Moving to MASH-compliant Guardrail

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INDOT Standards and Policy
AASHTO/FHWA Joint Implementation Agreement

- The 2016 *Manual for Assessing Safety Hardware* (MASH) is the current standard for crash testing safety hardware.
- MASH replaces the previous standard NCHRP Report 350.
- The American Association of State Highway and Transportation Officials (AASHTO) and the Federal Highway Administration (FHWA) entered into a Joint Implementation Agreement for the new installation and full replacement of safety hardware.
- The agreement sets dates after which only MASH-compliant hardware can be installed on the National Highway System (NHS) routes.
- INDOT has been encouraged to implement MASH-compliant hardware on our Non-NHS as well.

Full Replacement we have introduce the 50% rule.
Sunset Dates NCHRP 350/MASH 2009

Letting Dates

- December 31, 2017: Guardrail & Permanent Concrete Barriers
- June 30, 2018: Guardrail End Treatments (End Terminals)
- December 31, 2018: Impact Attenuators, Cable Barriers & Cable Terminals
- December 31, 2019: Bridge rails, temporary work zone devices*, transitions, other longitudinal barriers, other terminals, sign supports, and all other breakaway hardware

* Temporary work zone devices manufactured before 12/31/19 that were successfully crash tested under NCHRP 350 or MASH 2009 may continue to be used throughout their “normal service lives.”

- The implementation agreement sets dates after which only MASH-compliant hardware can be installed on the NHS routes (December 31, 2017).
- INDOT has been encouraged to implement MASH-compliant hardware on Non-NHS routes (June 30, 2018).
INDOT will be transitioning from the current (strong-post) w-beam guardrail to the Midwest Guardrail System (MGS) w-beam guardrail.

- New *Standard Drawings* series 601-MGSA
- Details will appear as Recurring Plan Details (RPDs) in each CIB until the publication of the 2018 Standard Drawings, RPD E601-R-658d

31-in. MGS w-beam guardrail with 8-in. blockouts and mid-span splice
MGS Highlights

• MGS w-beam guardrail is MASH compliant for test level 3 (MASH, TL-3). It is important to note that simply raising a guardrail system to a 31-in rail height does not make it MASH compliant.

• Several State DOTs have already adopted MGS as a standard guardrail system.

• System is non-proprietary and utilizes standard guardrail hardware.
MGS W-beam Guardrail Highlights

MGS has common elements and distinct differences with the current W-beam guardrail

• Cross Section (same)
  • Dimension from front face of W-beam rail to the back of the post is 1'-5”, same as W-beam

• Mounting Height (different)
  • The top of the W-beam rail element is at 31” (2'-7”) for MGS W-beam vs. 27 ¾” for W-beam

• W-beam Rail Element (same*)
  • *Rail element is the same 12-gage W-beam. Hole locations are adjusted.

• W-beam Rail Splice Location (different)
  • Splice is located mid-span for MGS vs. over the post for W-beam.
MGS W-beam Guardrail Highlights

- Post Material *(same)*
  - *Standard Specifications* 910.10
  - Posts can be either steel (W6x8.5 or W6x9) or wood (6x8).
- Post Length *(different)*
  - Posts are 6 ft in length for standard MGS w-beam vs. 7 ft for w-beam.
- Blockout depth and material *(same)*
  - *Standard Specifications* 911.02(f) and 926.03
  - MGS has been successfully crash tested with both 8” and 12” blockout.
  - INDOT will use the 8” blockouts, either wood or composite, for standard installations.
  - 12” and 16” (two 8-in.) wood blockouts are an option to address site-specific constraints.
MGS W-beam Guardrail Highlights

- Embankment Width Behind the Post (different)
  - 2 ft minimum is preferred.
  - Where an existing embankment is raised, widened, or disturbed in anyway other than removing existing posts, the 2 ft minimum embankment behind the post should be provided.
  - Reducing the offset below 2 ft should be reviewed and approved by the INDOT Standard and Policy Office

Outside of the Scope
- Limited Right-of-Way
- Environmental

If an embankment of less than 2 ft is approved, the correct working width must be provided.
MGS Post Blockouts (same)

- Timber or Composite blockouts may be used in when using steel posts. Timber blockouts are to be used with wood posts.
- Standard blockout is 8”. Depths of 12” and 16” can be utilized as needed due accommodate site constraints.
- MGS guardrail to concrete bridge railing transition uses only 12” blockouts.
Transition: Guardrail to Bridge Rail

- MGS Transition is used to transition from guardrail (semi-rigid) to concrete bridge rail (rigid).
- The MGS Transition is 42’-6¼” vs. the old 25’ TGB transition used with w-beam. Blockouts are 12” for the entire length of 42’-6¼”.

\[
\begin{align*}
\text{MGS Transition} & = 42’-6\frac{1}{4}” \\
\text{MGS W-beam GR} & \\
\text{W-Beam (12’-6”)} & \\
& \text{ht. transition + splice location transition.}
\end{align*}
\]
Height Transition: W-Beam Guardrail to MGS

- To tie an existing w-beam guardrail system into a 31” in MGS system, the height and splice location must be transitioned.
- The height is transitioned over 25 ft, and the splice location is transitioned over 12’-6” for a total transition length of 37’-6”
Curved Guardrail System (Std Dwg. 601-CWGS)

- Curved guardrail consists of W-beam and controlled released terminal (CRT) posts
- Currently no MASH-compliant equivalent
- Design Options
  - Transition MGS to W-beam. Use MGS Height Transition and Curved Guardrail System Standard.
  - Where there is limited space, it may be necessary to install NCHRP 350 compliant devices in a quadrant that requires curved w-beam guardrail. Coordination with Standards and Policy Office is required.
Example: Where this is limited space, it may be necessary to install NCHRP 350 compliant devices in a quadrant that requires curved W-beam guardrail. Coordination with Standards and Policy Office is required.
MGS Long Span Details

- The MGS Long Span is used to bridge a large underground obstruction
  - 18’-9” span length (Type 1)
  - 25’-0” span length (Type 2)

* Length can include the length of an OS end treatment, cable terminal anchor, or transition
NOTES:

1. Where the structure headwall projection is greater than 2 ft, above the grade, the inside face of the headwall shall be 8 ft from the face of MGS W-beam.

2. Where the structure headwall projection is 2 ft, or less above the grade, the inside face of the headwall may be 2 ft from the face of MGS Long-Span.

3. MGS Long-Span shall not be placed adjacent vertical or sloping curb.

INDIANA DEPARTMENT OF TRANSPORTATION
MIDWEST GUARDRAIL SYSTEM ASSEMBLY
LONG-SPAN
MGS Long Span Details

Structure Headwall Projection > 2” (0” Preferred)

Slope 20:1 Desirable, 10:1 Max. or Flatter
Shoulder Slope Break
3:1 Max.

2'-0” Min. at Face of Rail
2'-7” ± 1” at Face of Rail
8'-0” Min. ①

0” Min. 3’-5” Max.

STRUCTURE HEADWALL PROJECTION > 2”
MGS Long Span Details

Inside Face of Structure Headwall

2'-0" Min.

Face of MGS Long-Span

1"

2'-7"± 1"
at Face of Rail

Slope 20:1 Desirable
10:1 Max., or Flatter

Structure Headwall Projection ≤ 2"
(0" Preferred)

0" Min.
3'-5" Max.

STRUCTURE HEADWALL PROJECTION ≤ 2"

NOT ELEVATED
MGS Long Span Details

https://mwrsf.unl.edu/researchhub/files/Report109/lsc2aos1.wmv

MGS Long Span Details
MGS Long Span Details
Omitted Post

• Where only 1 post needs to be omitted
• CRT Post are not required upstream and downstream of the omitted post

NOTES:
1. A single post may be omitted within an MGS w-beam guardrail run.
2. Where a post is omitted a minimum length of MGS standard post spacing guardrail shall be placed as shown.
3. MGS w-beam guardrail run containing an omitted post shall not be placed adjacent vertical or sloping curb.

Omitted Post

- Examples of Minimum Distances for Omitted Post, See RPD E601-R-658d, sheets 23-24 for all minimum distances for omitted posts.

**Minimum Distance Between Omitted Posts**

PLAN VIEW

MINIMUM DISTANCE BETWEEN OMITTED POSTS
Examples of Minimum Distances for Omitted Post, See RPD E601-R-658d, sheets 23-24 for all minimum distances for omitted posts.

Minimum Distance Between Omitted Post and MGS Transition

PLAN VIEW

MINIMUM DISTANCE BETWEEN OMITTED POST AND MGS GUARDRAIL TRANSITION
Guardrail MGS Structure-Top Mounted Post

- Where a MGS Long Span cannot be used to span a flat-top structure with a width greater than 22’-6”, MGS Structure-Top Mounted Posts can be used.

Pay for each post as “Each”

Make note of the minimum offsets, from headwall

The post is anchored to the top of the flat-top structure. It cannot be attached to an arch-top structure

Pay for the length of MGS W-beam Guardrail

Make note of the minimum offsets, from outer structure edge
<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Description</th>
<th>Units</th>
<th>Unit Cost</th>
<th>RPD 601-R-658d</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>601-12281</td>
<td>GUARDRAIL MGS W-BEAM, 5 FT 3 IN SPACING</td>
<td>LFT</td>
<td>$20 per LFT</td>
<td>Sheets 2-5</td>
<td></td>
</tr>
<tr>
<td>601-12282</td>
<td>GUARDRAIL, MGS W-BEAM, 3 FT 1.5 IN SPACING</td>
<td>LFT</td>
<td>$40 per LFT</td>
<td>Sheets 2-5</td>
<td></td>
</tr>
<tr>
<td>601-12283</td>
<td>GUARDRAIL, MGS W-BEAM, 1 FT 6.75 IN SPACING</td>
<td>LFT</td>
<td>$55 per LFT</td>
<td>Sheets 2-5</td>
<td></td>
</tr>
<tr>
<td>601-12284</td>
<td>GUARDRAIL, MGS W-BEAM, DOUBLE FACED 6 FT 3 IN SPACING</td>
<td>LFT</td>
<td>$35 per LFT</td>
<td>Sheets 2-5</td>
<td></td>
</tr>
<tr>
<td>601-12286</td>
<td>GUARDRAIL, MGS W-BEAM, SHOP CURVED, 6 FT 3 IN SPACING</td>
<td>LFT</td>
<td>$25 per LFT</td>
<td>Same as MGS W-Beam</td>
<td>Applicable installed on radius of 150 ft or less.</td>
</tr>
<tr>
<td>601-12287</td>
<td>GUARDRAIL, MGS, LONG SPAN, TYPE 1</td>
<td>EACH</td>
<td>$2700 per EACH</td>
<td>Sheets 2-4, &amp; 8-9</td>
<td>Type 1 is for an 18’-9” w-beam span</td>
</tr>
<tr>
<td>601-12288</td>
<td>GUARDRAIL, MGS, LONG SPAN, TYPE 2</td>
<td>EACH</td>
<td>$3100 per EACH</td>
<td>Sheets 2-4, &amp; 8-9</td>
<td>Type 2 is for a 25’ w-beam span</td>
</tr>
<tr>
<td>601-12289</td>
<td>GUARDRAIL MGS, HEIGHT TRANSITION</td>
<td>EACH</td>
<td>$200 per EACH</td>
<td>Sheet 16</td>
<td></td>
</tr>
<tr>
<td>601-12291</td>
<td>GUARDRAIL, MGS, TRANSITION WITH CURB</td>
<td>EACH</td>
<td>$2500 per EACH</td>
<td>Sheet 11, &amp; 13-15 + RPD 601-R-659d</td>
<td></td>
</tr>
<tr>
<td>601-12292</td>
<td>GUARDRAIL, MGS, TRANSITION WITHOUT CURB</td>
<td>EACH</td>
<td>$2600 per EACH</td>
<td>Sheets 12-15 + RPD 601-R-659d</td>
<td></td>
</tr>
<tr>
<td>601-12293</td>
<td>GUARDRAIL, MGS, STRUCTURE, TOP-MOUNTED POST</td>
<td>EACH</td>
<td>$350 per EACH</td>
<td>Sheet 10</td>
<td>Each post mounted to the structure is paid for separately. Do not adjust the LFT of MGS W-beam</td>
</tr>
<tr>
<td>601-12294</td>
<td>GUARDRAIL, MGS, W-BEAM, CABLE TERMINAL ANCHOR</td>
<td>EACH</td>
<td>$900 per EACH</td>
<td>Sheets 17-22</td>
<td></td>
</tr>
</tbody>
</table>
Pay Items

- Pay Items Paid for by the “Linear Foot”, LFT
  - Guardrail, MGS W-Beam, 6 FT 3 IN Spacing
  - Guardrail, MGS W-Beam, 3 FT 1.5 IN Spacing
  - Guardrail, MGS W-Beam, 1 FT 6.75 IN Spacing
  - Guardrail, MGS W-Beam, Double Faced, 6 FT 3 IN Spacing
  - Guardrail, MGS W-Beam, Shop Curved, 6 FT 3 IN Spacing

All the linear pay items are paid for and measured the same. The only difference is in the description, “MGS”, was added.
Pay Items

• Pay Items Paid for by the “Linear Foot”, LFT

Linear Pay Items are Measured from Post to Post

ELEVATION VIEW
Pay Items

• Pay Items Paid for by “Each”
  • Guardrail, MGS, Long Span, Type 1
  • Guardrail, MGS, Long Span, Type 2
  • Guardrail, MGS, Height Transition
  • Guardrail, MGS, Transition With Curb
  • Guardrail, MGS, Transition Without Curb
  • Guardrail, MGS, Structure, Top-Mounted Post
  • Guardrail, MGS, W-Beam, Cable Terminal Anchor

Pay items paid for by Each, have slightly different limits then the previous w-beam guardrail.
Pay Items

- Pay Items Paid for by “Each”
  - Guardrail, MGS, Long Span, Type 1

A This length is required upstream and downstream of the outermost CRT post. It may contain, MGS W-Beam Guardrail, MGS Transition, MGS End Treatment, or MGS Cable Terminal End Anchor. These items are paid for separately from the MGS, Long Span, Type 1.

Minimum Length of MGS Long-Span, Type 1 and MGS W-Beam Guardrail Outside of CRT Posts = 131'-3"

2 Posts Omitted

Span Length, 18'-9"

Out to Out Structure Width

Installation Type 1
(2 Posts Omitted)
Pay Items

- Pay Items Paid for by “Each”
  - Guardrail, MGS, Long Span, Type 2

This length is required upstream and downstream of the outermost CRT post. It may contain, MGS W-Beam Guardrail, MGS Transition, MGS End Treatment, or Terminal End Anchor. These items are paid for separately from the MGS, Long Span, Type 2.

Pay Item Limit, Each, for Type 2, Between Outmost CRT Posts = 50’-0”

Minimum Length of MGS Long-Span, Type 2 and MGS W-Beam Guardrail Outside of CRT Posts = 150’-0”

3 Posts Omitted

Installation Type 2
(3 Posts Omitted)
Pay Items

- Pay Items Paid for by “Each”
  - Guardrail, MGS, Height Transition

The 25’-0” length is used to set the correct rail height. The remaining 12’-6” is to set the splice at the midspan between the posts.
Pay Items

- Pay Items Paid for by “Each”
  - Guardrail, MGS, Transition with or without Curb

Pay Item Limit, Each, MGS Guardrail Transition = 42’-6 ¼”

Whether the transition is adjacent curb or not, the length included with the pay item, Each, is the same.
Pay Items

• Pay Items Paid for by “Each”
  • Guardrail, MGS, Structure Top-Mounted Post

Each Structure Top-Mounted Post should be paid for per Each, in addition to the length of MGS W-Beam Guardrail.

Pay for each post as “Each”

Pay for the length of MGS W-Beam Guardrail run.
Pay Items

- Pay Items Paid for by “Each”
  - Guardrail, MGS, Structure Top-Mounted Post

Each Structure Top-Mounted Post should be paid for per Each, in addition to the length of MGS W-Beam Guardrail.

Pay for each post as “Each”

Pay for the length of MGS W-Beam Guardrail run.

Pay for End Treatment

Pay for End Treatment
Pay Items

- Pay Items Paid for by “Each”
  - Guardrail, MGS, W-Beam, Cable Terminal Anchor

Pay Item Limit, MGS W-beam Guardrail Cable Terminal

MGS Cable Terminal Anchor System = 12'-6"

5/8" Ø x 1 1/2" hex head bolt with hex nuts (Typ.)
5/8" Ø x 10" bolt and nut w/ round washers under head & nut

Post A

ELEVATION VIEW

Post B

5/8" button head guardrail bolt w/heavy hex nut recessed both sides. L = 10' T (min.)= 4". Use rectangular washer under head and round washer under nut. (Typ.)

5/8"Ø x 1 1/4" button head bolt with heavy nut recessed both sides (Typ.)
Pay Items

• Old pay items for w-beam may still be in a project. Pay special attention to the plan callouts. Reasons include:
  • Non-NHS route implementation date is July 1, 2018
  • Maintenance requires less than 50% of a guardrail run to be replaced
  • Short runs between driveways/intersections and curved end treatments
  • Limited space between a bridge and a driveway/intersection

• W-beam guardrail should be set at 2’-3 ¾” (27 ¾”) rail height and only steel posts used.
• In some cases the plans may call for a rail height of 2’-5” (29”). This would be called for on long stretches of MGS W-beam guardrail.
Pay Items

Old Pay Items with added mandatory supplemental description for MGS Implementation

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Description</th>
<th>Units</th>
<th>Unit Cost</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>601-94689</td>
<td>GUARDRAIL, END TREATMENT, OS</td>
<td>EACH</td>
<td>Bid history</td>
<td>Continue to use existing pay item, but must include a supplemental description of 27 3/4” or 31” as appropriate. Where MGS W-beam or MGS-W-Beam Transition will connect to the end treatment, use 31”</td>
</tr>
<tr>
<td>601-94690</td>
<td>GUARDRAIL, END TREATMENT, MS</td>
<td>EACH</td>
<td>Bid history</td>
<td></td>
</tr>
</tbody>
</table>

Projects let on or after July 1, 2018 may not use 27 3/4” height Guardrail, End Treatments.
When and Where to Upgrade Guardrail

The next several slides we will talk about where to use MGS W-beam guardrail and when to replace end treatments for:

- 4R Projects
- 3R Projects
- Partial 3R Projects
- Bridge Preventative Maintenance
- Bridge Rehabilitation

Design Memos 17-10 and 17-17 provide guidance on design details for MGS guardrail and associated pay items. These memos assume the need for guardrail replacement has already been established. The next few slides are intended to help navigate through the grey area of “do I have to upgrade my existing guardrail as part of the project scope of work?”
When and Where to Upgrade Guardrail

When and where guardrail will be upgraded to MASH-compliant hardware is based on the following items:

- Project Type
- Test Level of the Existing Guardrail, (IDM Section 49-5.02)
- Percent of Existing Guardrail being Replaced or Reset
When and Where to Upgrade Guardrail

• 4R Projects (New or Reconstruction)
  • If the existing guardrail is not NCHRP-350 compliant
    • Does not match Standard Drawing Series 601-WBGA
    • All the existing guardrail must be replaced with MASH-Compliant Hardware, regardless of the need to replace or reset the existing guardrail. (Full Replacement)
  • If the existing guardrail is NCHRP-350 compliant
    • And 50% or more of the existing guardrail run needs to be removed for any reason, e.g. to replace a structure or for MOT: Remove and replace the entire existing guardrail run with MASH-Compliant Hardware. (Full Replacement)
    • And less than 50% of the existing guardrail run needs to be removed:
      • Desirable: Replace removed portion of existing guardrail run with MASH-Compliant Hardware. Transition back to the existing guardrail. (Partial Replacement)
      • Minimum: Replace in kind or reset existing guardrail
      • If the amount of existing guardrail does not exceed 200 ft:
        • Replace in kind or reset existing guardrail or leave in place

*Where Partial Replacement is used, make sure the transition does not encroach into the 50 ft of existing OS end treatment.*
When and Where to Upgrade Guardrail

* The length of MGS height transition must be considered in the calculation for replacement.

** Standard MGS w-beam should be placed where the space between to MGS Systems is less than the length of two MGS height transition, (37'-6"toch) plus 100 ft of existing rail, 175 ft.

(A+B+C)/L < 50% Partial Replacement

(A+B+C)/L ≥ 50% Full Replacement

Sample Calculation for Proposed Guardrail Removal

Figure XXX-XX
When and Where to Upgrade Guardrail

Total Existing Guardrail Run (Non-MGS) = L

Sample One

\[
\frac{(A+B+C)}{L} < 50\% \quad \text{Partial Replacement}
\]

\[
\frac{(A+B+C)}{L} \geq 50\% \quad \text{Full Replacement}
\]

C=0 for this Sample.
When and Where to Upgrade Guardrail

Total Existing Guardrail Run (Non-MGS) = \( L \)

- Ex. Type I
- Existing Transition
- Bridge Rail
- Existing Transition
- Ex. Type I

OS End Treatment
MGS Transition
MGS w-beam Guardrail **
Replace = A

MGS Transition
MGS Height * Transition
Replace = B

MGS Height * Transition
OS End Treatment
Replace = C

Sample Two

\[
\frac{(A+B+C)}{L} < 50\% \quad \text{Partial Replacement}
\]

\[
\frac{(A+B+C)}{L} \geq 50\% \quad \text{Full Replacement}
\]
When and Where to Upgrade Guardrail

- 3R Projects (IDM section 55-5.04(01))
  - If the existing guardrail is not NCHRP-350 compliant
    - Desirable: Remove and replace the entire existing guardrail run with MASH-Compliant Hardware, regardless of the need to replace or reset the existing guardrail. (Full Replacement)
  - Minimum:
    - If less than 50% of the existing guardrail run is removed
      - Replace removed portion of existing guardrail run with MASH-Compliant Hardware. Transition back to the existing guardrail. (Partial Replacement)
    - Retrofit the remaining existing guardrail to meet IDM section 49-5.02
  - If less than 200 ft of existing guardrail is removed
    - Replace in kind or reset existing guardrail or leave in place.
    - Retrofit the existing guardrail to meet IDM section 49-5.02

Remember to:
- Check the Length of Need (LON), and
- Check to see if the existing guardrail can be eliminated.
If all the conditions are met, the existing guardrail will perform acceptably and may allow for the existing guardrail to remain in place or be partially replaced.

**IDM Section 49-5.02**

**49-5.02 Existing Non-NCHRP 350 Guardrail to Remain in Place**

Existing non-NCHRP 350 guardrail may be retained, subject to the following conditions.

1. A W-beam back-up plate is required at each W-beam-to-blockout connection where the W-beam element units are not lapped.
2. The height of guardrail should be a minimum of 2.25 ft with a maximum height of 2.5 ft as measured from the top of the W-beam to the ground surface at the face of rail.
3. A rubrail must also be used, including that for a guardrail run with a radius of 50 ft or less.
4. The flat-plate washers should be eliminated from under the head of the bolt holding the W-beam to the blockout except where washers are needed to transmit the forces in the W-beam to the anchor posts to obtain end anchorage. For example, if both ends of a guardrail run have positive anchorage at a bridge support or through a guardrail end treatment, all of the flat-plate washers should be eliminated except those in the transition. However, if the guardrail run ends without a positive connection, anchorage will have to be achieved through the last 5 posts and the washers must be left on these posts.
5. It is considered safer for an errant vehicle to traverse an embankment slope as steep as 3:1 at any height, than it is for the vehicle to impact a traffic barrier which can shield that slope (see Section 49-3.02). Therefore, on a reconstruction project, it may be necessary to remove portions of existing guardrail to be in accordance with the concept that guardrail should be provided only where clearly warranted. However, on a slope steeper than 4:1, the clear runout area shown in Figure 49-2F. Clear-Zone Application for Non-Recoverable Fill Slope, must be provided at the toe of slope.
When and Where to Upgrade Guardrail

• 3R Projects
  • If the existing guardrail is NCHRP-350 compliant
    • And 50% or more of the existing guardrail run is removed:
      • Desirable: Replace the entire existing guardrail run with MASH-Compliant Hardware. (Full Replacement)
      • Minimum: Replace removed portion of existing guardrail run with MASH-Compliant Hardware. Transition back to the existing guardrail. (Partial Replacement)
    • And less than 50% of the existing guardrail run is removed:
      • Desirable: Replace removed portion of existing guardrail run with MASH-Compliant Hardware. Transition back to the existing guardrail. (Partial Replacement)
      • Minimum: Replace in kind or reset existing guardrail
  • If less than 200 ft of existing guardrail is removed
    • Replace in kind or reset existing guardrail or leave in place
When and Where to Upgrade Guardrail

- **Partial 3R Projects, Functional or Structural (IDM Chapter 56)**
  - Follow guidance for 3R Projects

- **Partial 3R Projects, Preventative Maintenance (IDM Chapter 56)**
  - Where existing guardrail is going to be removed, Follow guidance for 3R Projects
  - Where all existing guardrail is to remain in place, Leave Existing Guardrail in Place

- **Bridge Preventative Maintenance Projects (IDM 412-3.01(05))**
  - Upgrade existing guardrail when found to be cost effective, e.g. the concrete bridge railing transition is being replaced and the posts for the existing transition needs to be removed; replace the guardrail transition.

- **Bridge Rehabilitation Projects (IDM 412-3.01(05))**
  - All existing roadside safety items, including but not limited to guardrail, transitions, and end treatments should be upgraded to current standards.
When to Upgrade an End Treatment

- 4R Projects, 3R Projects, and Partial 3R Projects Functional or Structural (IDM Chapter 56)
  - Existing Type I End Treatment
    - Replacement Required regardless of the need to replace or reset the existing guardrail
  - Existing NCHRP-350 Compliant may remain in place.
    - Replacement Required where existing guardrail is being fully replaced or the MGS height transition will encroach on the existing end treatment
    - Leave in place where existing guardrail is partially replaced and the MGS height transition does not encroach on the existing end treatment.
  - Existing MASH Compliant end treatments may remain in place.
  - New Installations should be MASH Compliant
When to Upgrade an End Treatment

- Partial 3R Projects, Preventative Maintenance (IDM Chapter 56)
  - Existing Type I End Treatment or NCHRP-350
    - Replacement Required where existing guardrail is being fully replaced or the MGS height transition will encroach on the existing end treatment
    - Leave in place where existing guardrail is partially replaced and the MGS height transition does not encroach on the existing end treatment.
    - Leave in place where existing guardrail is not replaced.

- Existing is MASH Compliant, Leave In Place
When To Upgrade an End Treatment

• Bridge Preventative Maintenance Projects, IDM 412-3.01(05)
  • Roadside safety features should be upgrade to current standard when proved to be cost effective as part of a preventative maintenance project.
    • If the guardrail work is very limited and does not require posts to be removed, the end treatments may remain in place.

• Bridge Rehabilitation Projects, IDM 412-3.01(05)
  • All existing roadside safety items including but not limited to guardrail, transitions, and end treatments should be upgraded to current standards.
    • There may be cases that allow an end treatment to remain in place. Ask the question.
When To Upgrade an End Treatment

- 3R Project, Small Structure Replacement
When To Upgrade an End Treatment

- 3R Project, Small Structure Replacement
When To Upgrade an End Treatment

• 3R Project, Small Structure Replacement
When To Upgrade an End Treatment

- 3R Project, Small Structure Replacement
When To Upgrade an End Treatment

- 3R Project, Small Structure Replacement

Step 1: What type of project is it? 3R Project
When and Where to Upgrade Guardrail

- **3R Projects**
  - If the existing guardrail is NCHRP-350 compliant
    - And 50% or more of the existing guardrail run is removed:
      - Desirable: Replace the entire existing guardrail run with MASH-Compliant Hardware. (Full Replacement)
      - Minimum: Replace removed portion of existing guardrail run with MASH-Compliant Hardware. Transition back to the existing guardrail. (Partial Replacement)
    - And less than 50% of the existing guardrail run is removed:
      - Desirable: Replace removed portion of existing guardrail run with MASH-Compliant Hardware. Transition back to the existing guardrail. (Partial Replacement)
      - Minimum: Replace in kind or reset existing guardrail
  - If less than 200 ft of existing guardrail is removed
    - Replace in kind or reset existing guardrail or leave in place
Step 2: What is the test level of the existing guardrail?  

NCHRP-350
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Step 3: What test level are end treatments NCHRP-350 (West Side)

**West Side**

**East Side**

Length between MGS and End of Ex. End Treatment = 200 ft - 50 ft - 62.5 ft = 87.5 ft

Length of MGS from Midspan of Culvert
50 ft / 2 + 37.5 ft = 62.5 ft

Step 3: Does the MGS Ht. Transition encroach on the existing end treatment?
There is still 87.5 ft between the MGS and ex. end treatment, do not remove
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Step 4: What percent of existing guardrail is being replaced? (West Side)

Step 4: \( \frac{125 \text{ ft}}{500 \text{ ft}} = 0.25, \ 25\% < 50\% \) Use Partial Replacement
When and Where to Upgrade Guardrail

• Extra Notes:
  
  • Where existing guardrail is being replaced, be consistent. If one side of the roadway is 50% or greater and the other is only 40%; Replace all the guardrail with MASH-Compliant MGS W-Beam on both sides of the roadway.
  
  • Where non-standard guardrail will not fit your specific guardrail location, send the following information to Katherine Smutzer at ksmutzer@indot.in.gov for alternate guardrail solutions:
    • Project Des Number
    • Construction plans
    • Plan details should show the standard guardrail system that will not fit your location
    • Plan detail should show a proposed solution, if the designer can not propose a solution, state so in the request
    • Snap shot of project location
QUESTIONS

Office of Standards and Policy

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NEW!!
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