

# Tech Brief

November 2021

## Midwest Guardrail System (MGS)

**CATEGORY:** Design (The following information is based on the current Illinois Department of Transportation (IDOT) Standard Drawings as well as recent research results).

**ISSUE:** Standard strong-post W-beam, referred to in Illinois as "27", or "old" rail, has been one of the most widely used traffic barriers in the United States. 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 has been adopted by IDOT as their standard w-beam system.

**OBJECTIVE:** To provide information on the MGS and some of its design flexibility to IDOT design engineers and other personnel who may have responsibilities for designing, installing, inspecting, or maintaining this design. IDOT Standard 630001-12 addresses the MGS system.

**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/](http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/), the Midwest Roadside Safety Facility Pooled Fund website at <http://mwrsf-qa.unl.edu/>, and the Texas Transportation Institute Pooled Fund website at <https://www.roadsidepooledfund.org/>.

**BASIC MGS DESIGN:** The major differences from the previous standard guardrail are the shifting of the W-beam rail splices from on the posts to mid-span between posts, and the raising of the rail height to 31". This provided a stronger system and better performance with higher center-of-gravity/bumper height pick-up vehicles. MGS uses the same rail element (with five holes punched per 12' section) as the previous standard guardrail but uses a 6' long steel (or wood) post and a 12" blockout. The slope of the ground in front of the rail must be flat (10:1 or flatter) as shown on the standard.



Illinois Department  
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## EXPECTED RESULTS:

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

**MGS DEFLECTION:** The standard MGS (6'-3" post spacing - Type A) resulted in a somewhat increased dynamic deflection when MASH tested. BDE Manual, Ch. 38-6.03, Figure 38-6V shows a minimum distance of 38 inches from the back of the post to any vertical rigid object. It also shows that deflection can be reduced by decreasing the post spacing: to 3'-1 1/2" (Type B) for 30" minimum distance; and to 1'-6 3/4" for 22" minimum distance. Each stiffening requires appropriate advance development (typically 25' per stiffening).



**MGS SOIL BACKING:** IDOT guidance for installation of guardrail (MGS and 27") is 24" of relatively flat slope behind the post; this is shown on Standard 630001-12. 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 of a 2:1 slope (reference: FHWA letter B-211, dated 06/10/11); however, Standard 630001-12 requires a 9' long steel post if less than 24" and the slope is steeper than 3:1. The MGS has also been successfully crash tested with an 8' long steel post placed 1' down a 2:1 slope from the slope break point; NOT an IDOT Standard - contact BSPE.

**MGS WITH CURBS:** The MGS system was successfully crash tested under MASH at TL-3 with a 6" curb placed 6" in front of the face of the rail - shown on Standard 630001-12. For lower speed ( $\leq 45$  mph) locations, the MGS system has been successfully tested to MASH at TL-2 when located 6 feet behind (selected as the worst case scenario) the face of a 6-inch high vertical concrete curb (also on the standard).

**MGS LONG-SPAN GUARDRAIL AND OMITTED POST:** As with standard 27" guardrail, 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 the standard 27" guardrail missing post designs, the MGS system does not require any nested rail. Testing has shown that a single post can be omitted without any additional modification. For 2 and 3 missing posts, three weakened (CRT) wood 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 2" should be allowed behind the rail to avoid "tripping" the vehicle. Standard 630106-02 shows missing post(s) designs, but also requires the CRT posts even when only one post is omitted (contact BSPE for use without CRT posts). Missing post(s) 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 designs may not be used in terminals or transition designs.



**MGS WITH NO BLOCKOUT:** The MGS system was also tested modified by removing the blockout, for use where the extra width caused by the blockout results in an undesirable affect. Standard 630006 provides this design, using only (standard) steel posts and a backup plate between the rail and each post.

**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 transition section and a modified post layout. The recommended design was successfully crash-tested under MASH criteria. Standard 631031-16 (TBT, Type 6) incorporates these designs, including extra and longer steel posts and a nested Thie-beam rail.



**MGS TERMINALS:** Several terminal designs have been modified or developed so they can be used to terminate the 31-inch high MGS design. These changes generally involve shallower embedment of standard terminal posts so the terminal railing matches the 31-inch height and developing adequate anchorage. MASH 16 terminals are available; see the IDOT Qualified Products List <http://idot.illinois.gov/doing-business/material-approvals/metals/index>.