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TDOT GUARDRAIL TRANSITION WITHOUT CURB WITH MWRSF BUTTRESS

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Objectives

This document provides an assessment of a roadway safety barrier system to determine its compliance with American Association of State Highway Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (MASH) as requested by Tennessee Department of Transportation (TDOT).

The assessed system is TDOT approach guardrail transition (AGT) attached to a concrete buttress, currently incorporated in TDOT Standard Drawing S-GRC-4 (Figure 1). It is comprised of the W-beam guardrail system transitioning to a nested thrie beam guardrail section via a shape transition section. The nested thrie beam section is then attached to the concrete buttress. The post spacing is reduced over the span of the transition such that the six posts adjacent to the concrete parapet are installed with 18.75-inch quarter post-spacing. These posts are installed with an embedment depth of 64 inches.

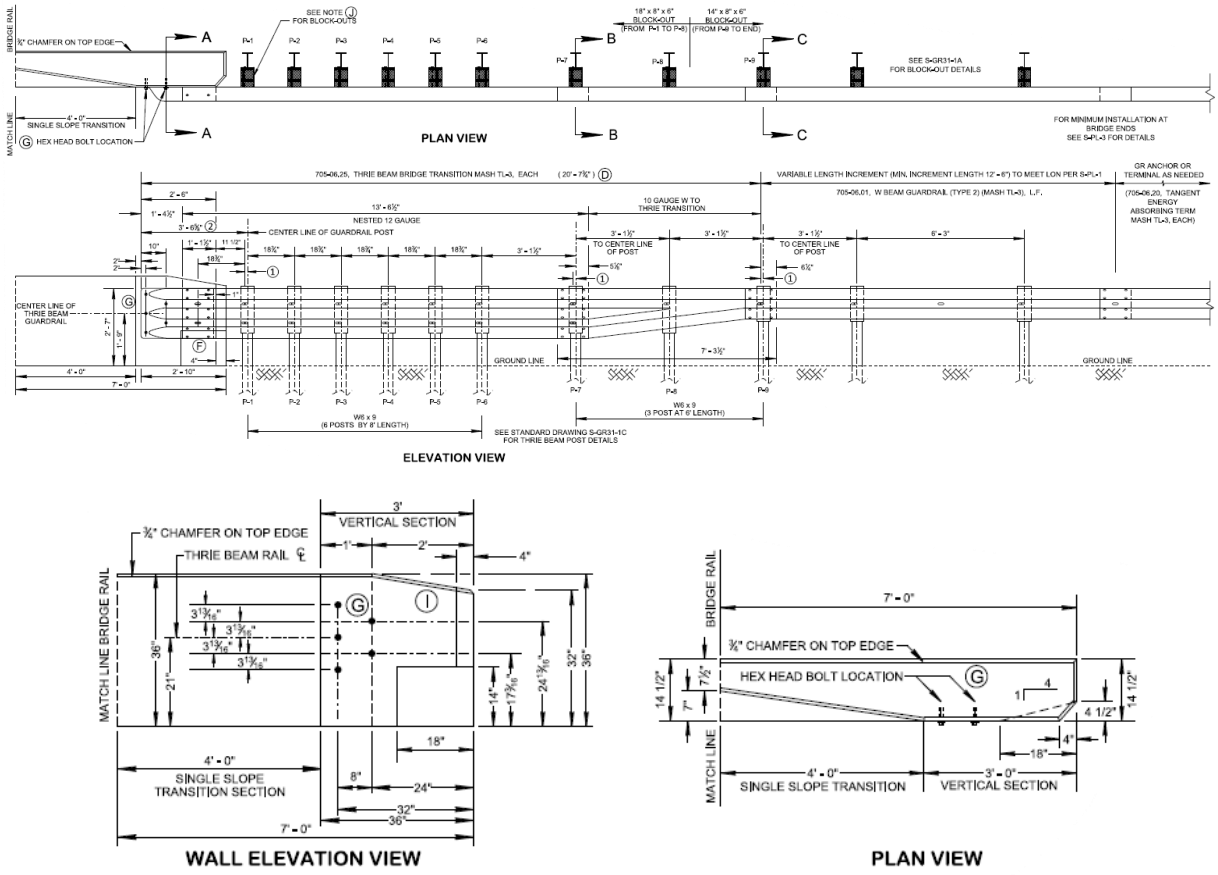

Figure 1. Key Details of TDOT AGT System (Source: TDOT Standard Drawing S-GRC-4, (06-28-2019))

The concrete buttress is 36 inches tall with several tapers built into the design to reduce potential for snagging of an impacting vehicle with the edges of the rigid buttress. This buttress was successfully tested with an AGT design by Midwest Roadside Safety Facility (MwRSF) in MASH Test 3-21, MwRSF Test AGTB-1 (*1*). Bottom 14-inch height of the buttress's traffic-side edge adjacent to the thrie beam guardrail is tapered back 4.5 inches to prevent snagging of an impacting vehicle underneath the thrie beam guardrail.

MASH Testing

The specific TDOT AGT system (Figure 1) has not been crash tested. However, there are relevant past tests of similar AGT systems that can be used to assess its MASH compliance to Test-Level 3 (TL-3) of MASH.

The nested thrie beam and post spacing design of TDOT AGT system is similar to an AGT system tested by Texas A&M Transportation Institute (TTI) (*2*). The TTI AGT system attached the nested thrie beam to a single slope rigid concrete parapet. A special steel bracket was attached to the back of the thrie beam where it connected to the single slope parapet. This bracket held the back of the nested thrie beam in the vertical plane. The TTI AGT system did not have a curb under guardrail transition. The bottom 13-inch height of the traffic-side edge of the single slope parapet adjacent to the thrie beam guardrail was tapered back 2.5 inches to prevent vehicle snagging (Figure 2).

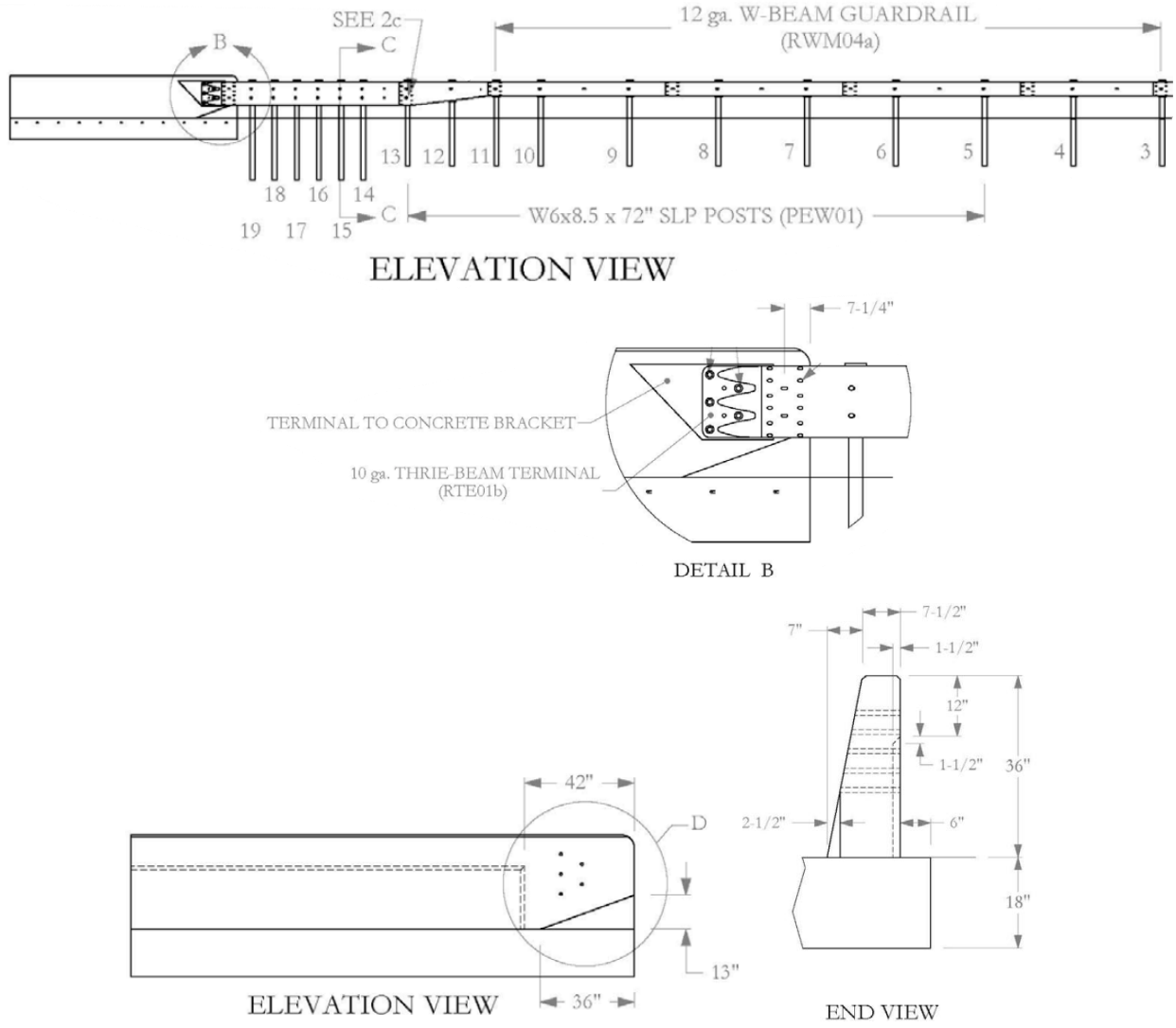

Figure 2. Key Details of TTI AGT (*2*).

While the TDOT AGT system uses details of the TTI AGT system described above, it does not use the single slope parapet, or the steel bracket used in the TTI design to hold the back of the thrie beam in the vertical plane. Instead, TDOT AGT uses the concrete buttress that was developed by MwRSF which has a vertical profile. The bottom traffic-side edge of the MwRSF buttress tapers back 4.5 inches to prevent snagging (*1*) (Figure 3).

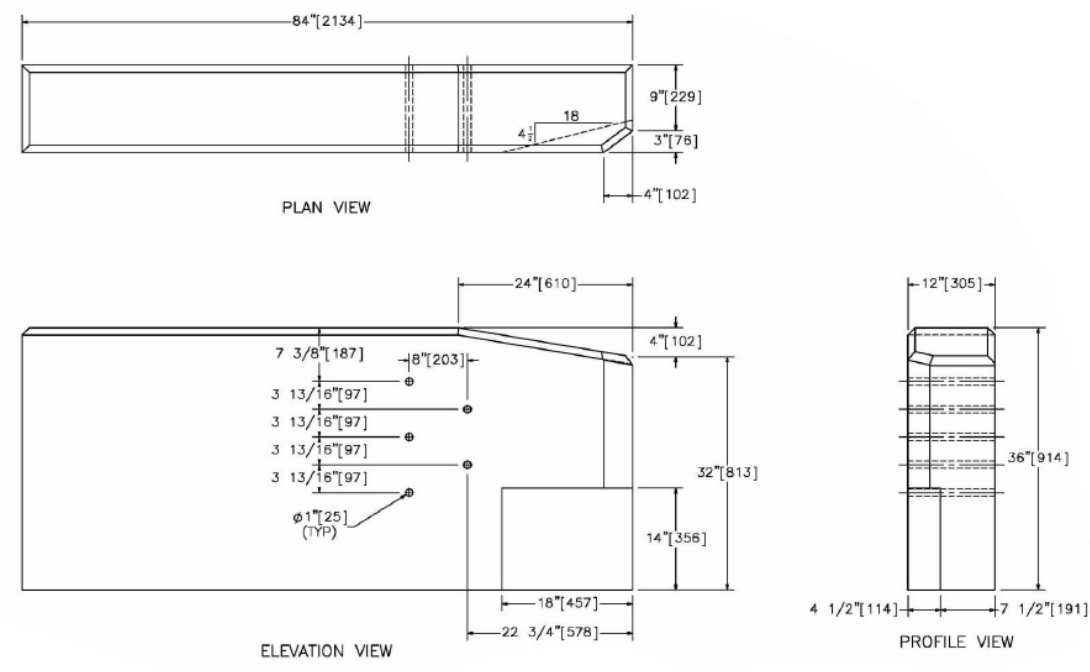

Figure 3. Concrete Buttress Tested by MwRSF (*1*).

MASH Compliance Assessment

Use of MwRSF's buttress in TDOT AGT design incorporates the two key design features of the TTI AGT's single slope parapet, i.e., tapering back the bottom edge of the concrete parapet to reduce vehicle snagging and keeping the back of the thrie beam in the vertical plane. For this reason, the replacement of TTI's single slope concrete parapet with MwRSF concrete buttress in TDOT AGT design is acceptable, and the TDOT AGT design is expected to perform similar to the TTI AGT design for MASH Test 3-21.

For guardrail transitions, MASH recommends an optional Test 3-20 with the small passenger vehicle. This test was not performed for the TTI AGT with the single slope parapet or the MwRSF AGT with the concrete buttress. However, MwRSF performed Test 3-20 with a slightly different version of concrete buttress with the top thrie beam rail height of 34 inches instead of 31 inches (*3*). This system passed Test 3-20. Increasing in thrie beam rail height to 34 inches results in a 3-inch increase in the space between the bottom of the thrie beam rail and the ground. This results in greater opportunity for the small car to wedge underneath the thrie beam rail and interact with the end of the concrete buttress, potentially causing increased vehicle snagging. Due to the similarities in the concrete buttress design and greater potential for small car snagging, the AGT with 34-inch rail height is more critical than the TDOT AGT design. Since the MwRSF AGT with 34-inch rail height passed Test 3-20, the TDOT AGT design is also expected to pass Test 3-20.

Based on the information presented herein, the TDOT AGT design, as presented in Figure 1 and TDOT Standard S-GRC-4, is considered MASH TL-3 compliant.

References

[1] Rosenbaugh, S.K., R.K. Faller, N. Asselin, and J.A. Hartwell, *Development of a Standardized Buttress for Approach Guardrail Transitions*, Report No. TRP-03-369-20, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, November 2020.

[2] Arrington, D. R., R. P. Bligh, and W. L. Menges, *MASH Test 3-21 on TL-3 Thrie Beam Transition Without Curb*. Report No. 9-1002-12-3, Texas A&M Transportation Institute, College Station, Texas, January 2013.

[3] Rosenbaugh, S.K., Fallet, W.G., Faller, R.K., Bielenberg, R.W., and Schmidt, J.D., *34-in. Tall Thrie Beam Transition to Concrete Buttress*, Report No. TRP-03-367-19, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, March 2019.