8.60 RUMBLE STRIPS IN HMA SHOULDERS

8.61 CONSTRUCTION CONSIDERATIONS – MILLED RUMBLE STRIPS

Milling has become the method of choice for installing rumble strips in HMA shoulders. The process utilizes a milling machine to produce shallow concave depressions in the HMA shoulder surface. The milled surface is then sealed with asphalt emulsion to prevent intrusion of water into the HMA shoulder. Milling provides the benefits of a more consistent pattern and depth, while increasing the "rumbling" warning to errant motorists. Milling allows for better compaction of the HMA shoulder, and eliminates the problem of tearing and raveling associated with other methods of producing shoulder rumble strips. While this technique overcomes many of the previous problems with rumble strip construction, there are other issues requiring the attention of both contractor and inspector in order to achieve the desired results.

Standard Road Plans *RH-64* shows configurations and details for milled shoulder rumble strips on interstates and expressways. Details for rumble strips on paved shoulders of two-lane roadways are also shown on *Standard Road Plan* *RH-64*. The grinding pattern itself is the same for all three situations, utilizing an industry standard width, depth, and spacing. Similarly, the offset distance from the paintline is the same for the three applications. Difference lies in the "skip" pattern specified for two-lane roadways and the outside shoulder of expressways versus the continuous pattern for interstates. Grinding dimensions and alignment of the pattern should be randomly checked and adjusted, if necessary. Rumble strips are typically placed on mainline HMA shoulders only, with the pattern omitted at specified locations near intersections and ramps & loops.

Milling equipment variations can result in differences in the rumble strip construction operation. The cutting head must be capable of providing a smooth cut, without tearing or snagging the HMA pavement. Multiple cutting heads and electronic controls can speed the process and eliminate variability in milling depth and pattern, especially at the beginning of each set of strips on shoulders of two-lane roadways and the outside shoulder of expressways.

All loose material resulting from the milling operation must be removed from the shoulder on a daily basis. Some milling machines are equipped with a vacuum system to assist in this effort. Millings may be used as fillet material adjacent to the paved shoulder or may become property of the contractor and properly disposed of off the project. Specific plans may require the millings to be taken to a designated location.

Bituminous Fog Seal, meeting the requirements of *Specification 2308*, is used to coat the rumble strips and thereby reduce premature deterioration of the milled surface. Asphalt emulsion is typically placed on the milled rumble strips only, unless the contract documents call for sealing the entire shoulder.

8.62 CONSTRUCTION CONSIDERATIONS – ROLLED RUMBLE STRIPS

Numerous variables associated with constructing rolled rumble strips have contributed to moderate inconsistency in depth and tearing that occur during placement. These deficiencies, combined with advantages provided by other recently adopted installation methods, have nearly eliminated use of rolled rumble strips on HMA shoulders. Rolled rumble strips are only to be used when specifically called for in the contract documents.

After the first day of shoulder resurfacing, most contractors/inspectors should be able to identify adjustments needed to produce uniform indentations in fresh HMA. Contractor

may "practice" construction of rolled rumble strips while placing lower lifts of shoulder resurfacing. This is a good idea for inexperienced project personnel or unfamiliar mixes.

Two primary problems associated with constructing rolled rumble strips in HMA shoulders are groove depth uniformity and mat tearing/cracking.

Groove depth uniformity is dependent upon uniformity of mat density and temperature at the time rumble strips are placed. Class 2 compaction is required for shoulders. This is simply a specified roller pattern. Normal overlap associated with compaction operations tends to produce short areas where indentations are shallow compared to the majority of grooves. This is not objectionable as long as length is minimized and limited to 7.5± m (25± feet).

For mainline surface mixes placed on the inside shoulder, it's more difficult to achieve adequate depths of grooves. It may be necessary to reduce the number of passes of the rubber-tired roller so 30 mm (0.1 foot) depth is achieved. Typically, this reduction would be one pass, from six passes down to five passes.

Higher mat temperatures are required to get adequate groove depth for mainline surface mixes with high crushed particle contents. Rolling with the rumble strip drum roller should generally follow immediately behind the intermediate rubber-tired roller.

Lower temperatures are appropriate for base mixes on the outside shoulder. Temperatures ranging from 60 to 65 degrees C (140 - 150 degrees F) should produce acceptable depths.

Mat tearing/cracking is also controlled by placement of rumble strips at appropriate temperatures. Rolling at high temperatures tends to induce more cracking than lower temperatures. Forward speed of roller must also be as slow as possible to help minimize tearing of hot HMA. Some contractors are now using a steel roller with projections on the drive drum rather than a small diameter trailer drum. This type of equipment is less sensitive to mat temperature and tends to produce more uniform indentations with less cracking and tearing. When the trailer drum system is used, a narrow temperature range may exist to achieve adequate depth without excessive tearing.

Excessive tearing can usually be partially closed by a static pass with a steel-tired roller. Again, it is very important to make this pass while mat is warm enough to close cracks without eliminating groove depths.

Some contractors have also added supplemental weights to the rumble strip roller to assist in producing acceptable groove depth. This may be accomplished by adding water to rear drum or fastening metal weights to rear of roller.

Most contractors have added a third drum to a conventional two-axle tandem steel roller. This supplemental drum has half sections of pipe welded at 200 mm (8 inch) spacing with tapered ends to produce grooves. It is mounted on rear of roller so it can be hydraulically pushed down onto fresh HMA mat. Amount of downward force is generally limited by maintaining enough weight in drive axle to move roller; therefore, additional weight as noted above is usually beneficial.

A lift thickness of at least 50 mm (2 inches) is needed to produce acceptable groove depths without weakening bond with lower layer. 75 mm (3 inches) should provide further protection against cracks developing through the entire lift.