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INTRODUCTION

Parapets/rails adjacent to vehicular traffic shall be crash tested as per NCHRP Report 350 and be evaluated in accordance with the AASHTO Manual for Assessing Safety Hardware (MASH).

Until the current VDOT parapet/rails standards are evaluated/crash tested in accordance with MASH, current VDOT parapet/rails are reclassified using the following Approximate Crash Test Acceptance Equivalencies.

Testing Criteria	Approximate Crash Test Acceptance Equivalencies					
MASH	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6
NCHRP Report 350	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6

The designer shall consider the use of open parapets/rails for structures over bodies of water in accordance with the Commonwealth Transportation Board resolution dated July 20, 1995. The District Structure and Bridge Engineer should be involved in the decision process. All of VDOT's standard parapets/rails are considered to be open except the F-shape concrete parapet.

Interstate bridges shall have parapet/rail which has an Adjusted Test Level of a minimum of TL-4.

Variations from crash tested rail (as per NCHRP Report 350) will require design exceptions using Form LD-440. See Part 1 File No. Pre.02-1 and -2 for instructions. In addition, variations on bridges in the NHS system must be approved by the Federal Highway Administration.

Special parapet/rail may be used with the approval of the State Structure and Bridge Engineer for unique uses on a case by case basis, e.g., historical considerations in matching existing parapets or rails, etc. Non-crash tested rail is not permitted.

The following FHWA website contains information about crash-tested parapets/rails (as per NCHRP 350).

http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers

All parapets and railings shall be oriented vertical regardless of cross slope or superelevation.

The figures in File Nos. 25.02-6 and -7 are adapted from the AASHTO *Guide Specifications for Bridge Railings*, 1989, including the 1992 Interims. The tables for Test Level Selection presented in File Nos. 25.02-1 thru -5 are adapted with permission from unpublished NCHRP Final Report, *Evaluation of Performance Level Selection Criteria for Bridge Railing*, April 1994. Test Levels in these tables are adjusted to reflect the Adjusted Test Level for MASH criteria.

NOTE:

Due to various restrictions on placing files in this manual onto the Internet, portions of the drawings shown do not necessarily reflect the correct line weights, line types, fonts, arrowheads, etc. Wherever discrepancies occur, the written text shall take precedence over any of the drawn views.

VDOT STANDARD PARAPETS AND RAILS:

The Structure and Bridge Division has developed parapet and railing standards based on crash tested designs from other entities. The table below contains information on each type of parapet or rail. For additional information, see the Manual of the Structure and Bridge Division, Part 3. For Texas T-6 railing, see Part 6.

Name	Standard Designation	Description	Height	NCHRP Test Level	Unit Weight plf	Use	Adjusted** Test Level
Kansas Corral	BCR-1	Concrete Railing with Curb	2'-3"	TL-2	340	Vehicles	TL-2
	BCR-2	Concrete Railing w/o Curb	2'-3"	TL-2	267	Vehicles	TL-2
	BCR-3	Concrete Railing with Curb	2'-8"	TL-4	417	Vehicles	TL-3
	BCR-4	Concrete Railing w/o Curb	2'-8"	TL-4	344	Vehicles	TL-3
Illinois 2399	BIR-1, BIR-2, BIR-4 and BIR-5	Steel Railing with Concrete Curb	2'-8"	TL-4	207	Vehicles	TL-3
F-Shape	BMB-3A	Concrete Median Barrier	2'-8"	TL-4	490	Vehicles	TL-3
	BMB-5A	Concrete (Split) Median Barrier	2'-8"	TL-4	689	Vehicles	TL-3
	BPB-3A, BPB-3B, BPB-3C and BPB-3D	32" - Concrete Parapet	2'-8"	TL-4	425*	Vehicles	TL-3
	BPB-4A, BPB-4B, BPB-4C and BPB-4D	42" - Concrete Parapet	3'-6"	TL-5	638*	Vehicles	TL-5

** Adjusted Test Level for MASH criteria

PARAPETS / RAILS / MEDIANS / SIDEWALKS VDOT STANDARD PARAPETS AND RAILS STANDARD SUMMARY TABLE

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VDOT STANDARD PARAPETS AND RAILS (Cont'd):

Name	Standard Designation	Description	Height	NCHRP Test Level	Unit Weight plf	Use	Adjusted** Test Level
BR27C	BR27C-12	One Steel Railing on 2'-0" Concrete Pedestal	3'-6"	TL-4	266*	Vehicles	TL-3
	BR27C-13	Four Steel Railings on 2'-0" Concrete Pedestal	4'-6"	TL-4	300*	Separate Vehicles from Ped/Bikes	TL-3
	BR27C-14	Three Steel Railings on 2'-0" Concrete Pedestal	4'-6"	TL-4	290*	Ped/Bikes Outside of Structure where barrier separates Ped/Bikes from traffic	TL-3
	BR27C-15	Three Steel Railings on 2'-0" Concrete Pedestal	4'-6"	TL-4	290*	Ped/Bikes Outside of Structure	TL-3
BR27D	BR27D-8	Two Steel Railings on 1'-6" Concrete Pedestal	3'-6"	TL-2	215*	Vehicles	TL-2
	BR27D-9	Four Steel Railings on 1'-6" Concrete Pedestal	4'-6"	TL-2	238*	Separate Vehicles from Ped/Bikes	TL-2
	BR27D-10	Three Steel Railings on 1'-6" Concrete Pedestal	4'-6"	TL-2	228*	Ped/Bikes Outside of Structure	TL-2
BR411	BR411-1	42" Texas C411 Railing	3'-6"	TL-2	357	Vehicles	TL-2
	BR411-2	54" Texas C411 Railing	4'-6"	TL-2	366	Ped/Bikes on Raised Sidewalk	TL-2
BRGC8	BRGC8	GC-8000 Railing	2'-9"	TL-4	180	Vehicles	TL-3

** Adjusted Test Level for MASH criteria

PARAPETS / RAILS / MEDIANS / SIDEWALKS VDOT STANDARD PARAPETS AND RAILS STANDARD SUMMARY TABLE

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VDOT STANDARD PARAPETS AND RAILS (Cont'd):

Name	Standard Designation	Description	Height	NCHRP Test Level	Unit Weight plf	Use	Adjusted** Test Level
BRCAS	BRCAS	California ST-20S Railing	4'-6"	TL-4	326	Vehicles	TL-3
BRMA	BRMA-1	42" Massachusetts S3 Railing with Curb	3'-6"	TL-4	247	Vehicles	TL-3
	BRMA-2	54" Massachusetts S3 Railing on Sidewalk	4'-6"	TL-4	118	Ped/Bikes on Raised Sidewalk	TL-3
BRSBD	BRSBD	SBD01d Railing	2'-9"	TL-4	162	Vehicles	TL-3
Thrie-Beam Guardrail	BTB-1	Thrie-Beam Guardrail (Side Mount)	2'-3"	TL-2	32	Low volume roads	TL-2
	BTB-2	Thrie-Beam Guardrail (Top Mount)	2'-3"	TL-2	32	Low volume roads	TL-2

Ped = Pedestrians

Low volume: Design year ADT < 750

Unit weights provided are for preliminary design purposes. They are provided for one parapet/rail line and include all weights above the top surface of deck or sidewalk including any steel attachments.

* BPB and BR27 series parapet/rail standards include –AT versions (e.g., Standard BPB-3A and Standard BPB-3A-AT) for architectural treatment on one or both faces. The designer shall calculate the unit weight when using an architectural treatment. The decision to incorporate architectural treatment into a bridge project and the type of treatments shall be made during the preliminary design. Incorporating or removing architectural treatments from a project at a later stage could require re-design and plan changes including quantities. See Chapter 5 of this manual for requirements, details and information for architectural treatment. Including architectural treatment on parapets/ railings will affect geometric items such as distance between face-to-face of curb/rail, out-to-out of deck, etc. Architectural treatment on parapets/rails will also affect substructure widths and quantities.

** Adjusted Test Level for MASH criteria

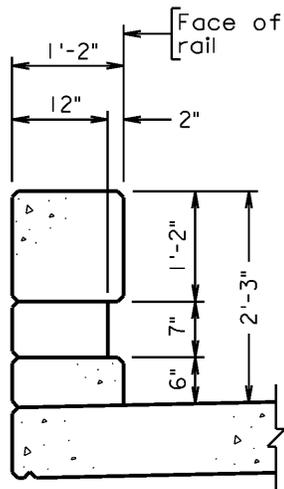
PARAPETS / RAILS / MEDIANS / SIDEWALKS VDOT STANDARD PARAPETS AND RAILS STANDARD SUMMARY TABLE

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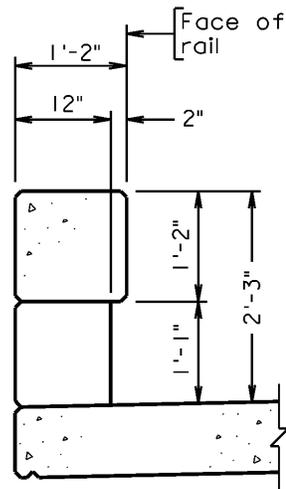
VDOT STANDARD PARAPETS AND RAILS (Cont'd):

Additional notes for the BR27C and BR27D series railing:

- A. The modifications to meet the AASHTO Bridge Specifications have been approved by the FHWA for projects with Federal funding.
- B. Usage of standards:
 - a. BR27C-12: Used as a traffic barrier.
 - b. BR27C-13: Used as a traffic barrier to separate pedestrian and/or bicycle facility from traffic with 4'-6" mounting height on traffic side.
 - c. BR27C-14: Used on the outside of a structure adjacent to a pedestrian and/or bicycle facility (for sidewalk or shared use path) mounted on top of deck where barrier separates the pedestrian and/or bicycle facility from traffic.
 - d. BR27C-15: Used as a traffic barrier on the outside of a structure adjacent to a pedestrian and/or bicycle facility where there is no barrier separating the pedestrian and/or bicycle facility from traffic. Barrier mounted on top of sidewalk (for sidewalk or shared use path) or top of deck (for signed shared roadway or bicycle lane).
 - e. BR27D-8: Used as a traffic barrier.
 - f. BR27D-9: Used as a traffic barrier to separate pedestrian and/or bicycle facility from traffic with 4'-6" mounting height on traffic side.
 - g. BR27D-10: Used on the outside of a structure adjacent to pedestrian and/or bicycle facility regardless of whether a barrier separates the pedestrian and/or bicycle facility from traffic or not. Barrier mounted on top of sidewalk or top of deck as applicable.

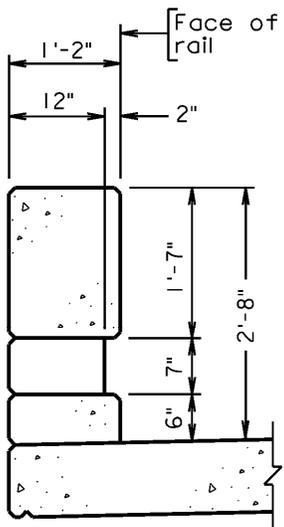


With curb BCR-1

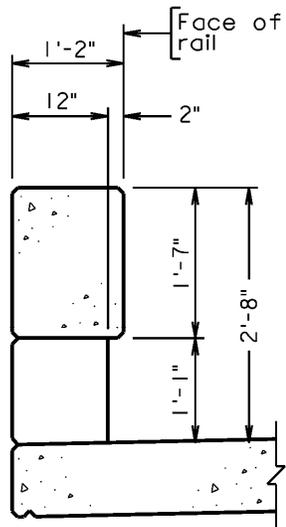


Without curb BCR-2

KANSAS CORRAL CONCRETE RAILINGS

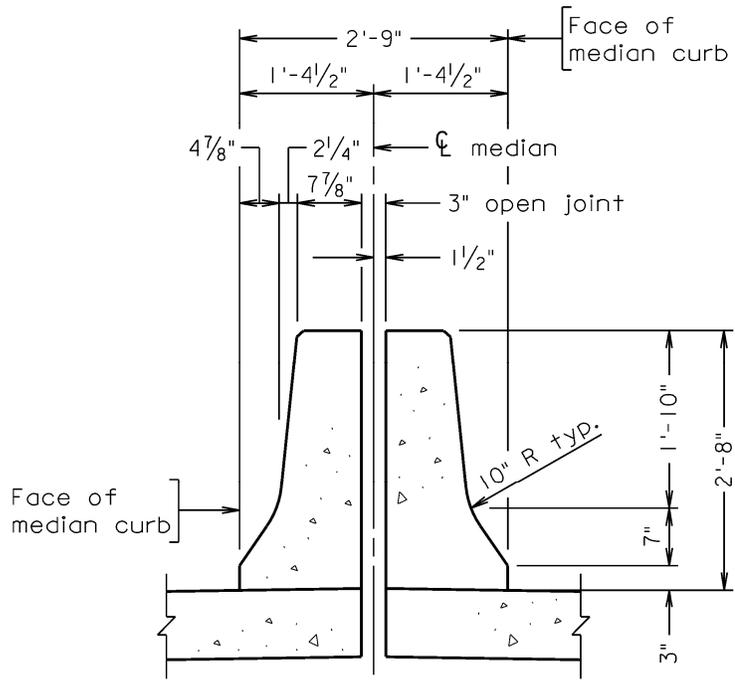


With curb BCR-3

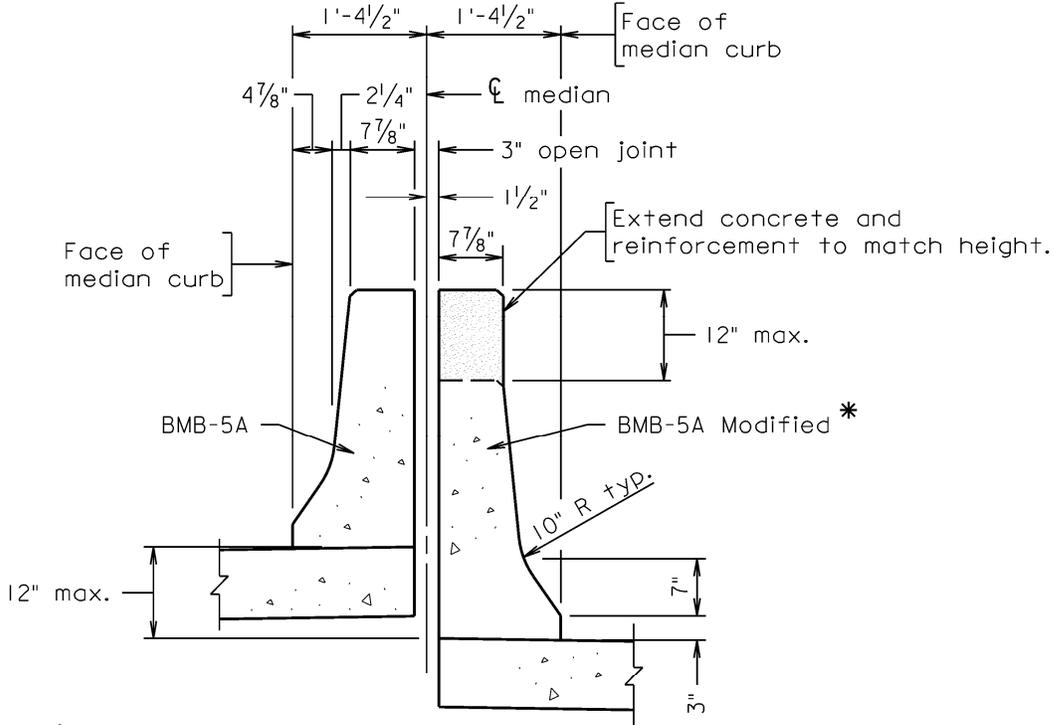


Without curb BCR-4

KANSAS CORRAL CONCRETE RAILINGS



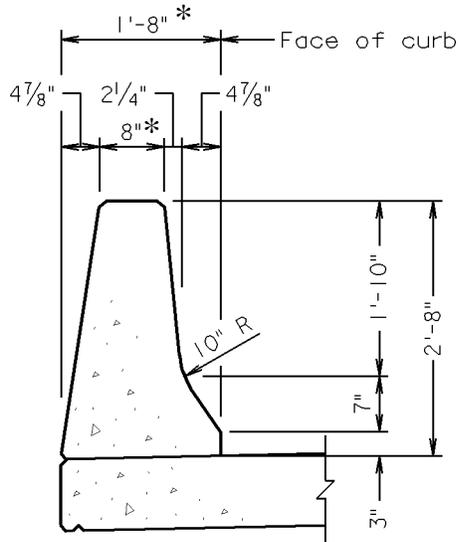
CONCRETE (SPLIT) MEDIAN BARRIER - BMB-5A



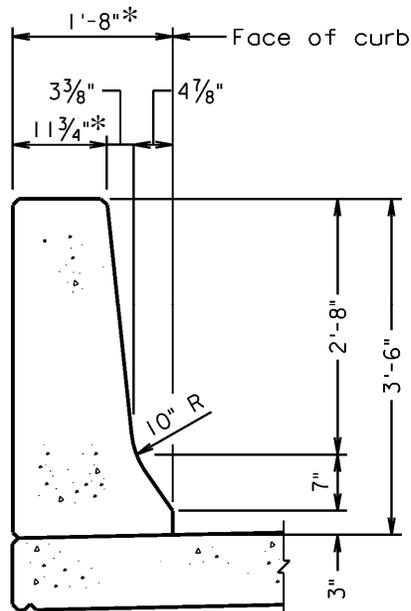
*When the elevation difference is greater than 12", use BMB-5A.

CONCRETE (SPLIT/DIFFERENT DECK EVELATIONS) MEDIAN BARRIER BMB-5A MODIFIED

Note: Contact the Engineering Services Program Area for the detail of BMB-5A Modified.



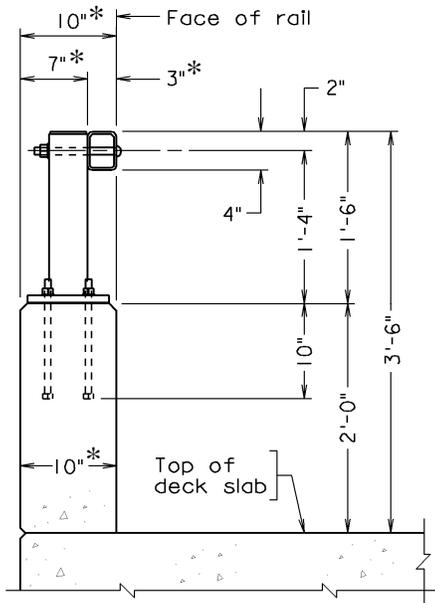
**32" - CONCRETE PARAPET (F-SHAPE)
BPB-3A, BPB-3B, BPB3C AND BPB-3D**



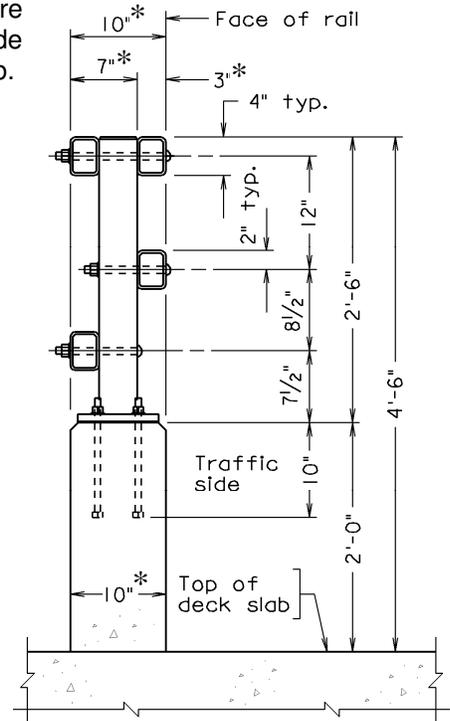
**42" - CONCRETE PARAPET (F-SHAPE)
BPB-4A, BPB-4B, BPB4C AND BPB-4D**

* BPB series parapet standards include -AT versions (e.g. Standards BPB-3A and BPB-3A-AT) for architectural treatment on one or both sides of the parapet increasing the widths shown above.

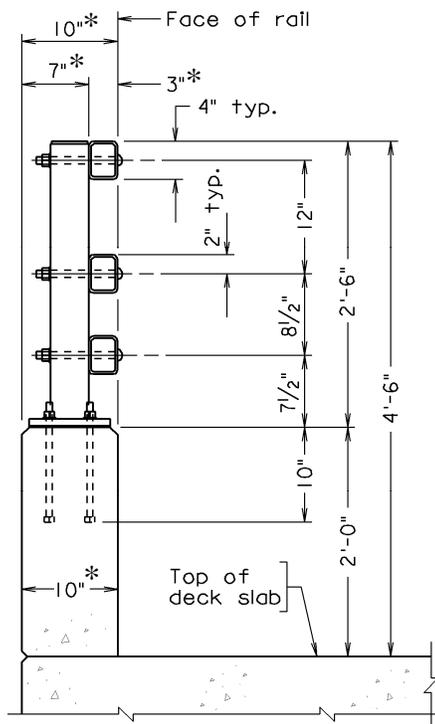
* BR27C series rail standards include -AT versions (e.g., Standards BR27C-12 and BR27C-12-AT) for architectural treatment on one or both sides of the railing increasing the widths shown below. 1" spacer plate(s) are used in the -AT Standards when the treatment is on the inside face (i.e., traffic side) to align the rail(s) with the concrete curb.



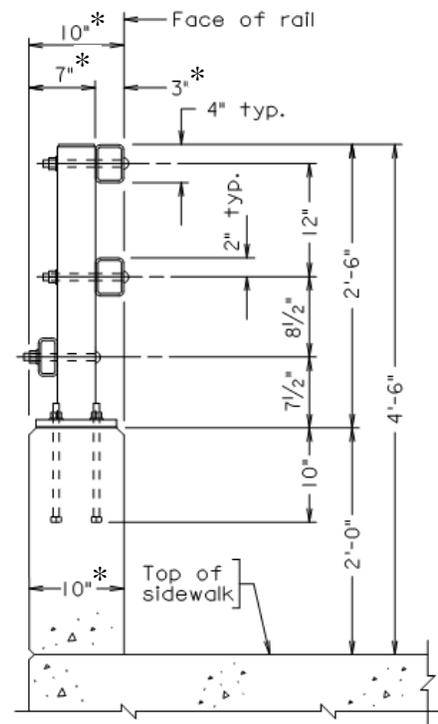
BR27C-12



BR27C-13



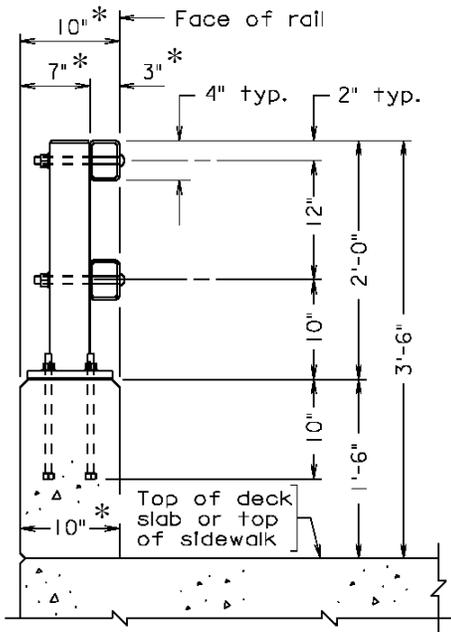
BR27C-14



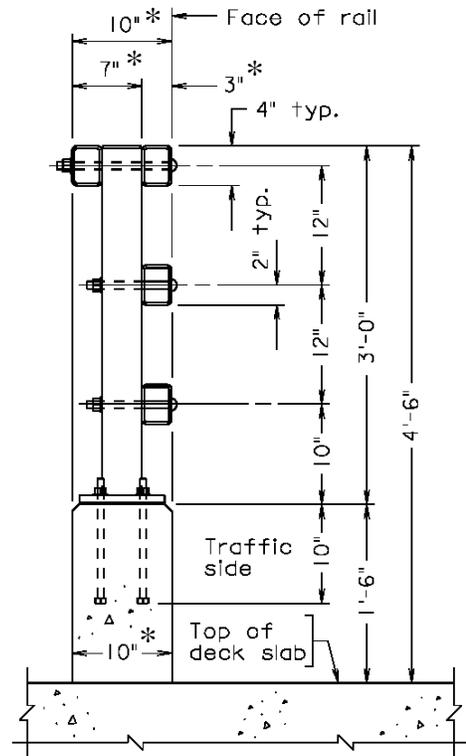
BR27C-15

**PARAPETS / RAILS / MEDIANS / SIDEWALKS
VDOT STANDARD PARAPETS AND RAILS
STANDARD TYPES**

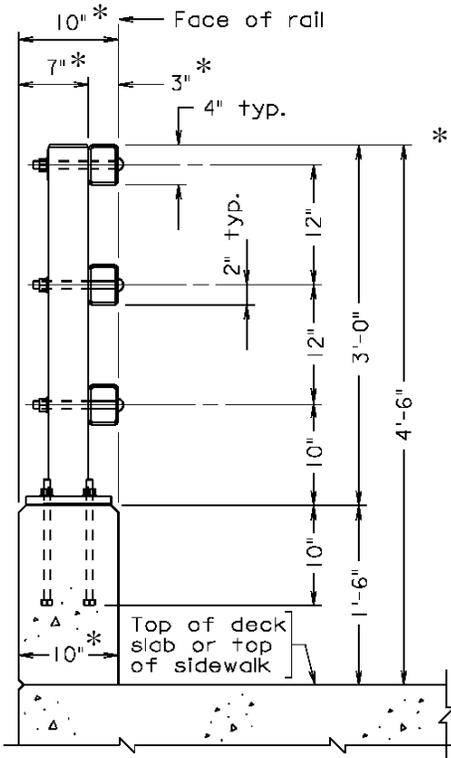
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BR27D-8



BR27D-9

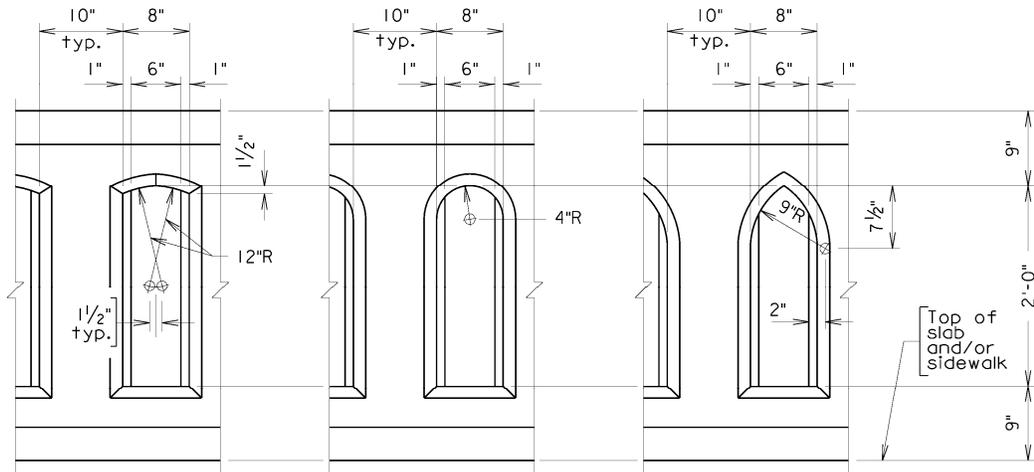


BR27D-10

* BR27D series rail standards include -AT versions (e.g., Standards BR27D-8 and BR27D-8-AT) for architectural treatment on one or both sides of the railing increasing the widths shown. 1" spacer plate(s) are used in the -AT standards when the treatment is on the inside face (i.e., traffic side) to align the rail(s) with the concrete curb.

**PARAPETS / RAILS / MEDIANS / SIDEWALKS
VDOT STANDARD PARAPETS AND RAILS
STANDARD TYPES**

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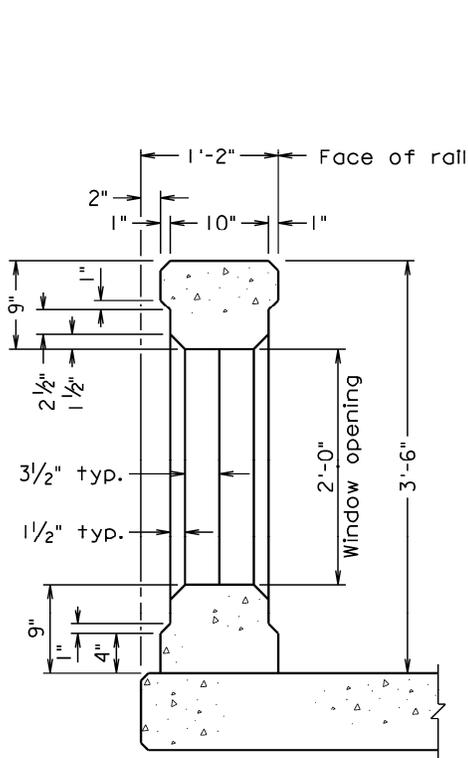


TYPE A

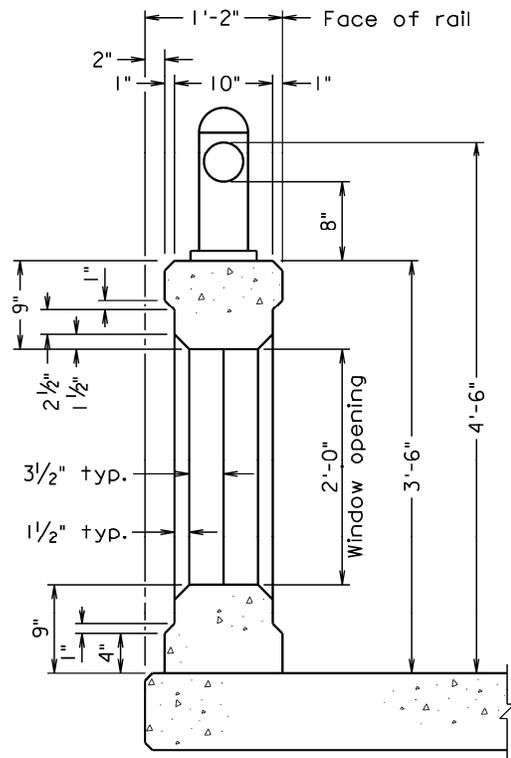
TYPE B

TYPE C

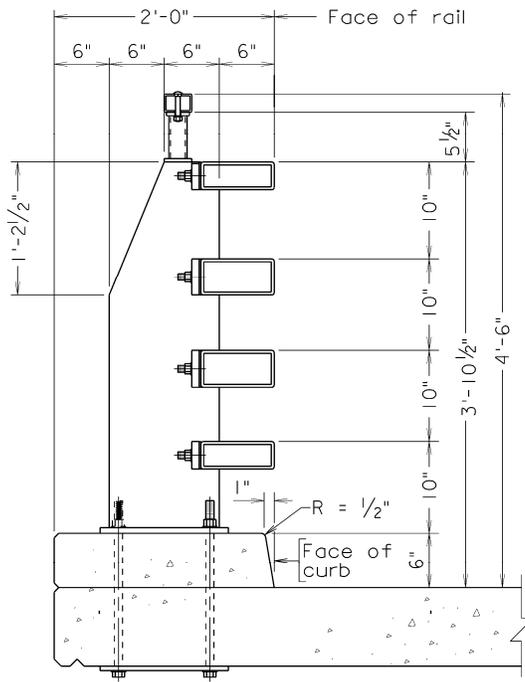
**Window Types
TEXAS C411 RAILING**



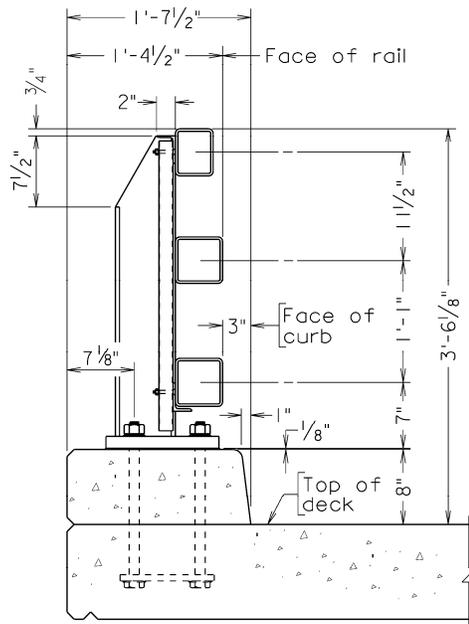
**42" TEXAS C411 RAILING
BR411-1**



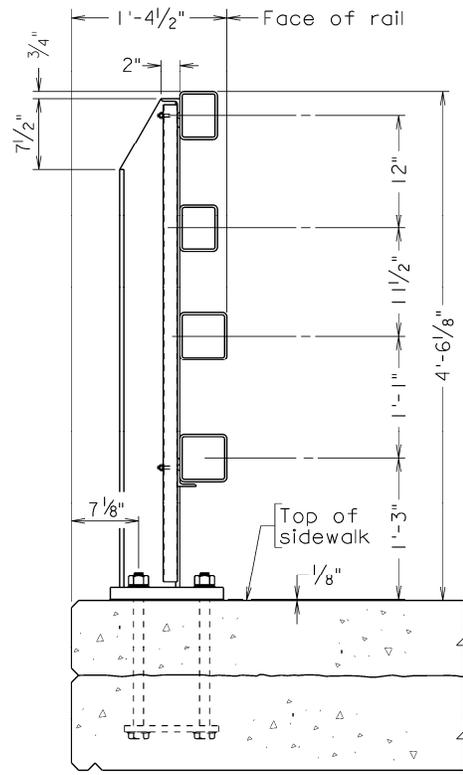
**54" TEXAS C411 RAILING
BR411-2**



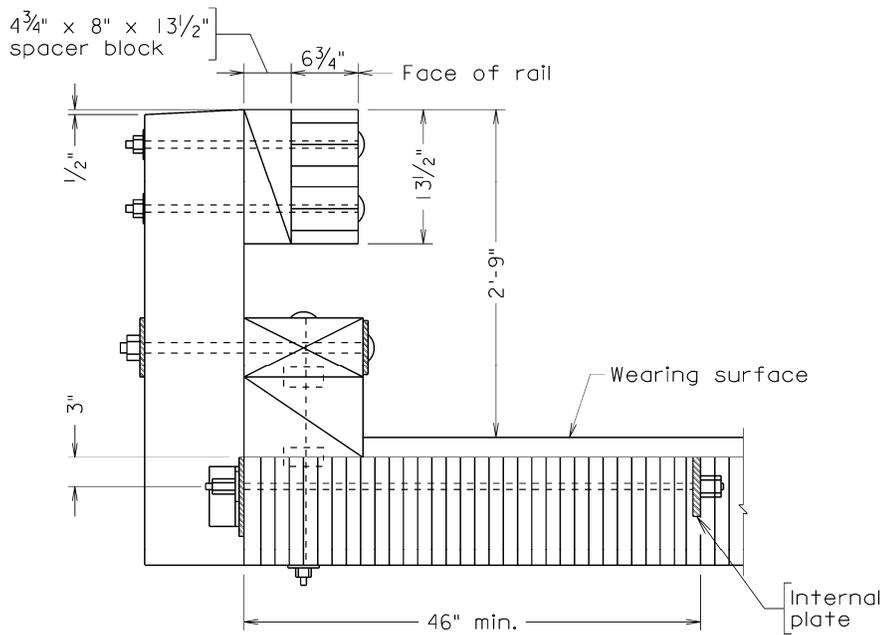
**CALIFORNIA ST-20S RAILING
BRCAS**



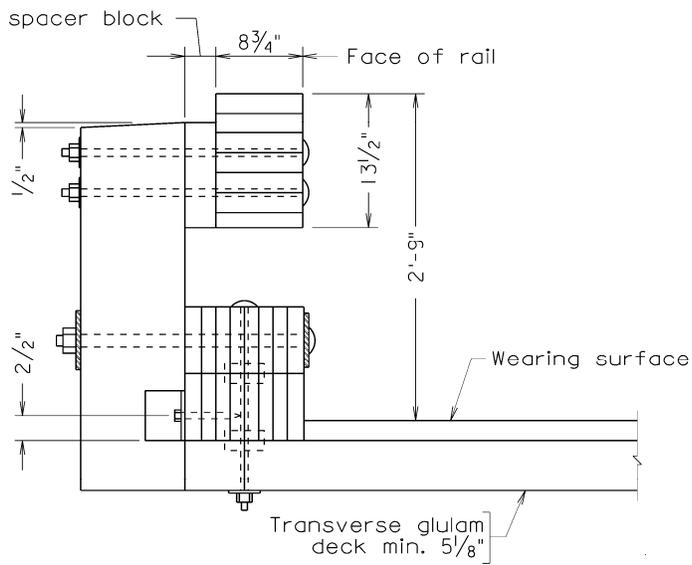
**42" MASSACHUSETTS
S3 RAILING with curb
BRMA-1**



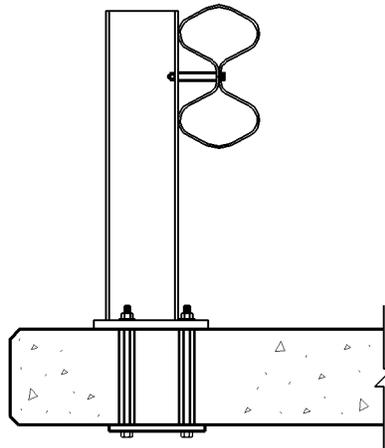
**54" MASSACHUSETTS
S3 RAILING on sidewalk
BRMA-2**



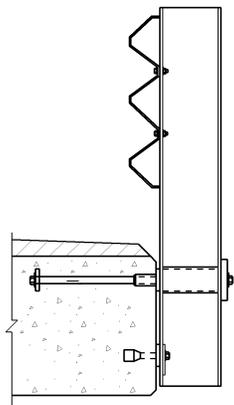
**GC - 8000 RAILING
BRGC8**



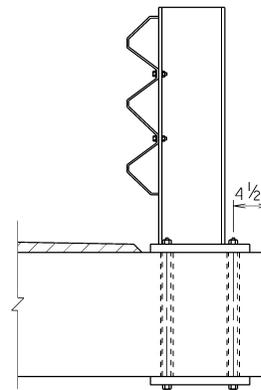
**SBD01d RAILING
BRSD**



RAILING TEXAS T-6
 Concrete slab spans \leq 20 feet
 CS-GR



BTB-1
THRIE-BEAM GUARDRAIL
 (Side Mount)



BTB-2
THRIE-BEAM GUARDRAIL
 (Top Mount)

**Evaluation of Performance Level Selection Criteria for Bridge Railing,
NCHRP Final Report (Unpublished), April 1994 – Modified**

Site Characteristics			Adjusted ADT Ranges for Bridge Railing Test Level (10 ³ vpd)								
			Highway Type								
			Divided (or Undivided with 5 or more lanes)			Undivided with 4 Lanes or Less			One Way		
Design Speed (mph)	% Trucks	Bridge Rail Offset	ADJUSTED * TEST LEVEL			ADJUSTED * TEST LEVEL			ADJUSTED * TEST LEVEL		
			TL-2	TL-3	TL-4/5	TL-2	TL-3	TL-4/5	TL-2	TL-3	TL-4/5
30	0	0-3 3-7 7-12 > 12	0 to ∞ 0 to ∞ 0 to ∞ 0 to ∞			0 to ∞ 0 to ∞ 0 to ∞ 0 to ∞			0 to ∞ 0 to ∞ 0 to ∞ 0 to ∞		
	5	0-3 3-7 7-12 > 12	0 to 206.8 to 477.6 to ∞ 0 to 281.8 to ∞ 0 to 412.6 to ∞ 0 to ∞			0 to 162.1 to 390.4 to ∞ 0 to 235.3 to ∞ 0 to 349.0 to ∞ 0 to ∞			0 to 103.4 to 238.8 to ∞ 0 to 140.9 to 315.8 to ∞ 0 to 206.3 to ∞ 0 to ∞		
	10	0-3 3-7 7-12 > 12	0 to 65.2 to 146.0 to ∞ 0 to 82.8 to 179.2 to ∞ 0 to 125.8 to 308.8 to ∞ 0 to 291.2 to ∞			0 to 50.2 to 114.9 to ∞ 0 to 66.5 to 154.7 to ∞ 0 to 103.2 to 286.5 to ∞ 0 to 254.3 to ∞			0 to 32.6 to 73.0 to ∞ 0 to 41.4 to 89.6 to ∞ 0 to 62.9 to 154.4 to ∞ 0 to 145.6 to 304.9 to ∞		
	15	0-3 3-7 7-12 > 12	0 to 38.6 to 86.2 to ∞ 0 to 48.6 to 104.4 to ∞ 0 to 74.2 to 176.0 to ∞ 0 to 168.8 to 351.2 to ∞			0 to 29.7 to 67.4 to ∞ 0 to 38.7 to 89.9 to ∞ 0 to 60.5 to 164.1 to ∞ 0 to 147.2 to 332.0 to ∞			0 to 19.3 to 43.1 to ∞ 0 to 24.3 to 52.2 to ∞ 0 to 37.1 to 88.0 to ∞ 0 to 84.4 to 175.6 to ∞		
	20	0-3 3-7 7-12 > 12	0 to 27.4 to 61.0 to ∞ 0 to 34.4 to 73.6 to ∞ 0 to 52.6 to 123.0 to ∞ 0 to 118.8 to 246.4 to ∞			0 to 21.1 to 47.7 to ∞ 0 to 27.3 to 63.4 to ∞ 0 to 42.8 to 114.9 to ∞ 0 to 103.5 to 233.5 to ∞			0 to 13.7 to 30.5 to ∞ 0 to 17.2 to 36.8 to ∞ 0 to 26.3 to 61.5 to ∞ 0 to 59.4 to 123.2 to ∞		
	25	0-3 3-7 7-12 > 12	0 to 21.4 to 47.4 to ∞ 0 to 26.6 to 56.8 to ∞ 0 to 40.8 to 94.6 to ∞ 0 to 91.8 to 189.8 to ∞			0 to 16.4 to 36.9 to ∞ 0 to 21.1 to 49.0 to ∞ 0 to 33.1 to 88.4 to ∞ 0 to 79.8 to 179.9 to ∞			0 to 10.7 to 23.7 to ∞ 0 to 13.3 to 28.4 to ∞ 0 to 20.4 to 47.3 to ∞ 0 to 45.9 to 94.9 to ∞		
	30	0-3 3-7 7-12 > 12	0 to 17.4 to 38.6 to ∞ 0 to 21.6 to 46.4 to ∞ 0 to 33.4 to 76.8 to ∞ 0 to 74.6 to 154.4 to ∞			0 to 13.4 to 30.1 to ∞ 0 to 17.2 to 39.9 to ∞ 0 to 27.0 to 71.8 to ∞ 0 to 64.9 to 146.4 to ∞			0 to 8.7 to 19.3 to ∞ 0 to 10.8 to 23.2 to ∞ 0 to 16.7 to 38.4 to ∞ 0 to 37.3 to 77.2 to ∞		
	35	0-3 3-7 7-12 > 12	0 to 14.8 to 32.6 to ∞ 0 to 18.2 to 39.0 to ∞ 0 to 28.2 to 64.8 to ∞ 0 to 63.0 to 130.2 to ∞			0 to 11.3 to 25.4 to ∞ 0 to 14.5 to 33.6 to ∞ 0 to 22.8 to 60.5 to ∞ 0 to 54.8 to 123.4 to ∞			0 to 7.4 to 16.3 to ∞ 0 to 9.1 to 19.5 to ∞ 0 to 14.1 to 32.4 to ∞ 0 to 31.5 to 65.1 to ∞		
	40	0-3 3-7 7-12 > 12	0 to 12.8 to 28.2 to ∞ 0 to 15.8 to 33.8 to ∞ 0 to 24.4 to 55.8 to ∞ 0 to 54.4 to 112.4 to ∞			0 to 9.8 to 22.0 to ∞ 0 to 12.5 to 29.1 to ∞ 0 to 19.7 to 52.3 to ∞ 0 to 47.3 to 106.6 to ∞			0 to 6.4 to 14.1 to ∞ 0 to 7.9 to 16.9 to ∞ 0 to 12.2 to 27.9 to ∞ 0 to 27.2 to 56.2 to ∞		

* Adjusted Test Level for MASH criteria

**PARAPETS / RAILS / MEDIANS / SIDEWALKS
BRIDGE RAILING TEST LEVEL SELECTION
30 MPH SELECTION TABLE**

PART 2
DATE: 28Dec2016
SHEET 1 of 9
FILE NO. 25.02-1

**Evaluation of Performance Level Selection Criteria for Bridge Railing,
NCHRP Final Report (Unpublished), April 1994 - Modified**

Site Characteristics			Adjusted ADT Ranges for Bridge Railing Test Level (10 ³ vpd)								
			Highway Type								
			Divided (or Undivided with 5 or more lanes)			Undivided with 4 Lanes or Less			One Way		
Design Speed (mph)	% Trucks	Bridge Rail Offset	ADJUSTED * TEST LEVEL			ADJUSTED * TEST LEVEL			ADJUSTED * TEST LEVEL		
			TL-2	TL-3	TL-4/5	TL-2	TL-3	TL-4/5	TL-2	TL-3	TL-4/5
40	0	0-3	0 to ∞			0 to ∞			0 to 378.7	to ∞	
		3-7	0 to ∞			0 to ∞			0 to 498.0	to ∞	
		7-12	0 to ∞			0 to ∞			0 to ∞		
		> 12	0 to ∞			0 to ∞			0 to ∞		
	5	0-3	0 to 100.6	to 221.0	to ∞	0 to 70.0	to 169.2	to ∞	0 to 50.3	to 110.5	to ∞
		3-7	0 to 130.8	to 260.6	to ∞	0 to 92.6	to 210.3	to ∞	0 to 65.4	to 130.3	to ∞
		7-12	0 to 165.8	to 410.2	to ∞	0 to 129.1	to 348.9	to ∞	0 to 82.9	to 205.1	to ∞
		> 12	0 to 284.6	to ∞		0 to 230.9	to ∞		0 to 142.3	to 374.9	to ∞
	10	0-3	0 to 33.2	to 80.8	to ∞	0 to 23.2	to 59.6	to ∞	0 to 16.6	to 40.4	to ∞
3-7		0 to 45.6	to 90.0	to ∞	0 to 32.6	to 69.6	to ∞	0 to 22.8	to 45.0	to ∞	
7-12		0 to 54.2	to 127.4	to ∞	0 to 40.9	to 110.7	to ∞	0 to 27.1	to 63.7	to ∞	
> 12		0 to 94.0	to 230.0	to ∞	0 to 73.2	to 203.5	to ∞	0 to 47.0	to 115.0	to ∞	
15	0-3	0 to 19.8	to 49.4	to ∞	0 to 13.9	to 36.1	to ∞	0 to 9.9	to 24.7	to ∞	
	3-7	0 to 27.6	to 54.4	to ∞	0 to 19.8	to 41.7	to ∞	0 to 13.8	to 27.2	to ∞	
	7-12	0 to 32.4	to 75.4	to ∞	0 to 24.3	to 65.8	to ∞	0 to 16.2	to 37.7	to ∞	
	> 12	0 to 56.2	to 135.8	to ∞	0 to 43.5	to 121.0	to ∞	0 to 28.1	to 67.9	to ∞	
20	0-3	0 to 14.2	to 35.6	to ∞	0 to 9.9	to 25.9	to ∞	0 to 7.1	to 17.8	to ∞	
	3-7	0 to 19.8	to 39.0	to ∞	0 to 14.2	to 29.8	to ∞	0 to 9.9	to 19.5	to ∞	
	7-12	0 to 23.0	to 53.6	to ∞	0 to 17.3	to 46.8	to ∞	0 to 11.5	to 26.8	to ∞	
	> 12	0 to 40.2	to 96.4	to ∞	0 to 31.0	to 86.1	to ∞	0 to 20.1	to 48.2	to ∞	
25	0-3	0 to 11.0	to 27.8	to ∞	0 to 7.7	to 20.2	to ∞	0 to 5.5	to 13.9	to ∞	
	3-7	0 to 15.4	to 30.4	to ∞	0 to 11.1	to 23.1	to ∞	0 to 7.7	to 15.2	to ∞	
	7-12	0 to 18.0	to 41.6	to ∞	0 to 13.4	to 36.3	to ∞	0 to 9.0	to 20.8	to ∞	
	> 12	0 to 31.2	to 74.6	to ∞	0 to 24.0	to 66.8	to ∞	0 to 15.6	to 37.3	to ∞	
30	0-3	0 to 9.0	to 22.8	to ∞	0 to 6.3	to 16.6	to ∞	0 to 4.5	to 11.4	to ∞	
	3-7	0 to 12.6	to 24.8	to ∞	0 to 9.1	to 18.9	to ∞	0 to 6.3	to 12.4	to ∞	
	7-12	0 to 14.6	to 34.0	to ∞	0 to 11.0	to 29.7	to ∞	0 to 7.3	to 17.0	to ∞	
	> 12	0 to 25.6	to 61.0	to ∞	0 to 19.6	to 54.6	to ∞	0 to 12.8	to 30.5	to ∞	
35	0-3	0 to 7.6	to 19.4	to ∞	0 to 5.3	to 14.0	to ∞	0 to 3.8	to 9.7	to ∞	
	3-7	0 to 10.8	to 21.0	to ∞	0 to 7.7	to 16.0	to ∞	0 to 5.4	to 10.5	to ∞	
	7-12	0 to 12.4	to 28.6	to ∞	0 to 9.3	to 25.1	to ∞	0 to 6.2	to 14.3	to ∞	
	> 12	0 to 21.6	to 51.4	to ∞	0 to 16.6	to 46.2	to ∞	0 to 10.8	to 25.7	to ∞	
40	0-3	0 to 6.6	to 16.8	to ∞	0 to 4.6	to 12.2	to ∞	0 to 3.3	to 8.4	to ∞	
	3-7	0 to 9.4	to 18.2	to ∞	0 to 6.7	to 13.9	to ∞	0 to 4.7	to 9.1	to ∞	
	7-12	0 to 10.8	to 24.8	to ∞	0 to 8.0	to 21.7	to ∞	0 to 5.4	to 12.4	to ∞	
	> 12	0 to 18.8	to 44.6	to ∞	0 to 14.4	to 40.0	to ∞	0 to 9.4	to 22.3	to ∞	

* Adjusted Test Level for MASH criteria

**PARAPETS / RAILS / MEDIANS / SIDEWALKS
BRIDGE RAILING TEST LEVEL SELECTION
50 MPH SELECTION TABLE**

PART 2
DATE: 28Dec2016
SHEET 2 of 9
FILE NO. 25.02-2

**Evaluation of Performance Level Selection Criteria for Bridge Railing,
NCHRP Final Report (Unpublished), April 1994 - Modified**

Site Characteristics			Adjusted ADT Ranges for Bridge Railing Test Level (10 ³ vpd)					
			Highway Type					
			Divided (or Undivided with 5 or more lanes)		Undivided with 4 Lanes or Less		One Way	
Design Speed (mph)	% Trucks	Bridge Rail Offset	ADJUSTED * TEST LEVEL		ADJUSTED * TEST LEVEL		ADJUSTED * TEST LEVEL	
			TL-3	TL-4/5	TL-3	TL-4/5	TL-3	TL-4/5
50	0	0-3	0 to 248.6	to ∞	0 to 171.7	to ∞	0 to 124.3	to ∞
		3-7	0 to 302.2	to ∞	0 to 212.7	to ∞	0 to 151.1	to ∞
		7-12	0 to 402.0	to ∞	0 to 291.4	to ∞	0 to 201.0	to ∞
		> 12	0 to ∞		0 to 453.9	to ∞	0 to 301.6	to ∞
	5	0-3	0 to 63.8	to 143.4	to ∞	0 to 41.9	to 101.5	to ∞
		3-7	0 to 68.8	to 201.2	to ∞	0 to 49.2	to 134.9	to ∞
		7-12	0 to 80.4	to 260.8	to ∞	0 to 58.1	to 193.3	to ∞
		> 12	0 to 137.2	to 363.8	to ∞	0 to 95.3	to 285.5	to ∞
	10	0-3	0 to 23.8	to 56.0	to ∞	0 to 15.4	to 37.9	to ∞
3-7		0 to 26.2	to 72.4	to ∞	0 to 18.0	to 47.5	to ∞	
7-12		0 to 31.8	to 89.4	to ∞	0 to 22.0	to 68.2	to ∞	
> 12		0 to 50.2	to 121.6	to ∞	0 to 34.6	to 96.2	to ∞	
15	0-3	0 to 14.6	to 34.8	to ∞	0 to 9.4	to 23.3	to ∞	
	3-7	0 to 16.2	to 44.2	to ∞	0 to 11.0	to 28.8	to ∞	
	7-12	0 to 19.8	to 54.0	to ∞	0 to 13.6	to 41.4	to ∞	
	> 12	0 to 30.8	to 73.0	to ∞	0 to 21.1	to 57.9	to ∞	
20	0-3	0 to 10.6	to 25.2	to ∞	0 to 6.8	to 16.8	to ∞	
	3-7	0 to 11.8	to 31.8	to ∞	0 to 7.9	to 20.7	to ∞	
	7-12	0 to 14.4	to 38.6	to ∞	0 to 9.8	to 29.7	to ∞	
	> 12	0 to 22.2	to 52.2	to ∞	0 to 15.2	to 41.4	to ∞	
25	0-3	0 to 8.2	to 19.8	to ∞	0 to 5.3	to 13.1	to ∞	
	3-7	0 to 9.2	to 24.8	to ∞	0 to 6.2	to 16.1	to ∞	
	7-12	0 to 11.4	to 30.0	to ∞	0 to 7.7	to 23.2	to ∞	
	> 12	0 to 17.4	to 40.6	to ∞	0 to 11.9	to 32.2	to ∞	
30	0-3	0 to 6.8	to 16.4	to ∞	0 to 4.4	to 10.8	to ∞	
	3-7	0 to 7.6	to 20.4	to ∞	0 to 5.1	to 13.2	to ∞	
	7-12	0 to 9.4	to 24.6	to ∞	0 to 6.3	to 19.0	to ∞	
	> 12	0 to 14.2	to 33.2	to ∞	0 to 9.8	to 26.3	to ∞	
35	0-3	0 to 5.8	to 13.8	to ∞	0 to 3.7	to 9.2	to ∞	
	3-7	0 to 6.4	to 17.2	to ∞	0 to 4.3	to 11.2	to ∞	
	7-12	0 to 8.0	to 20.8	to ∞	0 to 5.4	to 16.1	to ∞	
	> 12	0 to 12.0	to 28.2	to ∞	0 to 8.3	to 22.3	to ∞	
40	0-3	0 to 5.0	to 12.0	to ∞	0 to 3.2	to 7.9	to ∞	
	3-7	0 to 5.6	to 15.0	to ∞	0 to 3.7	to 9.7	to ∞	
	7-12	0 to 6.8	to 18.0	to ∞	0 to 4.7	to 14.0	to ∞	
	> 12	0 to 10.4	to 24.4	to ∞	0 to 7.2	to 19.3	to ∞	

* Adjusted Test Level for MASH criteria

**Evaluation of Performance Level Selection Criteria for Bridge Railing,
NCHRP Final Report (Unpublished), April 1994 – Modified**

Site Characteristics			Adjusted ADT Ranges for Bridge Railing Test Level (10 ³ vpd)								
			Highway Type								
			Divided (or Undivided with 5 or more lanes)		Undivided with 4 Lanes or Less		One Way				
Design Speed (mph)	% Trucks	Bridge Rail Offset	ADJUSTED * TEST LEVEL TL-3 TL-4/5		ADJUSTED * TEST LEVEL TL-3 TL-4/5		ADJUSTED * TEST LEVEL TL-3 TL-4/5				
			60	0	0-3	0 to 51.4	to ∞	0 to 38.8	to ∞	0 to 25.7	to ∞
3-7	0 to 94.6	to ∞			0 to 69.0	to ∞	0 to 47.3	to ∞			
7-12	0 to 133.0	to ∞			0 to 94.9	to ∞	0 to 66.5	to ∞			
> 12	0 to 166.2	to ∞			0 to 123.1	to ∞	0 to 83.1	to ∞			
5	0-3	0 to 26.6		to 118.2	to ∞	0 to 18.3	to 76.0	to ∞	0 to 13.3	to 59.1	to ∞
	3-7	0 to 37.4		to 137.2	to ∞	0 to 24.7	to 89.8	to ∞	0 to 18.7	to 68.6	to ∞
	7-12	0 to 50.0		to 157.6	to ∞	0 to 32.9	to 111.3	to ∞	0 to 25.0	to 78.8	to ∞
	> 12	0 to 60.2		to 224.4	to ∞	0 to 41.3	to 165.3	to ∞	0 to 30.1	to 112.2	to ∞
10	0-3	0 to 14.0		to 48.8	to ∞	0 to 9.2	to 30.0	to ∞	0 to 7.0	to 24.4	to ∞
	3-7	0 to 18.0	to 54.4	to ∞	0 to 11.3	to 35.1	to ∞	0 to 9.0	to 27.2	to ∞	
	7-12	0 to 21.8	to 63.0	to ∞	0 to 14.2	to 43.7	to ∞	0 to 10.9	to 31.5	to ∞	
	> 12	0 to 26.8	to 81.8	to ∞	0 to 18.0	to 60.3	to ∞	0 to 13.4	to 40.9	to ∞	
15	0-3	0 to 9.6	to 30.6	to ∞	0 to 6.1	to 18.7	to ∞	0 to 4.8	to 15.3	to ∞	
	3-7	0 to 11.8	to 34.0	to ∞	0 to 7.3	to 21.8	to ∞	0 to 5.9	to 17.0	to ∞	
	7-12	0 to 14.0	to 39.4	to ∞	0 to 9.1	to 27.2	to ∞	0 to 7.0	to 19.7	to ∞	
	> 12	0 to 17.2	to 50.0	to ∞	0 to 11.5	to 36.9	to ∞	0 to 8.6	to 25.0	to ∞	
20	0-3	0 to 7.2	to 22.4	to ∞	0 to 4.6	to 13.6	to ∞	0 to 3.6	to 11.2	to ∞	
	3-7	0 to 8.8	to 24.8	to ∞	0 to 5.4	to 15.8	to ∞	0 to 4.4	to 12.4	to ∞	
	7-12	0 to 10.2	to 28.6	to ∞	0 to 6.7	to 19.7	to ∞	0 to 5.1	to 14.3	to ∞	
	> 12	0 to 12.8	to 36.0	to ∞	0 to 8.4	to 26.6	to ∞	0 to 6.4	to 18.0	to ∞	
25	0-3	0 to 5.8	to 17.6	to ∞	0 to 3.7	to 10.7	to ∞	0 to 2.9	to 8.8	to ∞	
	3-7	0 to 7.0	to 19.4	to ∞	0 to 4.3	to 12.4	to ∞	0 to 3.5	to 9.7	to ∞	
	7-12	0 to 8.0	to 22.6	to ∞	0 to 5.3	to 15.5	to ∞	0 to 4.0	to 11.3	to ∞	
	> 12	0 to 10.0	to 28.2	to ∞	0 to 6.7	to 20.7	to ∞	0 to 5.0	to 14.1	to ∞	
30	0-3	0 to 4.8	to 14.6	to ∞	0 to 3.1	to 8.8	to ∞	0 to 2.4	to 7.3	to ∞	
	3-7	0 to 5.8	to 16.0	to ∞	0 to 3.6	to 10.2	to ∞	0 to 2.9	to 8.0	to ∞	
	7-12	0 to 6.6	to 18.6	to ∞	0 to 4.4	to 12.8	to ∞	0 to 3.3	to 9.3	to ∞	
	> 12	0 to 8.4	to 23.0	to ∞	0 to 5.5	to 17.0	to ∞	0 to 4.2	to 11.5	to ∞	
35	0-3	0 to 4.2	to 12.4	to ∞	0 to 2.6	to 7.5	to ∞	0 to 2.1	to 6.2	to ∞	
	3-7	0 to 5.0	to 13.6	to ∞	0 to 3.0	to 8.7	to ∞	0 to 2.5	to 6.8	to ∞	
	7-12	0 to 5.6	to 15.8	to ∞	0 to 3.7	to 10.8	to ∞	0 to 2.8	to 7.9	to ∞	
	> 12	0 to 7.2	to 19.6	to ∞	0 to 4.7	to 14.4	to ∞	0 to 3.6	to 9.8	to ∞	
40	0-3	0 to 3.6	to 10.8	to ∞	0 to 2.3	to 6.5	to ∞	0 to 1.8	to 5.4	to ∞	
	3-7	0 to 4.4	to 11.8	to ∞	0 to 2.7	to 7.5	to ∞	0 to 2.2	to 5.9	to ∞	
	7-12	0 to 5.0	to 13.8	to ∞	0 to 3.2	to 9.4	to ∞	0 to 2.5	to 6.9	to ∞	
	> 12	0 to 6.2	to 17.0	to ∞	0 to 4.1	to 12.5	to ∞	0 to 3.1	to 8.5	to ∞	

* Adjusted Test Level for MASH criteria

**Evaluation of Performance Level Selection Criteria for Bridge Railing,
NCHRP Final Report (Unpublished), April 1994 – Modified**

Site Characteristics			Adjusted ADT Ranges for Bridge Railing Test Level (10 ³ vpd)								
			Highway Type								
			Divided (or Undivided with 5 or more lanes)		Undivided with 4 Lanes or Less		One Way				
Design Speed (mph)	% Trucks	Bridge Rail Offset	ADJUSTED * TEST LEVEL		ADJUSTED * TEST LEVEL		ADJUSTED * TEST LEVEL				
			TL-3	TL-4/5	TL-3	TL-4/5	TL-3	TL-4/5			
70	0	0-3	0 to 17.0	to ∞	0 to 12.1	to ∞	0 to 8.5	to ∞			
		3-7	0 to 27.6	to ∞	0 to 19.2	to ∞	0 to 13.8	to ∞			
		7-12	0 to 29.2	to ∞	0 to 20.6	to ∞	0 to 14.6	to ∞			
		> 12	0 to 44.4	to ∞	0 to 32.8	to ∞	0 to 22.2	to ∞			
	5	0-3	0 to 12.4	to 95.2	to ∞	0 to 8.4	to 58.2	to ∞	0 to 6.2	to 47.6	to ∞
		3-7	0 to 18.0	to 96.8	to ∞	0 to 11.8	to 62.9	to ∞	0 to 9.0	to 48.4	to ∞
		7-12	0 to 19.6	to 119.0	to ∞	0 to 13.4	to 76.9	to ∞	0 to 9.8	to 59.5	to ∞
		> 12	0 to 26.6	to 156.0	to ∞	0 to 18.4	to 107.7	to ∞	0 to 13.3	to 78.0	to ∞
	10	0-3	0 to 8.8	to 40.4	to ∞	0 to 5.6	to 24.2	to ∞	0 to 4.4	to 20.2	to ∞
3-7		0 to 11.4	to 41.2	to ∞	0 to 7.3	to 26.5	to ∞	0 to 5.7	to 20.6	to ∞	
7-12		0 to 12.4	to 51.2	to ∞	0 to 8.1	to 32.4	to ∞	0 to 6.2	to 25.6	to ∞	
> 12		0 to 15.8	to 64.6	to ∞	0 to 10.5	to 44.5	to ∞	0 to 7.9	to 32.3	to ∞	
15	0-3	0 to 6.8	to 25.6	to ∞	0 to 4.2	to 15.3	to ∞	0 to 3.4	to 12.8	to ∞	
	3-7	0 to 8.4	to 26.2	to ∞	0 to 5.3	to 16.8	to ∞	0 to 4.2	to 13.1	to ∞	
	7-12	0 to 9.0	to 32.6	to ∞	0 to 5.8	to 20.5	to ∞	0 to 4.5	to 16.3	to ∞	
	> 12	0 to 11.4	to 40.8	to ∞	0 to 7.3	to 28.0	to ∞	0 to 5.7	to 20.4	to ∞	
20	0-3	0 to 5.4	to 18.8	to ∞	0 to 3.4	to 11.2	to ∞	0 to 2.7	to 9.4	to ∞	
	3-7	0 to 6.6	to 19.2	to ∞	0 to 4.2	to 12.3	to ∞	0 to 3.3	to 9.6	to ∞	
	7-12	0 to 7.2	to 23.8	to ∞	0 to 4.6	to 15.0	to ∞	0 to 3.6	to 11.9	to ∞	
	> 12	0 to 8.8	to 29.8	to ∞	0 to 5.7	to 20.4	to ∞	0 to 4.4	to 14.9	to ∞	
25	0-3	0 to 4.6	to 14.8	to ∞	0 to 2.8	to 8.8	to ∞	0 to 2.3	to 7.4	to ∞	
	3-7	0 to 5.4	to 15.2	to ∞	0 to 3.4	to 9.7	to ∞	0 to 2.7	to 7.6	to ∞	
	7-12	0 to 6.0	to 18.8	to ∞	0 to 3.7	to 11.8	to ∞	0 to 3.0	to 9.4	to ∞	
	> 12	0 to 7.2	to 23.4	to ∞	0 to 4.6	to 16.1	to ∞	0 to 3.6	to 11.7	to ∞	
30	0-3	0 to 4.0	to 12.2	to ∞	0 to 2.4	to 7.3	to ∞	0 to 2.0	to 6.1	to ∞	
	3-7	0 to 4.6	to 12.4	to ∞	0 to 2.9	to 8.0	to ∞	0 to 2.3	to 6.2	to ∞	
	7-12	0 to 5.0	to 15.6	to ∞	0 to 3.2	to 9.8	to ∞	0 to 2.5	to 7.8	to ∞	
	> 12	0 to 6.0	to 19.4	to ∞	0 to 3.9	to 13.3	to ∞	0 to 3.0	to 9.7	to ∞	
35	0-3	0 to 3.6	to 10.4	to ∞	0 to 2.1	to 6.2	to ∞	0 to 1.8	to 5.2	to ∞	
	3-7	0 to 4.0	to 10.6	to ∞	0 to 2.5	to 6.8	to ∞	0 to 2.0	to 5.3	to ∞	
	7-12	0 to 4.4	to 13.2	to ∞	0 to 2.8	to 8.3	to ∞	0 to 2.2	to 6.6	to ∞	
	> 12	0 to 5.2	to 16.4	to ∞	0 to 3.3	to 11.3	to ∞	0 to 2.6	to 8.2	to ∞	
40	0-3	0 to 3.2	to 9.0	to ∞	0 to 1.9	to 5.4	to ∞	0 to 1.6	to 4.5	to ∞	
	3-7	0 to 3.6	to 9.2	to ∞	0 to 2.2	to 5.9	to ∞	0 to 1.8	to 4.6	to ∞	
	7-12	0 to 3.8	to 11.6	to ∞	0 to 2.4	to 7.2	to ∞	0 to 1.9	to 5.8	to ∞	
	> 12	0 to 4.6	to 14.2	to ∞	0 to 2.9	to 9.8	to ∞	0 to 2.3	to 7.1	to ∞	

* Adjusted Test Level for MASH criteria

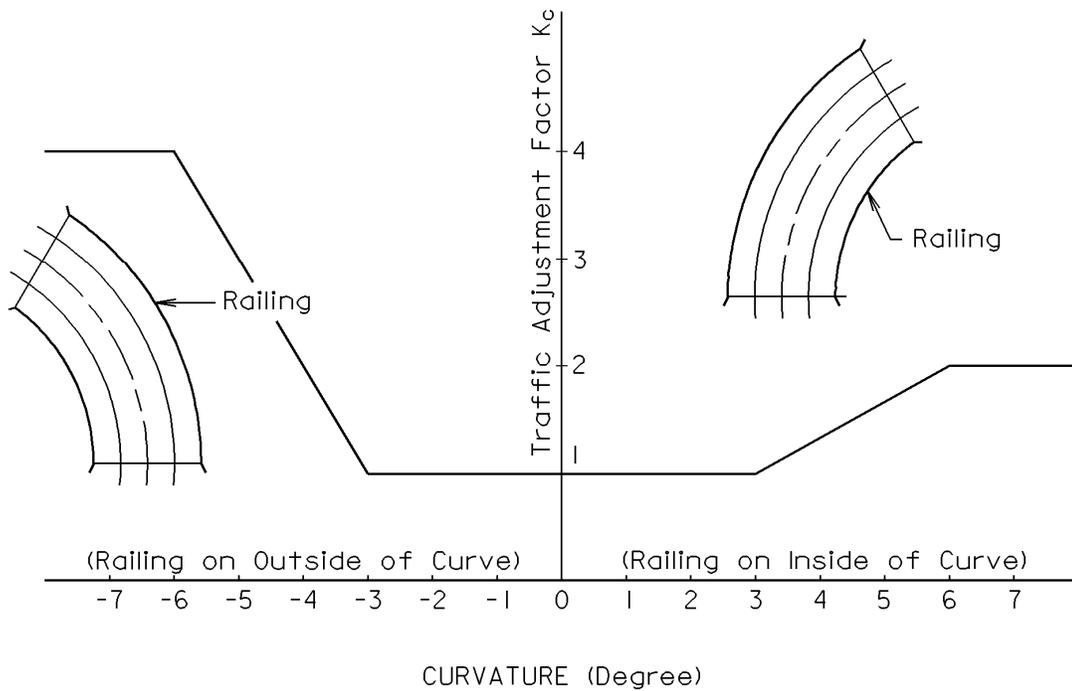


FIGURE A

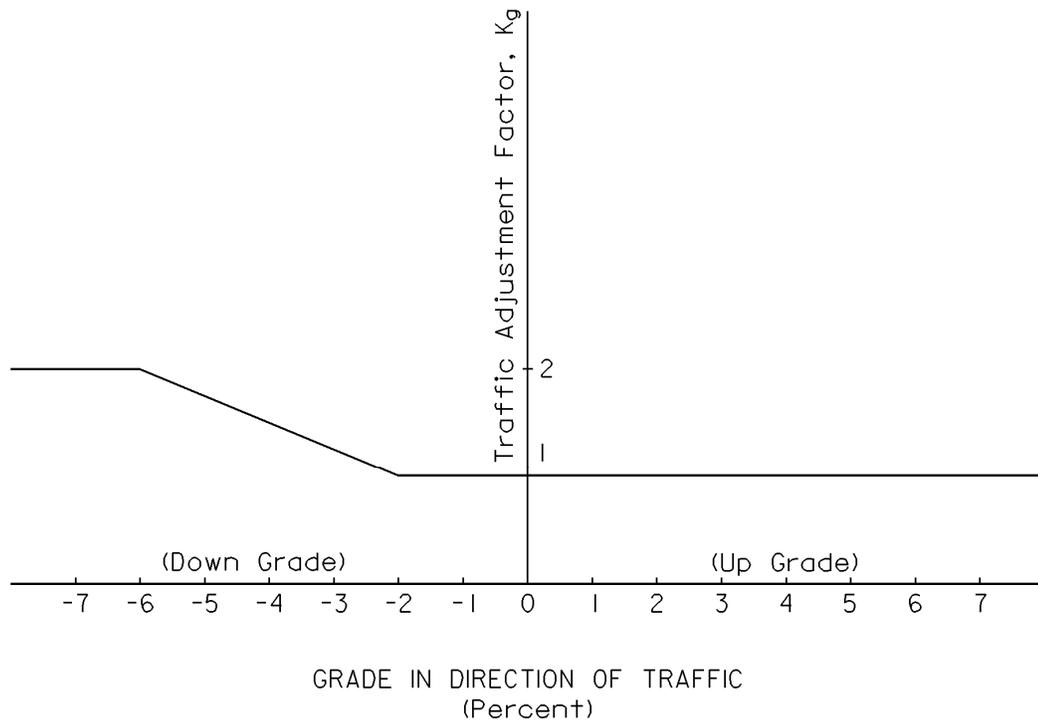


FIGURE B

**PARAPETS / RAILS / MEDIANS / SIDEWALKS
BRIDGE PERFORMANCE LEVEL SELECTION TABLES
GRADE AND CURVATURE ADJUSTMENT TABLES**

PART 2
DATE: 17Jul2009
SHEET 6 of 9
FILE NO. 25.02-6

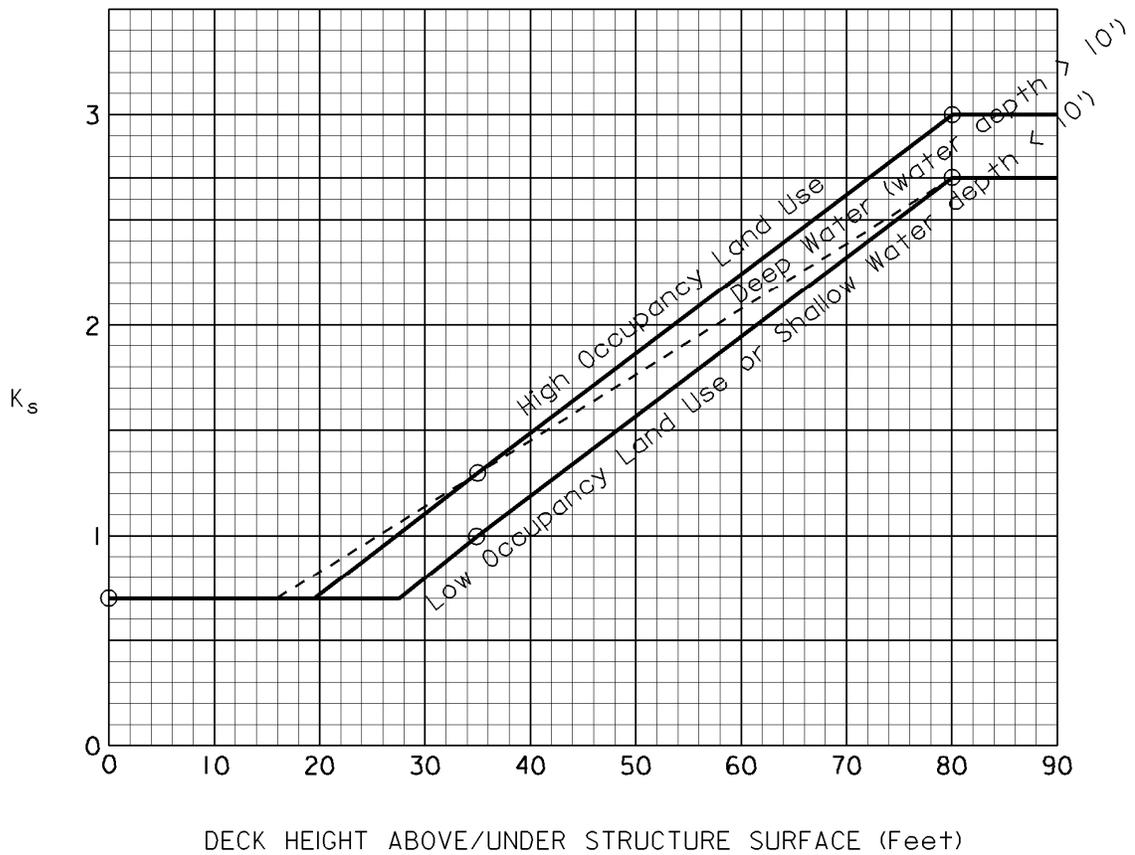


FIGURE C

DETERMINING THE TEST LEVEL REQUIRED FOR A PARTICULAR BRIDGE:

GENERAL:

Determine the appropriate traffic adjustment factors to the ADT using Figures A (curvature), B (grade) and C (deck height) in File Nos. 25.02-6 and -7.

$$\text{Curvature (Degree)} = 5729.58 / R$$

Where: R = radius of curve (in feet)

Calculate the adjusted ADT using the modification factors.

$$\text{Adjusted ADT} = \text{Design ADT} \times K_c \times K_g \times K_s$$

Where: Design ADT = total for highway (divided and undivided)

Design ADT = total for one-directional structure (one-way)

The estimated design-year ADT may be limited to 10,000 vehicles per day per lane for design speeds of 50 mph or greater, where the actual estimate exceeds that amount. For example, on a four-lane divided highway with estimated design-year ADT of 46,800 vehicles per day with design speed of 55 mph, Design ADT of 40,000 could be used instead of 46,800 in the Adjusted ADT calculation.

Confirm interpretation of the Design ADT with the road designer (i.e., total for highway or total for one-directional structure).

Select the appropriate Selection Table based on the design speed from File Nos. 25.02-1 thru -5. If the design speed is between values listed in the tables, go to the next higher speed. For example, if the design speed is 35 mph, use the 40 mph Selection Table.

Using the appropriate selected table:

Percent Trucks – Go to the appropriate row. If value is between, use higher %.

Bridge Rail Offset – Go to the appropriate sub row.

Highway Type – Go to the appropriate column and find the required Test Level corresponding to the calculated adjusted ADT.

Divided = Two-way traffic on bridge separated by median barrier or median (4' minimum)

Undivided = Two-way traffic on bridge without median barrier or median less than 4'

One-way = One-directional traffic on bridge (including Divided, but separate structures)

Note that One-way Adjusted ADT Range thresholds in tables on File Nos. 25.02-1 thru -5 are half those for Divided.

EXAMPLE:

Design speed: 45 mph
Percent trucks: 8%
Highway type: Urban Minor Arterial with 3 lanes in each direction separated by median barrier
(one bridge structure with total of 6 lanes)
Design year ADT: 19,800 vehicles (total for highway)
Grade in direction of traffic: - 3% (down grade)
Curved alignment – approaches and bridge, curvature is 4°
Deck height: 35 feet above surface, average water depth = 27.8 feet
Face of rail/parapet is offset 10 feet from edge of pavement (traveled lane)

Calculate Adjusted ADT:

From Figure A, using a 4° curve

For railing on inside of curve, $K_c = 1.33$

For railing on outside of curve, $K_c = 2.00$

From Figure B, with a -3% grade, $K_g = 1.25$

From Figure C, with deck height of 35 feet above surface
and deep water curve (avg. water depth = 27.8 > 10' on graph)

$K_s = 1.3$

$$\begin{aligned} \text{Adjusted ADT} &= \text{Design ADT} \times K_c \times K_g \times K_s \\ &= (19,800) \times 2.00 \times 1.25 \times 1.3 \\ &= 64,350 \end{aligned}$$

Since the design speed is 45 mph, use the 50 mph Selection Table.

Find row with 10% trucks and sub row with 7-12 feet rail offset.

Use column with Highway Type Divided and find the Test Level with the computed Adjusted ADT.

An adjusted ADT of 64,350 falls in between the values of 31,800 to 89,400 under Test Level 3.

Therefore, rail/parapet crash tested to Adjusted TL-3 is required.

NOTE: In this example, the Adjusted ADT is calculated based on the larger value for K_c for curvature. The outside rail/parapet governed. Normally for a bridge structure, even though the inside and outside rail/parapet may require different test levels, the higher level should be used for both sides. Different test levels for the rail/parapet may be applied if one side of the bridge structure requires a traffic barrier while the other side requires a sidewalk with pedestrian/and or bikeway access.

EXAMPLE:

Design speed: 45 mph
Percent trucks: 8%
Highway type: Urban Minor Arterial with 3 lanes in each direction separated by median barrier
(one bridge structure with total of 6 lanes)
Design year ADT: 19,800 vehicles (total for highway)
Grade in direction of traffic: - 3% (down grade)
Curved alignment – approaches and bridge, curvature is 4°
Deck height: 35 feet above surface, average water depth = 27.8 feet
Face of rail/parapet is offset 10 feet from edge of pavement (traveled lane)

Calculate Adjusted ADT:

From Figure A, using a 4° curve

For railing on inside of curve, $K_c = 1.33$

For railing on outside of curve, $K_c = 2.00$

From Figure B, with a -3% grade, $K_g = 1.25$

From Figure C, with deck height of 35 feet above surface
and deep water curve (avg. water depth = 27.8 > 10' on graph)

$$K_s = 1.3$$

$$\begin{aligned} \text{Adjusted ADT} &= \text{Design ADT} \times K_c \times K_g \times K_s \\ &= (19,800) \times 2.00 \times 1.25 \times 1.3 \\ &= 64,350 \end{aligned}$$

Since the design speed is 45 mph, use the 50 mph Selection Table.

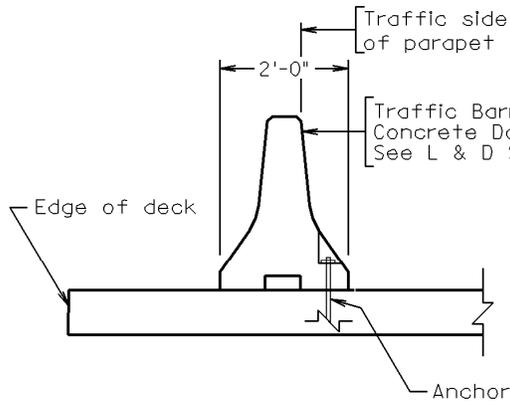
Find row with 10% trucks and sub row with 7-12 feet rail offset.

Use column with Highway Type Divided and find the Test Level with the computed Adjusted ADT.

An adjusted ADT of 64,350 falls in between the values of 31,800 to 89,400 under Test Level 4.

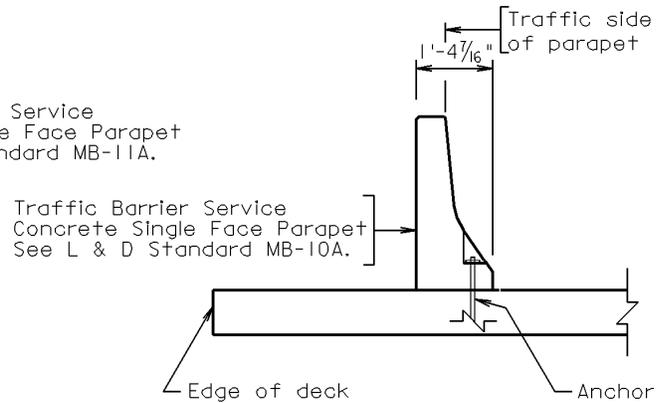
Therefore, rail/parapet crash tested to TL-4 is required.

NOTE: In this example, the Adjusted ADT is calculated based on the larger value for K_c for curvature. The outside rail/parapet governed. Normally for a bridge structure, even though the inside and outside rail/parapet may require different test levels, the higher level should be used for both sides. Different test levels for the rail/parapet may be applied if one side of the bridge structure requires a traffic barrier while the other side requires a sidewalk with pedestrian/and or bikeway access.



**TRAFFIC BARRIER SERVICE
CONCRETE DOUBLE FACE PARAPET**

Shown with traffic on one side
of barrier only



**TRAFFIC BARRIER SERVICE
CONCRETE SINGLE FACE PARAPET**

GENERAL GUIDELINES:

The following are guidelines for detailing temporary barrier service:

1. A temporary traffic barrier is required when:
 - the parapet/rail has been removed creating a hazardous opening for vehicular traffic.
 - maintenance/repair work (overlays, deck patching, etc.) on bridge deck and traffic needs to be channelized.
 - there is a need for traffic control.

2. The two approved temporary traffic barriers for bridge applications may be found in the VDOT Road and Bridge Standards:
 - MB-10A Traffic Barrier Service Concrete Parapet (Single Face)
 - MB-11A Traffic Barrier Service Concrete Parapet (Double Face)

3. Traffic Barriers on the traffic side of the barrier whether single face or double face shall be bolted to the concrete deck slab. Four bolts per section of barrier are required for each type. All four bolts are required on one side of the double face barrier unless vehicular traffic is also on the other side in which case both sides will require four bolts per section of barrier.

4. The preferred temporary traffic barrier is the double face; however, where the bridge width is critical, the single face barrier may be used. General use of the single face barrier is discouraged because of the non-symmetrical shape and due to increased handling costs.

GENERAL GUIDELINES (cont'd):

5. Method of attachment to the bridge deck shall be as per Detail A, bolting through the bridge deck. This may pose a problem when the bolts holes are drilled as the hole may spall once the drill is past the bottom layer of reinforcement. Adhesive anchors may be used in the following areas:
- where the bolts interfere with the top flange of the beam/girder.
 - for maintenance/repair work (overlays, deck patching, etc.)

See restrictions on adhesive anchors for structural applications in the current IIM-S&B-76.

When adhesive anchors are used, the designer shall place cell AADF and/or AASF from the *bdetails1.cel* cell library with the maintenance of traffic details in the bridge plans.

Sequence of Construction / Maintenance of Traffic:

Bridge with Road Plans:

The bridge designer shall consult with the road designer as to bridge requirements relative to the sequence of construction to be considered for the project. At that time, the stage construction, lane width requirements, type of barrier service, etc. can be determined. These discussions shall begin as soon as possible following the scoping and shall be completed prior to field inspection.

Bridge Plans without Road Plans:

The bridge designer shall determine the type of barrier service and shall develop the maintenance of traffic plans to include location of barrier service, tentative lane widths, channelization devices, and all other plans except signing and signalization. The proposed plan shall be reviewed by the L&D's Traffic Engineering Section, which will be responsible for confirming the lane widths and furnishing information for the necessary signing and signalization plans. Normally, the insertable sheet of the appropriate barrier service is included in the plans.

Bid Items:

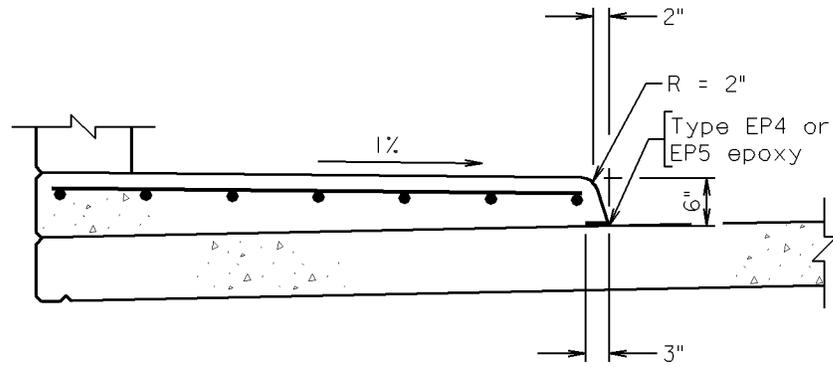
For bridge projects with road plans:

For consistency in plan preparation and contract items, as a part of the maintenance of traffic, all Concrete Traffic Barrier Service Concrete and Traffic Barrier Service Concrete (Double/Single) Face Parapet shall be included in the road plans and the bid item summary. Bridge plans shall note the following on the Quantities sheet:

Cost of Traffic Barrier Service Concrete (Single/Double) Face Parapet (*indicate which type*) is included in the road plans.

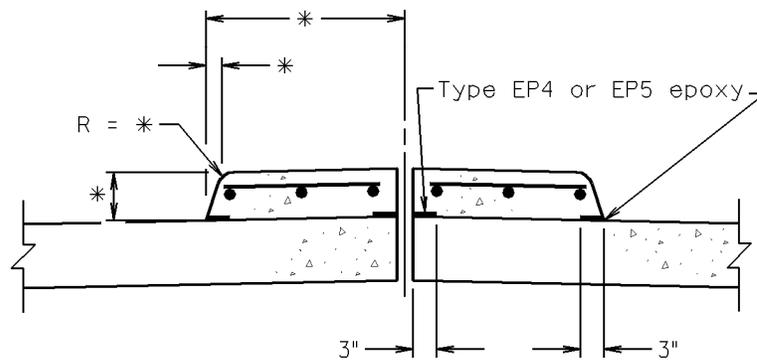
For bridge projects without road plans:

The quantity for barrier service will be shown on the quantities sheet in the bridge plans.



SIDEWALK

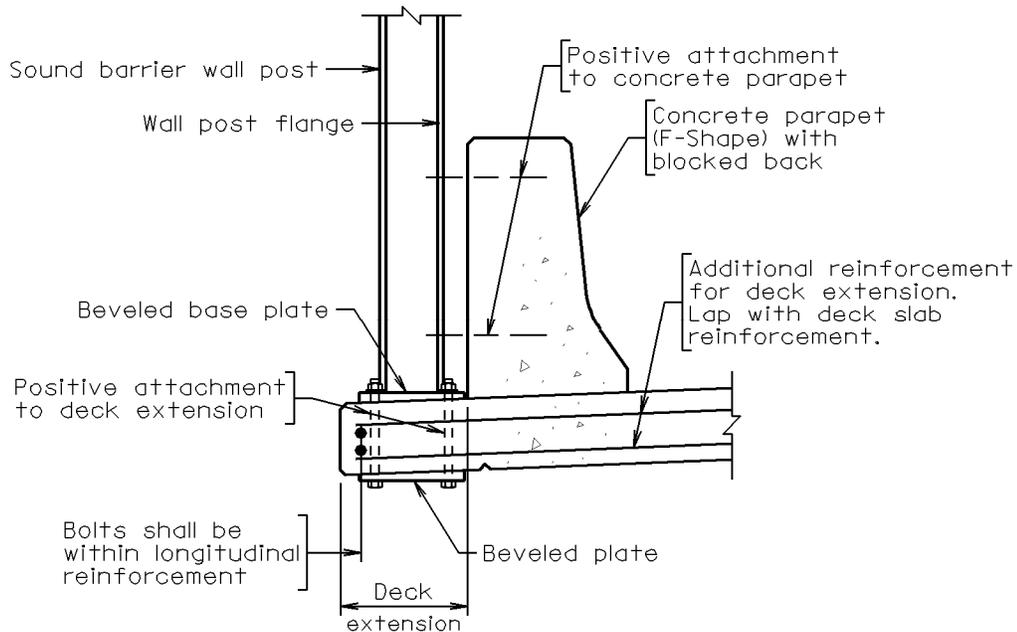
*Provide dimension in plans.



MEDIAN

Notes to designer:

1. Reinforcing steel shall be #3 @ 12".
2. Epoxy bonding compound shall be used adjacent to either sealed, open or filled joints (longitudinal or transverse) as shown.
3. Vertical reinforcing in parapet shall extend into deck slab.
4. All sidewalk and median reinforcing steel shall be corrosion resistant reinforcing.
5. Median height/shape shall be as specified for approaches.



SOUND WALL BARRIER ATTACHMENT

Notes:

- A. Provisions for sound barrier wall attachment to bridges and structures are to be made when requested by the Environmental Division or when shown on the road plans. The attenuation line shall be shown on structure plans. Sound wall attachment shall not be made on top of parapet.
- B. Sound barrier wall posts shall be positively attached to both the parapet and deck extension. The deck shall be extended a sufficient distance for the full length of sound wall.
- C. The details as shown above are for illustrative purposes only. Preliminary sizing of the wall post, base plate, deck extension and reinforcing steel is the responsibility of the bridge designer and needs to be provided in the plans for bidding purposes. The Topical Subcommittee Chairman for sound walls, Mr. Larry Hedgepeth, may be contacted for technical assistance. Final method of attachment, location of the wall posts relative to the back of parapet, and all required details/design shall be determined by the Contractor/wall designer.
- D. The contract pay item for sound barrier wall includes the design and detailing of the walls, complying with Section 519 of the VDOT *Road and Bridge Specifications* and any project special provisions. Careful attention to design and detailing shall be taken to avoid buckling of panels, sliding of panels over adjacent panels and improper sizing at joint locations. Anchorages shall have sufficient thread lengths to tighten nuts/washers. Wall posts may be flush with back of parapet. Install wall panels flush against the wall post flange. Terminate bottom of wall panels near the top of parapet.
- E. Conduit and lighting needs shall be considered in the design and detailing of sound wall attachments.
- F. Exterior stringer and cantilever deck slab shall be designed for additional loads of sound wall attachment. Cantilever length including the deck extension shall not exceed 0.3 of the beam/girder spacing.

PARAPET/RAIL TEXTURE GUIDELINES:

For textured concrete (architectural treatment) on parapets, rails, etc., see Manual of the Structure and Bridge Division, Volume V – Part 2, Chapter 5: Architectural Treatment.