STRONG POST GUARDRAIL USE WITH RIGID VMS MATERIALS

The VMS identified and presented do not present specific design guidance for highway safety appurtenances, nor are they a substitute for any other highway design practice. The user should refer to the AASHTO's *Roadside Design Guide* (RDG), *Manual for Assessing Safety Hardware* (MASH), and any specific state DOT practices for warrants, proper placement, and maintenance of roadside safety appurtenances when applying these VMS (RDG 2011, MASH 2016). In addition, before applying any of the techniques described on a proprietary roadside safety hardware device (e.g., guardrail terminal, crash cushion, breakaway sign support, etc.), the manufacturer should be contacted to discuss the potential for the treatment to adversely affect the performance of their safety hardware device.

Mow strips prevent vegetation growth several feet around guardrail installations, including: cable barriers, W-beam guardrail, guardrail transitions, and guardrail end treatments. It should be noted that W-beam guardrail posts, guardrail transition posts, and guardrail end treatment posts are treated equally with regard to the application of VMS. As previously stated a VMS should not be applied to any proprietary guardrail end treatment without consulting first with the product manufacturer.

Mow strips are typically asphaltic or concrete pavement and vary in thickness from several inches up to 200 mm (8 in) maximum. Strong post W-beam guardrail posts in mow strips and rock formations face similar problems with regard to facilitating rotation of the strong-posts. Details for installation of strong steel post W-beam guardrail posts in mow strips have been developed, which differ from that in rock formations. These details were originally developed and crash tested for use with both steel and wood posts in accordance with NCHRP Report 350 (Ross et. al 1993). The critical feature of the mow strip installation is the portion of the mow strip around the post omitted for the post rotation, also known as the "leave-out". The leave-out's critical measurement is from the back of the post to the edge of the mow strip and should be a minimum of 175 mm (7 in). Figure 1 shows the detail from the AASHTO RDG (RDG 2011). Leave-outs can be filled with low-strength grout, a two-part polyethylene foam or other material that has a compressive strength of 0.85 MPa (120 psi) or less. During an impact, the leave-out material allows for some degree of post rotation by deforming or crushing prior to generating sufficient force to cause post failure. Failure of the sacrificial leave-out backfill material also minimizes damage to the surrounding mow strip. Some states backfill with a coarse aggregate material and seal the surface with an asphaltic sealer material.

For strong steel post W-beam guardrail posts installed in asphalt or concrete surfacing that is thicker than 200 mm (8 in), refer to Figure 2 detail showing AASHTO RDG Figure 5-5l (b) for installation in rock formations (RDG 2011). For these installations, the backfill around the posts is typically a coarse aggregate material. In some locations it may be beneficial to seal the surface with an asphaltic crack sealant or other similar material to reduce water infiltration

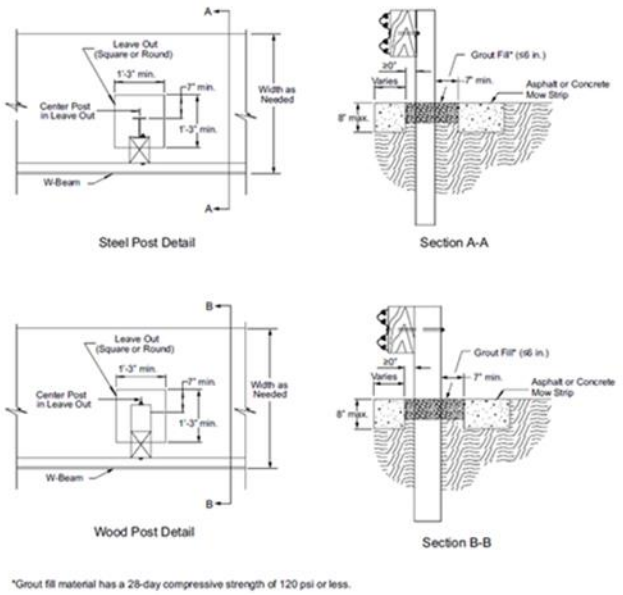

Figure 1. AASHTO RDG guardrail post detail in mow strip application (RDG 2011).

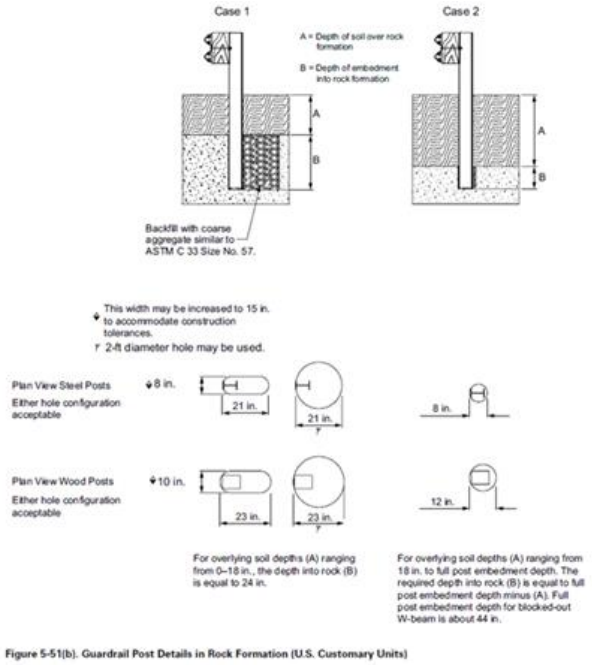

Figure 5-51(b). Guardrail Post Details in Rock Formation (U.S. Customary Units)

Figure 2. Guardrail post details in rock formation (RDG 2011).

The Texas Department of Transportation (TxDOT) W-beam guardrail with 7½-inch diameter round wood posts in concrete mow strip according to the safety-performance evaluation guidelines included in the MASH for Test Level Three (TL-3) longitudinal barriers. The crash test performed was in accordance with MASH Test 3-11, which involves a 2270P vehicle impacting the TxDOT W-beam guardrail with 7½-inch diameter round wood posts in concrete mow strip at a target impact speed and impact angle of 62 mi/h and 25°, respectively. The TxDOT W-beam guardrail with 7½-

inch diameter round wood posts in concrete mow strip performed acceptably for MASH Test 3-11 as shown in Figure 3.

Figure 3. Round wood post in concrete mow strip (Moran et. al 2019).

The 31-inch W-beam guardrail system with steel posts in concrete mow strip (Figure 4) performed acceptably for both MASH tests 3-10 and 3-11 and therefore the steel post W-beam system in concrete mow strip is considered acceptable for MASH TL-3 longitudinal barrier (Nauman et. al 2019).

Figure 4. W-beam guardrail in concrete mow strip (Nauman et. al 2019).

Summary

VMS applied in and around highway safety appurtenances should be done so cognizant of their effect on the performance of everything in the highway design environment. If a VMS is thought to possibly have a performance effect on a highway safety appurtenance then consideration should be given to crash testing the VMS and safety appurtenance together as a system. As of January 1, 2011, all newly developed

hardware must be tested using MASH. Of particular interest to the application of VMS FHWA also issued a memorandum dated January 7, 2016 regarding the federal-aid eligibility of highway safety hardware, after December 31, 2016 and the following apply to VMS (FHWA 2016):

- FHWA will no longer issue eligibility letters for highway safety hardware that has not been successfully crash tested to the 2016 edition of MASH.
- Modifications of eligible highway safety hardware must utilize criteria in the 2016 edition of MASH for re-evaluation and/or retesting.
- Non-significant modifications of eligible hardware that have a positive or inconsequential effect on safety performance may continue to be evaluated using finite element analysis.

For more information:

Association of State Highway and Transportation Officials (MASH). Manual for Assessing Safety Hardware, 2nd Edition. Washington, D.C., 2016.

Association of State Highway and Transportation Officials (AASHTO). AASHTO Guidelines for Vegetation Management, 1st ed. Washington, D.C., 2011.

American Association of State Highway and Transportation Officials (RDG). AASHTO Roadside Design Guide, 4th ed. Washington, D.C., 2011.

Federal Highway Administration. Roadway Departures (FHWA). https://safety.fhwa.dot.gov/roadway_dept/countermeasures/faqs/qa_bttabr.cfm#btcc2.

Federal Highway Administration. Memorandum, Joint Implementation Agreement for Manual for Assessing Safety Hardware (MASH). January 7, 2016. https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/docs/memo_joint_implementation_agmt.pdf.

FHWA-accepted roadside hardware: http://safety.fhwa.dot.gov/roadway_dept/road_hardware/index.htm

FHWA (FHWA Median). Proven Safety Countermeasures, Median Barrier. FHWA-SA-17-060. https://safety.fhwa.dot.gov/provencountermeasures

FHWA Guardrail 101 (FHWA 101). https://www.fhwa.dot.gov/guardrailsafety/guardrail101.pdf

Fitzgerald, W. W-Beam Guardrail Repair: A Guide for Highway and Street Maintenance Personnel. FHWA-SA-08-002. 2008. https://safety.fhwa.dot.gov/local_rural/training/fhwasa08002/

Ross, H., Sicking, D., Zimmer, R. and Miche, J. Recommended Procedures for the Safety Performance Evaluation of Highway Features, NCHRP Report 350. 1993. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_350-a.pdf.

Moran, S., Bligh, R., Menges, W., Schroeder, G. and Kuhn, D. MASH Test 3-11 Evaluation of TxDOT W-Beam Guardrail with 7½-Inch Diameter Round Wood Posts in Concrete Mow Strip. Texas Department of Transportation, Report 0-6968-R2. 2019.

Sheikh, N., Menges, W., Kuhn, D. Mash Evaluation of 31-Inch W-Beam Guardrail with Wood and Steel Posts in Concrete Mow Strip. Roadside Safety Research Program Pooled Fund Study No. TPF-5 (114). 2019. https://www.roadsidepooledfund.org/wp-content/uploads/2017/06/TRNo608551-1-45-Final.pdf.

Task Force 13 (TF 13). Standardized Highway Barrier Hardware Guide. http://www.tf13.org/Barrier-Hardware.php