

# APPENDIX J

Page

**APPENDIX J** ..... J-1

## **SECTION J-1- INTRODUCTION**

Introduction..... J-1

## **SECTION J-2- BARRIER SYSTEMS AND TERMINALS**

W-Beam Guardrail General Criteria..... J-2  
GR-MGS1 1A Strong Post W-Beam Guardrail ..... J-2  
GR-MGS2 Tangent End Terminal ..... J-3  
GR-MGS3 Strong Post W-Beam Guardrail Run-Off Only Terminal..... J-3  
GR-MGS4 Strong Post Transition From MGS1 to GR-2 W-Beam Guardrail J-3  
High Tension Cable ..... J-4  
Concrete Barrier ..... J-4  
Barrier Terminals General Criteria..... J-4  
Impact Attenuators ..... J-5

## **SECTION J-3 BARRIER INSTALLATION CRITERIA**

Barrier Warrants ..... J-6  
Fixed Objects Within Deflection Area ..... J-8  
Ponds or Other Bodies of Water ..... J-8  
Barrier Type Selection ..... J-8  
Determining Location of The Ends of Guardrail..... J-10  
Slopes For Barriers..... J-11  
Asphalt Paving Under Guardrail ..... J-11  
Asphalt Curbs ..... J-12  
Guardrail Installation Adjacent To Curb..... J-12  
Pavement Drop-Offs With Guardrail ..... J-16  
Radial Guardrail..... J-16

## **SECTION J-4 FIXED OBJECT ATTACHMENTS (FOA) AND BRIDGE GUARDRAIL ATTACHMENTS (BRGR)**

FOA ..... J-18  
BRGR ..... J-18  
Entrances or Connections Adjacent To A Bridge..... J-18

## **SECTION J-5 SAFETY/MAINTENANCE PROJECTS** ..... J-19

## LIST OF TABLES & FIGURES

### Page

Table J-3-1 Embankment Heights .....	J-6
Table J-3-2 Typical Fixed And Hazardous Objects Within The Clear Zone .....	J-7
Table J-3-3 Typical Barrier Selection And Placement .....	J-9
Figure J-3-1 Barrier Length Of Need Determination .....	J-10
Table J-3-4 Design Parameters For Roadside Barrier Layout.....	J-11
Figure J-3-2 Typical Curb Offset Layout For A Tangent Mgs Guardrail Terminal.....	J-13
Figure J-3-3 Typical Curb Offset Layout For A Tangent Mgs Guardrail Terminal at A Bridge With A Sidewalk .....	J-14
Figure J-3-4 Typical Curb Offset Layout For A Tangent Mgs Guardrail Terminal at A Bridge With A Shared Use Path .....	J-15

## APPENDIX J

### SECTION J-1- INTRODUCTION

#### INTRODUCTION

Traffic Barriers and their associated terminals discussed in this appendix must meet MASH (Manual for Assessing Safety Hardware) requirements. They do not prevent collisions or injuries from occurring and should only be used where the result of striking a fixed object hazard or leaving the roadway would be more severe than the consequence of striking the barrier. The roadway should be examined to determine the feasibility of adjusting site features so that the barrier will not be required (e.g. flattening a fill slope, removing or relocating a hazardous object such as a drainage headwall, sign support, etc.). The initial cost to eliminate the need for a barrier may appear excessive; however, the fact that a barrier installation will require maintenance costs for many years should not be overlooked.

When guardrail is wholly or partially within the project limits for any construction project, including heavy maintenance and RRR projects, Traffic Engineering Division shall perform a guardrail assessment on\* all existing guardrail systems and components including terminals. Refer to Traffic Engineering Division [IIM-TE-366](#) and [IIM-TE-367](#). Unless Traffic Engineering Division determines that the guardrail can be eliminated, the guardrail shall be upgraded to the latest standard in accordance with current VDOT Road and Bridge Standards for the following situations:

1. **When located within the project limits of a construction project.** When the line of rail extends outside the project limits with more than 60% of the existing substandard line of rail within the project limits, then the entire run shall be replaced including terminals and upgraded to meet the current Standards. If less than 60% is within the project limits, then only the rail within the project limits is to be upgraded. Consideration should be given to upgrading the entire line of rail even when less than 60% is within the project limits.
2. **When located within the project limits of transportation improvements associated with permitted land development projects.**
3. **When any road is accepted into the state roadway system, all guardrail must comply with current Standards. (For VDOT approved Developer Construction Plans, the Secondary Street Acceptance Requirements (SSAR) govern.)**

For definitions of RRR utilizing Federal Funding on National Highway System (NHS) Roadways, see [Appendix A, Section A-4](#) Guidelines for RRR Projects.

---

\* Rev. 7/17

## **SECTION J-2- BARRIER SYSTEMS AND TERMINALS**

(This section will expand as more MASH systems become available.)

### **W-BEAM GUARDRAIL GENERAL CRITERIA**

During **NEW CONSTRUCTION**, always install to the current VDOT Standards.

New and existing guardrail within the project limits must meet MASH requirements except when there is no approved MASH system for the particular circumstance. Therefore, a guardrail transition must be used to connect a MASH system to an NCHRP 350 system that meets the current Standards.

All guardrail shall be replaced or upgraded in accordance with **Section J-1**.

All w-beam guardrail panels shall be lapped in the direction of traffic. With two-way traffic, the laps on the right side of traffic are to be in the direction of traffic or toward the downstream end.

Refer to the current [Road and Bridge Standards](#) for transition designs between flexible and more rigid systems.

Roadside safety devices are to be equipped with identification stamps as per Code of Virginia [§33.2-274.1](#).

### **GR-MGS1, 1A STRONG POST W-BEAM GUARDRAIL**

GR-MSG1 strong post w-beam guardrail meets MASH requirements.

For GR-MSG1, the minimum height is 30" to the top of the rail with a maximum height of 32". When checking the height on a length of GR-MSG1, measure at increments of 50' at a post. Refer to the current Standards for measuring w-beam guardrail height. Only W6x9 or W6x8.5 steel posts are allowed. Blockouts can be 12"Dx6"Wx14"H wood or composite and are to be all wood or all composite within a single run of guardrail for new installations or for repair of existing installations. Other blockouts not noted must be from the VDOT approved products list. Wood blockouts shall include routing to prevent the blockout from rotating on the posts.

When posts are removed and are to be reused, the posts shall meet the current standard length. They shall be reused only with standard wood or composite blockouts. When resetting rail, the posts shall be removed and the holes backfilled prior to reinstalling the posts. The height of the rail shall be measured to ensure it meets the current Standard.

See **Section J-3** for guardrail installation adjacent to curb.

## **GR-MGS2 TANGENT END TERMINAL**

Use of a GR-MGS2 is intended solely for the use on the end of a tangent strong post w-beam installation.

The total length of the system is typically 50' with the LON (Length of Need) beginning at the 3<sup>rd</sup> post from the impact head.

## **GR-MGS3 STRONG POST W-BEAM GUARDRAIL RUN-OFF ONLY TERMINAL**

Use of a GR-MGS3 is required for trailing end terminal anchorage of GR-MGS1 strong post w-beam guardrail on divided or one-way roadways for run-off conditions only.

## **GR-MGS4 STRONG POST TRANSITION FROM MGS1 TO GR-2 W-BEAM GUARDRAIL**

GR-MGS4 is the transition used where existing GR-2 will remain in place and a new installation of a GR-MGS system will tie into the existing rail. GR-MGS4 will account for the difference in guardrail height and splice location.

## **GR-9**

Only the GR-9 to terminate MB-3, such as a CAT-350, is allowed until a MASH equivalent is developed and approved.

## **GR-10**

This system to span low fill culverts is allowed, with the following requirements, until a MASH equivalent is developed and approved. For Types I & II, raise the rail to 31" to match the MGS System height. It is not necessary to adjust the MGS post spacing and rail splice locations for Types I & II. The nested rail sections will be splice to splice instead of post to post\*. Type III installations will remain the same with rail nesting, post spacing, rail splice location, and GR-2 27 3/4" rail height per the Standard. On each end of a GR-10 Type III, GR-MGS4 transitions will be required to transition to the MGS system. Refer to Appendix I for additional information on GR-10.

## **THREE-BEAM BULL NOSE BARRIER**

This NCHRP 350 system is allowed, with the following requirement, until a MASH equivalent is developed and approved. If attaching to a GR-MGS system, contact the Standards and Special Design Section for guardrail transition guidance.

## **MB-3**

This 2-sided strong post system is allowed until a MASH equivalent is developed and approved with the following requirements. The height will remain the same. If the MB-3 splits to tie into 2 MGS Systems, GR-MGS4 transitions will be required. Refer to Appendix I for additional guidance.

---

\* Rev. 1/19

## HIGH TENSION CABLE

There is no standard for high tension cable since each available proprietary system is unique. Therefore, a Special Provision is needed when used on a project. Drawings of the proposed system must be submitted for approval prior to installation.\*

## CONCRETE BARRIER

There are currently no VDOT approved permanent MASH concrete barrier systems. Refer to [Appendix I](#) for guidelines on use of the current NCHRP 350 permanent concrete barrier. For temporary concrete barrier (traffic barrier service) refer to the VDOT Work Area Protection Manual.

## BARRIER TERMINALS GENERAL CRITERIA

Guardrail/barrier terminals are to be provided for all installations regardless of "Functional Classification". Terminals develop the necessary tension at the end of the system in order to redirect a vehicle and, if hit, minimize the damage to a vehicle and its occupants. The termini of guardrail/barrier must be designed and located so there are no exposed blunt ends that a vehicle could impact.

New and existing terminals within the project limits must meet MASH requirements. Those that are not within project limits but are part of a length of barrier that has 60% within the project limits (see **Section J-1**) must also meet MASH requirements. All terminals shall be installed as they were tested in accordance with MASH. Lapping of guardrail terminals must be in accordance with the Standards.

A site investigation shall be made to determine whether a terminal should be upgraded, or eliminated. For gaps between two runs of guardrail approximately 200' or less, closing the gap by continuing the run of guardrail is recommended, thereby eliminating the need for a terminal. Verify that the guardrail is still necessary. If it is, verify the LON (Length of Need).

Radial guardrail is not to be used in place of a MASH approved terminal section. Radial terminal sections that exist within the project limits shall be upgraded to an approved terminal section. Refer to **Section J-3** for additional guidance.

Before replacing a substandard terminal, the location of the existing terminal shall be checked to ensure sufficient length of need has been provided in the run of guardrail to adequately shield the hazard for which it was installed. In some cases it may be necessary to extend the guardrail to better shield the hazard or to provide for a more suitable site that would not require grading.

The site preparation for all installations shall be in accordance with current Standards and manufacturers' requirements.

An appropriate transition is required when used with an existing NCHRP 350 system that is not being upgraded to MASH.

---

\* Rev. 1/18

**GR-6**

This buried in the back slope NCHRP 350 terminal is allowed until a MASH equivalent is developed and approved. A GR-MGS4 transition will be required. Refer to Appendix I for additional guidance.\*

**IMPACT ATTENUATORS**

There are currently no VDOT approved MASH impact attenuators. Refer to [Appendix I](#) for guidelines.

---

\* Rev. 1/18

**SECTION J-3 BARRIER INSTALLATION CRITERIA**

**BARRIER WARRANTS**

The determining warrants for Traffic Barriers on VDOT projects are (1) Embankment Heights (see below) and (2) Fixed and Hazardous Objects within the Clear Zone (see **TABLE J-3-2**).

SYSTEM CLASSIFICATION		TRAFFIC VOLUMES	FILLS OVER 7.5'	FILLS OVER 15'	AT OBVIOUS NEEDS SUCH AS BRIDGES, LARGE END WALLS, PARALLEL WATER HAZARDS, ETC., AND FILLS WHERE RECOMMENDED DURING FIELD INSPECTION
INTERSTATE - PRIMARY AND ARTERIAL	FILLS WITHOUT RECOVERABLE SLOPES	ALL	√		√
	FILLS WITH RECOVERABLE SLOPES				√
SECONDARY AND FRONTAGE ROADS		ADT OVER 1000	√		√
		ADT 1000 - 250		*√	√
		ADT LESS THAN 250			√
URBAN		ALL			√

**TABLE J-3-1  
EMBANKMENT HEIGHTS**

\* Exception - Bristol, Salem, and Staunton Districts. Traffic barriers are to be provided only at obvious needs such as bridges, large endwalls, parallel water hazards, etc., and fills where recommended at field inspection.

When fill slopes are 3:1 or flatter, a barrier is not required unless there are hazardous obstacles within the clear zone limits. This may include the clear runoff area if the fill slope is between 3:1 and 4:1 (see [Appendix A, Figure A-2-4](#)).

In some limited situations in which the embankment slopes significantly downward, a vehicle could encroach farther from the through traveled way and the clear zone might not be adequate. In these cases, guardrail should be considered.

	Barrier Required	
	YES	NO
1. Sign Support (ground mounted): (A) Post of breakaway design (a)		X
(B) Post not meeting breakaway criteria (b)(c)(d)	X	
2. Lighting/Signal Poles and Towers (A) Breakaway design		X
(B) Not meeting breakaway design (b)(c)(g)(h)	X	
3. Bridge parapet ends, piers and abutments at underpasses	X	
4. Retaining walls (Including MSE walls) (j) *	X	
5. Trees with a diameter of 4 inches or greater (e)	X	
6. Utility Poles (f)		X
7. Above ground utilities (telephone pedestals, etc.) (i)	X	
8. Rough rock cuts and large boulders	X	
9. Streams or permanent bodies of water more than 2 feet deep (h)	X	
10. Sound Walls (k)	X	
11. Culvert Headwalls (l)	X	
<p><b>NOTES</b></p> <p>(a) Multiple post installations where the spacing between posts is less than the minimum spacing required for breakaway shall be replaced or shielded by barrier.</p> <p>(b) Every effort should be made to convert non-breakaway to breakaway.</p> <p>(c) Where these devices exist and cannot be converted to breakaway, relocated or removed, the choice of barrier should be in accordance with the deflection shown in <b>Table J-3-3</b>.</p> <p>(d) Wood posts larger than 6" x 8" nominal size do not meet the breakaway requirements even if drilled.</p> <p>(e) Every effort should be made to remove the tree rather than shield it with barrier.</p> <p>(f) Barrier will not normally be used to shield a line of utility poles. However, where barriers are used in front of utility poles for other reasons, the choice of barrier should be in accordance with the deflection shown in <b>Table J-3-3</b>.</p> <p>(g) Pedestal poles, except for those used for power supply should be converted to breakaway standards where possible.</p> <p>(h) A field review and evaluation should be made to determine if barrier is suitable for protecting motorists from these roadside hazards.</p> <p>(i) Consideration should be given to placing utilities underground.</p> <p>(j) When a barrier is required on the top of a retaining wall, a cast-in-place concrete parapet is to be used on top of the wall. Depending on the wall design, the parapet can be integrated into the wall or cast with a moment slab to resist overturning. Do not use guardrail in conjunction with a retaining wall.</p> <p>(k) A cast-in-place concrete barrier is required in front of a sound wall. Refer to Chapter 2E for sound barrier wall design procedures.</p> <p>(l) Consider extending new or existing culvert to move the headwall out of the Clear Zone or designing the headwall as a parapet for a new culvert installation. If guardrail cannot be installed due to the culvert width and shallow fill over the culvert, then cast-in-place concrete barrier must be used over the culvert. If the concrete barrier is being used as a parapet then it must be integral to the culvert or cast with a moment slab.</p>		

**TABLE J-3-2  
TYPICAL FIXED AND HAZARDOUS OBJECTS WITHIN THE CLEAR ZONE**

\* Rev. 1/19

## FIXED OBJECTS WITHIN DEFLECTION AREA

No fixed objects, regardless of their distances from the edge-of-pavement, will be allowed within the deflection zone of the guardrail system to assure that the guardrail system will perform as designed. This will include overhead sign supports, walls, drainage structures, bridge piers, signal supports, utility poles, trees, etc. If a sign or luminaire support must remain within the deflection zone, it must be a breakaway design.

When it is impractical to locate hazards outside of the deflection zone of standard guardrail, it may be necessary to use concrete barrier.

**Table J-3-3** (Typical Barrier/Guardrail Selection and Placement) specifies the minimum offset distance required from "hazardous objects" to meet deflection requirements of the different types of barrier systems.

## PONDS OR OTHER BODIES OF WATER

Barrier is to be constructed on all functional classifications at ponds or other bodies of water over 2 feet in depth when it is within the design clear zone.

## BARRIER TYPE SELECTION

When it has been determined that a barrier is required, a determination must be made as to the type of barrier that is to be used. System and terminal specific guidelines are provided later in this appendix that can be used in making a barrier system selection. The most desirable system is one that offers the lowest accident severity at the least cost within the given constraints.

The AASHTO *Roadside Design Guide* presents eight items which must be considered before a system selection is made.

- Performance capability
- Deflection
- Site conditions
- Compatibility
- Cost
- Maintenance
- Field Experience
- Aesthetics (occasionally)

In taking all eight items into account, the deflection, strength, and safety requirements **must** never be compromised. **Table J-3-3** shows the Standard types of MASH barrier currently available.

---

\* Rev. 1/18

The table includes barrier height, maximum dynamic deflection, minimum offset from hazardous object, post spacing, and typical terminal treatment for each Standard. The Road and Bridge Standards provide transition designs for use in various situations.

Weathering steel (COR-TEN) w-beam guardrail is no longer acceptable for use in new construction or maintenance replacement due to the potential for premature material failure from excessive rust. Guardrail terminals are no longer available with weathering steel. An acceptable “aesthetic” guardrail is powder coated galvanized rail with Standard posts conforming to applicable VDOT Standards, MASH requirements, and does not create undue maintenance problems and/or costs. Powder coating guardrail will have a significant impact on the cost and will require a separate pay item for powder coating. Contact the Materials Division for approved treatment methods.

BARRIER SYSTEM	VDOT STANDARD	BARRIER HEIGHT	MINIMUM OFFSET FROM HAZARD (MAXIMUM DYNAMIC DEFLECTION)	POST SPACING	DIVIDED ROADWAY OR ONE-WAY TRAFFIC		UNDIVIDED ROADWAY OR TWO-WAY TRAFFIC	
					RUN-ON TERMINAL END TREATMENT	RUN-OFF TERMINAL END TREATMENT (B)	RUN-ON TERMINAL END TREATMENT	RUN-OFF TERMINAL END TREATMENT
SEMI-RIGID (STRONG POST)	GR-MGS1	31" (C)	5'-0" (A) (D)	6'-3"	GR-MGS2	GR-MGS3	GR-MGS2	GR-MGS2
	GR-MGS1A	31" (C)	4'-0" (A) (D)	3'-1½"	GR-MGS2	GR-MGS3	GR-MGS2	GR-MGS2

**TABLE J-3-3**

**TYPICAL MASH BARRIER SELECTION AND PLACEMENT\***

For permanent installations only; not to be used for TMP plans.

For NCHRP 350 systems, refer to [Appendix I](#). For temporary concrete barrier (traffic barrier service) refer to the VDOT Work Area Protection Manual.

**NOTES:**

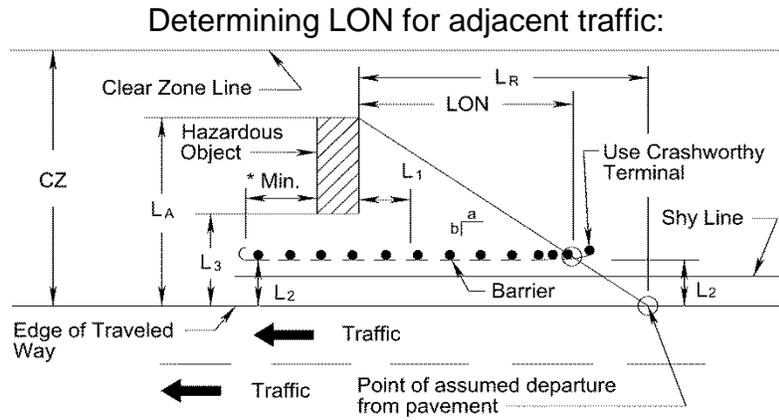
- (A) The deflection zone of all MGS w-beam guardrail systems will be measured from the face of rail and must be totally clear of any hazards in order to assure that the system will perform as tested.
- (B) The noted terminal end treatment applies when the terminal is installed outside the clear zone of opposing traffic on a divided roadway.
- (C) Vertical Height Tolerance for new installations, +/- 1".
- (D) Deflection distances are based on crash testing in controlled conditions. Where there is a potential for high speeds with high angles of impact, the distance to fixed objects should be increased (which will allow for possible higher deflections) or use concrete barrier. Consideration should be given to using concrete barrier for locations with high percentages of trucks.

---

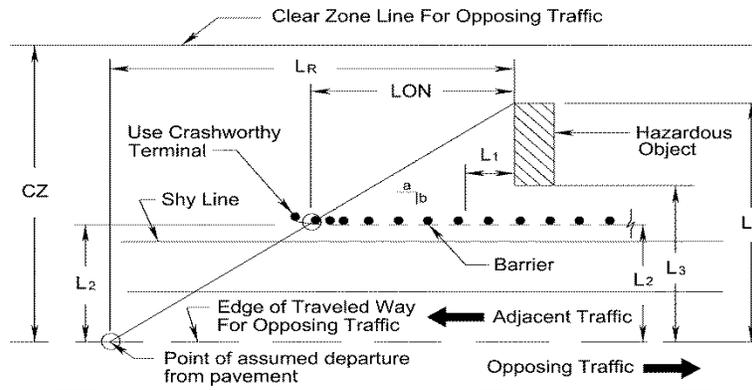
\* Rev. 1/18

### DETERMINING LOCATION OF THE ENDS OF GUARDRAIL

Figure J-3-1 and Table J-3-4 give a method to determine the location of the end of guardrail systems. Appropriate terminals shall be placed at this point.



### Determining LON for opposing traffic on two-way undivided roadway:



**FIGURE J-3-1 - BARRIER LENGTH OF NEED DETERMINATION**

- LON = Length of Need
- Cz = Clear Zone Width
- LA = Distance to back of hazard, Max. = Cz
- LR = Runout length
- L1 = Upstream length of Guardrail prior to flare
- L2 = Distance to Face of Guardrail
- L3 = Distance to front of hazard
- a:b = Flare Rate of Guardrail (if applicable)

\* For one-way traffic on undivided roadway the terminal can begin after end of hazard; 12.5' for GR-MGS3 to terminate GR-MGS1.

$$LON = \frac{LA + (b/a)(L1) - L2}{(b/a) + (LA/LR)}$$

$$LON \text{ (No Flare)} = \frac{LA - L2}{LA / LR}$$

DESIGN SPEED (MPH)	DESIGN TRAFFIC VOLUME				*	FLARE RATE	
	RUNOUT LENGTH (OVER 10000 ADT) Lr(FT)	RUNOUT LENGTH (5000 - 10000 ADT) Lr(FT)	RUNOUT LENGTH (1000 - 5000 ADT) Lr(FT)	RUNOUT LENGTH (UNDER 1000 ADT) Lr(FT)		SHY LINE (FT)	BEYOND SHY LINE
	80	470	430	380	330	12	NA
70	360	330	290	250	9	15:1	30:1
60	300	250	210	200	8	14:1	26:1
50	230	190	160	150	6.5	11:1	21:1
40	160	130	110	100	5	8:1	16:1
30	110	90	80	70	4	7:1	13:1

\*Shy line is measured from the adjacent edge of pavement and is a distance beyond which a roadside object will not be perceived as a threat by a driver. In other words, a driver will not react to an object beyond the shy line offset. If possible, the roadside barrier should be placed beyond the shy line offset.

Source: The 2011 *Roadside Design Guide* Tables 5.7, 5.9 & 5.10(b)

**TABLE J-3-4**  
**DESIGN PARAMETERS FOR ROADSIDE BARRIER LAYOUT**

**SLOPES FOR BARRIERS**

As a general rule, a roadside barrier should not be placed on an embankment if the slope of the embankment is steeper than 10:1. A clear run-out path should also be provided behind the terminal.

When guardrail is required, it is to be placed using at least the minimum fill shoulder width specified in the Geometric Design Standard.

**ASPHALT PAVING UNDER GUARDRAIL**

Asphalt paving shall be used under guardrail to control the growth of vegetation on projects which have asphalt concrete or portland cement concrete paved shoulders unless otherwise directed by the District Maintenance Engineer. Aggregate or soil stabilized shoulders do not require asphalt concrete paving under the guardrail. The additional paving is to begin and end without transition as detailed on “Asphalt Curb and Asphalt Paving under Guardrail” and the station limits of each segment is to be shown on the plans.

If more than one allowable type of asphalt concrete is called for on the project, the one with the lowest estimated unit cost is to be used. If the estimated unit costs are the same, the one with the smaller aggregate gradation is to be used.

For paving under GR-MGS1 and GR-MGS2, Standard MC-4 is applicable. If pavement depth under guardrail is greater than 2", then the Special Provision for Guardrail Post Leave-out shall be used. The leave-out in the pavement allows the post to rotate as intended when the guardrail is hit.\*

## ASPHALT CURBS

Standard MC-3B Asphalt curb is to be used, where necessary, in conjunction with MC-4 paving under guardrail on high fills to provide a means of erosion control to preserve the slopes. The need for the asphalt curb should be determined during the project Field Inspection.

A minimum 5' (1.5 m) length of asphalt curb is to be constructed past the end of an inlet and transitioned to grade level.

The same detail shown in Standard MC-3B for GR-2 is applicable for GR-MGS1.

## GUARDRAIL INSTALLATION ADJACENT TO CURB

Guardrail is not recommended where curb, or curb and gutter is used. Whenever it is necessary to provide guardrail along a curbed section for design speeds greater than 45 mph Standard GR-MGS1/1A shall be used in conjunction with Standard CG-3 or CG-7 (4" curb) and the face of the rail shall be aligned with the face of curb. For design speeds 45 mph or less, CG-2 or CG-6 (6" curb) or CG-3 or CG-7 (4" curb) can be used with the face of rail aligned with the face of curb or with the face of rail offset a minimum of 6' from the face of curb.

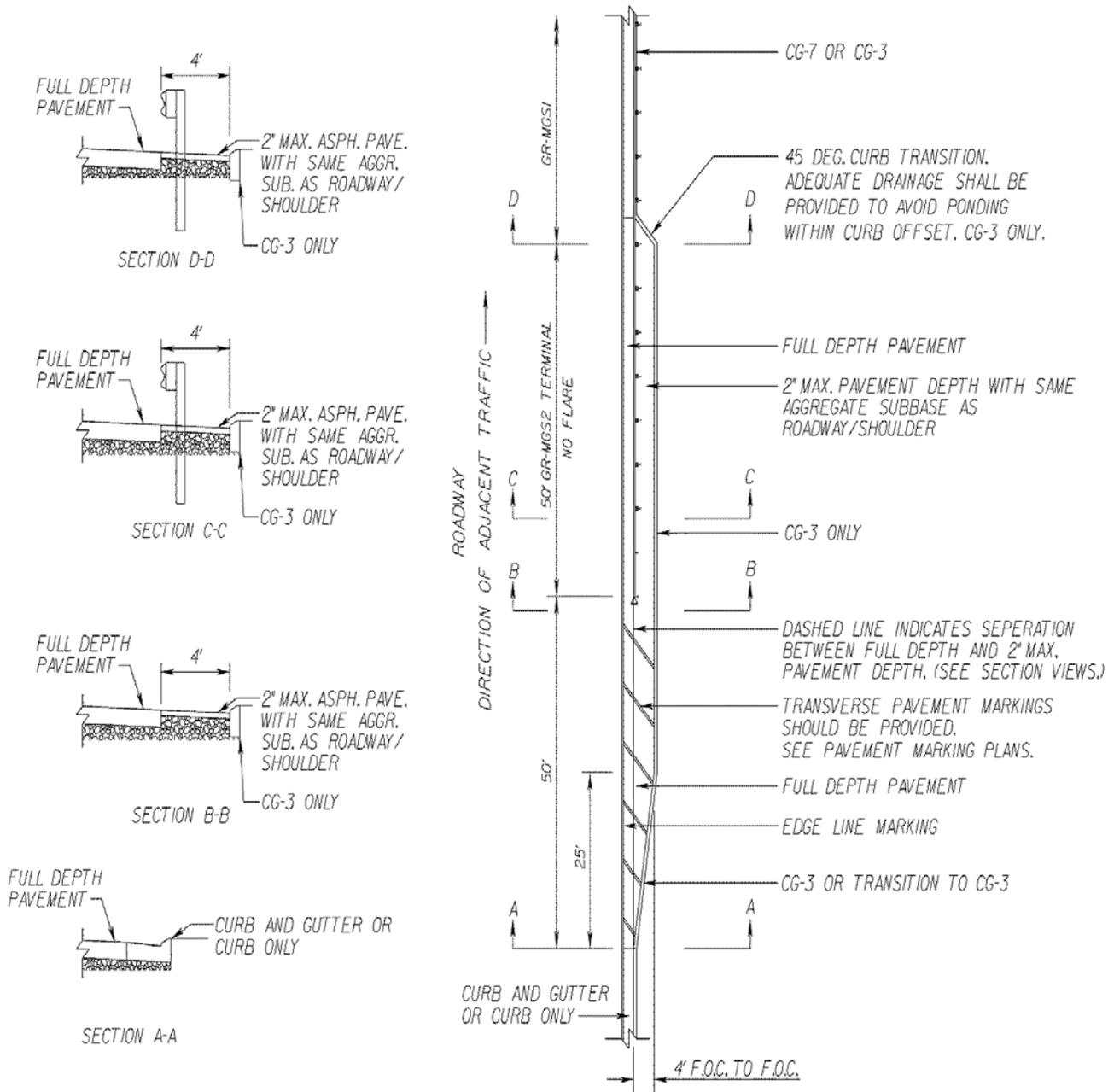
For new construction or upgrading, where guardrail is aligned with the face of curb, use the typical curb layout as shown in **Figure J-3-2** or as approved by the engineer at the terminal location. The designer will need to adjust the typical cross section as necessary to account for the curb layout. When existing curb cannot be removed or relocated, contact the Central Office Standards and Special Design Section.

It is usually impractical to install guardrail between the roadway and a sidewalk/sidewalk space. When necessary to provide guardrail along a sidewalk/sidewalk space due to a hazard, the guardrail shall be placed 1' behind the sidewalk (or sidewalk space) provided that minimum offset requirements from the face of curb are met.

When a sidewalk or shared-use path transitions from the roadway onto a bridge, guardrail is required if the travel way and the sidewalk or shared-use path are separated by a barrier on the bridge. See **Figures J-3-3 and J-3-4**.

---

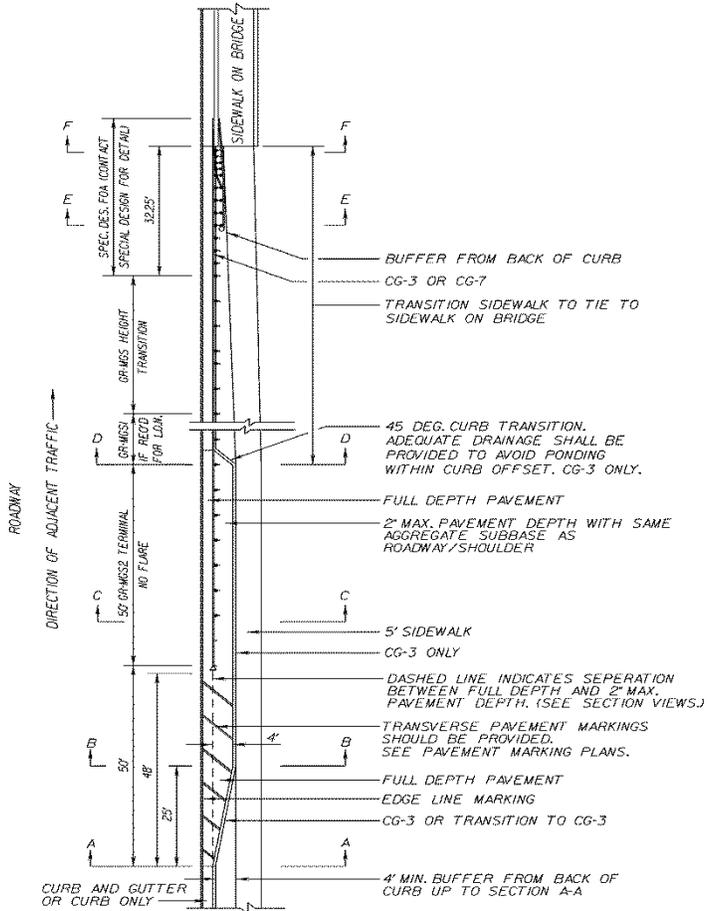
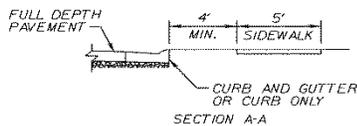
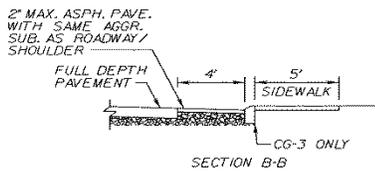
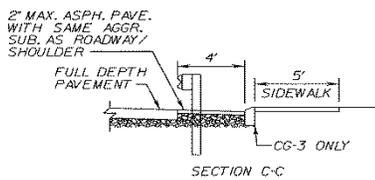
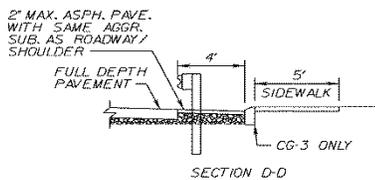
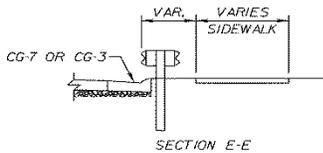
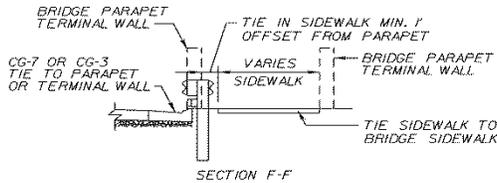
\* Rev. 1/19



**FIGURE J-3-2**

**TYPICAL CURB OFFSET LAYOUT FOR A TANGENT MGS GUARDRAIL TERMINAL\***

\* Rev. 1/18



**FIGURE J-3-3**  
**TYPICAL CURB OFFSET LAYOUT FOR A TANGENT MGS GUARDRAIL TERMINAL AT**  
**A BRIDGE WITH A SIDEWALK\***

\* Rev. 1/18



**PAVEMENT DROP-OFFS WITH GUARDRAIL**

Whenever the pavement drop-off is within 2'-0" in front of the face of rail and in order to ensure that a pavement drop-off does not become a factor in guardrail performance, the guardrail and blockout shall be removed during the paving operation to allow the pavement to be placed as close as possible to the post. This will place the drop-off to at least the face of guardrail or behind the face of guardrail. No more than 2" drop-off allowed. Any drop-offs at the edge of pavement will have to be feathered down across a paved shoulder to the guardrail. It is critical that the guardrail height measured from the top of the overlay to the top of the guardrail be within the guardrail height tolerance limits.

Whenever it is not practical to have the pavement drop-off at or behind the face of guardrail, the drop-off shall not be located any closer than 2'-0" in front of the face of guardrail. The drop-off shall be limited to a range of 1½" to 2" in height with a 3:1 or flatter wedge to minimize the effect of the drop-off on a vehicle. Any drop-off that should happen to fall within 2'-0" of the face of guardrail and/or have a height greater than 2" shall be reviewed on a per project basis. Any drop-off that should happen to fall within 2'-0" of the face of guardrail and/or have a height greater than 2" on the NHS shall be jointly reviewed by VDOT and FHWA.

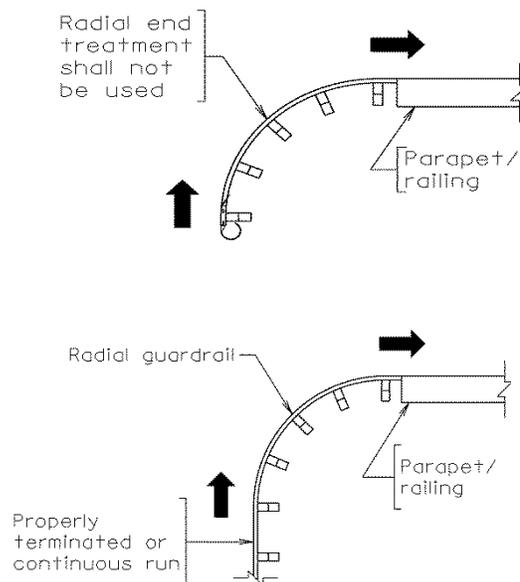
**RADIAL GUARDRAIL**

Radial guardrail is w-beam railing that is shop curved when the radius is 150 feet or less.

**Radial end treatments verses radial guardrail:**

Radial end treatments shall not be used as they do not reduce the severity of a crash (e.g., between a bridge parapet or guardrail end at a private entrance). A crash tested terminal shall be installed.

Radial guardrail that connects two railing systems around an intersection can be used to close a gap between the two systems that is hazardous. The area within the anticipated dynamic deflection of the guardrail shall be free of fixed objects with a ground slope no steeper than 2:1. (There is a potential for greater deflections due to the possibility of high angle impacts.)



When connecting a bridge parapet to a railing system around an intersection, the necessary fixed object attachment shall be installed at the parapet. The guardrail may then connect radial to the intersecting roadways guardrail and shall be terminated with a crash tested terminal. An impact attenuator may be necessary if there is not enough room for an FOA and properly terminated guardrail. The radius used should be as flat as possible. The recommended minimum radius is 50 feet. However, site conditions may dictate the need for smaller radii. The absolute minimum radii for guardrail along high speed roadways shall be 30 feet and for low speed roadways shall be 20 feet. If an intersection should require the use of a radius smaller than above contact the [Standards/Special Design Section](#) for review, approval and details. Radial guardrail shall not be used on Interstate Highways or High Speed Freeways.

## SECTION J-4 FIXED OBJECT ATTACHMENTS (FOA) AND BRIDGE GUARDRAIL ATTACHMENTS (BRGR)

When substandard FOA's or BR-GR's exist within the limits of construction projects; both FOA's and BR-GR's shall be upgraded or replaced in accordance with the current VDOT Road and Bridge Standard or Special Design BRGR.

### FOA

GR-FOA's are designed to help prevent potential vehicular snagging at the immediate upstream end of a rigid fixed object such as a vertical or safety-shaped bridge railing. These Standards use tighter post spacing and nested rail to achieve this. A rubrail is also provided to aid in the prevention of wheel snag.

There are currently no VDOT approved MASH FOA's. The MGS system will have to be transitioned to the current FOA Standards using the GR-MGS4 transition standard.

### BRGR

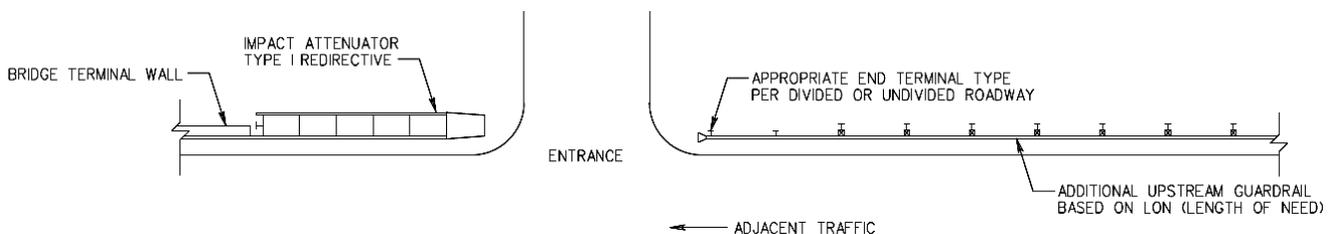
When the proposed design calls for the utilization of an existing bridge having an older type of parapet walls or rails, an appropriate detail showing the "Recommended Method for Attaching Guardrail to Bridge Rails" (BRGR) is to be obtained from the [Standards/Special Design Section](#) for inclusion in plans. Details of the existing bridge rail should accompany the request.

The MGS system will have to be transitioned to the BRGR using the GR-MGS4 transition standard.

### ENTRANCES OR CONNECTIONS ADJACENT TO A BRIDGE

When entrances or connections cannot be relocated or eliminated and are located adjacent to a bridge in areas with dense entrance locations, it may be necessary to install an impact attenuator since an FOA or a BRGR with a standard guardrail terminal may not fit. Plans fitting this criteria are to be submitted to the [Standards/Special Design Section](#) for review, approval and details.

Additional guardrail upstream of an entrance may provide some protection for secondary hazards such as bodies of water as shown below.



Refer to the **Section J-3** which discusses the use of radial guardrail off of a bridge into a connecting roadway.

## SECTION J-5 SAFETY/MAINTENANCE PROJECTS

When developing details for a Safety or Maintenance project, care must be taken to ensure proper barrier installation/maintenance/replacement to upgrade any outdated locations. There may be locations on a project where the guardrail has not been hit, but the installation may not be the safest that can currently be provided if an errant vehicle impacted the guardrail. Traffic Engineering Division shall perform a site assessment where attention should be given, but not limited to the following factors in evaluating these locations:

- (1) Location of barrier:
  - relative to hazard
  - relative to pavement
  - relative to shoulder break point
  - relative to fixed objects
- (2) Eliminating or shortening existing run of barrier:
  - remove or relocate fixed objects
  - regrade to flatten fill slopes
  - verify Length of Need (LON)
- (3) Type of guardrail used:
  - sufficient space for maximum deflection for type used
  - proper installation and height to effectively function
  - proper transitions used
- (4) Terminals:
  - proper end treatment on both ends of a run of barrier
  - proper installation and height to effectively function
  - proper transitions
  - replace substandard terminals with approved terminals.
  - at bridges/walls, guardrail terminals should not be located closer to the roadway than the bridge rail or wall (fixed object attachment or BRGR is required to connect the rail to the bridge rail or wall)
- (5) Shoulder width and site preparation:
  - provide sufficient width for site preparation
  - provide additional fill if necessary for proper flare installation
  - provide clear run-out area behind terminal installation
- (6) Fixed object attachments:
  - current Standard/BRGR attachments to fixed objects (such as bridges/walls)
  - guardrail alignment with bridge rail so that the end of the bridge with the fixed object attachment will not become an additional hazard
  - proper transitions to gradually stiffen the overall approach