revised.

Guidelines for Use:

Limited Access Highways (Interstates and Expressway/Freeways)

1. All construction and restoration projects shall incorporate the installation of milled shoulder rumble strips on each right and left shoulder which meet the following conditions when shoulder resurfacing or reconstruction is included as part of the project:
 - ▶ Right shoulders with a minimum paved width of eight feet.
 - ▶ Left (median) shoulders with a minimum paved width of four feet.

Installing milled rumble strips on bituminous paved shoulders requires an ID-2 surface with BCBC base (or better).

- ▶ This requires that Type 1-I, Type 6-I, and Type 7 shoulders be called for in the design phase of Limited Access Highway Projects.

When a Type 1-I shoulder is specified with rumble strips, the pavement detail shown in RC-25 sheet 1 of 3 must be revised so the pavement/shoulder joint starts at the beginning of the shoulder rather than two feet into the shoulder as is presently the standard. The concern associated with the current detail is that the shoulder rumble strips would be milled across this joint. In the interim, until the RC-25 standard is revised, Type 1-I shoulders will be constructed with full depth pavement across the total shoulder width. This will in effect move the pavement/shoulder joint to the beginning of the shoulder as is the case with our other shoulder types.

2. If it is desired to retrofit milled shoulder rumble strips on existing paved shoulders, these shoulders should be in sufficiently good condition, as determined by the District, to effectively accept the milling process without ravelling or deteriorating. Otherwise, the shoulders need upgraded prior to milling any desired shoulder rumble strips.
 - ▶ Milled shoulder rumble strips do not have to be part of a construction or restoration project. They can be installed via projects initiated exclusively for this purpose.

3. Do not install milled shoulder rumble strips on bridge decks or across transverse joints on concrete shoulders.
4. Coordinate the milling of the shoulder rumble strips with all necessary project phases. Do not mill the rumble strips until all construction phases, which utilize the shoulder to maintain traffic or construction vehicles/equipment, are complete.

Free (Non-Limited) Access Highways:

1. Consider milled shoulder rumble strip installation on a project-by-project basis, for rural restoration (3R and reconstruction) projects where single vehicle run-off-the-road accidents are a defined problem and shoulder rumble strips will help reduce the problem.
2. Installing milled shoulder rumble strips on bituminous paved shoulders requires an ID-2 surface with BCBC base (or better).

When a Type 1-I shoulder is specified with rumble strips, the pavement detail shown in RC-25, sheet 1 of 3, must be revised as stated on page A-3 of these guidelines under limited access highways.

3. As part of multi-modal transportation system planning, it is important to take into account the needs of bicyclists, horse-and-buggies, etc., who utilize paved shoulders for travel:
 - ▶ It is desirable to have a minimum paved shoulder width of eight feet when installing milled right shoulder rumble strips. This is to provide sufficient clear paved shoulder width for bicyclists after the rumble strips are installed. For right paved shoulder widths 8 feet and greater, the milled rumble strips are to be offset 18 inches \pm 1/2 inch from the pavement/shoulder joint.
 - If it is desired to install milled right shoulder rumble strips on paved shoulders that are six feet to less than eight feet wide, the review and approval of the Central Office Pedestrian/Bicycle Coordinator (located in the Bureau of Highway Safety & Traffic Engineering) is required to ensure that bicyclist needs are met. Do not mill shoulder rumble strips on right paved shoulderr that are less than six feet wide.

- * Please note that the designer has the flexibility (for paved shoulder widths 6 feet to < 8 feet) to adjust the offset of the milled shoulder rumble strips to better address the special needs of bicyclists. The offset may be adjusted from 4 inches to 18 inches \pm 1/2 inch from the pavement/shoulder joint. **When the designer selects offset placement other than 18 inches \pm 1/2 inch, it is necessary to revise the attached details for "Free Access Highways" to show the selected offset dimensions accordingly.**

4. As applicable, refer to Items 2, 3 and 4 listed prior under the "Limited Access Highways" section.

Standard Special Provision

ITEM XXXX - Milled Shoulder Rumble Strips (MSRS)

I. DESCRIPTION

This work is milling shoulder rumble strips as indicated in accordance with attached rumble strip (MSRS) details, or as directed.

II. CONSTRUCTION

- (a) General. Mill shoulder rumble strip as shown on attached milled shoulder rumble strip (MSRS) details.
- (b) Equipment. Use a machine capable of providing a smooth cut without tearing or snagging, and producing rumble strips as indicated. Equip machine with guides to provide uniformity and consistency in alignment of each cut with respect to the roadway.
- (c) Milling Operation. Mill shoulder rumble strips to have finished dimensions within tolerances specified. Mill shoulder rumble strips on new concrete shoulders after curing in accordance with Section 501.3(k). Alignment of pattern edge will be randomly verified and checked. Discontinue milling operation if satisfactory results are not being obtained, and submit an alternate construction plan to the Engineer for approval. At the end of each working day, move all equipment to a location as directed where it presents no hazard to roadway traffic.
- (d) Disposition of Milled Material. Remove and dispose of milled material in compliance with the Pennsylvania Department of Environmental Resources Residual Waste Regulations. Remove debris from areas disturbed by milling operation before opening roadway to traffic.

III. MEASUREMENT AND PAYMENT

- (a) Milled Concrete Shoulder Rumble Strips.
 - Linear Foot
- (b) Milled Bituminous Shoulder Rumble Strips.
 - Linear Foot

Measured longitudinally along edge of pavement as indicated. Includes removal and disposal of milled material.

Section 658 - Concrete Shoulders

Section 658.3(b) Concrete. Delete the second sentence.

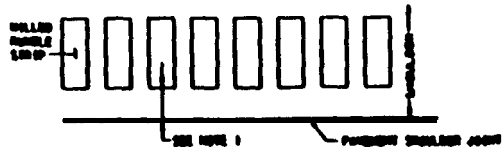
RC-25 Standard (Sheet 1 of 3) - Shoulders

When a Type 1-I shoulder is specified with rumble strips, the pavement detail shown in RC-25, sheet 1 of 3 must be revised so the pavement/shoulder joint starts at the beginning of the shoulder rather than two feet into the shoulder as is presently the standard. The concern associated with the current detail is that the shoulder rumble strips would be milled across this joint. In the interim, until the RC-25 standard is revised, Type 1-I shoulders will be constructed with full depth pavement across the total shoulder width. This will in effect move the pavement/shoulder joint to the beginning of the shoulder as is the case with our other shoulder types.

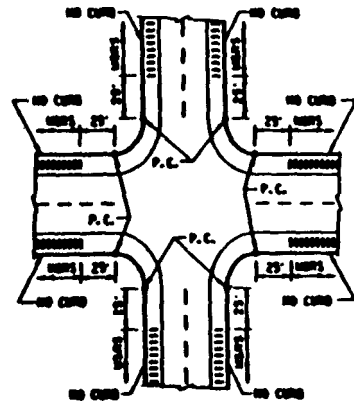
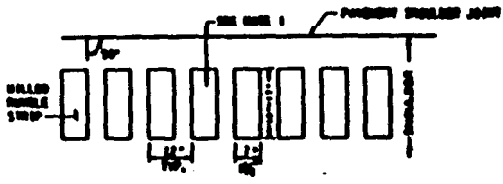
RC-25 Standard (Sheet 3 of 3) - Shoulders (Concrete)

Shoulder rumble strip detail contained in RC-25, sheet 3 of 3, will be replaced by this Standard Special Provision and shoulder rumble strip (MSRS) details until such time as RC-25 is revised to reflect current changes.

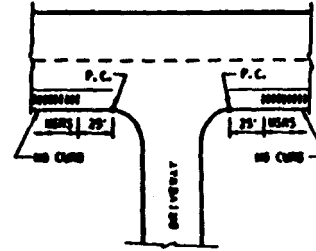
Details



TYPICAL RAN VIEW FOR MILLED SHOULDER RUMBLE STRIP (MSRS) PATTERN ON BITUMINOUS SHOULDERS

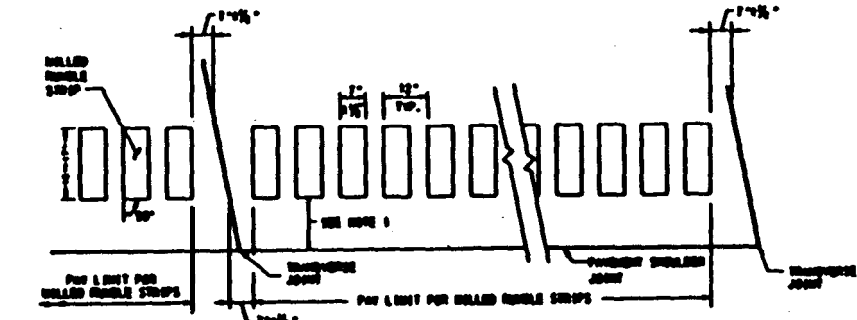


TYPICAL INTERSECTION DETAIL FOR MSRS INSTALLATION

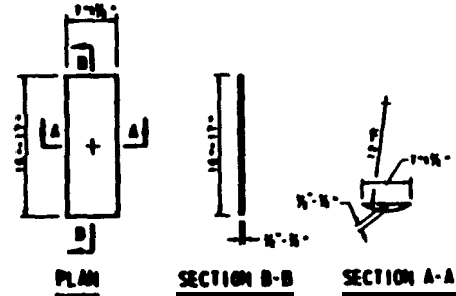


TYPICAL DRIVEWAY DETAIL FOR MSRS INSTALLATION

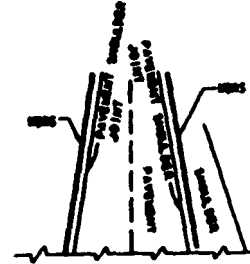
NOTES
 1. 12" ± - FOR LEFT SHOULDER
 2. 18" ± - FOR RIGHT SHOULDER



TYPICAL PLAN VIEW FOR MILLED SHOULDER RUMBLE STRIP (MSRS) PATTERN ON CONCRETE SHOULDERS



SECTION DETAILS OF MILLED SHOULDER RUMBLE STRIP (MSRS) PATTERN



GENERAL VIEW MILLED SHOULDER RUMBLE STRIP (MSRS) PATTERN

MILLED SHOULDER RUMBLE STRIP (MSRS) DETAILS FOR FREE ACCESS HIGHWAYS

DATE: June 5, 1996

SUBJECT: Milled Shoulder Rumble Strips

TO: District Contract Management Engineers

FROM: V. C. Shah, P.R., Chief
Contract Management Division
Bureau of Design

VCS

Recently, estimates for milling of rumble strips in concrete and bituminous shoulders have been significantly over the low bid prices.

In an effort to improve the estimates the Costs & Estimates Section has analyzed the bidding of these items from 7/95 - 4/96. A copy of the findings is attached. Overall the weighted average low bid prices for milling of rumble strips were \$0.36/LF for concrete and \$0.15/LF for bituminous.

Please consider this information in developing future estimates. These items will eventually become standard items.

If you have any questions please contact Jeff Bucher at (717) 783-6418.

Attachment

4340/JDB/br

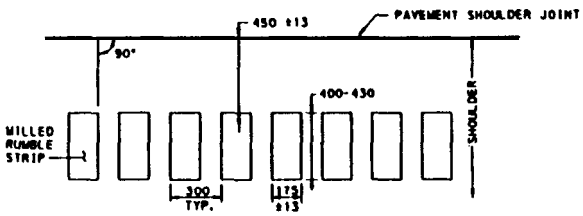
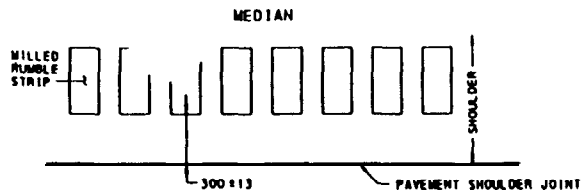
CC: M. G. Patel, P.E., Room 1118
v. c. Shah, P.E., Room 1109
D. J. Azzato, P.E., Room 1109
J. D. **Bucher**, Room 1109

MILED CONCRETE SHOULDER RUMBLE STRIPS

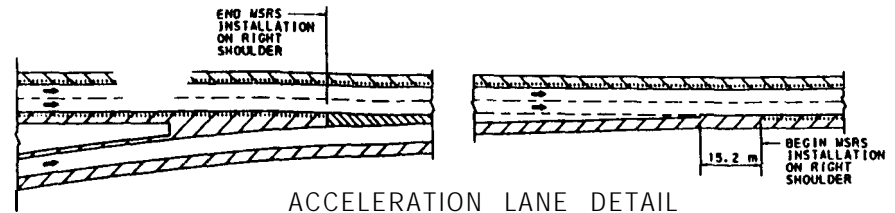
| DISTRICT | CMS # | QUANTITY (LF) | LOW BID UNIT PRICE | ITEM PRICE |
|--------------|--------|----------------|-------------------------------|---------------|
| 1 | 012183 | 67,369 | 0.53 | 35,706 |
| | 010034 | 78,002 | 0.36 | 26,061 |
| | 012181 | 64,495 | 0.40 | 25,798 |
| 2 | 021099 | 44,551 | 0.45 | 20,048 |
| | 020006 | 314,914 | 0.20 | 62,982 |
| 5 | 051179 | 14,726 | 1.10 | 16,200 |
| 12 | 122071 | 47,473 | 0.60 | 28,484 |
| | 124178 | 47,594 | 0.63 | 29,956 |
| TOTAL | | 679,061 | WEIGHTED AVG. 0.36 | 247,255 |

MILED BITUMINOUS SHOULDER RUMBLE STRIPS

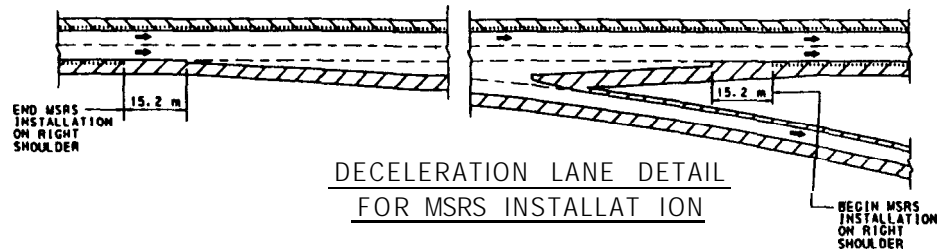
| DISTRICT | CMS | QUANTITY | LOW BID UNIT PRICE | ITEM PRICE |
|--------------|--------|-------------------|-------------------------------|---------------|
| 1 | 011134 | 204,994 | 0.22 | 45,099 |
| | 010034 | 525,863 | 0.11 | 57,645 |
| | 016085 | 1,000 | 4.90 | 4,900 |
| 2 | 021099 | 9,679 | 0.23 | 2,226 |
| | 020006 | 1,116,757 | 0.105 | 117,259 |
| 4 | 043244 | 924,000 | 0.18 | 166,320 |
| 5 | 051177 | 189,381 | 0.19 | 35,982 |
| 6 | 061221 | 24,975 | 0.50 | 12,486 |
| 10 | 104124 | 24,160 | 0.26 | 6,262 |
| 12 | 122701 | 28,960 | 0.25 | 7,240 |
| | 125189 | 46,010 | 0.24 | 11,042 |
| | 124174 | 103,986 | 0.18 | 18,717 |
| TOTAL | | 3,199,765 | WEIGHTED AVG. 0.15 | 485,400 |



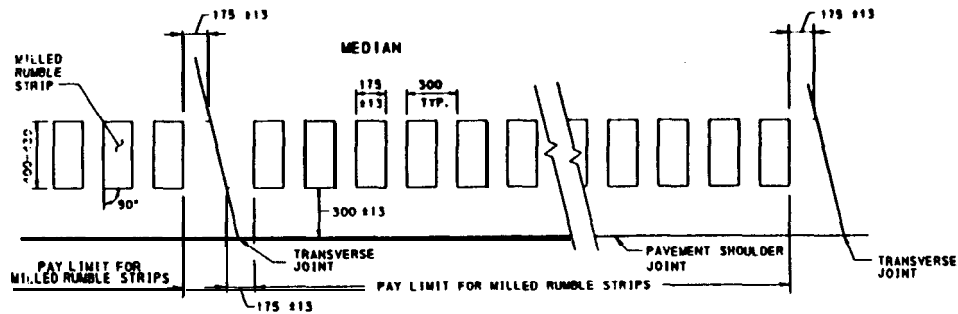
TYPICAL PLAN VIEW FOR MSRS PATTERN ON BITUMINOUS SHOULDERS



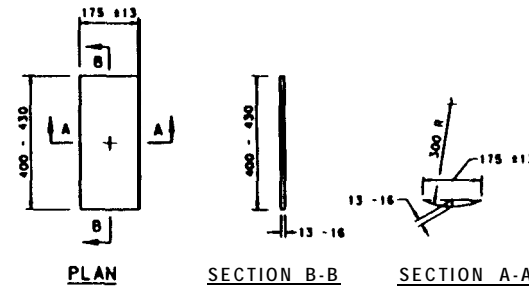
ACCELERATION LANE DETAIL FOR MSRS INSTALLATION



DECELERATION LANE DETAIL FOR MSRS INSTALLATION



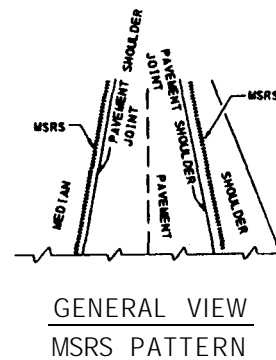
TYPICAL PLAN VIEW FOR MSRS PATTERN ON CONCRETE SHOULDERS



SECTION DETAILS OF MSRS PATTERN

NOTES

1. IF THERE IS NO ACTUAL PAVEMENT SHOULDER JOINT MEASURE FROM THE PAVEMENT SHOULDER TRAFFIC LINE.
2. DO NOT MILL SHOULDER RUMBLE STRIPS ACROSS A JOINT.
3. CONSTRUCT MSRS IN ACCORDANCE WITH PUBLICATION 408M SECTION 660.
4. ALL DIMENSIONS ARE IN MILLIMETERS (MM) EXCEPT AS NOTED.



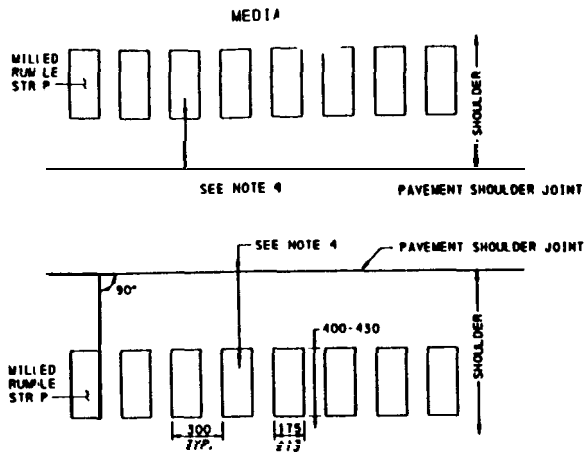
GENERAL VIEW MSRS PATTERN

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

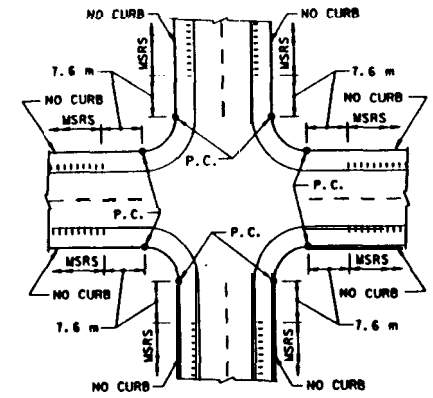
SHOULDERS
MILLED SHOULDER
RUMBLE STRIPS (MSRS)
(LIMITED ACCESS HIGHWAYS)

RECOMMENDED MAR. 06, 1998 RECOMMENDED MAR. 06, 1998 SHEET 4 OF 5
DIRECTOR, BUREAU OF DESIGN CHIEF ENGINEER RC-25M

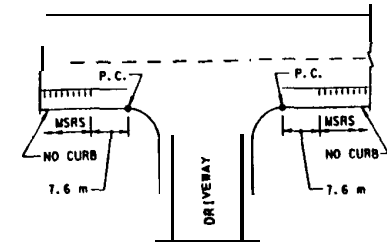
Penn DOT Standard Drawings



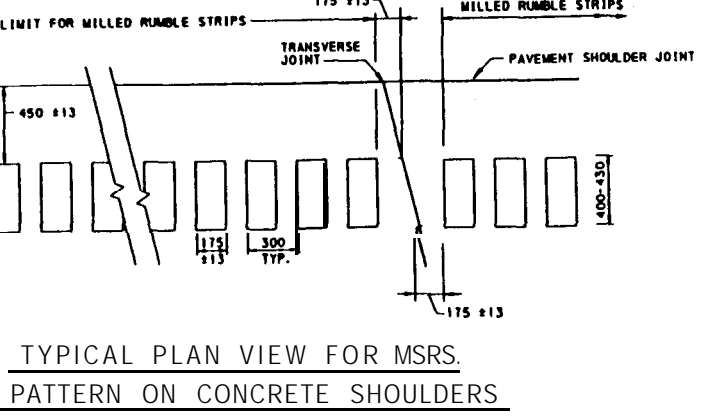
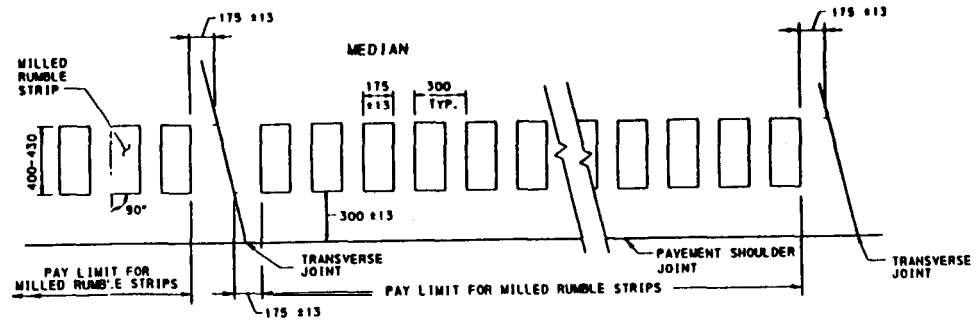
TYPICAL PLAN VIEW FOR MSRS PATTERN ON BITUMINOUS SHOULDERS



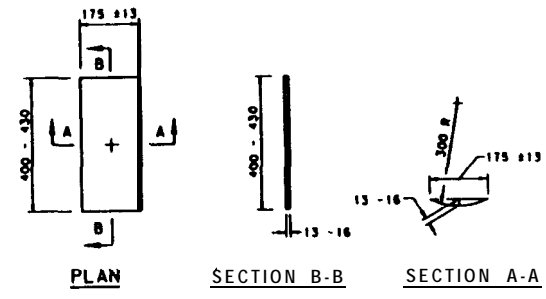
TYPICAL INTERSECTION DETAIL FOR MSRS INSTALLATION



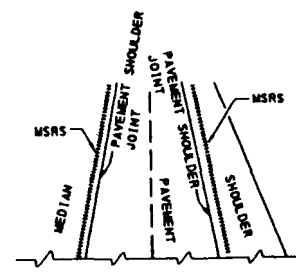
TYPICAL DRIVEWAY DETAIL FOR MSRS INSTALLATION



TYPICAL PLAN VIEW FOR MSRS PATTERN ON CONCRETE SHOULDERS



SECTION DETAILS OF MSRS PATTERN



GENERAL VIEW MSRS PATTERN

NOTES

1. MILLED SHOULDER RUMBLE STRIPS (MSRS) FOR FREE ACCESS HIGHWAYS ARE CONSIDERED ON A PROJECT BY PROJECT BASIS AS INDICATED ON THE CONSTRUCTION PLANS.
2. CONSTRUCT MSRS IN ACCORDANCE WITH PUBLICATION 408M, SECTION 660.
3. DO NOT MILL SHOULDER RUMBLE STRIPS ACROSS A JOINT.
4. 300 ± 13 FOR LEFT (MEDIAN) SHOULDERS. 450 ± 13 FOR RIGHT SHOULDERS ± 2.4 m WIDE. FOR RIGHT SHOULDERS LESS THAN 2.4 m WIDE, SEE CONSTRUCTION PLANS FOR OFFSET DIMENSION. IF THERE IS NO ACTUAL PAVEMENT SHOULDER JOINT, MEASURE FROM THE PAVEMENT SHOULDER TRAFFIC LINE.
5. ALL DIMENSIONS ARE IN MILLIMETERS (mm) EXCEPT AS NOTED.

| | | |
|--|---------------------------|-------------|
| COMMONWEALTH OF PENNSYLVANIA DEPARTMENT OF TRANSPORTATION BUREAU OF DESIGN | | |
| SHOULDERS MILLED SHOULDER RUMBLE STRIPS (MSRS) (FREE ACCESS HIGHWAYS) | | |
| RECOMMENDED MAR. 06, 1998 | RECOMMENDED MAR. 06, 1998 | SHT. 5 OF 5 |
| DIRECTOR, BUREAU OF DESIGN | CHIEF ENGINEER | RC-25M |