Fixing America's Surface Transportation Act

Tech Brief

November 2017

Midwest Guardrail System (MGS)

CATEGORY: Design (The following information was developed using DRAFT ADOT proposed MGS standards.)

ISSUE: Standard strong-post W-beam, referred to in Arizona as w-beam guardrail (G4), has been one of the most widely used traffic barriers in the United States. Recent testing with today's high center of gravity vehicles however has shown it to be near or at its performance limits in high speed, high angle roadside crashes. A new non-proprietary design, the Midwest Guardrail System (MGS) has been successfully crash-tested, both under NCHRP 350 and MASH at Test Level 3 (TL-3), and being adopted by ADOT as their preferred system.

OBJECTIVE: To provide information on the MGS and some of its design flexibility to ADOT design engineers and other personnel who may have responsibilities for designing, installing, inspecting, or maintaining this design. ADOT currently has DRAFT standard drawings and specifications available that were developed in conjunction with implementing MGS guardrail system by January 2018 in Arizona.

METHODOLOGY: This Technical Brief will describe the MGS characteristics and identify the types of locations for which variations of the design have been successfully crash-tested. For additional information please see the FHWA website at http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/ and the Midwest Roadside Safety Facility Pooled Fund website at http://mwrsf-qa.unl.edu/.

BASIC MGS DESIGN: The major differences from the standard guardrail are the shifting of the W-beam rail splices from the posts to mid-span between posts, and the raising of the rail height to 31". This provided a stronger system and a better performance with higher center-of-gravity/bumper height pick-up vehicles.

MASH TL-3 Test of MGS Transition to Thrie-beam

ADOT Infrastructure Delivery and Operations

ARTBA American Road & Transportation Builders Association

KLS Engineering

U.S. Department of Transportation Federal Highway Administration

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EXPECTED RESULTS:

Provide ADOT design engineers and others with summary information on the Midwest Guardrail System (MGS).

MGS uses the same steel or wood post and rail element (with five holes punched) as the standard guardrail; the wood post is 6' long. The blockout is now 12" deep (versus the 8" on the standard system). The standard MGS (6'-3" post spacing) resulted in a somewhat increased dynamic deflection when MASH tested. (Reference: FHWA letter B-212, dated 06/10/11). ADOT will select their specific criteria when the new system is adopted. ADOT requires the shoulder be widened and paved 2' – 8" from normal width of shoulder, this allows for the rail face to be placed over the paved roadway section.

MGS SOIL BACKING: Standard guidance for installation of guardrail (MGS and G4) is a minimum 10H:1V into the face of the rail, and 2 ft. minimum of 10H:1V behind the post, which is also the ADOT proposed requirement. When this is not practical to provide, the MGS has been successfully crash-tested to MASH with the standard 6' post placed right at the slope break point. (Reference: FHWA letter B-211, dated 06/10/11).

MGS WITH CURBS: Although previously tested under NCHRP 350, the standard MGS system with curb has not yet been successfully crash tested under MASH at TL-3; current ADOT guidance is to use a (embankment) curb height no greater than 4", when curbing cannot be avoided, shown on ADOT proposed Standard Drawing, C-10.01 with face of rail flush with face of curb. For lower speed locations, the MGS system has been successfully tested to MASH at TL-2 when located 6 feet behind the face of a 6-inch high vertical concrete curb (Reference: FHWA letter B-133, dated 03/01/05).

MGS LONG-SPAN GUARDRAIL AND OMITTED POST: As with standard guardrail (G4), an MGS design has been developed for use when guardrail posts must be "left out", e.g., when the guardrail crosses a low-fill culvert. Unlike standard guardrail (G4) missing post designs, the MGS system does not require nested rail in the clear span. Testing has shown that a single post can be omitted without any additional modification (i.e. no weakened wood posts or nesting). For 2 and 3 missing posts , three CRT posts with standard post spacing are placed on each side of the span (25-foot maximum) to reduce any snagging potential. Since larger deflections can be expected, nothing protruding more than 4" should be allowed behind the rail to avoid "tripping" the vehicle (Reference: FHWA letter B-189, dated 03/20/09). ADOT proposed standard for deflection are somewhat more restrictive. Adequate length, 50 ft. or more of standard MGS must extend on either side of the gap to maintain tension in the system. Terminal must not be placed any closer than 50 ft., from the rear of the system, to any omitted post installation. Omitted post designs should ONLY be used in standard guardrail runs and should be separated by a minimum of 50 ft, between additional missing post situations. Missing post should not be used with terminal or transition designs.

MGS TRANSITION DESIGN: The MGS system is compatible with most existing Thrie-beam to rigid barrier/bridge railing transition designs with the use of a non-symmetrical W-beam to Thrie beam 10-gauge transition section and a modified post layout upstream of the Thrie-beam. Steel or wood posts can be used. The recommended design was successfully crash-tested under MASH criteria (References: FHWA letters B-231, dated 01/27/12 and B-236, dated 05/30/12).

MGS TERMINALS: Several terminal designs have been modified so they can be used to terminate the 31-inch high MGS design. These changes generally involve shallower embedment of the original terminal posts so the terminal railing matches the 31-inch height of the MGS design and corresponding related adjustments. Several proprietary terminals have been successfully tested under MASH guidelines for use with the MGS system. See current FHWA Eligibility website at https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/listing.cfm?code=cushions and Arizona approved product list at https://azdot.com.